EXPLORING THE POTENTIAL OF INTEGRATED MUNICIPAL SOLID WASTE PLANNING AND MANAGEMENT IN DEVELOPING COUNTRIES: A CASE STUDY IN THE MUNICIPALITY OF BANDUNG, INDONESIA WITH A FOCUS ON HOUSEHOLDS

by

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Abstract

This study has four main objectives: to provide a synthesis of ideas and facts concerning municipal solid waste planning and management (MSWPM) including concepts and practices relating to integrated resource and environmental planning and management, and urban planning and management in developing countries; to propose a conceptual framework of integrated municipal solid waste planning and management (IMSWPM) for developing countries; to analyze and evaluate the potential of IMSWPM in the Municipality of Bandung, Indonesia; and to suggest recommendations for implementation in the municipality. Four data collection methods were employed in completing this study: interviews, questionnaires, field observations, and reviews of documentary materials.

Problems of municipal solid waste planning and management in developing countries are multiple and interrelated. The conventional approach which focuses on collection, transportation, and disposal activities and has a primary goal of technical efficiency in service provision, is no longer appropriate because it is unlikely that this approach will be able to deal with those complex problems. Involvement and participation from various actors other than the local cleaning authorities is called for. Partnerships of stakeholders become necessary. The increasingly complex issues associated with MSWPM and the inability of the conventional approach to deal with them lead to the necessity of an integrated approach.

From this study, IMSWPM is concluded to be an appropriate approach and it should be implemented immediately in the Municipality of Bandung for the following reasons: it fits the multiple and complex problems of MSWPM in the municipality; to some degree, it also fits the existing practices for waste management that include waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal; and the approach is in line with stakeholders' vision regarding an integrated approach to MSWPM.

This study indicates that technical guidelines for waste reduction and reuse by households prepared by the Directorate General of Human Settlement Development (DJCK) are simple and therefore should be easy to implement. Waste reduction is still unknown, while reuse has been part of households' tradition. Technical guidelines for source separation by households and communities included in a mayor's instruction are simple and should be operationally feasible. Source separation was supported by households, neighbourhood chiefs,

university students, and many government institutions. The existing scheme in service provision, involving local community organizations and the municipal cleaning enterprise (PDK-Bandung), has been enforced through a municipal law. The proposed recycling sites should be socially acceptable because they gather waste pickers at certain sites and avoid opposition from residents and municipal officials. Although supported by waste pickers, these sites are technically and financially infeasible. Despite lack of legal support, community-level composting can be operationally feasible as it was considered to be socially acceptable. Municipal-level composting with simple windrow technology has been practiced by PDK-Bandung and its sustainability depends largely on the availability and continuity of compost demands. All three final disposal sites owned and operated by PDK-Bandung were designed and built as sanitary landfills. The sustainability of sanitary landfill will depend on sufficient funds and law enforcement for proper operations.

Major tasks for successful implementation of IMSWPM in the Municipality of Bandung include: finding initiators-promoters of IMSWPM; promoting IMSWPM to key officials of the municipal government and PDK-Bandung; seeking political support from the mayor; establishing partnerships of stakeholders that include governments, the private sector, the public, non-governmental organizations, and foreign agencies; encouraging DJCK to publicize technical guidelines about 4Rs (reduce, reuse, replace, recycle); persuading PDK-Bandung to incorporate waste reduction and reuse and composting as part of its long-term (master) plan; persuading the Department of Health to abandon its policy regarding waste burning; asking the municipal government to raise the existing service fees by 20% and to provide more subsidies to PDK-Bandung; asking the Department of Industry and Trade to ban imports of wastes; and finding sponsors to support promotion of composting.

Barriers to implementation of IMSWPM in Bandung include lack of coordination capability of government institutions, institutional bureaucracy, difficulties in gaining consensus, difficulties in sustaining the partnership process, difficulties in gaining the local community's support, and politics. Despite these obstacles, IMSWPM has a good chance of success because of timely opportunities which include Indonesia's Agenda 21, the policy draft on 4Rs, the pilot project at the integrated final disposal site of PDK-Bandung, the City Development Strategy (CDS) Project, and support from stakeholders.

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LIST OF CONTENTS

	Page
TITLE	i
AUTHORIZATION	ii
ABSTRACT	iv
ACKNOWLEDGEMENTS	vi
LIST OF CONTENTS	viii
LIST OF TABLES	xv
LIST OF FIGURES	xviii
GLOSSARY AND LIST OF ABBREVIATIONS	xx
CHAPTER 1. INTRODUCTION	**1**
1.1. Background	1
1.2. Research Questions and Objectives	2
1.3. Research Contributions	5
1.4. Organizations of the Thesis	5
CHAPTER 2. LITERATURE REVIEW	**6**
2.1. Municipal Solid Waste Planning and Management (MSWPM) in Developing Countries	6
2.1.1. Waste Generation	8
2.1.2. Waste Handling and Storage at the Source	8
2.1.3. Collection	9
2.1.4. Transfer and Transport	10
2.1.5. Processing and Treatment	11
2.1.6. Disposal	13
2.1.7. Stakeholders in MSWPM	15
2.1.8. Problems and Constraints in MSWPM	18

LIST OF CONTENTS (Continued).

Page

2.1.9. Approaches to MSWPM 22

2.2. Integrated Solid Waste Management in Developed Countries 25

2.2.1. Objectives 26

2.2.2. Options 26

2.2.3. Policy Measures for Integrated Solid Waste Management 29

2.3. Integrated Resource and Environmental Planning and Management 31

2.3.1. Basic Characteristics 32

2.3.2. The Analytical Framework of IRM 33

2.3.2.1. Context 33

2.3.2.2. Vision 34

2.3.2.3. Legitimation or credibility 35

2.3.2.4. Functions 35

2.3.2.5. Structures 36

2.3.2.6. Processes and mechanisms 37

2.3.2.7. Organizational culture and attitudes 37

2.3.3. Implementation Issues 38

2.3.3.1. Operationalization 38

2.3.3.2. Problems/Obstacles 40

2.4. Sustainable Development 41

2.4.1. Major Concerns and Goals 44

2.4.2. Strategies 45

2.4.3. Principles 45

2.5. Planning Models 47

2.5.1. Synoptic (Rational Comprehensive) Planning 48

2.5.2. Incremental Planning 49

2.5.3. Transactive Planning 50

2.5.4. Advocacy Planning 50

2.5.5. Radical Planning 51

2.5.6. Roles of Planners 51

LIST OF CONTENTS (Continued).

Page

2.6. Urban Planning and Management in Developing Countries 52
2.6.1. Urban Planning from the Mid 1980s to the Present 52
2.6.2. The Future of Urban Planning in Developing Countries 55
2.6.3. Urban Management in Developing Countries 57
2.6.3.1. Driving forces of urban management 57
2.6.3.2. Major concerns in urban management 57
2.6.3.3. Avenues for achieving urban management objectives 59
2.7. Changes in Environmental Management 60
2.8. Concluding Remarks 62

CHAPTER 3. INTEGRATED MUNICIPAL SOLID WASTE PLANNING AND MANAGEMENT (IMSWPM) FOR DEVELOPING COUNTRIES: A CONCEPTUAL FRAMEWORK 66

3.1. Substantive Dimensions of IMSWPM 66
3.1.1. Holistic 66
3.1.2. Interconnective 67
3.1.3. Goal Oriented 70
3.1.4. Strategic 72
3.2. Procedural Dimensions of IMSWPM 75
3.3. The Policy Context of IMSWPM 78

CHAPTER 4. RESEARCH METHODOLOGY 81

4.1. Research Paradigms 81
4.2. Research Purposes 82
4.3. Operationalization 83

LIST OF CONTENTS (Continued).

Page

4.3.1. Feasibility of IMSWPM 83
4.3.2. Sustainability of IMSWPM 84
4.4. Data Collection Methods 85
4.5. Sampling 88
4.6. Data Collection 89
4.7. Data Analysis 92

CHAPTER 5. THE MUNICIPALITY OF BANDUNG, INDONESIA: THE STUDY LOCATION 93

5.1. Geographic Context 93
5.2. Socio-Demographic Context 96
5.3. Governmental Administrative Structure 98
5.4. Summary 101

CHAPTER 6. FINDINGS 102

6.1. Environmental Management in Indonesia 102
6.2. Indonesia's Agenda 21: Solid Waste Management 104
6.3. Vision and Mission of Bandung City 107
6.4. Municipal Solid Waste Planning and Management in the Municipality of Bandung 114
6.4.1. Waste Generation and Composition 119
6.4.2. Waste Reduction and Reuse 121
6.4.3. Source Separation 125
6.4.4. Service Provision 128
6.4.5. Recycling 133
6.4.6. Composting 145
6.4.7. Disposal 148

LIST OF CONTENTS (Continued).

	Page
6.5. Problems in MSWPM	153
6.5.1. Waste Burning and Dumping to Drains, Canals and Rivers	153
6.5.2. The Gap Between the Increasing Service Demand and the Capability of PDK-Bandung	156
6.5.3. Inappropriate Planning and Management	160
6.5.4. Lack of Coordination	161
6.5.5. Lack of Participation and Partnership	163
6.5.6. Lack of Awareness and Education	165
6.5.7. Weak Law Enforcement	171
6.5.8. Difficulties in Helping Waste Pickers	172
6.6. Ideas about IMSWPM	173
6.7. Goals of IMSWPM for Indonesia	179
6.8. Benefits of IMSWPM	182
6.9. Barriers to the Implementation of IMSWPM	183
6.10. Opportunities for the Adoption of IMSWPM	185
CHAPTER 7. ANALYSIS AND EVALUATION	**188**
7.1. Feasibility of IMSWPM	188
7.1.1. Ideological	188
7.1.2. Technical/Operational	190
7.1.3. Legal	193
7.1.4. Political	195
7.1.5. Institutional	198
7.1.6. Social	203
7.1.7. Financial	205
7.2. Sustainability of IMSWPM	212
7.2.1. Economic Aspects	212

LIST OF CONTENTS (Continued).

Page

7.2.2. Social Aspects 213
7.2.3. Environmental Aspects 215
7.3. Concluding Remarks 215

CHAPTER 8. DISCUSSION 217
8.1. Key Issues of IMSWPM and Indonesia's Agenda 21 217
8.2. Ideas about IMSWPM 220
8.3. Goals of IMSWPM 221
8.4. Benefits of IMSWPM 222
8.5. Potential Barriers to IMSWPM 224
8.6. Initial Implementation of IMSWPM 225
8.7. Increasing Financial Capacity of PDK-Bandung 230
8.8. Policy Instruments for IMSWPM 231
8.9. Education of Stakeholders and the Public 233
8.10. Planning Perspectives of IMSWPM 236
8.11. IMSWPM and Sustainable Development's Principles 245
8.12. Lessons for Other Municipalities in Indonesia 246

CHAPTER 9. CONCLUSIONS AND RECOMMENDATIONS 248
9.1. Conclusions 248
9.2. Recommendations 258
9.3. Future Research Directions 262

BIBLIOGRAPHY 265
APPENDICES 295
A. Interview form for government agencies, private sector, professors, foreign agencies, and non-governmental organizations 296
B. Interview form for chiefs of neighbourhood units (Ketua RT) 299

LIST OF CONTENTS (Continued).

	Page
C. Questionnaire for university (undergraduate) students	301
D. Interview form for households	304
E. Results of statistical tests	307
F. Chi-square Table	322

LIST OF TABLES

TABLE	Page
1. Waste composition in Jakarta and Bandung (%)	7
2. Commonly separated materials in five Asian cities	12
3. Criteria for using incineration in developing countries	15
4. Comparison of typical solid waste management practices in Asia	16
5. Stakeholder involvement in solid waste policy and action (Fernandez, 1993)	17
6. Problems and constraints on MSWPM in developing countries	19
7. The necessity for an integrated approach to solid waste management (UNEP, 1996)	25
8. Objectives of integrated waste management in developed countries	26
9. The hierarchy of options for integrated waste management	28
10. Conclusions about policy measures for integrated waste management	31
11. Coordination tools (Margerum and Born, 1995)	39
12. Priorities for enhancing IREM (Hooper, McDonald and Mitchell, 1999)	42
13. Alternative models for achieving integration (Hooper, McDonald and Mitchell, 1999)	43
14. Some principles of the Rio Declaration (UNCED, 1992)	46
15. Urban planning in developing countries from the mid 1980s to the present	55
16. Predictions of the future of urban planning in developing countries	56
17. Key themes, purposes, and major concerns of urban management	58
18. Interrelationships between activities and options in IMSWPM	69
19. Key issues of IMSWPM in developing countries	73
20. Stakeholder partnerships in IMSWPM in developing countries	77
21. Aspects and factors to be examined in feasibility analysis of IMSWPM	84
22. Characteristics of urban sustainability	85
23. The number of respondents	90
24. The number of population and population density in Kotamadya Bandung in 1995	96
25. Roles of stakeholders in environmental management in Indonesia	103

LIST OF TABLES (Continued).

TABLE	Page
26. Objectives and programs for solid waste management according to Indonesia's Agenda 21	108
27. Waste fees for PDK-Bandung's service in 1997	117
28. Waste management costs of PDK-Bandung in 1995 (rupiah)	118
29. The amount of waste generated and collected in Kotamadya Bandung in 1995	119
30. Guidelines for waste reduction prepared by DJCK	122
31. Guidelines for reuse prepared by DJCK	124
32. Guidelines for replacement prepared by DJCK	124
33. Technical guidelines for keeping cleanliness in markets	127
34. Technical guidelines for recycling according to Pemerintah Kotamadya Bandung	128
35. The number of collection vehicles used by PDK in 1996	129
36. Technical guidelines for achieving cleanliness in residential areas according to Pemerintah Kotamadya Bandung	132
37. Guidelines for recycling prepared by DJCK	134
38. Actors' roles in the partnership of plastic bottle recycling in Bekasi, West Java	135
39. Origins of waste pickers	138
40. Parents' occupation of waste pickers	139
41. Residential status of waste pickers	140
42. Modes of recovery from sickness by waste pickers	144
43. Technical guidelines for composting according to Pemerintah Kotamadya Bandung	146
44. Technical guidelines for maintaining cleanliness in final disposal site (TPA)	152
45. Burning frequency in neighbourhood units receiving service from PDK-Bandung	154
46. Burning frequency in neighbourhood units without service from PDK-Bandung	154
47. The number of households conducting waste burning	154
48. Response to the amount of the existing service fee among households	157
49. Willingness to pay a higher service fee among households	158
50. Willingness to do source separation by neighbourhood chiefs	166

LIST OF TABLES (Continued).

TABLE		Page
51.	Willingness to do source separation among households	166
52.	Opinion about source separation at home by undergraduate students	167
53.	Actor responsible for waste handling at home	168
54.	Opinion about composting from neighbourhood chiefs	169
55.	Opinion about composting among households	170
56.	Support for waste pickers from neighbourhood chiefs	173
57.	Households' willingness to allow waste pickers to enter their areas	173
58.	Technical feasibility of IMSWPM in the Municipality of Bandung	194
59.	Legal feasibility of IMSWPM in the Municipality of Bandung	196
60.	Political feasibility of IMSWPM in the Municipality of Bandung	199
61.	Institutional feasibility of IMSWPM in the Municipality of Bandung	202
62.	Social feasibility of IMSWPM in the Municipality of Bandung	205
63.	Financial feasibility of IMSWPM in the Municipality of Bandung	210
64.	A comparison between key issues of IMSWPM and those advocated by Indonesia's Agenda 21	218
65.	Fitness of avenues for achieving goals of IMSWPM in Bandung	222
66.	The existing and proposed fees for PDK's service (rupiah)	231
67.	Policy instruments for implementing IMSWPM in the Municipality of Bandung	232
68.	The relationship between communication goals and expected changes from individuals and institutions	234
69.	Characteristics of IMSWPM as a planning approach	237
70.	The contrast between the conventional approach and IMSWPM	241
71.	A comparison between IUDP and IMSWPM in Bandung	242
72.	Implementation plans of IMSWPM in the Municipality of Bandung	263

LIST OF FIGURES

FIGURE	Page
1. An integrated system model for optimal waste management (Solway and Haight, 1991)	27
2. A conceptual analytical framework for integrated resource management (Mitchell, 1998)	34
3. Interaction during the planning process (Margerum and Born, 1995)	38
4. A conceptual model of processes of change in environmental management (Hadfield and Seaton, 1999)	60
5. The communication escalator (Quirke, 1997)	62
6. Perspectives on sustainable development	65
7. The interrelationships of IMSWPM's components	68
8. A conceptual framework for IMSWPM for developing countries	71
9. Policy context of IMSWPM	78
10. Contribution of IMSWPM to sustainable development	86
11. Bandung Metropolitan Region	94
12. The administrative area of the Municipality of Bandung	95
13. Population density among kecamatan of Kotamadya Bandung in 1995	97
14. Governmental administrative structure in Indonesia (adapted from Bucholt (1994))	99
15. Environmental management in Indonesia	105
16. Opinion of university students about the cleanliness of Bandung City	112
17. Sources of income of PDK-Bandung in 1996	115
18. The growth of service fees collected by PDK-Bandung	118
19. Waste generators in Kotamadya Bandung, 1995	120
20. Waste composition of Kotamadya Bandung in 1995	120
21. Collection and transportation of municipal solid wastes in Kotamadya Bandung	129
22. Procedure for resolving customer's complaints	130
23. Distribution of waste pickers' age	138
24. Distribution of waste pickers' educational background	139

LIST OF FIGURES (continued).

FIGURE.	Page
25. Reasons to become waste pickers	140
26. Future plans of waste pickers	141
27. Use of working utensils by waste pickers	142
28. Average monthly income of waste pickers (rupiah)	142
29. Distribution of diseases experienced by waste pickers	143
30. Integrated final disposal site of PDK-Bandung	150
31. Frequency of burning/month among households	156
32. Opinion about the existing service fee	158
33. Willingness to pay more fee among households	159
34. Willingness to do source separation of waste among households	167
35. Support for composting among households	170
36. Willingness of households to allow waste pickers to enter their areas	174
37. Integrated urban solid waste management model of BPPT	176
38. An integrated solid waste management system in Pemukiman Kota Mandiri Bumi Serpong Damai (Tangerang, West Java)	177
39. Summary of findings about IMSWPM	187
40. A view of IMSWPM in Bandung from the IRM's framework	239

GLOSSARY AND LIST OF ABBREVIATIONS

ADB	:	*Asian Development Bank*
Adipura	:	An award given annually to any city which meet certain cleanliness criteria
APBD	:	*Anggaran Pembangunan Belanja Daerah* – National development budget
APBN	:	*Anggaran Pembangunan Belanja Negara* – Local (municipal or district) development budget
Bapedal	:	*Badan Pengendalian Dampak Lingkungan* – Environmental Impact Management Agency
Bappenas	:	*Badan Perencanaan Pembangunan Nasional* – National Planning Board
Bappeda	:	*Badan Perencanaan Pembangunan Daerah* – Local (provincial or municipal) Planning Board
Berhiber	:	*Bersih, Hijau, Berbunga* – A slogan about clean, green, and flowery
BPKP	:	*Badan Pemeriksa Keuangan Pembangunan* – The national development financial investigation body
BPPT	:	*Badan Pengkajian dan Penerapan Teknologi* – Agency for Technology Assessment and Application
BUDP	:	*Bandung Urban Development Project*
Bupati	:	Head of district (kabupaten)
Camat	:	Head of sub district (kecamatan)
CDS Project	:	*City Development Strategy* Project
Desa	:	Village
Deperindag	:	*Departemen Industri dan Perdagangan* – Department of Industry and Trade
DJCK		*Direktorat Jenderal Cipta Karya* – Directorate General of Human Settlement Development of the Department of Public Works
DPRD	:	*Dewan Perwakilan Rakyat Daerah* – People's Legislative Assembly (parliament at the provincial or municipal/district level)

GLOSSARY (continued).

DKI	:	*Daerah Khusus Ibukota* – Jakarta City Government
DTC-ITB	:	*Development Technology Centre* ITB
ESCAP	:	*Economic and Social Commission for Asia and the Pacific*
GDN	:	*Gerakan Disiplin Nasional* – National Discipline Movement
IEM	:	*Integrated Environmental Management*
IMSWPM	:	*Integrated Municipal Solid Waste Planning and Management*
IPTN	:	*Industri Pesawat Terbang Nasional* – The Indonesian' aircraft company
IREM	:	*Integrated Resource and Environmental Management*
IRM	:	*Integrated Resource Management*
ISWM	:	*Integrated Solid Waste Management*
ITB	:	*Institut Teknologi Bandung* – A government-owned university in Bandung
Itenas	:	*Institut Teknologi Nasional* – A privately-owned university in Bandung
IUDP	:	*Integrated Urban Development Planning*
IUIDP	:	*Integrated Urban Infrastructure Development Planning*
JICA	:	*Japan International Cooperation Agency*
K3	:	*Ketertiban, Kebersihan, Keindahan* – A slogan about neatness/order, cleanliness, and beauty
Kabupaten	:	District
Kecamatan	:	Sub-district
Kelurahan	:	Sub sub-district (part of sub district)
Kepala Desa	:	Village head
KLH	:	*Kantor Menteri Negara Lingkungan Hidup* – State Ministry for the Environment
Kotamadya	:	Municipality
LKMD	:	*Lembaga Ketahanan Masyarakat Desa* – An organization at the village level with tasks of coordinating activities and mobilizing local people
LSM	:	*Lembaga Swadaya Masyarakat* – Non-governmental organization
Lurah	:	Head of sub sub-district (keluarahan)

GLOSSARY (continued).

MPR	:	*Majelis Permusyawaratan Rakyat* – Advisory congress at the central government
MSW	:	*Municipal Solid Waste*
MSWPM	:	*Municipal Solid Waste Planning and Management*
NGO	:	*Non Governmental Organizations*
Patih	:	Head of wilayah (region)
PDK	:	*Perusahaan Daerah Kebersihan* – A semi-private cleaning enterprise owned by a municipal government
Pemerintah Daerah	:	Local government (district or municipal)
PKK	:	*Pendidikan Kesejahteraan Keluarga* – Family Welfare Education usually conducted by women's association
PKL	:	*Pedagang Kaki Lima* – side-walk moving vendors
PLN	:	*Perusahaan Listrik Negara* – A government-owned electricity company
PPLH-ITB	:	*Pusat Penelitian Lingkungan Hidup* – Centre for Environmental Research of ITB
P3KT	:	*Program Pembangunan Prasarana Kota Terpadu* – Integrated Urban Infrastructure Development Program
Puskesmas	:	*Pusat Kesehatan Masyarakat* – Public Health Clinic (health centre)
Rakorbang	:	*Rapat Koordinasi Pembangunan* – Development consultation meeting
RDTRK	:	*Rencana Detil Tata Ruang Kota* – City's detailed spatial plan
RIK	:	*Rencana Induk Kota* – City's master plan
RT	:	Rukun Tetangga – Neighbourhood units (administrative unit below the neighbourhood association (RW) level)
RW	:	Rukun Warga – Neighbourhood association (administrative unit below the village level)
TPA	:	*Tempat Pembuangan Akhir* – Final disposal site
TPS	:	*Tempat Pembuangan Sementara* – Temporary disposal site

GLOSSARY (continued).

UNCED	:	*United Nations Conference on Environment and Development*
UNCHS	:	*United Nations Centre for Human Settlements*
UNCRD	:	*United Nations Centre for Regional Development*
UNDP	:	*United Nations Development Programme*
UNEP	:	*United Nations Environment Programme*
UNESCO	:	*United Nations Educational Scientific and Cultural Organization*
Unyani	:	*Universitas Jenderal Ahmad Yani* – A privately-owned university in Bandung
Walikota	:	Mayor
WCED	:	*World Commission on Environment and Development*
WHO	:	*World Health Organization*
Wilayah	:	Region

CHAPTER 1.
INTRODUCTION

1.1. Background

Planning and managing municipal solid wastes are among the most challenging tasks faced by urban governments in developing countries (Schertenleib and Meyer, 1992a). Releasing municipal solid wastes into the environment, impacts the urban environments and the inhabitants. Illegal dumping of wastes into drains and rivers is common and pollutes the air, and surface and ground water supplies. Problems are being exacerbated by a number of factors: urbanization (Gotoh, 1989; Ouano and Ogawa, 1993), population growth (Sakurai, 1990; Arlosoroff, 1991), industrialization (ESCAP, 1993; Ouano and Ogawa, 1993; Muttamara, 1994), improved living standards (Ouano and Ogawa, 1993; Muttamara, 1994), and increasing availability of consumer products (Ouano and Ogawa, 1993). The interrelationships of these factors bring about several consequences, including increases in the production of solid wastes, number of people demanding service, complex nature of waste being generated, and difficulties in providing adequate service due in part to squatter settlements, and pressure to provide satisfactory service. Tremendous pressure is being forced upon municipal governments and in response, the international community and agencies are focusing efforts, expertise and funding to assist developing countries to deal with issues associated with municipal solid waste planning and management.

In developing countries, the conventional approach to municipal solid waste planning and management dominates. Major characteristics of this approach include: sole responsibility of municipal authorities for providing service including collection, transportation and disposal; a view that waste is a nuisance to the public (Cointreau, 1982), and a focus on technical efficiency (Agunwamba, 1998; Diaz, 1998). Common shortcomings of the conventional approach are the inability to cope with the high rates of urban growth and development, limited resources of local authorities (Halla and Mojani, 1999), lack of interest on waste reduction, recycling, and composting (Agunwamba, 1998), and lack of public participation (Soerjani, 1984; Silas and Indrayana, 1993; Sinha, 1993).

The inappropriateness of the conventional approach points to the necessity to consider approaches that differ from the conventional approach. Two alternative approaches are the non-conventional approach (Furedy, 1992, 1994b) and the integrated approach (Erbel, 1982). The non-conventional approach is proposed by Furedy (1994b) as an alternative to the conventional approach. The main goals of this alternative approach are based on social and ecological objectives. Empirical findings about implementation of this approach are lacking. The integrated approach has long been known (Erbel, 1982), but it only has gained momentum recently. This approach has been advocated by many as a better approach to deal with municipal solid waste management in developing countries (Agunwamba, 1998; Ali, Olley and Cotton, 1998; Campbell, 1999; Halla and Mojani, 1999; Hoornweg and Thomas, 1999). It is also viewed as a multisectoral or comprehensive approach and it takes into account many of the factors contributing to the problem, and involves stakeholders (Ouano and Ogawa, 1993; Furedy, 1995).

The integrated approach has been investigated in this research to examine if it is an appropriate way to address the complex problems of municipal solid waste planning and management in developing countries particularly focusing on Indonesia. A simple but valid argument for the necessity of the integrated approach is that no single actor or organization can alone solve the complex problems of municipal solid wastes. Based on their work on solid waste management in Asia, Hoornweg and Thomas (1999, 1) concluded that "Municipal governments are usually the responsible agency for solid waste collection and disposal, but the magnitude of the problem is well beyond the ability of any municipal government. They need help. In addition to other levels of government, businesses and the general community need to be more involved in waste management."

1.2. Research Questions and Objectives

Notwithstanding the promising potential of the integrated approach, research about application of such an approach in developing countries has been scarce. This may be due to problems discovered by several investigators, such as the technocratic and administrative actions taken by most municipal officials (Furedy, 1989a; Diaz, 1998) and the opposition of municipal officials to involving the informal sector, in particular waste pickers (Furedy, 1989a; Ouano, 1991b).

As in other developing countries, Indonesia has also faced similar problems and challenges of planning and managing municipal solid wastes. In this respect, Hoornweg and Thomas (1999, 1) stated that "Indonesia and the Philippines as well as parts of China and India are the Asian countries facing the greatest waste management challenge, based on projected waste generation rates and relative affluence to deal with the problem." The conventional approach is commonly practiced in Indonesia, although attempts to improve have been tried in several cities (Poerbo, 1991; Cervero, 1995; Silas, 1995). With the current emerging paradigm of partnerships and the changing role of government from "provider" to "facilitator" (Walton, 1992), it seems timely that an integrated approach to municipal solid waste planning and management be introduced. This research, on the potential of using the integrated approach within the Municipality of Bandung, Indonesia, will contribute to expanding knowledge about the potential of integrated municipal solid waste planning and management (IMSWPM) in Indonesia.

The Municipality of Bandung was selected as a case study for several reasons. According to the Directorate General of Human Settlement Development (DJCK) of the Department of Public Works, Indonesia, on a population basis the Municipality of Bandung is classified as a metropolitan city. The municipality has been facing difficult pressures in solid waste management due to rapid urbanization, industrialization, and population growth. The familiarity with, and accessibility to the study area as well as availability of research funding were also considerations in selecting this study area. In the context of changing central and municipal government policies, research on an integrated approach to municipal solid waste planning and management is timely. In 1997, for instance, the State Ministry of the Environment launched Indonesia's Agenda 21 in which the necessity for adopting the integrated approach is advocated. In that same year a new national law concerning environmental management was ratified by the parliament. This law states that every individual has an obligation to guard the environment. At the end of 1996, the Directorate General of Human Settlement Development drafted a policy containing guidelines for 4Rs (reduce, reuse, replace, recycle). The municipal government of Bandung has also issued laws concerned maintaining the cleanliness and health, beauty and social order for the city. The municipal government and the district government of Bandung in 1999 were engaged in the City Development Strategy (CDS) project assisted by the World Bank. This project prepared long-

term strategies to make Bandung as a model of healthy city for Indonesia. Finally, the municipal waste enterprise of the Municipality of Bandung that is responsible for providing service has been interested in exploring the potential of the integrated approach to municipal solid waste planning and management.

This case study provides valuable lessons about the potential, problems, and opportunities in promoting and implementing this approach in one municipal area. It is anticipated that the lessons learned are also important for other municipal governments in Indonesia, and for other governments in developing countries facing similar problems and having similar situations in terms of planning and management of municipal solid wastes.

Three research questions pertaining to the potential of integrated planning and management of municipal solid waste in developing countries in general, and in Indonesia in particular, are defined:

(1) What are the critical elements of an integrated municipal solid waste planning and management (IMSWPM) approach for developing countries?
(2) What is the potential for IMSWPM being adopted in the Municipality of Bandung, Indonesia?
(3) How can IMSWPM be promoted in the Municipality of Bandung?

The main objectives of this research are:

(1) To provide a synthesis of ideas and facts concerning municipal solid waste planning and management (MSWPM) in developing counties in terms of persisting problems, approaches, potential stakeholders, concepts and practices relating to integrated resource or environmental planning and management, and urban planning and management in developing countries;
(2) To propose a conceptual framework of IMSWPM for developing countries;
(3) To analyze and evaluate the potential of IMSWPM in the Municipality of Bandung; and,
(4) To prepare recommendations for the implementation of IMSWPM in the Municipality of Bandung.

This study is focused on households because they account for the largest proportion of the total municipal solid wastes generated. In 1994, for instance, households produced 51% of the total solid wastes generated in Jakarta (CV Galuh, 1996) and 55% in Bandung (PT. Kartika Pradipta Prisma, 1996).

1.3. Research Contributions

This study makes three contributions. First, from the conceptual or theoretical point of view, this study clarifies concepts regarding IMSWPM and then proposes a framework for this approach. Second, from the empirical viewpoint, this study presents findings regarding the potential for an integrated approach in an urban centre in a specific developing country. This research bridges the gap between the concepts and empirical practices of the integrated approach to municipal solid waste planning and management in general, and in Indonesia in particular. Third, from a methodological point of view, this study provides insights and experiences concerning data collection in the area of IMSWPM. These will be important and useful for other investigators interested in further investigations in MSWPM in Indonesia.

1.4. Organization of the Thesis

This thesis is organized into nine chapters. Chapter 2 presents a literature review on several key areas, such as municipal solid waste planning and management in developing countries, integrated waste management in developed countries, concepts relating to integrated resource and environmental planning and management, sustainable development, planning models, and urban planning and management in developing countries. Chapter 3 presents a proposed conceptual framework for IMSWPM for developing countries. In Chapter 4, the methodology is outlined. Chapter 5 presents the geographic, topographic and socio-demographic context, and the governmental administrative structure of the Municipality of Bandung. Chapter 6 provides the findings collected through interviews, questionnaires, field observations, and secondary documents. Chapter 7 provides an analysis and evaluation of the potential of IMSWPM in the Municipality of Bandung. Chapter 8 discusses the findings. Chapter 9 summarizes the conclusions, proposes recommendations, and indicates directions for future research.

CHAPTER 2.
LITERATURE REVIEW

This chapter highlights various perspectives on municipal solid waste planning and management with an emphasis on developing countries. Seven major topics are reviewed: municipal solid waste planning and management in developing countries, integrated waste management in developed countries, integrated resource and environmental planning and management, sustainable development, planning models, urban planning and management in developing countries, and the role of communication in managing change.

2.1. Municipal Solid Waste Planning and Management (MSWPM) in Developing Countries

Waste is the product of human activities. Webster's Dictionary (1988) defined waste as "needless and excessive consumption; deterioration or decay by use; misuse or lack of use; useless or damaged material produced during or left over from manufacturing processes, superfluous matter". Haight (1994, 2) distinguished waste from garbage. In this regard, waste is meant as "any residual materials which arise from human activities and which are not considered to be of immediate use", while garbage is defined as "any object which has no possible further use." In this study, municipal solid wastes refer to the non-hazardous solid wastes generated in a municipal area.

In general, there are six activities associated with municipal solid waste planning and management in developing countries: waste generation, waste handling and storage at the source, collection, transfer and transport, processing or treatment, and disposal (Cointreau, 1982; Gotoh, 1989; Tchobanoglous, Theisen and Vigil, 1993).

2.1.1. Waste Generation

The primary sources of municipal solid wastes (MSW) in developing countries, including Indonesia, are households, commercial establishments, markets, institutions, and street cleaning (Bebassari et al., 1988a; Rushbrook and Finnecy, 1988; Sumardjito and Sutisna, 1993; Cointreau-Levine, 1994; Listyawan, 1994), hospitals, and manufacturing businesses (Rushbrook and Finnecy, 1988; Muttamara, 1994).

The characteristics of MSW cited frequently are high density, high moisture content, largely organic, substantial amount of dust and dirt, and small particle size in the waste stream (Cointreau, 1982). Many of the organic constituents originate from kitchen waste, vegetable waste, garden trimmings, and leaf packaging. Although these findings are dated, in general, they are still valid. Perhaps the biggest change relative to the organic content is the decreasing use of leaves for packaging and their being replaced by plastics. Cointreau (1982) also acknowledged the difficulty in obtaining reliable data about the quantities and characteristics of municipal solid wastes of developing countries.

As in other developing countries, the composition of municipal solid wastes in metropolitan cities in Indonesia is also mostly organic. In Jakarta, for example, the proportion of the organic in 1981 was 79.5% and 73.9% in 1992 (Table 1). In Bandung, the amount of the organic fraction in 1988 accounted for 73.3%, and 63.6% of the total municipal solid wastes generated in 1994. In Surabaya, Indrayana and Silas (1993) reported that the organic waste was the largest proportion of the total municipal solid wastes produced.

Table 1. Waste composition in Jakarta and Bandung (%)

Component	Jakarta		Bandung	
	1981[1)]	1992[2)]	1988[3)]	1994[3)]
Organic	79.5	73.9	73.3	63.6
Inorganic:				
• Paper	8.0	10.2	9.7	10.4
• Metal	1.4	2.0	0.5	1.0
• Textile	2.4	1.6	1.3	1.7
• Plastic	3.7	7.9	8.6	9.8
• Glass	0.4	1.8	0.4	1.5
• Miscellaneous	4.6	2.6	6.2	12.0

Source: [1)] Maniatis, Vanhille and Martawijaya (1987)
[2)] Woolveridge (1995)
[3)] PT. Kartika Pradipta Prisma (1996)

The characteristics of municipal solid wastes have two important consequences for planning and management. First, the high organic content, accompanied by the hot and humid climate, results in the need for frequent collection and the appropriate design for storage containers or bins to overcome the unpleasant smell, rodents and insects which are attracted to the wastes. The increasing inorganic constituents provide an attractive opportunity for recycling activities which in turn offer some potential benefits, such as reducing the dependency on

foreign imports, creating small-scale enterprises or cottage industries, creating employment, conserving resources, reducing pollution, and reducing the amount of solid wastes requiring disposal (Cointreau et al., 1984; Arlosoroff and Bartone, 1987).

2.1.2. Waste Handling and Storage at the Source

Common activities by households involved in the handling, separation, and storage of wastes include depositing wastes into storage bins or plastic bags, separating some of the wastes into recyclables and non-recyclables, and selling the recyclables to itinerant buyers or giving them away free to waste pickers. Historically, itinerant buyers have often bought the recyclables from the householders or bartered these materials for food or other consumable products. Itinerant buyers are able to gather cleaner materials than the mixed waste sorted by the waste pickers. In Indonesia, for instance, itinerant buyers sell the collected materials to dealers, distributors, or small businesses (Sicular, 1992). Waste pickers regularly visited residents and picked whatever they could find of value as long as the householders allowed them to do so. In some places, however, residents are reluctant to allow waste pickers to enter their premises because of security concerns. Waste pickers use some of the recovered materials directly and trade the remainder to dealers (Sicular, 1992). In Thailand, as reported by Muttamara (1994), waste pickers sometimes sell recovered materials to junk shops.

Cointreau (1982) found that the various bins used to store the residents' waste at home can be grouped into standardized and non-standardized classes. The standardized bins are those usually provided by the municipal authorities and residents pay for them. The standardized bins made of plastic were designed to improve the collection activities performed by the municipal waste workers. However, the use of these bins has resulted in some unexpected problems, such as the loss of bins by theft, use of the bins by residents for other purposes, and excessive breakage. Some municipal authorities have given their residents freedom to provide their own bins, resulting in a variety of size and shape of bins.

Theoretically, waste handling, separation, and storage at source are the chief responsibilities of each waste generator. Separation of waste at the source has been intended to support and promote recycling efforts. As with composting, however, the practice of source separation in developing countries faces problems and barriers ranging from technical to social issues (Cointreau et al., 1984). For instance, the design and number of bins that are used by residents and the provision of these bins are among the technical issues that have to be dealt

with, as well as the public's inconvenience of keeping a variety of waste bins within their homes (UNCHS, 1994). It is also interesting to note that, in certain places, waste pickers have opposed the idea of source separation. With all wastes being separated, other people will become interested in collecting these recyclables and the situation threatens the potential earnings of traditional waste pickers (Furedy, 1994a).

2.1.3. Collection

Flintoff (1984) described four types of collection systems in developing countries: communal bin, block collection, curbside collection, and door-to-door collection. Communal bin means that householders deliver their waste into a bin located within walking distance. Waste workers then transport them to recycling centres or final disposal sites. With block collection, the collectors or waste workers have a regular schedule of visiting residents. When the vehicle comes at its scheduled time, householders are asked to bring their waste to the vehicle. In curbside collection, collectors decide the time of collection and householders are asked to put their waste outside their houses so that waste workers can retrieve it. In door-to-door collection, householders are not involved in the collection process since the collectors or waste workers enter the premises and pick up the waste. According to UNCHS (1994), the use of these collection schemes in developing countries has varied from one city to another.

In Indonesia, although schemes of collection vary from one city to another, there are two kinds of collection: primary and secondary (Indrayana and Silas, 1993; Silas, 1995). Primary collection involves waste generators collecting their own wastes and taking them to the nearest temporary disposal site. Community organizations have been often responsible for primary service provision. According to a study in Surabaya by the Japan International Cooperation Agency (JICA) (1993), there were several noted benefits from appointing community organizations as service providers, such as the implementation of a beneficiary pay principle, employment creation, practicality in charging and collecting fees, and responsiveness to the needs and capability of the community. A study in Jakarta by JICA (1987) recommended community organizations provide the collection service in the future. Secondary collection has been the main responsibility of the municipal cleaning or sanitation department whose primary task is to collect and transport wastes from communal bins or containers to any transfer point, processing station, or final disposal site.

2.1.4. Transfer and Transport

Transfer and transport include delivering waste collected from the source to any transfer points for further processing or to the final disposal sites. This activity is capital intensive. Large investments are required to provide and maintain the vehicles as well as to hire crews. Either municipal authorities or private contractors, or both, are typically responsible for transfer and transport of municipal solid wastes. In Jakarta, Indonesia, for instance, the involvement of private corporations has been arranged through contracting or privatization of some collection and transportation service (Cervero, 1995).

Manschot (1991) reported that the municipal cleaning department of Jakarta used rear-loading hydraulic compaction vehicles, arm-roll trucks, tipper trucks, tipper trucks with cranes attached, and open-body trucks for transfer and transport of wastes. Manschot found that the cleaning department preferred to use mechanized trucks for transportation because they could move wastes quickly. In addition, Forbes (1995) reported that in Jakarta static compactors with Japanese technologies had been used in one transfer station.

Four interesting issues related to transfer and transport are notable in some developing countries. First, some studies have shown that contracting out collection and transportation of wastes to private enterprises could result in a less expensive service delivery than that provided by public authorities (Bartone et al., 1991; Sinha, 1993; Cointreau-Levine, 1994). Second, locating transfer stations has become a major problem in municipal areas in Indonesia (Forbes, 1995). It has been increasingly difficult and expensive to find the appropriate sites for transfer stations in municipal areas. Third, the time required by municipal collection crews to sort out recyclable materials is a concern for municipal authorities. As reported by Muttamara, Visvanathan and Alwis (1994), a study in Thailand by the Japan International Cooperation Agency (JICA) found that municipal waste collection crews spent almost 40 percent of their time collecting recyclable materials. To earn some extra income, the workers dropped their recyclables off to a dealer before going to the transfer station or final disposal site. This time-consuming activity reduced the frequency of collection and may have lead to reduced collection coverage. Fourth, the involvement of waste pickers in the trucks or transport vehicles or at the transfer points is a concern. Sometimes the waste pickers pay the municipal waste crews to obtain a licence for picking valuable materials from the waste collected in the trucks. In Metropolitan Manila, Philippines, Medina (1993) reported that the municipal crews

themselves recovered some materials from collection vehicles and then sold them to middlemen. Municipal officials complained about this activity because it delayed transportation activities.

2.1.5. Processing and Treatment

The main objective of processing is to capture valuable materials from the waste. This is known as resource recovery. Bartone (1990, 7), for instance, defined resource recovery in its broadest sense as including "the repairing, refurbishing, or remanufacturing of discarded goods; the separating, or reprocessing, and recycling of raw materials; and the processing of selected fraction of waste stream into new products such as compost and energy." In this study, solid waste processing will be classified into composting the organic fraction, recycling the inorganic fraction, and energy recovery through combustion processes. The purpose of waste treatment is to convert waste into safer material before going to final disposal sites.

Over the years, attempts to introduce composting to developing countries have been tried widely. In the 1980s, for instance, centralized and mechanized composting plants were installed with the aid of foreign agencies and consultants (Ambrose, 1982). However, many were subsequently abandoned because of problems such as the high operating and maintenance costs of the plant, the lack of skilled human resources, the high price of the compost produced, and the poor quality of the compost because of contamination from obnoxious materials. Recognizing this failure, recent attempts in composting in developing countries have shifted to small-scale, community-based schemes.

Based on case studies of five neighbourhood composting projects and one of a city-level project in Jakarta, Indonesia, Woolveridge (1994) identified six critical success factors for composting: management, source and continuity of funding, marketing, secure access to available and suitable land, community support, and cooperation with the local cleaning authority.

Besides the organic constituent, many materials from the municipal solid waste stream can be diverted either for reuse or for recycling. UNCHS (1994), for instance, reported on commonly separated materials in five Asian cities (Table 2). Materials can be grouped into glass and porcelain, paper and paper products, plastic products, metal, textiles, rubber and leather items, bones, wood, and construction debris. These materials have become the main source of income for many urban poor in developing countries, and in particular, waste pickers.

Table 2. Commonly separated materials in five Asian cities

Category	Items collected
• Glass and porcelain	• Bottles, windows and door glass, porcelain crockery, vases
• Paper and paper products	• Newspapers, magazines, books, paperboards, cardboard boxes, cement bags
• Plastic products	• Containers for oils, toilet products and cosmetics, plastic bags, sheet plastic, pipes
• Metal	• Iron and steel, aluminium, copper, tin containers
• Textiles	• Curtains, clothes and tapestries, textile mill waste
• Rubber and leather items	• Tires, shoes
• Bones	• Dead animal carcasses, slaughterhouse waste, hotel, restaurant waste
• Wood	• Broken furniture, garden waste
• Construction debris	• Brick and concrete rubble, iron, timber

Source: UNCHS (1994)

The role of the informal sector is well known as being very important in recovery or recycling activities (Soerjani, 1984; Maniatis et al., 1987; UNCHS, 1994; Forbes, 1995). The informal waste picking activities have not only created jobs and supported cottage industries, but, they have also contributed to diverting some significant portions of municipal solid wastes that would otherwise go to the final disposal sites. In other words, informal waste picking activities, conducted mostly by waste pickers, can directly reduce the waste management costs borne by municipal authorities. The involvement of the informal sector, however, is not free from problems. For instance, since informal activities involve a large number of waste pickers, some politicians, municipal officials, and residents oppose them. They consider waste pickers as a nuisance to society (Versnel, 1986; Indrayana and Silas, 1993; Furedy, 1994b).

Versnel (1986) commented that one reason why many government officials in Indonesia oppose waste pickers is because waste picking activities are considered to conflict with policies on land use, town planning, and the philosophy of modern development. Some waste pickers do illegal activities, such as stealing belongings from residents' homes. Waste pickers' existence and activities have been opposed not only by the government officials but also by many urban residents. In Bandung, Indonesia, for example, Versnel reported that police captured and arrested waste pickers, sent them to rehabilitation centres, and transported them to transmigration areas outside Java.

As in other developing countries, recycling activities in Indonesia are highly labour-

intensive (Soerjani, 1984; Maniatis et al., 1987) and are largely conducted by the informal sector (UNCHS, 1994; Forbes, 1995). The role of waste pickers, in particular, is very evident. Because of the high level of unemployment in a country like Indonesia, waste picking has existed as a viable alternative for many poor people in urban areas. Waste pickers can be found in almost every Indonesian city. As reported by Forbes (1995), in Jakarta alone there were about 300,000 waste pickers living in the city and their activities alone were estimated to save the city's cleaning department about US$ 3 million each year in elimination of materials that would otherwise be put to disposal.

The work of waste pickers in Indonesia is unhealthy and is often conducted in hazardous conditions (Maniatis et al., 1987). Waste pickers or "pemulung" sort materials with their bare hands and move from one place in the dump to another with bare feet, making them prone to injuries. They appear to neglect their own safety. Some suggest that waste pickers' activities should be recognized and conducted in a more organized and hygienic manner (Soerjani, 1984; Versnel, 1986; Maniatis et al., 1987). Indrayana and Silas (1993) reported that many non-governmental organizations had been working in Jakarta and Surabaya to assist waste pickers to conduct their activities more effectively and safely.

Recycling activities by the informal sector offer three main benefits: employment created for the very poor and uneducated people in urban areas, reduction of waste management costs for the local cleaning department, and production of materials for further users, in particular the recycling businesses. The role of government is crucial in determining the social and economic conditions of the many actors in the informal waste recycling businesses. For example, the policy of the Indonesian government in 1992 to ban the import of recycled paper and plastic from developed countries ensured that the existence of domestic recycling activities by the informal sector was maintained (Forbes, 1995).

2.1.6. Disposal

Three disposal options have been commonly employed: open dumping, landfill, and incineration (Cointreau, 1982; Holmes, 1984; Bartone et al., 1991; Hoornweg and Thomas, 1999). Simple open dumping has been the most common option because it is a cheap, fast, and a convenient mode of disposing of wastes. The main drawback of this option is the pollution of wastes to surrounding water and air.

The sanitary landfill has its main components: cover, liner, leachate and gas collection

systems, all of which are engineered to prevent water and air pollution. A sanitary landfill is an expensive technology to install and maintain especially for developing countries. It requires skills that cannot be easily found. Pilot projects to install sanitary landfills have been possible because of the support given by international lending agencies, such as the World Bank, Asian Development Bank (ADB), and Japan International Cooperation Agency (JICA). In Indonesia, for instance, JICA was responsible for a feasibility study of sanitary landfills in Jakarta (JICA, 1987) and Surabaya (JICA, 1993), while the ADB was responsible for the funds for sanitary landfills in Bandung (Sumardjito and Sutisna, 1993). A current problem with landfills is the difficulty of finding suitable sites (Silas and Indrayana, 1993). Sites tend to be distant from the municipal area, and this has direct implications for transportation costs.

A distinct phenomenon that occurs at the landfill sites in developing countries, which is not found in developed countries, is the involvement of waste pickers. There can be thousands of waste workers working in the disposal areas diverting valuable items. This has been a great concern to many since working in this area is not only unhealthy but also dangerous. Forbes (1995) noted that in the largest landfill of Jakarta, Indonesia, fire could be a real danger for waste pickers during the dry season. Despite this situation, it has been difficult for the government to ban waste pickers from picking valuable materials at landfill sites.

An alternative disposal option is incineration. Due to the high organic content of the municipal waste stream, however, it has been argued that incineration is not a viable disposal option for developing countries (Lohani, 1984; World Health Organization, 1991). Incineration has been seen as an attractive disposal option in developing countries because of the increasing amount of waste being generated in municipal areas, the limited number of landfills available and the difficulty of finding more landfill sites, the need to dispose of waste rapidly, and the ability of the incineration to burn or dispose of practically any material. Silas and Indrayana (1993) reported that an incinerator with a burning capacity of 200 tonnes per day had been used in Surabaya, Indonesia because of the difficulty in finding new landfill sites. This modern incinerator was designed by France and began operating in 1991. Waste pickers were involved and were paid by the operator to retrieve plastics to minimize damage to the equipment.

Obstacles hinder incineration in developing countries, including the high investment required, high operating and maintenance costs, high skills of the operators, the lack of experience, and the lack of financial support from the government. Fritz and Gillen (1998)

proposed some criteria for the use of incineration in developing countries (Table 3).

Table 3. Criteria for using incineration in developing countries

- A mature and well-functioning waste management system has been in place for a number of years.
- Solid waste is currently disposed of at controlled and well-operated landfills.
- The supply of combustible waste will be stable and amount to at least 50,000 tons/year.
- The waste meets the minimum criteria for fuel combustibility of 6 MJ/kg, throughout the seasons, with an average value of not less than 7 MJ/kg.
- The community is willing to absorb the increased treatment cost through treatment charges and tax-based subsidies.
- Skilled staff can be recruited and maintained.
- The planning environment of the community is sufficiently stable to allow for a planning horizon of 15 years or more.

Source: Fritz and Gillen (1998, 4).

Hoornweg and Thomas (1999, 19) provide a good summary comparing solid waste management practices among low-income, middle-income, and high-income countries in Asia (Table 4). In their report, Indonesia was categorized as among the middle-income countries.

2.1.7. Stakeholders in MSWPM

Stakeholders in MSWPM may include central, provincial, and municipal governments; private solid waste businesses, private industries, community organizations, non-governmental organizations (NGOs), waste pickers at dump site, itinerant waste pickers, households, individual collectors (Fernandez, 1993; UNCRD, 1994), schools (Fernandez, 1993), consultants (Ali, Coad and Cotton, 1996), social activists and environmentalists (Furedy, 1994a), industrialists and manufacturers, product distributors, advertising agencies, the mass media, consumer groups, and the general public (Ouano and Ogawa, 1993).

Fernandez (1993) proposed a framework concerning the roles that can be played by some stakeholders in solid waste policy and action (Table 5). The roles are classified as policy makers, supporters or facilitators, and doers (taking action). Roles of stakeholders may exist in any activities, such as waste generation; storage; separation, recycling and processing; collection; transportation; intermediate treatment; and disposal. Major roles of central and municipal governments are policy and action. Municipal governments, in particular, play roles in almost every activity, from generation to disposal. The private sector may have supporting and policy roles. Supportive roles may exist in waste generation, storage, and separation, recycling and processing, while policy roles occur in collection, transportation, intermediate

Table 4. Comparison of typical solid waste management practices in Asia

Activity	Low income countries	Middle income countries	High income countries
Source reduction	No organized programs, but reuse and low per capita waste generation rates are common.	Some discussion of source reduction, but rarely incorporated into any organized program.	Organized education programs are beginning to emphasize source reduction and reuse of materials.
Collection	Sporadic and inefficient. Service is limited to high visibility areas, the wealthy, and businesses willing to pay.	Improved service and increased collection from residential areas. Larger vehicle fleet and more mechanization.	Collection rate greater than 90 percent. Compactor trucks and highly mechanized vehicles are common.
Recycling	Most recycling is through the informal sector and waste picking. Mainly localized markets and imports of materials for recycling.	Informal sector still involved, some high technology sorting and processing facilities. Materials are often imported for recycling.	Recyclable material collection services and highly technology sorting and processing facilities. Increasing attention towards long-term markets.
Composting	Rarely undertaken formally even through the waste stream has a high percentage of organic material.	Large composting plants are generally unsuccessful, some small-scale composting projects are more sustainable.	Becoming more popular at both backyard and large-scale facilities. Waste stream has a smaller portion of compostables than low- and middle-income countries.
Incineration	Not common or successful because of high capital and operation costs, high moisture content in the waste, and high percentage of inerts.	Some incinerators are used, but experiencing financial and operational difficulties; not as common as high-income countries.	Prevalent in areas with high land costs. Most incinerators have some form of environmental controls and some type of energy recovery system.
Landfilling	Low-technology sites, usually open dumping of wastes.	Some controlled and sanitary landfills with some environmental controls. Open dumping is still common.	Sanitary landfills with a combination of liners, leak detection, leachate collection systems, and gas collection and treatment systems.
Costs	Collection costs represent 80 to 90 percent of the municipal solid waste management budget. Waste fees are regulated by some local governments, but the fee collection system is very inefficient.	Collection costs represent 50 to 80 percent of the municipal solid waste management budget. Waste fees are regulated by some local and national governments, more innovation in fee collection.	Collection costs can represent less than 10 percent of the budget. Large budget allocations to intermediate waste treatment facilities. Upfront community participation reduces costs and increases options available to waste planners (e.g., recycling and composting).

Table 5. Stakeholder involvement in solid waste policy and action (Fernandez, 1993)

Stakeholder	Generation	Storage	Separation, recycling and processing	Collection	Transportation	Intermediate treatment	Disposal
Central government	Policy		Policy		Supportive role	Supportive role	Policy
Municipal government		Policy	Policy	Policy & Action	Policy & Action	Policy & Action	Policy & Action
Private solid waste businesses	Supportive role	Supportive role	Supportive role	Policy	Policy	Policy	Policy
Private industry	Supportive role	Supportive role	Supportive role				
Community organization	Policy & Supportive role	Action	Action	Action	Supportive role	Supportive role	Supportive role
NGOs (national scope)	Supportive role	Supportive role	Policy	Policy		Supportive role	Supportive role
Waste pickers at dump site						Supportive role	Policy
Itinerant waste pickers		Action	Supportive role				
Households	Action	Action	Action	Supportive role			
Collectors (individual)	Action	Action	Action	Action	Supportive role	Supportive role	Supportive role
Schools	Policy	Policy	Policy				

treatment, and disposal. Non-governmental organizations may be primarily involved in the supportive roles, such as in waste generation, storage, intermediate treatment, and disposal. The major roles of households are taking action in such areas as waste generation, storage, and separation.

2.1.8. Problems and Constraints in MSWPM

Over the years, problems and constraints in MSWPM in developing countries have been discovered by many investigators. They can be divided into physical, technical, financial, legal, social, institutional and managerial, and interrelated categories and when combined together result in a complex situation. Table 6 summarizes the findings.

Common physical problems and/or constraints are the climate, inaccessible roads, uncontrolled squatter settlements, and traffic congestion. Technical problems are numerous, but the most notable one is operational inefficiencies in service provision. The main financial problem is lack of funds. Recovery of costs has become an important concern recently in order to ensure sustainable service provision in the long term because the amount of subsidies from government has always been insufficient to pay for the service. Lack of appropriate legislation and weak capacity for enforcement are two major problems of the legal system. Social problems associated with MSWPM are many. One particular problem which has drawn much attention for years is the case of waste pickers due to conflicting views between municipal officials and those who support waste pickers. Most institutional and managerial problems are centred on the issue of institutional development. Some problems have evolved due to interrelationships between problems. Lack of service provision to low-income settlements, for example, may be a combination between lack of funds, difficult access to these areas, and a concern for cost recovery.

Planning and management of municipal solid wastes can also be complicated by conflicts of interests among stakeholders. The investigations by Furedy from 1984 to 1994, in particular, reveal several conflicts on different matters, such as between source separation efforts and the earning of waste pickers (1994a), between independent community efforts and the municipal authorities' efforts in service provision (1994b), between increased mechanization and the informal waste system (1993), between technical efficiency and humane concerns, in particular the lives of waste pickers (1989b), and competing interests between the municipal authorities and private enterprises (1984a). In general, the most prevalent conflict is

Table 6. Problems and constraints in MSWPM in developing countries

Aspects	Problems/Constraints	Investigator(s)
Physical	• Climate	Flintoff (1984), Lohani (1988), Ogawa (1989), Sumardjito and Sutisna (1993)
	• Narrow, inaccessible roads	Gotoh (1989), Lohani (1989), Ogawa (1989), Furedy (1995)
	• Uncontrolled squatter settlements	Sakurai (1990), Silas (1995)
	• Traffic congestion	Kirov (1982), Betts (1984), Holmes (1984), Lohani (1988), UNCHS (1994)
Technical	• Operational inefficiencies	Johnson (1992), Meyer and Schertenleib (1992), Haight and Ratha (1995), Pfammatter and Schertenleib (1995)
	• The number of bins for source separation	Cointreau et al. (1984), UNCHS (1994)
	• Insufficient collection	Karamoy and Dias (1986), Lohani (1988), Forbes (1995), Pfammatter and Schertenleib (1995)
	• Routing problems	Furedy (1994a)
	• Inadequate transfer station	Sicular (1992), UNCHS (1994)
	• The use of inappropriate composting technologies	Ambrose (1982)
	• Plastic-contaminated waste for making compost	Wilson, Bourgeois and Vicharangsam (1988), Furedy (1989c)
	• Lack of support in source separation	UNCHS (1994)
	• Inadequate landfill sites	UNCHS (1994)
	• Inappropriate disposal methods	Maniatis et al. (1987), UNCHS (1994), Cervero (1995)
	• Uncontrolled open dumping	Lohani (1988), Bartone et al. (1991)
Financial	• Lack of funds	Cointreau (1982), Lohani (1988), Ogawa (1989), Sakurai (1990), Doberstein (1992), Ouano and Ogawa (1993), Haight and Ratha (1995)
	• Low cost recovery	Cointreau (1987), Arlosoroff (1991), Johnson (1992), Pfammatter and Schertenleib (1995)
	• Foreign currency exchange	Flintoff (1984)
Legal	• Lack of appropriate legislation and insufficient enforcement	Kirov (1982), Sakurai (1990), Sumardjito and Sutisna (1993), Muttamara (1994), UNCHS (1994), Leitmann (1995)

Table 6. Continued.

Aspects	Problems/Constraints	Investigator(s)
Social	• Culture	Lohani (1988)
	• Public's attitude about waste	Ouano (1993), UNCHS (1994)
	• Public opposition to waste pickers	Cointreau et al. (1984), Furedy (1984a), Poerbo (1991), UNCHS (1994)
	• Public's inconvenience to do source separation	Cointreau et al. (1984), Poerbo (1991), Indrayana and Silas (1993), Noor (1994)
	• Municipal officials' attitude against waste pickers	Indrayana and Silas (1993), Furedy (1994b)
	• Municipal officials' opposition to privatization	Cervero (1995)
	• Lack of public awareness	Vogler (1984), UNCHS (1994), Ali and Saywell (1995)
	• Uncoordinated waste pickers' activities	Furedy (1989a), Sakurai (1990)
	• Waste pickers' opposition to source separation	Furedy (1994a)
	• Limited utilization of the formal and informal sectors	Furedy (1989a), Meyer and Schertenleib (1992), Schertenleib and Meyer (1992a)
	• Limited community participation	Ogawa (1989), Ouano (1991b)
	• Insufficient public education	Sakurai (1990)
Institutional and managerial	• Poor management (deficiencies)	Johnson (1992), Sicular (1992), UNCHS (1994), Pfammatter and Schertenleib (1995)
	• Lack of planning	Golueke (1987), Sakurai (1990), Sicular (1992), Diaz and Furedy (1993), Cervero (1995)
	• Narrow view of waste management	Meyer and Schertenleib (1992), Sicular (1992), Furedy (1993), van Beukering (1994)
	• Unclear goals and objectives of waste management	Sicular (1992)
	• Lack of coordination among agencies and government bureaucracies	Yeung and McGee (1986), Sakurai (1990)
	• Inadequate institutional arrangements	Johnson (1992)

Table 6. Continued.

Aspects	Problems/Constraints	Investigator(s)
Institutional and managerial (continued)	• Untrained personnel or lack of experts	Karamoy and Dias (1986), Ogawa (1989), Haight and Ratha (1995)
	• Lack of interest of municipal authorities in recycling efforts	Arlosoroff (1985), van Beukering (1994), Cervero (1995)
Combination of the above aspects	• Lack of service provision to low-income settlements	Sicular (1992)
	• Inadequate service coverage	Bartone et al. (1991), Johnson (1992), Schertenleib and Meyer (1992a), Furedy (1995)
	• Lack of compost uses	Betts (1984), Gaur (1984)
	• Difficulties in creating and sustaining markets for compost	Arlosoroff and Bartone (1987), Maniatis et al. (1987), Lohani (1988), Woolveridge (1994)
	• Difficulties in promoting source separation and developing recycling industries	UNCHS (1994)
	• Affordability of service	Cointreau (1982), Flintoff (1984), Arlosoroff and Bartone (1987)
	• Difficulty in finding sites for transfer station and landfill	Sicular (1992), Silas and Indrayana (1993)
	• Accumulation of uncollected waste	Cointreau (1982), Forbes (1995)
	• Environmental and public health risks from waste	Medina (1993), Haight and Ratha (1995)
	• The use of inappropriate equipment	Sakurai (1990), Doberstein (1992), Furedy (1993)

between formal waste management activities and scavenging activities of the informal waste pickers (Betts, 1984; Schertenleib and Meyer, 1992a). A dilemma between increasing service coverage and the need to improve the quality of service is another tension that needs to be addressed (Arlosoroff, 1991).

Conflicts in MSWPM have also been encountered in Indonesia, including conflict of interests between waste pickers and communities, waste pickers and local municipal officials (Poerbo, 1991), conflict between affordability and environmental harm due to illegal dumping

by those who refuse to pay the fees levied upon them (Cervero, 1995), and conflict in providing primary collection services as well as the collection of fees between the City's Sanitation Department and local community organizations (Johnson, 1992).

2.1.9. Approaches to MSWPM

Three approaches to MSWPM are identified from a review of literature: the conventional approach with its well-known activities of collect-transpose-dispose, the non-conventional approach, and the integrated approach. The conventional approach views waste as a nuisance to the public (Cointreau, 1982; Maung, 1982). Municipal authorities have an obligation to remove it as quickly as possible in order to protect the public's health and the municipal environment, and also for aesthetic reasons (Cointreau, 1982; Cointreau et al., 1984; Manschot, 1991; Poerbo, 1991). Provision of waste collection and transportation service is considered a public good (Bose and Blore, 1993). According to Bartone (1990), the attitude of the municipal officials can be typified as "out of sight, out of mind". There is a lack of interest by the public authorities in reusing municipal solid waste (Arlosoroff, 1985; van Beukering, 1994). With top-down approaches to planning, the conventional approach has been common in developing countries (Furedy, 1993).

Because of its focus only on collection, transportation, and disposal, the main objective of the conventional approach has been operational efficiency. Any problems related to these three activities have been viewed as technical matters (Betts, 1984) and engineering solutions are often sought to solve them (Furedy, 1984a). Common attempts to achieve operational efficiencies are the procurement of collection-related equipment (Schertenleib and Meyer, 1992b) and privatization of the collection and transport of waste (Fernandez, 1993).

Furedy (1984a, 1994b, 1995) commented that the conventional approach has been increasingly unable to cope with the complex problems of municipal solid waste planning and management. Not only is the approach expensive, but it is also financially unsustainable (Sicular, 1992). Many cities spent between 30 and 50 percent of their operating budgets on solid waste management (Arlosoroff and Bartone, 1987). Most local municipal authorities in Malaysia, for instance, had about 50 percent of their operating budget for solid waste management and out of this figure 70 percent was alone spent on collection of solid waste (Sinha, 1993). Despite these expenditures, service coverage and service quality remained unsatisfactory.

The use of the conventional approach often reveals additional challenges. In Indonesia, for example, this approach suffers from a lack of public participation. Many residents assume that since they have paid the waste service fee to the City's sanitary department, they are not obliged to participate in waste management (Soerjani, 1984). A similar finding was reported for Malaysia (Sinha, 1993). In Indonesia, an image has been created within a community that local authorities would always provide the service for the public, and this has resulted in the community's dependence on technical assistance and financial support from the local, provincial, central governments, or foreign lending agencies (Silas and Indrayana, 1993).

The second approach to MSWPM is termed the non-conventional approach (Furedy, 1992, 1994b). Unlike the conventional approach, this approach regards waste more as a resource. This idea is inspired by resource conservation advocated by the Brundtland Report in 1987. Goals of this approach are focussed on social and environmental aspects, including assisting poor people, accommodating informal activities in waste recovery and recycling, promoting source separation, developing partnerships among communities, private sector and municipalities, and environmental education (Furedy, 1992). Acceptance of this approach in many developing countries has been low (Furedy, 1994b). Factors which hinder acceptance include the entrenchment of the conventional approach; the lack of people, research, expertise, and financial resources to support efforts for change; and, the lack of interest of the main environmental groups in Southern countries to work on municipal solid waste management.

The third approach is the integrated approach and is based on a premise that no single entity or actor alone can solve the complex problems of municipal solid waste management. Halla and Mojani (1999, 351), for instance, concluded that "Provision of municipal services by local authorities alone cannot be sustained in most cities of the developing countries". A more comprehensive view of the problems and a more coordinated effort to tackle problems are required. Erbel (1982) referred to the integrated approach as one that considers technical, financial, socio-economic, organizational, institutional, and legislative factors. Meanwhile, Ali, Coad and Cotton (1996, 159) defined the integrated approach as "a set up in which the two sectors operate in such a way that they accept each other's role, in planning and operation, develop partnership, and avoid any such action which affects the counterpart." They referred to the two sectors as the formal and informal systems of municipal solid waste management. Some regard the integrated approach as a multi-sectoral approach because it takes into account

various factors and involves stakeholders from many different sectors (Ouano and Ogawa, 1993; Furedy, 1995).

One distinct attribute of the integrated approach is the partnership among stakeholders (Fernandez, 1993; Furedy, 1993, 1994a, 1994b; Ouano and Ogawa, 1993; Ali, Coad and Cotton, 1996). Hoornweg and Thomas (1999, 3), for instance, stated that "To carry out integrated solid waste management, local governments need partners." Cooperation among stakeholders and the spirit of shared responsibility are considered critical in this approach.

Partnerships between the formal waste management sector and the informal sector of waste recycling involving waste pickers have faced difficulties (WHO, 1991; Sicular, 1992; ESCAP, 1993; UNCHS, 1994; UNCRD, 1994; Furedy, 1995). Furedy (1989a) observed that attempts to integrate the formal and informal systems were hindered by technocratic and manipulative administrative actions. She pointed out that tensions among competing views from some stakeholders, such as municipal authorities, community organizations, educational institutions, environmental non-governmental organizations (NGOs), and activists can be a major barrier to the partnership (Furedy, 1991).

An exceptional partnership occurred in Surabaya. In this metropolitan city, a partnership for municipal solid waste planning and management was implemented by the municipal government, involving local communities, waste pickers, and university staff and students (Silas and Indrayana, 1993). Between 2,500 and 3,000 waste pickers were involved. The focus of this partnership was on improving the effectiveness and efficiency of the waste collection system, and on involving people in low-income settlements and waste pickers. The partnership was based on three main principles (Indrayana and Silas, 1993; Silas, 1995). First, every citizen should participate in the process of preserving the city's living environment. Second, all participants or stakeholders should share responsibilities and costs in achieving certain objectives. Third, encouraging community participation is a means of making people able to manage their own businesses or problems.

Indrayana and Silas, (1993) reported three barriers to partnerships in Surabaya. First, fear by government officials that a partnership could complicate their work. Second, initiating a partnership took time and a strong and sustained commitment from everyone involved. Third, a partnership of stakeholders could sometimes be costly. Indrayana and Silas suggested three prerequisites for implementing successful partnerships in Indonesia. Government policy is very

crucial and functions as a driving force for government officials' support and as a basis of rights for other stakeholders to take part. Without such a policy, it will be very difficult to bring partnerships of stakeholders into reality. The willingness of the decision makers or policy makers to recognize the contributions of citizen also is important. Finally, open relationships between municipal officials and other stakeholders are necessary.

2.2. Integrated Solid Waste Management in Developed Countries

An integrated approach to planning and management of MSW has been widely used in developed countries (Erwin and Healy, 1990; National Round Table on the Environment and the Economy Canada, 1991; Solway and Haight, 1991; Jessup, 1992; Kreith, 1994; Rhyner et al., 1995; Wilson, 1996; Hoornweg and Thomas, 1999). As mentioned in Hoornweg and Thomas (1999), the UNEP International Environmental Technology Centre (1996) identified various reasons to adopt an integrated approach to solid waste management (Table 7).

Table 7. The necessity for an integrated approach to solid waste management (UNEP, 1996)

- Some problems can be solved more easily in combination with other aspects of the waste system than individually;
- Adjustments to one area of the waste system can disrupt existing practices in another area, unless the changes are made in a coordinated manner;
- Integration allows for capacity or resources to be completely used; economies of scale for equipment or management infrastructure can often only be achieved when all of the waste in a region is managed as part of a single system;
- Public, private, and informal sectors can be included in the waste management plan;
- An ISWM plan helps identify and select low cost alternatives;
- Some waste activities cannot handle any charges, some will always be net expenses, while others may show a profit. Without an ISWM plan, some revenue-producing activities are "skimmed off" and treated as profitable, while activities related to maintenance of public health and safety do not receive adequate funding and are managed insufficiently.

Source: Hoornweg and Thomas (1999, 18)

Tchobanoglous, Theisen and Vigil (1993, 15) defined integrated solid waste management as "the selection and application of suitable techniques, technologies, and management programs to achieve specific waste management objectives and goals." In this regard, an integrated waste management model consists of some or all waste management options combined into an integrated, synergistic model. Similarly, Ham (1992, 73) stated that integrated solid waste management involves "the coordinated use of waste reduction, recycling,

treatment, and disposal systems to achieve minimal environmental impacts and maximum utilization of resources, at a reasonable cost." Likewise, Willms (1991, 354) referred to integrated waste management as "a waste management program that integrates some or all of the various component types of waste management." Figure 1 shows a model of an integrated waste management by Solway and Haight (1991) that includes hazardous waste treatment. In this framework, the primary sources of municipal solid wastes consist of households, commercial establishments, institutions, and industries. The waste generated will be processed through various options: source separation and recycling, hazardous waste treatment, combustion, and landfill. The other option, reuse, comprises the use of inorganic recyclables and organic compostables produced through source separation and recycling processes; organic and inorganic recyclables obtained after hazardous waste treatment; and heat and electricity produced by combustion plants. Some treated fly ash and bottom ash resulted from the combustion will be sent to landfill.

2.2.1. Objectives

Integrated waste management has several objectives, including reducing the amount of waste material generated, reducing the amount of natural resources used by the manufacturing sector, reducing the volume of material to be landfilled (Crutcher and Yardley, 1991), achieving minimal environmental impacts and maximum utilization of resources at a reasonable cost (Ham, 1992), and achieving more efficient use of resources and environmentally enhanced waste disposal methods (Poland, 1991). Table 8 summarizes these objectives.

Table 8. Objectives of integrated waste management in developed countries

- Reduce the amount of waste generated
- Minimize environmental impacts
- Reduce the amount of natural resources used by the manufacturing sector
- Reduce the amount of waste to be landfilled
- Maximize the utilization of resources

2.2.2. Options

The hierarchy of options in an integrated waste management scheme varies, and the options selected may be unique for each community. As quoted in Charles (1992, 56), for example, the United States Environmental Protection Agency stated that "No single element of the hierarchy is the appropriate solution for all communities. Rather, communities should seek

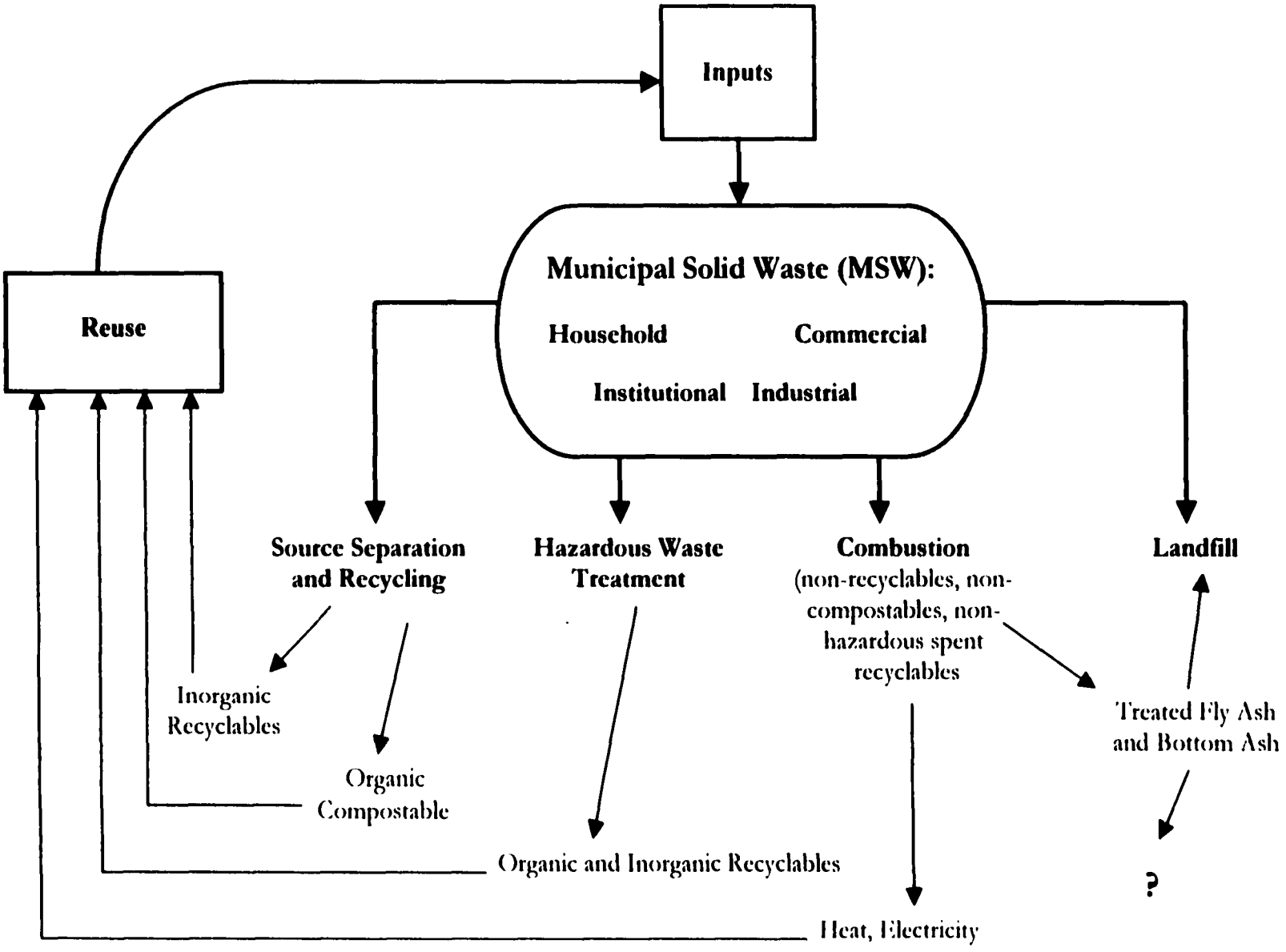


Figure 1. An integrated system model for optimal waste management (Solway and Haight, 1991)

solutions by integrating the complementary elements of the hierarchy." Table 9 shows some hierarchies of options for integrated waste management.

Table 9. The hierarchy of options for integrated waste management

Author or Agency	Hierarchy of Options
Hoornweg and Thomas (1999)	• Reduce • Reuse • Recycle • Recover through physical, biological, or chemical processes (e.g., composting, incineration) • Landfilling
Wilson (1996)	• Avoidance • Minimization • Recycle • Treatment • Disposal
Rhyner et al. (1995)	• Reducing the quantity and toxicity of waste • Reusing materials • Recycling • Composting • Incineration with energy recovery • Landfilling • Incineration without energy recovery
Kreith (1994)	• Source reduction • Recycling and composting • Incineration • Landfills
The United States EPA (Jessup, 1992)	• Source reduction • Recycling • Combustion and landfilling
National Round Table on the Environment and the Economy Canada (1991)	• Waste (source) reduction • Recycling • Incineration/energy recovery • Landfill disposal
Solway and Haight (1991)	• Reducing waste stream through reduction and reuse • Cleaning the waste stream by isolating hazardous wastes • Recycling to the maximum feasible extent • Composting organic waste • Burning the remaining combustibles with maximum energy recovery • Landfilling what remains
Erwin and Healy (1990)	• Source reduction • Recycling (and composting) • Waste combustion with energy recovery • Landfilling

2.2.3. Policy Measures for Integrated Solid Waste Management

Based on the findings from 25 developed countries, Wilson (1996) has classified five types of policy measures to support integrated solid waste management. The policy instruments consist of information dissemination and use mechanisms, economic sticks, producer responsibility, "carrots", and legislative sticks. The primary aim of information dissemination is to encourage and persuade consumers, businesses, and authorities to change their behaviour in particular toward waste reduction initiatives. The importance of coordinated publicity and campaign, especially long-term education programs conducted at schools, is emphasized. Several options for providing businesses with useful and necessary information include, for instance, telephone advice line, information clearing house, demonstration programs, publication of specific guidance, provision of technical assistance, and information exchange about mistakes and successes. Besides encouragement and persuasion, information can also be used as an effective "stick". A good example is about community right-to-know legislation in the USA where companies have an obligation to reveal their emissions of chemicals in their annual reports. This legislation has triggered many voluntary initiatives for waste reduction by industries.

Economic sticks or coercion can also be applied to change behaviour of consumer, industry and commerce. According to Wilson (1996), these instruments are used through changing cost structure at some point in the product lifecycle: primary production, manufacturing, distribution, consumption, and disposal. Another widely used policy instrument for industries is the deposit refund system, aimed at achieving waste reduction targets for beverage industries. Alternatively, an economic "stick" used in many European countries has been product taxes, designated for disposable or non-recyclable goods. The taxes were used to support the deposit refund system. One instrument less common in developed countries is the use of liability for environmental damage caused by a company's waste. This instrument persuades waste generator to reduce, recycle or treat its waste in order to avoid a liability charge. In the case of households, Wilson (1996) noted that the cost of collection, treatment and disposal might be in the form of property tax and/or a direct contract between a household and the waste contractor. In most cases, a flat rate approach has been used, instead of volume- or quantity-based fees.

As mentioned by Wilson (1996, 393), according to Anders (1995), the use of producer responsibility ""whereby the "producer" (manufacturer, importer, distributor, retailer) of the products giving rise to the waste takes responsibility for those wastes, rather than expecting society to pay for waste collection and disposal" has been emerging in many developed countries. The use of producer responsibility as a policy instrument is aimed at making producers responsible for the collection and disposal of their waste. In many European countries, producer responsibility has been focused on packaging wastes (Wilson, 1996). Although the first initiatives for producer responsibility occurred in Taiwan in 1989, the most popular practice occurred in Germany in 1991 through its Packaging Ordinance. Wilson reported that because of the public's high enthusiasm, the targets for recycling were surpassed which resulted in over supply and led to exports to the other European countries.

As policy instruments, "carrots" refer to the provision of financial incentives. Wilson (1996) concluded that most developed countries have used grants or subsidies. They include, for instance, subsidies for waste prevention programs, subsidies for research and development and for demonstration, subsidies for in-house recycling and waste treatment schemes, subsidies for new central treatment facilities, tax concessions, subsidies to support the supply of materials for recycling, subsidies to develop the demand (markets) for recycled materials, and charge/rebate schemes.

Another form of "carrot" is the recycling credit through which the waste collection authority receives some amount of money from the waste disposal authority and uses it as incentive for recycling. For the waste disposal authority, meanwhile, that payment represents savings for the reduction of the amount of waste requiring disposal. Wilson (1996) reported that this scheme has been used in the U.K., Australia, and certain provinces in Canada. Other kinds of "carrot", found in Denmark and the USA, are preferential purchase policies. These policies urge governments, local authorities, and private industry to purchase materials made from recycled materials. Thus, the intent is to develop markets for recycled materials and respectively to support the recycling industry.

Legislative "sticks" are defined by Wilson (1996, 396) as "all of the policy instruments which work through restricting the options legally available for waste management". Most developed countries use licensing for storage, treatment and disposal facilities for various types of wastes. Other forms of legislative "sticks" include: an obligatory requirement for local

authorities, waste producers, and/or households to provide particular types of facilities for certain types of wastes; restrictions on the use of landfill for particular types of waste; and restrictions on certain types of products which create waste, for instance, the ban of aluminium can and non-refillable containers for domestic sale of beer in Denmark.

Wilson (1996, 397) proposed a few conclusions concerning policy instruments for integrated waste management (Table 10). One thing is clear: a combination of policy measures will be required to support the implementation of integrated waste management.

Table 10. Conclusions about policy measures for integrated waste management

- There is no one policy measure which, on its own, can achieve systematic waste reduction. An integrated waste management strategy requires a combination of measures.
- There is no right or wrong approach, there are merely "horses for courses", that is, tailored sets of measures adapted to the circumstances of a particular country or region.
- The need is for a balanced set of measures, probably containing one or more from each of the five categories discussed above. Thus, sticks and carrots, legislative measures and economic instruments are all needed.
- In putting together a balanced set of policy measures, it is important to take care to encourage waste prevention as well as recycling.
- Similarly, care is required to encourage the demand for recycled materials, and for products made from them, as well as encouraging the supply of materials for recycling.

2.3. Integrated Resource and Environmental Planning and Management

Cairns (1991a, 5) referred to integrated environmental management (IEM) as "coordinated control, direction, or influence of all human activities in a defined environmental system to achieve and balance the broadest possible range of short- and long-term objectives." The emergence of integrated resource management (IRM) and IEM has been motivated by various reasons, including failure in environmental management to deal with linkages, complexities, multiple perspectives, multiple uses, and externalities (Margerum and Born, 1995), dissatisfaction with the outcomes from narrowly-focussed environmental management (Bowonder, 1987; Born and Sonzogni, 1995; Margerum and Born, 1995; Hooper, McDonald and Mitchell, 1999), need to capture the maximum benefits from multiple uses of scarce resources through coordinated action (Lang, 1986b; Hooper, McDonald and Mitchell, 1999), many obstacles from fragmented and shared responsibilities among agencies (Mitchell,

1990), failure in dealing with different competing views (Bowonder, 1987; Hooper, McDonald and Mitchell, 1999), and increasingly complex problems of resource management due to interconnecting forces: technical, social, economic, administrative, political, and legal (Petak, 1980). According to Margerum and Born (1995), problems in resource or environmental management should be addressed from a holistic view.

The integrated approach to resource and environmental management offers many potential benefits. This approach can provide an opportunity to define common goals and identify the most critical issues (Margerum and Born, 1995), eliminate data redundancy, preserve resources, and reduce expenditures to deal with conflicts over competing uses (Cairns, 1991a), function as a medium to address different concerns, achieve and secure agreement, set up coordinated action and conflict resolution (Lang, 1986b), and improve effectiveness through cooperation and coordination (Walther, 1987; Mitchell, 1990).

2.3.1. Basic Characteristics

According to Monika (1993) and Born and Sonzogni (1995), the concept of integrated resource management (IRM) has been most explicitly defined by Mitchell who outlined the components of this approach. Mitchell (1986) argued that IRM involves comprehensive, integrated, and unified approaches. It is comprehensive because it takes into account many aspects; it is integrative because it blends diverse elements into a harmonious whole; and it is unified since it arranges many perspectives into a whole, large scope. Similarly, Born and Sonzogni (1995) and Margerum and Born (1995) argue that IRM and/or integrated environmental management (IEM) has four distinctive themes: comprehensive or inclusive, interconnective, strategic or reductive, and goal-focussed. The first two attributes, inclusive and interconnective, are basically identical to those mentioned by Mitchell (1986). Being strategic involves identifying the most critical aspects to narrow the focus of the system being analyzed; and goal-focused refers to the development of common goals from a variety of interests. Other distinctive dimensions of IRM, according to Lang (1986b) are: action-oriented because its aim is to bridge the gap between planning and implementation; interactive by involving stakeholders; and flexible to options and adaptive to unpredictable change. In summary, IRM or IEM is a "dual-perspective" approach (Margerum and Born, 1995) since it has a broad view of the system being addressed and focuses on key variables.

Mitchell and Hollick (1993) proposed five building blocks of (IRM): a systems

approach, an integrated approach, a stakeholder approach, a partnership approach, and a balanced approach. A systems approach implies identifying the elements of a system and their interrelationships and interconnections between the system with other systems (Muller-Merbach, 1994). The integrative nature of IRM is represented by identifying key issues and variables, finding linkages among these key issues and variables, and by consulting with many stakeholders. Thus, IRM is also a "stakeholder approach" because it emphasizes the importance of involving many stakeholders to participate in the decision-making process. Grimble and Chan (1995) suggested that by involving different stakeholders, trade offs over the use and management of resources and distributional impacts upon stakeholders can be discussed. The main purpose of a stakeholder approach is to recognize roles, authorities, and responsibilities of each stakeholder, find common objectives among stakeholders, and develop mechanisms to resolve conflicts. Although conflicts cannot be avoided, the main emphasis is on cooperation and accommodation rather than on competition of interests of stakeholders. The last building block, the balanced approach, has been inspired by the idea of sustainable development of the Brundtland Commission (1987) that advocated balanced development between the economy and the environment. Implications of the balanced approach of IRM are the preservation of the quality and integrity of natural systems and the satisfaction of social and economic norms and values. Mitchell and Hollick concluded that the adoption of IRM is expected to foster the acceptance and pursuit of cooperative initiatives, to facilitate cooperation among stakeholders, and to assist the development of complementary regulatory instruments and the preparation of plans.

2.3.2. The Analytical Framework of IRM

The analytical framework of IRM, developed by Mitchell (1998) as shown in Figure 2, consists of seven main components: context, vision, legitimation or credibility, functions, structures, processes and mechanisms, and organizational attitudes and cultures.

2.3.2.1. Context

The analytical framework of IRM begins with recognizing the context of the problem or system being analyzed. Context may involve physical, historical, social, cultural, economic, and institutional aspects (Mitchell and Hollick, 1993). By identifying and examining the context of the problem or the system, constraints and opportunities for devising solutions can be formulated. Mitchell (1990) asserted that by analyzing the context of the problem,

justification can be made to indicate whether integration is necessary or not. Several factors that deserve attention in investigating the context of the problem include the state of the natural environment; predominant ideologies; choice of goals, objectives, and strategies; economic conditions, and legal, administrative and financial arrangements (Mitchell, 1990).

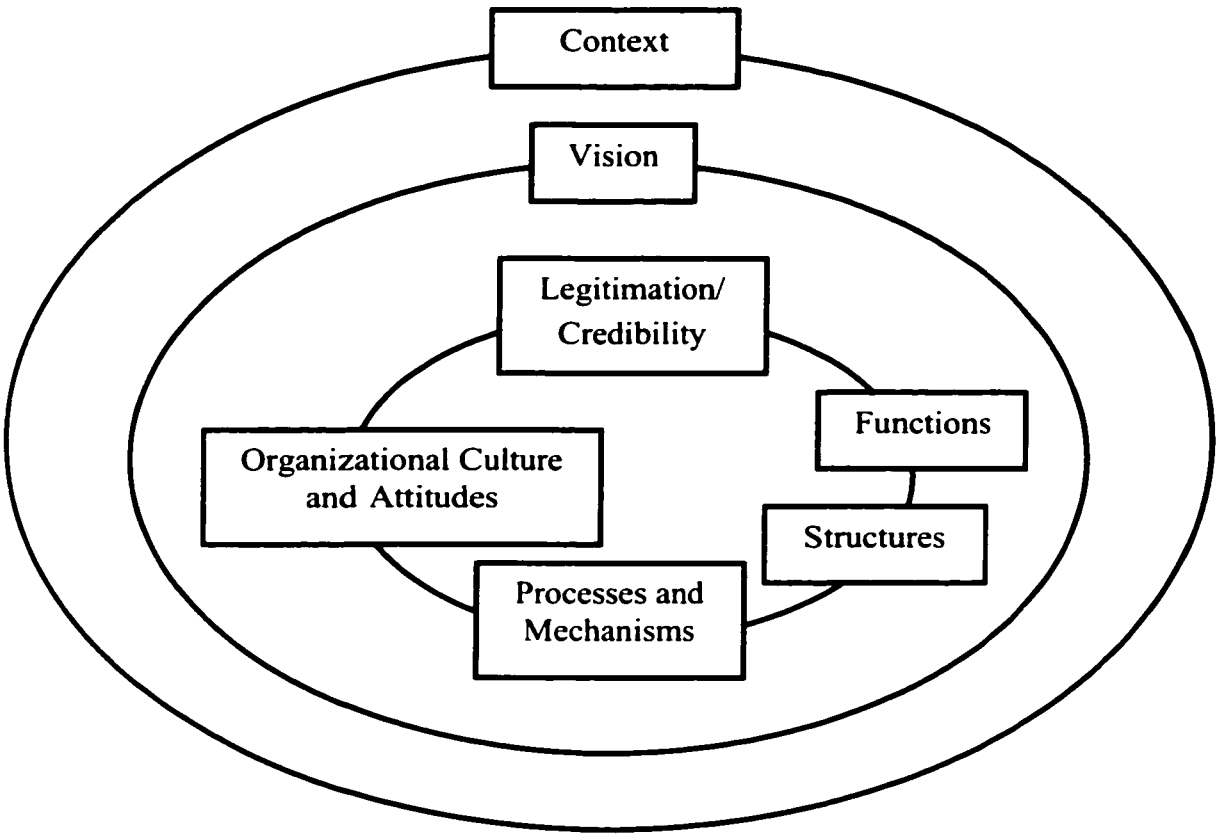


Figure 2. A conceptual analytical framework for integrated resource management (Mitchell, 1998)

2.3.2.2. Vision

The next component of IRM is vision or direction. According to Kotter (1990, p. 36), vision is "a description of something (an organization, a corporate culture, a business, a technology, an activity) in the future, in terms of what it should become" or "a concept for a new and desirable future reality that can be communicated throughout the organization" (Namaki, 1992, 25). Mitchell (1998) argued that the state of the desirable future should be specified to direct an integrated approach in attaining that future.

2.3.2.3. Legitimation or credibility

Legitimacy is a prerequisite for the effective implementation of any policy. Without legitimacy or credibility, individuals, agencies, or the public may neither respect nor follow that policy. According to Mitchell and Hollick (1993), legitimacy can be achieved through legislative, political, administrative, and financial instruments. Legislation can provide formal credibility to any agency because it can require any stakeholders to comply, since to do otherwise would result in penalties. In addition, statute or legislation can also be used to assign power or to be employed for resolving conflicts (Mitchell, 1990). Political legitimacy can formally or informally support the credibility of any stakeholder or agency in the eyes of others. Government agencies through administrative procedures can establish legitimacy for any appointed stakeholder or agency. Legitimacy through financial arrangements enables any stakeholder to provide financial support to others. In the implementation of IRM, a combination of these instruments may be used.

In deciding the appropriate means for providing legitimacy, Mitchell (1990) suggested attention to three important aspects: the objectives of relevant agencies by identifying both common and different interests, the authority and responsibility of each agency, and the rules for mediation and arbitration by higher level authorities to reconcile any conflicts that cannot be settled by stakeholders directly involved. Thus, it is important to know who or which agency has the right and obligation to resolve deadlocks (Mitchell, 1990). Because IRM includes many stakeholders, it is likely that conflicts will arise. Therefore, conflict resolution will be important in planning and implementation of this approach. Mitchell (1990) noted that even when objectives and powers are stated explicitly, conflicts can still arise because of boundary effects as a result of fragmented of shared responsibilities.

2.3.2.4. Functions

The next component is to determine the management functions required and distribute them to each actor or stakeholder. Mitchell (1990) contended that an important concern is to decide which management functions should be delegated to which scale or hierarchy such as the local, state, or federal level. He advised that a guiding principle in allocating management functions to stakeholders is to assign them to the scale or hierarchy that has the closest association with those people getting the service or the product.

Mitchell (1990) categorized management functions into two groups: generic and substantive. The former involves data collection, planning, regulation, development, monitoring, and enforcement; while the latter is specific to a resource or sector which in water management comprises supply, sewage treatment, pollution control, and other substantive functions from linkages between water and land and from linkages among water, environment and economy.

2.3.2.5. Structures

Organizational structures will be needed and should be designed to facilitate efficient performance of the identified management functions (Mitchell and Hollick, 1993). As cited in Mitchell (1990), Paterson argued that the primary motivation in designing the structures should be to determine organizational units that have well-defined functions with clear autonomy and responsibilities so that they can perform their tasks effectively. Mitchell (1990) added that because the perfect match between functions and structures can rarely be found, boundary problems are likely to emerge and lead to conflicts.

Mitchell (1990) proposed a few important points to be considered in designing organizational structures. First, a perfect fit between management functions and organizational structures can rarely be achieved and this can lead to "grey" responsibilities in which either there is no clear assignment regarding which agency should be responsible for certain functions; or that there are many competent agencies responsible for the same management functions. This situation leads to the second consideration, what Mitchell called "the emergence of boundary problems" resulting from shared or fragmented responsibilities. Third, it is important to be aware of the consequences of the organizational structures chosen. Generally, the design of organizational structures lies along a continuum, with a few, big organizational structures at one end, and many, small structures at the other end. In the former case, the structures tend to be centralized and carry out many management functions, while on the other one, the structures are decentralized with each having only a few functions. It is difficult to determine the best structure. In addition, the selection of the structure can be context-dependent. In other words, the context or area of the study and local conditions may dictate the best arrangement between management functions and the organizational structures. Therefore, it is possible to use a combination of a few large organizational structures and many small ones, depending upon the context of the problem or the system. Fourth, another issue is

accountability. When authority and responsibilities have been defined and assigned, then the next step is to examine whether the appointed agencies or organizations have accomplished their mission and tasks accordingly or not. In addition, Mitchell (1990) emphasized a need for flexibility of the structure.

2.3.2.6. Processes and mechanisms

After determining the management functions and establishing the required organizational structures, mechanisms and processes to operate the system should be defined. These processes and mechanisms are important for addressing boundary problems as well as facilitating bargaining, negotiation, and mediation of conflicts. Processes to facilitate integration and coordination could be addressed at the political and bureaucratic levels. Examples of formal mechanisms at the political level are interministerial councils and select committees to deal with a specific issue. At the bureaucratic level, four mechanisms can be used: interdepartmental committees, commissions, task forces established for a specific purpose and period, and review procedures by which government agencies disseminate plans or proposals to related agencies for comment. Another mechanism, as important as the formal one, is the informal approach that supports cooperation and participation. Furthermore, the inclusion of viewpoints of the general community and individuals in planning and management exercises should be ensured. Several processes that can be used to bring together diverse perspectives or interests are regional planning, benefit cost analysis, environmental impact assessment, and public participation.

2.3.2.7. Organizational culture and attitudes

The effectiveness of any implemented policy and the success of the integration, cooperation, and coordination of efforts will be influenced by the organizational culture and attitudes of the individuals involved (Mitchell and Hollick, 1993). It is therefore important to recognize the characteristics of the organizational culture and the participants' attitudes regarding their support for integration. Mitchell (1990) pointed out that human dimensions should be given as much consideration as the other components of IRM. Because culture and attitudes can be specific from one area to another, it is therefore important to know the context, people, and local conditions of the area or system being studied.

2.3.3. Implementation Issues

A framework for implementing the integrated approach (Figure 3), proposed by Margerum and Born (1995) will be highlighted. Then, some common and unique problems in the implementation of IRM, particularly discovered by Mitchell (1986, 1990, 1997), will be summarized.

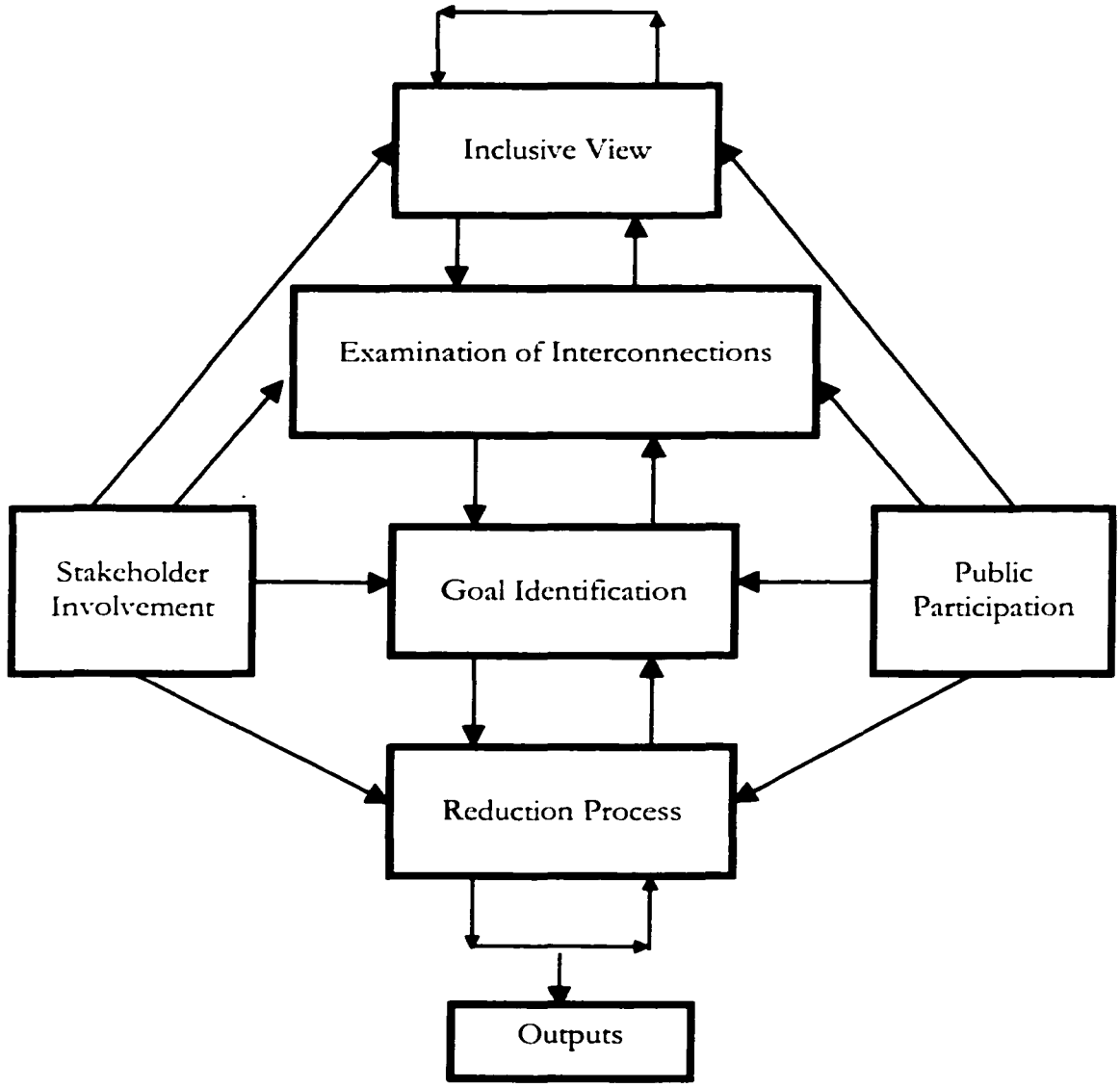


Figure 3. Interaction during the planning process (Margerum and Born, 1995)

2.3.3.1. Operationalization

The conceptual framework proposed by Margerum and Born (1995) is based on their proposition that interaction is the key operational element to achieve integration. They describe the essence of interaction as information exchange and conflict resolution. Their framework,

therefore, is primarily intended to ease interaction among the affected stakeholders and the public.

The interaction during the planning process occurs in the four components of IEM: the inclusion of views, the examination of interconnections or linkages, goal identification, and the reduction process. Essentially, what Margerum and Born propose is not different from what has been addressed by others (Lang, 1986b; Mitchell and Hollick, 1993, Slocombe, 1993) who emphasize that the process involved in the integrated approach is interactive and participatory. According to Margerum and Born (1995), one critical element of IEM is coordination that has two dimensions: communication and conflict resolution. They identified many tools for communication and conflict resolution (Table 11).

Table 11. Coordination tools (Margerum and Born, 1995)

Element	Tools
• Communication	• Information and data sharing procedures • Common database or data gathering • Joint forecasting or scenarios • Joint models or jointly used geographical information systems (GIS) • Regular communication mechanisms • Informal communication • The creation of common jurisdictional boundaries • Joint reviews of plans or environmental impact statements • Formal review or clearance procedures • Supervisory oversight • Joint budgeting process • Scheduled meetings • Coordinating committees • Joint staff • Joint permit reviews • Joint planning process • Plans
• Conflict resolution	• Additional research or analysis • Interpersonal or inter-group communication • Appeals to higher authority • Special meetings of committees or other groups • Negotiation or bargaining within the group • Appeals to outside party or third party intervention (i.e., facilitation and mediation)

2.3.3.2. Problems/Obstacles

Various implementation obstacles of IRM and/or IEM have been recognized. They include the need and scope for integration in a given context (Hooper, McDonald and Mitchell, 1999), a concern that management authority will be abused (Cairns, 1991a), an overly lengthy time required for comprehensive planning (Mitchell, 1986; Cairns, 1991a) and to facilitate public participation (Mitchell, 1990), the sensitivity of line agencies (Mitchell, 1986, 1997; Cairns, 1991a), inadequate institutional arrangements (Mitchell, 1986, 1997; Cairns, 1991a; Hooper, McDonald and Mitchell, 1999), vague, outdated, unrealistic, and excessive recommendations (Mitchell, 1986), data required to assist planning and management decisions (Mitchell, 1990), financial resources needed to carry out the process (Mitchell, 1990; Hooper, McDonald and Mitchell, 1999), bureaucratic resistance and information access (Hooper, McDonald and Mitchell, 1999), and a long learning process (Walther, 1987). Another possible obstacle, according to O'Riordan as cited in Mitchell (1990), is the combination of organizational culture, personalities and participants' attitudes that can hamper integration and cooperation. Other important findings from water management in Nigeria (Mitchell, 1994) reveal institutional gridlock as a primary problem in the implementation of IRM. This gridlock consists of the inadequate funding, ambiguous responsibilities, preoccupation with institutional structures, and lack of attention to operation and maintenance.

Mitchell (1990) offers some recommendations to overcome the above problems. These initiatives may include: a well-defined scope for IRM; identifying common goals, objectives, and activities so that participants could determine how they might participate; and, devising the appropriate institutional arrangements through an appropriate mix of legislation and regulations, policies and guidelines, administrative structures, economic and financial arrangements, political structures and processes, historical and traditional customs and values, and key participants or actors. Furthermore, he points out that institutional arrangements should incorporate bottom-up initiatives in order to balance the top-down directions.

According to O'Toole (1986), the success of implementation in a situation that involves many actors depends on many factors. They include, for instance, policy characteristics (i.e., clarity of goals, specificity, flexibility of goals and procedures, validity, and complexity of change required), resources (i.e., funding, sufficiency of power, facilities, and staff), number of actors involved, the multi-actor structure (i.e., authority, hierarchy, capabilities,

interdependence, tradition, and the extent of power diffusion), attitudes and perceptions of the implementing personnel (i.e., perception, interests, motivation, and conflicts), timing and duration, contextual aspects, strategy and procedures of implementation, and communication.

Other ideas regarding the implementation of IREM (integrated resource and environmental management) are provided by Hooper, McDonald and Mitchell (1999). They identify major causes of disappointment or encouragement of IREM, including the need for integration; scope, ambiguity and vagueness; dubious premises; context; visibility, identity, leadership and communication; coordination and collaboration; information availability, accessibility and integration; connections with local and regional planning; financial arrangements, market processes and property rights; and, conflict resolution.

Based on experiences in Australia and Canada, Hooper, McDonald and Mitchell (1999) suggest five priorities to enhance IREM, consisting of need, scope and context; best management practice; information accessibility and integration; financial arrangements; and, local and regional planning capacity (Table 12). In addition, they also offered three alternative models for achieving integration: voluntary, cooperative, and coercive. Each option has its own emphasis and assumptions regarding integration, structures for integration, and implementation consideration (Table 13).

2.4. Sustainable Development

There are various definitions and concepts about sustainability and sustainable development (Tisdell, 1988; Lele, 1991; Slocombe, 1993; Atkinson, 1994; White, 1994; Barrow, 1995; Beatley, 1995). The Oxford English Dictionary (1989, 327) defined sustainable as "capable of being upheld or defended; maintainable; capable of being maintained at a certain rate or level." Liverman et al. (1988, 133) defined sustainability as "the indefinite survival of the human species through the maintenance of basic life support systems (air, water, land, biota) and the existence of infrastructures and institutions which distribute and protect the components of these systems." As cited in Fricker (1998, 369), Veiderman (1995) defined sustainability as "a vision of the future that provides us with a road map and helps us focus our attention on a set of values and ethical and moral principles by which to guide our actions."

According to Lele (1991), sustainability has three connotations: literal, ecological, and social. Literally, sustainability means sustaining anything; ecologically, it refers to sustaining the ecological basis of human life; and socially, it means sustaining the social basis of human

Table 12. Priorities for enhancing IREM (Hooper, McDonald and Mitchell, 1999)

Consideration	Suggestions
1. Need, scope and context	Need: • Explicit allocation of human and financial resources • Firm establishment for the approach Scope and context: • Selective and a relatively small number of key variables and relationships • Custom designing solutions with regard to perspectives specific to space and time
2. Best Management Practice	• A range of practices and institutional arrangements to achieve goals
3. Information accessibility and integration	• Designing an integrated information management systems • Methods: adaptive environmental assessment and management, multi-objective decision support systems, modeling tools and geographic information systems
4. Financial arrangements	• Cost sharing
5. Local and regional planning capacity	• Strengthening local and regional planning capacity on substance and process of planning • Incorporate IREM's principles in planning • Strive to move IREM from a fringe activity to the core business of government (economic, resource and environmental management, development planning approval processes).

life. Lele (1991, 615) argued that any discussion about sustainability should address three questions: "What is to be sustained? For whom? How long?" Brown et al. (1987) identified common themes in the concept of sustainability: the continued support of human life on Earth, long-term maintenance of the stock of biological resources and the productivity of agricultural systems, stable human populations, limited growth economies, and continued quality in the environment and ecosystems.

As with sustainability, the definitions and concepts of sustainable development have also varied and some even indicated that they have led to confusion and lack of consensus (Tisdell1988; Lele, 1991; Atkinson, 1994; White, 1994; Barrow, 1995; Beatley, 1995). As cited in Brown et al. (1987, 716), The World Resources Institute viewed sustainable development as a "development strategy which manages all assets, natural and human resources as well as

Table 13. Alternative models for achieving integration (Hooper, McDonald and Mitchell, 1999, 750)

Features	Voluntary option	Co-operative option	Coercive option
• Emphasis regarding integration	• Encourage consideration of each other's goal and processes. • Do not specify performance goals or outcomes.	• Prescribe goals and processes. • Specify planning components and considerations, along with performance goals.	• Prescribe regulatory actions and processes. • Specify regulatory actions and conditions, along with required processes and plans.
• Assumption about integration	• Good will, trust, respect and willingness to work collaboratively.	• Compliance is not a problem. • Discretion should be encouraged regarding policy development and coordination.	• Compliance is a potential problem. • Willingness to work together is not apparent, and prescription is necessary.
• Structures for integration	• Continue with existing agencies. • A mutually acceptable coordinating mechanism is developed by participants.	• No new integrating agency is created, but an existing agency is designated to have lead role. • Different agencies can have lead roles depending upon the issue or problem to be addressed.	• A new agency is created, which is given some or all of the powers and responsibilities previously held by existing agencies.
• Implementation consideration	• Encourage consideration of benefits to be realized through integration, collaboration and coordination.	• Build capacity for agencies to reach policy goals and outcomes.	• Induce adherence to policy prescriptions and regulatory standards. • Build calculated commitment as a primary means to achieve compliance.

financial and well being." Carew-Reid (1994, 31) stated that "Sustainable development means improving and maintaining the well-being of people and ecosystems." The most popular definition of sustainable development has been the one of the World Commission on Environment and Development (WCED, 1987, 43), also renown as The Brundtland Commission, that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

2.4.1. Major Concerns and Goals

The World Resources Institute (1992) identified four interacting dimensions of sustainable development: economic (e.g., natural resources use, energy consumption, export and import, poverty, living standards), human (e.g., population growth, carrying capacity, distribution of population, meeting basic human needs, improving social well-being, protecting cultural diversity, participation), environmental (e.g., erosion, pollution, species extinction, maintenance of the Earth's biodiversity, conservation), and technological (e.g., pollution control, creation and development of cleaner and more efficient technologies, and encouragement of participation across industries). Barrow (1995) identified common themes of sustainable development: the maintenance of ecological integrity, the integration of environmental care and development, the adoption of an internationalist (North-South interdependence) stance, the satisfaction of at least basic human needs for all, a stress on normative planning (utilitarian conservation), the need for inter-generational, intra-generational and inter-species concern, a stress on the application of science to development problems, the acceptance of some economic growth (within limits), attaching a proper value to the natural and cultural environment, and the adoption of a long-term view of development. Parnwell and Turner (1998) summarized the work of Drakakis-Smith (1995, 1996, 1997) concerning major concerns in urban sustainable development into: quality of life, social justice, human rights, social and ethnic self determination, democracy, empowerment and participation, people-focused approaches, integrated and comprehensive approaches, and bottom-up initiatives.

The Brundtland Commission proposed seven major objectives for environmental and development policies. They include reviving growth; changing the quality of growth; meeting essential needs for jobs, food, energy, water and sanitation; ensuring a sustainable level of population; conserving and enhancing the resource base; reorienting technology and managing risk; and merging environment and economics in decision making (Mitchell, 1997).

2.4.2. Strategies

As mentioned in Lele (1991), according to Jacobs, Gardner and Munro (1987), sustainable development required integration of conservation and development, satisfaction of basic human needs, achievement of equity and social justice, provision of social self determination and cultural diversity, and maintenance of ecological integrity. MacNeil (1989) proposed five conditions for sustainable development: slowing down the rate of population growth, sustaining natural resources and the environment, reforming public policies to discourage environmental destruction, changing the nature of production through reduction of energy and material content, and merging the environment and economics in decision making. Davidson (1996) suggested a few requirements for sustainable development: participative planning mechanisms, strategic decision making for the common good of a future generation, an integrated approach for an efficient use of scarce resources, legal backing and institutional basis for enforcement, and a long-term examination of the impacts of action. In the urban context, Drakakis-Smith (1996) proposed some prerequisites for managing sustainability: equity in the distribution of the benefits of economic growth, access to adequate basic human needs, social justice and human rights, environmental awareness and integrity, and awareness of linkages and representations of change over space and time.

Barrow (1995) summarized directions for implementation strategies for sustainable development. Among those suggestions include the need for corrective treatment of root causes of non-sustainability, a move away from consumerism, the adoption of a much longer planning horizon by politicians and planners, a reduction of pollution and waste, a social transition toward a more equitable sharing of resources, the use of adaptive strategies to deal with the unforeseen, coordination of various approaches, and the adoption of multi-disciplinary study, planning and administration, and a proactive approach.

2.4.3. Principles

As mentioned by Fricker (1998), according to Veiderman (1995), three main principles guide sustainable development: the humility principle (recognizing the limitations of human knowledge), the precautionary principle (advocating caution when in doubt), and the reversibility principle (requiring us not to make any irreversible changes). The most frequently cited principles for sustainable development are those of the Rio Declaration (UNCED, 1992).

Among the principles in the Declaration are human-oriented, equity, integrated development, cooperation, capacity building, participation, enactment of effective environmental, legislation, precautionary, internalization of environmental costs, environmental impact assessment, women's vital role, recognizing the potential of youth, recognizing the vital role of indigenous knowledge and traditional practices, and global partnerships. Table 14 shows some principles of the Declaration.

Table 14. Some principles of the Rio Declaration (UNCED, 1992)

Principle 1. Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.

Principle 3. The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations.

Principle 4. In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5. All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development...

Principle 7. States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem...

Principle 8. To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9. States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10. Environmental issues are at best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in the decision making processes. States shall facilitate and encourage public awareness and participation by making information widely available...

Principle 11. States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries can be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

Principle 13. States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage...

Table 14. Continued.

Principle 15. In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious of irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 16. National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution.

Principle 17. Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have significant adverse impact on the environment and are subject to a decision of a component national authority.

Principle 20. Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development.

Principle 21. The creativity, ideals and courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22. Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices.

Principle 27. States and people shall cooperate in good faith and a spirit of partnership in the fulfillment of the principles embodied in this Declaration.

Source: Carrol-Foster (1993, 313-316)

2.5. Planning Models

There are various definitions of planning. Alexander (1986, 43), for example, defined planning as "the deliberate social or organizational activity of developing an optimal strategy of future action to achieve a desired set of goals, for solving novel problems in complex contexts, and attended by the power and intention to commit resources and to act as necessary to implement the chosen strategy". With regard to linking knowledge to action, Friedmann (1987, 38) offered three definitions of planning. The first one is that "Planning attempts to link scientific and technical knowledge to actions in the public domain." This is similar to the definition of planning according to Forester (1989, 3) that "planning is the guidance of future action." The second definition of planning according to Friedmann is "Planning attempts to link scientific and technical knowledge to processes of societal guidance." Friedmann argues that the state has a responsibility in articulating societal guidance toward a change in the society. This statement

is related to the third definition of planning that "Planning attempts to link scientific and technical knowledge to processes of social transformation."

There are various bases for classifying planning models. As mentioned in Hudson (1979), for instance, Faludi (1973) divided planning theories into substantive and procedural models. Healey (1997) outlined traditions of the American and European planning thought into three: economic planning, physical development, and public administration (policy analysis). Alexander (1986) categorized planning models into three: substantive (e.g., physical planning, land-use planning, transportation planning, public investments in infrastructure, housing, environmental and resource planning, social and economic planning), instrumental (e.g., regulatory planning, allocative planning, development planning), and contextual (comprehensive planning, social planning, advocacy planning, radical planning, incremental planning). In this review, only contextual planning models are highlighted: synoptic (rational comprehensive planning), incremental, transactive, advocacy, and radical. Here, "context" refers to "time, social institutions and value-ideological premises..."(Alexander, 1986, 75). Most of these contextual planning models were developed in response to the criticisms of the synoptic or rational comprehensive planning (Hudson, 1979; Mitchell, 1997).

2.5.1. Synoptic (Rational Comprehensive) Planning

The synoptic or rational comprehensive planning model has been the dominant planning tradition in America (Hudson, 1979; Mitchell, 1997) and was popular during from the 1950s to early 1960s (Alexander, 1986). It sees problems from a systems view (Hudson, 1979) so it considers a wide range of factors (Alexander, 1986) and relies heavily on quantitative analysis (Hudson, 1979; Mitchell, 1997). Some premises of synoptic planning include the supremacy of the planners' expertise for determining other people's needs, the necessity of a central planning agency with the authority to formulate plans (Alexander, 1986), and the ability of planners to manage and control a situation through sufficient information (Mitchell, 1997).

The planning process of the synoptic model usually consists of several phases: problem definition, establishment of goals and objectives, identification of alternatives means of achieving goals and objectives, assessment of the options using some explicit criteria, selection of a preferred solution and its implementation, and monitoring and evaluation (Mitchell, 1997). Each of these phases allows iterations (Hudson, 1979) and they involve feedback mechanisms (Mitchell, 1997).

Hudson (1979) noted that one distinctive strength of the synoptic planning model is its simplicity because it addresses fundamental issues in terms of ends, means, trade-offs, and action. However, this planning model has been criticized because of its insensitivity to institutional capabilities, reductionism, bias toward central control in defining problems and solutions (Hudson, 1979), and failure to appreciate the cognitive limits of decision makers (Hudson, 1979; Mitchell, 1997).

2.5.2. Incremental Planning

The incremental planning model was proposed by Lindblom (1959) who called it "the science of muddling through". This model was developed as a response to the criticisms of the rational comprehensive model. Unlike the synoptic model which adopts the view of "economic person" who strives to find the best solution, the incremental model follows the concept of "administrative person" who seeks to satisfy his/her goals or objectives. This is because the incremental planning model accepts the idea of "bounded rationality", recognizing the limits of the cognitive capability of decision makers in coping with the complexity of the real world (Alexander, 1986; Mitchell, 1997).

Among the premises of the incremental planning model are the beliefs that the problem is not clearly defined and no single correct solution exists (Mitchell, 1997), decision making is spread out among numerous actors and every actor decides in accordance with his/her preference and capacity to handle information about various problems (Khakee, 1998), policies should be developed by trial and error instead of deliberate planning and people's behaviour and interactions will eventually produce socially optimal outcomes with a minimum of regulation (Alexander, 1986), and the context of the policy is always normal conditions, not crisis (Friedmann, 1987). Major characteristics of the planning process of the incremental planning model are decentralized bargaining processes for policy decisions (Hudson, 1979), an ongoing series of incremental decisions (Mitchell, 1997) or incremental and marginal changes in policy (Khakee, 1998).

The incremental planning model suffers from a few criticisms. Alexander (1986), for instance, pointed out that the ultimate outcome resulting from many decentralized sensible decisions is frequently a state which nobody wants. Other criticisms include its focus on short-term decisions and inability to allow abrupt policy change, and tendency to support the status quo (Mitchell, 1997).

2.5.3. Transactive Planning

As mentioned in Hudson (1979), the transactive planning model was developed by Friedmann in 1973. Some premises of this model include: more decentralized decision making by the local people (Hudson, 1979; Mitchell, 1997), more emphasis on processes of personal and organizational development (Hudson, 1979; Mitchell, 1997; Khakee, 1998), and recognizing the importance of personal growth, cooperative spirit, and freedom from manipulation (Hudson, 1979). Mitchell noted that the local people will have more control over planning. This is unlike the synoptic model in which control rests with the planners or the planning institution.

The planning process in the transactive model involves more face-to-face dialogues (interactions) and mutual learning with the people affected by decisions (Hudson, 1979; Mitchell, 1997; Khakee, 1998). Friedmann (1987) noted two criticisms of the transactive planning model: conflicting personalities among people and unwarranted personal trust.

2.5.4. Advocacy Planning

According to Alexander (1986), advocacy planning grew in America during the mid 1960s. Some major objectives of this model include defending the interests of the weak or the poor (Davidoff, 1965; Hudson, 1979; Alexander, 1986) and allowing planners to represent groups whose interests are threatened (Khakee, 1998), and challenging the myth of a unique public interest and supporting the development of plural plans (Davidoff, 1965; Hudson, 1979; Alexander, 1986; Khakee, 1998). These objectives were based on the premise of plural society, comprising many groups with diverse interests and values (Davidoff, 1965; Alexander, 1986). Davidoff (1965, 332) stated that "...planners should be able to engage in the political process as advocates of the interest both of government and of such others groups, organizations, or individuals who are concerned with proposing policies for the future development of the community."

Davidoff (1965) argued that plural plans would be capable of improving planning practice through providing a medium for presenting alternative choices strongly supported by their proponents, and creating a competitive environment for the public planning agency and the others to win political support. These might lead to superior plans that could be accepted by many. Davidoff thought that the concept of advocacy did not imply nullifying the significant

role and obligation of the public planning agency.

Two criticisms of advocacy planning were mentioned by Alexander (1986). The first is the appropriateness of the legal model in the political context. This is because the role of planners in this planning model resembles that of lawyers which tends to be adversarial. The second criticism is its ineffectiveness in building support for constructive alternatives.

2.5.5. Radical Planning

As mentioned by Alexander (1986), the radical planning model grew in America in late 1960s and early 1970s with its aim of battling the status quo. Alexander also called this model "anti planning". Hudson (1979) viewed radical planning model as collective actions to achieve concrete results in the immediate future. Unlike in the synoptic planning model in which planners worked for the government, in radical planning the planners led social changes outside the government establishment (Alexander, 1986). One major irony or criticism of the radical planning model was provided by Alexander (1986, 78) by noting that "Once radical planners won the battle against the status quo, they cannot avoid becoming part of the very institutions they have sworn to alter."

Commenting on the SITAR (Synoptic, Incremental, Transactive, Advocacy, Radical) planning models, Hudson (1979) and Kaufman (1979) argued that no single planning model could prevail without inputs from the others. Mitchell (1997) further argued that the use of any planning approach is dependent on the situation or context.

2.5.6. Roles of Planners

Alexander (1986) identified several roles for planners. They include technician-administrator, mobilizer, mediator, entrepreneur, advocate, adviser, and interpreter or communicator. Alexander noted that some roles are more appropriate for certain situations than others. According to Alexander (1986), the traditional role of planners was represented by those who worked as a technical expert for the government. This role is known as technician or administrator. The effectiveness of this role depends on the willingness of political leaders to delegate authority to them.

The role of planners as mobilizer was meant as mobilizing allies to develop support for plan implementation. Forester (1982) called this role organizer because planners organized meetings for public attention, for instance, concerning courses of options or addressing costs

and benefits. Another planners' role close to mobilizer or organizer is entrepreneur because it looks for and gathers resources such as funds, administrative approval, and political support, required for implementation. Alexander (1986) noted that in conflict situations, planners can play their role as mediator by identifying problems of common concerns and then mediating different interests into a supportive coalition or consensus. In these situations, Forester (1987) noted that as mediator, planners are neutral from the conflicting parties.

Referring to advocacy planning, planners have their role as advocate by representing special interest groups. Planners as facilitators assist the decision-making process and policy development. As adviser, planners provide advice or suggestions to their clients. Finally, as interpreters or communicators, planners may be engaged in mediating a process of social interaction or creating and communicating messages to win trust from others. Alexander (1986, 83) stated that the role of planners as interpreters or communicators was based on the premise that sometimes "...how planners develop and present proposals is perhaps even more important than the content of the proposals themselves."

2.6. Urban Planning and Management in Developing Countries

The objective of this review is to understand themes in urban planning and urban management in developing countries considered relevant for municipal solid waste planning and management, and in particular, ideas relating to integration. This review will indicate that there is an interrelationship between urban planning and management and municipal solid waste planning and management (MSWPM) in developing countries.

2.6.1. Urban Planning from the Mid 1980s to the Present

Since the mid 1980s to the present, the emphasis in urban planning has been on long-term, city-wide processes rather than small or pilot projects (Werna, 1995). A particular emphasis has been on local capacity building and institutional strengthening for the management of urban development. In addition, initiatives to enhance bottom-up participation in the delivery of urban services in the context of rules and guidelines provided by central or municipal governments have been started (Werna, 1995). In this regard, Werna indicated that these initiatives have some significant implications for the process of urban planning and management, such as changes in roles, authority, and responsibilities of actors and in access to

funds among different levels of government agencies.

One dominant planning model that has marked urban planning in developing countries since the mid 1980s to the present is integrated urban development planning (IUDP), supported by many international lending agencies, in particular the World Bank (Blair, 1983; Miles and Arthur, 1992). IUDP has been used in many Asian countries, such as India (Wegelin, 1994), Indonesia, Philippines (Walton, 1992), Thailand, Sri Lanka, and Pakistan (Miles and Arthur, 1992).

In Indonesia, IUDP was implemented through the IUIDP (Integrated Urban Infrastructure Development Project) or P3KT (Program Pembangunan Prasarana Kota Terpadu) started in 1985 (van der Hoff and Steinberg, 1992b). Commenting on IUIDP, van der Hoff and Steinberg (1992a, vii) stated that "...it represents one of the largest nation-wide urban (infrastucture) development programmes in Asia and receives a large volume of assistance." They added that the initiative for adopting IUIDP was motivated by a few major reasons: mismatch between local community needs and centrally administered infrastructure provision; inadequate infrastructure operation and maintenance by local government and local communities; duplication in infrastructure provision by central, provincial, and local governments; and, over dependence on central government grant funding. In Indonesia, IUIDP covered several major services, including spatial urban planning, water supply, sewerage and human waste, solid waste management, drainage and flood control, urban roads, market infrastructure, and housing. As cited in Sidabutar (1992), according to Suselo (1985), IUIDP was based on four main principles: resource optimization, resource mobilization, decentralization, and mutual agreement.

The core of IUDP is the integration of spatial and sectoral projects. According to Miles and Arthur (1992), there are two main objectives of this approach. First, it is aimed at making urban development planning more responsive to the immediate needs of the urban population. This is so because master plans often fail to address the immediate needs of urban people, or because these needs do not receive the expected priority and funds from the governments. Second, IUDP seeks to optimize development projects within financial and institutional constraints. Thus, inter-institution coordination is introduced to achieve this objective. Without doubt, coordination among government agencies is very crucial in developing countries. Based on a survey conducted of Third World planners, Knox and Masilela (1989, 73) concluded that

"Lack of coordination between planning authorities and other government agencies responsible for the provision of urban services and infrastructure is one of the major problems impending planning efforts in the Third World."

Besides its emphasis on integrating spatial and sectoral projects, IUDP has other distinctive features, such as strengthening governments' financial and managerial capability, introducing cost recovery through direct-user fees for public services, recognizing the importance of partnerships between governments and the private sector (Miles and Arthur, 1992), and initiating a new role for governments as facilitator (Walton, 1992). This new role is expected to change the public's image of the governments' predominant role as provider of public services. Because of constraints on resources, governments acknowledge that it is time for the public to take a greater part in the development process by sharing responsibilities as well as costs.

According to Miles and Arthur (1992), there are five guiding principles for the implementation of IUDP. These principles are the encouragement of project and policy complementarity, the integration of top-down directions and bottom-up initiatives, the design of incremental plans and low-cost solutions, the integration of infrastructure and service delivery, and the assurance of financial and administrative capability and political support.

Although IUDP has gained wide acceptance in many developing countries, several problems have been recognized. As reported by Miles and Arthur (1992), these obstacles include the lack of response of local governments to the immediate needs of their population, the lack of community participation, the difficulty to impose full-cost recovery for low-income communities, the limited access to urban services of poor people, and politics. Miles and Arthur proposed some suggestions for the implementation of IUDP in developing countries. They include focusing on the partnership between the public and private sectors, enhancing community participation, linking top-down direction with bottom-up initiatives, physical and economic planning, concentrating on site- or project-specific actions, integrating strategic long-term planning and IUDP, and getting political support for the implementation. Table 15 summarizes urban planning from the mid 1980s to the present.

Table 15. Urban planning in developing countries from the mid 1980s to the present

Features	Characteristics
• Substance	• Spatial and sectoral planning
• Focus	• Integration of spatial and sectoral planning
• Process	• Combination of top-down direction and bottom-up initiatives
• Planning model used	• Integrated Urban Development Planning (IUDP)
• Rationale for the use of the model	• Integration of efforts and planning • Optimization and mobilization of resources • Partnership of the governments, public, and private sector
• Product of planning	• Integrated Urban Development Projects
• Empirical findings	• Implemented in many developing countries through the assistance of foreign agencies • Implementation problems: - unresponsiveness of local governments to the needs of beneficiary population - lack of community participation - difficulty to implement cost-recovery schemes - distribution of benefits and costs to different people - politics

2.6.2. The Future of Urban Planning in Developing Countries

Speculation concerning the future of urban planning in developing countries has varied. For instance, Walton (1992) suggested that urban planning and management in developing countries should be conducted by discontinuing the Western-type urban master plans. Walton argued that developing countries should define their own planning approaches based upon their own specific needs. In particular, the solutions should be appropriate, affordable, and people-related. Similarly, Miles and Arthur (1992) concluded that the era of master plans was over and was being changed by strategic planning with continuous updating.

Turner (1992) argued that the future urban planning in developing countries would be characterized by the use of incremental urban planning and management; the improvement of existing institutions, in particular the coordination of agencies; a recognition of the difficulty of planning large cities in detail; putting land-use control in its wider urban strategy; disseminating more information to the public; monitoring the effects of policies and programmes; and, more training for professionals who will formulate and implement policies and programs. Safier (1992) speculated some features of the next generation of urban planning:

the identification of main issues resulting from the dynamics of development, a blend between flexible and incremental action with long-term strategic directions, harmonization of priorities and strategies of national government with specific urban issues, responsiveness to multiple constraints, rapid adjustment to conflict of interests, and an extensive concern with implementability.

Carden (1995) suggested that urban planning in developing countries in the future will be characterized by a more open process, more adaptive to changes, and less deterministic. Devas (1993) argued that the rigid, blue-print model of urban planning was no longer valid. The new type of urban planning would be characterized by incremental, flexible, and iterative processes supported by an effective system of monitoring and feedback. Table 16 delineates some predictions about the future of urban planning in developing countries.

Table 16. Predictions of the future of urban planning in developing countries

Features	Speculation	Promoters
• Planning model	• Discontinuation of master plans	Miles and Arthur (1992), Walton (1992)
	• Use of incremental planning	Turner (1992), Devas (1993)
	• Use of strategic planning with continuous updating	Miles and Arthur (1992)
	• A mix between incremental action and long-term directions	Safier (1992)
	• Continuation of IUDP	Miles and Arthur (1992)
• Principles	• Articulating own approaches based on specific needs	Walton (1992)
	• Appropriate, affordable, and people-oriented approaches	Walton (1992)
	• Partnerships	Walton (1992)
	• Open process, adaptive (flexible) and less deterministic	Devas (1993), Carden (1995)
	• Strategic	Miles and Arthur (1992), Safier (1992),
	• Recognizing multiplicity of policy objectives, constraints, and conflicts	Safier (1992)
	• Multidisciplinary or integrated development	Miles and Arthur (1992)
	• Implementable	Safier (1992)

2.6.3. Urban Management in Developing Countries

The separated review of urban planning and urban management in this study does not mean that urban planning and urban management are distinct. Although they are different, both are closely interconnected. In this regard, Devas (1993) and the Executive Director of UNCHS (1993, 10) argued that planning can not be separated from management. The Director stated that "...planning is the fundamental tool of good management. The two concepts are inseparable: without planning there can be no management to speak of, and without management, planning becomes nothing more than a depository of good intentions entirely separated from reality." This statement signifies the importance of both planning and management.

In order to provide a distinction between urban planning and urban management, the proposition by Devas and Rakodi (1993b, 44) can be used. They mention that "urban planning is primarily concerned with anticipating and preparing for the future, and particularly with the spatial and land-use dimensions of urban development; meanwhile, urban management is concerned more with the immediate operations of a range of public services, and with a wide variety of public interventions which affect urban conditions as a whole."

2.6.3.1. Driving forces of urban management

There have been several driving forces for the emergence of urban management in developing countries since the late 1980s. These include rapid urbanization (Bartone, 1991; Miles and Arthur, 1992; Stren, 1993), a new understanding by the international community and the World Bank regarding a broader view on urban affairs, with an emphasis on urban productivity (Cohen and Leitmann, 1994), an understanding about the role of cities as the engines of national economic development (Wegelin, 1990; Bartone, 1991; Davidson and Nientied, 1991; Rakodi and Devas, 1993; Stren, 1993), a concern by the international community and the World Bank about the importance of urban environmental management (Cohen and Leitmann, 1994), a concern about urban poverty alleviation (Cohen and Leitmann, 1994), the increasing importance of institutional strengthening (Stren, 1993), and the adoption of management principles from the private sector into the public sector (Werna, 1995).

2.6.3.2. Major concerns in urban management

Leitmann, Bartone and Bernstein (1992) provide some insights about the most

important issues that need to be addressed in urban management in developing countries. These problems include poor governance (i.e., weak institutional capacity in planning, managerial and operational capacity, jurisdictional complexity, lack of effective public education, insufficient community and private sector participation), lack of public awareness, ill-conceived regulatory and economic policies, and insufficient knowledge.

The Urban Management Program of the World Bank noted five major themes in urban management: municipal management, urban infrastructure management, urban land management, urban environmental management, and urban poverty alleviation (Jones and Ward, 1994; Wegelin, 1994). Table 17 delineates some of the findings about themes, purposes, and major concerns in urban management in developing countries.

Table 17. Key themes, purposes, and major concerns of urban management

Themes	Purposes	Major Concerns
• Municipal management	• Promoting policies and practices that facilitate the efficient and equitable provision of urban services • Initiating and facilitating processes of capacity building at local level to ensure sustainable improvements	• Mobilizing resources • Financial management • Increasing the efficiency of intergovernmental arrangements • Municipal organization and administration • Central-local government relationship • Community participation • Partnerships: governments, private sector, and community • New role of governments as enabler or facilitator
• Urban infrastructure management	• Supporting capacity building to promote an urban infrastructure delivery approach that provides and maintains adequate infrastructure, responsive to effective demand, affordable, and appropriate standards.	• Building linkages between urban infrastructure and services and macro-economy • Devising means to improve infrastructure maintenance: administrative, financial, and technical • Schemes for partnerships • Demand management • Comprehensive municipal infrastructure and service improvement plan
• Urban land management	• Removing impediments to the efficient and equitable functioning of urban land markets	• Land registration • Land use regulations • Public land pricing • Land tax administration • Land market assessment • Identifying and rectifying constraints of urban land markets

Table 17. Continued

Themes	Purposes	Major Concerns
• Urban land management (continued)		• Institutions and instruments to support land markets • Urban land tenure and property rights • Urban planning and informal land management
• Urban environmental management	• Supporting capacity building for urban environmental planning and management processes at city, country and regional levels	• Legal and regulatory framework for environmental protection • Assignment of jurisdiction for legislation, monitoring and enforcement • Increased awareness and political commitment • The use of economic instruments as alternatives to command and control • Improving urban waste management capacity and operational efficiency • Developing city-specific urban environmental strategies that respond to the circumstances of individual cities • Formulating effective national and urban policies and practices to prevent environmental deterioration • Environmental implications of land use control and property rights • High-priority curative actions
• Urban poverty alleviation	• Increasing the capacity of (municipal) urban managers to address urban poverty issues	• Municipal regulatory framework • Managing the economic aspects of poverty • Managing the social aspects of poverty

2.6.3.3. Avenues for achieving urban management objectives

Tools that can be used to overcome problems and to achieve objectives of urban management have been proposed. Amos (1989), for instance, pointed out that sound urban management is determined by the ability to coordinate activities of different agencies at national and local levels. Davidson and Nientied (1991) suggested six critical success factors in achieving objectives of urban management: institutional development, decentralization, effective urban communication, people's participation in decision making, partnerships between public and private sectors, and spatial planning. Eberhard (1990) proposed six avenues for dealing with the rapid growth of cities of developing countries: new forms or designs of organization of economic activity, institutional innovation, public policy instruments, tapping

the under-utilized resources in the urban ecosystem, application of appropriate technologies, and development of interventions for the physical networks of the city. Chowdhury and Furedy (1994) proposed three mechanisms to deal with urban management: strengthening local authorities, citizen participation, and an extended role for non-governmental organizations and voluntary agencies.

2.7. Changes in Environmental Management

Changes are common phenomena in environmental management. Hadfield and Seaton (1999) classified different kinds of changes, such as physical, knowledge, technological, perceptual, policy, institutional and behavioural. They proposed a conceptual model linking processes of these changes (Figure 4).

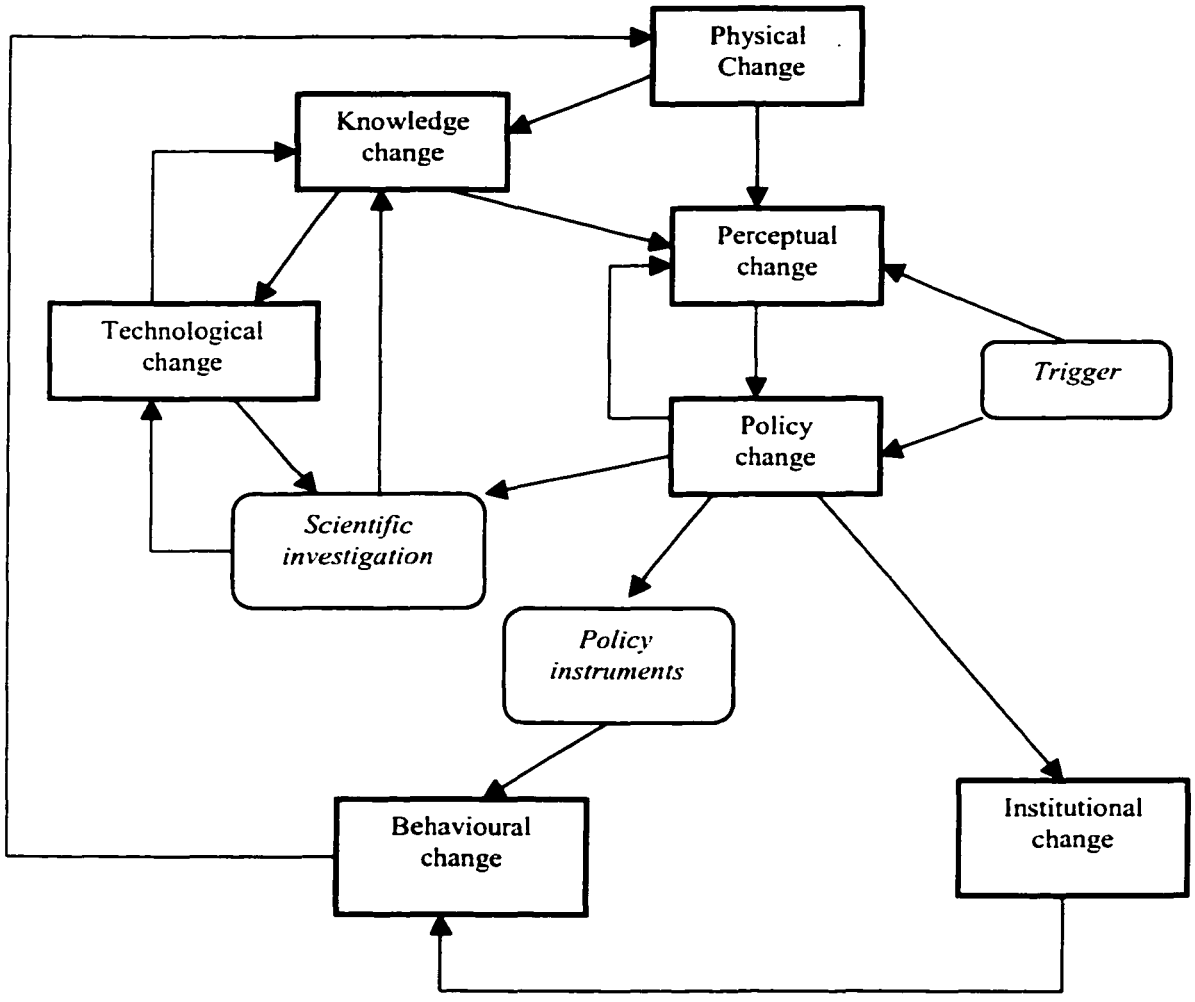


Figure 4. A conceptual model of processes of change in environmental management (Hadfield and Seaton, 1999)

Hadfield and Seaton (1999) argued that relationships among physical change and knowledge and perception are complex. As their model suggests, perceptual change may occur directly due to physical change or indirectly through knowledge change. Knowledge, technology, and scientific investigation are interdependent. Knowledge change, for instance, can cause changes in technology and vice versa. Besides broadening knowledge, scientific advances can push technological changes. Physical changes of the environment gain their significance when they are recognized as a problem. The existence of a problem is often triggered by a dramatic event such as a crisis and may eventually catch attention and become a policy issue, likely leading to changes in policy. Hadfield and Seaton's model suggests that policy changes can result in further scientific investigation. In addition, policy changes can bring about changes in behaviour and institutions. Institutional changes can also drive behavioural changes that are expected to affect changes in the physical environment.

Carew-Reid et al. (1994) commented that changing values, knowledge, technologies and institutions are complex due to such obstacles as differing value judgements, scientific uncertainties, the nature of the problems, institutional and organizational resistance, and governments' stance on the problems. Making the required changes calls for continuous public discussions, negotiation and mediation, and consensus development.

Quirke (1997) contended that communication has a pivotal role in managing change, in particular organizational (institutional) and behavioural changes. A conceptual framework for communicating change, called "the communication escalator" (Figure 5), is proposed by Quirke. The model is based on a premise that communicating change is a continuous and dynamic process.

The communication escalator consists of five main stages: creating and increasing awareness, building understanding, gaining support, involving people (stakeholders), and gaining commitment. The aim is to make stakeholders move up to the highest ladder or to gain their commitment. The higher the ladder, the more face-to-face interactions are being used.

The main aim of creating and increasing awareness is to attract attention from people (stakeholders). This is consistent with Hadfield and Seaton's (1999) argument that a change will become meaningful when it draws attention or consideration of the people. This first stage can be conducted through distribution of information. The second stage, building understanding, is aimed at providing the rationale for change, getting feedback and refining the communication

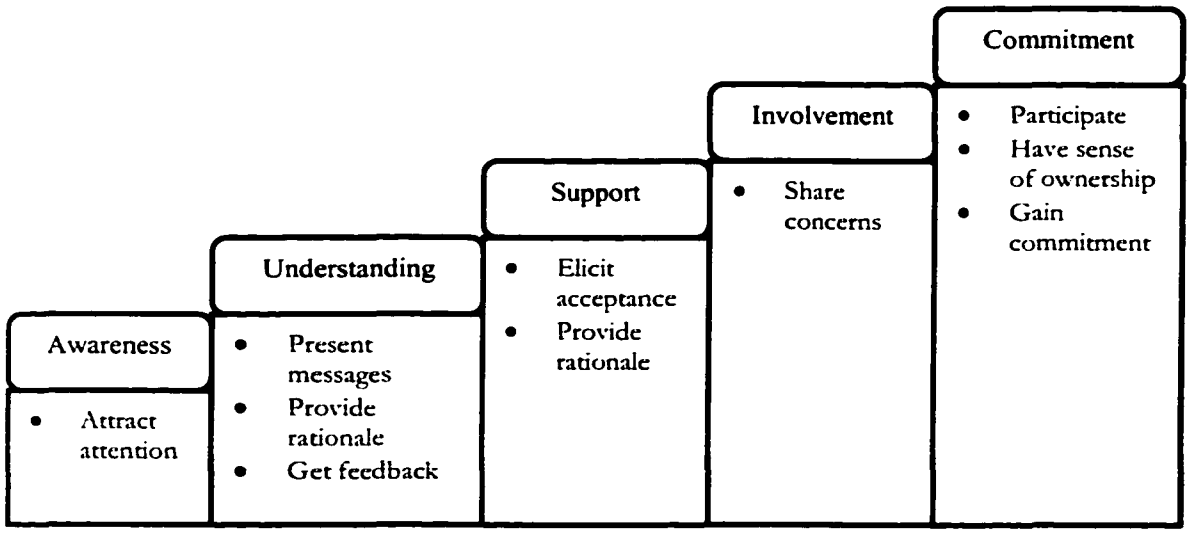


Figure 5. The communication escalator (Quirke, 1997)

process between the sender and the recipient. Besides reminding again about the rationale for change, another objective of the third stage (gaining support) is to elicit acceptance of stakeholders concerning the significance and necessity of the change. The fourth stage, involving people, is performed by sharing concerns. The last stage is to gain commitment of stakeholders and this can occur if they have participated because participation can nurture a sense of ownership. Quirke's (1997) approach will be used as part of public education strategy.

2.8. Concluding Remarks

Problems and constraints in MSWPM in developing countries are many and can be divided into physical, technical, financial, legal, social, and institutional categories, and their interrelationships. These varying problems are amplified by the many stakeholders involved, and together with conflicts, have increased the complexity of the planning and management processes. Attempts to deal with planning and management of urban solid waste in developing countries need to consider this complexity and hence choice of appropriate methods.

Recognizing the complexity of MSWPM and acknowledging the three approaches, this study argues that the integrated approach is preferable to the conventional and the non-conventional ones. While the conventional approach has its primary focus on technical excellence or operational efficiency of service delivery, and the non-conventional approach on social and ecological goals, the integrated approach can incorporate the strengths of those two

approaches. In addition, the idea of partnerships advocated in the integrated approach is very important for addressing the many problems of MSWPM in developing countries. Partnerships can relieve some burdens usually carried by the governments through sharing them among stakeholders. It is expected that partnerships of stakeholders will lead to more sustainable and equitable arrangements in service provision.

The very brief review of integrated municipal solid waste management in developed countries has provided four important lessons about objectives, options, the varying hierarchy of options, and policy instruments. Findings about objectives and options and their hierarchy in municipal solid waste management in developed countries provide insights for the formulation of an integrated approach to MSWPM for developing countries.

While the five types of policy measures have been implemented in developed countries, the use of policy measures in developing countries seems still to focus on the economic and legislative sticks. The use of producer responsibility is lacking. Carrots or economic incentives are still rare and they may indicate the constraints of central and/or municipal governments to allocate funding for subsidizing initiatives toward the implementation of integrated solid waste management.

The review of integrated resource and environmental management has indicated the importance of the multiple perspectives of this approach, notably multiple interests in resource uses, multiple stakeholders, multiple views of stakeholders, multiple conflicts, and multiple authorities and responsibilities from different agencies. The multiple perspectives of municipal solid waste planning and management are found in the context of problems, conflicts, goals and objectives, and stakeholders involved. With regard to these perspectives, this study argues that MSWPM in developing countries calls for an integrated approach.

The review of integrated resource and environmental management has also indicated that any integrated approach embodies two major components: substance and process (Born and Sonzogni, 1995; Margerum and Born, 1995). Substance is concerned with the major building blocks of the approach, while process is about the methodology or procedures to implement it. Therefore, an integrated approach to municipal solid waste planning and management in developing countries needs to address these components as well.

One explicit model of integrated planning and management is the IRM (Integrated Resource Management) proposed by Mitchell (1998). His conceptual framework has seven

components: context, vision, legitimacy, functions, structures, processes and mechanisms, and organizational culture and attitudes. An integrated approach to MSWPM in developing countries needs to address these components.

The summary of sustainable development provided some perspectives of sustainable development, including definition, major concerns, goals or objectives, directions for implementation strategies, and principles (Figure 6). Perspectives of sustainable development can be divided into three categories (economic, social, and environmental) and they are relevant to the various issues associated with municipal solid waste planning and management. Hence, integrated municipal solid waste planning and management in development countries need to take them into account.

A major theme in urban planning and management in developing countries is the recognition given to the need for integration and coordination. The idea of integration and coordination has been included in IUDP (Integrated Urban Development Planning). Distinctive principles of IUDP are mobilization and optimization of resources to achieve diverse objectives, integration of efforts and planning, mutual agreements of actors or stakeholders, and recognition of multiplicity of constraints and conflicts leading to the adoption of a multidisciplinary approach. In addition, IUDP introduces important ideas such as partnerships of stakeholders, enhancing people's participation, an open and adaptive planning process, being strategic (long-term view with short- term action), recognizing multiplicity of objectives, constraints, and conflicts, and, the interplay of top-down directions and bottom-up initiatives. This study argues that many of these principles and ideas characterize integrated planning and management for developing countries. Therefore, the conceptualization of an integrated approach for MSWPM for developing countries needs to consider them.

The discussion on the various kinds of changes proposed by Hadfield and Seaton (1999) is relevant to MSWPM. Changes in the physical urban environment due to pollution from solid waste have been common in developing countries. As mentioned before, the various problems in MSWPM have contributed to negative impacts on water, land, and air. Improvements in MSWPM in developing countries will involve several forms of changes, including knowledge and technology, perception, policy, institution and behaviour.

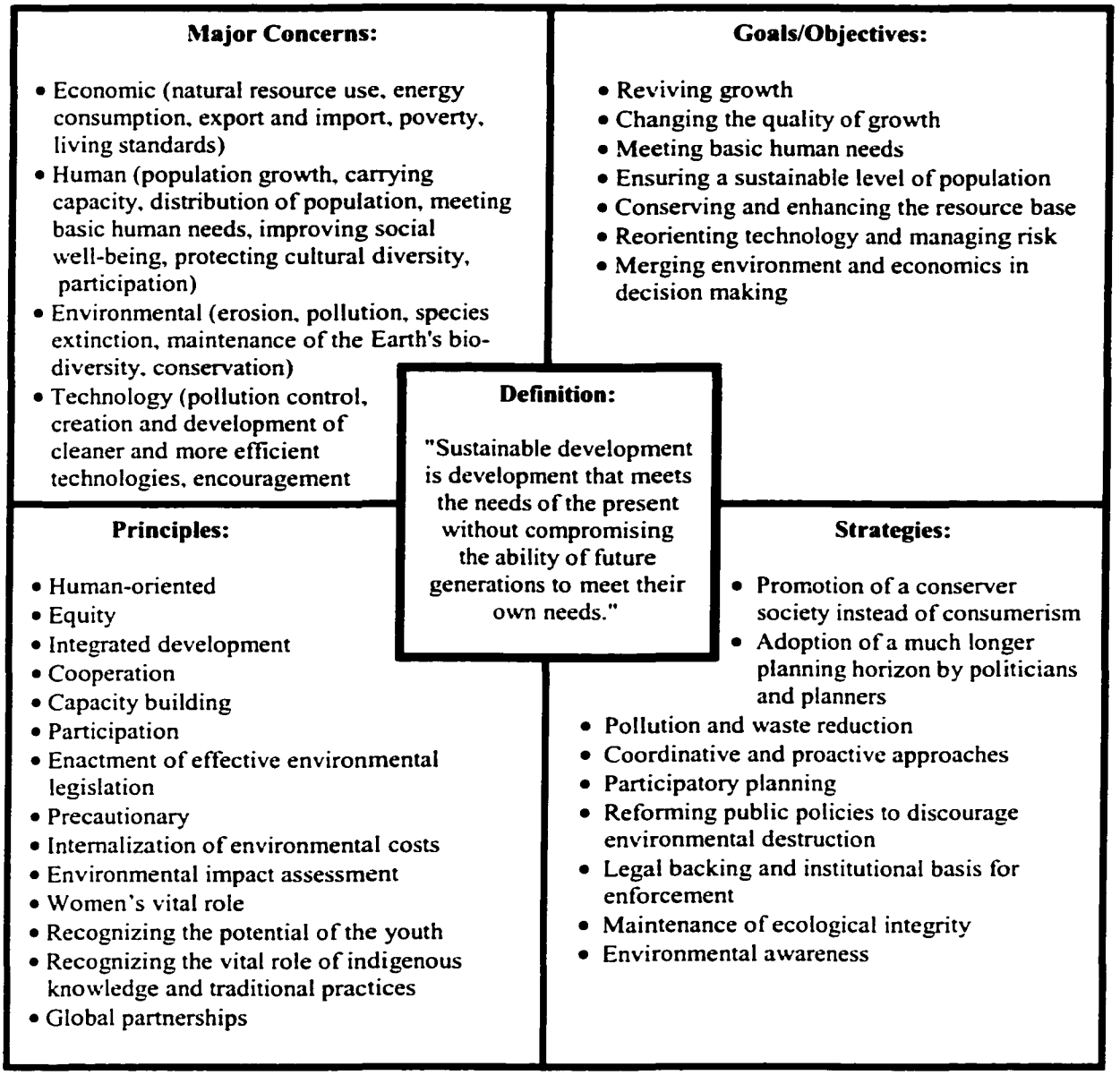


Figure 6. Perspectives on sustainable development

CHAPTER 3.
INTEGRATED MUNICIPAL SOLID WASTE PLANNING AND MANAGEMENT (IMSWPM) FOR DEVELOPING COUNTRIES: A CONCEPTUAL FRAMEWORK

The purpose of this chapter is to present a conceptual model of an integrated municipal solid waste planning and management (IMSWPM) approach for developing countries. The literature review on integrated resource and environmental planning and management has shown that any conceptual framework should have two basic elements: substance and process (Slocombe, 1993; Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997). Therefore, the proposed conceptual framework for IMSWPM will be based on these key characteristics.

3.1. Substantive Dimensions of IMSWPM

The substantive dimensions of integrated planning and management are characterized by four elements: holistic, interconnective, goal oriented, and strategic or reductive (Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997). These dimensions are incorporated in the proposed conceptual framework for IMSWPM.

3.1.1. Holistic

The holistic nature of integrated planning and management is reflected through the breadth of perspectives being addressed (Lang, 1986a; Mitchell, 1986; Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997). Integrated planning and management is multi-dimensional or systems oriented (Slocombe, 1993). In the context of municipal solid waste planning and management (MSWPM), the nature of a holistic view is based on the various problems, constraints, and conflicts that necessitate consideration of a broad range of aspects. The summary of problems, constraints, and conflicts in the literature review points to the need to consider various perspectives, such as public and environmental health, physical, technical, social, financial, institutional and managerial, political, and legal aspects.

3.1.2. Interconnective

The interconnective nature of integrated planning and management implies the necessity of examining interrelationships among various components of the system being addressed (Slocombe, 1993; Muller-Merbach, 1994; Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997). In the context of IMSWPM, this feature calls for a need to identify the components and their interrelationships. Four main components are activities, actors (stakeholders), options, and aspects (perspectives).

Any discussion about municipal solid waste planning and management cannot be separated from associated activities, including waste generation, source separation and storage, collection, transportation with or without transfer, processing and treatment, and disposal (Cointreau, 1982; Gotoh, 1989; Tchobanoglous, Theisen and Vigil, 1993). Concerning the actors or stakeholders, Fernandez (1993) provided a generic list of stakeholders regarding solid waste policy and action. They include central government, municipal government, private solid waste businesses, private industry, community organizations, non-governmental organizations, waste pickers, itinerant buyers, households, individual collectors, and schools. Another stakeholder who should be added to this list is the foreign agencies that have also been involved in MSWPM in developing countries. All these stakeholders can be categorized into five groups: government institutions or departments, the private sector, individuals, non-governmental organizations (NGOs), and foreign agencies.

The proposed IMSWPM involves options, such as reduce, reuse, recycling, composting, and disposal. Due to its nature, hazardous waste is not included in the definition of solid waste in this study. With regard to the aspects to be considered, the holistic nature of IMSWPM has indicated the various perspectives to be taken into account, such as public and environmental health, physical, technical, social and cultural, economical and financial, institutional and managerial, political, and legal. Figure 7 shows the general relationships of the four components. In this figure, activities become the centre of the relationships among the components because they cover wastes from generation to disposal.

The conceptual framework for IMSWPM is based on activities and options (Table 18). Two appropriate options for waste generation are reduction of wastes and reuse of materials which otherwise will become waste. The significance of these options has been recognized worldwide (Wilson, 1996). The main objectives of waste reduction and reuse are to reduce the

amount of waste generated and its impacts in the environment, and to reduce waste management costs.

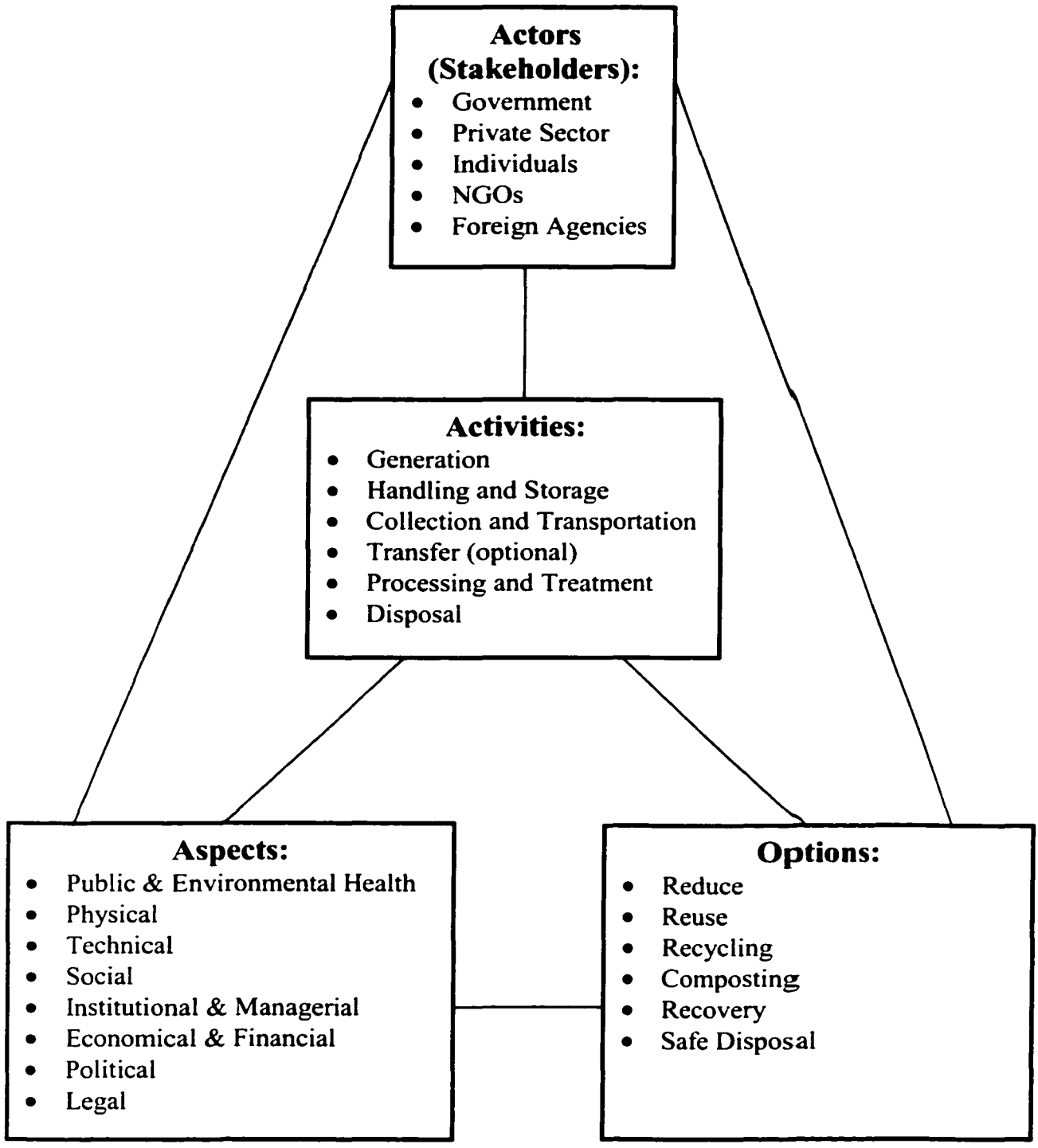


Figure 7. The interrelationships of IMSWPM's components

Table 18. Interrelationships between activities and options in IMSWPM

Activity	Options	Level
• Waste generation	• Reduce	Household
	• Reuse	Household
• Handling and storage at source and collection and transportation	• Reuse of valuable materials resulting from separation	Household
	• Small-scale composting	Household
	• Medium-scale composting	Community
• Transfer stations (optional)	• Reuse of valuable materials from separation	Municipal
• Processing and transportation	• Reuse of valuable materials	Municipal
	• Recycling	Municipal
	• Large-scale composting	Municipal
• Disposal	• Landfill	Municipal
	• Incineration	Municipal

The appropriate options for waste handling and storage at source and collection of wastes are reuse of valuable materials resulting from separation of wastes into dry and wet constituents; small-scale composting at households, and medium-scale composting at community areas. Itinerant buyers usually buy the separated materials from households or barter with them for other products such as foods or kids toys. Beside the production of valuable materials and the ease in collection and disposal, source separation is important because it nurtures the sense of shared-responsibility, caring, and participation. Composting at households can be conducted voluntarily. Voluntary or mandatory medium-scale community composting can be promoted or practiced by communities.

Suitable options for processing of waste include reuse of any valuable materials from separation of wastes into organic and inorganic streams at recycling sites, recycling the inorganic waste, and medium- or large-scale composting of the organic waste by municipal authorities or private contractors. Waste that is neither sent to household or community composting facilities nor sent to other users is expected to be delivered to any recycling site. In addition, the mixed waste that is not separated by waste producers will also be sent to these sites for separation. After separation, the organic waste will be sent to the medium- or large-scale municipal composting facilities, while the inorganic stream can either be taken by waste pickers or processed on sites. The residuals left at recycling sites will be brought to any landfill for disposal. At the recycling sites, waste pickers will be allowed to collect valuable materials.

Recycling facilities are expected to be provided by the government, private sector, or other parties. In this way, waste pickers will not only have cleaner materials that are more ready to be marketed to waste brokers, but, they may also have a better chance of receiving a good price from their brokers.

Disposal activities may involve two options: landfill and incineration. The use of simple and open dumping is not recommended because of its negative impacts for the environment and urban inhabitants. Landfill is preferred to incineration because it is cheaper and often technically easier to manage and maintain. However, in the next five or ten years, incineration may be appropriate for metropolitan or big cities in developing countries because of the pressures from the increasing production of waste in urban areas, the limited number of landfills available, the difficulty in finding landfill sites, and the need to dispose of waste rapidly. The model, linking activities and options, is shown in Figure 8.

It should be noted that collection and transportation activities are not shown in the proposed framework. However, they can occur in linking two or more connected activities. As mentioned in the previous chapter, there are generally two kinds of collection: primary and secondary (Indrayana and Silas, 1993; Silas, 1995). In the proposed framework, local community organizations will be responsible for collecting and transporting wastes from the source to any temporary storage sites or even to recycling sites, provided that they are capable of doing it. Meanwhile, the local cleaning authority or the private contractor will collect and transport waste from temporary storage sites to recycling sites and from recycling sites to final disposal sites. In the proposed framework, transfer stations are also not incorporated because they are optional. In case transfer stations are used, their main function is to pool waste from various sources, in particular temporary storage (disposal) sites. An appropriate option for transfer stations is reuse of any valuable materials obtained through separation of the incoming wastes.

3.1.3. Goal Oriented

Some of the goals of IMSWPM in developing countries can be inspired from the goals of integrated waste management in the developed countries and major concerns of urban management in developing countries. As previously mentioned in the literature review, some of these goals include reducing the amount of waste generated and disposed; improving waste

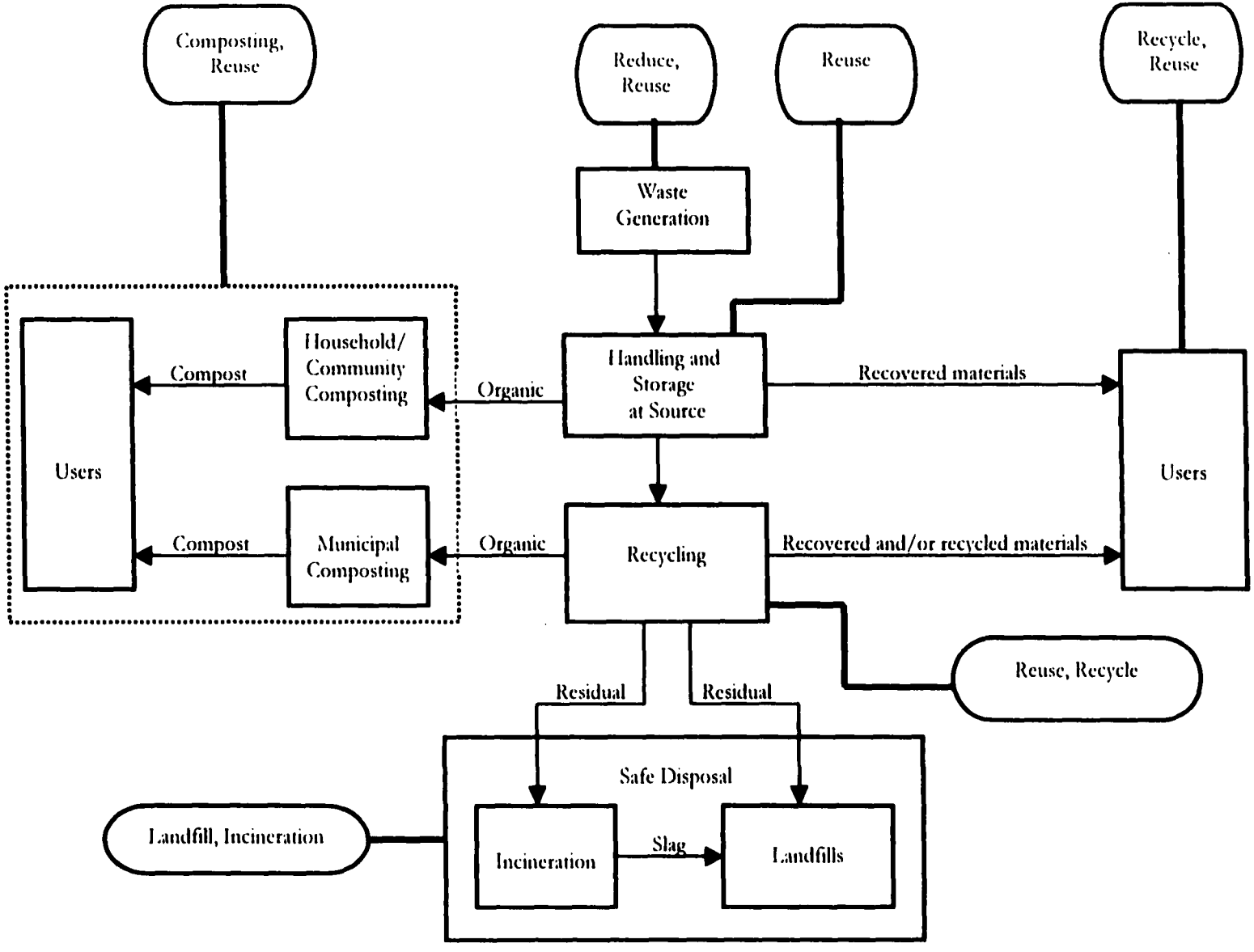


Figure 8. A conceptual framework for IMSWPM for developing countries

management capacity; minimizing environmental impacts on air, water, and land; conserving valuable resources; and enhancing environmentally-sound waste disposal methods. Based on these goals and the various problems in MSWPM in developing countries, goals for IMSWPM are proposed: maintaining cleanliness and health of the urban environment; strengthening capability of the municipal authority; providing efficient, effective, equitable, and reliable service; promoting reduce, reuse, source separation and recycling, and composting; fostering partnerships of stakeholders; developing the recycling industry through the involvement of both the formal and informal sectors; and, promoting the use of appropriate technology.

3.1.4. Strategic

The idea of a strategic or reductionist approach in integrated planning and management points to focusing on key aspects, parameters, or areas of the system being analyzed. Key issues in IMSWPM are determined based on the problems associated with the activities in municipal solid waste planning and management (Table 19).

In waste generation, two key issues should be addressed: government policy on waste reduction and reuse initiatives, and public education on waste reduction and reuse. Government policy on waste reduction and reuse is important to support the reduction of waste generated. Findings in the literature review have rarely indicated the existence of such policy. Therefore, waste reduction and reuse should become an agenda of the government. Public education is also a key ingredient in the success of waste reduction and reuse initiatives. Public education is aimed at providing knowledge, increasing awareness and understanding, and gaining participation.

With regard to waste handling at source, three key issues are identified: public education, government policy on mandatory source separation, and law enforcement. As discussed in the literature review, some urban residents were unwilling to practice source separation because of the inconvenience (Cointreau et al., 1984; Poerbo, 1991; Indrayana and Silas, 1993). Public education about source separation should be conducted with urban residents in order to ensure their understanding, awareness and participation. Government policy will be needed to support mandatory source separation. Once public education has been widely conducted, then laws for mandatory source separation should be issued and enforced so as to create and ensure a level playing field.

Table 19. Key issues of IMSWPM in developing countries

Locus	Key Issues
• Waste generation	• Existence of government policy on waste reduction and reuse • Public education concerning waste reduction and reuse initiatives
• Handling and storage at source	• Public education about source separation • Existence of government policy on mandatory source separation • Issuance and enforcement of laws for source separation
• Service provision	• Provision of satisfactory service • Existence of government policy for partnerships • Public education concerning the risks of illegal dumping and waste burning • Law enforcement
• Household and community composting	• Public education about composting and the need to create need for compost among households • Existence of government policy on household- and community-level composting • Provision of funds to build and operate composting facilities
• Municipal composting	• Existence of government policy to support the use of compost • Availability of sufficient funds • Creation of markets for compost
• Recycling	• Existence of government policy to support recycling activities • Seeking funds to provide facilities for recycling sites and/or seeking approval from municipal authorities to change existing transfer stations into recycling sites • Educating and gaining support from waste pickers • Organizing recycling activities
• Safe disposal (landfill, incineration)	• Ability to provide affordable and sustainable service • Maintaining operation so as to minimize health risks to the public and the environment • Law enforcement

Key issues associated with service provision consist of efficient and effective service delivery, government policy on partnerships, public education about the risks of waste burning and waste dumping to drains, canals, and rivers, and law enforcement. The provision of satisfactory (efficient and effective) service is aimed at reducing chances of urban residents throwing away waste at illegal places or burning waste because these acts bring about pollution

both to the environment and the people. The literature review showed a necessity for involving the private sector in service provision. The existence of government policy which recognizes involvement of the private sector and the public in service provision is important. Public education is also considered as important in order to increase the public's understanding and awareness and eventually a willingness not to engage in illegal dumping and waste burning. Should satisfactory service be provided and public education also be provided, then it will be necessary to discourage urban residents from continuing those practices by enforcing laws.

A few key issues related to household and/or community composting include public education about composting and the need for compost among households, government policy to encourage and persuade composting practices, and provision of funds to build and operate composting sites. The findings in the literature review about household and community composting in developing countries have indicated a lack of support from the local community and local government (Poerbo, 1991; Woolveridge, 1994). Despite this limitation, composting should be promoted in order to reduce the amount of waste to be disposed and also to produce natural fertilizer. Public education on composting needs to be promoted to enable households to know about using such material. Another key issue is the provision of funds to conduct composting pilot projects for promotion or public education and to build the infrastructure and operate the composting sites by households and community organizations. Some funds will be needed to provide facilities for households and in particular community organizations to enable them to participate in small-scale or medium-scale operations.

Three key issues in municipal composting are the existence of government policy to support the use of compost, the provision of funds, and the creation of markets for compost. The funds will be used to locate, create, and sustain markets for compost. Availability of government policy to support the use of good quality compost as an alternative to chemical fertilizers will be very important. The most difficult issue is to create and sustain markets for product (Arlosoroff and Bartone, 1987; Maniatis et al., 1987; Lohani, 1988; Woolveridge, 1994). In Indonesia, for instance, this effort will be challenged by the use of chemical fertilizer by farmers because chemical fertilizer usage is supported by the government. Some amount of funds will be required to supports efforts at finding and developing markets.

There are several key issues regarding the operation of recycling sites. The first is the existence of government policy supporting recycling initiatives. This is important particularly

for the informal waste recycling businesses. The second is to seek funds to provide recycling sites equipped with facilities, or to seek approval from municipal authorities to convert existing transfer stations into recycling sites. Approval will be needed to involve waste pickers to work in these sites. Funding will be needed to provide the facilities required for sorting and recycling activities. The third issue is educating and gaining support from waste pickers about the proposed scheme. Many waste pickers who currently work at dump sites will be asked to move to the new location and some of them may refuse if the recycling site is distant from their homes; or, they may object because they are satisfied with their current earnings and living standards. However, recognizing that there are a large number of waste pickers in urban areas in developing countries, it will be difficult to accommodate all waste pickers at these sites. Nevertheless, the operation of recycling sites is expected to attract waste pickers instead of working at dump sites. The last issue is the need to reorganize waste picking activities. Should the sites be approved and provided by the local government and waste pickers be willing to work in these sites, then their activities should be organized to follow certain rules or guidelines to prevent or minimize pollution to surrounding areas as well as address issues of workers' health and safety.

Key issues regarding safe disposal include the capability of providing affordable and sustainable service, the necessity of ensuring operation that minimizes health risks to the public and the environment, and law enforcement. Landfills and in particular incineration are not inexpensive options. Therefore, their proper operation should be able to be sustained over the long term, while at the same time their costs must be affordable or otherwise they will either be abandoned or their operation becomes improper, for instance by neglecting or violating standards. Law enforcement will be required to ensure proper operation of those facilities.

3.2. Procedural Dimensions of IMSWPM

The process involved in IMSWPM should be characterized by partnerships among stakeholders that involve interaction, coordination, conflict resolution, and enforcement. Partnerships of stakeholders mean arrangements of several actors in order to perform specific tasks, achieve certain objectives, or solve particular problems or key issues associated with MSWPM. Partnerships may occur in any initiatives that include waste reduction and reuse, the provision of collection and transportation services and the improvement of service quality, source separation, the operation of recycling sites, composting at households, communities and

municipality, and the operation of safe disposal options. In these partnerships, each stakeholder will have certain role(s), authority, and responsibilities. Fernandez (1993) categorized stakeholders' roles in urban solid waste policy and action into three: policy maker, facilitator or catalyst, and the doer. Table 20 illustrates stakeholders' partnerships in IMSWPM.

In general, policy makers may have authority and responsibilities for various tasks, such as providing goals, directions, or guidance; formulating policy; establishing political support; preparing programs; and, providing resources. Facilitators or catalysts may have authority and responsibilities in several arenas, such as facilitating the implementation of policy into action; motivating or encouraging participants; initiating and building communication networks; increasing awareness and educating participants, and, providing support. The doers or those who will take action can have authority and responsibilities in providing voluntary willingness and cooperation in taking action to achieve certain goals or to solve specific problem(s); obeying laws and regulations; conducting monitoring and enforcement; and, implementing programs.

Partnerships of stakeholders in IMSWPM in developing countries will function as a medium for participation and empowerment; distribution of roles, authority and responsibilities; defining goals/objectives; making joint plans and decisions; setting priorities and targets; developing management strategies; sharing various burdens; assessing progress; and, seeking compromise. Partnerships offer three main benefits. First, all stakeholders can share their contribution according to their capabilities. Second, partnerships can relieve some burdens usually carried out by the central and/or local government that has limited capacity in providing subsidies. Third, partnerships can not only nurture community or public involvement and participation, but they can also result in more sustainable efforts or actions because every stakeholder has its own roles, authority, responsibilities, and contribution.

A few communication tools that can be used in the partnership of stakeholders in MSWPM in developing countries may include information sharing, regular and informal communication, joint reviews, joint budgeting and/or staff, joint planning process, and plans. Tools for conflict resolution include interpersonal or intergroup communication, special meetings, consensus building, and appeals to higher authority.

Table 20. Stakeholder partnerships in IMSWPM in developing countries

Initiatives / Stakeholders	Reduce and Reuse	Source Separation	Service Provision	Recovery and Recycling	Composting (household, community, municipal)	Safe Disposal
Government	P, A, F	F	P, A	P, F	P, A, F	P, A
Private Sector	A, P, F	A, P, F	A, P	P, A, F	A, P, F	A, P
Individuals	A	A	A	A	A	F
NGOs	F	F	F	F	F	F
Foreign Agencies	F, P	F	F	F	P, F, A	F, P

Legends: ▭ : High-level ▭ : Medium-level ▭ : Low-level involvement

P : Policy making F : Facilitation A : Action

In summary, if partnerships of stakeholders works well and each actor carries out his/her tasks according to agreed roles, then with some mechanisms for coordination and conflict resolution in place, eventually these partnerships will be capable of achieving goals/objectives or solving/reducing the various and complex problems and/or conflicts of municipal solid waste planning and management.

3.3. The Policy Context of IMSWPM

The policy context of integrated municipal solid waste planning and management (IMSWPM) in developing countries based on the literature review, can be outlined into a hierarchy of sustainable development, sustainable urban development, urban environmental management, and municipal solid waste planning and management (Figure 9).

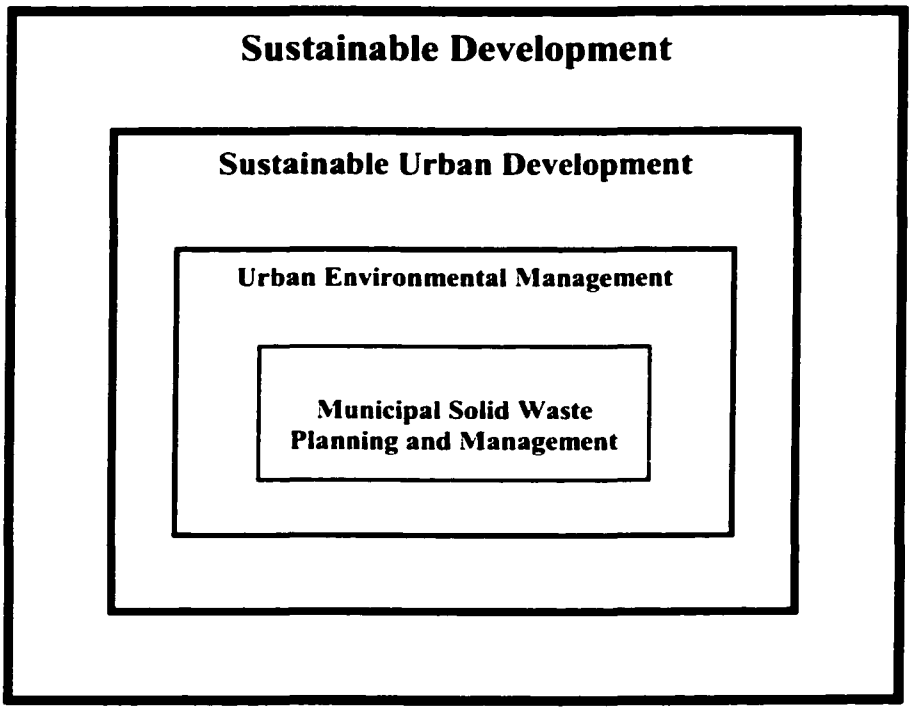


Figure 9. Policy context of IMSWPM

The concept of sustainable development has been widely accepted by developed and developing countries. National policies for sustainable development are considered as an umbrella for the others. As mentioned in the literature review, various goals or objectives of sustainable development include economic, social, environmental, and technological. Some goals of sustainable development at the national level are related to municipal solid waste

planning and management. For example, the provision of sanitation, including waste collection and disposal, is required for the satisfaction of basic human needs.

The second policy level is sustainable urban development. Policies for sustainable urban development are derived from those for sustainable development at the national level. Consequently, there are similarities in concerns and goals. Drakakis-Smith (1995), for instance, identified some goals of sustainable urban development, such as economics (e.g., growth, equity, efficiency), ecological (e.g., ecosystem integrity, carrying capacity, biodiversity), and social (e.g., empowerment, participation, institutional development). A few directions for the implementation of sustainable urban development from Drakakis-Smith (1995, 1996) and Davidson (1996) include: empowerment and participation, people-focused approaches, participative planning, integrated and comprehensive approaches, bottom-up initiatives, strategic decision making for the common good of future generations, an integrated legal backing and institutional basis for enforcement, and a long-term examination of the impacts of action. Some of the goals and requirements for sustainable urban development are related to IMSWPM.

The third policy level is urban environmental management. As stated by Ali, Olley and Cotton (1998, 256), a study by UNDP (1997) concluded that "The collection and disposal of rubbish is increasingly perceived as one of the greatest environmental problems facing many metropolitan areas of the developing world." As a result, international agencies have been concerned with the mounting pressures on the urban environments of developing countries. Various kinds of aid have been provided by foreign experts and lending agencies, in particular the World Bank. The primary objective was to support capacity building for urban environmental planning and management at the city or municipal level. Included in this objective was an intention to improve urban waste management capacity and operational capacity. Campbell (1999) argued that the expected outcome of institutional development is an organization or an institution of waste management which is capable of preparing waste management legislation, regulations, guidance, and standards; developing its human resources to maintain effective waste management activities; financing its activities, formulating strategic planning of long-term integrated waste management, authorizing the development of waste management facilities; monitoring and enforcing standards for all waste management services and facilities; and, providing information related to waste.

Recent innovations in urban solid waste management in developing countries have been focused on institutional development. Two particular themes have emerged: privatization of service and partnerships among governments, the private sector, and local community organizations (Cervero, 1995; Kironde and Yhdego, 1997; Agunwamba, 1998; Ali, Olley and Cotton, 1998; Diaz, 1998; Halla and Mojani, 1999; Hoornweg and Thomas, 1999). These innovations also represents a shift in policy from the previous "infrastructure provision" to the current "local capacity building". IMSWPM is considered as an alternative form of partnerships and way of increasing the capacity of the municipal authorities to deal with the increasing complex problems associated with municipal solid wastes.

The fourth policy level is any policy formulated specifically to deal with various issues in municipal solid waste planning and management, including waste prevention and source reduction, service provision, recycling, composting, and safe disposal. A combination of policy instruments of information dissemination, economic incentives (carrots), producer responsibility, economic coercion (stick), and legislative coercion may be required (Wilson, 1996) to achieve various goals.

In conclusion, the policy context of IMSWPM in developing countries indicates three main points. First, there has been a growing recognition by local and central governments as well as the international community about the magnitude of problems associated with wastes and the adverse impacts on the urban environment. Second, improving urban environmental management capacity, including waste management, becomes increasingly important in order to achieve some goals of sustainable (urban) development. Third, approaches to urban environmental management and solid waste management which foster partnerships of stakeholders are believed to be capable of improving the local capacity for dealing with the complex issues of municipal solid waste planning and management in developing countries.

CHAPTER 4.
RESEARCH METHODOLOGY

4.1. Research Paradigms

Babbie (1998, G5) defined a paradigm as "A model or framework for observation and understanding, which shapes both what we see and how we understand it." According to Creswell (1994) and Neuman (1994), every research paradigm deals with theory and methods. Creswell divided research paradigms into qualitative and quantitative types. The former is also known as the interpretative, constructivist, or naturalistic approach, while the latter is known as the positivist, empiricist, or experimental.

Creswell (1994, 1-2) defined qualitative research as "an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting." As quoted in Babbie (1998, 281), Kvale (1996) contrasted interpretivism from positivism by writing that "There is a move away from obtaining knowledge primarily through external observation and experimental manipulation of human subjects, toward an understanding by means of conversations with the human beings to be understood. The subjects not only answer questions prepared by an expert, but themselves formulate in a dialogue their own conceptions of their live world." According to Babbie (1992), interpretivism is considered as qualitative inquiry. Creswell pointed out that instead of testing theories and hypotheses as in quantitative research, in qualitative research the researcher gathers findings, asks questions, looks for categories or patterns, and develops a theory or contrasts patterns against other theories. In this regard, Creswell (1994, 10) noted that "a theory base does not guide the study because those available are inadequate, incomplete, or simply missing." Four types of data collection methods for qualitative research include observations, interviews, documents, and visual materials.

Quantitative research was defined by Creswell (1994, 2) as "an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true." Creswell pointed out that quantitative research is characterized by deductive logic in which theories and hypotheses are tested in a cause-and-

effect relationship. Two kinds of data collection methods for quantitative research are survey procedures and experimental designs.

Creswell (1994) defined three schools of thought about the use of research paradigm: the purist, the situationalist, and the pragmatist. Proponents of the purist school argue that one paradigm should not be mixed with the other. The situationalists contend that a particular paradigm should suit a certain situation. And the pragmatists propose to use several paradigms in understanding social phenomena. The pragmatists use mixed methods to gather both qualitative and quantitative data. As mentioned in Creswell (1994, 185), according to Greene et al. (1989), the main purposes of the mixed methods are: "triangulating or converging findings, elaborating on results, using one method to inform another, discovering paradox or contradiction, and extending the breadth of the inquiry." Based on this classification, this study on integrated municipal solid waste planning and management (IMSWPM) falls more appropriately into the pragmatist group than any other. This is so because IMSWPM will be explored and evaluated using qualitative and quantitative data obtained through surveys, observations, interviews, and document analysis.

4.2. Research Purposes

With regard to the primary research objective, according to Mitchell (1989), any research can be classified into a hierarchy of description, explanation, prediction and prescription. Descriptive research is concerned with "what", "where" and "when" questions. Explanatory research focuses on the "how" and "why" questions, and it seeks to explain causal relationships between variables. Predictive research tries to present events or behavior that will occur provided that certain conditions are met. Instead of dealing with "what is" or "what will be" issue, prescriptive or normative research strives to suggest the "what should be" situation.

Based on the above hierarchy, this study is aimed at exploring and describing the potential of the proposed integrated municipal solid waste planning and management (IMSWPM) approach in a developing country. The nature of this research is therefore descriptive and to some degree, explanatory and prescriptive. Research on the integrated approach to urban solid waste planning and management in developing countries has been lacking. Therefore, this study will explore, describe, and explain findings about IMSWPM and then evaluate them in order to consider the potential of the approach in an urban context in a

developing country. In addition, this research is also prescriptive because it will present some recommendations to improve the existing practices.

4.3. Operationalization

According to the Oxford English Dictionary (1989, 224), a few meanings of the word "potential" are "possessing potency or power", "Possible as opposed to actual; existing in a latent or underdeveloped state, capable of coming into being or action", and "expresses potentiality or possibility". Therefore, exploring the potential of IMSWPM means to know the possibility of using this approach in the future due to its power or strengths. In this study, the potential of IMSWPM will be viewed relative to two criteria. The first is the feasibility of this approach in the future. The second is the sustainability or the potential contribution of this approach for sustainable development.

4.3.1. Feasibility of IMSWPM

Two meanings of feasibility found in the Dictionary are "capability of being done, practicability" and "capable of being dealt with successfully in any way either in a material or immaterial sense." Feasibility indicates fitness or suitability and acceptability. Borrini-Fayerabend (1999) proposed several dimensions of feasibility for participatory management: legal, political, institutional, economic, and socio-cultural.

The feasibility analysis of IMSWPM is examined from seven aspects: ideological, technical (operational), legal, political, institutional, social, and financial. Ideological feasibility is concerned with the reasons for adopting the approach. Technical feasibility is analyzed regarding the fitness of this approach to existing practices in municipal solid waste planning and management (MSWPM), including waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. Legal feasibility deals with fitness within existing laws, regulations, and government policies pertaining to MSWPM. Based on Borrini-Fayerabend's (1999) idea, political feasibility highlights fitness with the current political will, acceptance by stakeholders, capacity to enforce decisions, and the presence of specific phenomena, such as corruption and intimidation. Institutional feasibility analyzes the suitability of IMSWPM relative to the existing bodies and rules, inter-institution relations and their possible conflicts, and organizations of stakeholders. Social feasibility examines the appropriateness of the public's attitude and acceptance of IMSWPM. Financial feasibility refers

to availability of financial resources to carry out IMSWPM. Included in this examination are opportunities for finding prospective funding sources in the future. Table 21 summarizes factors to be examined in the feasibility analysis.

Table 21. Aspects and factors to examined in feasibility analysis of IMSWPM

Aspect	Examination
• Ideological	• Reasons for adopting the integrated approach
• Technical	• Fitness within existing practices in MSWPM: - Waste reduction and reuse - Source separation - Service provision - Recycling - Composting (household, community, municipal) - Disposal
• Legal	• Fitness within existing laws, regulations, and policies
• Political	• Acceptance by stakeholders • Fitness with: - Current political will - Capacity to enforce decisions - Presence of specific phenomena (e.g., corruption and intimidation)
• Institutional	• Suitability with: - Existing bodies and rules associated with MSWPM - Inter-institution relations, coordination, possible conflicts - Organizations of stakeholders
• Social	• Appropriateness with the public's attitude and acceptance
• Financial	• Availability of: - financial resources - opportunities for finding prospective funding sources

4.3.2. Sustainability of IMSWPM

The significance and necessity of considering sustainability in policy and planning have been suggested by many (Beatley, 1995; Drakakis-Smith, 1996; Luther and Borner, 1996; Davidson, 1996; Maclaren, 1996). Based on Wall's (1997) proposition, one valid question about the sustainability of IMSWPM is to ask whether and in what form IMSWPM might contribute to sustainable development. In this study, therefore, the sustainability of IMSWPM is meant to address how this approach incorporates certain concerns of sustainable development and supports the achievement of some goals of sustainable development.

Three major aspects of any discussion about sustainability are economic, social, and environmental. If IMSWPM is to be sustained, then it should be environmentally wise, economically viable, and socially just. Maclaren (1996, 185) identified some common characteristics of urban sustainability, such as "intergenerational equity, intragenerational equity (including social equity, geographical equity, and equity in governance), protection of the natural environment (and living within its carrying capacity), minimal use of nonrenewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human needs". Equity or equal rights exist in every category: equal rights in earning income, equal rights to the provision of basic needs, and equal rights in having a healthy environment (Table 22).

Table 22. Characteristics of urban sustainability

Economic	Social	Environment
• Intergenerational equity • Intragenerational equity • Minimal use of non renewable resources • Economic vitality and diversity	• Intergenerational equity • Intragenerational equity • Community self-reliance • Individual well-being • Satisfaction of basic human needs	• Intergenerational equity • Intragenerational equity • Protection of the environment

Specific economic issues to be addressed are income generation, poverty, living standards and consumption patterns, and the use of recycled materials. Included in the social issues are the satisfaction of basic human needs, participation, empowerment, and human rights and social justice. Environmental issues are concerned particularly with the protection of the environment through pollution reduction and conservation. The contribution of IMSWPM is expected to support the achievement of some goals of sustainable development (Figure 10).

4.4. Data Collection Methods

This study is a case study because it attempts to explore the potential of IMSWPM in one metropolitan region in a developing country, Indonesia. According to Babbie (1998, 282), "A case study is an idiographic examination of a single individual, group, or society. Its chief purpose is description, although attempts at explanation are also acceptable."

One particular method for collecting data that has gained attention in developing countries is the participatory approach such as the participatory rural appraisal (PRA). Through this method, the local people are more actively brought into discussions with the external

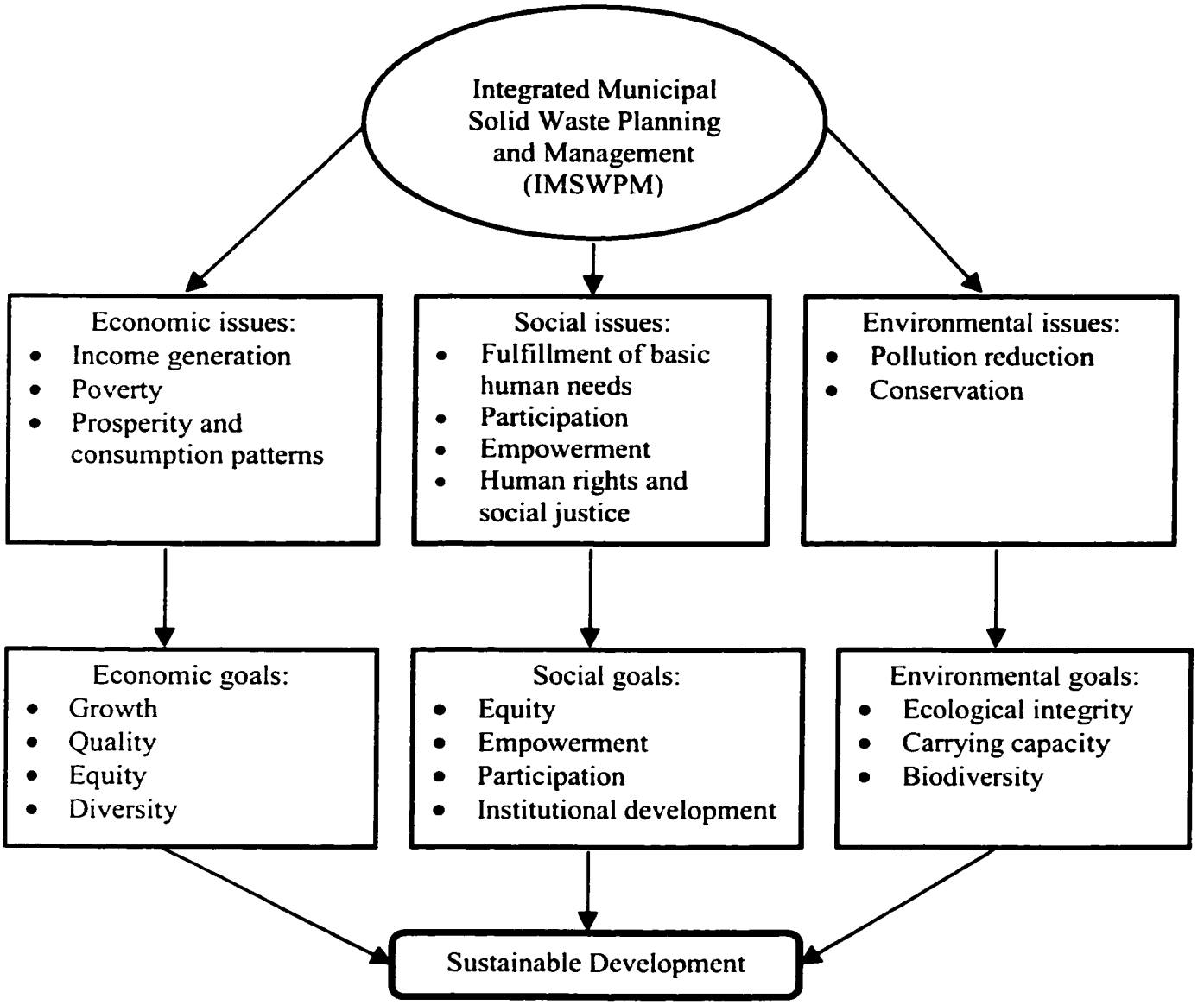


Figure 10. Contribution of IMSWPM to sustainable development

observer to jointly gather facts and directly share experience from their lives. This kind of engagement has been successful and it has been adapted for urban areas as well. Although the advantages of this approach were recognized, it was not used in this study for a variety of reasons. First, identifying and bringing together representatives of stakeholders in MSWPM might not be easy, especially for a researcher who did not have enough legitimacy. This is particularly true in the case of government officials such as those in the central government in Jakarta. They were very busy and it would be difficult to invite them all at the same time to discuss issues. Second, inviting various stakeholders at the same time even in Bandung would

not only require support from credible persons but also financial support to arrange and conduct the meeting. Third, inviting residents at the same time also may not be easy. In summary, addressing the various issues surrounding MSWPM in the Municipality of Bandung using the participatory approach would pose a tremendous challenge. As a result, interview surveys and questionnaires were employed. These techniques have limitations, but they were practical for this study.

Layder (1993) suggested four types of data collection methods in field research. These include documentary materials, questionnaires, interviewing, and observation. Such methods can produce both quantitative and qualitative data. All of these data collection methods are used in this study. Documentary materials were collected from various sources such as government institutions, private consulting firms, foreign agencies, and newspapers/magazines. Structured questionnaires were administered to households and university (undergraduate) students. Interviews were conducted with various respondents such as government officials, private sector employees, professors, representatives of waste pickers, neighborhood chiefs, members of non-governmental agencies, and representatives of foreign agencies. Observations were also conducted in many places relevant to the study such as temporary disposal sites, final disposal sites, community areas, public facilities (bus terminals, markets, train stations, public gardens).

An interesting phenomenon occurred during the interviews with the central government officers in Jakarta. Although this study is exploratory, attempts were made to gather quantitative evidence. At a preliminary stage of the data collection period, many questions in the survey with the central government officials were designed to use a Likert scale, using a continuum ranging one to five, and a few questions using a continuum from one to three. This scaling was employed in order to ease subsequent data processing and analysis. However, after interviewing eight government officers, the use of this scale was decided to be abandoned because of the inconvenience which quantitative questions caused to respondents. The Likert scale questions were working poorly because the respondents did not feel comfortable in answering questions directed to selecting "points." Sometimes, the situation of the conversation became inconvenient. Respondents might begin to feel that they were being the object of a research project and they began to resent the tone of questioning. Recognizing this situation, questions were transformed from a scale-type selection to an open type. This new format was

more acceptable and successful. This experience should be an important lesson for those wanting to do research by interviewing government officers, in particular bureaucrats who have a high rank within their institution in Indonesia. Respondents seemed more enthusiastic when the nature of the conversation was more exploratory in nature. However, the main difficulty of this kind of conversation was to follow the flow of discussion as planned by the researcher because the respondent could jump from one topic to another. Experiences in Jakarta may also suggest that the use of the closed questionnaires that work well in the quantitative paradigm may not work very well when a research requires a considerable number of government officers as the main respondents. In other words, an exploratory kind of questioning is more attractive for government officers.

4.5. Sampling

Stakeholders in municipal solid waste planning and management in developing countries can be classified into five groups: government departments and institutions, the private sector, individuals, non-governmental organizations, and representatives of foreign agencies. In this case study, samples were mainly drawn from these groups of respondents in the Municipality of Bandung. Some interviews were also conducted in Jakarta with key government officials and representatives of foreign agencies.

Samples from the government departments and institutions, private consulting firms, a private contractor, one non-governmental organization, and foreign agencies were purposively selected. Respondents actively involved in MSWPM were identified and interviewed. Purposive sampling was also used for the interviews with university professors. Some samples from neighborhood leaders were collected purposively, while some others were gathered randomly depending upon the purpose. Samples from households were prepared through stratified sampling based on two kinds of variables. The first was the availability of waste collection and transportation service provided by the local sanitation authority in the Municipality of Bandung. The second was based on wealth. Households were divided into three groups: high-income class, middle-income class, and low-income class. The high-income class was identified through a few indicators, such as the location of home, and appearance of the home in which every house must be a permanent building and have a garage. The middle-income class was identified by the appearance of the home in which each house must be a permanent building but did not have a garage. And the low-income class was identified by

location, and the appearance of the house in which every house must be very simple or semi-permanent and did not have a garage. This kind of stratification was used as an alternative to the low chance of expecting respondents to reveal their income during the interviews. Respondents in each class were selected randomly.

Sampling of university students was conducted at three universities: one government-owned university (Bandung Institute of Technology (ITB)) and two private universities (University of General Ahmad Yani (Unyani) and National Institute of Technology (Itenas)). The selection of these universities was based primarily on their willingness to allow the distribution of the questionnaires. The total number of respondents for each group and the number of respondents for each stakeholder in every group for this study are shown in Table 23.

In terms of the number of respondents, this study suffers from a lack of non-governmental organizations being interviewed. Two waste consultants in Bandung revealed that there were very few non-governmental organizations working in waste issues and they argued that the economic crisis might have had an impact on the decreasing number of non-governmental organizations. Recognizing this shortcoming, further research should be aimed at surveying more non-governmental organizations.

Another weakness of this study may be concerned with the number of respondents. Statistical guidelines were not formally pursued in determining number of respondents. The number of population for each group of stakeholders was unable to be determined due to time and budget constraints. Rather than being concerned with numbers, emphasis was placed on selecting the credible respondents to interview. Randomness in the samples is also a limitation. This study did not use the simple random sampling method in order to save time, budget, and because of a concern about its practicality.

4.6. Data Collection

Data collection for this study was conducted mostly from December 1996 to August 1997. The long period of data collection was due to several circumstances which disrupted the continuity of the collection process.

Data collection commenced in November 1996 by obtaining official approval from the Bureau of Social and Political Affairs of the Ministry of Internal Affairs in Bandung and Jakarta. After short interviews in Bandung and Jakarta, the permission letters were granted in

Table 23. The number of respondents

Group of stakeholders	Stakeholders	Number of respondents	Total number of respondents in the group
• Individuals	• Households	362	789
	• Chiefs of neighborhood units	60	
	• Professors	12	
	• Undergraduate students	346	
	• Representatives of waste pickers	6	
	• Itinerant buyers	3	
• Foreign agencies	• The World Bank	3	4
	• JICA	1	
• Government institutions	• Municipal cleaning enterprise (PDK-Bandung)	6	53
	• Municipal government of Kotamadya Bandung	6	
	• District cleaning of Kabupaten Bandung	2	
	• District government of Kabupaten Bandung	1	
	• Planning Boards (Bappenas and Bappeda)	3	
	• State Ministry of the Environment and the Provincial Bureau of the Environment	4	
	• Environmental Impact Management Agency (Bapedal)	3	
	• Directorate General of Human Settlements Development (DJCK)	2	
	• Agency for Technology Assessment and Application (BPPT)	3	
	• Department of Social Affairs	1	
	• Department of Labour	1	
	• Department of Education and Culture	2	
	• Department of Parks (Dinas Pertamanan)	2	
	• Department of Health	2	
	• Department of Information	2	
	• Department of Industry and Trade	1	
	• Department of Cooperatives and Small Business Development	2	
	• Department of Agriculture	2	

Table 23. Continued.

Group of stakeholders	Stakeholders	Number of respondents	Total number of respondents in the group
• Government institutions (continued)	• Development Technology Centre-ITB	2	
	• Market Enterprise (Perusahaan Daerah Pasar)	1	
	• Police Department	1	
	• Centre for Research in Environmental Studies (PPLH–ITB)	2	
	• Development Technology Centre (DTC- ITB)	2	
• Private Sector	• Consulting firms	8	12
	• Contractors	2	
	• Waste recyclers	2	
• NGO	• NGO working on waste management	2	2
TOTAL			**860**

two weeks. Data collection began with several interviews with government officials and representatives of foreign agencies in Jakarta. Interviews were conducted until the third week of December before the Christmas and New Year's holiday.

The next data collection was conducted for five weeks, from January to mid February 1997. Because of the Idul Fitri (moslem) holiday that happened during the third week of February 1997, data collection was then postponed until mid March. Thereafter, data collection continued for eight weeks, to May 1997. Since the Government of Indonesia would hold a general election in the third week of May 1997, data collection was postponed for two weeks, one week before and after the election based on the recommendation from the Bureau of Social and Political Affairs of the Ministry of Internal Affairs in Jakarta. The next data collection period lasted for ten weeks, from mid June to the end of August 1997. After this date, data collection was primarily conducted through finding news or secondary data from online newspapers/magazines in Indonesia via the Internet.

4.7. Data Analysis

This study generated both qualitative and quantitative data. Qualitative data have been classified based on their similarities. Quantitative data have been tabulated and presented descriptively, and some were examined through non-parametric statistical tests. Both qualitative and quantitative data were used to analyze the feasibility of IMSWPM from its fitness and acceptability, and sustainability of this approach in terms of its potential contribution to sustainable development.

CHAPTER 5.
THE MUNICIPALITY OF BANDUNG, INDONESIA: THE STUDY LOCATION

5.1. Geographic Context

The Municipality of Bandung (Kotamadya Bandung) has an area of 16,668 hectares and is administered by "Pemerintah Daerah Kotamadya Bandung", a municipal government below the provincial level. Other areas surrounding the municipality belong to the District of Bandung (Kabupaten Bandung) and are administered by "Pemerintah Daerah Kabupaten Bandung", a district government below the provincial level as well. Both the municipality and the district form The Bandung Metropolitan Region, with a total area of 320,649 hectares. In total, the area of the municipality is only 5.2% of the total area of the metropolitan region. Figure 11 shows the map of Bandung Metropolitan Region and Figure 12 illustrates the administrative area of Kotamadya Bandung.

The Municipality of Bandung is divided into six "wilayah" or regions. Each wilayah consists of a few "kecamatan" and each kecamatan consists of several "desa" or villages. The municipality has 26 kecamatan and 135 desa. The municipality is headed by a mayor, called "Walikota"; each wilayah is headed by "Patih"; each kecamatan is chaired by "Camat"; and each desa is led by "Lurah".

The Municipality of Bandung is at an average of 768 meters above sea level. The highest point is located in the northern part of the city at 1,050 meters above sea level, and the lowest point is at the southern part of the city at 675 meters above the sea level. The northern part of the city consists of hilly areas, while the southern part consists of plain areas. In general, the climate in the municipality is cool and humid due to the mountains surrounding it. The average temperature in 1995 was a maximum of 30^0 C in September and a minimum of 17.2^0 C in August. Monthly rain fell in 1995 was an average of 160.4 mm and the average number of rainy days per month is 17.8. The average humidity in 1995 was 80%.

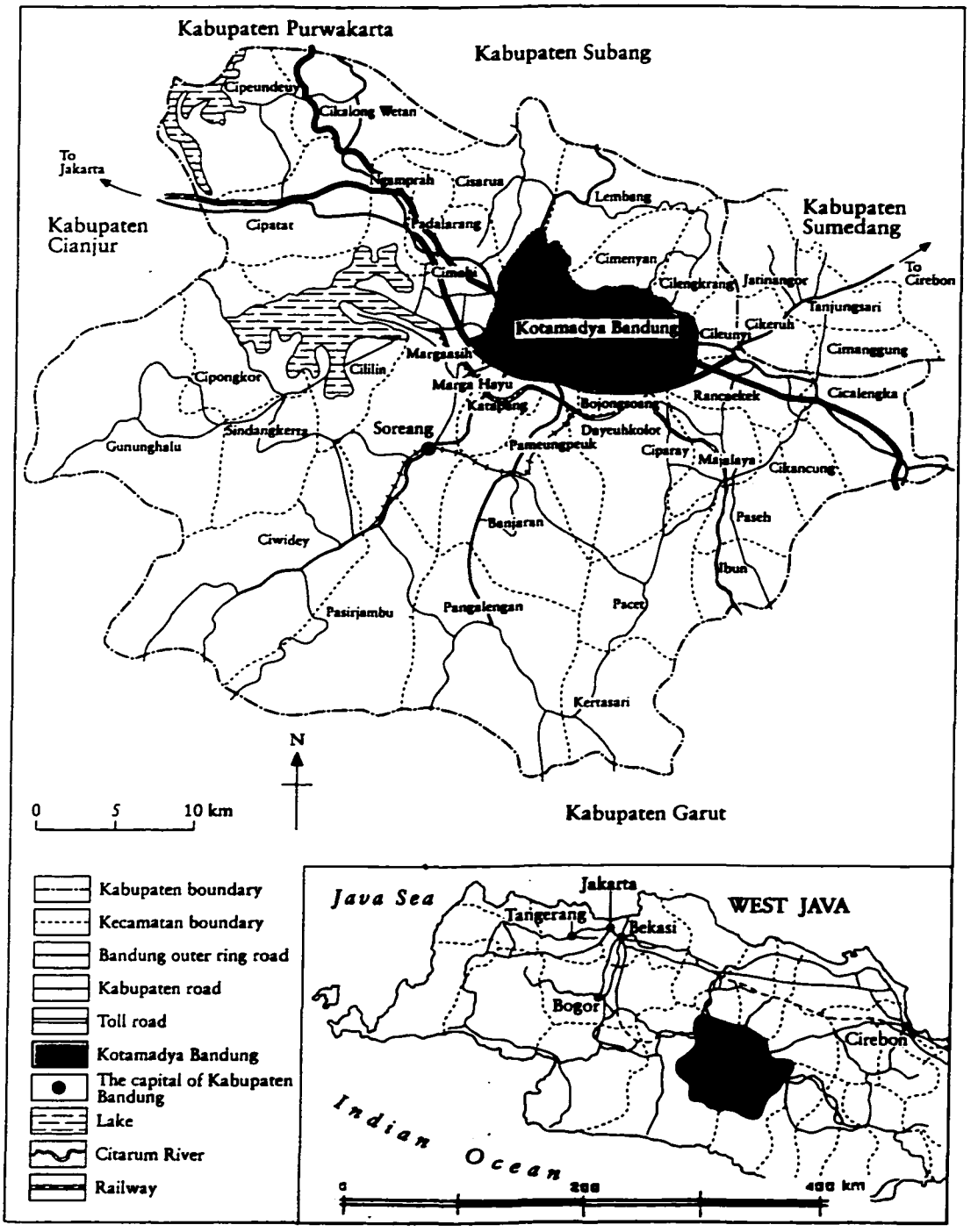


Figure 11. Bandung Metropolitan Region
(Source: Firman, 1996, p.2)

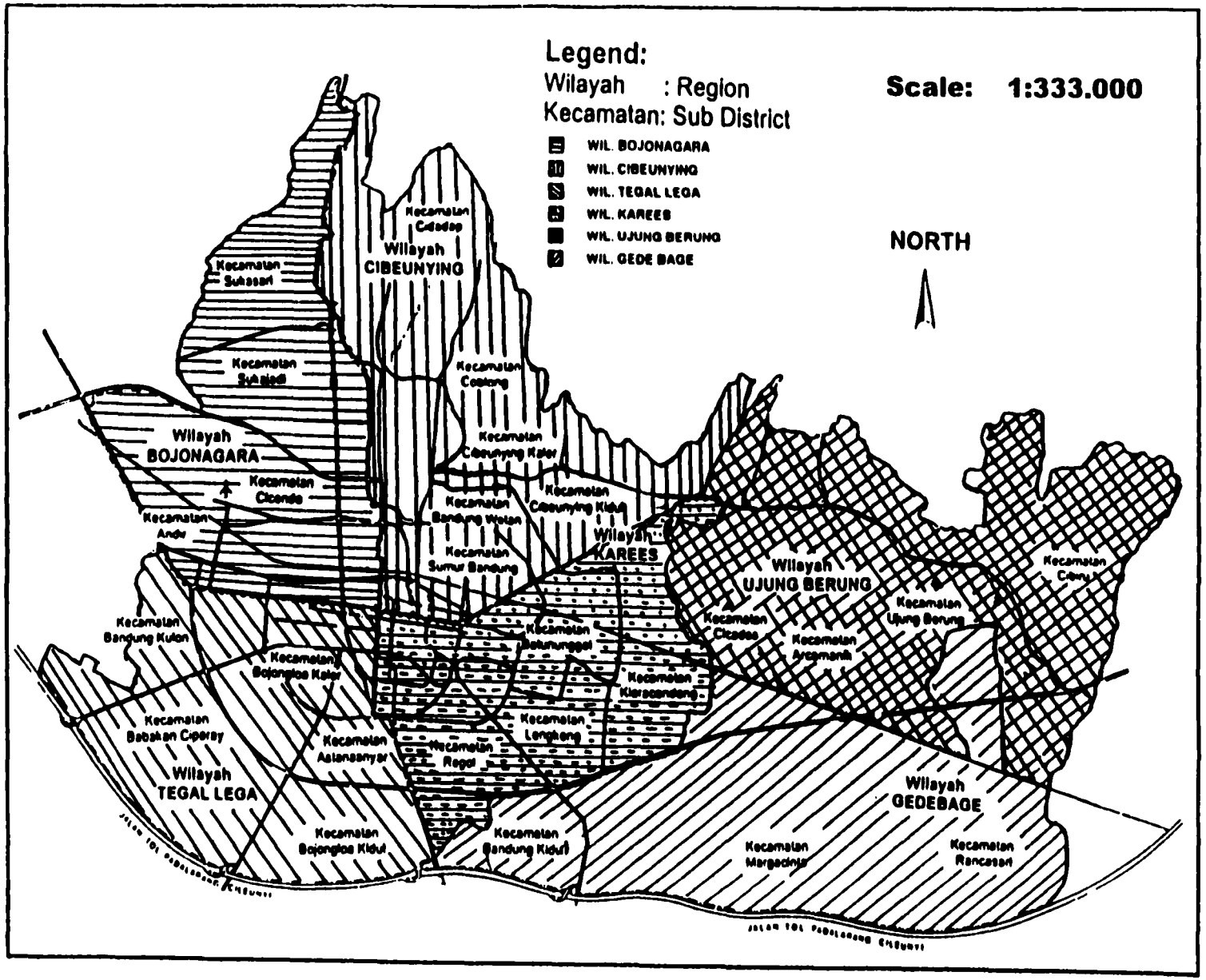


Figure 12. The administrative area of the Municipality of Bandung

5.2. Socio-Demographic Context

The population of the Municipality of Bandung in 1995 was 1,809,964 persons, with an annual population growth rate of 3.48% (Table 24). The population density of the municipality in 1995 was 108.59 persons per hectare. In that year, the population density in each kecamatan varied, from 32.96 persons per hectare in Kecamatan Rancasari to 307.06 persons per hectare in Kecamatan Bojongloa Kaler. Figure 13 illustrates population density in 1995. A local newspaper reported that the number of people of the Municipality of Bandung in 1999 was about 2.5 million people with an average density of 140 persons per hectare.[1] It was also mentioned that according to UNESCO the ideal population density is between 60 and 70 persons per hectare.

Table 24. The number of population and population density in Kotamadya Bandung in 1995

Wilayah (Region)	Kecamatan	Number of desa	Area (ha)	Number of households	Population	Density (persons/ha)
Cibeunying	Sumur Bandung	4	314	7,311	45,525	144.98
	Bandung Wetan	3	339	7,489	43,002	126.85
	Cibeunying Kidul	6	462	20,741	96,757	209.43
	Cibeunying Kaler	4	452	11,723	52,147	115.37
	Coblong	6	736	18,302	97,138	131.98
	Cidadap	3	612	8,036	41,031	67.04
Tegal Lega	Bandung Kulon	8	647	18,487	83,755	129.45
	Babakan Ciparay	6	746	22,073	83,697	112.19
	Bojongloa Kaler	5	303	18,809	93,038	307.06
	Bojongloa Kidul	6	637	11,052	61,188	96.06
	Astanaanyar	6	289	14,751	74,864	259.04
Bojonagara	Andir	6	371	19,223	94,208	253.93
	Cicendo	6	687	19,359	84,320	122.74
	Sukajadi	5	430	17,629	82,465	191.78
	Sukasari	4	628	12,589	69,441	110.57
Karees	Regol	7	430	15,106	72,555	168.73
	Lengkong	7	591	13,283	70,417	119.15
	Kiaracondong	6	613	21,673	103,928	169.54
	Batununggal	8	503	25,450	109,341	217.38
Ujung Berung	Cibiru	4	1,082	9,690	43,007	39.75
	Ujung Berung	7	1,035	12,024	53,363	51.56
	Arcamanik	4	881	8,806	42,296	48.01
	Cicadas	3	867	21,274	76,621	88.37
Gede Bage	Bandung Kidul	4	607	7,835	30,959	51.00
	Margacinta	3	1,088	14,378	61,459	56.49
	Rancasari	4	1,318	10,411	43,442	32.96
Total		135	16,668	387,504	1,809,964	108.59

Source: Kantor Statistik Bandung (1996). "Kotamadya Bandung Dalam Angka 1995".

[1] "Pertambahan Jalan dan Kendaraan Tidak Seimbang, Beban Bandung dari Tahun ke Tahun Makin Berat", *Pikiran Rakyat Online*, 15-April-1999. (http://www.pikiran-rakyat.com/).

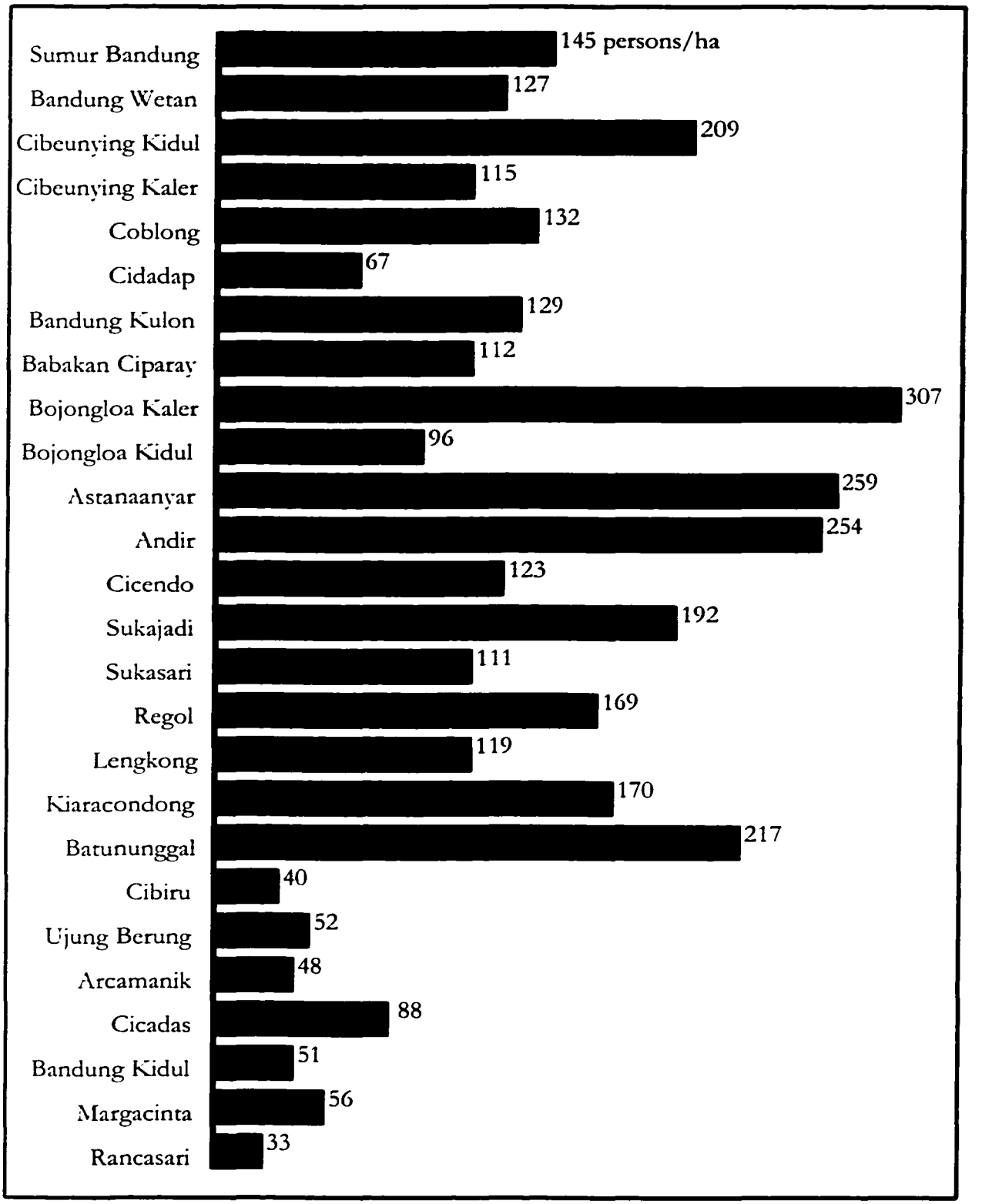


Figure 13. Population density among kecamatan of Kotamadya Bandung in 1995

The population of the Municipality of Bandung in 1995 consisted of 50.5% males and 49.5% females. This population was composed of 83% Moslems, 7% Christians and Catholics, 0.30% Hindu, 0.60% Buddhists, and 9.10% others. In terms of occupation, the population of the municipality in 1995 consisted of government officers (8%), military forces (3%), private sector workers (12%), farmers (2%), traders (10%), students (23%), university students (7%), and others (36%).

5.3. Governmental Administrative Structure

The general administrative structure (hierarchy) of the Indonesian government, including the Municipality of Bandung, from the lowest to the highest level, is shown in Figure 14. At the bottom level is the head of village (desa or kelurahan), called "Kepala Desa" or "Lurah", who is usually selected directly by his or her people. Each Lurah leads several informal leaders (Ketua Rukun Warga - RW) and chiefs of neighbourhood units (Ketua Rukun Tetangga - RT). Ketua RW is selected by the chiefs of neigbourhood units (Ketua RT). One ladder up the village level is the sub district level (kecamatan). The head is called "Camat" and each Camat becomes the superior of village heads (Lurah).

Some kecamatan form a district (kabupaten) or municipality (kotamadya). District and municipality are government at level II (Daerah Tingkat II). The head of a district is called "Bupati", and that of a municipality is "Walikotamadya". Both Bupati and Walikotamadya are selected by the parliament (Dewan Perwakilan Rakyat Daerah Tingkat II or DPRD Tingkat II) usually every five years after the general election. Each mayor is assisted by a secretary and has a planning board (Badan Perencanaan Pembangunan Daerah Tingkat II or Bappeda Tingkat II) which coordinates with various sectoral offices (dinas) at the district or municipal level. In accomplishing his/her tasks, the city's mayor or the district's bupati consults with the parliament.

Similarly, at the provincial level (Daerah Tingkat I), the governor is elected by the parliament in the provincial government (DPRD Tingkat I). As in the district or municipal level, the governor conducts consultation with the parliament. He or she is also has a secretary. The provincial planning board (Bappeda Tingkat I) is responsible directly to the governor. The Planning Board coordinates tasks with departments at the provincial government.

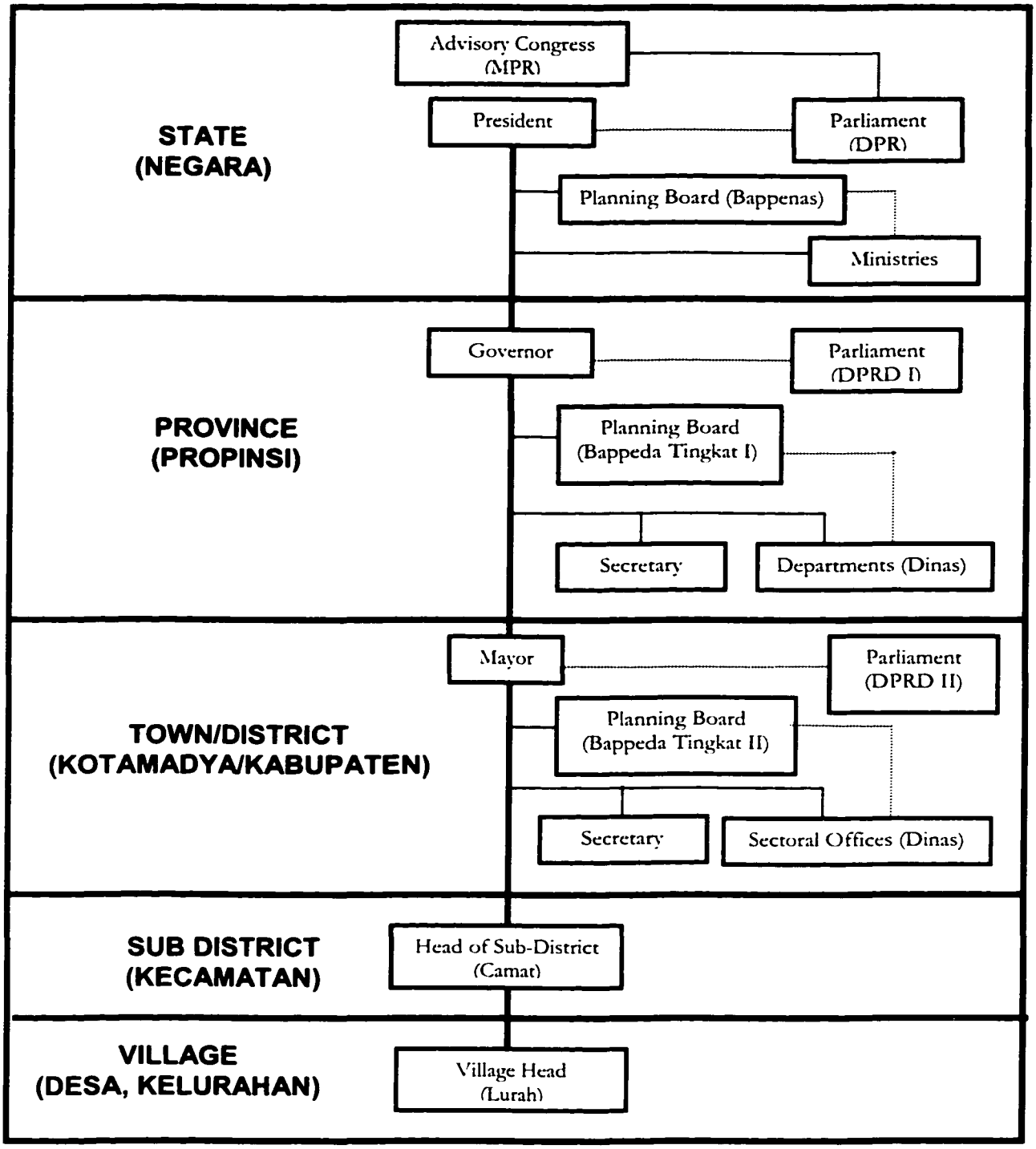


Figure 14. Governmental Administrative structure in Indonesia (adapted from Bucholt (1994))

At the highest level of the hierarchy is the President who is selected by the advisory congress (Majelis Permusyawaratan Rakyat – MPR) every five years following the general election. The president consults with the parliament. The president leads the national planning

board (Bappenas) which has authority in planning, budgeting, coordination and monitoring (Poppe, 1998).

The annual bottom-up planning process in Indonesia, including Kotamadya Bandung, starts from the village (desa) level at which the village community meeting occurs to identify and get consensus about the needs of the local people. This process is usually facilitated by the village resilience community council or "Lembaga Ketahanan Masyarakat Desa (LKMD)" (Poppe, 1998). The main output of the meeting is a proposal of activities for a village. This proposal is then brought to the head of sub district (Camat).

At the sub district (kecamatan) level, all proposals from the villages are discussed at a forum called "Rapat Koordinasi Pembangunan (Rakorbang) Kecamatan" or sub-district development coordination meeting (Poppe, 1998). In this meeting, an agreement is sought among the Camat and all Lurah which represent their villages. The agreed activities for each village will form project proposals that will be brought to the district (kabupaten) or town (kotamadya) level.

Poppe (1998) mentioned that the process at the district or town and provincial levels are similar. At the district or town level, project proposals from all kecamatan will be discussed and evaluated in the district development coordination meeting (Rakorbang Tingkat II). The results of this meeting are agreed project proposals that will be submitted to the provincial level to get funding sources from the provincial government or the central government. Some parts of the agreed activities will be funded through the district budget (Anggaran Pembangunan Belanja Daerah - APBD).

At the provincial level, the regional development consultation meeting (Rakorbang Tingkat I) takes place to discuss all the proposals from all districts (towns). The outcomes of this meeting are project proposals that will be brought to the national consultation meeting in order to get the funding from the central government. As in the district or town level, some activities will be funded by the provincial budget sources.

At the national or central level, the proposals from the entire provinces are discussed and evaluated at the national development consultation meeting (Rapat Koordinasi Pembangunan Nasional). The role of the national planning board (Bappenas) was very significant in determining which projects from each province will be funded through the national budget (APBN). After the national parliament reaches an agreement with the

government about the national budget, then the president will give a national speech about the national budget for the upcoming fiscal year.

5.4. Summary

Some insights about the Municipality of Bandung can be summarized. First, the municipality has a long period of rainy season, about five months a year. This situation creates hardships for service provision. The long, rainy days also increase difficulties for composting activities. At the final disposal sites, hard rains can disrupt waste disposal activities. Second, the municipality is increasingly crowded and the provision of an effective, efficient and reliable service is therefore very important in order to keep the city clean and to protect the people from the negative impacts of solid wastes. Third, the administrative structure and the annual bottom-up planning process indicate not only the government's bureaucracy, but also time required from planning to implementation. It will be impossible to solve or alleviate all issues (problems) associated with municipal solid wastes by depending on the government's funds. Other efforts and contributions from various actors will be needed, for instance, through partnerships.

CHAPTER 6.
FINDINGS

Findings of this study are presented and organized from the broad context such as environmental management in Indonesia and Indonesia's Agenda 21, to the local context of the Municipality of Bandung and its long-term vision and mission. Findings about integrated municipal solid waste planning and management (IMSWPM) follow: municipal solid waste planning and management (MSWPM) in the Municipality of Bandung, problems, ideas, goals, benefits, potential barriers to implementation, and opportunities for the adoption and implementation of IMSWPM.

6.1. Environmental Management in Indonesia

According to the State Ministry of the Environment of Indonesia or "Kantor Menteri Negara Lingkungan Hidup" (KLH, 1995), environmental management in Indonesia should be based on sustainable development because the Government is committed to the adoption and implementation of this vision. The State Ministry of the Environment has defined sustainable development as a development process to optimize the use of natural and human resources by harmonizing human activities within the carrying capacity of the environment.

Some major concerns about policies for environmental management were identified by the State Ministry of the Environment (KLH, 1995). They included inadequate attention to the selection of location for development, waste minimization or reduction, waste management, implementation of environmental quality standards, rehabilitation of the environment, institutional development, public participation, and human resource development.

Five main goals for environmental management in Indonesia were recognized by the State Ministry of the Environment (KLH, 1995). They are to achieve a harmonious relationship between human beings and the environment, to ensure a controllable and wise use of resources, to make Indonesian people the guardian of the environment, to accomplish development that considers the interests of the current and future generations, and to protect the country from impacts which may damage and pollute the environment.

Six strategies for environmental management were outlined by the State Ministry of the Environment (KLH, 1995). They include developing institutions to improve their capacity for

achieving coordination, developing a regulatory framework to anticipate future challenges in environmental management, human resource development in government institutions to increase their capacity in dealing with various issues in environmental management, developing and using environmentally-friendly technology to reduce pollution in the environment, increasing awareness and willingness of the private sector and the public in carrying out the costs for environmental management, and developing preventive efforts for environmental management.

The State Ministry of the Environment identified main principles for environmental management in Indonesia (KLH, 1995). The first principle is to be beneficial, which means that any development effort and activity should provide maximum benefits for human beings, restore cultures, and preserve the environment. The second principle is that everyone has the obligation to sustain and prevent the environment from being degraded. This principle was incorporated through laws (Undang-Undang Nomor 4 Tahun 1982 and Undang-Undang Nomor 23 Tahun 1997). The third principle is the need for partnerships of stakeholders in environmental management. In this sense, three main stakeholders are recognized: the government, private sector, and the public (Table 25). Partnerships for environmental management should be based on top-down and bottom-up mechanisms and their implementation should be coordinated.

Table 25. Roles of stakeholders in environmental management in Indonesia

Actors	Roles in partnership
Government	• Formulate policies and coordinate them • Act as facilitator and catalyst • Foster the capacity development of the private sector and the public • Develop human resources of government institutions and organizational restructuring • Control natural resource use and strive for environmental sustainability
Private Sector	• Strive for and participate in preserving the environment • Integrate the environment into its business strategy and management • Support the creation of a business environment that supports sustainable development • Make products that are environmentally-friendly • Increase cooperation with government and the public
Public	• Increase capacity for preserving the environment • Develop self-organizing capacity for sustaining the environment • Monitor and control government development policies • Empower women and the youth in environmental management

According to the State Ministry of the Environment, partnerships of stakeholders for managing the environment should occur in policy making, planning, implementation, and monitoring and evaluation (KLH, 1995). The State Ministry of the Environment acknowledged that partnerships of stakeholders would work under four conditions: willingness for achieving a common vision and goals, consensus concerning the roles of each stakeholder, agreements on mechanisms for interaction and communication, and openness of stakeholders in finding solutions for problems.

Several constraints in achieving environmental management goals were noted by the State Ministry of the Environment. The first is that existing institutions have not had sufficient coordination capability to deal with various environmental issues. The second is that environmental law enforcement has not been institutionalized, even though the laws have been in place. The third constraint is the fact that the capacity of government officers in environmental management at the local and national levels is weak and limited. Another constraint is that the development and use of environmentally-friendly technology to reduce environmental damage and to restore the environment have been lacking. The last obstacle is that the private sector and public's responsibility in sharing the costs for environmental management is still relatively low. Figure 15 summarizes the findings about environmental management in Indonesia.

6.2. Indonesia's Agenda 21: Solid Waste Management

Indonesia's Agenda 21 is an attempt to promote and implement sustainable development. This agenda was prepared by the State Ministry of the Environment and was launched at the end of April 1997. This agenda mentions that any future strategy for waste management should be consistent with the principles of sustainable development and that an integrated waste management strategy should be adopted. This strategy integrates four aspects: minimization of waste; maximization of reuse, recycling and composting; extension of waste service coverage; and, use of environmentally-sound waste disposal.

The importance of waste minimization is acknowledged because of the increasing waste production caused by population growth, urbanization, and industrial growth. In the future, costs for managing waste which comply with environmental quality standards will be high. Initiatives to reduce waste from industries, households, and packaging should be a priority. For the industrial sector, cleaner production principles should be adopted, including good

housekeeping, changing production techniques and technologies, and changing input materials. Reduction of waste generation by households would happen through changing individuals and households' consumption patterns. Indonesia's Agenda 21 (State Ministry of the Environment, 1997, 303) stated that "In the long-term, with economic development and subsequently increased consumption, minimization of household waste will become increasingly necessary for sustainable waste management."

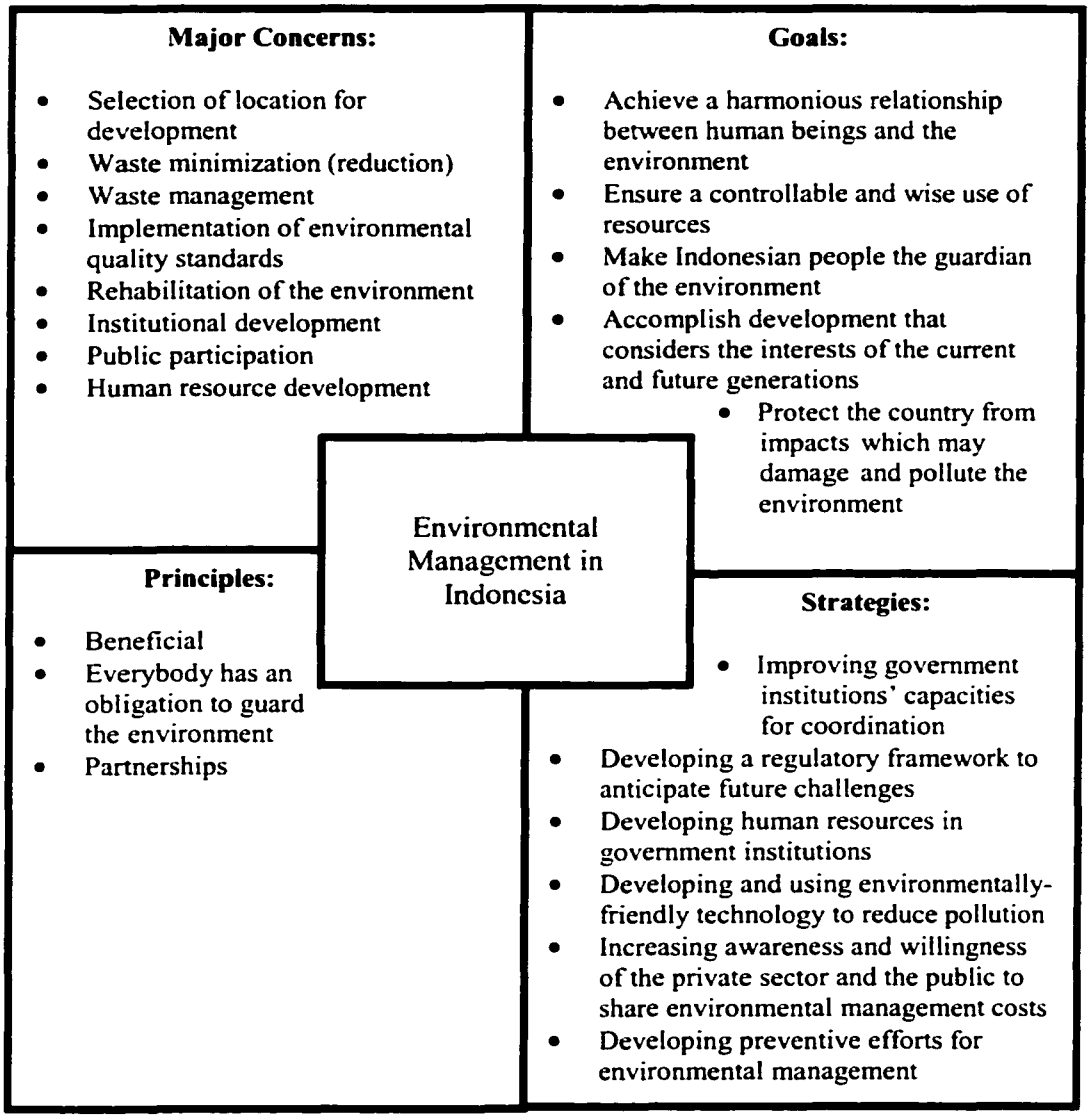


Figure 15. Environmental management in Indonesia

Agenda 21 identifies three major constraints to waste minimization in Indonesia: weak monitoring and enforcement capacity, inadequate policies and regulations, and the high level of commitment required. Prerequisites for waste minimization are the existence of economic

instruments for coercion and incentives, an appropriate administration and tax structure, and strong political will from the government.

Maximization of reuse, recycling and composting has several potential benefits, including reduction of waste generation, reduction of waste management costs for collection and transportation, treatment and disposal, promotion of more careful use of diminishing natural resources, reduction of herbicide and pesticide use and provision of nutrients to the soil, and creation of jobs for the urban poor, in particular waste pickers (State Ministry of the Environment, 1997).

Six major challenges for the maximization of reuse, recycling and composting are mentioned in Indonesia's Agenda 21. They include lack of faith and interest of municipal authorities to develop the informal waste sector, lack of formal mechanisms established to help waste pickers to recover valuable materials in a safe and sanitary manner, lack of participation of the public, insufficient demand for compost, unwillingness of municipal authorities to recognize cost savings in transportation and disposal resulted from composting, and the sensitivity of the recycling industry which operates at small profit margin.

Extending waste service coverage is very important, because insufficient service provision in urban areas has led to indiscriminate disposal such as waste dumping to drains and rivers, and burning, resulting in pollution of water, air, and land. Various factors have contributed to this problem, including low technology and outdated vehicles and equipment, inadequate waste management practices, shortage of funds, low willingness to pay service fees, and lack of public awareness about the various impacts of waste. In response to these situations, the strategy for extending waste service coverage would emphasize the strengthening of local cleaning agencies, enhancement of service fee collection and better cost recovery, improvement of the regulatory system and enforcement of laws, and promotion of community participation and private sector involvement.

Four disposal options are recognized by Indonesia's Agenda 21: sanitary landfill, controlled landfill, open dumping, and incineration. Sanitary and controlled landfills are appropriate for big and/or metropolitan cities. Controlled landfills may also be appropriate for medium cities. Open dumping has been the most common disposal option used by small cities. Incineration is not recommended because it is infeasible due to its high costs, complex

technology, and low calorific value of waste. However, Agenda 21 recognized that incineration might become part of the solution for waste disposal in the future.

Agenda 21 outlines short- and long-term objectives and programs for minimization of waste; maximization of reuse, recycling and composting; extension of waste service coverage; and, use of environmentally-sound waste disposal. The planning horizon is five years for the short-term (1998-2002) and seventeen years for the long-term (2003-2020). Table 26 delineates those objectives and programs.

6.3. Vision and Mission of Bandung City

The long-term vision for the City of Bandung, known as Vision 2020[1], was formulated in 1999. Through the City Development Strategy project funded by the World Bank, the municipal government of Kotamadya Bandung and the district government of Kabupaten Bandung reached an agreement about the character of the city in the future. They envisioned the City of Bandung as one that is safe, healthy, beautiful, harmonious, religious, dynamic, efficient, productive, and innovative. In that project, various stakeholders were involved, including governments, universities, non-governmental organizations, and the general public. Two main objectives of the project were to increase participation from the public and to build a good working relationship between the municipal government and the district government of Bandung.

The municipal government of Kotamadya Bandung has been striving to achieve its mission to create Bandung as a neat, clean, green, and beautiful city as represented by its twin slogans: K3 (Ketertiban, Kebersihan, Keindahan) or "neat, clean, beautiful" and Berhiber (Bersih, Hijau, Berbunga) or "clean, green, bloomy". Bandung has been known as the Flower City.

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[1] "Menuju Tatar Bandung 2020 yang Cergas dan Ramah" *Pikiran Rakyat Online*, 3-September-1999. (http://.www.pikiran-rakyat.com)

Table 26. Objectives and programs for solid waste management according to Indonesia's Agenda 21

Area	Short and Long-term Objectives	Short and Long-term Programs (Activities)
Waste minimization	For the period 1998-2002: • Establish waste minimization as a primary objective in waste management programs • Set technically and economically feasible goals or targets for waste minimization in the industrial/commercial and packaging sectors • Encourage the reduction and/or elimination of waste destined for final disposal • Improve community awareness and participation regarding waste minimization	For the period 1998-2002: • Strengthen commitment of the National Government on waste minimization • Minimize waste generated by individuals, households and commercial activities • Minimize and/or eliminate waste generated during the production process through the implementation of Clean Production principles
	For the period 2003-2020: • Implement and achieve designated targets and goals for waste minimization • Promote a fundamental shift in behaviour and attitude that strives toward a sustainable consumption pattern	For the period 2003-2020: • Develop procedures for assessing waste quantity and compositional changes caused by waste minimization policies • Review objectives, targets and the effectiveness of existing economic instruments • Develop new instruments to further increase efficiency and technological innovation in waste minimization • Change existing regulations and policies that do not incorporate waste minimization principles
Reuse, recycling and composting	For the period 1998-2002: • Establish national commitments from government on recycling and composting • Achieve meaningful recycling (between 15 and 25% of the total waste) and composting (between 30 and 40% of the total waste) in selected cities	For the period 1998-2002: • Increase commitment to reuse, recycling and composting activities • Demonstrate government commitment to recycling and composting activities by encouraging government agencies and enterprises to use recycled and compost products

Table 26. Continued

Area	Short and Long-term Objectives	Short and Long-term Programs (Activities)
Reuse, recycling and composting (continued)		For the period 1998-2002: (Continued) • Provide further support to the informal sector (waste pickers, lapak) by providing access to credit for composting and recycling units • Coordinate and/or integrate reuse and recycling activities of the informal sector such as waste pickers, lapak (collectors of waste) and bandar (waste broker) with the formal solid waste management system such as the cleaning authority, local government, and policy makers at the central government • Develop public education and awareness programs to promote the use of products made from recycled material and to encourage active participation in reuse and recycling activities at household level • Develop and implement a marketing strategy to increase the market for compost to different target users in agriculture, nurseries, plantations, and households • Review waste import policies to ensure that reuse and recycling of local waste is not threatened • Conduct research to identify new uses for recycled material • Provide incentives for consumers and producers to use recycled products through subsidies, product charges, and deposit refund systems
	For the period 2003-2020: • Reach the optimum levels of recycling and composting which are economically feasible	For the period 2003-2020: • Institute a solid waste management system that integrates waste minimization, recycling, collection, and disposal • Develop a waste segregation system that segregates all types of wastes including organic, glass, paper and metals • Conduct further research on uses and markets for recycled products • Analyze the economic, financial, and technological feasibility of implementing mechanical sorting and large-scale, mechanical composting plants • Continue and improve public education programs that promote the use of products made from recycled material and the use of compost

Table 26. Continued

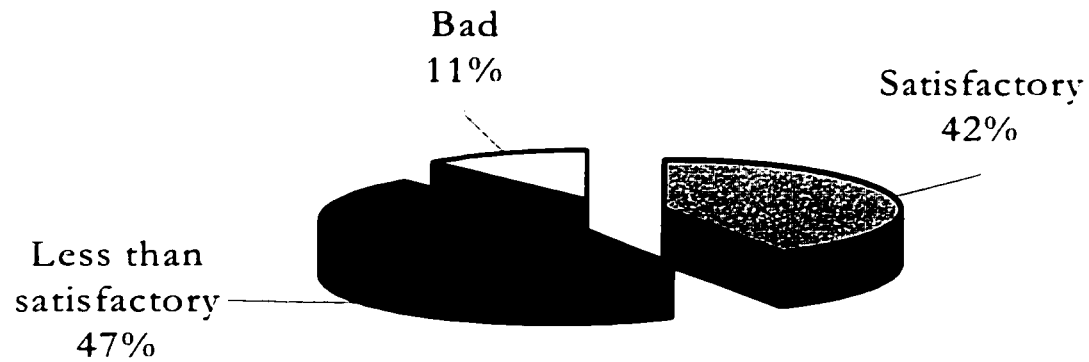
Area	Short and Long-term Objectives	Short and Long-term Programs (Activities)
Extension of service coverage	For the period 1998-2002: • Increase the solid waste service coverage to 70-80% for medium cities and small towns and 90-100% in the metropolitan and large cities	For the period 1998-2002: • Prepare and implement programs for increasing solid waste coverage and monitor the development and use of final disposal sites • Prepare and implement priority programs for solid waste services in high density slums and flood-prone areas • Conduct studies on needs and demands for solid waste services for strategic and priority cities in terms of affordability, spatial planning and the potential for implementing regional waste management systems • Encourage the full integration of primary waste collection which is mainly community-based with formal, city-managed disposal systems • Evaluate and if necessary, modify solid waste collection fees which reflect affordability
	For the period 2003-2020: • Achieve full environmentally-safe service coverage for solid waste	For the period 2003-2020: • Monitor and evaluate the performance of the established cleaning enterprise (Perusahaan Daerah Kebersihan) • Expand programs that disseminate regulations, technical guidelines and standards for the provision of waste services to all levels of government agencies • Develop an easily accessible information system to assist community planning for the expansion of services, the imposition of fees, the technical design of new facilities, and the processing of complaints • Evaluate alternative methods of financing such as development impact fees and municipal bonds • Increase cost recovery and fee collection rates • Increase participation by the community and the private sector in the provision of waste services and infrastructure

Table 26. Continued

Area	Short and Long-term Objectives	Short and Long-term Programs (Activities)
Environmentally sound waste disposal	For the period 1998-2002: • Ensure that all new disposal sites dispose of solid waste in an environmentally-sound manner and that existing disposal sites begin to improve solid waste disposal techniques	For the period 1998-2002: • Institute long-term planning procedures for selection, development, use, reclamation and future use of landfill sites, and incorporate factors such as transport distance to waste generation centres, site mitigation measures and cost of reclamation • Accommodate resource recovery measures and biogas extraction for power generation in the operation and design of landfills • Improve existing disposal sites that are not environmentally sound through compacting, periodic covering with soil, and the collection and treatment of gas and leachate • Promote regional cooperation between municipalities (kotamadya) and districts (kabupaten) where appropriate to develop regional landfill sites • Evaluate the feasibility of alternative methods of solid waste disposal such as incineration in anticipation of increasing costs for securing land for waste disposal and of the changing nature of waste characteristics
	For the period 2003-2020: • Ensure that all solid waste is treated and disposed according to environmental quality standards, taking into consideration the local carrying capacity of all receiving media (water, soil, and air)	For the period 2003-2020: • Periodically review and update existing standards based on scientific findings and improvements in technological and institutional capabilities in implementing and enforcing standards • Review existing economic instruments and develop new instruments as necessary to achieve higher efficiencies and higher levels of innovation in treatment technology • Strengthen the capability to enforce and monitor compliance • Institute a system to monitor disposal sites

A few activities have been started to achieve that mission. In July 1995, for instance, the municipal government issued a municipal law about K3[2]. In order to enforce this law, the municipal government of Kotamadya Bandung established a coordinating committee, involving many government institutions. The primary tasks of this team were to prepare programs and instructions for K3, guide and assist the Camat and Lurah in coordinating the implementation of K3 programs in their areas, monitor and enforce the implementation of K3 programs by the Camat and Lurah, and evaluate the performance of the implementation of K3 programs for the city's Mayor.

Figure 16. Opinion of university students about the cleanliness of Bandung City



The cleanliness aspect of the city involved waste storage and separation, street sweeping, collection, transfer and transportation of waste, waste treatment or processing, and final disposal. In order to obtain an image about the cleanliness of the City of Bandung, surveys of university students were taken (Figure 16). They were chosen as respondents because they are among those who travel in and around the city every day and they have their own impressions concerning the cleanliness of the city. From a total of 346 undergraduate students from three universities, only 42% replied that the city's cleanliness was satisfactory, while 47% argued that the city's cleanliness was less than satisfactory, and 11% thought that the cleanliness of the city was bad. It should be noted here that the result of the chi-square test

[2] Peraturan Daerah Kotamadya Bandung Daerah Tingkat II Bandung Nomor: 06 Tahun 1995 Tentang Ketertiban, Kebersihan and Keindahan di Wilayah Kotamadya Daerah Tingkat II Bandung, 19 Juli 1995.

(Appendix E) indicates that the students' responses are not associated with their origin ($\{X^2=10.02\} < \{\chi^2_{df=4;\alpha=0.01}=13.277\}$). Nevertheless, these findings suggest that maintaining the cleanliness of the city is still a major challenge.

One attempt to deal with cleanliness was through the establishment of the Adipura Success Team[3]. The municipal government of Kotamadya Bandung had been striving to get the Adipura Award presented annually by the central government to cities that comply with certain criteria of cleanliness. In November 1995, for instance, the mayor of the city issued an instruction[4] emphasizing the need to enhance the implementation of K3 programs as part of the efforts to receive the Adipura Award. Officials of the municipal government considered that winning this award would provide a good image not only for the city but also for the ruling government. The main tasks of the team were to prepare plans and programs for enhancing cleanliness, coordinate and implement programs, and monitor, evaluate, and report the progress to the city's Mayor. Despite the criticisms that efforts to win the award were sporadic and incidental, such efforts stimulated and mobilized action by both the municipal government and the residents to maintain the cleanliness throughout the city.

Beauty of the city was enhanced through good maintenance of buildings, parks, streets, trees, fences, bridges, canals, and public facilities. The Department of Parks, in particular, was very aggressive in planting trees throughout the city and persuading private businesses to contribute funds for planting trees.

To ensure neatness and order, a law was issued to regulate the proper use of streets, trading places, public facilities, and building construction. The municipal government of Kotamadya Bandung also formed the Yustisi Team with a main task of educating the public about the importance of keeping social order and the city neat. The mayor also issued an instruction[5] about the need to support the national discipline movement ("Gerakan Disiplin Nasional – GDN") advocated by the president in 1995. The primary objective of the instruction was to stimulate and foster the culture of being neat and clean in the public domain and government institutions. Campaigns through mass media about the importance of GDN were

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[3] Surat Keputusan Walikotamadya Kepala Daerah Tingkat II Bandung Nomor: 660/SK. 703-Bag.Huk/1996 Tentang Pembentukan Tim Sukses Adipura Kotamadya Daerah Tingkat II Bandung, 3 Desember 1996.

[4] Instruksi Walikotamadya Kepala Daerah Tingkat II Bandung Nomor: 015 Tahun 1995 Tentang Meningkatkan Ketertiban, Kebersihan dan Keindahan (K3) Menuju Adipura, 9 Nopember 1995.

[5] Instruksi Walikotamadya Kepala Daerah Tingkat II Bandung Nomor: 005 Tahun 1995 Tentang Pelaksanaan Gerakan Disiplin Nasional, 4 Juli 1995.

conducted in the city. In addition, the municipal government also enhanced the monitoring of the cleanliness and social order in public facilities.

The latest and interesting concern related to the mission of the Bandung City was the plan to form a city council. A local newspaper[6] reported a meeting in July 1999 among actors or public figures in Bandung, including the city mayor, experts from universities, and one non-governmental organization. They hoped that the council would bring together various stakeholders to discuss and plan the future of the city. It was expected that the municipal planning board (Bappeda) would work with the council in planning and developing the city according to the aspirations of its citizens.

6.4. Municipal Solid Waste Planning and Management in the Municipality of Bandung

Municipal solid waste planning and management (MSWPM) in the Kotamadya Bandung has been the main responsibility of the "Perusahaan Dinas Kebersihan (PDK-Bandung)", a semi- private cleaning enterprise owned by the municipality, established in August, 1985 based on a municipal regulation.[7] The establishment of PDK has two main objectives: is to increase public service in cleanliness so as to maintain and improve the cleanliness of the city and preserve its environment, and to generate income for the municipal government. When first established in 1985, the total assets of PDK-Bandung were 4.58 billion rupiah.

The 1985 municipal law mentioned that PDK had a board of directors, consisting of the principal director, one technical director, and one general director. The city mayor had the authority to appoint the directors. Each director is selected every four years. The appointment and promotion of any head of organizational units ("Kepala Bagian") and sub-units ("Kepala Seksi") was also in the hands of the mayor.

In June 1993, another municipal law[8] was announced to revise the 1985 law. Total assets of PDK were reassessed at 7.1 billion rupiah and the appointment of any head of

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[6] "Wahana Aksesibilitas Warga Untuk Menata Pembangunan Kodya Bandung Perlu Memiliki "Dewan Kota"" *Pikiran Rakyat Online*, 16-Juli-1999. (http://www.pikiran-rakyat.com).

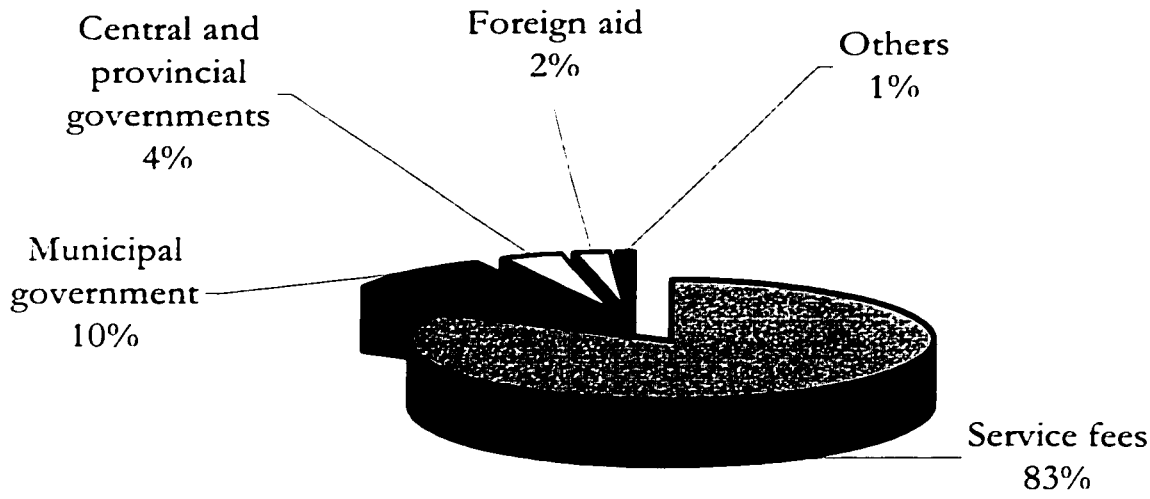
[7] Peraturan Daerah Kotamadya Daerah Tingkat II Bandung Nomor: 02/PD/1985 Tentang Pembentukan Perusahaan Daerah Kebersihan Kotamadya Daerah Tingkat II Bandung.

[8] Peraturan Daerah Kotamadya Daerah Tingkat II Bandung Nomor: 15 Tahun 1993 Tentang Perubahan Pertama Peraturan Daerah Kotamadya Daerah Tingkat II Bandung Nomor 02/PD/1985 Tentang Pembentukan

organizational units and sub-units was decentralized to the board of directors. The new law allows a public accountant to conduct the internal auditing of PDK, provided that the selection of that consultant is approved by the national financial investigation body ("Badan Pemeriksa Keuangan Pembangunan – BPKP").

To carry out its tasks, PDK obtains funds from various sources, such as service fees, central, provincial, and municipal governments, foreign grants or loans, and other sources, including public organizations, and non-governmental organizations. Based on a local consultant's report, in 1996 for example (Figure 17), waste service fees accounted for 83% of the total PDK's income, while the total subsidies from the central, provincial and municipal governments were 14% (CV. Galuh, 1996). The remainder was from various sources, such as foreign aid, public organizations, and non-governmental organizations.

Figure 17. Sources of income of PDK-Bandung in 1996



The annual budget plan of PDK is prepared and given by the directors to the mayor for approval at least three months before the beginning of the upcoming fiscal year. Financial statements of PDK have to be submitted by the board of directors to the mayor once a year. In

Perusahaan Daerah Kebersihan Kotamadya Daerah Tingkat II Bandung, 4 Mei 1993.

addition, reports of spending are prepared regularly every three months and be submitted to the mayor.

The amount of PDK's service fee is regulated through the municipal law issued in 1993 (Peraturan Daerah Kotamadya Daerah Tingkat II Bandung Nomor: 15 Tahun 1993). This decree determined the targeted actors for charges and included owners of any business activities, industries, factories, hotels, shops, offices, and households (Table 27). Households were divided into four groups based on property areas or electricity power consumption. The first class is for the very simple house with space of no more than 36 square meters or using less than 500 watts of power. The second class is for the medium-size house with space of more than 36 but less than or equal to 70 square meters, or consuming power between 501 and 2200 watts. Large houses are classified in the third group. Any houses having space of more than 70 but less than or equal to 120 square meters or using power between 2201 and 6600 watts are in this group. The fourth group is for the luxury houses that have space of more than 120 square meters or consuming more than 6601 watts of power. Monthly service fees for households of class I, II, III and IV are 1500, 2500, 3500, and 5000 rupiah, respectively. It is stated in that law that the cost for managing the solid and non-hazardous waste is 7500 rupiah per cubic meter. In 1986, the cost was 4650 rupiah per cubic meter. It is mentioned in the 1993 municipal law that adjustment to the service fee was conducted based on the economic changes and the need to increase the service for the public.

Based on a private consultant's report (CV. Galuh, 1996), the service fee collection in 1992 resulted in 3,754 million rupiah, increased to 4,369 million rupiah in 1993, and went up to 5,771 million rupiah in 1994. Then, it reached 7.5 billion rupiah in 1997[9], and 9.6 billion rupiah in 1998[10]. Based on conversations with PDK staff, the service fees collected from the users were insufficient to cover all the costs for the city's urban solid waste management.

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[9] "Tidak Logis, Tunggakan Sampah Kodya Bandung" *Pikiran Rakyat*, 28-Mei-1998, p. 2.

[10] "Honor Karyawan PD. Kebersihan Bandung Rp. 130 Ribu Per Bulan", *Suara Pembaruan Online*, 23-Mei-1999. (http://www.suarapembaruan.com/)

Table 27. Waste fees for PDK-Bandung's service in 1997

Description	Types of service					
	Residential: directly to the final disposal site	Residential: from temporary disposal sites to the final disposal site	Private businesses: sending their own waste directly to the final disposal site	Private businesses: to temporary disposal sites	Private businesses: from temporary disposal sites to the final disposal site	Traders in market: from the market to the final disposal site
1. Payer	Each household	Each household	Each businessman (woman)	Each businessman (woman)	Each businessman (woman)	Traders
2. Basic fee	none	none	3,500 rupiah/m^3	7,500 rupiah/m^3	7,500 rupiahs/m^3	none
3. Amount of fee	Based on the agreement	I: 1,500 rupiah per month *) II: 2,500 rupiah per month III: 3,500 rupiah per month IV: 5,000 rupiah per month	At least 3,500 rupiah per month	≤ 1 m^3 : 7,500 rupiah per month 1.1-1.5 m^3 : 11,250 rupiah per month 1.6-2.0 m^3 : 15,000 rupiah per month	At least 7,500 rupiah per month	Varied from 150 to 1000 rupiah per day, based on the size of business
4. Collecting agency	Ketua RW/RT	PDK-Bandung	PDK-Bandung	PDK-Bandung	PDK-Bandung	PDK-Bandung
5. Location for paying fee	Based on the agreement	Same location as payments for electricity bill	Same location as payments for electricity bill and banks	Same location as payments for electricity bill and banks	Same location as payments for electricity bill and banks	Officials of PDK-Bandung
6. Payment times	Based on the agreement	Places for paying the electricity bill: Day 1-20 Banks: Day 1-28	Places for paying the electricity bill: Day 1-20 Banks: Day 1-28	Places for paying the electricity bill: Day 1-20 Banks: Day 1-28	Places for paying the electricity bill: Day 1-20 Banks: Day 1-28	Daily

*) Classification of house:
Class I : less than or equal 36 m^2 or using electricity less than 500 watts
Class II : 37-70 m^2 or using electricity between 500 and 2199 watts
Class III: greater than 70 m^2 and less than or equal 120 m^2 or using electricity between 2200 and less than or equal 6600 watts
Class IV: greater than 120 m^2 or using electricity greater than 6600 watts
Source: PDK-Bandung (1997)

Figure 18 illustrates the growth of service fees collected by PDK-Bandung over time. Meanwhile, waste management costs of PDK-Bandung for every cubic meter of waste in 1995 were 1,720 rupiah for temporary disposal, 3,775 rupiah for collection, and 2,014 rupiah for final disposal. Table 28 shows the components of waste management costs in 1995.

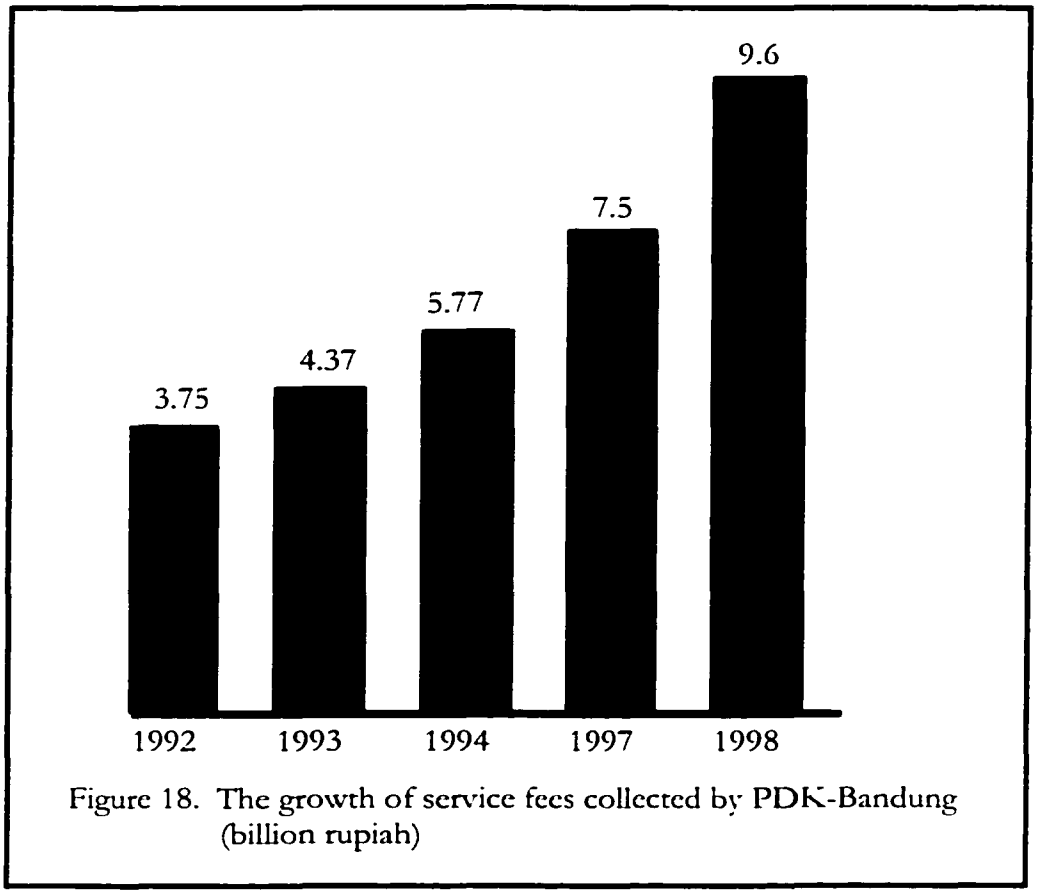


Figure 18. The growth of service fees collected by PDK-Bandung (billion rupiah)

Table 28. Waste management costs of PDK-Bandung in 1995 (rupiah)

Component	Temporary disposal	Collection	Disposal
Depreciation/m^3	1,012	1,960	1,482
Operation and maintenance/m^3	708	1,815	532
Total	1,720	3,775	2,014

Collection of the service fee has been conducted through the PLN (government-owned electricity corporation) offices. Here, recipients of PDK's service who use electricity also pay waste retribution at the same location that they pay their electricity bill. According to the officials of PDK-Bandung, this scheme has been satisfactory in capturing the targeted payers. They estimated that the scheme had been able to capture about 90% of the total service

recipients. PDK-Bandung used to pay 5% of the total service fee collected to PLN for the collection services provided.

Besides PDK, other institutions are responsible for cleanliness in the city. The Department of Parks, for instance, is responsible for the collection, transportation, and disposal of all wastes collected in all parks in Kotamadya Bandung. The Department of Public Works is responsible for cleaning solid waste at drains, canals, and rivers. One semi-private corporation (Perusahaan Dinas Pasar) of the municipal government owns and operates markets in the city and has its own waste management for the markets. In addition, a community might have its own service for its area.

6.4.1. Waste Generation and Composition

According to data for 1995 (Table 29), the volume of waste generated in the Municipality of Bandung was about 6.89 thousand cubic meters per day, of which 59% was from residential areas. As can be seen from that table, every day there was about 4.25% of the total waste or 293 cubic meters not collected by the PDK, and this uncollected waste could go to anywhere, in particular to canals (drains) and rivers. Figure 19 illustrates the distribution of waste generators in 1995. Based on the data provided by PDK-Bandung (Figure 20), the waste composition of the Municipality of Bandung in 1995 consisted of organic (63.6%), paper (10.4%), textiles (1.7%), plastic and rubber (9.8%), ceramics (1.5%), metals (1%), and others (12%). It is evident that municipal solid wastes generated in Kotamadya Bandung is still dominated by organic waste.

Table 29. The amount of waste generated and collected in Kotamadya Bandung in 1995

Sources	The amount of waste generated (m^3/day)	Percentage of waste generated (%)	The amount of waste collected (m^3/day)	Percentage of waste collected (%)
Residential areas	4,075.000	59.14	3,939.710	96.68
Industrial areas	1,299.120	18.86	1,141.537	87.87
Markets	460.000	6.68	460.000	100
Stores, restaurants, hotels	328.660	4.77	328.660	100
Offices	296.350	4.30	296.350	100
Public facilities	98.870	1.43	98.870	100
Streets	320.000	4.64	320.000	100
Canals/drains	12.000	0.18	12.000	100
Total	6,890.000	100	6,597.127	95.75

Source: Kantor Statistik Bandung (1996). "Kotamadya Bandung Dalam Angka 1995".

Figure 19. Waste generators in Kotamadya Bandung, 1995

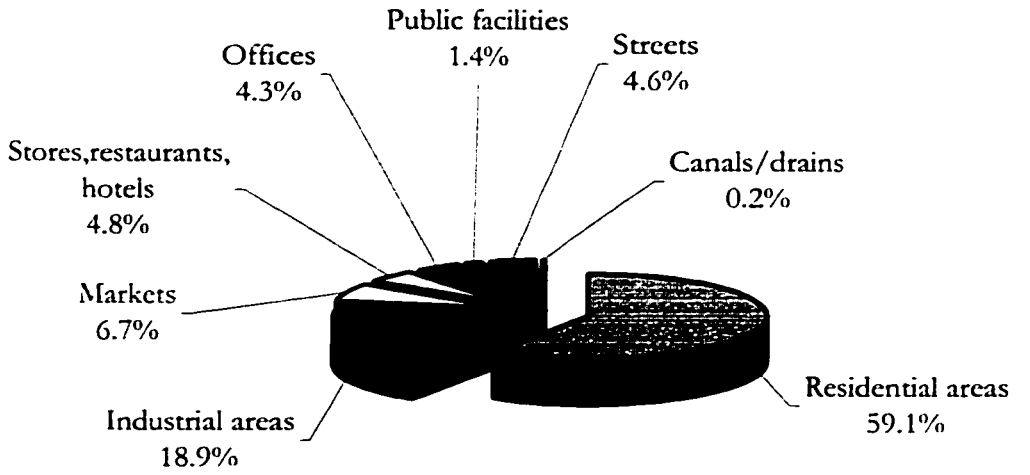
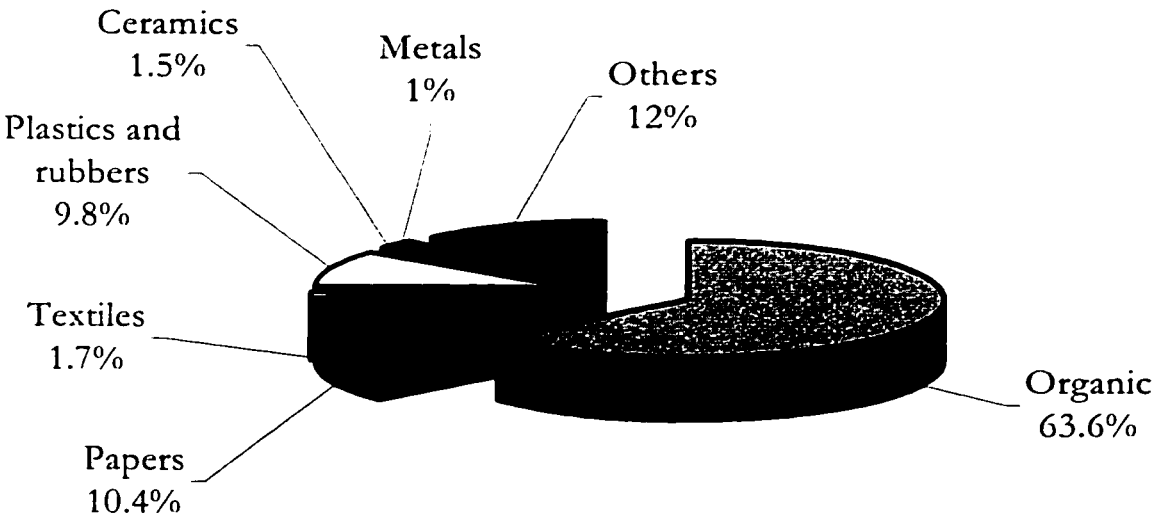


Figure 20. Waste composition of Kotamadya Bandung in 1995



6.4.2. Waste Reduction and Reuse

An official of the World Bank stated that waste reduction or minimization is a new paradigm in waste management in Indonesia. The predominant conventional approach placed a higher priority on disposal than reduction initiatives. Results from interviews, however, indicated a surprising trend. Many respondents or stakeholders, in fact, have begun to recognize the importance of waste reduction. Many stakeholders suggesting a higher priority to waste reduction initiatives include the National Planning Board (Bappenas), the Directorate General of Human Settlements Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Application (BPPT), the Department of Health, the Environmental Research Centre (PPLH-ITB), the Development Technology Centre (DTC-ITB), some professors, and the World Bank. In this respect, Bapedal stated that its focus for waste reduction/minimization had been on industries rather than on the general public. Therefore, Bapedal was very supportive of waste reduction programs, particularly those designed for the public and prepared and launched by other actors.

Other than Bapedal and the World Bank, most of the respondents mentioned above agreed that waste reduction was a new subject for them, even for the Directorate General of Human Settlements Development (DJCK). As a central government institution responsible for the many policies in MSWPM in Indonesia, DJCK in 1996 was still in the stage of studying this issue, assisted by its consultant. They hoped that they could prepare a more detailed draft about policies on 4Rs (reduction, reuse, replace, and recycling) (CV. Galuh, 1996). Table 30 shows guidelines for waste reduction for several waste generators such as households, markets, commercial establishments (stores and the like), offices, industries, and streets.

Recognizing the importance and novelty of waste reduction, several respondents called for public education programs to promote waste reduction. This idea was supported by the Directorate General of Human Settlements Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Environmental Research Centre (PPLH-ITB), consultants, and some professors. In this regard, officials of the Department of Education and Culture acknowledged that their institution did not have competence regarding this issue, although they had been conducting public education on waste

management for young people. Thus, they asked other actors to play their roles in providing public education for waste reduction.

Table 30. Guidelines for waste reduction prepared by DJCK

Target	Guidelines
• Households	• Choose any product with less packaging (buy products that do not produce more waste) • Avoid single use item • Do not ask for more plastic bags
• Markets	• Sell products without packaging (plastic bags) • Give a plastic bag only for products that require it • Encourage buyers to bring their own bags
• Commercial establishments	• Sell products with less packaging • Give a plastic bag only for products that require it • Charge more for extra packaging • Encourage buyers to bring their own bags
• Offices	• Purchase items that do not produce more waste • Increase the efficiency of use of any office equipment • Try to become a more paperless office • Use waste paper if possible
• Industries	• Avoid producing either hazardous waste or waste that cannot be recycled • Try to become a paperless factory • Keep a good maintenance system • Avoid wasteful use of production resources
• Streets	• Facilitate the public to participate by: - providing recycling bins for wet and dry waste - posting signs about laws for disposing of waste in illegal places • Charge penalty for those disposing of waste in illegal places

The Department of Information which had responsibility for public education had conducted public education about K3 (Ketertiban, Kebersihan, Keindahan) or "order, cleanliness, beauty" and Berhiber (Bersih, Hijau, Berbunga) or "clean, green, bloomy" through the mass media and by posting signs in many places in the City of Bandung. Therefore, if this department was asked to assist public education on waste reduction, then the materials or content of the news to be delivered to the public should be prepared and provided by those with knowledge about it. Officials of PDK-Bandung agreed that waste reduction will be increasingly important in the future, but admitted that their institution did not have programs for public education about waste reduction and therefore expected other actors to take part.

Officials of the Environmental Research Centre (PPLH-ITB) suggested that efforts to introduce the idea of waste reduction should be targeted at households. They thought that households had potential for reducing the amount of waste produced in Bandung. Households should have knowledge and understanding about waste reduction before they become willing to participate. This argument was exactly the same as those of DJCK, BPPT, and waste consultants. They all agreed that the understanding by a community about waste reduction and its importance would determine its willingness to participate.

While most respondents viewed waste reduction as involving efforts to reduce the production of waste, the Department of Health had its own idea. This department viewed waste reduction as efforts to reduce the amount of waste before going to final disposal sites. Therefore, waste reduction efforts could be done through controlled waste burning or simple open dumping.

Despite the recognition by many stakeholders about the importance of waste reduction, an official of the World Bank argued that in order to implement this new paradigm, strong political will from the Government of Indonesia was essential. As mentioned earlier, this suggestion is also recognized in Indonesia's Agenda 21.

Unlike waste reduction in which many responses could be obtained from various respondents, the idea of reuse only receive a few answers, in particular from the Directorate General of Human Settlements Development (DJCK) and its consultant and some professors. When confronted with this idea, many respondents said that reuse has been commonly practiced by households in the country. Some professors in Bandung said that reuse was a common phenomenon in Indonesia, particularly for the low-income families. Without education, campaigns, or being told by others, these families had consciously practiced reuse as part of their strategy of their lives. However, this suggestion does not necessarily imply that public education in reuse is not needed. Indeed, the professors predicted that public education in reuse and waste reduction will be increasingly important when the standards of living start to improve. For instance, when the low-income families have their income increased, there is no guarantee that they will keep up their habits to reuse. These professors cited a well-known phrase in the Indonesian society, "the OKB (Orang Kaya Baru) syndrome" or the "new rich person" syndrome. The new rich person wants to enjoy his or her new standard of living like everyone else. If public education about waste reuse is to be conducted, the educated and

wealthy people should be targeted as well because they produce more waste than the poor. Moreover, wealthy persons seem to have less motivation to practice reuse since they can afford to buy new products and dispose of the old ones.

DJCK and its consultant were the only respondents who provided ideas about reuse and replacement. This finding is not surprising, since at that time they were working on preparing policies about the 4Rs. DJCK had prepared some guidelines for reuse for households, markets, commercial establishments, offices, and industries (Table 31), while Table 32 shows some examples of guidelines for replacements as part of the 4Rs (CV. Galuh, 1996).

Table 31. Guidelines for reuse prepared by DJCK

Target	Guidelines
• Households	• Maximize the use of bags for carrying other items • Use bottles for keeping spices • Select durable packaging that can be used for other purposes
• Markets	• Promote the use of reusable bags for carrying products • Provide lease for rarely used products
• Commercial establishments	• Provide reusable bags for carrying products to be purchased
• Offices	• Become a paperless office • Use reusable/refillable/rechargeable equipment
• Industries	• Reprocess scrap to produce another product • Use recycled materials for production
• Streets	• Encourage the use of reusable packaging

Table 32. Guidelines for replacement prepared by DJCK

Target	Guidelines
• Households	• Replace the use of product that produces more waste with another which produces less • Replace single-use product with reusable products • Replace the use of any product that generates waste that cannot be recycled
• Commercial establishments	• Sell products that can be recycled • Sell reusable products
• Offices	• Replace paper-consuming procedures with more paperless ones • Replace the use of office needs containing virgin material with those from recycled materials
• Industries	• Replace processes that create more scrap with those that produce less • Replace the use of materials that cannot be either recycled or used for another process

6.4.3. Source Separation

The idea of source separation received extensive support from many respondents. The National Planning Board (Bappenas), the Directorate General of Human Settlements Development (DJCK), the State Ministry of the Environment, the Department of Health, the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Environmental Research Centre (PPLH-ITB), municipal officials of Kotamadya Bandung, a contractor, waste consultants, waste recyclers, some professors, and the World Bank are examples.

Several respondents including the Directorate General of Human Settlements Development (DJCK), Department of Health, PDK-Bandung, the contractor, and waste recyclers, agreed with source separation involving separating waste into two streams: the wet or organic, and the dry or inorganic. The Department of Health supported source separation of waste into organic and inorganic streams as long as such efforts could reduce the risks of spreading diseases. Bappenas stated that although the agency did not deal with the technical issues of source separation, in general it supported source separation.

A few respondents, such as DJCK, PDK-Bandung, waste consultants, and some professors, suggested that source separation should become the backbone of recycling and waste reduction initiatives. They all agreed that the overall success of recycling programs in the future will be determined by the public's willingness and participation to participate in source separation programs. Waste consultants and the World Bank stressed the necessity of including source separation as an integral part of the city's MSWPM Master Plan.

One local community in Bandung initiated source separation efforts as led by the young-men's association. This association collected only used papers and then sold them to brokers or "bandars" and used the money for their activities. PDK-Bandung provided technical assistance for conducting the source separation program.

According to officials of DJCK, the importance of source separation has long been recognized, but to implement it has not been easy. DJCK had an experience with source separation in Jakarta. A pilot project to promote source separation in a residential area was established. At the beginning of the project, good support was received from the residents. However, the residents got frustrated after the pilot project ended, because their efforts to separate waste did not receive necessary support by the local cleaning authority. After learning

that their separated waste was mixed again in the collection vehicles by waste crews, they stopped participating. Learning from this experience, officials of BPPT who were also engaged in that project concluded that source separation implied not only separating waste into different storage bins, but also required the use of appropriate collection vehicles as well as staff training. The vehicles should accommodate the placement of the separated waste into separate spaces. Officials of BPPT and a consultant of DJCK suggested that the success of source separation will be influenced by several factors such as public education, public participation, good waste management service by the service provider, monitoring, and enforcement of regulations.

Another actor that mentioned the difficulty in implementing source separation was the market enterprise or Perusahaan Daerah Pasar. An official of this enterprise stated that it seemed to be impractical for traders in the market to separate their waste. It should be noted that market waste is up to 70% organic. It would take time to educate traders so that they would be willing to separate and deposit their waste into different bins. It was not easy to find a location inside the trading areas for the container bin to take the inorganic waste. It should be noted that markets used to have only one big container for all wastes, located outside the trading areas. After the trading hours, workers of Perusahaan Daerah Pasar swept and cleaned the market areas as soon as possible. It would take more time for them to separate the scattered waste inside the trading areas, provided that they were willing to do so. An official of the municipal government of Kotamadya Bandung mentioned that according to the technical guidelines for keeping cleanliness in markets based on the Adipura criteria, there was no obligation to practice source separation in markets (Table 33).

PDK-Bandung did not disagree with the vital role of source separation in recycling and waste reduction initiatives, but admitted that it did not have programs to promote this idea to the public. This also was confirmed by waste consultants in Bandung who suspected that PDK-Bandung did not care about waste contamination.

Many professors and waste recyclers had similar comments about several potential benefits of source separation. First, source separation can reduce the amount of waste requiring disposal. Second, it increases the efficiency of recycling activities and reduces waste contamination. Third, it supports the production of recycled materials and reduces the use of virgin materials. Fourth, it has potential in reducing the impact of waste (pollution) on the

environment. Fifth, source separation supports the creation of jobs for the urban poor, in particular waste pickers.

Table 33. Technical guidelines for keeping cleanliness in markets

Consideration	Expected Condition	Actors involved
• Inside and outside areas	• Must be clean • Waste should not be seen • Awareness of traders for disposing waste in the designated places	• Traders should place their waste in a tied and neat bag • Public education and supervision by Camat and Dinas Pasar and coordinated with PDK-Bandung
• Waste storage (bin/container)	• Waste should be put in bags and should not be scattered around • Each trader should provide its own waste bags (storage)	• Coordination of officials of Dinas Pasar, Camat, and PDK-Bandung
• Kiosk, traders	• Each should have its own waste bags (storage) • After trading, each should clean its own area.	• Camat and Dinas Pasar, coordinated by Police and PDK-Bandung

Many respondents suggested the need for public education regarding source separation. This recognition was supported by the Directorate General of Human Settlements Development (DJCK), the Agency for Technology Assessment and Application (BPPT), the contractor, waste consultants, professors, and the World Bank. Some professors stated that public education in source separation had been lacking. They suggested that it would take time to educate the public and gain their willingness to participate because generally speaking people in Bandung were not interested in issues about waste. Waste consultants, however, had a different perspective based on their experiences in Jakarta and Surabaya, that households were generally supportive of the idea of source separation and they were willing to participate.

According to an official of the municipal government of Kotamadya Bandung, the pursuit of the Adipura Award had encouraged efforts for more source separation. In December 1995, the City Mayor issued his instruction that all stakeholders in the municipality should take part in trying to earn that award. Table 34 shows this guideline that urges households to do source separation.

Table 34. Technical guidelines for recycling according to Pemerintah Kotamadya Bandung

Expected Condition	Actors involved
• Every household separates its waste into organic and inorganic streams • Every desa/kelurahan should have at least one site for collecting the inorganic waste	• Assistant of the City's Mayor with Camat and Lurah and the young men's association prepare an action plan for public education in recycling and implement it through coordination with PDK-Bandung

6.4.4. Service Provision

In the Municipality of Bandung, waste collection and transportation service has been divided into primary and secondary services. Primary collection has been provided by the informal sector, usually local people in a community, using handcarts operated by two or three persons: one pulling the cart and others pushing it. These people collect waste from households and bring it to the temporary storage or disposal site in that community. Meanwhile, the secondary collection has been provided by PDK-Bandung using trucks. PDK collects waste from the temporary storage or disposal sites and transports it to a transfer station or directly to a final disposal site. The new principal director of PDK-Bandung, appointed in early 1999, reported that PDK-Bandung had about eighteen hundreds workers employed to deliver the service[11].

PDK-Bandung has two modes of collection: direct and indirect. Direct collection serves residential areas that can be accessed by the collection trucks (Figure 21). It is called "direct" because the collection trucks collect and transport waste directly to any final disposal site or TPA (Tempat Pembuangan Akhir). Indirect collection involves trucks collecting waste from temporary disposal sites or TPS (Tempat Pembuangan Sementara) and taking it to final disposal sites or TPA. This option is used to serve areas inaccessible to the collection trucks. PDK-Bandung used to provide three collections every week to all regions (wilayah) in the city.

Waste from public facilities, such as bus terminals and train stations, and recreation centres, and from streets, is collected by PDK workers and brought to temporary disposal sites (TPS) using "gerobak" or handcarts. There, the waste is collected and transported to final

[11] "Honor Karyawan PD. Kebersihan Bandung Rp. 130 Ribu Per Bulan", *Suara Pembaruan Online*, 23-Mei-1999. (http://www.suarapembaruan.com/)

disposal sites (TPA) using PDK's trucks. Table 35 shows the number and variety of vehicles used by PDK-Bandung in 1996.

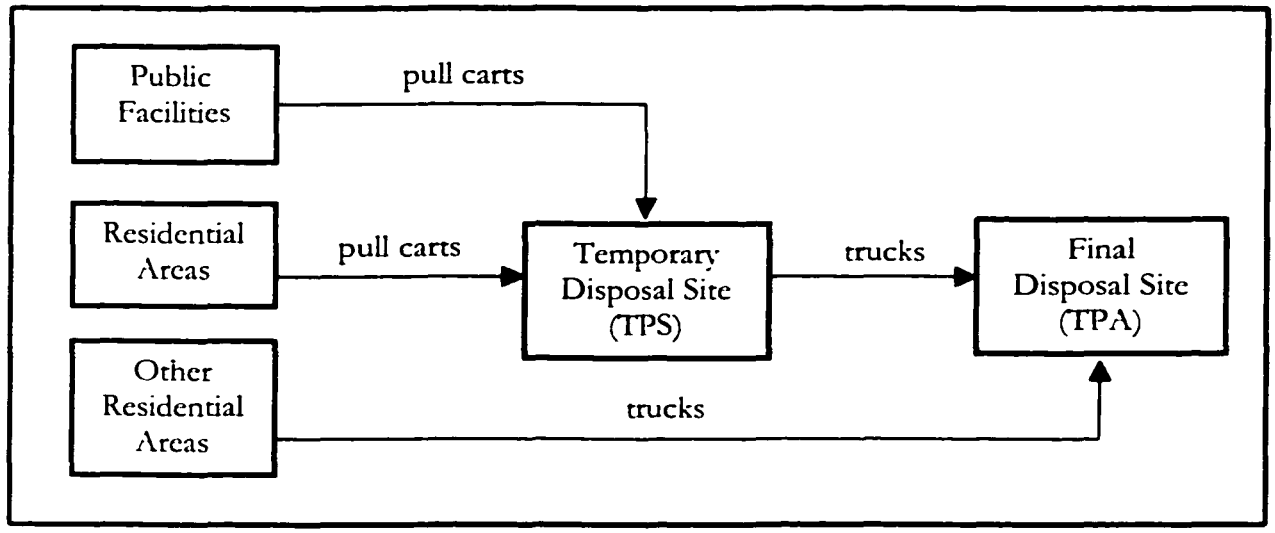


Figure 21. Collection and transportation of municipal solid wastes in Kotamadya Bandung

Table 35. The number of collection vehicles used by PDK in 1996

Vehicle	Number (unit)
Hand carts (gerobak, becak)	2,736
Small dump truck	12
Large dump truck	19
Small compaction truck	9
Large compaction truck	11
Small arm roll truck	5
Large arm roll truck	68
Wheel loader	5
Bulldozer	6

Source: PDK-Bandung (1997)

In order to deal with a constrained budget, PDK-Bandung has changed some of its workers from sweepers into welders and from welders into machine repairmen. Some officials of PDK-Bandung interviewed said that they were happy with this approach because they could save money on vehicle repair and maintenance once contracted out.

PDK-Bandung has established a procedure for dealing with subscribers' complaints (Figure 22). If a recipient of PDK-Bandung's service had any complaint either about the service or the fee, then he or she can send his/her complaint by directly going to the PDK-

Bandung's office, calling by telephone, or sending a letter. In certain cases, complaints appeared in the local newspaper. One unit in the PDK which has been assigned to deal with claims and complaints, will then contact the organizational section responsible for operation or the one responsible for retribution collection. Based on the coordination among these units, a reply to the compliant is provided.

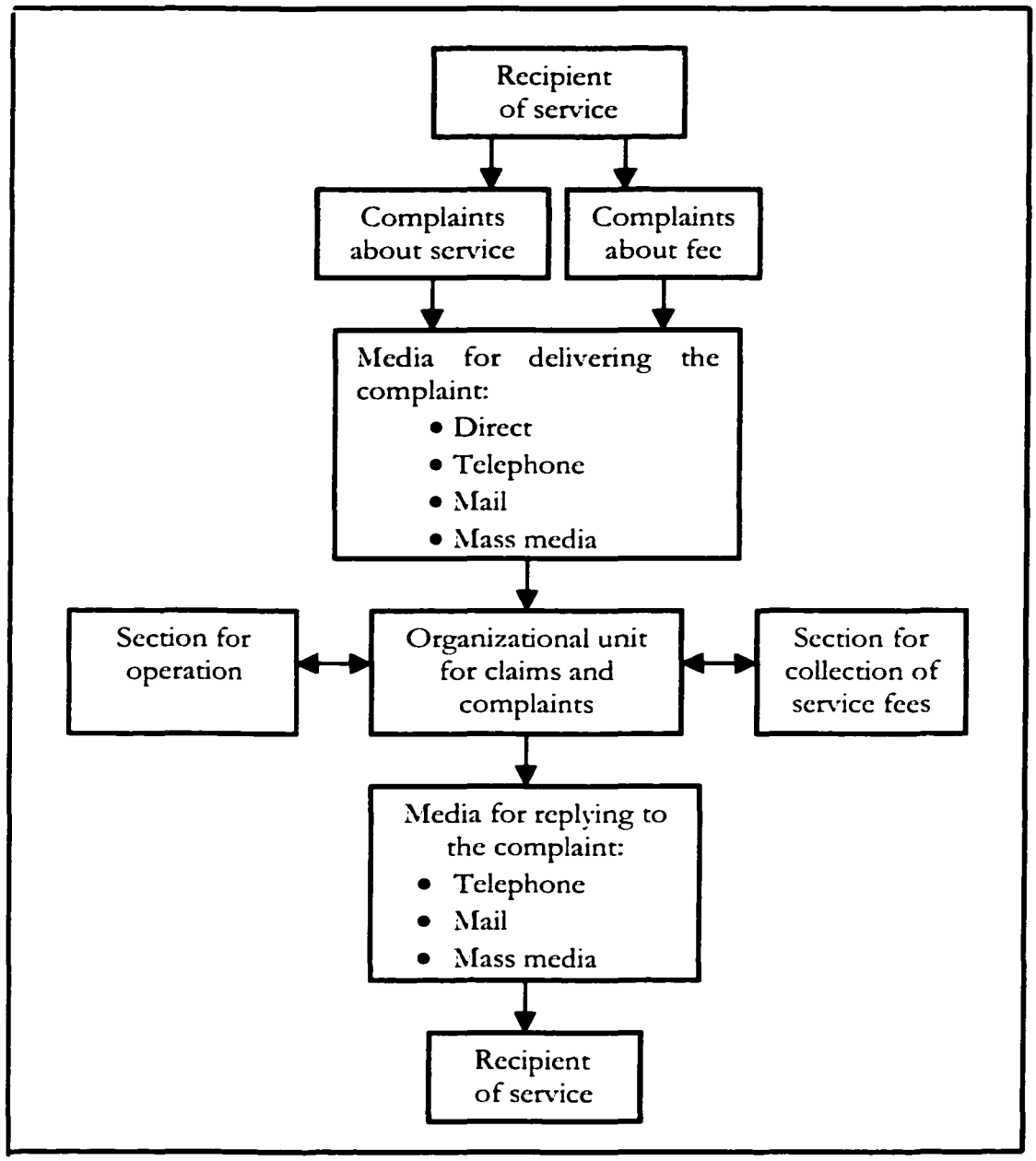


Figure 22. Procedure for resolving customer's complaints

One of the professors interviewed related about an incidence in his community. At one time, the primary collection service provided by the local people had to be abandoned because their tasks were going to be taken over by PDK. There were two reasons. First, newly-constructed streets in that community became accessible to the PDK collection trucks. Second, the trucks would also to collect waste from a residential area for wealthy people located beside that community. Some time after the change over, a few residents thought that service provided by PDK was not as good as that provided by the local people. Some women said that they did not like the take over because they felt sorry for the local people losing the jobs. Besides, they used to ask for help from them for many other household matters, such as cleaning back yards, cutting grass, moving, replacing a broken roof, etc.

Some households in a community area revealed an interesting view regarding the primary collection fees. They stated that their monthly primary collection fees were almost the same as their monthly retribution fees for PDK-Bandung. This happened because the primary collection fee was determined through an agreement between the provider and them. Those who wanted more service from the persons providing the service had to pay accordingly.

One municipal official of Kotamadya Bandung said that according to an instruction by the City Mayor about keeping the city clean, each community area or Rukun Warga (RW) should have at least two persons assigned for street sweeping and collecting household waste and bringing it to the nearest temporary storage or disposal site. This arrangement could be made through the chief of the community area (Ketua RW) and the village resilience community council[12] ("Lembaga Ketahanan Masyarakat Desa – LKMD"), and be supervised by the Lurah and Camat. Table 36 shows those guidelines.

PDK-Bandung admitted that it was unable to provide service to all residents in the city. In this sense, some professors said that extending service coverage was a big challenge for the municipal government in dealing with the impacts of urbanization. Three weaknesses of PDK-Bandung were pointed out as being the inability to self finance its operation, inefficiency in operation and maintenance, and inappropriate investment. An official of the World Bank in Jakarta argued that extending service coverage was vital in efforts to reduce pollution from waste burning and illegal dumping. Extending service coverage was not only a need for Bandung, but also a necessity for other metropolitan or large cities throughout Indonesia. He

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[12] LKMD is an organization which used to coordinate activities and mobilize people at the village or desa level.

Table 36. Technical guidelines for achieving cleanliness in residential areas according to Pemerintah Kotamadya Bandung

Consideration	Expected Condition	Actors involved
• Yards	• Must be clean • Waste should not be seen	• Each owner, supervised by Ketua RW and Lurah
• Streets	• Waste storage (bins) should be available and be closed • No scattered waste	• The community coordinated by Ketua RW and supervised by Lurah
• Canals	• No clogged canals • No waste being dumped in canals	• The community coordinated by Ketua RW and Lurah
• Street sweepers and waste collectors	• Each RT/RW should have at least two people to do street sweeping and collecting households' waste and bringing it to the temporary storage/disposal site	• The community, coordinated by Ketua RW, LKMD and supervised by Lurah
• Residents	• Putting waste at its proper place • Aware of the importance of keeping their areas clean • Reminding others that do not comply with the community norms	• Public figure, Lurah, and Camat and assisted by officials of Pemerintah Kotamadya Bandung

suggested some ideas for increasing service coverage and quality, including improving capacity and quality of the existing system; improving human resource capacity, institutional development, financial capability; and, increasing partnerships among local authorities, communities, and the private sector. The World Bank (1995) also reported several findings in several developing countries that supported privatization of collection and transportation service. In Jakarta, for example, some collection and transportation activities had been contracted out to private contractors. Two waste consultants in Bandung, however, said that the idea of privatization has not been accepted by the municipal government of Kotamadya Bandung.

The Directorate General of Human Settlements Development (DJCK) mentioned that it did not have a particular policy about extending service. This was left in the hands of the local authority. An official of DJCK mentioned that general criteria for determining a service area have been provided. Considerations included the function of the area (e.g., residential, commercial, industrial, green belt), population density, service area, environmental condition

(e.g., cleanliness, existing waste management practices), income of the population, and topography. Furthermore, any strategy for providing service should be directed toward the achievement of balance among different factors, such as sanitation, economics, quantity of service, and quality of service.

6.4.5. Recycling

As mentioned before, many stakeholders agreed that recycling could be done more effectively through source separation efforts. The importance of recycling as a vital component of IMSWPM in Indonesia had been supported by many stakeholders, such as the National Planning Board (Bappenas), the Directorate General of Human Settlements Development (DJCK), the Department of Health, the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Development Technology Centre (DTC) - ITB, the Environmental Research Centre (PPLH) - ITB, consultants, waste recyclers, professors, waste pickers, an NGO, and the World Bank. DJCK had prepared guidelines on recycling for households, markets, commercial establishments, offices, industries, and streets (Table 37). According to the Department of Health, recycling activities should consider aesthetic aspects, avoid accidents, and prevent risks to the surrounding people.

A surprising finding about policies on recycling emerged from the Department of Industry and Trade (Deperindag) and the Department of Cooperatives and Small Business Development (Departemen Koperasi dan PUK) in Bandung. Deperindag had many responsibilities regarding industrial development but did not have experts and policies specifically addressed at recycling. As a result, its current policy was to let the recycling industry grow as long as it did not create pollution. Officials of the Department of Cooperatives and Small Business Development said that their department had programs and funds for developing small businesses, but none had been focussed on small recycling businesses in Bandung.

PDK-Bandung had a cooperative with most of its members being the waste collection crews. These crews used to collect "Aqua" (a brand name of spring water) plastic bottles and sell them to the cooperative. The cooperative resold those bottles to waste brokers ("bandars") and the profits were used to fund members' needs. This cooperative sold 5 tonnes of Aqua plastic bottles on a monthly average. Collection did not involve waste pickers. Officials of the PDK mentioned that plastic was easily marketed to waste brokers in Bandung.

Table 37. Guidelines for recycling prepared by DJCK

Target	Guidance
• Households	• Provide standardized bags to facilitate source separation efforts (one for organic and another for inorganic) • Provide communal bins that facilitate source separation • Donate products that are not used anymore • Exchange an item for another
• Markets	• Provide bags and bins to facilitate source separation • Encourage used item sale
• Commercial establishments	• Provide packaging that can be recycled • Provide standardized bags to facilitate source separation
• Offices	• Provide bins to facilitate source separation • Donate or trading office waste • Use products that can be recycled
• Industries	• Reprocess scrap for another use • Charge a fee for collecting and processing products that create hazardous waste (i.e., batteries) • Conduct treatment for hazardous waste produced, for instance, using small-scale incinerator • Give incentives to companies willing to do recycling of their products (i.e., plastics, bottles)
• Streets	• Provide bins to facilitate source separation • Charge penalty for those throwing waste at illegal places • Involve waste pickers to divert valuable materials

A remarkable finding about partnerships in plastic recycling occurred in Bekasi, West Java.[13] A partnership was initiated by two large soft drink manufacturers: PT. Aqua Golden Mississippi and PT. Coca Cola Amatil Indonesia and involved small-scale businesses and waste pickers (Table. 38). PT. Aqua provided sixteen and PT. Coca Cola three shredding machines to small-scale businesses. Each machine was worth 17 million rupiah with a shredding capacity of 500 kilograms of plastic bottles daily. For each machine, every owner of a small-scale business had to pay 315,000 rupiah each month for 4.5 years. These owners would use their shredders to cut plastic (PET) bottles into flakes. They bought the bottles from the waste pickers at a price of 550 rupiah per kilogram, and sold the plastic flakes to big factories which would process them into polyester, dacron, nylon, and others. The price of each kilogram of plastic flake was 1300 rupiah. The directors of PT. Coca Cola and PT. Aqua believed that this scenario could provide social, economic, and environmental benefits

[13]) "Daur Ulang Botol Plastik: Menyulap Limbah Menjadi Kain Polyester", *Republika Online*, 1-Nopember-1998 (http://www.republika.co.id/).

Table 38. Actors' roles in the partnership of plastic bottle recycling in Bekasi, West Java

Actor	Roles
• PT. Aqua Golden Mississippi and PT. Coca Cola	• Provide shredders to owners of small-scale businesses (each was worth 17 million rupiah) • Allow owners of small-scale businesses to pay the shredders over 4.5 years with some grace periods
• Waste pickers	• Collect plastic bottles • Sell them to owners of small-scale businesses
• Small-scale businesses	• Buy plastic bottles from waste pickers • Cut plastic bottles into plastic flakes • Sell flakes to big factories • Pay the shredder at an amount of 315,000 rupiah each month
• Big factories	• Purchase plastic flakes from small-scale businesses at 1300 rupiah/kg • Process flakes into other products (polyester, dacron, nylon, others).

Recovery and trading of corrugated paper is a big business in Bandung. A local newspaper recently reported that factories and large stores are the major providers of corrugated paper.[14] They sell to brokers who have a very tight quality inspection procedures to ensure that the corrugated paper should be relatively clean and free from contamination of oil and cellophane tape. Brokers then sell most of the paper to paper factories in Jakarta and Surabaya, while some is sold in batches of 10 and 20 kilograms to truck drivers who use it for shipping purposes. The daily trading volume fluctuates depending upon the demand from the paper factories, but it was estimated to be between 10 and 20 tonnes with the price of about 500 rupiah per kilogram. These findings imply that the amount of daily transaction of corrugated paper in the City of Bandung could reach between 5 and 10 million rupiah. The brokers also stated that they do not accept corrugated paper collected by waste pickers because of its poor quality.

Many respondents or stakeholders did not disagree that recycling in many municipal areas in Indonesia, including Bandung, was conducted extensively by waste pickers and small-scale recycling businesses. Stakeholders confirming this phenomenon included the Directorate General of Human Settlements Development (DJCK), the Agency for Technology Assessment and Application (BPPT), the Development Technology Centre (DTC) - ITB, the Environmental

[14] "Bisnis Kardus Bekas Mengalami Kelesuan". *Pikiran Rakyat Online*, 25-Nopember-1999. (http://www.pikiran-rakyat.com/1199/25/index.htm).

Research Centre (PPLH) - ITB, PDK-Bandung, consultants, professors, waste pickers, an NGO, and the World Bank. In this sense, BPPT, DTC-ITB, PPLH-ITB, consultants, the NGO, and the World Bank believed that the role of waste pickers in the recycling industry should be recognized by the local government. When confronted with this issue, officials of PDK-Bandung mentioned that their institution did not currently have policies regarding waste pickers. They did state that waste pickers' activities at the temporary disposal sites were discouraged because they could disturb the work of waste collection crews. An official of PDK-Bandung at one final disposal site in Bandung explained that waste pickers were not officially allowed to work at final disposal sites (TPA), but there was an unofficial policy to allow about 75 waste pickers from a community of 200 waste pickers to work at this TPA.

In all three final disposal sites in Bandung and in particular at TPA Leuwi Gajah and TPA Pasir Impun, many waste pickers conduct their activities during the day sorting valuable materials. Interviews with two waste pickers at each of TPA Leuwi Gajah and TPA Pasir Impun revealed that they sorted materials, such as metal, glass, plastic, bottles, and corrugated papers. This finding was similar to that from an interview with a waste picker and his small broker ("lapak") at the Dago area (northern area of Bandung) who also collected such materials. Interviews at these sites revealed two basic needs. First, they hoped that the involvement of various actors in MSWPM in Bandung would enable land to be provided for recycling centers. They imagined these sites as a place for recycling activities and being equipped with good facilities and water. Second, they expected that their existence and activities would be recognized by the municipal government. Relative to these wishes, an interesting comment was provided through an interview with an official of the municipal government of Kotamadya Bandung. He reported that in 1993 the city's Mayor established a team to coordinate waste pickers in Bandung. This team had three main responsibilities: to design and locate a site to collect materials sorted by waste pickers in Bandung, to improve waste pickers' skills for their jobs, and to propose a suitable design to synchronize waste pickers's activities and PDK's routine activities. Unfortunately, the recommendations of that team were never implemented and he did not know why.

Several points are significant from the interviews with the waste pickers at TPA-Leuwi Gajah, TPA-Pasir Impun, and Dago. First, they mentioned that they lived close to the TPA or a large container bin or temporary disposal site for two main reasons: access to resources and

security (not captured by the local authority). By living close to a disposal site, they have direct access to resources ("waste"). In addition, they also felt that they have occupied the site and prevented others from interfering. Staying close to a disposal site also minimized theirs being charged and put in jail by the municipal authorities. The municipal government of Kotamadya Bandung used to conduct operations to catch beggars, homeless, and mobile waste pickers scattered around the city because they were considered as nuisances. Therefore, waste pickers worked only at temporary disposal and in particular a final disposal site. Second, they worked in a group. The numbers in a group varied depending on the population. In both TPAs, for instance, they stated that a group could range between 15 and 20 persons, while in Dago, it consisted of only about five people. Third, all respondents reported that they worked for particular bandars (brokers). These bandars used to send their trucks to pick up the materials they collected.

Respondents in TPA Pasir Impun and Dago declined to reveal their daily income, but said that their earnings were sufficient only to meet their food needs. Those at TPA Leuwi Gajah stated that they could collect 10,000 rupiah a day and sometimes could even reach 15,000 rupiah. The respondents in Dago who specialized in metal (steel) wished that they could earn enough money to buy aluminium-rich scrap at IPTN, a national aircraft industry, because the material had a high profit margin and could easily be sold.

Related findings about waste pickers were provided by a local consultant working for Germany's GTZ (Deutche Gessellschaft fur Technische Zusammenarbeit GmbH). This consultant conducted a survey of 91 waste pickers in Bandung in 1996 using structured questionnaires. The results of this survey provide data about waste pickers regarding demographic, social, waste-picking, economic (income), and health aspects. The respondents consisted of 23 females (25%) and 68 males (75%). In general, this finding was consistent with the observations at the three final disposal sites (TPA) owned by PDK-Bandung that the society of waste pickers was male dominated. The distribution of respondents' age shows that 81% of them were between 16 and 45 years and none of them was older than 55 years (Figure 23). Again, this finding also supports the nature of waste-picking activities that require physical strength that is not suited to elderly people.

Most of the respondents, as shown in Table 39, were from outside Bandung but still from West Java Province. They accounted for 60% of the pickers. Meanwhile, waste pickers

who had their origin in Bandung accounted for 34% of the total, and those from either outside West Java Province or outside Java Island only accounted for 6% of the total. These findings suggest that waste pickers in the City of Bandung were mostly from within this municipality and its surrounding areas.

Figure 23. Distribution of waste pickers' age

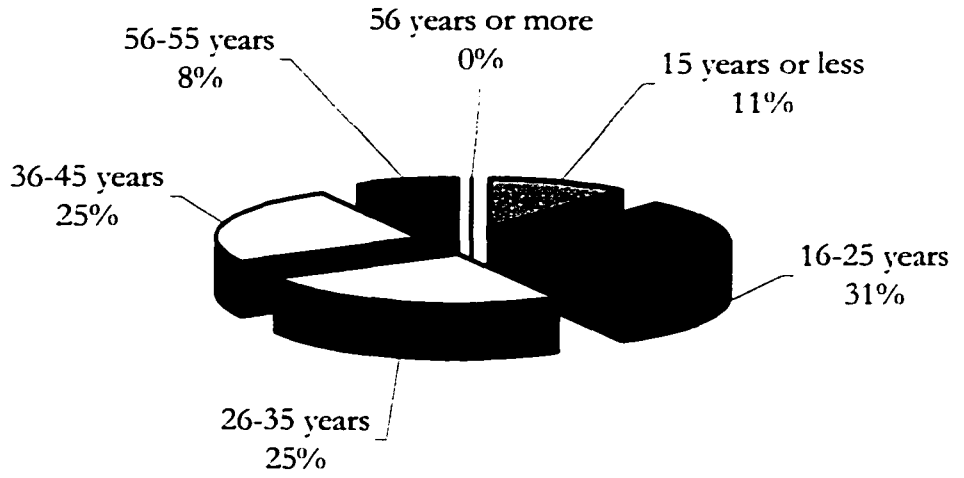


Table 39. Origins of waste pickers

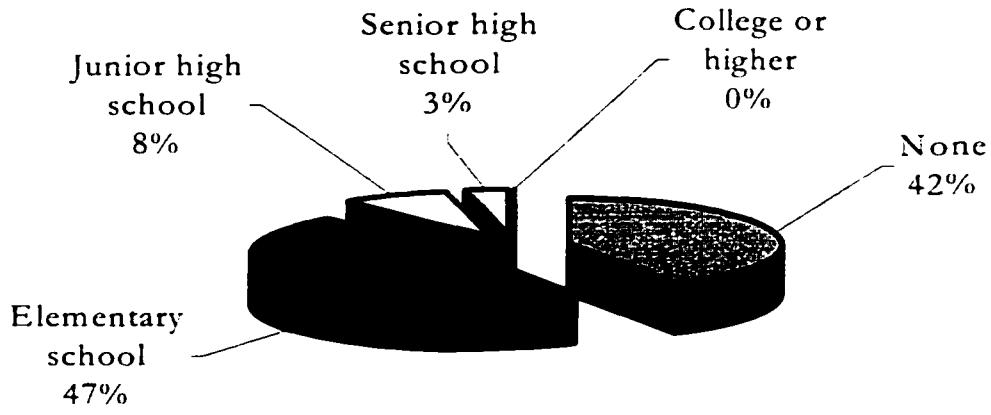
Origin	Number of waste pickers	Percentage
Bandung	31	34%
Outside Bandung	55	60%
Outside the West Java Province	4	5%
Outside the Java Island	1	1%
Total	91	100%

Social data of waste pickers show marriage status, formal education level, parents' occupation, reasons to become waste pickers, residential status, and future plans. Most respondents were married and they accounted for 74%. Respondents who were not married accounted for 22% of the total, while the widowers accounted for the smallest portion (4%).

Waste pickers generally have low formal education. As shown in Figure 24, none of the respondents had graduated from college or higher. The number of waste pickers who did not have formal education at all or did not enter schools accounted for 42% of the total sample. Those who had elementary education or between Grade 1 and 6 accounted for 47% of the

sample. Meanwhile, the proportion of waste pickers who had an education background in Junior and Senior high school combined for only 11%.

Figure 24. Distribution of waste pickers' educational background



Concerning the distribution of occupation of waste pickers' parents (Table 40), 49% of the respondents had parents working as farmers, 18% as labourers, 3% as waste pickers, 4% as government officers, 3% as private employees, 7% as military forces, and 16% in other occupations. In this regard, the parents' occupations as farmers, labourers, and waste pickers combined for 70% of the total respondents.

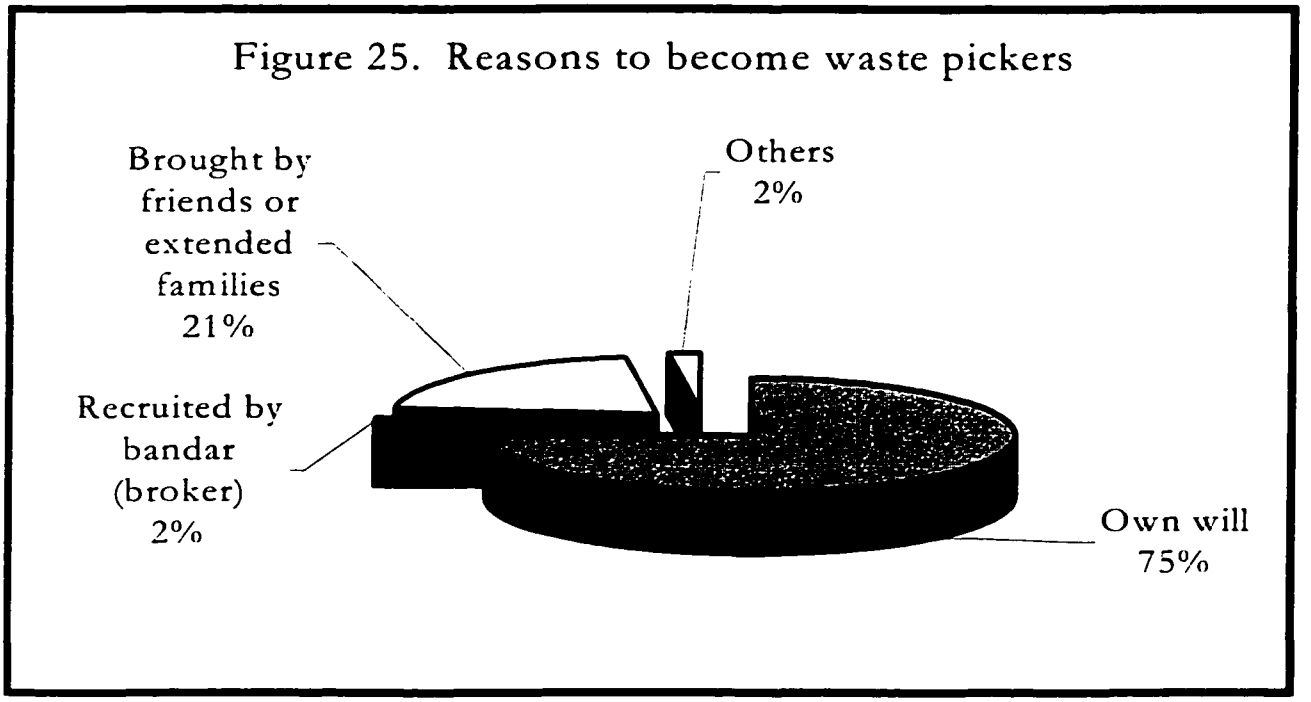
Table 40. Parents' occupation of waste pickers

Occupation	Number of waste pickers	Percentage
Farmers	45	49%
Labourers	16	18%
Waste pickers	3	3%
Government officers	4	4%
Private employees	3	3%
Military forces	6	7%
Others	14	16%
Total	91	100%

Most waste pickers consciously selected waste picking activities as their occupation. As shown in Figure 25, they accounted for 75% of the total respondents. Another interesting fact was that 21% of them became waste pickers because they were brought to disposal sites by

their friends or extended family members who also worked as waste pickers. The proportion of waste pickers who became waste pickers because they were recruited by a waste broker (bandar) accounted for only 2% of the sample.

Figure 25. Reasons to become waste pickers



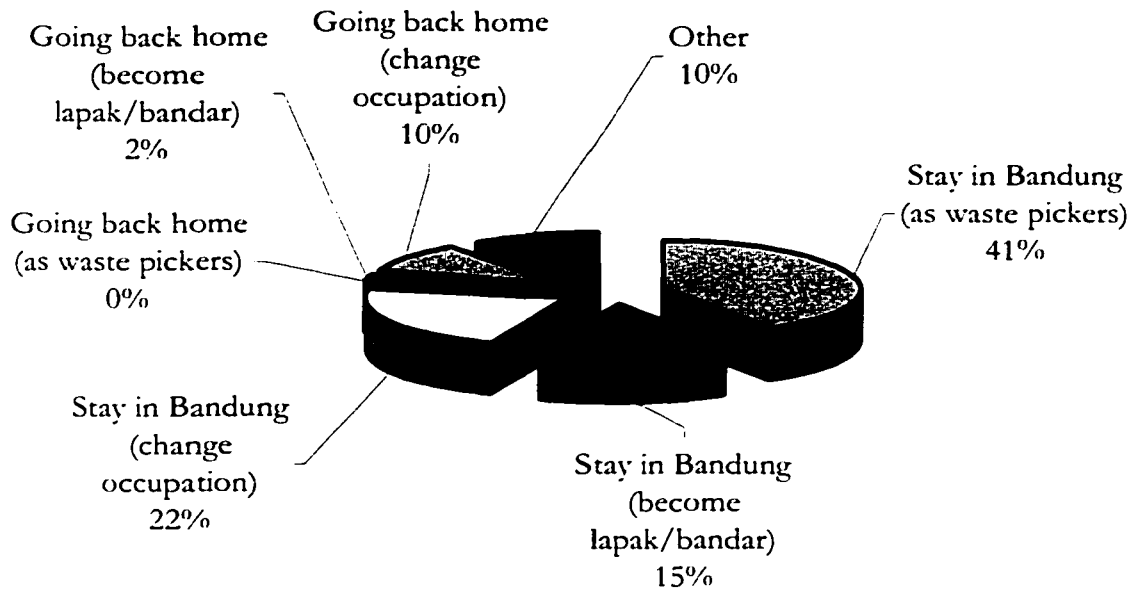
Finding about residential status of waste pickers (Table 41) shows that 35% of them owned a house, 8% rented a house, 13% rented a room, 17% stayed with their parents, 4% lived with their extended family or friends, 5% resided with their small broker (lapak) or large broker (bandar), and 18% with others. The consultant's report noted that the houses owned by waste pickers were usually very simple and did not meet heath standards.

Table 41. Residential status of waste pickers

Residential status in Bandung	Number of waste pickers	Percentage
Own a house	32	35%
Rent a house	7	8%
Rent a room	12	13%
Stay with parents	15	17%
Stay with the extended family or friends	4	4%
Stay with lapak/bandar (broker)	5	5%
Others	16	18%
Total	91	100%

Waste pickers' future plans shows that 41% of the respondents wanted to stay in Bandung and still continue to work as waste pickers, 15% to stay in Bandung and become a lapak or a bandar, 22% to live in Bandung but change occupation, 2% to go home and become lapak or bandar, 10% to return home and change occupation, and 10% for others (Figure 26). These findings suggest that the proportion of the respondents who wanted to work with waste, either as waste pickers or as a lapak or bandar, was 58%. Meanwhile, the number of waste pickers who wanted to find another job accounted for 32%.

Figure 26. Future plans of waste pickers



Data about waste-picking activities show working modes and utensils used. Most of the respondents (80%) conducted their activities at specific locations, while the rest (20%) moved from one place to another. It should be noted here that mobile waste pickers have a higher chance to be caught by the municipal officials than their counterparts who work at fixed sites. Concerning the utensils used, most of them (99%) wore hats, only 2% used masks, 98% wore boots, and 12% used gloves (Figure 27).

Figure 27. Use of working utensils by waste pickers

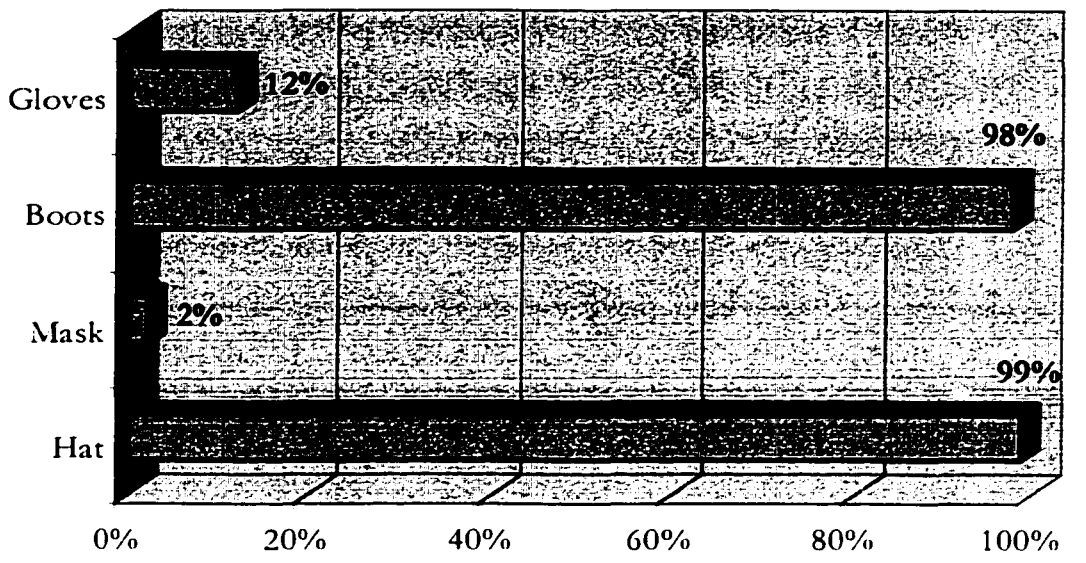
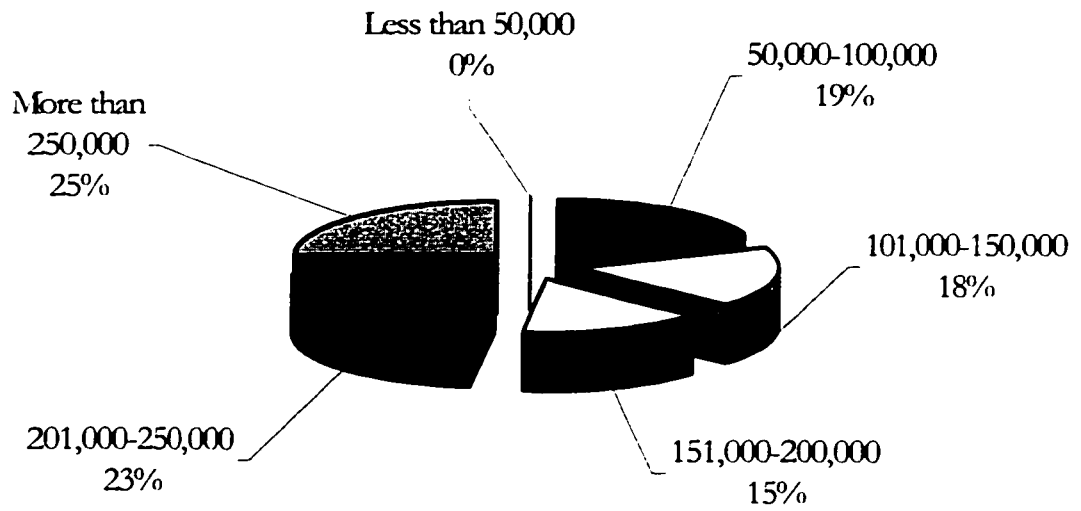


Figure 28. Average monthly income of waste pickers (rupiah)



Respondents' average monthly income is shown in Figure 28. None had an average monthly income less than 50,000 rupiah. The combined number of the respondents who had an average monthly income between 201,000 and 250,000 rupiah and 251,000 or more accounted for 48% of the sample. It should be noted here that the official minimum wage for labour

according to the Government of Indonesia at that time was around 200,000 rupiah per month. This means that although waste pickers have been socially marginalized, their income often could compete with that of the average labourers. This may support the fact that some waste pickers have been consciously and willingly selecting waste picking activities for their occupation.

Data about waste pickers' health show the frequency of sickness, the diseases experienced, and modes of recovery. From 91 respondents, 74% said that they rarely experienced sickness and 26% mentioned that they often have illness. Data about the diseases and modes of recovery were obtained from only 47 waste pickers. As shown in Figure 29, colds were the common disease experienced by waste pickers and accounted for 63% of the sample. The next highest percentage was digestion-related diseases that accounted for 17% of the respondents. Respiration-related diseases and skin-related diseases have the same proportion of 9% each. As shown in Table 42, the proportion of waste pickers who used traditional medicine or purchased non-prescription drugs was almost the same as those who went to the doctor at community health centres or the "Puskesmas."

Figure 29. Distribution of diseases experienced by waste pickers

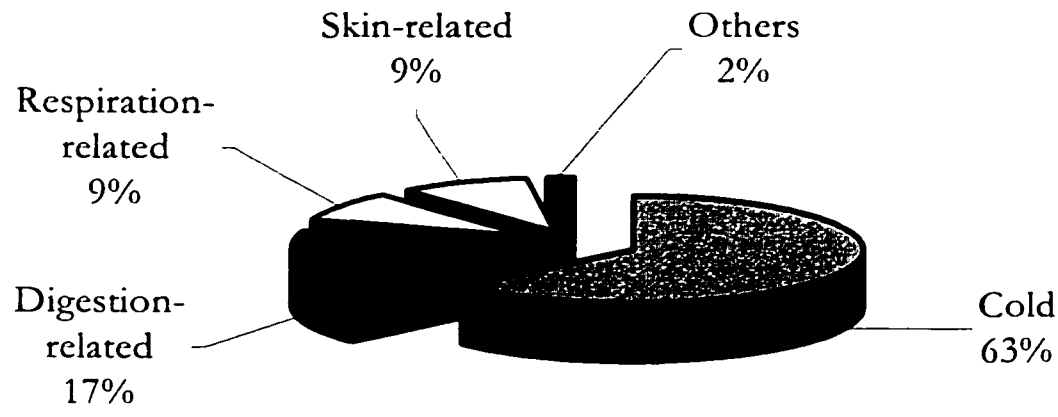


Table 42. Modes of recovery from sickness by waste pickers

Diseases	Number of waste pickers	Percentage
Curing themselves (traditional medicine, non prescription drugs)	23	49%
Going to the doctor (Puskesmas)	24	51%
Others	0	0%
Total	47	100%

Besides waste pickers, other actors involved in recycling efforts in Bandung were the itinerant buyers, although their number was significantly fewer than that of waste pickers. Interviews with three itinerant buyers in the Buah Batu area (south and eastern area of Bandung) indicated that they walked while pushing their handcarts from one residential area to another to buy used papers, newspapers, plastic bottles, and corrugated paper from households. Their favourite items were plastic and newspaper because they could easily be sold to a small broker (lapak). They all said that they sold those materials to the same lapak. According to them, some lapaks accepted all kinds of materials, while others took only particular material, such as used papers and newspaper.

A waste consultant in Bandung stated that the municipal government of Kotamadya Bandung did not have programs for waste pickers. This consultant suggested the need for coordination among relevant agencies, such as the Department of Social Affairs (Dinas Sosial), the Department of Labour (Dinas Tenaga Kerja), and NGOs to provide guidance, direction, and assistance to waste pickers in Bandung.

Two research institutions of ITB had also conducted some work related to recycling. The Development Technology Centre (DTC-ITB) had developed a small-scale plastic shredder to support small recycling businesses. It also offered training to unemployed workers about recycling paper into art paper. Meanwhile, the Environmental Research Centre (PPLH-ITB) and an NGO had a project on the integrated resource recovery system a few years ago. Officials of PPLH-ITB referred this project as the one led by the late Professor Hasan Poerbo (Poerbo, 1991) in the early 1990s. This project involved waste pickers in operating the recycling and composting activities. But this project finally failed due to factors such as low support from the municipal government, difficulties in acquiring land and water, and the low commitment from the workers.

6.4.6. Composting

Composting is done incidentally at the final disposal sites. In TPA Pasir Impun, for example, composting was treated by the wives of waste pickers through screening in order to produce compost of good quality. However, this production occurs only if there is any demand. The compost was marketed at a price of 500 rupiah (about 20 cents Canadian in 1997) per bag. A small composter for households was also built by PDK-Bandung as a model to promote composting to the public. An official of TPA Pasir Impun explained that compost making in this site was still in a pilot study phase, and therefore he did not know whether it would be sustainable.

Composting also received support from many respondents or stakeholders for MSWPM in Indonesia, such as the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Department of Health, the municipal government of Kotamadya Bandung, consultants, a contractor, professors, an NGO, and the World Bank. DJCK considered composting as a means of waste processing and an integral part of source separation. As mentioned before, the importance of composting was recognized in Indonesia's Agenda 21. BPPT regarded composting as a means of waste reduction, and therefore believed it should not be judged only from a commercial point of view only. This idea is also recognized by Indonesia's Agenda 21. The Department of Health had a policy[15] regarding prerequisites for composting, including the consideration of aesthetic aspects, the availability of pollution control procedures, and site treatment to prevent the development of insects or vectors. As a means of waste reduction, according to the contractor, composting was actually an effort to put value on the organic waste. An official of the World Bank observed that the maximization of recycling, including composting, should become an integral part of the city's Solid Waste Master Plan.

In order to get the City's Adipura Award (cleanliness award), the municipal government had prepared technical guidelines for composting at the household and community level. Camat

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[15] Keputusan Direktur Jenderal Pemberantasan Penyakit Menular dan Penyehatan Lingkungan Pemukiman Nomor: 281-II/PD.03.04.LP Tanggal: 30 Oktober 1989 Tentang Persyaratan Kesehatan Pengelolaan Sampah.

and Lurah are expected to coordinate the implementation of composting efforts by households and communities (Table 43).

Table 43. Technical guidelines for composting according to Pemerintah Kotamadya Bandung

Level of Composting	Expected Condition	Actors involved
• Households	• Each household separates waste into two streams: organic and inorganic • Each household that has spacious yards installs small-scale composter	• The Assistant of the City's Mayor, Camat, and Lurah prepare and implement an action plan for public education about composting
• Communal (Rukun Warga – RW)	• Each household separates waste into two streams • Each RW has at least one community-level composter	• The Assistant of the City's Mayor, Camat, and Lurah prepare and implement an action plan for public education about composting

A waste consultant and a composting contractor in Bandung explained that PDK-Bandung usually made compost by excavating the organic waste compacted in the TPA site. They thought that PDK-Bandung was not sufficiently concerned about waste contamination and the quality of the compost. In this regard, an official of the World Bank felt that the existing practice of composting in final disposal sites should be discouraged because there is no guarantee that the compost is free from hazardous substances.

A private composting contractor in Bandung offered a more advanced technique for composting by using worms, also known as vermi-composting. This technology is designed to process organic waste from households, markets, and restaurants into compost. The contractor identified several benefits of this technology, such as reducing waste and pollution, reducing waste management costs, increasing use of the natural fertilizer and reducing the use of chemical fertilizers, enriching land by providing humus, and creating employment.

The process of vermi-composting was not complex, according the contractor. First, organic waste from households, markets, restaurants, and agricultural sites was collected. Then, that waste was cut into pieces using shredders and afterwards, the flakes were distributed into several boxes. Last, worms were put into those boxes and they ate the waste in about three weeks. The worms' secretion becomes the particle-like humus.

In order to operate and sustain the vermi-composting, the contractor had proposed a scheme involving the contractor, PDK-Bandung, and communities. In this approach, PDK-

Bandung would collect organic waste from several sources and bring it to various processors operated by organized communities or waste pickers. Then, PDK-Bandung would buy the worms from the contractor and send them to the processors. The role of the contractor, besides providing or selling worms, was to buy the compost produced by the communities. The contractor had offered this idea to the municipal government of Kotamadya Bandung and PDK-Bandung, but an agreement had not been achieved.

The use of compost (natural fertilizer) gained momentum in Indonesia in 1998 when the country was experiencing a shortage in chemical fertilizer production. This crisis had turned farmers in several places in the country from chemical fertilizer to compost. The Agency for Technology Assessment and Application (BPPT) had responded to this situation by providing assistance in a few places to build and operate composting plants.

Several respondents or stakeholders in MSWPM in Indonesia had suggested the need for public education about composting. Those who supported this need included the Directorate General of Human Settlement (DJCK), the Agency for Technology Assessment and Application (BPPT), the Development Technology Centre (DTC) - ITB, the Environmental Research Centre (PPLH) - ITB, some professors, an NGO, and the World Bank. In this regard, officials of BPPT believed that composting was still unpopular for the general public. DJCK had prepared promotional material for composting by providing a manual for household composting. This manual contains information about the scale or size of the composter, costs, and practical design. One senior researcher at DTC-ITB explained her experience with household and communal composting. In the household composting at one community, the women took care of the composting activities. Meanwhile, in communal composting, the community had complained about the increasing population of flies.

As previously mentioned, the project of PPLH-ITB led by the late Professor Hasan Poerbo in the early 1990s also tried to promote composting to a community but finally failed. Several difficulties were the poor support of the local government, difficulties in finding suitable site (land) and water, difficulties in marketing the compost, and the lack of awareness from the local community.

One professor of ITB who had promoted composting in his neighbourhood reported the difficulty in gaining acceptance from his community, even though he provided all the money to build and operate the composting facility. He commented that some neighbours did not know

about composting, while some others seemed to ignore it. Therefore, he was very supportive of any efforts to introduce composting to households to make them at least know what composting was as well as its importance.

PDK-Bandung which knew the difficulties in sustaining composting initiatives still regarded introducing composting to the public as important. Some long-term goals for public education in composting are to ensure that the public knows about composting, to stimulate willingness to use compost, and eventually, to influence it to be willing to conduct composting in the home or community. At one final disposal site (TPA Pasir Impun), every visitor there could take a leaflet about composting at the household level.

6.4.7. Disposal

PDK-Bandung owns three final disposal sites (TPA): TPA Pasir Impun, TPA Jelekong, and TPA Leuwi Gajah. All these TPAs were designed and built as sanitary landfills through the Bandung Urban Development Project (BUDP), funded by ADB (Asian Development Bank). All sites lie in the administrative area of Kabupaten Bandung.

When the field observation was conducted in 1997, TPA Pasir Impun was being operated by four regular workers of PDK-Bandung and 10 temporary workers. This final disposal site was only used in the dry season and only accepted waste from nearby areas. This TPA had space of 3 hectares and a reserve of 5 hectares. On average, this TPA received 20 trucks, or about 550 cubic meters of waste daily. TPA Pasir Impun was built through a comprehensive study under the Bandung Urban Development Project II and also was designed as a sanitary landfill. This design was planned to be an excellent example of land preparation, operation, and supporting facilities.

Assisted by a foreign NGO from Australia, PDK-Bandung has been developing "an integrated final disposal site" at TPA Pasir Impun. The term "integrated" referred to a combination of several options that include recycling, composting, energy recovery, and safe disposal options through sanitary landfill (with leachate treatment) and a small-scale incineration. Figure 30 illustrates this model of integrated TPA.

At TPA Pasir Impun, recycling activities collected plastic waste and processed paper waste into corrugated paper. Waste pickers also collected any valuable materials in this TPA. Energy recovery was conducted by landfill gas mining to generate electric power. It was

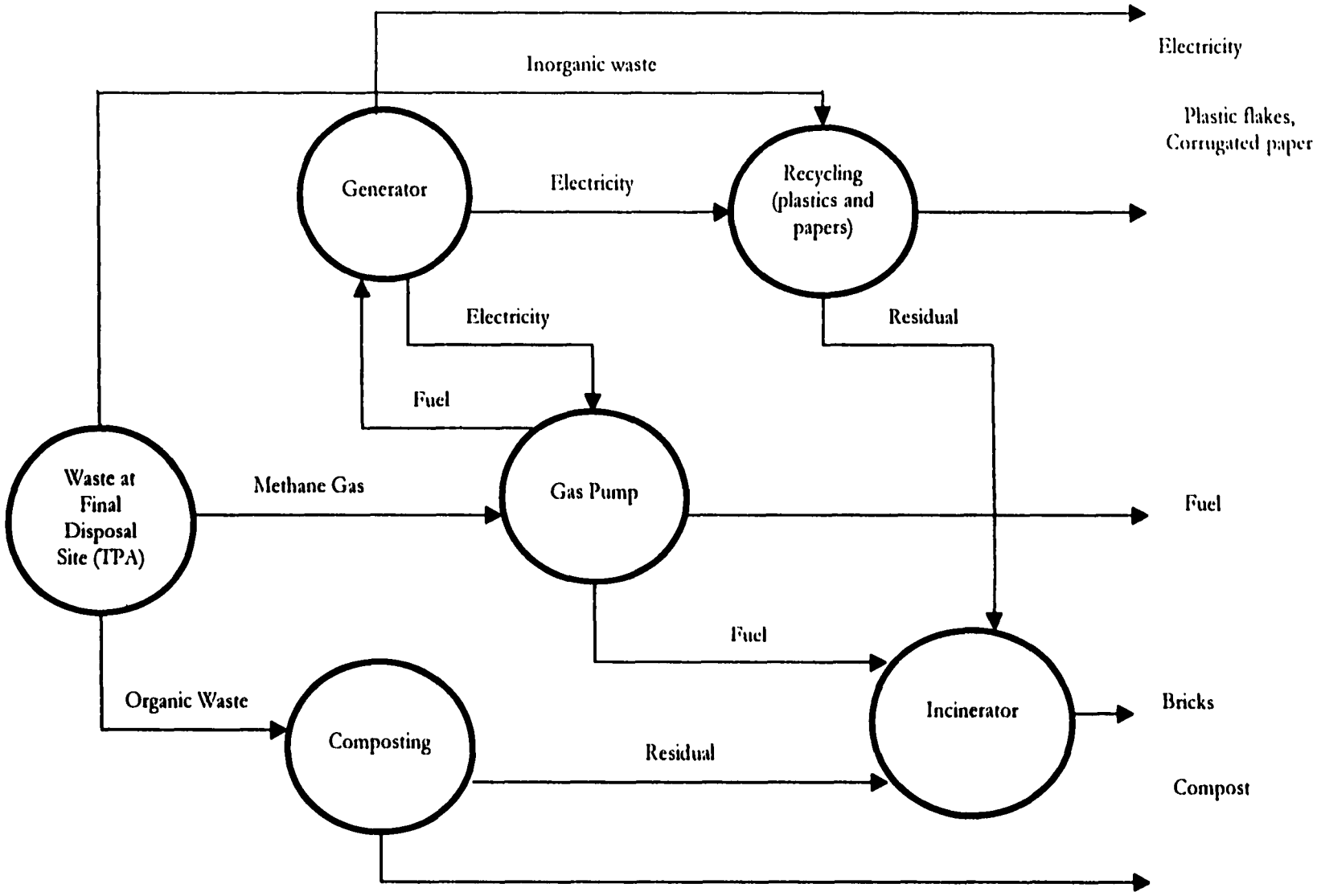


Figure 30. Integrated final disposal site of PDK-Bandung
Source: PDK-Bandung (1997)

planned that the power produced would be able to supply electricity for one kelurahan. This TPA had two ponds for natural leachate treatment. An official of the TPA, however, admitted that the leachate treatment did not work as expected.

A small-scale incinerator was installed at TPA Pasir Impun to burn some inorganic residual, such as plastic, wood, and papers. The slag of the incinerator was then used to make bricks. The officials of the TPA explained that those bricks had been tested for strength and they seemed comparable to regular bricks. However, those officials did not know whether there might be health risks from the use of those bricks. Therefore, at present PDK-Bandung only used those bricks in the construction of temporary disposal sites in Kotamadya Bandung. As a sanitary landfill, this TPA used both a liner and soil cover.

TPA Jelekong is located in the southern part of Kotamadya Bandung and has a space of 10 hectares. This TPA was also built through the Bandung Urban Development Project (BUDP). The distance from the center of the City to this TPA is 23 kilometers. This TPA was also designed and built as a sanitary landfill. The design and construction costs for this TPA were about 3.4 billion rupiah spent during 1986-1993. This cost included all expenses for a site selection study, feasibility study, impact assessment study, purchasing land, detailed design, and construction. As for TPA Pasir Impun, this TPA also had facilities for composting, recycling, gas mining, and leachate treatment. However, when the field observation was conducted in 1997, the gas mining and leachate treatment did not work. In other words, it functioned only as an open landfill. Officials of PDK-Bandung stated that much equipment and facilities from the Asian Development Bank (ADB) through the BUDP were not in good shape or damaged.

TPA Leuwi Gajah was the largest final disposal site (17 hectares) of the three TPAs owned by PDK-Bandung and received most of the waste generated in the Kotamadya Bandung. Each day, this TPA received between 4,000 and 5,000 cubic meters of waste. The design of this TPA included biogas collection and leachate collection but these features were not built due to the limited budget available at that time. Although this TPA was also designed and built as a sanitary landfill, when the field observation was conducted in 1997, an official of PDK-Bandung admitted that this TPA was operated as an open landfill. In addition, he said that in 1994 the operation of this TPA was disrupted by a landslide at the site.

An official of the Environmental Impact Management Agency (Bapedal) explained that options of waste disposal comprise simple open dumping, sanitary landfill, and incineration. An official of the Directorate of Human Settlement Development (DJCK) pointed out that that the use of open dumping should be avoided because it poses a permanent threat to the environment. Officials of BPPT added that simple open dumping represents the old attitude of "out of sight out of mind". However, the Department of Health allowed the use of simple open dumping as long as the dumpsite was filled with soil and its location from the nearest source of water was at least 10 meters.

According to an official of DJCK, the use of a sanitary landfill has both advantages and drawbacks. Several advantages of sanitary landfill include economic savings, less investment than that for incineration, more practical than incineration, and no need to separate waste. Disadvantages of sanitary landfill include finding suitable land (site), compliance with standards, possible opposition from local communities, need for site maintenance after its closure, and the risks of methane gas if not properly managed. According to the Department of Health, after its closure, a landfill could not be used for settlement sites. According to DJCK, several aspects needed to be regarded in selecting sites for final disposal. These aspects comprise legal, environmental regulations, impact assessment analysis, public order, city cleanliness, land use and spatial plans, and MSWPM regulations.

The Department of Health had prepared several criteria for final disposal sites. First, the site should not become a source of smell, smoke, ash, noise, flies and other disease vectors. Second, it should not create pollution of water sources. Third, the site should not be located on land with high altitude nor on a place prone to flooding. Fourth, the site should have good drainage, facilities for leachate treatment, and pest control.

As an aspect to be evaluated in the Adipura Award, the government of Kotamadya Bandung provided technical guidelines for maintaining cleanliness at any final disposal site (Table 44), involving PDK-Bandung, the municipal spatial planning agency (Dinas Tata Ruang), the municipal planning board (Bappeda), the municipal city planning agency (Dinas Tata Kota), and central and provincial governments.

Table 44. Technical guidelines for maintaining cleanliness in final disposal site (TPA)

Consideration	Expected Condition	Actors involved
• Design and construction	• Designed and constructed for a sanitary landfill system	• PDK-Bandung with financial assistance from local, provincial, and the central governments
• Location	• At the boundary of the administrative area • Distant from residential areas • Far from water resources	• PDK-Bandung supported by Dinas Tata Ruang Bappeda, Dinas Tata Kota, and cooperating with Pemerintah Daerah Kabupaten Bandung
• Condition	• No waste scattered around • The volume of waste dumped does not exceed its designed capacity • Minimize the population of flies • Reduce the offensive odour • Cover waste with soil • Use leachate treatment and gas mining pipes • Conduct recycling activities	• PDK-Bandung

PDK-Bandung had been running a small-scale incineration plant at TPA Pasir Impun with the purposes of training human resources, learning from small mistakes, working with available funds, and only involving its own workers. Some officials of PDK-Bandung said that many foreign suppliers of incineration had offered their products to PDK-Bandung, but they were too expensive for their enterprise.

According to Bapedal, incineration could be used as a means of waste disposal. In the Jabotabek (Jakarta-Bogor-Tangerang-Bekasi) area, incineration had been planned to dispose most of the industrial hazardous waste. An official of the Directorate General of Human Settlement Development (DJCK) stated that incineration was capable of reducing waste to 5% of its initial volume and 15-20% of initial weight. According to the Department of Health, smoke and ash from incineration should meet standards, and waste water should be treated.

An official of the World Bank stated that based on a study[16] in 1994, the cost of

[16] Mott/MacDonald Environmental Consultants, Sinclair Knight, Core Laboratories (1994). Third Jabotabek Urban Development Project (JUDP III). Environmental Component 2, Part B.

incineration for the Jabotabek (Jakarta-Bogor-Tangerang-Bekasi) area, was between 29 and 45 thousand rupiah for each tonne of waste, while the comparable cost of sanitary landfill was about 7600 rupiah. However, with the increasing difficulty in finding sites, increasing land prices, and the changing nature of waste, incineration could become a viable option in the future. Officials of BPPT mentioned several prerequisites for successful incineration. They included sufficient funding, good organization and management, good facilities, public participation, and regulatory instruments.

6.5. Problems in MSWPM

Various problems in MSWPM in Indonesia, and particularly in the Municipality of Bandung have been identified. These problems are environmental pollution due to household waste, the gap between increasing service demand and PDK-Bandung's capability, inappropriate planning and management, lack of coordination among actors (stakeholders), lack of participation, lack of awareness and education, weak law enforcement, and difficulties in helping waste pickers.

6.5.1. Waste Burning and Dumping to Drains, Canals and Rivers

Part of urban environmental pollution in large and metropolitan cities in Indonesia has occurred through uncontrolled waste burning and illegal dumping to drains, canals and rivers. This situation is recognized by Indonesia's Agenda 21. Waste burning and illegal dumping to drains and rivers by households are almost uncontrollable. Findings from surveys completed for several chiefs of neighbourhood units or "Ketua RT" and households provide insights about waste burning in the City of Bandung. Surveys to Ketua RT were conducted with 44 chiefs whose areas received collection and transportation service from PDK-Bandung. In addition, surveys were administered to 16 chiefs whose areas did not yet receive the service from PDK-Bandung. The areas of these 16 leaders were located at the boundary between the Municipality of Bandung and the District of Bandung.

Among chiefs whose areas had service from PDK-Bandung (Table 45), 10 out of 44 persons (23%) mentioned that they did waste burning once a month in their areas to reduce waste, in particular when the collection service from PDK came late. In this sense, they separated their waste into wet and dry streams and then burnt the dry one. As mentioned previously, PDK-Bandung had regular collection schedules for every region (wilayah) in the

Kotamadya Bandung three times a week. Officials of PDK said that if everything went well, then collection and transportation service was usually conducted according to the schedule. However, if a problem occurred with the collection vehicles or the waste crews, then the scheduled service could be late or absent.

Table 45. Burning frequency in neighbourhood units receiving service from PDK-Bandung

Burning frequency	Number of chiefs	Percentage
Never	34	77%
Once a month	10	23%
Total	44	100%

Table 46. Burning frequency in neighbourhood unit without service from PDK-Bandung

Burning frequency	Number of chiefs	Percentage
Once a week	14	87%
2-3 times per week	2	13%
Total	16	100%

From 16 chiefs or Ketua RTs whose areas did not have service from PDK-Bandung (Table 46), all said that they practiced waste burning routinely in their areas. Of these, 14 chiefs (87%) responded that they used to burn waste once a week, while others (13%) performed waste burning between two and three times a week.

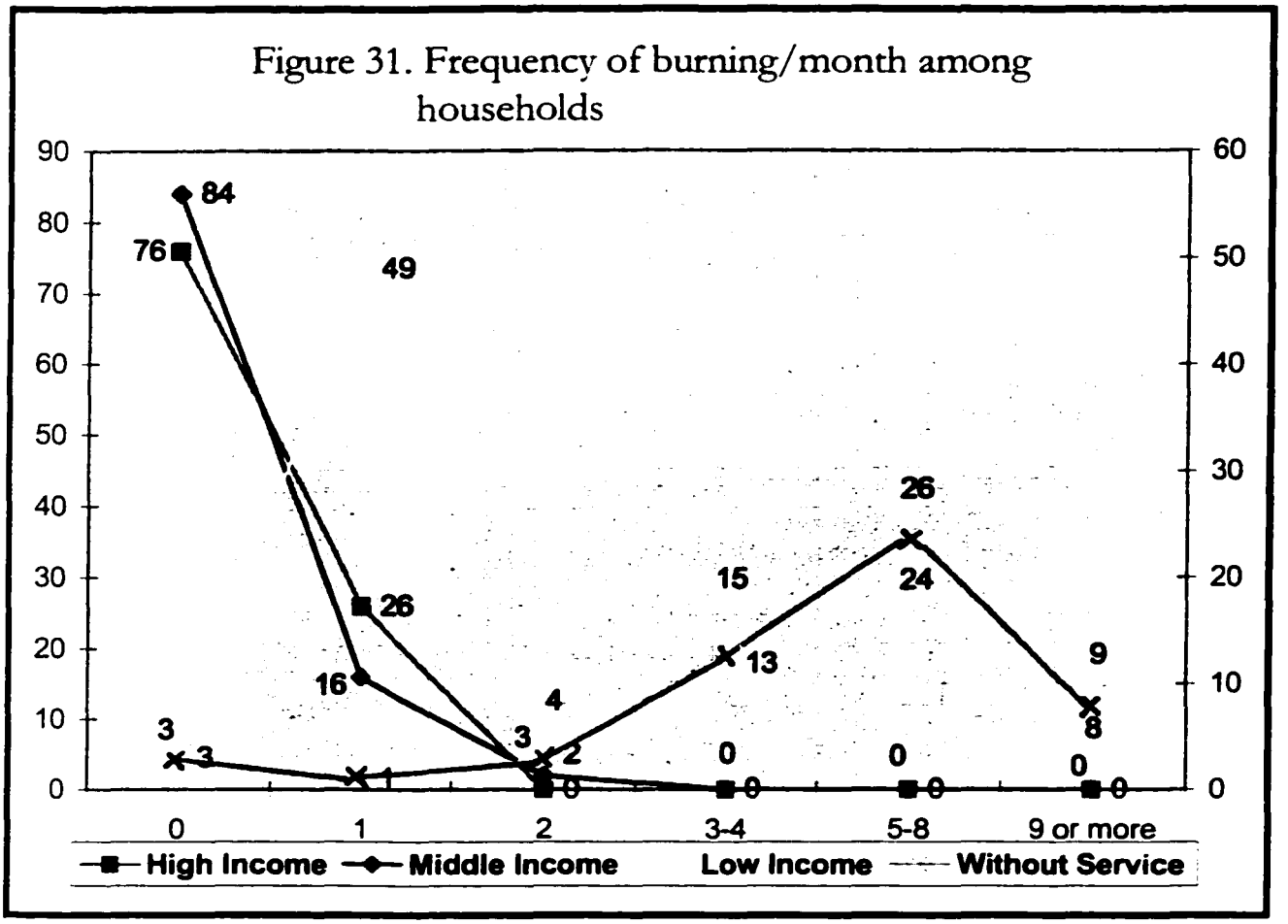
Table 47. The number of households conducting waste burning

Household	Frequency of burning/month						Total
	0	1	2	3-4	5-8	9 or more	
High Income	76	26	0	0	0	0	102
Middle Income	84	16	2	0	0	0	102
Low Income	3	49	4	15	26	9	106
Without PDK's service	3	1	3	13	24	8	52
Total	166	92	9	28	50	17	362

Surveys on waste burning were also conducted with households (Table 47). In these surveys, households were classified into four groups. The first three groups were categorized to provide insight about waste-burning behaviour by different classes of wealth, while the last group was chosen only to indicate waste-burning incidence in an area that did not have collection and transportation service from PDK-Bandung, regardless of the wealth of the residents. All households of this fourth group resided in Wilayah Ujung Berung at the administrative boundary between the Municipality of Bandung and the District of Bandung.

Of 102 households in the high-income group, 76 households (75%) mentioned that they never burnt waste, while 26 households (25%) said that they rarely burnt waste once a month. From 102 households representing the middle-income group, 84 households (82%) stated that they never burnt their waste, 16 respondents (16%) burnt waste once a month, and only 2 households (2%) burnt their waste twice a month. Among 106 households in the lower-income group, 3 households (3%) said that they never burnt their waste, 49 households (45%) performed waste burning once a month, 4 households (4%) burnt waste twice a month, 15 households (14%) conducted waste burning between three and four times a month, 26 households (25%) used waste burning between five and eight times a month, and 9 households (9%) burnt waste nine times or more a month. From 52 respondents in the last group (the group without service from PDK-Bandung), 3 households (6%) indicated that they never burnt their waste, 1 household (2%) burnt waste once a month, 3 households (6%) conducted waste burning twice a month, 13 households (25%) performed waste burning between three and four times a month, 24 households (46%) burnt waste between five and eight times a month, and 8 households (15%) conducted waste burning nine times or more a month. Figure 31 shows the distribution of burning each month among households. The results of the statistical tests (Appendix E) indicate that burning frequency by households is strongly associated with their income level ($\{X^2=194.012\} > \{\chi^2_{df=10;\alpha=0.01}= 23.209\}$), and that burning frequency among households is also strongly dependent upon the availability of service in their areas ($\{X^2=121.39\} > \{\chi^2_{df=5;\alpha=0.01}= 15.086\}$).

In Bandung, a few stakeholders such as PDK-Bandung, Environmental Research Centre (PPLH) - Bandung Institute of Technology (ITB), waste consultants, and some professors agreed that illegal waste dumping to drains (canals) and rivers has caused floods in the rainy season. In this regard, among the 44 chiefs surveyed, only three persons raised their concerns about the behaviour of some of their constituents who still dumped their waste into the river in their areas. In addition, one chief reported that he used to have problem with clogged canals in his area during the dry season because many households dumped their waste into it. Some other residents complained about the offensive odour and the number of mosquitoes. Of the 16 chiefs or Ketua RTs whose areas did not received service from PDK, only one person reported waste dumping to a river in his area.



6.5.2. The Gap Between the Increasing Service Demand and the Capability of PDK-Bandung

The gap between the increasing service demand and PDK-Bandung's capability has left some areas unserved and caused unsatisfactory service delivery to some areas already receiving service. PDK-Bandung acknowledged that some areas in Kotamadya Bandung had not been served. As mentioned before, the percentage of waste collected in Kotamadya Bandung in 1995 was 95.75%. In other words, 4.25% of the total waste generated or 293 cubic meters in residential and industrial areas was not collected daily. There were several reasons why this had occurred. Officials of PDK-Bandung mentioned their institution had inadequate funding to provide sufficient collection, transportation vehicles, and crews. At the time when this study was conducted in 1997, they indicated that their revenues collected from service fees were not sufficient to cover the operating and maintenance costs.

Officials of PDK-Bandung claimed that ideally service fees should be increased at least once in three years to keep pace with the inflation rate. They said that service fees had not been increased since 1993. PDK's officials believed that there were social and political reasons for freezing the fees adjustment. Raising fees has been an unpopular act for the public, and the City Mayor who has had the authority to make the decision had been reluctant to do so. Consequently, with the virtually same revenue for several years, PDK-Bandung had to manage with increasing operation costs. Even with the current subsidy received from the municipal government, PDK-Bandung claimed that their overall revenues still fell below their costs. Officials admitted that in dealing with this situation, sometimes they had to reduce service quality by decreasing the collection and transportation frequency. This fact appears to be in line with the claims by 9 out of 44 Ketua RTs (20%) whose areas received PDK's service who complained about irregular and insufficient collection.

In order to know the public's opinions about the existing service fee and the possibility for increasing it in the future, surveys were conducted with households to ask about these two issues (Table 48 and Figure 32). Of 102 households in the high-income group, 16 respondents (15%) thought that the existing fee was low, 86 respondents (85%) considered it sufficient, and none mentioned it as too high. Among 102 households in the middle-income group, 11 households (11%) said that the current fee was low, 91 households (89%) thought it sufficient, and none considered it as too high. And from 106 households in the lower-income group, no respondent said that the current fee was low, 102 households (96%) replied that the existing fee was sufficient, and 4 households (4%) said that it was too high.

Table 48. Response to the amount of the existing service fee among households

Category	Households			Total
	High Income	Middle Income	Low Income	
Low	16	11	0	27
Sufficient	86	91	102	279
Too high	0	0	4	4
Total	102	102	106	310

The willingness of households to pay a higher service fee in order to get better service is shown in Table 49. Survey results show that percentages for those who would be willing to pay more and those who would refuse are 45% (46 households) and 55% (56 households) in the high-income group, 33% (34 households) and 67% (68 households) in the middle-income

group, and 18% (19 households) and 82% (87 households) in the lower-income class. Figure 33 illustrates the distribution of households' responses. The results of the chi-square tests (Appendix E) indicate that households' response to the existing service fee is associated with their income level ($\{X^2=23.98\} > \{\chi^2_{df=4;\alpha=0.01}= 13.277\}$), and so does their willingness to pay more for the PDK's service fee in order to get better service ($\{X^2=17.81\} > \{\chi^2_{df=2;\alpha=0.01}= 9.210\}$).

Figure 32. Opinion about the existing service fee

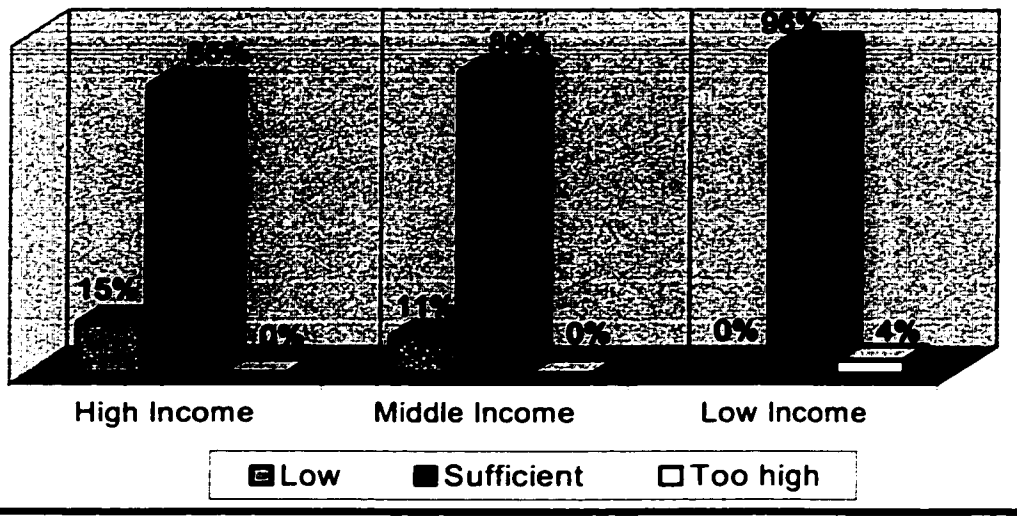


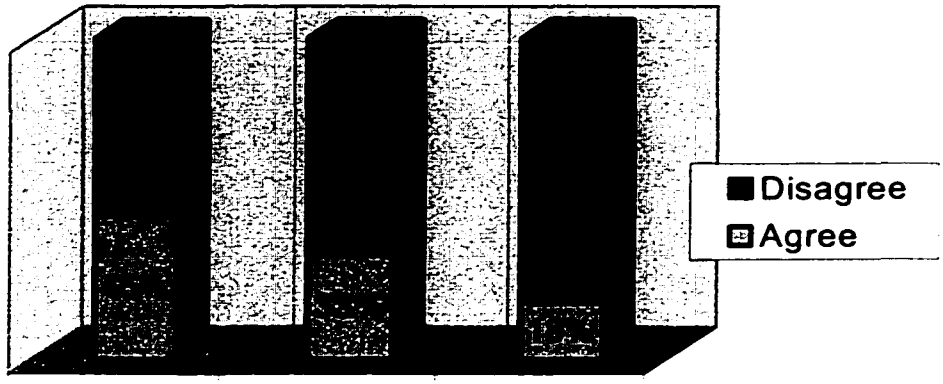
Table 49. Willingness to pay a higher service fee among households

Category	Households			Total
	High Income	Middle Income	Low Income	
Willing to pay more	46	34	19	99
Refuse to pay more	56	68	87	211
Total	102	102	106	310

Another reason why some areas in the Municipality of Bandung did not receive service was given by the Directorate General for Human Settlement Development (DJCK) of the Ministry of Public Works. According to officials of DJCK, the gap between the increasing service demand and local authority capability has been a persisting problem in Indonesia, in particular in metropolitan and large cities. In the Municipality of Bandung, the increasing development of residential areas had widened the gap between service demand and the capacity of PDK-Bandung as the service provider. This problem had also been faced by the cleaning

authority in the District of Bandung (Dinas Kebersihan Kabupaten Bandung) because controlling the growth of residential areas was almost impossible. If there were demands for new homes, and a private developer could find suitable sites, either in the administrative area of Kotamadya Bandung or Kabupaten Bandung, then the local authority would likely grant its approval. And when this happened, the pressure to provide waste collection and transportation service was put either on PDK or Dinas Kebersihan Kabupaten Bandung. Unfortunately, Dinas Kebersihan Kabupaten Bandung, with larger areas to be served, had less capability than that of PDK-Bandung in terms of funds and human resources. Consequently, many residential areas in Kabupaten Bandung still did not have waste collection service from Dinas Kebersihan Kabupaten Bandung.

Figure 33. Willingness to pay more fee among households



For areas that had not yet received PDK's service, the policy of PDK-Bandung had been to eventually provide collection service to these areas once in two weeks. Interviews with 16 chiefs of neighbourhood units whose areas did not have service show that 12 of them (75%) had been complaining about this policy. They thought that this policy was unacceptable because the two-week interval was too long and within this period organic waste would decompose and spread offensive odours. One chief said that he used to call PDK to remind its duty to collect waste in his area on time. He also added that PDK's waste collection crews often did not collect waste appropriately, leaving debris scattered around the temporary disposal site.

All sixteen chiefs expected PDK-Bandung to provide regular service to their areas as soon as possible.

The fact that some areas in Bandung did not get service from PDK-Bandung was not surprising to the World Bank. An official of the World Bank concluded that one major challenge in service provision facing government of metropolitan or large cities in Indonesia is to increase service coverage and quality. In this sense, some professors in Bandung suspected that part of the problem in service coverage and quality had been caused by PDK's inability to self finance its operation, inefficiency in operation and maintenance, inappropriate investment, and inefficiency in retribution collection.

6.5.3. Inappropriate Planning and Management

National Planning Board (Bappenas), the Directorate General for Human Settlement Development (DJCK), and the Department of Health have recognized that planning and management for urban solid waste in metropolitan or large cities in Indonesia has become increasingly complex because of the wide variety of issues to be addressed and the many actors involved in MSWPM. Several respondents conveyed their opinions and/or facts indicating some problems with the current planning and management of municipal solid waste in Indonesia, including Bandung. Some officials of the Agency for Technology Assessment and Application (BPPT) thought that the conventional approach was still being used by many local authorities in Indonesia, including the Kotamadya Bandung.

The officials of BPPT and some professors in Bandung argued that planning and management of municipal solid waste in Bandung lacked a long-term perspective. They explained that the existing planning mode was more reactive than proactive. In this regard, the officials of PDK-Bandung admitted that they did not have a comprehensive, long-term plan, for instance, a five year plan, but they were developing an integrated final disposal site assisted by experts from Australia. If this integrated model can succeed in its pilot project, it would become a basis for PDK's future long-term plan in Kotamadya Bandung.

Officials of PDK-Bandung acknowledged that their poor capability in planning capacity had been in part due to the limited number of qualified persons. PDK-Bandung has been experiencing difficulties in recruiting qualified graduates from universities with good reputations because they might find a better job elsewhere, the salary offered by PDK was not high enough, or they thought that working with waste was not prestigious.

A few respondents such as at the Directorate General of Human Settlement Development (DJCK), a waste contractor in Bandung, and some professors in Bandung, agreed that the existing planning and management of municipal solid waste in Bandung had not emphasized waste reduction and resource recovery. Thus, any interest to give value to waste or to process it was lacking. Actually, this is not surprising because PDK-Bandung has long been handling waste as solely a technical problem. Officials of DJCK mentioned that institutionally efforts regarding waste reduction and recovery through reuse, recycling, and composting had been relatively new, although such efforts and practices had been done by households and in particular by waste pickers.

Two waste consultants in Bandung commented that PDK-Bandung seemed to be still viewing itself as the sole actor responsible for MSWPM in Kotamadya Bandung. As a result, potential contributions from other actors such as private contractors, the public, and non-governmental organizations (NGO) had not received recognition. Those consultants argued that if the focus of MSWPM in Bandung were changed from collection, transportation, and disposal to waste reduction and recovery, then actors, such as consultants, NGOs, and particularly the local community, would have to be recognized and involved because it would be impossible to tackle this issue by PDK-Bandung alone.

Officials of the Development Technology Centre (DTC-ITB) believed that MSWPM in Bandung was preoccupied with using expensive but inappropriate technology, and therefore improper investment. For instance, they noted the use of compactor vehicles. They claimed that the use of these vehicles was ineffective because the waste generated in Kotamadya Bandung is mostly organic and therefore there is no urgent need for compacting. The interviews with officials of PDK-Bandung and the field observations also revealed that PDK-Bandung was unable to maintain most of its expensive equipment. Two damaged bulldozers parked at the largest final disposal site (TPA Leuwi Gajah) were observed in 1997.

6.5.4. Lack of Coordination

The lack of coordination of effort among various actors (stakeholders) involved in MSWPM was identified by many respondents, such as the Directorate General for Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Department of Health, district cleaning (Dinas Kebersihan) of Kabupaten Bandung, waste consultants, and some professors. In this regard, the

State Ministry of the Environment and professors, for instance, stated that institutional bureaucracy was the main cause of the lack of coordination. Bureaucracy had hindered initiatives to coordinate various actors involved in tackling any problems in MSWPM.

In the Municipality of Bandung, the lack of coordination had led to some conflicts. A dispute between PDK-Bandung and the local cleaning department of District Bandung (Dinas Kebersihan Kabupaten Bandung) occurred due to the lack of coordination between them. This conflict was about the collection of service fee over a large residential area located in Kabupaten Bandung. After an investigation by the local government of Kotamadya Bandung, it was determined that PDK-Bandung had mistakenly been collecting fees and the collected fees were returned to the payers.

Another conflict between PDK-Bandung and the local government of Kabupaten Bandung occurred over the charge for the use of final disposal sites. An agreement was made between PDK-Bandung and the district government of Kabupaten Bandung that obliged PDK-Bandung to pay 50 million rupiah each year for the use of the final disposal sites. However, the district government of Kabupaten Bandung unexpectedly told PDK-Bandung that the latter had a debt for the disposing fee totalling 18 billion rupiah. The district government of Kabupaten Bandung told PDK-Bandung that the disposing fees had been changed from 50 million rupiah per year to 5,000 rupiah per cubic meter of waste dumped in the final disposal site. Officials of the government of Kotamadya Bandung complained that the district government of Kabupaten Bandung had unfairly changed and increased the fees without consultation. This conflict was rather bitter, and eventually caught the attention of the city Mayor of Kotamadya Bandung and the Bupati of Kabupaten Bandung. At the time of writing, it was not known whether this conflict had been settled.

Similar conflict about waste disposal fees also occurred in Jakarta, involving the provincial government of Jakarta (DKI) and the municipal government of Bekasi.[17] Like PDK-Bandung which has its final disposal sites at the administrative areas of the District Bandung, the government of DKI operates a large landfill site (about 100 hectares) located in Bekasi. This landfill site was designed and built as a sanitary landfill. However, because of the limited funding available, the municipal cleaning department (Dinas Kebersihan) of DKI is

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[17] "DPRD II Kodya Bekasi Setujui Penutupan TPA Bantar Gebang". *Suara Pembaruan Online*, 4-Nopember-1999. (http://www.suarapembaruan.com/News/1999/11/041199/Jabotabek/ja09/ja09.html).

unable to operate it properly and this has resulted in many kinds of pollution to surrounding areas. This situation eventually drew protests from the people around the site and the parliament (DPRD) of the municipal government of Bekasi responded by agreeing to close the operation of that site. In addition, the municipal government of Bekasi was reported asking some compensation from the DKI government which currently is looking for another new landfill site.[18] PDK-Bandung should take lessons from this bitter conflict in order to avoid such a possible situation in the future.

Several institutions, such as the National Planning Board (Bappenas), the State Ministry of the Environment, Bapedal and DTC-ITB recognized that weak institutional capability had partly been responsible for the lack of coordination among actors involved in many activities or programs in MSWPM in Indonesia. Therefore, they all agreed that all those institutions needed to be strengthened by improving the skills of their staff.

6.5.5. Lack of Participation and Partnership

Lack of participation and partnership with the private sector was considered by Bappenas, DJCK, the Agency for Technology Assessment and Application (BPPT), a waste contractor, and the World Bank as a problem in MSWPM in Indonesia's metropolitan or large cities, including Bandung. The private sector, in particular contractors, has capacity to take part in service provision. The World Bank (1995), for instance, has reported on studies in many developing countries that privatization of service enables the provision of service more efficiently than when it was provided by local authorities. However, as stated by a prospective contractor in Bandung, PDK Bandung seemed unwilling to subcontract some of its tasks. In this regard, officials of PDK-Bandung defended their position by stating that contracting out some of their activities would transfer some of their revenues to other parties and this would leave it with a reduced budget. In addition, the decision to privatize some service in Bandung will become a political decision of the parliament (DPR) of the Kotamadya Bandung and the Mayor of the city.

Besides the private sector, another party that had also been complaining about the lack of partnership was NGOs. A local newspaper[19] reported that twelve leaders of NGOs in

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[18] "Pemda Bekasi akan Tuntut Bagian Retribusi Sampah Kepada DKI". *Suara Pembaruan Online*, 4-Desember-1999. (http://www.suarapembaruan.com/News/1999/12/041299/Jabotabek/ja02/ja02.html).

[19] "Lingkungan Hidup Kini Tak Lebih Sebagai Objek Ekonomi" *Jawa Pos*, 2-Juli-1997.

Jakarta in 1997 stated that they were concerned with the government's unwillingness to recognize roles and participation from the public and NGOs in urban environmental management. However, the government's unwillingness to recognize NGOs has been common in Indonesia. This had been because NGOs used to stand against the government's policies or acts. Nevertheless, with the current crisis in Indonesia in which the foreign donor agencies asked for more NGOs' involvement, local governments have had no choice but to start recognizing NGOs' existence and their participation.

An interview with a foreign NGO in the Municipality of Bandung, however, gave a different perspective. This NGO had been working with PDK-Bandung to assist the building and operation of landfill gas mining and small-scale incineration at one final disposal site (TPA–Pasir Impun). One member said that his NGO brought its own money to help PDK-Bandung and PDK officials had been very cooperative. He mentioned that he had not yet encountered any problems during his stay in Indonesia or with his involvement in Bandung.

The lack of public participation in MSWPM had been raised by many stakeholders, such as the National Planning Board (Bappenas), the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Department of Parks, a waste contractor, professors, and the World Bank. They indicated the importance of public participation in several basic aspects related to MSWPM, such as proper storage and disposal, avoiding illegal dumping and waste burning, ensuring the cleanliness of their areas, and paying service fees.

Two comments were heard from 14 chiefs of neighbourhood units (Ketua RT) in Kotamadya Bandung who referred to the observation about low community participation in their areas. First, they argued that this had been so because the maintenance of cleanliness of their areas had been done by each household and by paid workers. Every household was responsible for achieving the cleanliness of its own property and the street in front. Paid workers were employed to clean streets, canals, and other open spaces or community facilities. Second, the primary waste collection service provided by the local community organization had been good. According to those Ketua RTs, these two conditions might have contributed to the low participation of the local communities.

Several comments regarding low community awareness were also heard from the 10 Ketua RTs whose areas did not yet get service from PDK. First, they thought that households felt that they had paid the cleanliness fees so that they did not have to participate because the paid workers would do it for them. Second, many households perhaps were busy, especially if both husband and wife were working. Third, households were willing to participate only in special events requiring their participation, for instance in the celebration of the national independence day or the Adipura event. Fourth, those chiefs argued that lack of education ("penyuluhan") could be also a factor. Interestingly, some chiefs said that the most regular education was done for and by the women's association, or PKK, in its monthly meeting.

6.5.6. Lack of Awareness and Education

Many stakeholders raised concern about the lack of awareness of many government institutions about various issues related to urban solid waste planning and management in Indonesia. The first issue, widely noted by many stakeholders, was the lack of awareness regarding benefits from waste minimization. This issue was suggested by the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Environmental Research Centre (PPLH) - ITB, a contractor, professors, and the World Bank. They accepted that waste minimization was a relatively new topic in Indonesia. They all agreed that it was time to start promoting the idea of waste minimization to all relevant stakeholders, in particular the industry and the public (households).

The second issue mentioned by DJCK and consultants was the lack of community awareness about source separation. They knew that source separation could offer several potential benefits, such as supporting recycling businesses, helping waste pickers by providing valuable materials to them, minimizing chances for contamination of materials, and reducing impacts on the environment.

The third issue was the lack of public education in source separation. This had been raised by many stakeholders, such as DJCK, the State Ministry of the Environment, Bapedal, a contractor, consultants, a local NGO, and the World Bank. In order to know the prospect for promoting and conducting source separation in Kotamadya Bandung, interviews were conducted with chiefs of neighbourhood units (Ketua RT), households, and undergraduate

students. The primary purpose of these interviews was to learn about opinions regarding source separation.

Of 44 Ketua RTs whose areas got service from PDK-Bandung (Table 50), 33 persons (75%) supported and 11 leaders (25%) rejected source separation. Meanwhile, among the 16 Ketua RTs whose areas were without service from PDK-Bandung, all supported source separation. The result of the chi-square test (Appendix E) shows that the support for source separation from neighbourhood chiefs is not associated with the availability of PDK's service in their areas ($\{X^2=4.89\} < \{\chi^2_{df=1;\alpha=0.01}= 6.635\}$).

Table 50. Willingness to do source separation by neighbourhood chiefs

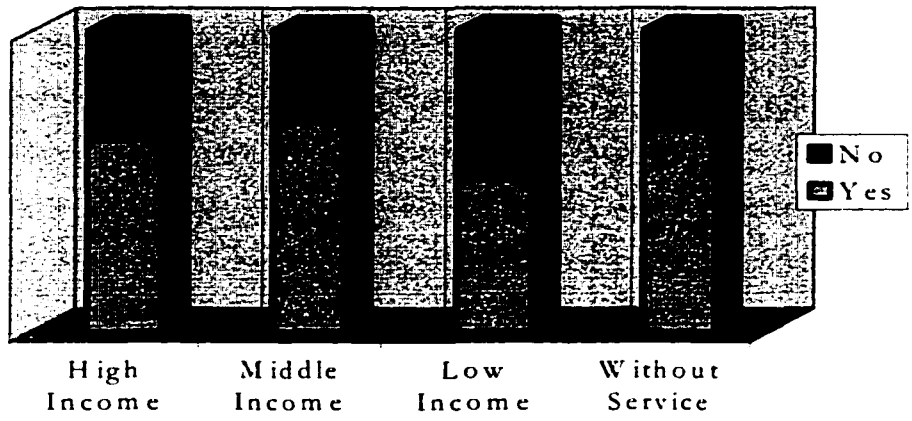
Category	Chiefs of neighbourhood units		Total
	With service from PDK	Without PDK' service	
Supporting source separation	33	16	49
Rejecting source separation	11	0	11
Total	44	16	60

From 102 households in the high-income group (Table 51 and Figure 34), 65 households (64%) supported source separation while 37 households (36%) rejected it. Of 102 households in the middle-income class, 71 households (70%) supported source separation and 31 households (30%) disagreed. Among 106 households in the low-income group, the proportion between those who supported and those who were against the idea was almost the same. Here, 54 households (51%) gave their support while 52 households (49%) did not. The surveys conducted with 52 households that did not have service from PDK-Bandung showed that 35 households (67%) supported the idea of source separation and 17 households (33%) rejected it. The results of the chi-square test (Appendix E) indicate that the support for source separation from households is not associated with their income level ($\{X^2=8.02\} < \{\chi^2_{df=2;\alpha=0.01}= 9.21\}$).

Table 51. Willingness to do source separation among households

Category	Households				Total
	High Income	Middle Income	Low Income	No PDK's service	
Supporting	65	71	54	35	225
Rejecting	37	31	52	17	137
Total	102	102	106	52	362

Figure 34. Willingness to do separation of waste among households



Surveys of undergraduate students were conducted at three universities: ITB (Bandung Institute of Technology), Itenas (National Institute of Technology), and Unyani (University of Jenderal Ahmad Yani). They were asked to choose one among four scales representing their preference on source separation: extremely agree, agree, disagree, and extremely disagree.

Table 52. Opinion about source separation at home by undergraduate students

Category	Universities			Total
	ITB	Itenas	Unyani	
Extremely agree	46	61	58	165
Agree	61	50	54	165
Disagree	3	4	6	13
Extremely disagree	3	0	0	3
Total	113	115	118	346

Findings from 113 students at ITB (Table 52) showed that 46 students (40%) extremely agreed, 61 students (54%) agreed, 3 students (3%) disagreed, and 3 students (3%) extremely disagreed with source separation. From 115 students of Itenas, 61 students (53%) extremely agreed, 50 students (43%) agreed, 4 students (4%) disagreed, and none extremely disagreed. And out of 118 students of Unyani, 58 students (49%) extremely agreed, 54 students (46%) agreed, 6 students (5%) disagreed, and none extremely disagreed. The results of the chi-square test (Appendix E) indicates that the support for source separation from university (undergraduate) students is not associated with their origin ($\{X^2=10.75\} < \{\chi^2_{df=6;\alpha=0.01}= 16.812\}$).

An important consideration related to the success of source separation is the actor most responsible for daily waste handling in the homes. Face-to-face interview surveys conducted in households also asked a question about this matter. In these surveys, every respondent was asked to identify the one person most responsible for handling waste daily in his/her home, either the house sitter, mother, father, son/daughter, or anybody (no particular person being responsible for daily waste handling).

Table 53. Actor responsible for waste handling at home

Actor	Households				Total
	High Income	Middle Income	Low Income	Without Service	
House sitter	55	35	3	1	94
Mother	18	28	45	22	113
Father	0	4	6	3	13
Son/daughter	11	2	2	1	16
Anybody	18	33	50	25	126
Total	102	102	106	52	362

From 102 households in the high-income class (Table 53), waste handling in 55 households (54%) was managed by the house sitter, 18 households (18%) by mother, none by father, 11 households (10%) by son/daughter, and in 18 households (18%) it could be done by anybody. Among 102 households in the middle-income group, waste handling in 35 households (34%) was conducted by the house sitter, 28 households (28%) by mother, 4 households (4%) by father, 2 households (2%) by son/daughter, and in 33 households (32%) it could be done by anybody. Of 106 households in the lower-income group, waste handling in 3 households (3%) was done by the house sitter, 45 households (42%) by mother, 6 households (6%) by father, 2 households (2%) by son/daughter, and in 50 households (47%) it could be done by anybody. In the 52 households with no service from PDK-Bandung, waste handling in 1 household (2%) was conducted by the house sitter, 22 households (42%) by mother, 3 households (6%) by father, 1 household (2%) by son/daughter, and for 25 households (48%) it could be done by anybody.

Another factor regarding lack of community awareness was related to composting. Development Technology Centre (DTC) - ITB, waste consultants, a waste contractor, and some professors in Bandung suggested the importance of composting. They recommended educating the public about small-scale composting that can be done by households or by communities.

Table 54. Opinion about composting from neighbourhood chiefs

Category	Chiefs of neighbourhood units		Total
	With PDK's service	Without PDK's service	
Support composting	27	15	42
Do not support composting	17	1	18
Total	44	16	60

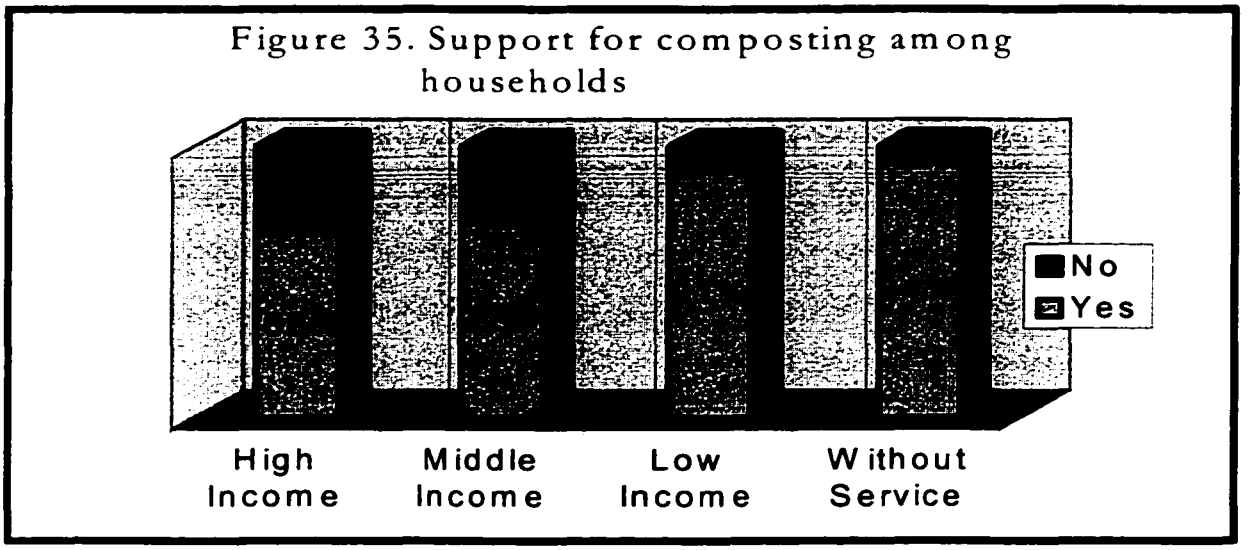
In regard to composting, interviews with chiefs of neighbourhood units (Ketua RT) and households explored their views on composting (Table 54). From 44 chiefs whose areas got service from PDK-Bandung, 27 persons (61%) supported composting to be conducted in their areas while 17 persons (39%) did not agree. Meanwhile, among 16 chiefs whose areas did not receive service from PDK, 15 persons (94%) agreed to do composting in their areas and only 1 person (6%) rejected it. The result of the chi-square test (Appendix E) proves that the support for composting by neighbourhood chiefs is not associated with the availability of PDK's service in their areas ($\{X^2=5.86\} < \{\chi^2_{df=1;\alpha=0.01}= 6.635\}$).

The chiefs who supported community composting in their community areas had a few suggestions. First, the site should be isolated, not too close to residents' homes, clean, neat, and safe. Second, it must not spread the offensive odour nor be noisy. Third, it should be simple, cheap, and benefit the surrounding communities. Fourth, it should have specific persons to operate the site, be well-organized by Ketua RT, involve consultations with the community, and be regularly supervised by officials of PDK. Last, the local government should provide the money to operate and maintain the site.

Interviews with households (Table 55 and Figure 35) revealed that among 102 households in the high-income class, 69 households (68%) supported composting in their community areas while 33 households (32%) opposed it. Within the middle-income group, 73 out of 102 households or 72% supported composting in their areas and 29 households (28%) were against it. Among 106 households in the lower-income families, 96 households (91%) agreed with composting in their areas, while 10 households (9%) rejected it. And from 52 households whose areas did not have service from PDK, 49 respondents (94%) supported composting in their community areas and 3 households (6%) disagreed. The results of the chi-square test (Appendix E) show that the support for composting by households depends on their income level ($\{X^2=17.62\} > \{\chi^2_{df=2;\alpha=0.01}= 9.21\}$), and the availability of PDK'service in their areas ($\{X^2=8.27\} > \{\chi^2_{df=1;\alpha=0.01}= 6.635\}$).

Table 55. Opinion about composting among households

Category	Households				Total
	High Income	Middle Income	Low Income	Without service	
Supporting	69	73	96	49	287
Refusing	33	29	10	3	75
Total	102	102	106	52	362



Several stakeholders, such as the State Ministry of the Environment, the Agency for Technology Assessment and Application (BPPT), the Environmental Research Centre (PPLH) - ITB, the Development Technology Centre (DTC) - ITB, professors, and a local NGO addressed the difficulties in raising a community's awareness about composting. First, two professors who had experiences with community composting argued that the low community awareness and participation might be because either people did not know about it or they just ignored it. Second, DTC-ITB and PPLH-ITB indicated that land availability was a major constraint in promoting community composting. DTC-ITB, for instance, had tried to promote this idea to high schools in the Kotamadya Bandung but was unsuccessful because of this problem. Third, another problem, as stated by PPLH-ITB, was the lack of support from the local government. Based on its experience, the municipal government of Kotamadya Bandung was reluctant to provide a vacant space or land for the composting activities. The government seemed afraid that this space would be occupied and became a home of the homeless or waste pickers. Local government officials seemed to object to this outcome.

6.5.7. Weak Law Enforcement

Another problem in municipal solid waste planning and management in Indonesia, including Bandung, had been the weak law enforcement and monitoring. This issue was raised by the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Directorate General of Human Settlement Development (DJCK), the Department of Health, the Police Department, and some professors. Officials of the State Ministry of the Environment, for instance, said that with its status as a "state ministry" or "non-departmental" ministry, it did not have sufficient funds and human resources to support enforcement; its main responsibility had been in formulating general policies in environmental management. Bapedal, as a government institution, had more capability for law enforcement than the State Ministry of the Environment, but Bapedal's main target had been industry, in particular hazardous wastes. DJCK mentioned that it had provided general guidance in many aspects of municipal solid waste planning and management but the enforcement of these standards was left to local government (authorities).

As mentioned before, the municipal government of Kotamadya Bandung had a law (Peraturan Daerah) containing a penalty for those throwing waste in illegal places. A few signs publicizing this law were placed in several public places, such as bus terminals, parks, and main streets. The law stated that violators of this law would be either fined for 50,000 rupiah or imprisoned for up to three months. Field observations at several places, such as terminals, main streets, and public gardens, revealed that often such a sign was accompanied by waste scattered nearby. In other words, illegal waste disposal was still done by many people and this may also indicate the ineffectiveness of that law. In this regard, the Police Department mentioned that it had been very difficult or almost impossible to enforce this law through this department itself. A more coordinated approach involving various actors was preferred. An example of this was the formation of a Yustisi Team in Kotamadya Bandung to conduct public education regarding several basic behaviours, such as always carrying a citizen identification card, crossing a street at the designated sections, and throwing waste in the public bins provided. In addition to the lack of staff, the Police Department added that in general they did not have good knowledge about laws pertaining to MSWPM.

The Department of Health that issued health standards for many aspects of MSWPM had the responsibility to ensure that those standards were met. Officials of this department in

Bandung stated that many of those standards had been violated or neglected. Based on their observations, for example, none of the final disposal sites owned by PDK-Bandung were operated according to the standards issued by their department. They felt that the standards to protect the public's health and safety were ineffective. They acknowledged that their department did not have sufficient power to enforce the implementation of those standards.

6.5.8. Difficulties in Helping Waste Pickers

Several actors had encountered difficulties in helping waste pickers. Some of these obstacles were caused by the different directions taken by major actors in their attempts to help waste pickers. The first group was supported by Department of Labour (Dinas Tenaga Kerja) and Department of Social Affairs (Dinas Sosial). Both departments had wanted to help waste pickers to change their job in order to get a better social status and better life. The Department of Labour did not recognize waste picking as an occupation, while the Department of Social Affairs viewed waste picking as an indecent job and categorized waste pickers into the same group as beggars and the homeless. These departments had been working together to provide training in several skills to waste pickers to change their occupation into farmers, tailors, barbers, and craftsmen.

The second group with a different approach was represented by PPLH-ITB, DTC-ITB, waste recyclers, some consultants, and the World Bank. These actors argued that waste pickers should be recognized, allowed and facilitated regarding their activities. PPLH-ITB, plastics recyclers, and the consultants suggested that waste pickers had been an integral part of the recycling businesses in Indonesia, including Bandung. PPLH-ITB thought that local government officials still viewed waste pickers as a nuisance to the society. As a result, it had been difficult to change the image or status of waste pickers from scavenger to waste labour.

In order to know the public's acceptance of waste pickers, the interviews conducted with Ketua RTs and households also inquired about this issue (Table 56). Surveys of 44 Ketua RTs whose areas got service from PDK-Bandung showed that 22 chiefs (50%) were willing to allow waste pickers to work in their areas, while the other 22 chiefs (50%) disagreed. Among 16 Ketua RTs whose areas did not have service from PDK, 11 persons (69%) agreed to grant permission for waste pickers to enter their areas, while 5 persons (31%) refused to do so. The result of the chi-square test (Appendix E) indicates that the support for waste pickers from

neighbourhood chiefs is not associated with the availability of PDK's service in their areas ($\{X^2=1.66\} < \{\chi^2_{df=1;\alpha=0.01}= 6.635\}$).

Table 56. Support for waste pickers from neighbourhood chiefs

	Chiefs of neighbourhood units		Total
Category	With PDK's service	Without PDK's service	
Support waste pickers	22	11	33
Do not support waste pickers	22	5	27
Total	44	16	60

Table 57. Households' willingness to allow waste pickers to enter their areas

Category	Households				Total
	High Income	Middle Income	Low Income	Without service	
Be willing	59	66	56	24	205
Refusing	43	36	50	28	157
Total	102	102	106	52	362

Surveys with households (Table 57) showed that among 102 households in the high-income group, 59 households (58%) gave their permission, while 43 households (42%) refused. From 102 households in the middle-income class, 66 households (65%) were willing to allow waste pickers to enter their areas, while 36 households (35%) opposed it. Of 106 households in the lower-income group, 56 households (53%) supported waste pickers' activities in their areas, while 50 households (47%) did not. Among 52 households whose areas had no service from PDK, 24 households (46%) agreed to allow waste pickers to enter their areas, and 28 households (54%) disagreed. Figure 36 illustrates the willingness of households to allow waste pickers to enter their areas.

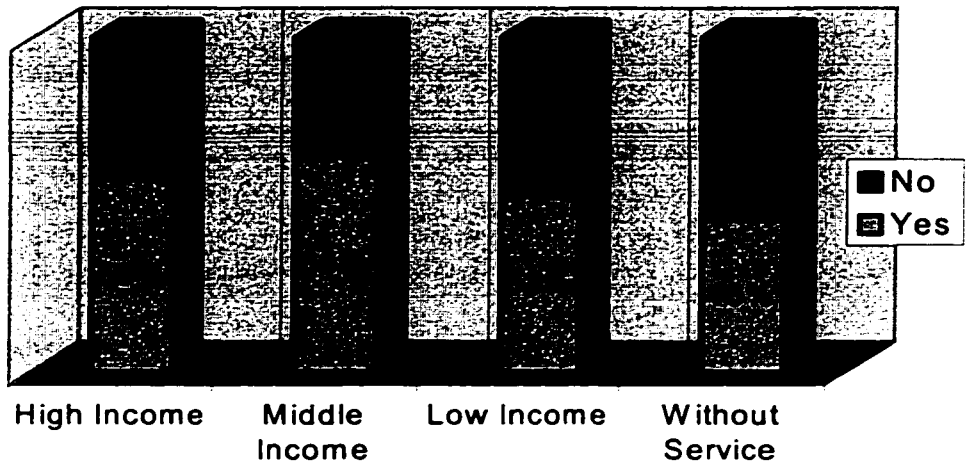
The results of the chi-square test (Appendix E) show that the support for waste pickers by households is not associated with their income level ($\{X^2=3.02\} < \{\chi^2_{df=2;\alpha=0.01}= 9.21\}$), nor is their support dependent on the availability of PDK's service in their areas ($\{X^2=2.71\} < \{\chi^2_{df=1;\alpha=0.01}= 6.635\}$).

6.6. Ideas about IMSWPM

Results from interviews and investigation of the relevant documents provided by respondents have led to several ideas about integrated municipal solid waste management (IMSWPM) in Indonesia, and in particular in Bandung. These ideas about IMSWPM can be summarized into: be comprehensive (consider a wide range of factors), foster public and

private participation (partnerships), coordinate various actors (stakeholders), use all available technological options, combine top-down and bottom-up planning, be responsive to the local needs, adopt a new paradigm that waste is everybody's problem, and incorporate IMSWPM into the city's Master Plan and Spatial Plan.

Figure 36. Willingness of households to allow waste pickers to enter their areas



Several respondents suggested that IMSWPM in Indonesia should be comprehensive by considering a wide variety of aspects. This suggestion was supported by the Directorate General of Human Settlement Development (DJCK), the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Department of Health, consultants, and some professors. In this sense, the professors said that IMSWPM should be multidisciplinary. The Department of Health proposed use of a holistic view in looking at activities of MSWPM, encompassing waste generation and storage, reduction through burning and simple open dumping, collection, transportation, the use of transfer stations, waste processing/treatment (recycling, composting, incineration), and the use of final disposal options. Moreover, this department added that various considerations about these activities should be based on physical and biological criteria with an objective of minimizing the spread of diseases to the public. DJCK, BPPT, PDK-Bandung, and the consultants had the same idea about various aspects to be regarded in IMSWPM. These comprised technical-operational, organizational-managerial, financial, legal, and participatory considerations.

Many respondents agreed that IMSWPM in Indonesia should foster more coordination of various stakeholders involved in any aspect of MSWPM. Otherwise, as they commented, the term "integrated" became inappropriate. Stakeholders suggesting this opinion included the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Application (BPPT), PDK-Bandung, the Department of Parks, the Environmental Research Centre (PPLH) - ITB, some professors, and the World Bank. Their expectations from coordination of stakeholders, however, varied. The most commonly mentioned expectation was to achieve integrated policies. This was suggested by DJCK, the State Ministry of the Environment, Bapedal, BPPT, PPLH-ITB, and some professors. To reach a consensus was the second expectation and was proposed by DJCK, PDK-Bandung, and the district cleaning (Dinas Kebersihan) of Kabupaten Bandung. The third expectation, as pointed out by the Department of Parks, PDK-Bandung, and the World Bank, was to empower agencies to take part in solving various problems of MSWPM, in particular in ensuring the city's cleanliness.

Fostering public and private sector participation is another shared idea about IMSWPM in Indonesia. This idea was raised by the National Planning Board (Bappenas), DJCK, a contractor, waste consultants, some professors, and the World Bank. Bappenas and DJCK stated that the central government of Indonesia started to play its role more as a facilitator than as a provider. Bappenas was concerned with the limited capability of the central government to provide more subsidies to the local government. Therefore, the partnership among the local government, private sector, and local community would be expected to compensate for a decreased subsidy.

A prospective private contractor in Bandung claimed that although the idea of partnership involving the private sector has been promoted in Indonesia and even tried in a few cities, PDK-Bandung still objected to the idea of service privatization. This opinion was also supported by waste consultants in Bandung.

Another idea about IMSWPM similar to integrated waste management in the developed countries is the use of various technological options. This idea was proposed by DJCK, the Department of Health, BPPT, PDK-Bandung, and a contractor in Bandung. In this regard, DJCK mentioned that the use of any option is possible as along as it complies with all relevant

laws. BPPT had been studying and developing a model of an integrated municipal solid waste management (Figure 37) and was hoping to implement it through a pilot project before developing it full scale. The model suggests that every 100 tonnes of solid waste would consist of 80 tonnes organic and 20 tonnes inorganic. The organic fraction would be composted and result in 25% compost (20 tonnes), 15% residual (12 tonnes), and 60% mass reduction (48 tonnes) due to aeration. The residual would be sent to incineration. The inorganic fraction (20 tonnes) is expected to be recycled and result in 70% of materials for reuse and 30% of residual that would also be burnt by the incineration. The final amount of waste requiring disposal would be 3.6% (3.6 tonnes) of the total incoming waste.

An implementation of an integrated solid waste management system (Figure 38) at residential level has occurred in a large residential area ("Pemukiman Kota Mandiri Bumi Serpong Damai") for the middle and high-income families in the District of Tangerang, West Java. Here, the developer has allocated one hectare of land for waste processing.[20] The solid waste generated daily is about 250 cubic meters and they are collected and sent to the processing site. The incoming waste is separated into four streams: organic compostable, inorganic recyclable, inorganic combustible, and the residual (non compostable, non recyclable, and non combustible). The organic stream, about 100 cubic meters daily, was composted by 17 workers. The chief of the processing site reported that it takes a month to process the organic waste into compost. The price for each kilogram of compost is 750 rupiah. The developer used to buy the compost for its parks and some residents use it for their gardens. The inorganic stream was sorted by waste pickers who recover plastic, papers, and metals. From waste pickers' recovery, about 50 cubic meters of waste are reduced. In addition, their activities also result in about 50 cubic meters of inorganic waste which cannot be recycled and they will be sent to a small incinerator. The slag of the incinerator can be used for street fillings. The incineration is operated by four crews. The remaining waste, an amount of 50 cubic meters daily, is sent by the developer to a final disposal site, outside the residential area. Included in this waste are food packaging and hazardous wastes.

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[20] "Sisa Sampah Bisa jadi Uang". *Kompas Online*, 21-Oktober-1999. (http://www.kompas.com/kompas-cetak/9910/21/METRO/sisa17.htm)

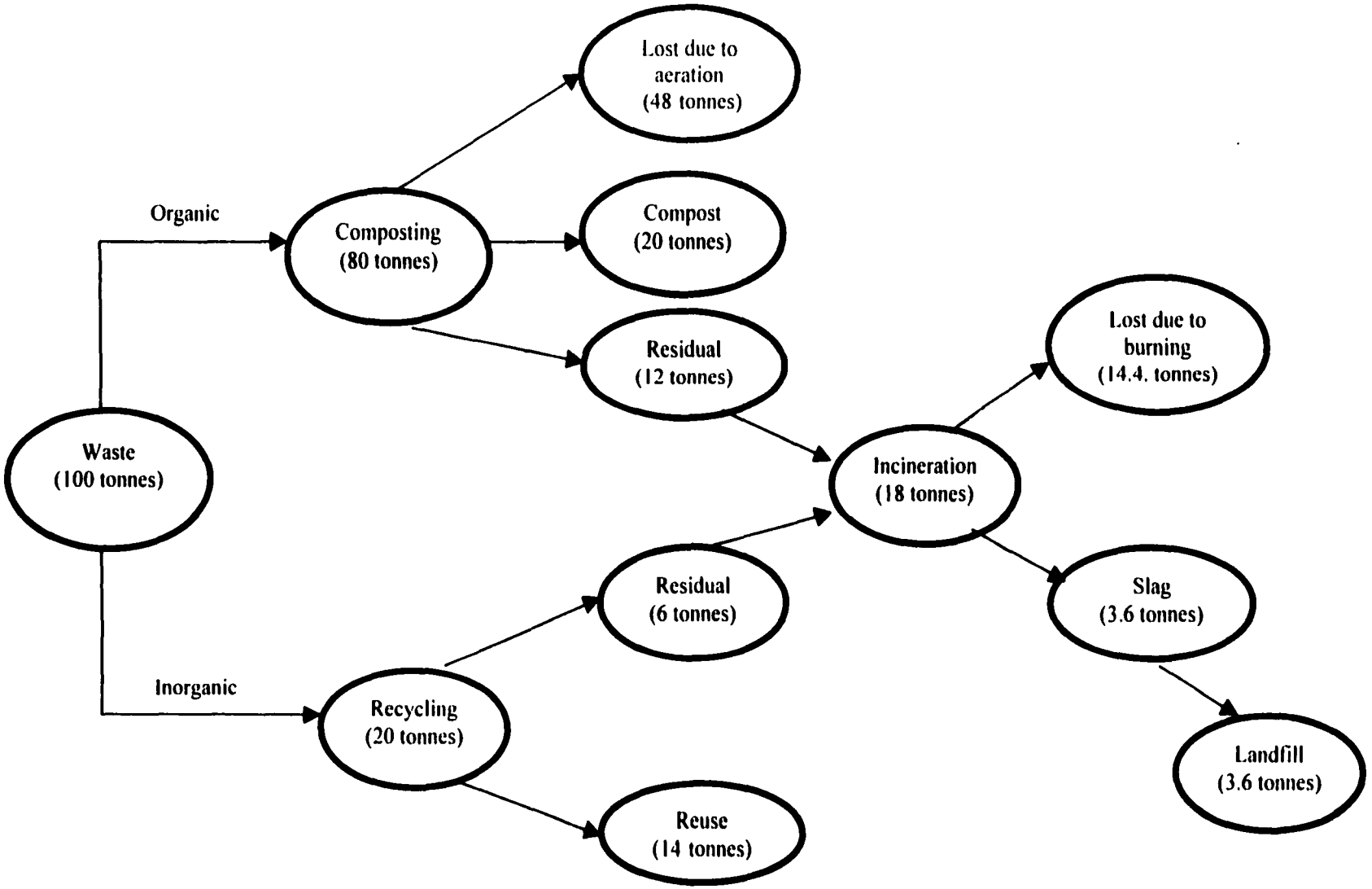


Figure 37. Integrated urban solid waste management model of BPPT

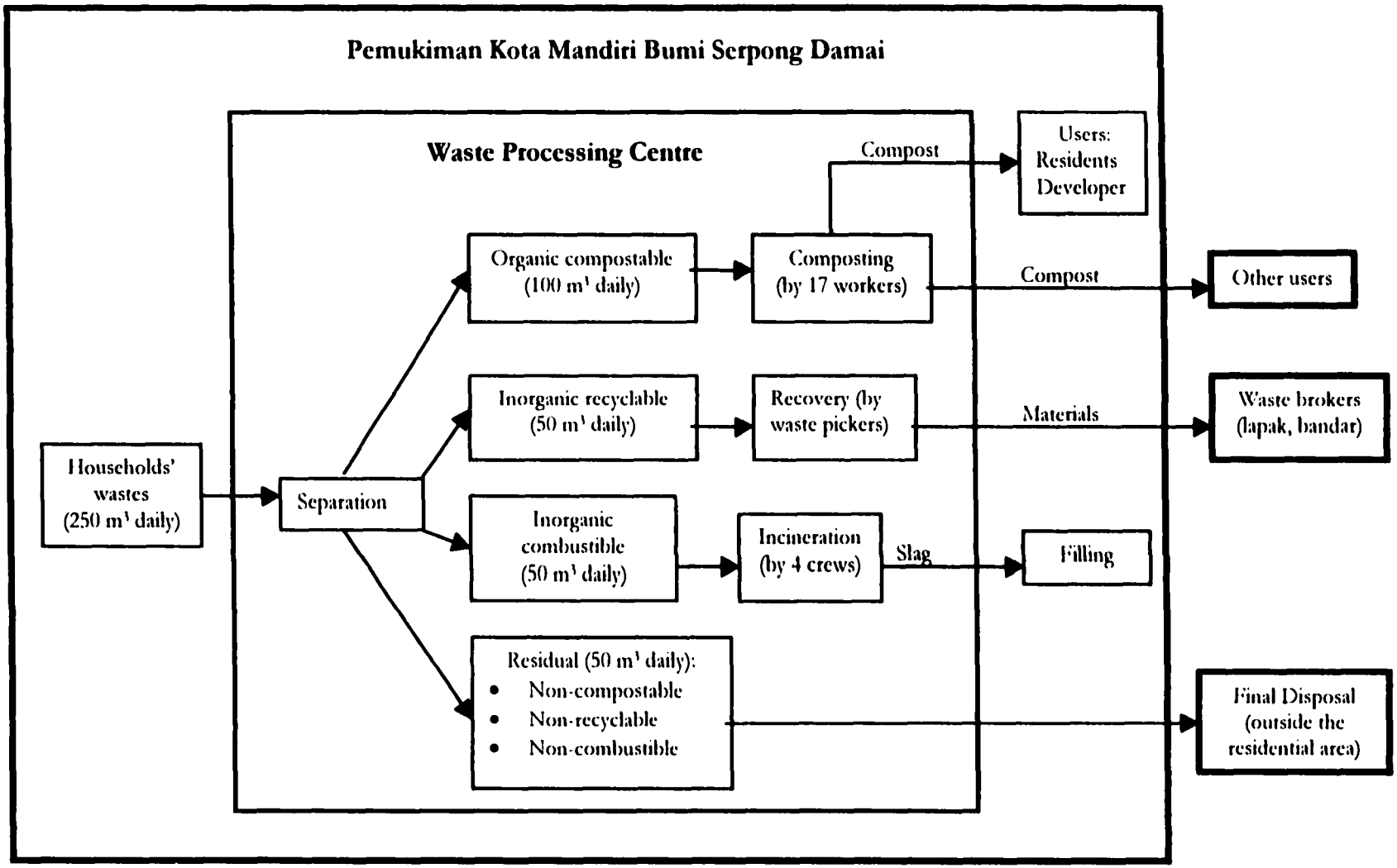


Figure 38. An integrated solid waste management system in Pemukiman Kota Mandiri Bumi Serpong Damai (Tangerang, West Java)

Source: *Kompas Online*, 21-Oktober-1999

The next idea about IMSWPM perceived by the Directorate General of Human Settlement Development (DJCK) and waste consultants was that IMSWPM should combine top-down and bottom-up planning. In this regard, the consultants stressed the importance of the planning process by mentioning that IMSWPM should involve more actors. Meanwhile, DJCK described top-down planning as needing to consider government laws and regulations, principles and theories in MSWPM, techniques in MSWPM, and procedures and standards in MSWPM, and bottom-up planning to take into account local needs, local conditions (economy, social, cultural), the existing practices in MSWPM, and inputs from the local community.

Another idea about IMSWPM in Indonesia suggested by the World Bank was that IMSWPM should be responsive to local needs. IMSWPM should facilitate the fulfilment of the immediate needs of certain people (community), not just those of government officers. The next idea about IMSWPM proposed by waste consultants in Bandung was that IMSWPM should adopt a new paradigm that waste is everybody's problem. They stated that many people might still think that waste is the sole responsibility of PDK-Bandung. The proposed paradigm, as the consultants argued, would require responsibility from every individual.

The last idea about IMSWPM, proposed by the Agency for Technology Assessment and Application (BPPT), was that IMSWPM should be considered as a component of the city's Master Plan (Rencana Induk Kota- RIK) and in the Detailed Spatial Plan (Rencana Detil Tata Ruang Kota - RDTRK) to support the achievement of sustainable cities. According to BPPT, the current municipal solid waste plan was still detached from the city's master plan and spatial plan.

6.7. Goals of IMSWPM for Indonesia

Various goals of IMSWPM can be identified from the interviews and documents provided by respondents. The first goal is to maintain the quality and integrity of the environment, was suggested by the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Department of Health, the Environmental Research Centre (PPLH) - ITB, waste recyclers, and the World Bank. DJCK, for instance, argued that the city's cleanliness, health, and beauty were prerequisites for social welfare. The Department of Health stated that ensuring the quality of the living environment is part of minimizing health disturbance to urban residents. PPLH-ITB and waste recyclers thought that reduction of pollution from waste is inseparable from preserving the quality and integrity of the

Bandung urban environment. These recyclers said that they can take part in this effort by diverting some valuable materials that would otherwise become pollutants. Officials of the World Bank said that in order to maintain the quality of the urban environment, waste service coverage should be increased and service quality should be improved.

Adoption of 3Rs (reduce, reuse, recycle) or 4Rs (reduce, reuse, replace, recycle) is the second goal. This goal received much attention by most stakeholders during the interviews. An important finding was that waste minimization or reduction efforts had been given a high priority by many respondents, such as the National Planning Board (Bappenas), the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Development (BPPT), the Department of Health, DTC-ITB, a contractor, waste consultants, some professors, and the World Bank. In this regard, Bapedal had initiated waste minimization for industries by introducing a cleaner production policy based on the paradigm of front-of-pipe instead of end-of-pipe. As mentioned before, DJCK had also prepared policies of 4Rs for waste generators.

The third goal of IMSWPM is to promote partnerships among governments, community, private sector, and other actors such as NGOs. This idea was suggested by Bappenas, DJCK, the Department of Health, professors, an NGO, and the World Bank. Facilitating coordination among actors involved in MSWPM is the fourth goal. Respondents suggesting this goal included Bappenas, the State Ministry of the Environment, Bapedal, the Department of Health, the Department of Parks, the Department of Education and Culture, the Department of Labour, the Department of Social Affairs, PDK-Bandung, PPLH-ITB, and some professors. The adoption of this goal was motivated by various reasons. The State Ministry of the Environment, Bapedal, PPLH-ITB, and professors argued that coordination can lead to more integrated policies and planning. Bappenas and Bapedal mentioned that coordination could strengthen institutions to perform their tasks and thereby improve urban environmental management capacity. The Department of Labour, the Department of Social Affairs, and the Department of Education and Culture stated that coordination of various actors (agencies) can be used to share responsibilities and budget for more effectiveness. Similarly, the Department of Parks, PDK-Bandung, and the district cleaning department (Dinas Kebersihan Kabupaten Bandung) mentioned that coordination of efforts among them was useful in keeping the city

clean. The PDK-Bandung and and Dinas Kebersihan Kabupaten Bandung expected that coordination could be used to mediate and resolve conflicts among agencies. The Department of Health thought that coordination of various actors would increase capacity law enforcement.

The fifth goal is to nurture public education and participation. In other words, public empowerment should be a goal of this new approach. This proposition was conveyed by the Directorate General for Human Settlement and Development (DJCK), the State Ministry of the Environment, the Department of Education and Culture, the Department of Parks, the Department of Health, PPLH-ITB, and professors. The Department of Education and Culture was particularly concerned with educating the younger generation about cleanliness and to stay healthy. The Department of Health thought that knowledge about proper waste management and risks from waste should be given to the public. DJCK and professors argued that public participation would work only if they know and understand the complex problems of MSWPM in Bandung. Thus, public education was expected to educate the public, increase their awareness, and hopefully increase their willingness to participate. PPLH-ITB recommended several topics for public education in Bandung, including waste minimization at households; proper storage, placement, and disposal; obligation to pay retribution; recycling; composting; health risks from waste; and, law enforcement.

The sixth goal is to support the use of appropriate technology. This goal was suggested by DJCK, the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Agency for Technology Assessment and Application (BPPT), the Development Technology Centre (DTC) -ITB, the Environmental Research Centre (PPLH) - ITB, professors, a contractor, and the World Bank. Their opinions about the term appropriate technology, however, differed and can be categorized into two different positions. The first regarded appropriate technology as any technology that can be used to tackle particular problems of MSWPM. As long as this technology could meet all standards and other requirements, then it should be used. An important point from this view is that an appropriate technology does not necessarily imply an inexpensive one. This predominant position was supported by many actors, such as DJCK, the State Ministry of the Environment, Bapedal, the Department of Health, BPPT, a contractor, some professors, and the World Bank. The second opinion was held by DTC-ITB, PPLH-ITB, and some other professors. Basically, they said that an appropriate technology did not necessarily have to be expensive. In their view, the most

important features of an appropriate technology are that it be simple, cheap, replicable, and implementable through a gradual process.

The last goal is that employment opportunities should be created in order to alleviate urban poverty. Respondents raising this goal were PPLH-ITB, DTC-ITB, and waste recyclers. Every respondent had the same concern with helping waste pickers in Bandung. The waste recyclers, in addition, hoped that the creation of employment opportunities would not only assist waste pickers, but also support the development of small recycling businesses.

6.8. Benefits of IMSWPM

Stakeholders in MSWPM in Bandung and Jakarta perceived many potential benefits. A benefit proposed by officials of BPPT was a reduction in the amount of waste generated and corresponding impacts on the urban environment. They argued that this benefit could be attained through the use of several options, such as reduce, reuse, recycle, composting, and safe disposal. It should be noted that BPPT's vision about integrated municipal solid waste management resembled the view about integrated waste management in developed countries.

Two additional benefits recognized by many stakeholders in Bandung and also in Jakarta, especially by government officials, are integrated policies/planning and integrated programs/efforts. Many expressed the importance of integrated policies not only in municipal solid waste management but also in urban environmental management in general because of a concern about overlapping policies among government institutions. The benefit of achieving integrated policies was voiced by the National Planning Bureau (Bappenas) and the Municipal Planning Bureau (Bappeda), the Directorate General of Human Settlement Development (DJCK), the State Ministry of the Environment, the Environmental Impact Management Agency (Bapedal), the Environmental Research Centre (PPLH) - ITB, PDK-Bandung, waste consultants, and the World Bank. Furthermore, the benefit of having integrated programs or efforts was perceived by many stakeholders. They included Bappenas and Bappeda, the Department of Public Works, the Department of Education and Culture, Bapedal, BPPT, PPLH-ITB, DTC-ITB, the Department of Parks, the Department of Health, PDK-Bandung, waste consultants, and the World Bank. Most of these stakeholders argued that integrated programs/efforts should increase the chances for sustainable actions.

A few stakeholders thought that IMSWPM could also strengthen capacity of institutions and subsequently increase the capacity of the municipality to deal with waste management as

well as other urban environmental management issues. This benefit was proposed by Bappenas, the State Ministry of the Environment, Bapedal, PPLH-ITB, DTC-ITB, the Department of Health, professors, and the World Bank.

Strengthened partnerships were considered by Bappenas, a waste contractor, some professors, an NGO, and the World Bank as a benefit through recognition and involvement of governments, the private sector, and the public. Enhanced planning is another benefit. Officials of DJCK and BPPT and some professors contended that IMSWPM should accommodate inputs from the public. Similarly, officials of the World Bank added that IMSWPM would be a better planning approach if it were responsive to the immediate needs of the local community.

Another benefit of IMSWPM perceived by stakeholders is reduced bureaucratic hurdles. This benefit was suggested by the State Ministry of the Environment, the Department of Parks, and some professors. They commented that this benefit could be achieved through coordination among stakeholders involved in MSWPM. Officials of the State Ministry of the Environment said that bureaucracy had hindered them in getting the necessary data from other government institutions for their studies. Meanwhile, officials of the Department of Parks stated that from their experience the bureaucracy often slowed down their actions.

The Environmental Impact Management Agency (Bapedal), the State Ministry of the Environment, the Department of Health, officers of the municipal government of Kotamadya Bandung, some professors, and the Police Department consider increased effectiveness in law enforcement as a major benefit. Weak monitoring and law enforcement has been a common problem throughout Indonesia, including Bandung.

The last benefit of IMSWPM suggested by the Directorate General for Human Settlement and Development (DJCK), PDK-Bandung, the district cleaning department (Dinas Kebersihan) of Kabupaten Bandung, and waste consultants was resolving conflicts and gaining consensus. As mentioned previously, PDK-Bandung and Dinas Kebersihan Kabupaten Bandung were involved in some conflicts, and they strongly believed that those conflicts could have been resolved if they met more frequently.

6.9. Barriers to the Implementation of IMSWPM

Interviews with respondents revealed a few main barriers to the implementation of IMSWPM in Indonesia, including Bandung. These obstacles comprise institutional

bureaucracy, gaining consensus, sustaining the process, gaining local community support, and politics.

The first barrier identified by many respondents was the institutional bureaucracy that could hinder coordination among actors. This limitation was raised by the Directorate General for Human Settlement and Development (DJCK), the State Ministry of the Environment, the Department of Parks, PDK-Bandung, professors, an NGO, and the World Bank. Some professors in Bandung said that bureaucracy or institutional arrogance had led to piecemeal thinking and weakened efforts which hindered the integration of policies. The Department of Parks added that bureaucracy could hinder efforts in bringing together various actors. One NGO in Jakarta was doubtful about bringing together stakeholders to take part in solving the various problems in MSWPM. As mentioned before, this NGO was unsure about the distribution of power among government institutions, community, and its own organization. The State Ministry of the Environment, DJCK, and the World Bank acknowledged that strong political commitment or the involvement of social actors such as the city's Mayor could have a significant impact in overcoming bureaucracy.

The second barrier was difficulty to gain consensus among interested parties. Actors that suggested this idea included the Directorate General for Human Settlement and Development (DJCK), the State Ministry of the Environment, PDK-Bandung, the district cleaning department (Dinas Kebersihan) of Kabupaten Bandung, consultants, and professors. DJCK, for instance, provided an example about seeking a consensus with representatives of a local community in order to find a landfill site. The negotiation process was long and very difficult. The State Ministry of the Environment and professors predicted that gaining a consensus on decision making, strategy formulation, and policy making among various actors might not be easy. PDK-Bandung and Dinas Kebersihan Bandung also agreed that finding a win-win solution in a conflict was not easy.

Another barrier would lie in sustaining the process, in particular if the process takes place over a long period of time. DJCK, for instance, commented about the limited budget available to support such a process. The Department of Health, the Environmental Research Centre (PPLH) of ITB and some professors added that maintaining a long-term commitment from a community to be involved in a lengthy process may pose a major problem.

Another barrier to the implementation, as noted by the Department of Health, PPLH-ITB, and some professors, would be gaining the local community's support and also mobilizing them. The professors mentioned that if the local community had limited experience and capability to be involved in a partnership, then empowering them becomes a necessity. In this respect, the Development Technology Centre (DTC) of ITB thought that more empowerment should also be given to government institutions to improve their capacity.

The last barrier mentioned by one NGO in Jakarta, involved the politics or the possibility that the idea of partnerships will be abused. This NGO warned that partnerships of stakeholders as espoused by IMSWPM should be treated only as a means to achieve its various goals and not as a goal by itself. This NGO argued that partnerships of stakeholders could be used by government institutions or officers to legitimize their action by saying that they had conducted participatory or democratic processes by including other actors, when in fact the involvement often was minimal.

6.10. Opportunities for the Adoption of IMSWPM

The above findings suggest five main opportunities for the introduction, adoption, and implementation of IMSWPM in Indonesia, and particularly, in the Municipality of Bandung, Indonesia. The first is Indonesia's Agenda 21, prepared by the State Ministry of the Environment. The second is the policy on 4Rs (reduce, reuse, replace, recycle) drafted by the Directorate General of Human Settlement Development (DJCK) of the Department of Public Works. This policy recognizes the importance of waste reduction efforts. Moreover, it will encourage local authorities to shift their attitude from collection-transportation-disposal to source reduction initiatives. In other words, the use of the conventional approach to MSWPM will be discouraged and could be changed toward an approach that promotes reduction efforts. Furthermore, this policy will also recognize and foster involvement and participation from various actors or stakeholders, such as the governments, private sector, public, and others. The third opportunity is the pilot project of PDK-Bandung with its integrated final disposal site. This project represents the integrated approach to MSWPM in terms of the various options of recycling, composting, waste reduction through incineration, energy recovery, and sanitary landfilling. This pilot project reflects an early understanding about the appropriateness of the integrated approach to MSWPM in the Municipality of Bandung and this is a golden opportunity to introduce IMSWPM to PDK-Bandung. The fourth opportunity is the support

from chiefs of neighbourhood units, households, and students. The findings shown previously indicate their collective support for source separation, recycling that involves waste pickers, and composting. In addition, many stakeholders also raised their concern regarding the importance of coordination and partnerships. All those supports suggest another good opportunity for the introduction, adoption, and implementation of IMSWPM in Bandung. The last opportunity is the City Development Project since it nurtures cooperation and participation from various stakeholders: the public, universities, non-governmental organizations, and the municipal and district governments.

A summary about the findings on IMSWPM, including vision and mission of the Bandung City, ideas, problems, goals, benefits, barriers, and opportunities for implementation, is illustrated in Figure 39.

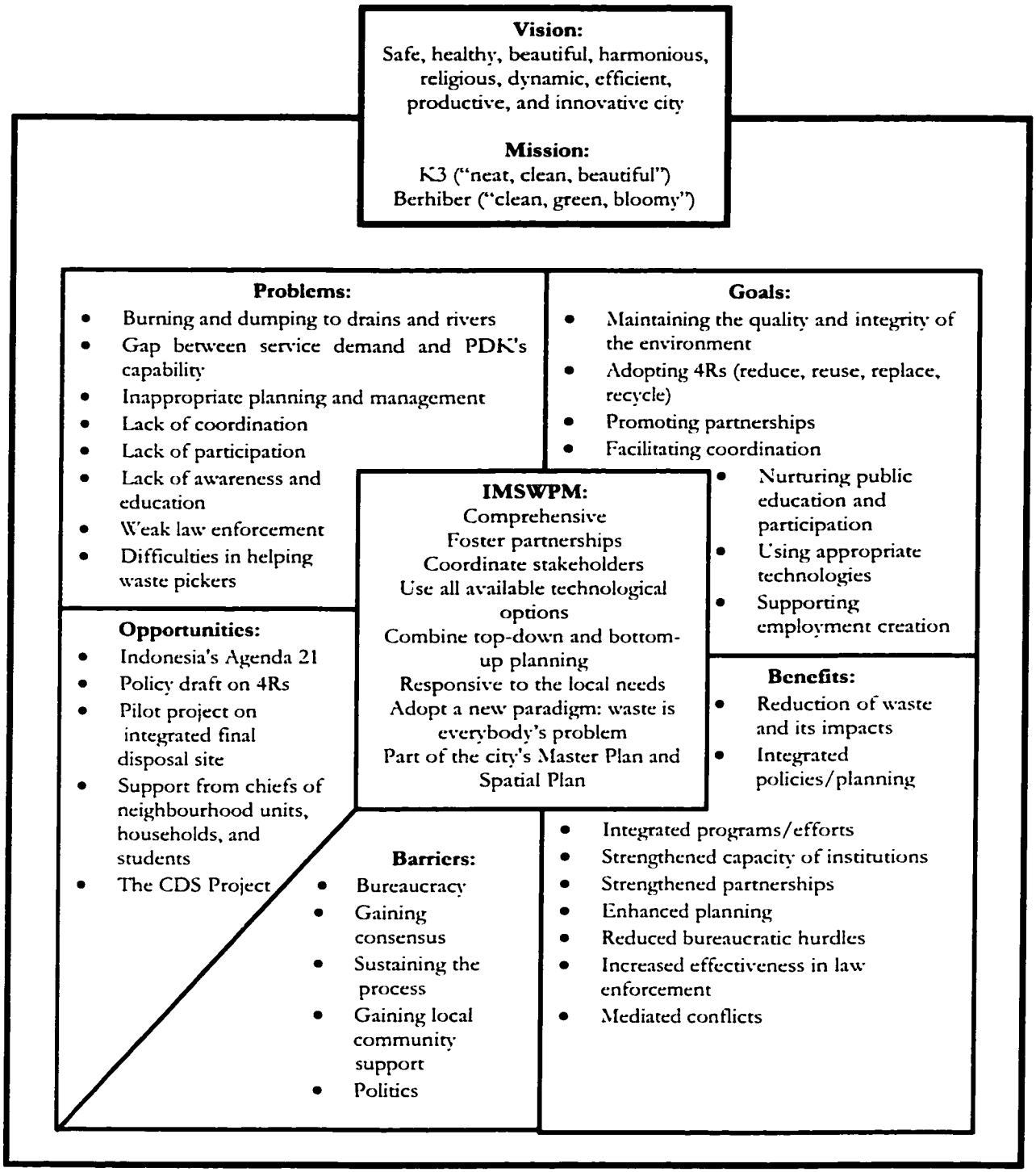


Figure 39. Summary of findings about IMSWPM

CHAPTER 7.
ANALYSIS AND EVALUATION

The objective of this chapter is to analyze and evaluate the potential of integrated municipal solid waste planning and management (IMSWPM) in the Municipality of Bandung based on the findings presented in Chapter 6 and the criteria (feasibility and sustainability) discussed in Chapter 4. The feasibility of IMSWPM is examined from various perspectives, including ideological, technical (operational), legal, political, institutional, social, and financial. The sustainability of IMSWPM is viewed regarding its contribution to economic, social, and environmental aspects.

7.1. Feasibility of IMSWPM

7.1.1. Ideological

Ideological feasibility of IMSWPM deals with the rationale for adopting this approach. Several reasons for the necessity for integrated planning and management were mentioned in the literature review, including the need to tackle complex problems (Halla and Mojani, 1999; Hoornweg and Thomas, 1999), the necessity for a holistic view in solving various problems (UNEP, 1996 as cited in Hoornweg and Thomas (1999)), the need for achieving various objectives (Crutcher and Yardley, 1991; Poland, 1991; Ham, 1992), the dissatisfaction with narrowly-focussed management (Bowonder, 1987; Born and Sonzogni, 1995; Margerum and Born, 1995; Hooper, McDonald and Mitchell, 1999), failures in dealing with competing views (Bowonder, 1987; Hooper, McDonald and Mitchell, 1999), and the need to capture maximum benefits through coordinated action (Erbel, 1982; Lang, 1986b; Mitchell, 1990; Hooper, McDonald and Mitchell, 1999).

Various problems in municipal solid waste planning and management (MSWPM) in the Municipality of Bandung comprise environmental pollution due to household waste, the gap between increasing service demand and the capability of PDK-Bandung, inappropriate planning and management, lack of coordination among actors, lack of participation, lack of awareness and education, weak law enforcement, and difficulties in helping waste pickers. These problems involve various physical, technical, social, financial, institutional, political, and legal issues. In addition, the municipality also faces some challenges, such as the increasing

production of waste due to population growth, urbanization, and industrialization; the need for disposing of waste quickly and properly; the increasing demand for satisfactory service provision; the need to increase public awareness and participation; the desire to have a healthy city; and, difficulties in finding landfill sites. With regard to the complexity of the problems and challenges in waste management, IMSWPM is a suitable approach.

The growing dissatisfaction with narrowly focussed management is highlighted by the use of the conventional approach used by PDK-Bandung. First, PDK-Bandung uses the paradigm of "collect-transport-dispose". Second, PDK-Bandung has little interest in resource recovery or recycling initiatives. Third, PDK-Bandung still considers itself as the sole authority for waste management the municipality. Besides maintaining the cleanliness of the city, other issues should be addressed and each requires involvement and participation from others.

Another reason to adopt the integrated approach is a need to deal with competing views or conflicts. One example of a conflict is assisting waste pickers. There were two competing views about appropriate efforts to help waste pickers. The first was to change the waste picking occupation. This view was supported by the Department of Social Affairs and the Department of Labour. The second was that waste pickers should be recognized and their activities should be facilitated. This view was supported by the Environmental Research Centre (PPLH) - ITB, the Development Technology Centre (DTC) - ITB, waste recyclers, some consultants, and the World Bank. IMSWPM is an appropriate approach to address this conflict. First, stakeholders expected that IMSWPM would provide them with a medium for resolving conflicts and gaining consensus. Second, the findings about waste pickers by the GTZ's consultant indicated that 32% of the respondents wanted to change their current occupation and 56% wanted to stay in Bandung as waste pickers or waste brokers (lapak or bandar). Therefore, the Department of Social Affairs and the Department of Labour can still provide training to waste pickers who want to change their occupation, while those who support waste pickers can help them conduct their activities in a more organized, safe, and healthier manner.

Stakeholders expected to capture various benefits from coordination of many aspects of MSWPM. They hoped that an integrated approach would become a medium for achieving some important objectives such as reducing the amount of waste generated and its impact on the urban environment; seeking integrated policies, planning and programs; strengthening

municipal institutions; fostering partnerships of stakeholders; reducing bureaucratic hurdles; and, mediating conflicts. These expectations are all in line with IMSWPM.

7.1.2. Technical/Operational

Technical or operational feasibility of IMSWPM is examined regarding the goodness of fit between this approach and existing practices, including waste reduction and reuse, source separation, service provision or collection and transportation, recycling, composting, and safe disposal. According to some stakeholders, such as the Directorate General of Human Settlement Development (DJCK), a waste consultant, and some professors, reuse has been traditionally conducted by households, in particular the low-income ones, in their daily lives, particularly during the recent economic crisis. In other words, reuse is technically feasible because households have consciously practiced it based on their own will.

The Directorate General of Human Settlement Development (DJCK) with assistance of a local waste consulting firm has developed technical guidelines for waste reduction for households, markets, commercial establishments, and industries. In these guidelines, households can achieve waste reduction by choosing or purchasing any product with less packaging, avoiding single use items, and avoiding the use of more plastic bags for packaging. These guidelines appear simple and technically should be easy to implement. Technical guidelines for waste reduction efforts in markets include selling products without plastic bags, giving a limited number of plastic bags, and encouraging buyers to bring their own reusable bags. These guidelines may not be easy to implement. This situation is almost similar for commercial establishments. They will unlikely refuse their customers' request for extra (packaging) bags.

With the current economic crisis, coupled with advances in computer and telecommunication technologies, the practice of waste reduction initiatives by offices toward an effective, efficient, and paper-less office perhaps is underway, in particular in the private businesses. Thus, the DJCK's guidelines for waste reduction by offices seem to be operationally feasible because they become a necessity for both governments and private businesses as they strive for savings in their budgets. Although DJCK had also prepared guidelines for waste reduction initiatives by industries, the Environmental Impact Management Agency (Bapedal) has the mandate to promote and implement waste reduction for industries through the introduction of Clean Production principles with a particular focus on hazardous

waste. One of the biggest handicaps for the implementation of Clean Production practices is that it is still based on persuasion. Industries are unlikely to be willing to make adjustments to their production system.

Separation of waste at source into dry and wet streams has not become mandatory for waste generators in the municipality. The municipal government only has an instruction encouraging residents to separate their wastes into organic and inorganic streams, and each desa or kelurahan to have at least one site for collecting the inorganic waste. This instruction is easy to understand and implement. In general, practices of source separation by households into dry and wet streams as suggested by the municipal government and DJCK are lacking. Source separation should be technically feasible if households have the freedom to provide their own bins for storing the inorganic and organic streams and the use of dual containers should not consume a lot of space in their homes. The use of standardized bags should not be endorsed. Learning from the failure of a pilot project for residential source separation in Jakarta, the success of source separation by households in Bandung will be influenced by the willingness of PDK to adapt some of its collection vehicles to facilitate the collection and transportation of both organic and inorganic wastes. The role of community leaders such as Ketua RT or Ketua RW will be influential in persuading their members to practice source separation. For some private businesses, source separation has been practiced to earn extra income. As an example, many large-scale private businesses continue to be the major providers of corrugated papers from their source separation activities. Source separation along streets only require the provision of different bins for dry and wet waste, as well as signs about laws for disposing waste at illegal places. Those guidelines have been implemented in Bandung.

The proposed IMSWPM acknowledges the importance of local community organizations and the local cleaning authority both in providing collection and transportation services. The idea of a partnership between the local government and the private sector in service provision is also emphasized. In the Municipality of Bandung, local community organizations at the neighbourhood levels such as RT (Rukun Tetangga) or RW (Rukun Warga) have been responsible for providing the primary collection and transportation service from householders to temporary disposal sites. Meanwhile, PDK-Bandung as the local cleaning enterprise has been responsible for providing the secondary collection and transportation service from temporary to final disposal sites. Therefore, the scheme of involving local

community organizations and the municipal cleaning institution in service provision fits well operationally with the existing practice.

Providing recycling sites as proposed by IMSWPM was recognized as important by officials of PDK-Bandung. However, they judged these sites to be technically infeasible in the future because of uncertainties in land availability and funds. It should be noted that PDK-Bandung had informally allowed its waste collection crews to use two transfer depots as sites for sorting the Aqua[1] plastic bottles.

DJCK has also developed technical guidelines for recycling initiatives. The recycling guidelines for households and markets are identical with those for source separation because DJCK argued that source separation should become the backbone of recycling activities. Commercial establishments and offices can support recycling efforts by using products than can be recycled. According to Indonesia's Agenda 21, commercial establishments and offices can also participate through purchasing products made from recycled materials. If detailed information about products made from recycled materials could be available, the DJCK's guidelines and Agenda 21's suggestion could be practiced by commercial establishments and offices.

Household- and community-level composting initiatives in the municipality have been rare. According to the technical instruction of the municipal government, each household with spacious yards is urged to install a small-scale composter and each community area (Rukun Warga) should have at least one community-level composter. Household and community composting are technically feasible provided the requirements proposed by chiefs of neighbourhood units can be met such as the provision of suitable space, using appropriate technology, proper operation and management, consultation with the community, and supervision from PDK's officials. Municipal-level composting has been practiced by PDK-Bandung using simple windrow technology. According to officials of PDK-Bandung, they have used this technology to produce compost for plantation sites. The use of simple windrow technology is technically feasible because officials of PDK have the knowledge, skills and experience.

Three final disposal sites owned by PDK-Bandung have been designed and built as sanitary landfills. As a pilot project, TPA Pasir Impun has been operated as an integrated final

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[1] "Aqua" is a well-known brand name of natural spring water.

disposal site. It uses a sanitary landfill and a small-scale incinerator. TPA Jelekong and TPA Leuwi Gajah have been operated as strictly landfills mainly due to constrained budget. This study would suggest a sanitary landfill could be operationally feasible because it can be operated by officials of PDK-Bandung, while incineration currently is not feasible because of the lack of competent staff.

In conclusion, a number of practices proposed by IMSWPM are technically feasible. A summary of the analysis is shown in Table 58.

7.1.3. Legal

The legal feasibility of IMSWPM was examined in relation to the existing laws, regulations and government policies pertaining to an integrated approach, waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. At the national level, the credibility for an integrated approach to MSWPM is provided by Indonesia's Agenda 21 which proposes integration of four areas: minimizing waste; maximizing reuse, recycling and composting; increasing service coverage; and, using environmentally-sound waste disposal. In this Agenda, improving community awareness and participation in waste reduction is considered a short-term objective, and public education to promote the use of products made from recycled materials and to participate in reuse at household level is a short-term program. Agenda 21 recognizes three possible actors for providing service: municipal cleaning authorities, private contractors, and local community organizations. It also recognizes the role of waste pickers in recycling businesses. The agenda suggests development and implementation of a marketing strategy to increase the markets for compost to different target users in agriculture, nurseries, plantations, and households. The necessity for environmentally-sound waste disposal practices, using sanitary landfills, controlled landfills, and/or incineration is also emphasized.

Other policies at the national level have been from the Directorate General of Human Settlement Development (DJCK), the Department of Industry and Trade, and the Department of Health. A policy of DJCK was about 4Rs (reduce, reuse, recycle, replace). Besides emphasizing involvement of various actors in 4Rs, this policy also recognizes the important role of recovery and recycling not only in reducing the amount of waste requiring treatment and disposal, but also in employment creation. Moreover, the policy also acknowledges waste

Table 58. Technical feasibility of IMSWPM in the Municipality of Bandung

Practices	Findings	Evaluation
• Waste reduction and reuse	• Reuse has been practiced by households, in particular low-income households. • DJCK's technical guidelines for waste reduction for households, markets, commercial establishments, and industries. • Bapedal's responsibility in promoting Clean Production principles to industries.	• Reuse is operationally feasible. • DJCK's guidelines for waste reduction for households are simple and should be technically feasible. • DJCK's guidelines for waste reduction for markets and commercial establishments are technically difficult to implement. • DJCK's guidelines for waste reduction for offices can be technically feasible. • Clean Production practices are technically difficult to implement.
• Source separation	• Source separation by households, are still voluntary and lacking. • DJCK's guidelines about the use of standardized bags to facilitate source separation. • Technical instruction for source separation from the mayor. • Source separation by private businesses to earn extra income.	• Source separation by households can be technically feasible if it is supported by PDK, facilitated by community leaders, and lets households provide their own bags. • Source separation of valuable materials is technically feasible for private businesses.
• Service provision	• Involvement of both local community organizations and PDK-Bandung.	• The existing scheme in service provision has been operationally feasible.
• Recycling	• No formal sites for recycling by waste pickers. • Informal practices of plastic bottle recovery by PDK' collection crews. • DJCK's guidelines about recycling for households, commercial establishments, offices, and industries.	• Recycling sites are technically infeasible due to uncertainty in land availability and funds. • DJCK' guidelines about recycling by commercial establishments and offices should be technically feasible in the future.
• Composting	• Lack of household- and community-level composting initiatives. • Certain requirements for implementing community-level composting. • Municipal-level composting by PDK-Bandung using simple windrow technology.	• Community-level composting should be operationally feasible if the requirements can be met. • Municipal-level composting is technically feasible because PDK-Bandung has the knowledge, skills, and experience.
• Safe disposal	• All three final disposal sites were designed and constructed as sanitary landfills. • Incineration is still in the pilot project ("learning phase").	• The use of sanitary landfill is technically feasible, while incineration is not.

pickers as an important actor in recovery and recycling businesses. The policy of the Department of Industry and Trade on the waste recycling industry has been "inaction" because it lets recovery and recycling businesses exist and grow as long as they do not create problems for the environment, for instance, pollution. The Department of Health has issued a policy regarding health standards for recycling, composting, and disposal activities. In this policy, controlled waste burning can be practiced by households, communities, or municipal cleaning authorities as a means of waste reduction.

At the municipal level, there has not been any municipal law or government policy passed which specifically recognizes the necessity for an integrated approach to municipal solid waste planning and management. The legitimacy for IMSWPM, therefore, is lacking. Laws and policies for waste reduction and reuse were absent. Legal support for source separation rests with an instruction from the mayor. As mentioned previously, a municipal law has determined the arrangements for service provision by both local community organizations and PDK-Bandung. The role of private contractors has not been accepted by the municipal government. Unlike policies at the national level, the role of waste pickers has not been officially accepted by the municipal government, including PDK-Bandung. Composting receives support through an instruction from the mayor. However, this instruction is insufficient because it does not make composting mandatory for communities. No laws have been specifically issued to deal with recovery and recycling. The municipal law which designates PDK's mandate emphasizes the importance of environmentally-sound waste disposal practices at both temporary and final disposal sites. Table 59 summarizes the analysis.

7.1.4. Political

The political feasibility of IMSWPM is analyzed on four aspects: acceptance by stakeholders, political will, capacity to enforce decisions, and existence of specific phenomena such as corruption and intimidation. Most stakeholders in Bandung and Jakarta, including officials of government institutions, representatives of the World Bank, professors, and an NGO, accept IMSWPM as an appropriate approach to manage wastes in metropolitan or large cities in Indonesia. A few respondents were pessimistic about this approach. Professors commented that IMSWPM is an ideal approach because the Government of Indonesia in 1996 was just promoting the ideas of integration ("keterpaduan") of policies, and partnership

Table 59. Legal feasibility of IMSWPM in the Municipality of Bandung

Aspect	Available laws/regulations/policies		Evaluation
	National level	Municipal level	
• The necessity for an integrated approach to MSWPM	• Agenda 21	• Not available	• Lack of legitimacy for IMSWPM
• Waste reduction and reuse	• Agenda 21 • Policy draft on 4Rs • Policy regarding waste burning	• Not available	• Lack of laws/regulations/policies regarding waste reduction and reuse • Policy of waste burning should be changed.
• Source separation	• Agenda 21 • Policy draft on 4Rs • Policy about health standards	• Instruction from the mayor (persuasion)	• Legal support for source separation is insufficient
• Service provision	• Agenda 21 • Policy from DJCK	• A municipal law	• Legitimacy for involving community organizations and PDK-Bandung is sufficient. • Legal support for involving private contractors in service provision is not available.
• Recycling	• Agenda 21 • Policy draft on 4Rs • Policy about health standards • "Inaction" policy of the Department of Industry and Trade	• Instruction from the mayor (persuasion)	• Lack of credibility for recycling • Lack of legitimacy for waste pickers' involvement in recycling activities
• Composting	• Agenda 21 • Policy about health standards	• Instruction from the mayor (persuasion)	• Lack of legitimacy for household- and community-level composting
• Safe disposal	• Agenda 21 • Policy from DJCK • Policy about health standards	• A municipal law	• Legitimacy for safe disposal practices is sufficient.

("kemitraan") of stakeholders in many of its policies, including urban environmental management. They commented that it would take time to see whether these ideas would be implemented or they would just become political jargon. One senior researcher at the Development Technology Centre (DTC) of ITB was skeptical about IMSWPM unless government institutions were strengthened to enable them to integrate policies and planning, and to engage in partnerships of stakeholders.

Many stakeholders believe that the integrated approach is appropriate to deal with the various issues associated with municipal solid waste planning and management. They proposed various goals for the integrated approach, included maintaining or preserving the integrity and quality of the environment, adopting 4Rs (reduce, reuse, replace, recycle), promoting partnerships among stakeholders, facilitating coordination, supporting the use of appropriate technology, and supporting the creation of employment opportunities. All these goals are in line with IMSWPM.

The current political will for IMSWPM in the Municipality of Bandung is weak, although there have been some initiatives by the municipal government to address cleanliness, beauty, and social order. The previous mayor had tried to establish a team assigned with the task of designing a system which could integrate the informal waste picking activities and the formal waste collection system operated by PDK-Bandung. This idea is similar to what is proposed by IMSWPM as well as Indonesia's Agenda 21. It was unfortunate, however, that the recommendations of that team were never implemented

The capacity to enforce decisions pertaining to IMSWPM is also weak. Poor law enforcement in environmental management, including waste management, has been a common problem throughout Indonesia. In the Municipality of Bandung, the Police Department acknowledged that it was almost impossible for its department to enforce a municipal law forbidding anyone from throwing waste haphazardly at places not designated as disposal sites. Officials of the Department of Health said that the operation of landfills owned and operated by PDK-Bandung did not usually follow the standards issued by their institution, but they could do little.

Specific phenomena such as corruption and intimidation may exist but not be easily visible. A local newspaper[2] reported corruption in the cleaning department of the Bandung District (Dinas Kebersihan Kabupaten Bandung). The alleged corruption occurred regarding the collection of service fees from traders at markets and from side-walk moving vendors (Pedagang Kaki Lima (PKL)). Two modes of corruption were notified by members of the parliament of Kabupaten Bandung: the amount of fees collected from traders and moving vendors was larger than what is stated in the district law, and the receipts for the collected fees were not given to the payers. The parliament members suspected that fee collectors took some money in their pockets, resulting in less money being given to the district government. This occasion should give a good lesson for PDK-Bandung in order to ensure that the same practice does not take place.

Waste consultants in Bandung mentioned the case of intimidation of waste pickers. They noted the exploitative relationship between waste pickers and their brokers in which the former usually have a low bargaining position in waste trading activities. Waste brokers set the price for the materials sold by waste pickers. Municipal government officials in Kotamadya Bandung disagreed with allowing waste pickers to scatter around the city to collect valuable materials. Municipal authorities conduct operations to catch beggars, homeless, and moving waste pickers and send them to prison. PDK-Bandung officially does not acknowledge waste pickers.

In sum, the political feasibility of IMSWPM in the Municipality of Bandung is mixed because although there have been some positive signs, there also are some challenges or constraints. Table 60 summarizes the analysis and evaluation.

7.1.5. Institutional

Following Borrini-Fayerabend's (1999) proposition, the institutional feasibility of IMSWPM is assessed relative to three aspects: existing bodies and rules for municipal solid waste planning and management; inter-institutional relations, coordination and conflicts; and, organizations of stakeholders. Three major government institutions are responsible for solid waste in the Municipality of Bandung: PDK-Bandung, the Department of Parks, and the

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[2] "Diperkirakan Mencapai Milyaran Rupiah. DPRD Menduga Ada Kebocoran di 3 Dinas". *Pikiran Rakyat Online*, 30-Nopember-1999. (http://www.pikiran-rakyat.com/1199/30/index.htm).

Department of Public Works. The municipal government has established the organizational structure, mandates, and rules for each institution.

Table 60. Political feasibility of IMSWPM in the Municipality of Bandung

Consideration	Findings	Evaluation
• Acceptance of stakeholders	• Most stakeholders accept IMSWPM as an appropriate approach to waste management. • The proposed goals for an integrated approach to waste management are in line with IMSWPM.	• Positive signs of political acceptability of IMSWPM among government institutions.
• Political will	• Agenda 21 calls for the integrated approach to waste management. • Lack of political will for IMSWPM at the municipal level.	• Lack of political will for the adoption and endorsement of IMSWPM
• Capacity to enforce decisions	• Weak law enforcement.	• Weak capacity to enforce decisions related to IMSWPM.
• Specific phenomena (e.g., corruption, intimidation)	• Exploitative relations between waste pickers and their brokers • Waste pickers in the city can be caught by municipal authorities.	• Allowing waste pickers to scatter in the city is politically unacceptable.

According to the State Ministry for the Environment, one of the major constraints to environmental management in Indonesia is insufficient coordination capability within government institutions to deal with the various environmental issues (KLH, 1995). In the Municipality of Bandung, inter-institutional coordination has been practiced in many initiatives that deal with cleanliness, beauty and social order. The biggest coordination effort, the Adipura Award Success Team, involved fifteen institutions. The City of Bandung received an award for its cleanliness. Other coordinating teams established by the mayor have included those for K3 (clean, green, neat), GDN (national discipline movement), and Justice (Yustisi). The Department of Education and Culture collaborated with the Department of Internal Affairs and universities in conducting public education programs about cleanliness and health for youth. Coordination among government institutions in MSWPM has worked well whenever it directly involved leadership from the mayor.

Of conflicts among institutions, three types were identified in this study. The first was between PDK-Bandung and the district government of Kabupaten Bandung concerning charges

for final disposal sites. The dispute was eventually resolved at the highest political level between the mayor of the municipality and the bupati of the district government. The second conflict occurred between the Department of Parks and the Department of Public Works regarding coordinating cleanliness for the city. The former opted to follow the latter in order to avoid further poor working relationships between them. The third conflict involved those who supported waste pickers, such as PPLH-ITB and NGOs, and the municipal government institutions such as the Department of Labour and the Department of Social Affairs which both refused to acknowledge waste pickers. There was no reconciliation of this conflict. These findings suggest that conflicts related to MSWPM may not always be easy to resolve. When interviewed, officials of the Department of Parks, some professors, and waste consultants shared the same comment that arrogance caused much trouble in cooperation and coordination among various actors.

This study identified five groups of stakeholders in IMSWPM: government institutions, the private sector, individuals, non-governmental organizations, and foreign agencies. Government institutions responsible for municipal solid waste planning and management have been regulated through government laws. The role of the private sector varies. Some have been actively involved such as waste consulting firms and waste processing factories or small-scale waste-related businesses, while others such as many private businesses voluntarily contribute to the greenness of the city through their donations, coordinated by the Department of Parks. The remarkable role of PT. Aqua Golden Mississippi and PT. Coca Cola Indonesia in sponsoring plastic recycling in Bekasi was not found in Bandung, although such efforts would be good for waste pickers in Bandung

Some professors stated that in general the public in the City of Bandung lacked awareness about environmental issues, including solid wastes. This will become a major challenge for IMSWPM that calls for participation from the public, in particular households. Based on the interviews with the neighbourhood chiefs, they can have an important role in increasing awareness of and mobilizing their members because they are informal leaders in their community. The informal neighbourhood scheduled meetings are good media for disseminating messages among households. In addition, those meetings can be used to prepare plans and consensus to maintain cleanliness as well as to support proper waste management practices in their areas.

In Indonesia, non-governmental organizations (Lembaga Swadaya Masyarakat (LSM)) have been well known for their persistent and brave role in criticizing government policies. In addition, they have been reluctant to work with the government. As a consequence, in general, government institutions did not have good relationships with them. Leaders of NGOs in Jakarta in 1997 voiced their concern regarding governments' unwillingness to recognize their roles and participation in urban environmental management. In Bandung, however, one non-governmental organization was reported to work together with the municipal government in developing small-scale, community-based paper recycling activities. The NGO was responsible in organizing the participants (recyclers), while the government provided a two-year loan of 80 million rupiahs (about $ 16,000 dollars Canadian).[3] This finding suggests that non-governmental organizations have a potential role in certain initiatives associated with IMSWPM.

A few foreign organizations have been involved in waste management in the municipality. The Asian Development Bank (ADB), for example, assisted and funded the design and construction of sanitary landfills owned by PDK-Bandung. Germany's GTZ worked to help waste pickers. The World Bank in 1999 facilitated the coordination of various stakeholders in the City Development Strategy (CDS) project. These findings indicate that there are opportunities to involve foreign agencies in various initiatives toward IMSWPM in Bandung in the future.

In conclusion, despite some conflicts among government institutions and poor working relationships between government institutions and non-governmental organizations, IMSWPM that calls for participation from various stakeholders fits with the institutional arrangements in waste management in the municipality. Table 61 summarizes the analysis and evaluation.

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[3] "Kertas Daur Ulang Berdayakan Industri Kecil". *Pikiran-Rakyat Online*, 29-Pebruari-2000. (http://www.pikiran-rakyat.com/2000/0200/29/07290203.htm).

Table 61. Institutional feasibility of IMSWPM in the Municipality of Bandung

Consideration	Findings	Evaluation
• Existing bodies and rules for MSWPM	• Main institutions for solid waste: PDK-Bandung, the Department of Parks, and the Department of Public Works. • Mandate and rules for institutions have been established by the municipal government. • No institution opposed IMSWPM.	• Existing bodies and rules for waste management do not pose obstacles for IMSWPM.
• Inter-institution relations, coordination, and conflicts	• Many government institutions have been involved in various initiatives associated with cleanliness and health, beauty and social order. • The Adipura Award Success Team was a large coordinating committee involving 15 institutions. • The role of the mayor was influential in facilitating coordination among institution. • Inter-institution conflicts may arise and may not be easy to resolve.	• Partnerships of stakeholders in IMSWPM are possible. • Conflict resolution varies depending on the nature of disputes and the actors involved.
• Organizations and roles of stakeholders	• Waste consulting firms, waste processing factories, and small-scale waste-related businesses have been involved in the waste businesses. • Lack of public awareness of the environmental issues. • The informal community organizations can be used to promote awareness and participation toward proper waste management practices. • One NGO worked together with municipal government to develop small-scale paper recycling businesses. • The involvement of some foreign agencies (ADB, GTZ, World Bank) in initiatives associated with waste management and cleanliness.	• The private sector can have a potential role and contribution in some aspects related to IMSWPM . • Potential roles of community leaders and informal community meetings for disseminating messages about cleanliness and proper waste management by households. • NGOs can have a role in various initiatives associated with IMSWPM. • Good prospects for involving foreign agencies.

7.1.6. Social

The social feasibility of IMSWPM was assessed by the level of acceptance by the public for implementing waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal.

The idea of separating waste into wet (organic) and dry (inorganic) streams was supported by 49 out of 60 (82%) neighbourhood chiefs (Ketua RT), 190 out of 310 households (61%), and 330 out of 346 (95%) university students. Acceptance of source separation by neighbourhood chiefs did not depend on the availability of PDK's service in their areas. Households' support for source separation was not associated with their income. The students' support for source separation is independent from their origins.

Source separation has been practiced by households, for instance, by separating some valuable items such as clothes, bottles, papers, and newspapers, and then selling or bartering them with consumable items or children's toys. Households have commonly been involved in these practices with itinerant buyers who go from house to house. In Bandung, there are many well known trading places for specific used items such as clothes, shoes, books, houseware, and electronics. However, findings about waste reduction by households were not available, although Indonesia's Agenda 21 recognizes the importance of promoting this idea to government institutions and households. In conclusion, based on the experience and willingness of households, source separation and reuse are socially acceptable, while waste reduction is still relatively unknown.

The scheme for service provision has been regulated through a municipal law in which the local community organizations are responsible for the delivery of the primary service from households to temporary disposal sites, and PDK-Bandung for the secondary service from the temporary disposal sites to final disposal sites. There has not been any protest from the public concerning this arrangement. The provision of effective, efficient and reliable service has a close relationship with good waste disposal behaviour by households. Unsatisfactory or unavailable service provision has led to waste burning and indiscriminate dumping into drains, canals and rivers. The results of the statistical tests indicated that waste burning by households is associated with income levels, and the availability of service in their areas. Chances for waste burning were higher in the lower-income households and for those without PDK's service compared to their counterparts with higher income and service available.

The role of the informal sector in recycling has been widely acknowledged by many stakeholders. One of the major concerns in recovery and recycling initiatives is the role of waste pickers. Although their contributions have been recognized in Indonesia's Agenda 21, waste pickers still face difficult challenges from both the public and government officials. The results of the interviews with chiefs of neighbourhood units showed that 27 out of 60 (45%) refused to allow waste pickers to enter their areas for sorting valuable materials. One community area was even determined to reject waste pickers because some of them stole belongings. The results of interviews with households showed a similar finding that 157 out of 362 (43%) disagreed about giving consent to waste pickers to come to their areas. These findings support the idea of localizing and organizing waste pickers at certain sites to conduct their activities in order to avoid opposition from households and neighbourhood chiefs. In other words, recycling sites proposed by IMSWPM should be socially acceptable because they can become sites for waste pickers to conduct their activities. Waste pickers who were interviewed had imagined this kind of place.

Community composting received support from neighbourhood chiefs and households. The results of interviews with neighbourhood chiefs indicated that 42 out of 60 (70%) supported composting in their areas. Support for composting from neighbourhood chiefs was not associated with the availability of PDK's service in their areas. Interviews with households showed that 287 out of 362 (79%) supported composting in their areas. The results of the statistical tests, however, revealed that households' support for composting was associated with their income level and the availability of service in their areas. There was a tendency that the lower the income level of households, the higher the percentage who supported composting. This may suggest that the lower income households with the lower chances for having satisfactory services were more concerned with composting because they viewed it as a means for disposing of their organic waste. Similarly, households without PDK's service might view composting as a means for disposing of their organic waste, resulting in their higher support for composting than their counterparts enjoying the PDK's service. Despite these findings, in general composting is socially acceptable. In conclusion, most components of IMSWPM can be accepted by the public in the municipality. Table 62 summarizes the analysis and evaluation.

Table 62. Social feasibility of IMSWPM in the Municipality of Bandung

Activities	Findings	Evaluation
• Waste reduction and reuse	• Waste reduction is a new topic in Indonesia and findings at households were lacking. • Reuse has been part of households' tradition. • Many trading places for used products in the city.	• Waste reduction is still unknown. • Reuse is socially acceptable.
• Source separation	• Separation of valuable items has been practiced by households. • Supported by households, neighbourhood chiefs, and undergraduate students.	• Source separation is socially acceptable.
• Service provision and safe disposal	• No opposition to the current arrangement for involving community organizations and PDK. • Close relationship between reliable service and waste burning and dumping to drains, canals, and rivers.	• The current scheme for service provision can be accepted by the public.
• Recycling	• Opposition from neighbourhood chiefs and households for allowing waste pickers to enter residential areas. • Waste pickers expected to have recovery and recycling sites.	• The proposed recycling sites should be socially acceptable.
• Composting	• Community-level composting was supported by households and neighbourhood chiefs.	• Composting is socially acceptable.

7.1.7. Financial

Financial feasibility refers to the available financial resources and opportunities for prospective funding sources. The implementation of IMSWPM will require sufficient funds to carry out partnerships in waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. Potential actors that can contribute to provide funds for promoting waste reduction and reuse, source separation, composting, and recovery and recycling, include the Directorate General of Human Settlement Development (DJCK), the Environmental Impact Management Agency (Bapedal), the State Ministry of the Environment, PDK-Bandung, the municipal government of Kotamadya Bandung, non-governmental organizations, foreign agencies, and individuals.

Efforts to promote the importance of source separation need to be initiated immediately to support the implementation of Indonesia's Agenda 21. The experience and failures from a residential source separation pilot project in Jakarta should provide lessons about the necessity to introduce and acquaint households with source separation in their homes or community before it becomes mandatory. PDK-Bandung, non-governmental organizations, and donors should work together to initiate pilot projects for source separation in different residential areas such as high-, middle-, and low-income households. The promotion and implementation of reuse may not require funds as much as waste reduction since it has been part of households' tradition to meet their needs.

A shortage of funds in PDK-Bandung has been a major problem. Based on 1995 data, the total costs for operation and maintenance and depreciation for temporary disposal, collection and final disposal were 7,509 rupiah per cubic meter of waste. According to a municipal law issued in 1995 that has not been changed, the waste management cost of solid waste has been determined to be 7,500 rupiah per cubic meter. This implies that with daily waste collected and disposed of about 6,600 cubic meter, the total waste management costs in of PDK in each month should be about 1,485 million rupiah. The monthly service fees collected in 1999 were only about 800 million rupiah. Therefore, it is not surprising that PDK-Bandung has not been able to provide service to all residents in the municipality, and to operate all disposal sites as sanitary landfills. Moreover, it is unlikely to expect PDK-Bandung to allocate more of its revenues for promoting waste reduction, source separation, recovery and recycling, and composting.

There are three opportunities to obtain additional funds for the provision of effective, efficient, and reliable service provision. The first is through increasing the existing service fees for PDK to increase its capacity for hiring crews, purchasing collection vehicles, and operating the existing final disposal sites as sanitary landfills. However, this suggestion might disappoint households. Ever since 1997 the economic crisis in Indonesia may have influenced households' opinions about the existing PDK's service fee. A total of 310 households, 279 (90%) thought that the existing fee was sufficient. In addition, 211 out of 310 households (68%) were unwilling to pay more in order to get better service. These findings suggest that increasing the current PDK's fee will pose a challenge for the municipal government of Kotamadya Bandung. The second opportunity is through municipal government subsidies. If the possibility for

increasing the current service fees is unlikely, then the municipal government of Kotamadya Bandung should be willing to increase subsidies to PDK-Bandung. The third opportunity is by allowing private contractors provide service to some residents. The major handicap with this proposal, however, is that the regulation has not yet recognized and accepted the role of the private sector in the municipality. Unless the municipal government changes its regulation, privatization of service provision is impossible.

As stated earlier, the idea of recycling sites is not accepted by PDK-Bandung because it will require additional land and facilities. Therefore, unless other funding sources can be found, the proposed recycling sites will never be implemented. To overcome this situation, partnerships with large-scale businesses in credit provision to the informal waste sector, as suggested by Indonesia's Agenda 21, should be promoted. This suggestion has been practiced in the partnerships in plastic bottle recycling in Bekasi, West Java, sponsored by PT. Aqua Golden Mississippi and PT. Coca Cola Indonesia. Another alternative is to use some of the existing transfer stations, and this idea has actually been taking place. Waste collection crews of PDK-Bandung have informally used two transfer stations as sites for plastic bottle recovery operations. They choose plastic bottles because the markets have been relatively steady compared to the other products such as used papers, corrugated paper, and metal. The other alternative is through contributions by potential donors that have been previously mentioned.

Composting has to be promoted and introduced to households and communities. Pilot projects will be needed to show the public how they can work and contribute in reducing the amount of waste requiring treatment and disposal as well the production of compost for planting purposes. Unless the public knows the importance of composting, it will not be willing to purchase and install a small composter in their homes as urged by the mayor. A composter should be provided free to households and communities willing to use it, but this will require funds.

Interviews with chiefs of neighbourhood units revealed various requirements to perform composting by communities. Not only did neighbourhood chiefs ask for the provision of facilities to conduct community-level composting in their areas, they also wanted some money to hire the workers who would operate the facilities. Communities will unlikely be willing to spend more of their money to finance the operation of community-level composting in their areas unless the municipal government endorses it. In another sense, some funds will be

required to promote and initiate pilot projects of community-level composting in the municipality.

An alternative to promote composting at communities could be based on what has been practiced in one large residential area in Serpong, West Java. There, a developer has adopted an integrated waste management model that includes composting. This approach might well be applied in Bandung by encouraging developers to perform composting in residential areas they manage, in particular the middle- and high-income ones. This approach will reduce the funds required to promote and operate community-level composting. Similar efforts to promote community-level composting need to be conducted as well with high schools and universities, with the primary purpose to educate the young people. Although the biggest handicap as reported by the Development Technology Centre (DTC-ITB) was the lack of demonstration space, a small composter can be used as an example. This idea could be tried with coordination of the Department of Education of Culture.

Indonesia's Agenda 21 proposes access to credit for the informal waste sector including waste pickers and small collectors (lapak) for composting. This suggestion might not work well as is the case with recycling. Unlike recycling in which markets are available, finding and sustaining markets for compost continues to be a major challenge. In other words, unless the markets for compost are economically feasible and sustainable, the scheme for providing access to credit for the informal waste sector will not be financially feasible because the possibility for returning the credit is low.

The continuity of municipal-level composting activities by PDK-Bandung depends on the availability of compost demands. Composting at the final disposal sites with the simple windrow technology does not require funds if a sufficient amount of compost demand exists. The largest users of the compost produced by PDK-Bandung have been plantation centres. Perhaps PDK-Bandung and the municipal government of Kotamadya Bandung should become responsible for the funds for composting at the municipal level. A proposal to contract out composting to a private contractor who uses vermi-composting technology was rejected by officials of PDK-Bandung because it will take too much money from PDK's incomes. Therefore, the potential of involving private contractors in composting funded by PDK-Bandung is poor.

A vice chair of farmers' association of the West Java Province was reported to raise his concern concerning a necessity for promoting the use of organic fertilizers such as compost to farmers.[4] He recognized that it will take time to change farmers' willingness to use the organic fertilizer. Once they believe in the effectiveness of the organic fertilizer, the next challenge will be to produce high quality compost in a large scale. This finding suggests that there is a good prospect for the high quality compost in the future.

Of three final disposal sites owned and operated by PDK-Bandung, only TPA Pasir Impun has functioned as a sanitary landfill. Some additional income will be needed to operate its final disposal sites as sanitary landfills. Two possible alternatives for additional funds are through increasing the existing service fees and the government subsidies. Based on the conclusion of the State Ministry of the Environment (KLH, 1995) that the public's and the private sector's willingness to share environmental management costs is in general still low, increasing the existing service fees should be given priority in the near future. The use of incineration is still in the "learning phase" or pilot project stage. The technology is expensive and this is why PDK-Bandung has refused to purchase composting technologies offered by several vendors. As suggested in Indonesia's Agenda 21, the use of incineration for metropolitan or large cities can be financially feasible in the future.

One way to overcome funding shortages to environmentally-sound waste disposal options is proposed by Indonesia's Agenda 21 through regional cooperation between municipalities (kotamadya) and districts (kabupaten) where appropriate to develop regional landfill sites. If this idea can be implemented, both municipal and district governments can enjoy the benefits from having technically, economically, and environmentally viable waste disposal sites. PDK-Bandung and the district cleaning department of Kabupaten Bandung need to consider and explore this possibility.

In conclusion, IMSWPM at the present time is financially infeasible if the required funds to carry out the various initiatives are expected to come only from PDK-Bandung or the municipal government. Table 63 summarizes the analysis and evaluation.

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[4] "Sosialisasikan Sistem Tani Organik". *Pikiran Rakyat Online*, 1-Maret-2000. (http://www. pikiran-rakyat. com/ 2000/0300/01/07010302.htm).

Table 63. Financial feasibility of IMSWPM in the Municipality of Bandung

Aspect	Findings	Evaluation
• Waste reduction and reuse	• Funds for promoting waste reduction are unknown. • Promoting reuse does not require funds as much as waste reduction. • Potential contributors: DJCK, KLH, Bapedal, PDK-Bandung, the municipal government, foreign sponsors, NGOs, private businesses, individuals.	• Promotion of waste reduction is financially infeasible due to uncertainties in funding sources. • Promotion of reuse can be financially feasible since it needs less money than waste reduction.
• Source separation	• Initiatives for promoting source separation by households/communities are lacking. • Funds for promoting source separation are unknown, but finding prospective funding sources may not be difficult. • Potential funding sources: DJCK, KLH, Bapedal, PDK-Bandung, NGOs, private businesses, local communities, and foreign sponsors.	• Promotion and introduction of source separation is financially feasible
• Service provision	• Funds for service provision are from service fees, regulated by a municipal law. • Shortage of funds experienced by PDK-Bandung. • Funding possibilities: increasing the current service fees, more subsidies from the municipal government, and allowing private contractors to provide service.	• The scheme for involving local community organizations and the municipal cleaning institution (PDK-Bandung) is financially feasible as it is funded through the service fees.
• Recycling	• Lack of funds to provide land and facilities for the proposed recycling sites. • Informal practices of recycling at two transfer depots by PDK's collection crews. • Funding sources for recycling credits to the informal waste sector are unknown. • Partnerships in plastic bottle recycling in Bekasi sponsored by PT. Aqua Golden Mississippi and PT. Coca Cola Indonesia. • Potential funding contributors: foreign donors, private businesses, NGOs, and the municipal government	• The proposed recycling sites are financially infeasible.

Table 63. Continued.

Aspect	Findings	Evaluation
• Composting	• Funding sources for promoting and initiating household- and/or community-level composting are unknown. • Municipal-level composting depends on the orders. • Contracting out composting is too costly for PDK-Bandung. • Good prospects for high quality compost in the future • Potential funding contributors: DJCK, KLH, Bapedal, PDK-Bandung, the municipal government, the Department of Education and Culture, NGOs, foreign sponsors, and individuals.	• Promotion and introduction of household- and community-level composting can be financially feasible if funding sources are available. • Municipal-level composting is financially feasible if compost demand exists.
• Safe disposal	• Only one out of three final disposal sites is operated as a sanitary landfill due to lack of funds. • Households' unwillingness to pay more for the service fees. • The price of commercial incineration technology is too expensive for PDK's budget. • Incineration is still in the pilot project ("learning") phase. • A suggestion of Indonesia's Agenda 21: establishing regional landfill sites between municipalities and districts.	• The use of sanitary landfill and incineration is financially infeasible at the present time.

7.2. Sustainability of IMSWPM

Sustainability of IMSWPM is analyzed along three aspects: economic, social, and environment. The economic analysis looked at contributions to income generation, employment creation, savings in waste management, poverty alleviation, and economic diversity. The social aspects will be viewed relative to the satisfaction of basic human needs, social participation, human rights and social justice, and institutional development. Major environmental issues to be examined are pollution reduction and the maintenance of the city's cleanliness and neatness, and resource conservation.

7.2.1. Economic Aspects

It was difficult to gather data about the direct contribution of MSWPM to the economic growth in the Municipality of Bandung. With limited data available, figures about income generation and employment creation can be provided. In 1999 PDK-Bandung had about 1,800 staff with a total monthly salary around 400 million rupiah ($ 80,000 Canadian). A consultant's report (PT. Kartika Pradipta Prisma, 1996) estimated that about 3,500 people were involved in the informal waste businesses in Bandung. Although the number of people involved in the corrugated paper businesses is not known, the daily transactions of corrugated paper could worth between 5 and 10 million rupiah. About 100 people were involved in the small-scale paper recycling activities, facilitated by a local NGO and funded by the municipal government.

Employment creation or income generation has also been enjoyed by some people hired as primary service collection workers, although their number was not available. The municipal government endorses every community (Rukun Warga) to arrange and fund its own primary service collection to bring households' waste to temporary disposal sites. Through consensus, each community determines the fees for the service as well as the salary for the workers.

Another kind of economic contribution of IMSWPM is in terms of savings of waste management costs from the recovery activities by the informal waste sector. A consultant's report (PT. Kartika Pradipta Prisma, 1996) estimated that the recovery of inorganic waste by the informal actors including waste pickers, small collectors (lapak), and big brokers (bandars) could save PDK-Bandung up to 1.7 million rupiah daily.

It is not easy to see the contribution of IMSWPM in poverty alleviation in the Municipality of Bandung. A major focus of urban poverty alleviation in developing countries,

as discussed in the literature review (Jones and Ward, 1994; Wegelin, 1994), has been on managing the economic and social aspects of poverty, including waste pickers and this has been a very difficult task. If waste pickers can be assisted so that they can improve their economic and social status, some day they will be expected to change their occupation. The poverty problem, however, will remain because there is a high chance that other unemployed people will replace them as the next generation of waste pickers. Waste pickers will always exist if two conditions co-exist: there is demand for secondary materials and there are unemployed people with low-level educational background and few skills. In summary, it is difficult to expect IMSWPM to contribute to alleviating poverty.

IMSWPM can make a contribution to economic diversity, for instance, through the use of recycled materials and a reduction in use of virgin materials. Reuse and recovery have been practiced by both households and businesses in Bandung. Although figures about rates of participation were not available, reuse and recovery practices are very important in changing consumption patterns away from wasteful habits. One of the long-term goals of waste reduction proposed by Indonesia's Agenda 21 is to promote a fundamental shift in behaviour and attitude that strives toward sustainable consumption patterns. The corrugated paper business alone in the City of Bandung is a big business with daily transactions amounting to between 5 and 10 million rupiah.

7.2.2. Social Aspects

According to Indonesia's Agenda 21, the provision of service to urban residents is considered essential for meeting basic human needs. In urban or especially metropolitan areas in which population density tends to be high and house areas tend to be smaller, the availability of effective, efficient and reliable service becomes a necessity. Unlike those who reside in rural areas where every household is capable of performing its own disposal by simple open dumping, most people in the metropolitan areas do not have a similar option. In other words, urban residents become more dependent on support from others who provide service to them. In 1994, for example, when landslides took place at the largest final disposal site in Bandung, waste collection in the city had to be abandoned for two weeks. The city was in crisis: all collection trucks loaded with waste were parked in the city; temporary disposal sites were overloaded with waste; and, a bad smell was everywhere. For people in large or metropolitan

cities in Indonesia, including Bandung, the availability of effective, efficient and reliable service has indeed become a basic need.

The service coverage of PDK-Bandung in 1995 was almost 96%. Some residential and industrial areas were not served. The proposed IMSWPM that supports partnerships of stakeholders in service provision is expected to increase the capacity in service provision by improving the capability of PDK-Bandung, involving private contractors, or persuading large residential areas to provide their own service to the residents.

Another contribution of IMSWPM is to nurture and strengthen public participation in proper waste management. Without public participation, the achievement of many goals will unlikely be successful. Participation depends on attitude and behaviour to support various initiatives in reuse, source separation, composting, proper disposal, service fee payment, and law enforcement. Unlike the conventional approach which places municipal cleaning authorities as the sole actor, the proposed IMSWPM approach calls for involvement from various stakeholders.

In terms of human rights and social justice, IMSWPM acknowledges the existence and role of waste pickers. This approach proposes that recovery and recycling sites to accommodate and facilitate waste pickers conducting their activities should be established. IMSWPM not only recognizes the social status of waste pickers, but also gives security to them by providing specific sites at which to work. Such sites were prepared by the previous mayor but were never implemented.

Another social goal is institutional development. According to the State Ministry of the Environment, institutional development deals with efforts for improving capacity for coordination, developing a regulatory framework to anticipate future challenges in environmental management, and developing human resources of government institutions (KLH, 1995). IMSWPM advocates partnerships of stakeholders in order to strengthen the capability of municipal authorities to provide satisfactory, equitable, and reliable service for all residents as well as to deal with the other issues associated with MSWPM. In other words, IMSWPM supports the idea of developing the capacity of municipal institutions to deal with their waste management tasks.

7.2.3. Environmental Aspects

The State Ministry of the Environment expected local government to formulate policies and coordinate partnerships of stakeholders in order to increase capacity for environmental sustainability (KLH, 1995). According to a national law issued in 1997 (Undang-Undang Nomor 23 Tahun 1997), everybody has an obligation to sustain and prevent the environment from being degraded. By promoting partnerships, the capacity to enhance various initiatives in waste reduction and reuse, source separation, service provision, recovery and recycling, composting and safe disposal, can be enhanced. These initiatives should make direct contribution in maintaining the cleanliness and health of the urban environment. The municipal government and the district government of Bandung have recognized the necessity to make Bandung a healthy city.

Another contribution to enhance the environment is through resource conservation by reusing and recycling materials which would otherwise be treated as waste. Reuse practices by households, and the recovery and recycling activities by the informal waste sector and the formal waste processing factories all contribute to reducing the use of virgin materials, and such efforts can be regarded as a kind of natural resource conservation.

7.3. Concluding Remarks

IMSWPM is an appropriate and timely approach in the Municipality of Bandung. Such an approach will become sustained when stakeholders believe it to be an adequate approach to deal with the problems and challenges; when they maintain their vision of a healthy city; and when they see the continued economic, social and environmental benefits of the approach. The sustainability level of IMSWPM will be greater if the municipal government embraces this approach through passage of a municipal law.

Based on the DJCK's guidelines, both waste reduction and reuse by households are technically viable because they are simple and should be easy to implement. Those guidelines are also politically acceptable because they are supported by many government institutions. Reuse has been part of households' tradition. The promotion of reuse seems to require less funds than that for waste reduction. The sustainability of reuse is greater than that of waste reduction.

With regard to the mayor' instruction, source separation by households should be technically feasible. Source separation is also politically and socially acceptable as it is supported by many government institutions, households, neighbourhood chiefs, and university students. However, legitimacy of source separation is insufficient because the instruction is only persuasion. The sustainability of source separation can be high as prospective funding sources are available.

The involvement of community organizations and PDK-Bandung has been regulated by a municipal law, and therefore its legitimacy is sufficient. This arrangement is also socially acceptable. The financial feasibility of this scheme is high because it has been funded mostly through the service fees collected by local community organizations and by PDK-Bandung. The role of private contractors, however, has not been possible. The sustainability of service provision by local community organizations and PDK is high, but this arrangement could become insufficient in the future unless PDK-Bandung improves its service capability.

The proposed recycling sites should be socially acceptable because they concentrate waste pickers at certain sites and reduce the number of waste pickers who enter residential areas or scatter around the city, and therefore avoid opposition from some households, neighbourhood chiefs, and municipal officials. However, those sites are technically and financially infeasible, and lack legitimacy. The sustainability of the recycling sites is uncertain or low.

Community-level composting is socially acceptable and operationally feasible if some requirements proposed by neighbourhood chiefs can be met. Funding sources appear also available to promote and introduce community-level composting. Legal support for community- and household-level composting is insufficient. The sustainability of household-level composting may not be as high as that of community-level composting because it requires every household to purchase and operate a composter. The sustainability of the municipal-level composting depends on the availability and continuity of compost demands.

The use of safe disposal, in particular sanitary landfill, is technically viable. It is also backed by a municipal law concerning the necessity for proper disposal. The sustainability of a sanitary landfill site, however, is low due to insufficient PDK's budget. Sanitary landfills can be sustained if sufficient additional funds are available, and enforcement for proper operation is upheld.

CHAPTER 8.
DISCUSSION

This chapter discusses the findings of integrated municipal solid waste planning and management (IMSWPM) in the Municipality of Bandung, Indonesia. Topics which will be highlighted include key issues, ideas, goals, benefits, potential barriers, initial implementation, increasing financial capacity of PDK-Bandung, policy instruments, education of stakeholders and the public, planning perspectives, and lessons for other municipalities in Indonesia.

8.1. Key Issues of IMSWPM and Indonesia's Agenda 21

Key issues of IMSWPM outlined in Chapter 3 can be related to government policies, public education programs, law enforcement, and availability of funds. Government policies are required for waste reduction and reuse, source separation, partnerships in service provision, household- and community-level composting, the use of compost, and recycling activities by the informal waste sector. Public education programs are necessary for promoting waste reduction and reuse, source separation, composting and the use of compost; discouraging waste burning and illegal dumping to canals, drains, and rivers; and, teaching waste pickers regarding a need for proper operations at recycling sites. Law enforcement is important to support mandatory source separation, discourage illegal waste dumping practices, and ensure safe waste disposal practices. Sufficient funds will be required to build and operate composting facilities, create and develop markets for high quality compost, build and operate recycling sites for the informal waste sector, train PDK staff, operate environmentally-sound waste disposal sites, and to conduct those public education programs. Many of these key issues have already been addressed by Indonesia's Agenda 21 (Table 64). In other words, there is good fit between key issues of IMSWPM and the objectives and programs of Agenda 21. This implies that addressing key issues of IMSWPM will contribute to the achievement of goals of Indonesia's Agenda 21.

Table 64. A comparison between key issues of IMSWPM and those advocated by Indonesia's Agenda 21

Locus	Key Issues of IMSWPM for developing countries	Objectives and Programs of Indonesia's Agenda 21
• Waste generation	• Existence of government policy on waste reduction and reuse • Public education concerning waste reduction and reuse initiatives	• Waste minimization as an objective in waste management programs • Increasing community awareness and participation in waste minimization • Promoting a fundamental shift in attitude and behaviour toward a sustainable consumption pattern
• Handling and storage at source	• Public education about source separation • Existence of government policy on mandatory source separation • Issuance and enforcement of laws for source separation	• Public education to households to encourage separation of waste into organic and inorganic streams
• Service provision	• Provision of satisfactory service • Policy for partnerships • Public education concerning the risks of illegal dumping and waste burning • Law enforcement for illegal (haphazard) waste dumping	• Increasing solid waste service coverage to 90-100% in metropolitan and large cities • Promoting and supporting partnerships in service provision among governments, the private sector, and the public
• Household and community composting	• Public education about composting and the need to create need for compost among households • Policy on household- and community-level composting • Provision of funds to build and operate facilities	• Providing the informal sector with access to credit for composting units

Table 64. Continued

Locus	Key Issues of IMSWPM for developing countries	Objectives and Programs of Indonesia's Agenda 21
• Municipal composting	• Availability of sufficient funds • Creation of markets for compost • Existence of government policy to support the use of compost	• Increasing commitment to composting activities by government agencies • Promoting and developing markets for compost
• Recycling sites	• Policy to support recycling activities • Seeking funds to provide facilities for recycling sites • Seeking approval from municipal authorities to change existing transfer stations into recycling sites • Educating and gaining support from waste pickers • Organizing recycling activities	• Increase government commitment to recycling activities • Promote the use of recycled products within government agencies and enterprises • Coordinate and/or integrate recycling activities of the informal sector with the formal solid waste management system • Provide the informal sector with credit for recycling unit • Review waste import policies to ensure the continuity of domestic waste recycling businesses • Public education programs to encourage participation in recycling activities
• Safe disposal (landfill, incineration)	• Ability to provide affordable and sustainable service • Maintaining operation so as to minimize health risks to the public and the environment • Law enforcement	• Ensure an environmentally-sound manner disposal for new disposal sites

8.2. Ideas about IMSWPM

Stakeholders in Bandung and Jakarta had their own opinions about an integrated approach to waste management as an approach that is holistic, coordinates various stakeholders, uses all available technological options, combines top-down and bottom-up planning, is responsive to local needs, adopts a paradigm that waste is everybody's problem, and is part of the City's Master Plan. Their ideas can be divided into two major dimensions of integrated planning and management: substantive and procedural. Substantive dimensions are characterized by four attributes. The first attribute is holistic or breadth of perspectives (Lang, 1986a, 1986b; Mitchell, 1986; Slocombe, 1993; Born and Sonzogni, 1995; Margerum and Born, 1995; UNEP, 1996 cited in Hoornweg and Thomas (1999); Margerum, 1997). Relevant findings which represent this attribute include being comprehensive, incorporating IMSWPM into the City's Master Plan, using all available technological options, and combining top-down and bottom-up planning. The second attribute is interconnnective or examination of interrelationships (Willms, 1991; Ham, 1992; Slocombe, 1993; Muller-Merbach, 1994; Born and Sonzogni, 1995; Margerum and Born, 1995; UNEP, 1996 cited in Hoornweg and Thomas (1999); Margerum, 1997). The four findings which reflect the holistic view can also be regarded to reflect this attribute. The third attribute is to be goal oriented, which refers to the identification and achievement of common goals (Tchobanoglous, Theisen and Vigil, 1993; Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997) and can be related to two aspects: being comprehensive, and being responsive to local needs. The fourth attribute is strategic or focusing on key issues (Lang, 1986b; Mitchell and Hollick, 1993; Born and Sonzogni, 1995; Margerum and Born, 1995) and can also be linked with the two findings for the previous attribute.

Stakeholders' ideas which can be classified as procedural (Born and Sonzogni, 1995; Margerum and Born, 1995; Margerum, 1997) include fostering public and private participation (partnerships), coordinating various stakeholders, and combining top-down and bottom-up planning. In should be noted that accepting the paradigm that waste is everybody's problem can also be regarded as part of fostering partnerships. Beside its inclusion in the substantive dimension, combining top-down and bottom-up planning can also be incorporated as part of the planning process.

8.3. Goals of IMSWPM

Goals of IMSWPM proposed by stakeholders include preserving the quality and integrity of the urban environment, extending affordable service coverage, adopting 4Rs (reduce, reuse, replace, recycle), promoting stakeholders' partnerships and facilitating coordination among stakeholders, supporting the creation of employment opportunities, and supporting the use of appropriate technology. These goals are in line with those mentioned in the literature review. The goals of maintaining the quality and integrity of the environment, adopting 4Rs, and using appropriate technology can be related to each of reducing the amount of waste and its impacts (Crutcher and Yardley, 1991; Ham, 1992), reducing the amount of waste to be landfilled and enhancing environmentally-sound waste disposal (Crutcher and Yardley, 1991; Poland, 1991), and optimizing the use of natural resources or resource conservation (Crutcher and Yardley, 1991; Ham, 1992). Promoting partnerships and nurturing public education and participation are similar to fostering partnerships of sectors and ensuring equity (UNEP, 1996 cited in Hoornweg and Thomas (1999)). The finding about facilitating coordination can be associated with coordinating planning and management (UNEP, 1996 as cited in Hoornweg and Thomas (1999)). The goal of supporting employment creation can be included in achieving specific objectives/goals (Tchobanoglous, Theisen and Vigil, 1993). There is one more goal of integrated solid waste management which is not observed from the stakeholders in Bandung and Jakarta: using a systems approach in problem solving (UNEP, 1996 as cited in Hoornweg and Thomas (1999)).

Findings in the literature review indicated several avenues to achieve objectives of urban management. They include enhancement of local authorities' capacity (Miles and Arthur, 1992; Sidabutar, 1992; Walton, 1992; Chowdhury and Furedy, 1994), coordination of government agencies at national and local levels (Amos, 1989; Miles and Arthur, 1992), institutional development (Eberhard, 1990; Davidson and Nientied, 1991), mobilization of resources (Eberhard, 1990), partnerships between the public and the private sector (Davidson and Nientied, 1991; Miles and Arthur, 1992; Walton, 1992), citizen participation (Davidson and Nientied, 1991; Chowdhury and Furedy, 1994), involvement of non-governmental organizations and voluntary agencies (Chowdhury and Furedy, 1994), application of appropriate technologies (Eberhard, 1990), spatial and economic planning (Eberhard, 1990; Davidson and Nientied, 1991; Miles and Arthur, 1992). The achievement of various goals of

IMSWPM in the Municipality of Bandung, to some extent, is also in line with those avenues (Table 65).

Table 65. Fitness of avenues for achieving goals of IMSWPM in Bandung

Avenue	Application in IMSWPM
• Enhancement of local authorities' capacity	• Provision of more funds to PDK-Bandung • Recruitment of competent staff by PDK-Bandung • Improvement of coordination among actors
• Coordination of government agencies	• Coordination of municipal agencies with other stakeholders to carry out initiatives for waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal
• Institutional development	• Establishment of a co-operative structure for stakeholders' partnerships with PDK-Bandung as the leader
• Citizen participation	• More active participation from the public to support proper waste management practices
• Partnerships between the public and the private sector	• Involvement of community organizations and private sectors in service provision
• Involvement of non-governmental organizations and voluntary agencies	• Recognition of NGOs and voluntary agencies to take part in initiatives associated with waste, cleanliness and health, beauty and social order
• Mobilization of resources	• Striving to involve various actors to share costs for achieving various goals and benefits of IMSWPM, and ultimately the vision of a healthy city
• Application of appropriate technologies	• Using any technology which fits local conditions
• Spatial planning	• Integrating IMSWPM into the city's long-term master plan

8.4. Benefits of IMSWPM

Stakeholders in Bandung and Jakarta shared expectations about benefits of IMSWPM: reduction of the amount of waste generated and impacts on the urban environment, integrated policies/planning and integrated programs/efforts, strengthened institutions, enhanced partnerships of stakeholders, more proper planning, reduced bureaucratic obstacles, increased power and effectiveness in law enforcement, and better ability to resolve conflicts and gain consensus.

Most benefits of IMSWPM perceived by stakeholders are similar to those of integrated resource and environmental management identified in the literature review. The first benefit of IMSWPM, reduction of the amount of waste and its impact on the urban environment, is a unique benefit of integrated planning and management in the context of municipal solid waste. This benefit, however, can also be analogous to long-term preservation of the environment (Cairns, 1991a).

The next benefits, integrated policies and planning and integrated efforts (programs), are similar to identifying the most critical issues (Margerum and Born, 1995), setting up coordinated action (Lang, 1990), and improving effectiveness from cooperation and coordination (Walther, 1987; Mitchell, 1990). In addition, these perceived benefits reflect the motivations for adopting integrated planning and management as mentioned in the literature review, such as failure to deal with multiple and interdependent issues (Margerum and Born, 1995), dissatisfaction with the outcomes from narrowly-focussed management (Bowonder, 1987; Born and Sonzogni, 1995; Margerum and Born, 1995;), and the need to capture maximum benefits from coordinated action (Lang, 1990a).

Strengthened institutions as another benefit of IMSWPM in Bandung and Jakarta were not mentioned in the literature review. Increased capacity of local authorities in dealing with waste and urban environmental management could be an important contribution of IMSWPM. This perceived benefit, for instance, may be achieved through the involvement of various stakeholders, deployment of experts from across agencies, provision of data for planning and policy making, and sharing expenses.

Enhanced partnerships of stakeholders as another benefit of IMSWPM in Bandung and Jakarta are similar to two benefits of integrated planning and management mentioned in the literature review: to provide an opportunity to define common goals and identify the most critical issues (Margerum and Born, 1995) and to set up coordinated action and conflict resolution (Lang, 1990).

Better planning was also perceived by stakeholders as a benefit of IMSWPM. They meant proper planning as one that accommodates inputs from the public and is responsive to the immediate needs of the local community. Although this benefit is not mentioned in the literature review, it can be related to such benefits as creating a way to address different concerns and achieve and secure agreement (Lang, 1990), providing an opportunity to define

common goals and identifying the most critical issues (Margerum and Born, 1995), and setting up coordinated action (Lang, 1990). In addition, IMSWPM is a better planning approach than the conventional approach because it is more comprehensive, involves various stakeholders, and combines top-down directions with bottom-up initiatives.

Reduced bureaucratic obstacles are an important benefit of IMSWPM. Bureaucracy had slowed down some actions that were supposed to be immediately taken, and also hindered the data collection required for planning and policy making. Although this benefit was not explicitly mentioned in the literature review, it may represent an argument of Mitchell (1990) regarding one reason for using the integrated planning and management: overcoming the many obstacles from fragmented and shared responsibilities among agencies.

The benefit of increasing power and effectiveness in law enforcement is not different from improving effectiveness through improved cooperation and coordination (Walther, 1987; Mitchell, 1990). Many stakeholders in Bandung and Jakarta raised their concern over the weak enforcement in MSWPM and environmental management in Indonesia

The last benefit of IMSWPM expected by stakeholders was a way to address and resolve disputes. Although this benefit was suggested only by officials of the municipal government of Kotamadya Bandung and those of the District of Bandung, it is a very important benefit of IMSWPM. This benefit was described in the literature review as a way to address different concerns, achieve and secure agreement, resolve conflicts (Lang, 1990), and reduce expenditures to deal with conflicts (Cairns, 1991a).

8.5. Potential Barriers to IMSWPM

The procedural dimension of IMSWPM necessitates partnerships of stakeholders in municipal solid waste planning and management. Stakeholders in Bandung and Jakarta, however, predicted that these partnerships might be hindered by obstacles such as institutional bureaucracy, difficulties in gaining consensus, sustaining the process, gaining and mobilizing community support, and politics (e.g., possible abuse of partnerships). These findings are exactly the same as those mentioned in the literature review: sensitivity of agencies and bureaucracy, and inadequate institutional arrangements (Mitchell, 1986, 1994, 1997; Cairns, 1991a; Hooper, McDonald and Mitchell, 1999); difficulties in gaining consensus and support from various stakeholders, and willingness of government agencies to turn over some of their responsibilities to their partners (Hooper, McDonald and Mitchell, 1999); and possibilities of

abusing new authority (Cairns, 1991a). Difficulties in sustaining the process is a mixture of various factors such as lack of financial resources (Mitchell, 1990, 1994; Hooper, McDonald and Mitchell, 1999), lengthy time for planning and public participation (Walther, 1987; Mitchell, 1986, 1990; Cairns, 1991a), and participants' personalities and attitudes (O'Riordan as cited in Mitchell (1990).

8.6. Initial Implementation of IMSWPM

Implementation of IMSWPM can be divided into two parts: initial and on-going. The former is concerned with the preparation and initiation to get the process of partnerships started, while the latter deals with routine activities which may evolve into such stages as problem setting, direction setting, implementation, and monitoring and evaluation (Julian, 1995; Margerum, 1999).

Three main steps for the initial implementation of IMSWPM in the Municipality of Bandung are proposed: finding initiators-promoters, establishing legitimacy, and building capacity. Initiators and promoters are required to start the process for establishing legitimacy for IMSWPM and implementing partnerships of stakeholders in IMSWPM in the Municipality of Bandung. In addition, initiators-promoters can also play their roles as facilitators by helping stakeholders engaged in the partnerships. Therefore, some initiators-promoters, for instance, between three and five persons, should be identified and appointed by the municipal government. Potential actors that can play their roles as initiator-promoter are academia, planners, consultants, activists, policy makers, or representatives of foreign lending agencies.

The first task of an initiator-promoter is to conduct a stakeholder analysis in order to identify actual and potential stakeholders and their contribution in IMSWPM. Then, they need to make initial contacts with potential stakeholders. The aims of this task are to gain stakeholders' understanding about the complexity of the issues associated with municipal solid waste planning and management and the necessity for adopting an integrated approach, to investigate stakeholders' willingness to participate, to explore possibilities for arranging meetings with other stakeholders to discuss common interests, and to know stakeholders' views, interests, and expectations.

Sufficient credibility is very important for partnerships involving various stakeholders (O'Toole, 1986; Mitchell, 1998; Hooper, McDonald and Mitchell, 1999). Legitimacy should be established in order to provide identity and ensure commitment, participation and compliance

from stakeholders and the public. Gaining legitimacy for IMSWPM in Bandung can be a challenge as legal support for this approach is lacking

Two paths to establish legitimacy are proposed: indirect or direct. Each has its own strengths and weaknesses. The indirect approach to establishing legitimacy involves urging the municipal government of Kotamadya Bandung to adopt Indonesia's Agenda 21 as the umbrella for its various policies because the rationale, objectives, and programs in solid waste management in this Agenda are consistent with IMSWPM. Thus, the municipal government is expected to embrace and endorse Agenda 21 in order to provide legitimacy for both this Agenda 21 and IMSWPM. In this approach, the municipal government could establish a coordinating committee, involving various stakeholders, to implement Agenda 21. Such an attempt would be similar to what has been done by the municipal government in establishing the committee for K3 (neatness, cleanliness, beauty), the Adipura Award, and GDN (national discipline movement). The proposal to establish a coordinating committee for Agenda 21 at the municipal level is inspired from an idea voiced by environmental experts and non-governmental organizations in Jakarta, who have asked the Government of Indonesia to establish a council for sustainable development ("Dewan Pembangunan Berkelanjutan).[1] The coordinating committee would be responsible for preparing plans and programs, providing guidance, coordinating implementation, monitoring and evaluation, and enforcement. In addition it would have the task of communicating progress to the Mayor and the public. Within this committee, there would be a unit responsible for IMSWPM.

One major strength of the indirect approach is with its ideal message to promote and implement Agenda 21 which has been envisioned by the State Ministry of the Environment as a national strategy toward sustainable development. However, this approach has a shortcoming. Because of the many issues addressed in Agenda 21, IMSWPM may not get immediate attention from those on the committee. It may take longer to recognize the importance and necessity for IMSWPM and allocate resources for it. The indirect approach is suggested as an ideal route to follow due to its coverage, but it should be recognized as a long-term achievement.

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[1] Diusulkan Adanya Dewan Pembangunan Berkelanjutan". *Republika Online*, 18-Nopember-1999. (http://www.republika.co.id/9911/18/31277.htm)

A second and more direct approach to establishing legitimacy for IMSWPM is by promoting the necessity for adopting IMSWPM to PDK-Bandung and key officials of the municipal government. PDK-Bandung will be asked to lead the partnerships involving various stakeholders. During the interviews conducted by this study, officials of PDK-Bandung stated that they could accept the idea of an integrated approach to MSWPM that advocates partnerships of stakeholders as long as it does not put more financial burdens on their institution. If funding sources can be available, for instance through potential contributors, there will be a high chance that PDK-Bandung will be willing to accept its role as the leader. This approach is preferred to the indirect route for establishing legitimacy for IMSWPM in the Municipality of Bandung.

Strong political support is also vital for effective implementation of stakeholder partnerships (O'Toole, 1986; Yeung and McGee, 1986; Miles and Arthur, 1992; Mitchell and Hollick, 1993; Hooper, McDonald and Mitchell, 1999). The role of the Mayor will be very significant in influencing officials of various municipal government institutions. Therefore, the Mayor should be asked for his or her support and commitment to the adoption and implementation of many initiatives in IMSWPM and environmental management in Bandung. The Mayor's support and commitment would influence the attitudes and behaviour of municipal government officials and increase their commitment to the implementation of IMSWPM. It should be noted that in 1996, before the economic crisis, the Government of Indonesia promoted two political issues: integration ("keterpaduan") of government policies, and partnerships ("kemitraan") of stakeholders. The current mayor of the Municipality of Bandung in 1999 also supported the importance of integration of government policies, and the need to strengthen coordination among government institutions. These findings suggest that any effort to facilitate coordination and collaboration among various stakeholders, including IMSWPM, should be timely given the current political climate in Bandung and Indonesia.

Building capacity for implementing stakeholder partnerships requires an organizational structure, assignment or recruitment of staff, funding, and mechanisms and ways for coordination and dealing with conflicts. Hooper, McDonald and Mitchell (1999) offer three alternative structures for partnerships: voluntary, co-operative, and coercive. The co-operative structure is adopted. It consists of the PDK-Bandung as a coordinating organization and members or workgroups for waste reduction and reuse, source separation, service provision,

composting, recycling, and safe disposal. Adopting this structure would mean that no new agency or institution needs to be created. Instead, an existing organization (PDK-Bandung) would have a leading role. In Indonesia, workgroup has the similar and familiar words "Kelompok Kerja" or "Pokja" commonly used in the government system.

The co-operative structure fits exactly with what Alexander (1993, 337) called a "lead organization", defined as "the arrangement in which one organization is charged with, or assumes, the responsibility for coordinating the activities of all relevant organizations in the interorganizational network." Alexander noted that the appointment of the lead organization can be based on expertise, power, or both; and that the implementation of activities rests with the other actors in the network. The appointment of PDK-Bandung as the leader reflects the importance of both its expertise and power.

Some benefits arise from appointing PDK-Bandung as the lead organization. First, it already has a mandate from the municipal government to deal with waste management. Therefore, legitimacy for the partnerships will be strengthened. Second, with its limited funds, PDK-Bandung still has capacity to facilitate the partnerships, especially if the existing service fees can be increased. In addition, PDK-Bandung can also allocate some of its office and staff for the partnerships. Third, the appointment of PDK-Bandung would open an opportunity to promote and eventually institutionalize IMSWPM in the formal planning process for waste management in the territory of PDK-Bandung. Fourth, opposition from PDK-Bandung is expected to be less compared to the creation of a new, autonomous, and detached organization responsible for the partnerships in IMSWPM as in the case of the coercive model.

Despite the potential benefits, the co-operative model has several shortcomings. According to Hooper, McDonald and Mitchell (1999), one assumption of the co-operative model is that stakeholders' compliance is not an issue. In the current situation, stakeholders' compliance will be a major issue and this is being worsened by weak enforcement capacity. The coercive model which is aimed at enforcing and ensuring compliance is not recommended because of the challenges in obtaining immediate enforcement. In the early stage of introducing a new approach, the co-operative model is better suited because building collaboration from various stakeholders is more important than devising mechanisms to force them to comply. Another possible shortcoming of the co-operative model which has PDK-Bandung as the lead agency is that it may discourage involvement and participation from local non-governmental

organizations because they may view the partnerships as being ruled by a government institution. If PDK-Bandung is willing to recognize, involve and not be arrogant with NGOs, then opposition can be reduced. Open relationships among stakeholders can reduce suspicions which lead to opposition. Based on the experience in Surabaya, open relationships between government officials and other stakeholders were critical during the implementation of partnerships in waste management (Indrayana and Silas, 1993).

As the lead institution, PDK-Bandung's tasks would be to lead, facilitate, encourage, ensure coordination, and mediate conflicts between and within workgroups. Staff assigned should be knowledgeable about MSWPM, have strong leadership and credibility, be dedicated and committed, and be humble in order to lead the various workgroups. Some experts from outside should also be appointed to help PDK-Bandung carry out these tasks.

The number of potential stakeholders in each workgroup varies, but may reach as high as 20 persons. This is not necessary, especially in the beginning because it will be difficult to gather them all for a meeting at the same time. Thus, a smaller number, for instance, between 5 and 7 persons for each workgroup, is favorable because it is more manageable. After the process of partnerships develops, some other participants can be added. PDK-Bandung would not have to arrange meetings with all participants at the same time. Separate meetings with each work group would be favorable to initiate contacts, build understanding, and gain support.

It will be unrealistic to use either a voluntary or mandated approach to appoint participants; instead, a mixture is required. The voluntary approach alone may not produce enough participants, while mandatory assignment may not always be possible. These two options should be used together for selecting representatives from government agencies, including universities; non-governmental organizations; foreign agencies and individuals.

Although PDK-Bandung is proposed as the lead agency, it does not have to be responsible for all or most of the funds required for the partnerships. Alternative funding should come from various contributors, including the municipal government, other government institutions, donations from private businesses, and foreign sponsors. The idea of cost sharing among participants should be used to ensure long-term sustainability (Hooper, McDonald and Mitchell, 1999). This same scheme has been used by some government institutions in the Municipality of Bandung to accomplish joint programs (activities) such as the promotion of cleanliness and health to the youth.

Partnerships of stakeholders will require a mix of informal and formal coordination tools. Informal mechanisms include meetings, telephone calls, and correspondence (Alexander, 1993). Formal coordination tools include joint staff, joint planning process, joint budgeting process, and scheduled meetings (Margerum and Born, 1995).

Several tools to mediate and resolve conflicts include special meetings, interpersonal and inter-institutional communication, and appeals to higher authorities. Involvement of a third party may be required. Experts from universities or waste consultants, for example, have the potential to bridge differences between non-governmental organizations and government institutions regarding the future of waste pickers.

8.7. Increasing Financial Capacity of PDK-Bandung

There is an urgent need to increase the financial capability of PDK-Bandung and an alternative to meet such need is through increasing the existing service fees. Adjusting the existing service fees with a small increase every three years is preferable to one big increase in five years or more, although both schemes will likely draw disappointment from the public. From the interviews, most households did not want to pay more. Nevertheless, this scheme is selected because it introduces a smaller increase than the latter; it will make the public and private sector accustomed to fee adjustments; and, it allows PDK-Bandung to adjust its revenues more quickly. Two main disadvantages of this scheme are that the small increase may not be able to close the gap with the inflation rate, and it may also mean more frequent protests from the public, questioning the rationale for the fee adjustment. The latter option has stronger ground for increasing the fee because the gap between revenues and increasing costs due to the inflation rate is higher than the former. In addition, it also implies less frequent protests from the public. However, the biggest obstacle for this option is that the increase will likely be bigger than the former, for instance between 50% and 100% or even more, and this can create stronger animosity from the public.

In order to reduce disappointment and animosity from the public and private businesses, an increase of 20% of the existing service fees for all households and private businesses. Based on the latest information mentioned in Chapter 6, the monthly service fees collected in 1998 were about 800 million rupiah. Based on this figure, the proposed increase will generate additional revenues of 160 million rupiah or maybe more. After three years, this new fee can be evaluated and adjusted again. The additional revenues should be allocated to increase service

coverage and support environmentally-sound waste disposal practices at all final disposal sites. Table 66 shows the existing and the proposed fees for PDK's service. It should be noted that the new daily fee for traders in markets is adjusted from 150 to 200, instead of 180, because based on my experience in 1999, the smallest currency used for day-to-day transactions was either 50 or 100 rupiah. The amount of 180 rupiah is, therefore, not practical. Even if this number is used, fee collectors will likely charge 200 rupiah and keep 20 rupiah in their pockets.

Table 66. The existing and proposed fees for PDK's service (rupiah)

Target	Existing fee	Proposed new fee
• Households	Class I : 1500 Class II : 2500 Class III : 3500 Class IV : 5000	Class I : 1800 Class II : 3000 Class III : 4200 Class IV : 6000
• Private businesses	7500/m^3/month	9000/m^3/month
• Traders in markets	150 to 1000/daily	200 to 1150/daily

8.8. Policy Instruments for IMSWPM

According to Wilson (1996), policy measures for integrated solid waste management can be classified into five kinds: information dissemination and use mechanisms, economic sticks, producer responsibility, carrots, and legislative sticks. A combination of these instruments need to be used to implement IMSWPM in the Municipality of Bandung.

Information dissemination or exhortation (Harrison, 1999), for instance, can be used to create and increase awareness and build understanding about waste reduction and reuse by households and students, and encourage and persuade waste generators, in particular households, to separate their waste into wet (organic) and dry (inorganic) streams. Legislative sticks such as laws, regulations and policies can be used to provide legitimacy for IMSWPM, make source separation by households mandatory, and allow participation of private contractors in service provision. Economic sticks are laws or regulations which are used, for example, to determine service fees for households, private businesses, and traders in markets. Carrots are subsidies or grants provided for various purposes such as conducting public education programs about reduce and reuse, source separation at different residential areas, and risks from indiscriminate dumping. As a policy instrument, producer responsibility can be applied to encourage or persuade beverage manufacturers to collect and recycle their bottles,

for instance, through refunds. Table 67 summarizes necessary policy instruments for IMSWPM in the Municipality of Bandung.

Table 67. Policy instruments for implementing IMSWPM in the Municipality of Bandung

Policy Instrument	Purposes
• Information dissemination	• Publicizing the accomplishments by PDK-Bandung and stakeholders in the partnerships in IMSWPM to the mayor and the public • Creating and increasing awareness, building understanding, getting support, having involvement, and gaining commitment to waste reduction and reuse by households and students • Persuading commercial establishments to discourage giving extra (plastic) packaging bags to customers • Encouraging industries to support clean production • Encouraging and persuading waste generators, in particular households, to separate their waste into wet (organic) and dry (inorganic) streams • Changing attitudes and behaviour of individuals and households to discourage waste burning and illegal dumping to drains, canals and rivers • Promoting composting to households and communities • Promoting the use of products made from recycled materials
• Legislative sticks	• Providing legitimacy for IMSWPM and partnerships of stakeholders, and enforcing PDK-Bandung to lead the partnerships • Making source separation by households mandatory • Obligating households to provide facilities for keeping separated wastes in their homes • Obligating commercial establishments to provide standardized containers to facilitate source separation • Allowing participation of private contractors in service provision • Prohibiting imports of waste • Integrating reuse and recycling activities of the informal waste sector, involving waste pickers, lapak and bandar, and the formal solid waste management system • Enforcing environmentally-sound waste disposal practices
• Economic sticks	• Determining service fees (charges) for households, commercial establishments, and traders at markets
• Carrots	• Providing subsidies or grants to conduct public education programs about reduce and reuse, source separation at different residential areas, and risks from indiscriminate dumping • Giving subsidies for building capacity and facilitating partnerships of stakeholders in various initiatives in waste management

Table 67. Continued.

Policy Instrument	Purposes
• Carrots (continued)	• Providing subsidies to PDK to offset the discrepancy resulting from the gap between waste management costs and revenues collected from service fees • Providing the informal sector access to credit for recycling and composting units • Providing funds to conduct research to identify new uses or markets for recycled materials • Providing money and facilities to conduct composting at communities • Providing money to develop markets for compost to different target users in agriculture, nurseries, plantations, and households • Providing funds to support environmentally-sound waste disposal practices
• Producer responsibility	• Encouraging beverage manufacturers to collect and recycle their bottles, for instance, through refunds

8.9. Education of Stakeholders and the Public

The implementation of IMSWPM that involves partnerships will require changes in knowledge and perception (attitudes), behaviour, policies, and institutions. As with Indonesia's Agenda 21, these changes should be considered as a long-term goal. Education of stakeholders and the public is required to promote and facilitate those changes by communicating the vision and mission of the city, the various problems associated with waste management, the necessity for adopting IMSWPM, and the significance of partnerships in various initiatives in IMSWPM.

Communication has a critical role in communicating and facilitating change from individuals and institutions (Carew-Reid et al., 1994; Quirke, 1997). According to Quirke, the primary goals of communicating change are to increase awareness, build understanding, gain support, get involvement, and gain commitment. The relationships between the goals of communication and the expected changes are shown Table 68.

Many potential actors need to be involved in public education programs. They include municipal government institutions, students, youth organizations, social organizations, non-governmental organizations, households and house sitters, public figures, private sector, heads

Table 68. The relationship between communication goals and expected changes from individuals and institutions

Goal	Expected changes in knowledge, perception, and behaviour	Expected changes in policies and institutions
• Create and increase awareness	• Increased awareness of: - the various issues associated with waste, cleanliness and health, beauty and social order in the city - the vision and mission of Bandung City - Indonesia's Agenda 21 as a national strategy for sustainable development	• Increased awareness of: - the importance of, and necessity for IMSWPM and partnerships of stakeholders - the vital role of coordination in stakeholders' partnerships in IMSWPM - the vision and mission of Bandung City - Indonesia's Agenda 21 as a national strategy for sustainable development
• Build understanding	• Recognize: - risks/impacts of waste burning and illegal dumping to drains, canals, and rivers - the importance of reducing the amount of waste and impacts on the environment - the importance of Agenda 21 • Understand: - that waste is everybody's problem (Government Law Number 23 1997) - the importance of sharing waste management costs - the necessity for having a healthy city - the importance of waste separation at source	• Recognize: - the importance of efforts from various stakeholders to achieve the vision and mission - the existence and role of waste pickers • Understand: - the vision and mission of Bandung City - the complex issues (problems) in MSWPM - the importance of coordination in tackling various problems associated with waste, cleanliness and health, beauty and social order - the necessity of stakeholders' participation/ partnerships and the need for IMSWPM
• Gain support	• Support: - ideas related to IMSWPM (waste reduction and reuse, source separation, service provision, composting, recycling, and safe disposal) - the role of waste pickers - initiatives for partnerships in IMSWPM - initiatives toward the achievement of the vision and mission of the city - Agenda 21	• Support: - any initiatives related to achieving the vision and mission of the city - IMSWPM and partnerships of stakeholders - the involvement of waste pickers - the adoption of Agenda 21

Table 68. Continued

Goal	Expected changes in knowledge, perception, and behaviour	Expected changes in policies and institutions
• Have involvement	• Avoid waste burning and dumping to drains, canals, and rivers • Be willing to: - separate waste at their place (homes) - pay service fees - maintain cleanliness - practice waste reduction and reuse - take part in monitoring and enforcement of proper waste management practices - obey laws/regulations pertaining to IMSWPM • Be involved in community cleanliness events	• Be willing to adopt Agenda 21 and IMSWPM • Be involved in: - coordination and collaboration in IMSWPM and the achievement of the city's vision and mission - enforcement of environmentally-sound waste disposal practices • Prepare policies for: - promoting waste reduction and reuse - enhancing recycling activities (businesses) involving waste pickers - the adjustment of service fees • Endorse source separation • Establish policies for possible involvement of private contractors in service provision
• Gain commitment	• Commitment to: - proper waste management practices, cleanliness and health, beauty (greenness), and social order - the desire of having a healthy city - sharing waste management costs	• Commitment to: - encouraging partnerships of stakeholders in IMSWPM and various initiatives toward the healthy city - proper waste management practices, cleanliness and health, beauty (greenness), and social order

of neighbourhood units (Ketua RT and Ketua RW), universities (students and professors), women's organizations, mass media, and foreign donor agencies. It should be noted that by law the municipal government of Kotamadya Bandung has an obligation to provide public education about city cleanliness, involving Lurah, Camat, and other staff from various municipal government institutions, including PDK-Bandung. Education programs for students at schools will require the involvement of the Department of Education and Culture and schools' heads and teachers.

A few methods can be used for public education in MSWPM, such as talks by public figures, demonstrations, films or slide shows, site visits, and provision of guidelines and instructions. Included in the public figures are religious leaders. In the Municipality of Bandung, for example, one well-known leader of an Islamic school ("pesantren") used to lead his students in

cleanliness activities in the city. In addition, assisted by one local radio station, he initiated the collection of materials that can be reused or recycled, such as used clothing, newspaper, plastic, metal, and wood. Despite its general lack of involvement in public education in MSWPM in the Municipality of Bandung, some media have disseminated information to educate and increase awareness. These media include television, radio, newspapers and magazines, movies, billboards, flyers or pamphlets, brochures, and pictures.

8.10. Planning Perspectives of IMSWPM

According to Alexander (1993), there are several dimensions of planning theory, such as substance, rationale or motivation, process, model, product, and the roles of planners. The proposed IMSWPM can be seen from these viewpoints as well. First, the substantive dimensions are holistic, interconnective, goal oriented, and strategic. Second, the common motivations for adopting an integrated planning and management are the dissatisfaction with the narrowly-focussed approach such as the conventional approach to MSWPM, the need to deal with multiple and interconnecting issues, the need to deal with conflicts, and the potential for gaining more benefits from coordinated action. Third, the process involved is based on interaction and involvement of various stakeholders in their partnerships for the achievement of various goals. Communication will be used to help coordination and resolve conflicts among stakeholders. Fourth, with regard to the planning model used, IMSWPM resembles transactive planning

because it stresses interaction with and participation among the various stakeholders. This kind of planning approach will change the predominant top-down approach common in developing countries. In addition, because IMSWPM is strategic in nature, therefore it also inherits some characteristics of strategic planning. Fifth, the products of IMSWPM are bundles of programs or activities directed toward the accomplishment of various initiatives in waste reduction and reuse, source separation, service provision, composting at households, communities, and the municipality, recycling, and safe disposal. Sixth, in terms of the various potential roles of planners, the role of facilitator and mediator will be the most challenging one because it requires knowledge and skills in inter-personal relationships, in particular to deal with conflicts (Briassoulis, 1999). Table 69 summarizes the characteristics of IMSWPM as a planning approach.

Table 69. Characteristics of IMSWPM as a planning approach

Attribute	Description
• Substance	• Holistic • Interconnective • Goal oriented • Strategic (reductionist)
• Rationale/Motivation	• Dissatisfaction from the failures of the conventional approach • The need to deal with multiple and interconnecting issues • The need to deal with conflicts • The need to capture benefits from coordinated action
• Planning process	• Interaction with and involvement of stakeholders in partnerships in various initiatives • Coordination and conflict resolution
• Planning model	• Transactive • Strategic
• Product of planning	• Bundles of programs (activities) for partnerships of stakeholders
• Roles of planners	• Facilitator • Mediator • Coordinator

IMSWPM can also be viewed relative to the SITAR planning models discussed by Hudson (1979). With its emphasis on partnerships of stakeholders, IMSWPM reflects transactive planning more than the other models such as synoptic, incremental, advocacy, and radical, although it also contains some aspects of synoptic and advocacy planning. IMSWPM as an

interplay of directions and involvement of government officials with the local knowledge of the community represents transactive planning. Knowledge of the experts represented by government officials is blended with that of the community during planning and implementation.

IMSWPM can be viewed from the components of IRM (Integrated Resource Management) proposed by Mitchell (1998): context, vision, legitimacy, functions, structures, processes and mechanisms, and organizational culture. According to Margerum and Born (1995), integrated planning and management approaches posses dual perspectives, and so does IMSWPM. This approach has a broad view of municipal solid waste planning and management, but it focuses on key issues. Therefore, the context of IMSWPM is both broad and strategic.

Stakeholders involved in the City Development Strategy Project have envisioned Bandung as a safe, healthy, harmonious, religious, dynamic, efficient, productive, and innovative city. The mission of Bandung City can be characterized by its twin slogans: K3 (neat, clean, beautiful), and Berhiber (clean, green, flowery). As previously mentioned, legitimacy for IMSWPM rests with Indonesia's Agenda 21. At the municipal level, there has not been any law issued which recognizes the necessity for an integrated approach.

Planning and management functions of IRM are manifest in IMSWPM through initiatives in waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. Stakeholders involved in the partnerships may play roles as policy makers, facilitators, and/or doers. Three alternative arrangements for stakeholders' partnerships were offered by Hooper, McDonald and Mitchell (1999): voluntary, co-operative, and coercive. As previously discussed, the co-operative structure is selected.

Based on the suggestion from the State Ministry of the Environment, stakeholders' partnerships should occur in policy making, planning, implementation, and enforcement. Necessary mechanisms for implementing IMSWPM in Bandung consist of ways for coordination and conflict resolution. The organizational culture for the implementation of IMSWPM in Bandung can be characterized by a spirit for cooperation, openness, willingness to recognize others, and an understanding to pursue integrated efforts. Figure 40 illustrates a view of IMSWPM in Bandung from the IRM's framework.

The conventional approach to MSWPM in developing countries can be contrasted with the proposed IMSWPM approach based on various features, such as the rationale, view on waste, objectives, ideologies, focus, nature of planning and decision making, and power. The rationale

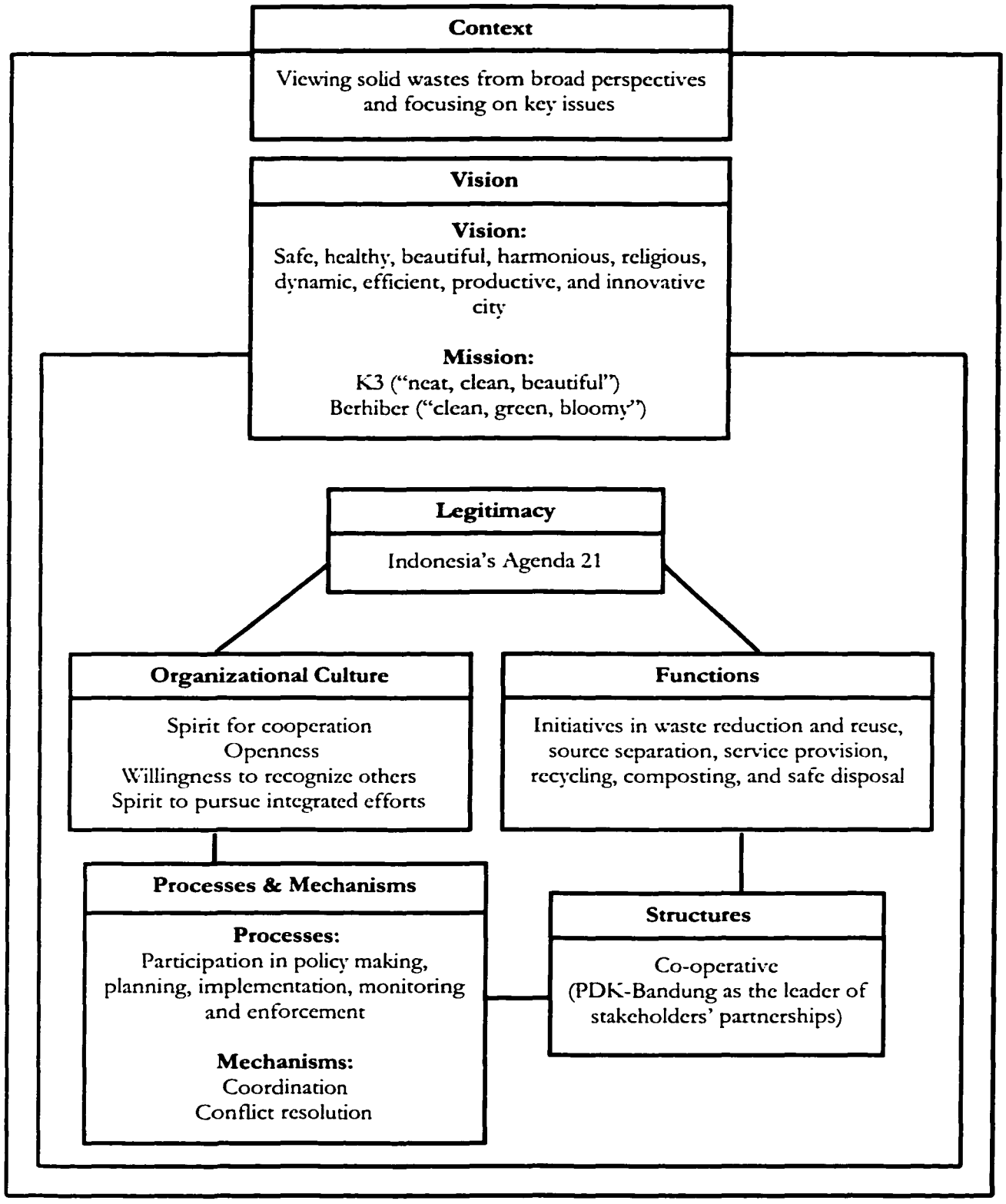


Figure 40. A view of IMSWPM in Bandung from the IRM's framework

for an integrated approach has been mentioned above. The ideology of the conventional approach is that waste management is a public work. As a result, government is responsible for public good. Using the command and control principle, the public should comply with what has been determined by the government, for instance concerning waste handling at the source and paying the fees levied. The integrated approach places waste management in a broad context, and considers technical, social, economic, environmental, institutional, and legal aspects. In addition, this approach also argues that everybody has rights and responsibilities for various aspects of waste management. Consequently, this approach advocates partnerships of stakeholders.

The focus of the conventional approach is on operational efficiency of collection, transportation, and disposal. The municipal cleaning authority strives to remove waste as quickly and cheaply as possible. The focus of the integrated approach, meanwhile, is on the coordination of initiatives among different actors to achieve various objectives or solve various problems of MSWPM.

The nature of planning and decision making is different between the conventional and the integrated approach. In the former, planning is predominantly top-down, includes very little or no involvement of other actors, and has a narrow scope. Decision making is exclusively in the hands of the local or municipal cleaning authority. Planning in the integrated approach is characterized by an interplay between top-down and bottom–up approaches, participation from various stakeholders, and a holistic perspective. The nature of decision making is marked by a group, participatory, open and adaptive process. In this respect, power becomes distributed among stakeholders. Table 70 compares the two approaches.

As mentioned in the literature review, IUDP (Integrated Urban Development Planning) has been common in developing countries, including Indonesia. To some degree, IUDP and IMSWPM shares similar objectives, features, and critical success factors for implementation. Two main objectives of IUDP are to make urban planning more responsive to the immediate needs of the urban population, and to optimize development projects within financial and institutional constraints (Miles and Arthur, 1992). The first objective is exactly the same with a benefit of IMSWPM suggested by stakeholders in Bandung and Jakarta: better planning. Stakeholders expected IMSWPM to enable the inclusion of inputs from the public. The second objective of IUDP is more concerned with optimizing the capacity of municipal authorities,

while IMSWPM supports mobilization of resources through partnerships involving various stakeholders.

Table 70. The contrast between the conventional approach and IMSWPM

Feature	The Conventional Approach	The Integrated Approach (IMSWPM)
• Rationale	• Waste should be moved and disposed of as quickly and cheaply as possible	• No single actor can alone solve the complex problems or issues associated with MSWPM
• View on waste	• Waste as garbage	• Waste as resource and waste as garbage
• Objectives	• Mainly public health and aesthetic	• Many objectives: economic, social, environmental, political
• Ideologies	• Waste management as a public work • Government is responsible for public good • Command and control • Public compliance	• Putting MSWPM in its broad context: technical, social, economic, environmental, institutional, legal • Everybody has rights and responsibilities • Partnerships
• Focus	• Operational efficiency in collection, transportation, and disposal activities	• Coordination of initiatives from different actors to achieve various objectives or solve various problems
• Planning	• Predominantly top-down • Very little or no involvement of other actors • Narrow scope	• Top-down and bottom–up • Participation from various stakeholders • Holistic
• Decision making	• Exclusive (municipal cleaning authorities)	• Group and participatory • Open and adaptive
• Power	• Government dominated	• Distributed among stakeholders

A few features of IUDP include strengthening governments' financial and managerial capability, introducing cost recovery through direct-user fees for public services, recognizing the importance of partnerships between governments and the private sector (Miles and Arthur, 1992), and initiating a new role for governments as enabler or facilitator (Walton, 1992). Similar features exist in IMSWPM: increasing financial capability of PDK-Bandung, adjusting service fees, advocating partnerships, and proposing PDK-Bandung to lead partnerships. In municipal solid waste planning and management, municipal authorities still possess a traditional role as service provider.

Miles and Arthur (1992) offered some suggestions for the implementation of IUDP: focusing on the partnership between the public and private sector, enhancing community

participation, linking top-down direction with bottom-up initiatives, physical and economic planning, concentrating on site- or project-specific actions, integrating strategic long-term planning and IUDP, and getting political support. Based on the findings, the successful implementation of IMSWPM in Bandung would be determined by strong political support and leadership, support from stakeholders, open and constructive relationships between government institutions and other stakeholders, an understanding concerning the importance of incorporating IMSWPM into the city's master plan, and available resources. Table 71 shows a comparison between IUDP and IMSWPM.

Table 71. A comparison between IUDP and IMSWPM in Bandung

Consideration	IUDP	IMSWPM
• Main objectives	• Making urban development planning more responsive to the immediate needs of the urban population • Optimizing development projects within financial and institutional constraints.	• Better planning (incorporation of inputs from the public) • Mobilizing resources through partnerships of stakeholders
• Distinctive features	• Strengthening governments' financial and managerial capability • Introducing cost recovery through direct-user fees for public services • Recognizing the importance of partnerships between governments and the private sector • Initiating a new role for governments as enabler or facilitator	• Increasing financial capability of PDK-Bandung • Adjusting service fees • Advocating partnerships and proposing PDK-Bandung to lead the partnerships • PDK-Bandung plays as service provider and as the coordinator of partnerships.
• Critical success factors for implementation	• Focusing on the partnership between the public and private sectors • Enhancing community participation • Linking top-down direction with bottom-up initiatives • Concentrating on site- or project-specific actions • Integrating strategic long-term planning and IUDP • Getting political support	• Strong political support and leadership • Support from stakeholders • Open and constructive relationships between government institutions and other stakeholders • Incorporating IMSWPM into the city's master plan • Available resources

According to Forester (1980), not only is planning practice instrumental, but it is also communicative. It is instrumental because planning practice is a means of achieving certain ends (objectives). It is communicative because it shapes attention and expectations for others. IMSWPM also incorporates these attributes. First, the implementation of IMSWPM through partnerships is expected to be capable of achieving goals of various initiatives, such as waste reduction and reuse, source separation, recycling, composting, and safe disposal. Second, the practice is expected to send messages to all stakeholders that everybody has a responsibility to guard the urban environment; that an integrated approach is called for; that cooperation, involvement and participation from stakeholders are necessary; that it is unreasonable to depend on PDK-Bandung to tackle all the issues the city; and, that government officials should be more open and willing to recognize the involvement of others, in particular communities and non-governmental organizations.

Friedmann (1987, 38) stated that "Planning attempts to link scientific and technical knowledge to actions in the public domain." This is similar to the definition of planning according to Forester (1989, 3) that "planning is the guidance of future action." IMSWPM is proposed as an appropriate planning and management approach. It also suggests that the planning process should be changed by involving more stakeholders because they have a potential contribution through conducting many initiatives in partnerships. The new planning process will move away from the top-down and once dominated by PDK-Bandung into one that is more open and adaptive (Safier, 1992; Devas, 1993; Carden, 1995).

A second definition of planning, according to Friedmann (1987, 38), is that "Planning attempts to link scientific and technical knowledge to processes of societal guidance." Friedmann argued that the state has a responsibility to articulate societal guidelines so as to achieve a change in society. This statement relates to another definition that "Planning attempts to link scientific and technical knowledge to processes of social transformation" (Friedmann, 1987, 38). In the context of municipal solid waste planning and management, the roles and involvement of many government institutions are very evident in the partnerships of IMSWPM. Officials of government institutions have a responsibility to provide guidelines for the various initiatives in MSWPM for the public. Various kinds of changes need to be introduced. For example, changing attitudes and behavior of the public about waste is important. This change is stated as a long-

term and ideal goal of Agenda 21: to change from the throw away society into a conserving society.

Alexander (1986) identified various roles for planners, including those of technical experts or administrators or programmers, mobilizers, organizers, entrepreneurs, advocates, mediators, facilitators or catalysts, and communicators or interpreters. Planners who work for government as technical experts can be involved in policy making and planning, for instance, to identify the appropriate policy instruments and institutional arrangements for implementation of this approach, devise mechanisms for enforcement, and formulate avenues to institutionalize this approach into formal planning initiatives (authorities). Planners acting as programmers can assist government in formulating programs and preparing technical guidelines necessary for IMSWPM, preparing public education programs, and proposing programs to strengthen local and regional planning authorities responsible for MSWPM.

The triple roles of entrepreneurs-mobilizers-organizers will be important, especially in the implementation of IMSWPM. Some important tasks may include finding and identifying avenues of sources of resources, building legitimacy, gaining political support, initiating and organizing contacts and meetings with stakeholders and the public, establishing partnerships of stakeholders, finding opportunities to link various initiatives, and coordinating donor agencies and seeking coherence in aid programs.

Planners can act as advocates, for example, by representing the interests of waste pickers and other interest groups, challenging the inappropriateness and inadequacy of the conventional approach to MSWPM, and calling for the necessity for adopting IMSWPM. Some tasks that can be accomplished by planners acting as communicators include disseminating messages to stakeholders and the public, communicating the vision and mission of the city, and promoting changes to government, the public, and the private sector.

Among those roles, the most important which can be played by foreign planners in the Municipality of Bandung or Indonesia, as part of global partnerships, are the triple roles of entrepreneurs-mobilizers-organizers. In general, planners from outside the country gain higher credibility than their domestic counterparts due to their origin, coming from the developed countries. In addition, they are also expected to be capable of bringing skills (expertise) and funds.

8.11. IMSWPM and Sustainable Development's Principles

As discussed in the literature review, principles for sustainable development were stated in the Rio Declaration (Carrol-Foster, 1993; Mitchell, 1997; Briassoulis, 1999). IMSWPM reflects some of those principles, such as human-orientation, equity, integrated development, cooperation, capacity building, participation, precautionary, internalization of environmental costs, recognition of the role of women and youth, acknowledgement of the role of traditional practices, and global partnerships.

As an approach, IMSWPM is stakeholder-oriented, similar to sustainable development's principle of human-orientation, and also stresses the spirit of cooperation among various stakeholders. IMSWPM recognizes the potential roles, authorities, responsibilities and contributions from individuals, communities, and institutions (organizations) to alleviate the various problems in waste management as well as in attaining various objectives as voiced by the stakeholders. The principle of equity, as mentioned in Chapter 4, addresses equal rights in earning income, getting the provision of waste collection service, and having a healthy living environment.

IMSWPM can be regarded as an integrated development approach as it adopts a holistic view for municipal solid waste planning and management and fosters coordination among stakeholders in partnerships for waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. In addition, the partnerships can contribute to improving the capacity to deal with the various problems associated with municipal solid waste planning and management. The principle of participation in IMSWPM is reflected through stakeholders' roles as policy makers, facilitators, and doers in the partnerships.

IMSWPM that advocates stakeholders' partnerships is precautionary in nature since it strives to avoid the worst situations, such as the increasing amount of uncollected waste; uncontrollable waste burning and illegal dumping to drains, canals, and rivers; pollution to air, water and lands; a dirty and unhealthy city; and, landfill crises. The principle of internalizing environmental costs is represented by higher responsibility and contribution of stakeholders in sharing waste management costs because the subsidies from the municipal government of Kotamadya Bandung will not be sufficient.

The role of women and youth is also recognized in IMSWPM. Women can have an important role in supporting proper waste management practices at home and teach children about cleanliness and health in their families. The young people such as high-school students and university students can play a vital role as well in cleanliness, health and proper waste management practices in their schools and homes. Traditional practices which are recognized in IMSWPM are households' behaviour to separate valuable items from others ands reuse them for other purposes or trade them for other valuable (consumable) products or give them free to others. These practices provide both economic and environmental benefits.

Global partnerships in IMSWPM are acknowledged through the recognition of foreign agencies' roles in assisting developing countries to deal with the various issues of MSWPM. As mentioned before, the Asian Development Bank (ADB), the World Bank, the Germany's GTZ, and a non-governmental organization from Australia, have been involved in initiatives associated with cleanliness and MSWPM in the Municipality of Bandung. In summary, IMSWPM is supportive of sustainable development.

8.12. Lessons for Other Municipalities in Indonesia

Many other municipalities in Indonesia can take a few valuable lessons from this study. Despite contextual differences in the political situations, economic prosperity, social and cultural diversity, the urban environment, and the solid waste planning and management, it is important to be proactive by considering MSWPM from a long-term view. This study reinforces a proposal advocated by stakeholders about the necessity for incorporating MSWPM into the city's long-term master plan. This is particularly critical with regard to increasing difficulties in finding landfill sites. A long-term (master) plan should assist municipalities in identifying and preparing for suitable landfill sites which will be used in the future. This is better than a reactive plan which may place municipalities in crisis situations.

Operating landfill sites properly is a necessity for minimizing pollution to surrounding areas, and a prerequisite for reducing opposition and animosity from both the surrounding communities and other municipal or district governments. This is particularly important because large and metropolitan cities appear to rely on the willingness of other municipalities (districts) to allow them to buy land for landfill sites. Failure to keep obligations to operate landfill sites properly could be costly. These were true for Jakarta and Bandung. As previously mentioned,

Jakarta had to face a crisis after its largest landfill site was protested by communities in the Municipality of Bekasi in which the parliament also agreed to close the site. Bandung had to deal with a conflict with the district government of Kabupaten Bandung regarding charges for disposal sites as well as animosity from a community living nearby a landfill site who demanded compensation of 1 billion rupiah. Violations to proper waste disposal operations bring about two long-term implications: either that communities and other governments have been increasingly reluctant to give permits for future landfill sites, or if they can agree, will demand more money or compensation

Political decisions by the municipal governments may have significant impacts. In Jakarta, for example, the municipal government allows private contractors in service provision. Waste pickers in Surabaya are recognized by the municipal government as part of service provision. In Bandung, however, neither private contractors nor waste pickers have been accepted by the municipal government.

The inability of municipal cleaning authorities to deal with the various issues related to MSWPM and the emergence of partnerships should strengthen the adoption of an integrated approach which has also been advocated by Indonesia's Agenda 21. Two strong and clear messages emerge from this Agenda: the necessity for achieving various goals (objectives) in solid waste management, and the need for partnerships among government, the private sector, and the public.

As aspired by stakeholders in Jakarta and Bandung, IMSWPM was perceived to be capable of offering various important goals and benefits. Achieving those goals and benefits will depend on two critical factors: ability of overcoming potential barriers, and willingness to change attitude, behaviour, and policies. Any municipality wanting to adopt and implement IMSWPM should anticipate and be prepared to deal with these aspects.

Any municipality wishing to adopt and implement Agenda 21 as its umbrella for all policies related to MSWPM should be cautious about possible inappropriateness of some stated goals and programs being applied to a local context. For example, Agenda 21 considers law enforcement of environmentally-sound waste disposal practices as a long-term objective. In the Municipality of Bandung, this is too late because the municipality has been struggling to deal with pollution.

CHAPTER 9.
CONCLUSIONS AND RECOMMENDATIONS

This chapter presents main conclusions, recommendations, and directions for further research. The conclusions of this study relate to theoretical perspectives, empirical evidence, and implications for policies. The recommendations deal with the necessity for integrated municipal solid waste planning and management (IMSWPM) in the Municipality of Bandung, waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. Some further research topics are identified both in developing countries and in the Municipality of Bandung.

9.1. Conclusions

Approaches to municipal solid waste planning and management in developing countries can be categorized into the conventional approach, the non-conventional approach, and the integrated approach. Main characteristics of the conventional approach include sole responsibility of municipal authorities for providing service including collection, transportation and disposal; a view that waste is a nuisance to the public (Cointreau, 1982), and a focus on technical efficiency (Agunwamba, 1998; Diaz, 1998). Common limitations of the conventional approach are the inability to cope with the high rates of urban growth and development, limited resources of local authorities (Halla and Mojani, 1999), lack of interest on waste reduction, recycling, and composting (Agunwamba, 1998), and lack of public participation (Soerjani, 1984; Silas and Indrayana, 1993; Sinha, 1993).

The non-conventional approach proposed by Furedy (1992) is characterized by its social and ecological objectives, including assisting poor people, accommodating informal activities in waste recovery and recycling, promoting source separation, developing partnerships among communities, private sector and municipalities, and environmental education. Empirical findings about the implementation of this approach are lacking (Furedy, 1994b).

The integrated approach has long been known, but it only has gained momentum recently. It considers technical, financial, socio-economic, organizational, institutional, and legislative aspects (Erbel, 1982). This approach has been advocated by many as a better

approach to deal with urban solid management in developing countries (Agunwamba, 1998; Ali, Olley and Cotton, 1998; Campbell, 1999; Halla and Mojani, 1999; Hoornweg and Thomas, 1999). One distinct attribute of the integrated approach is the partnership among stakeholders (Fernandez, 1993; Furedy, 1993, 1994a, 1994b; Ouano and Ogawa, 1993; Ali, Coad and Cotton, 1996).

Problems of municipal solid waste planning and management (MSWPM) in developing countries are multiple, interrelated and complex. The nature of those problems has three major implications. First, the conventional approach with its focus on collection, transportation, and disposal activities and its primary goal on technical efficiency in service provision is no longer appropriate because it is unlikely that this approach will be able to deal with the complexity. Second, involvement and participation from various actors other than the local cleaning authorities is needed. It is impossible to tackle those multiple problems by the local cleaning authorities that have limited capability. Partnerships of stakeholders in municipal solid waste planning and management are essential. Third, the increasingly complex issues associated with municipal solid waste planning and management and the inability of the conventional approach to deal with them lead to the necessity of an integrated approach to MSWPM in developing countries.

In general, any integrated approach to resource and environmental planning and management embodies two basic dimensions: substantive and procedural (Born and Sonzogni, 1995; Margerum and Born, 1995). The former is characterized by four main attributes: holistic, interconnective, goal oriented, and strategic. The latter is marked by interactions of stakeholders. In the context of municipal solid waste, the proposed integrated urban solid waste planning and management (IMSWPM) approach has these dimensions.

The holistic nature of IMSWPM is reflected through the need to take into account various perspectives, such as public and environmental health, physical, technical, social/cultural, economical/financial, institutional and managerial, political, and legal. The interconnectiveness of IMSWPM emphasizes the interactions among four main components: activities, actors (stakeholders), options, and aspects (perspectives). Goal oriented means the identification of common goals among stakeholders. The strategic nature of IMSWPM is reflected by the identification of key issues associated with waste generation, source separation, service provision, composting, recovery and recycling, and safe disposal.

The procedural dimension of IMSWPM in developing countries should be characterized by partnerships among various stakeholders in order to perform specific tasks, achieve certain objectives, or solve particular problems or key issues associated with municipal solid waste planning and management. Partnerships of stakeholders in IMSWPM can function as a medium for participation and empowerment; distribution of roles, authority and responsibilities; defining goals/objectives; making joint plans and decisions; setting priorities and targets; developing management strategies; sharing various burdens; assessing progress; and, seeking compromise. Partnerships of stakeholders in IMSWPM may occur in many initiatives, including waste reduction and reuse, source separation, service provision, recovery and recycling, composting, and environmentally-sound (safe) disposal.

The policy context of IMSWPM in developing countries highlights three main points. First, local and central governments and the international community have recognized the magnitude of problems of municipal solid wastes and the adverse impacts on the urban environment and urban inhabitants. Second, improving capacity for urban environmental management, including municipal solid waste planning and management, has been considered as a prerequisite to achieving some goals of sustainable urban development. These goals, according to Drakakis-Smith (1995), include economics (e.g., growth, equity, efficiency), ecological (e.g., ecosystem integrity, carrying capacity, biodiversity), and social (e.g., empowerment, participation, institutional development). Third, approaches to municipal solid waste planning and management which foster partnerships among government, the private sector, and the public have been sought to improve the local capacity to deal with those complex problems.

The context of this study, the Municipality of Bandung, provides a few insights. First, the municipality with a long period of rainy season, about five months a year, faces hardships in service provision, composting initiatives, and final disposal operations. Second, increases in population growth and waste production have made the provision of an effective, efficient, and reliable service a necessity for keeping the city clean and protecting the people from the negative impacts of solid wastes. Third, the governmental administrative structure and the annual bottom-up planning process pose not only the government bureaucracy, but also times required from planning to implementation. These suggest the impossibility of alleviating all

issues associated with municipal solid wastes by depending on the government's funds. Efforts and contributions from various stakeholders will be needed, for instance, through partnerships.

IMSWPM is an appropriate approach to municipal solid waste planning and management in the Municipality of Bandung because it is consistent with integrated planning and management approaches, such as the need to deal with the complex problems and challenges of MSWPM, the dissatisfaction with the narrow focus of the conventional approach to MSWPM, the need to deal with competing views, and stakeholders' expectations to capture benefits from coordination in many issues of MSWPM. The sustainability of IMSWPM will be greater if the municipal government adopts it through a municipal law or an instruction from the mayor concerning the necessity for this approach.

IMSWPM differs from the pilot project at the integrated final disposal site of PDK-Bandung. IMSWPM advocates separation of waste at its source of generation, while PDK's project concentrates on separating waste coming to the final disposal site. IMSWPM promotes inclusion of various stakeholders, while the integrated final disposal site only involved PDK's staff and experts from a foreign non-government organization. IMSWPM emphasizes the need to recover and recycle any valuable materials, while PDK's project only focuses on plastic and paper.

Despite its shortcomings, the pilot project on the integrated final disposal site of PDK-Bandung offers several benefits. They include the reduction of the amount of waste to be disposed through plastic and paper recycling, composting, and incineration; the reduction of the toxicity of pollutants to be disposed through leachate treatment; the extension of the life of the disposal site; the potential generation of electricity using methane gas; and, the production of brick from the incineration slag.

In general, IMSWPM is in line with Indonesia's Agenda 21. Both advocate the necessity for an integrated approach to municipal solid waste planning and management, particularly for large and metropolitan cities. Many key issues proposed by IMSWPM with regard to waste generation, source separation, service provision, recycling, composting, and safe disposal have been incorporated in the long- and short-tem objectives and programs of Agenda 21 in four areas: minimization of waste; maximization of reuse, recycling and composting; extension of waste service coverage; and, use of environmentally-sound waste disposal.

All ideas concerning an integrated approach to municipal solid waste planning and management proposed by stakeholders in Bandung and Jakarta are in line with the proposed IMSWPM. Those ideas include the need for considering a wide range of factors (comprehensive), fostering public and private participation (partnerships), coordinating various actors (stakeholders), using all available technological options, combining top-down and bottom-up planning, being responsive to the local needs, adopting a new paradigm that waste is everybody's problem, and including IMSWPM into the city's Master Plan and Spatial Plan.

Although slight differences exist regarding the goals of an integrated approach to MSWPM between those proposed by stakeholders in Bandung and Jakarta and those proposed by IMSWPM, in general they are similar. The goals of IMSWPM in the Municipality of Bandung may include preserving the quality and integrity of the urban environment, strengthening the capability of the municipal authorities to deal with the various issues in MSWPM and environmental management, extending affordable service coverage, adopting 4Rs (reduce, reuse, replace, recycle), promoting stakeholder partnerships and facilitating coordination among stakeholders, supporting the creation of employment opportunities, supporting the use of appropriate technology, and nurturing public education and participation in many aspects of MSWPM.

Benefits from IMSWPM in the Municipality of Bandung may include reduced quantity of waste, decreased impacts of solid waste on the urban environment, greater effectiveness due to integrated policies/planning and integrated efforts/programs, strengthened institutional capacity to deal with waste management issues, enhanced partnerships of stakeholders, better planning, reduced bureaucratic hurdles, increased power and effectiveness in law enforcement, and reduced conflicts.

The proposed IMSWPM is timely the Municipality of Bandung. First, IMSWPM fits the multiple and complex problems of MSWPM in the municipality. Second, it also fits well with the existing practices for waste management that include waste reduction, source separation, service provision, recovery and recycling, composting, and safe disposal. Third, this approach is in line with stakeholders' vision regarding an integrated approach to MSWPM. Fourth, the approach fits the existing opportunities, such as Indonesia's Agenda 21, the policy draft on 4Rs (reduce, reuse, replace, recycle), the pilot project at the integrated final disposal

site of PDK-Bandung, the City Development Strategy (CDS) Project, and satisfactory support from stakeholders for source separation, recycling.

Despite a few disagreements, IMSWPM is generally acceptable in the Municipality of Bandung. Ideas accepted by stakeholders include waste reduction and reuse initiatives, source separation, a scheme of employing both local community organizations and the municipal cleaning enterprise in service provision, recycling, composting, and safe disposal. Ideas rejected include the privatization of service and the formal recognition and involvement of waste pickers at the proposed recovery and recycling centres.

Technical guidelines for waste reduction and reuse by households prepared by the Directorate General of Human Settlement Development (DJCK) are simple and therefore should be easy to implement. Reuse is socially acceptable since it has been part of the tradition of households, while waste reduction is socially still unknown. The sustainability of reuse seems compared to waste reduction.

Technical guidelines for source separation by households and communities included in a mayor's instruction are simple and therefore should be operationally feasible. Not only was source separation supported by many government institutions, it was also accepted by households, neighbourhood chiefs, and university (undergraduate) students. Because source separation has not been mandatory, its legitimacy is still insufficient. Nevertheless, the sustainability of source separation in the future can be high since prospective funding sources to promote it to the public are available.

The existing scheme in service provision, involving local community organizations responsible for the provision of primary collection service and PDK-Bandung responsible for the secondary collection service as well as treatment and final disposal, has been enforced through a municipal law. As a result, the legitimacy for this scheme is sufficient. In addition, this scheme is also financially sustainable because it is funded mostly through the services fees collected by both the community organizations and PDK-Bandung. However, the existing scheme in service provision will be insufficient unless PDK-Bandung improves its service capability or private contractors are involved, provided that the municipal government will allow this arrangement.

The proposed recycling sites should be socially acceptable because they gather waste pickers at certain sites, avoid opposition from residents and municipal officials, and prevent

waste pickers from being caught by municipal authorities. In addition, those sites were supported by some representatives of waste pickers. However, the proposed recycling sites are technically and financially infeasible because they did not get support from PDK-Bandung. Therefore, the sustainability of those sites is uncertain or low.

Despite lack of legal support, community-level composting can be operationally feasible as it was considered to be socially acceptable. The sustainability of community-level composting should be higher compared to household-level composting because it frees each household from purchasing and operating a composter in its home. Municipal-level composting with simple windrow technology has been conducted by PDK-Bandung and its sustainability depends largely on the availability and continuity of compost demands. The sustainability of municipal-level composting conducted by PDK-Bandung will be higher if it is viewed as part of waste treatment processes.

All three final disposal sites owned and operated by PDK-Bandung were designed and built as sanitary landfills. Therefore, the use of sanitary landfill is technically feasible. Moreover, the necessity for environmentally-sound waste disposal practices is enforced by a municipal law as well as by health standards issued by the Department of Health. The sustainability of sanitary landfill will depend on availability of funds and law enforcement.

The proposal to promote, embrace, and implement IMSWPM, as advocated by this study, is timely for the Municipality of Bandung. The existing opportunities included Indonesia's Agenda 21; the policy draft on 4Rs (reduce, reuse, replace, recycle); the pilot project at the integrated final disposal site of PDK-Bandung; support from stakeholders for source separation, recycling, and composting; the City Development Strategy project; and, a wish to establish a City Council can be used to promote IMSWPM. The various challenges associated with MSWPM, coupled by the desire to have a healthy city will make IMSWPM an attractive and appropriate approach to MSWPM in Bandung Metropolitan Region.

Barriers to implementation of IMSWPM in Bandung may include the lack of coordination capability of government institutions, weak and limited capacity of government officials, institutional bureaucracy, difficulties in gaining consensus, difficulties in sustaining the partnership process, difficulties in gaining local community support, and politics.

Initial implementation of IMSWPM in the Municipality of Bandung involves finding initiators-promoters, establishing legitimacy, and building capacity for partnerships in

IMSWPM. Some initiators-promoters will be required to identify actual and potential stakeholders and their contributions in IMSWPM, make initial contacts with them, and facilitate partnerships.

Establishing legitimacy for IMSWPM can be indirectly done by urging the municipal government of Kotamadya Bandung to adopt Indonesia's Agenda 21 as the umbrella for its various policies so that both Agenda 21 and IMSWPM will gain legitimacy, or directly by promoting the necessity for IMSWPM to PDK-Bandung and some officials of the municipal government. To gain political support from the municipal government, the mayor should be asked to support the adoption and implementation of IMSWPM.

Capacity for partnerships in IMSWPM can be built through the establishment of a cooperative network, consisting of PDK-Bandung as the lead agency and workgroups of participants as members; the provision of funds; the assignment and appointment of staff; and the infrastructure (mechanisms and ways for coordination and conflict resolution).

The implementation of IMSWPM will require changes in knowledge and perception (attitudes), behaviour, and policies of stakeholders and the public. Communication can be used to facilitate change from individuals and organizations through creating and increasing awareness, building understanding, gaining support, getting involvement, and having commitment (Quirke, 1997). Therefore, messages regarding the vision and mission of Bandung City, the various issues associated with MSWPM, the necessity for adopting IMSWPM, and the importance of partnerships of stakeholders in IMSWPM should be promoted with stakeholders and the public.

The triple roles of planners as entrepreneurs-mobilizers-organizers will be particularly important in the introduction and implementation of IMSWPM in the Municipality of Bandung. Their main tasks may consist of finding and identifying sources of resources, gaining political support, building legitimacy for IMSWPM, initiating and organizing contacts and meetings with stakeholders and communities, establishing partnerships of stakeholders, finding opportunities to link various initiatives in IMSWPM, and coordinating donor agencies or seeking coherence in aid programs. Foreign planners wishing to assist the introduction and implementation of IMSWPM in the Municipality of Bandung should consider playing those roles because they gain higher credibility, coming from the developed countries.

Five kinds of policy measures for integrated waste management have been identified by Wilson (1996): information dissemination, legislative sticks, economic sticks, carrots, and producer responsibility. Information dissemination is required to increase awareness and change attitudes and behaviour of stakeholders and the public. Legislative sticks are meant as regulations which determine order about certain matters by certain actors. Economic sticks can be interpreted as coercion in economic terms. Carrots refer to the provision of financial incentives. Producer responsibility is aimed at making producers responsible for the collection and disposal of their waste. This study supports the assertion of Wilson regarding the necessity for using a mix of those instruments.

The legitimacy for IMSWPM in the Municipality of Bandung can be built through regulation (legislative sticks), information dissemination (exhortation), and the provision of government subsidies or grants (carrots) from the municipal government. Both waste reduction and reuse initiatives need two policy instruments: information dissemination and government subsidies or grants. Policy instruments for source separation comprise information dissemination to encourage and persuade waste generators, in particular households, to separate their wastes into dry (inorganic) and wet (organic) streams; government subsidies or grants to provide funds for public education and awareness programs; and regulations (legislative sticks) to make source separation mandatory. To ensure capability of providing an effective, efficient, reliable and sustainable service to all residents, four policy instruments are needed: legislative sticks, economic sticks, carrots, and information dissemination. Recycling initiatives require five kinds of policy instruments: information dissemination, carrots, legislative sticks, economic incentives, and voluntary producer responsibility. Two policy instruments for composting will be needed: information and dissemination and carrots (government subsidies or grants). The operation of environmentally-sound waste disposal practices requires three policy instruments: legislative sticks, carrots, and economic sticks.

In general, the role of the private sector in waste management has not been fully recognized in the Municipality of Bandung. Potential involvement of the private sector maybe in service provision, municipal-level composting initiatives, and provision of credits to the informal waste recycling businesses. If PDK-Bandung continues to be unable to provide service to all residential and industrial areas, then private contractors should be allowed to fill the gap, provided that the economic of scale of service provision can be met. Private

contractors have the ability to produce high quality compost such that produced through vermi-composting technology. However, this scheme will work only if markets are available. The partnerships in plastic recycling involving two large beverage manufacturers in Bekasi, West Java, small-scale businesses, and waste pickers should be promoted in Bandung as such initiatives can assist the development of the local waste recycling industry.

The conceptual framework of IRM (Integrated Resource Management) proposed by Mitchell (1998), consisting of seven components, including context, vision, legitimacy, functions, structures, processes and mechanisms, and organizational culture and attitudes, appears transferable to IMSWPM. The context of municipal solid waste is dual: a broad view with a focus on key issues (Margerum and Born, 1995). A vision of Bandung City is a city that is safe, healthy, beautiful, harmonious, religious, dynamic, efficient, productive, and innovative. Legitimacy of IMSWPM rests with Indonesia's Agenda 21. Planning and management functions of IRM are manifest in initiatives for waste reduction and reuse, source separation, service provision, recovery and recycling, composting, and environmentally-sound waste disposal. A co-operative structure proposed by Hooper, McDonald and Mitchell (1999) is selected and it assigns PDK-Bandung as a lead agency (Alexander, 1993). Processes in IMSWPM should be characterized by participation of stakeholders in policy making, planning, implementation, and monitoring and enforcement. Two major mechanisms are coordination and conflict resolution. The organizational culture should be reflected by a spirit for cooperation, openness, willingness to respect others, and an awareness of the importance of pursuing integrated efforts.

Theoretically, IMSWPM is consistent with goals and strategies of environmental management in Indonesia. Many goals and expected benefits of IMSWPM can provide a positive contribution to the achievement of environmental management goals. However, the implementation of IMSWPM will also have to overcome the same barriers faced in environmental management, such as bureaucracy (arrogance), limited capacity of government officials, and weak law enforcement.

As a planning approach, IMSWPM is conceptually in accordance with sustainable development as it possesses the same principles, such as human (stakeholder)-oriented, equity, integrated development, cooperation, capacity building, participation, precautionary,

internalization of environmental costs, recognition of the role of women and youth, acknowledgement of the role of traditional practices, and global partnerships.

Empirically, IMSWPM in the Municipality of Bandung offers three kinds of contributions to sustainable development in terms of economic, social, and environmental aspects. Contributions of IMSWPM on the economic aspects are manifest in the forms of income generation, employment creation, savings in waste management costs, and economic diversity through the use of recycled materials. IMSWPM' s contributions on the social aspects consist of meeting a basic (primary) human need of the urban residents, nurturing public participation, acknowledging the existence and role of waste pickers, and developing municipal institutions. Contributions of IMSWPM on the environment are the maintenance of the cleanliness and health of the urban environment, and natural resource conservation through the use of recycled materials.

This study offers some important lessons for other municipalities in Indonesia. The lessons include a need for being proactive by considering municipal solid waste planning and management from a long-term view, in particular to avoid landfill crises in the future; a necessity for proper final disposal operations so as to prevent or minimize pollution to surrounding areas; an awareness of the impacts of government's political decisions upon policies related to municipal solid waste planning and management; an increasingly importance of partnerships to achieve various goals associated with cleanliness and health, beauty and social order; an understanding concerning barriers to and changes required for the implementation of IMSWPM; and a need to adapt Indonesia's Agenda 21 to local conditions.

9.2. Recommendations

Initiators and promoters of IMSWPM should approach the municipal government of Kotamadya Bandung and PDK-Bandung to establish a cooperative network for partnerships of stakeholders in IMSWPM, led by PDK-Bandung and involving workgroups of participants responsible for initiatives in waste reduction and reuse, source separation, service provision, recycling, composting, and safe disposal. One way of getting political support for IMSWPM is by asking the mayor to give his/her support and commitment to the partnerships of stakeholders in IMSWPM. For example, the mayor could establish regular meetings with PDK-Bandung and stakeholders to report and discuss the programs and their implementation.

Indonesia's Agenda 21 should be promoted in the IMSWPM in the Municipality of Bandung in order to create and increase awareness, build understanding, and gain support from all stakeholders and the public. It is expected that the municipal government will eventually be willing to embrace and endorse Agenda 21 as an umbrella of its policies. The endorsement of Agenda 21 will provide strong credibility to both this agenda and IMSWPM. The State Ministry of the Environment has a responsibility for marketing Agenda 21, or otherwise it will have no effect. In this sense, the State Ministry of the Environment can work together with other actors, such as the Directorate General of Human Settlements Development (DJCK), non-governmental organizations, and foreign donor agencies to conduct aggressive campaigns about Agenda 21 to municipal governments and the public in Indonesia, including Bandung.

The economic crisis and the looming government's debt should awaken every citizen about efforts to achieve savings in every aspect of his/her life. Promoting reuse for residents is consistent with those efforts. Therefore, the Directorate General of Human Settlement Development (DJCK) should immediately publicize its policy on 4Rs (reduce, reuse, replace, recycle), provide guidance on how this policy can be implemented by various stakeholders, and take an active role in promoting the importance and benefits of waste reduction and reuse initiatives.

Following Indonesia' Agenda 21, PDK-Bandung should adopt waste reduction and reuse as part of its long-term plan. As previously discussed, the scope of waste reduction in the pilot project of integrated final disposal site, although necessary, is insufficient. As also advocated by IMSWPM, waste reduction initiatives should be started at the beginning of waste generation, instead of at final disposal sites. PDK-Bandung should immediately initiate efforts to introduce the idea of separating waste into dry (inorganic) and wet (organic) streams to the public, in particular households and communities. Based on an instruction from the mayor, initiatives for source separation by households and communities should be organized and coordinated with the young men's association, chiefs of neighbourhood units (Ketua RT or Ketua RW), Lurah, and Camat. Similar efforts for students could be arranged with the Department of Education and Culture and universities in Bandung. Learning from the failures in a pilot project of source separation by residents in Jakarta, PDK-Bandung should anticipate and prepare for modifying some of its collection vehicles to accommodate the collection of two different streams of waste. This will be important to prevent the mixing of the separated wastes

by the collection crews as it could discourage residents to support and participate in source separation. Potential funding contributors should be identified to support efforts for source separation. If possible, some funds may have to be allocated to assist PDK-Bandung in changing its collection vehicles.

The finding that women, such as mothers, wives and house sitters, were mostly responsible for waste handling at home should not lead to a conclusion that public education about proper waste management practices at homes should be targeted only at them. Although most regular education has been done for and by the women's association ("PKK"), men and youth should also become the targets. Eventually, source separation should be enforced. This will require the municipal government of Kotamadya Bandung to change the existing mayor's instruction into a law. Once the law is issued, each household has to put its wastes into two streams (wet and dry), and each community should have at least one site to keep the inorganic waste.

The policy of the Department of Health that allows residents to burn their waste should be changed because it is no longer appropriate for metropolitan cities such as the Municipality of Bandung in order to reduce various negative impacts on the urban environment. The new policy should prohibit urban residents to practice waste burning.

PDK-Bandung has a challenge concerning the provision of collection and transportation service for areas not yet served. Many chiefs of neighbourhood units complained about the two-week waste collection interval because in their view it is too long. They expect PDK-Bandung to shorten that interval or to provide its service to their areas. Therefore, the highest priority should be the provision of service for those who do not yet have it and the improvement of service quality to those who have already got it. Because increasing the capacity of PDK requires more collection vehicles and crews, this study suggests that the municipal government should add more subsidies to PDK-Bandung and at the same time increases the current retribution fees that has not been changed since 1993 by 20%. The additional subsidies and revenues should be used by PDK-Bandung to upgrade its collection vehicles, acquire more collection vehicles, develop human resources, and hire more crews or assign extra working hours to the existing crews to earn extra income. Part of those subsidies and revenues should be allocated to fund the operations of two final disposal sites more properly. In order to discourage waste burning and illegal dumping to drains, canals, and rivers,

public education and awareness programs should be conducted as part of promoting proper waste management practices by individuals and households. Both the municipal government of Kotamadya Bandung and PDK-Bandung should take charge for this program.

Based on the recommendations of Indonesia' Agenda 21, the municipal government of Kotamadya Bandung and/or PDK-Bandung should conduct a comprehensive study regarding the potential (feasibility and sustainability) of involving private contractors in service provision. Another study to explore possibilities of having regional waste provision for Bandung Metropolitan Region should be conducted along with the district government of Kabupaten Bandung.

As mentioned in Indonesia's Agenda 21, the domestic recycling industry in Indonesia is sensitive to fluctuations in supply and demand. Therefore, the Department of Industry and Trade should support a recommendation to ban imports of waste in order to protect the domestic recycling businesses as well as the lives of many urban people in the informal waste sector, such as waste pickers, itinerant buyers, small collectors (lapak), and big brokers (bandar).

Providing the informal waste sector access to credit will be important. Credits for waste pickers can be used to change their occupation from sorting valuable materials at dump sites to becoming itinerant buyers, purchasing or bartering valuable materials directly with households. Based on the partnerships in plastic bottle recycling in Bekasi, West Java, sponsored by PT. Aqua Golden Mississippi and PT. Coca Cola Indonesia, access to credit for waste pickers can be also used to establish cooperatives among them. Therefore, beverage manufacturers should be asked to participate in such efforts in the Municipality of Bandung. In this way, some waste pickers in Bandung will enjoy support and feel secured for their lives. Potential donors (sponsors) should be identified to assist the establishment of recycling sites as part of assisting waste pickers.

PDK-Bandung should begin to initiate campaigns on composting by conducting small-scale composting projects run by local communities along with the other actors, such as PPLH-ITB, DTC-ITB, non-governmental organizations, and foreign donors. This is because efforts to promote composting in the Municipality of Bandung have been lacking. Following Indonesia's Agenda 21, potential funding sources should be found to assist the public education programs about composting, and to provide credits to communities and waste pickers to conduct

composting. Therefore, efforts to identify, create and develop markets for compost should also be pursued. Without sustainable markets, composting initiatives by communities and waste pickers will not survive in the long term. Another recommendation about composting for PDK-Bandung is based on the suggestion from some stakeholders. They argued that PDK-Bandung should incorporate composting as an integral component of is long-term (master) plan, not just as part of the pilot project of the integrated final disposal site. In addition, PDK-Bandung might consider composting as part of waste treatment processes.

Subsidies from the municipal government of Kotamadya Bandung and additional revenues from increasing the existing service fees should be available to enable PDK-Bandung to operate its final disposal sites according to health standards issued by the Department of Health. Once PDK-Bandung gets its required funds, enforcement should be upheld to reduce violations. Although the use of incineration in the Municipality of Bandung is infeasible in the next five years, PDK-Bandung should continue with its pilot project at the integrated final disposal site that also includes incineration to gain experience and to determine the feasibility of this option in the future. Following a recommendation of Indonesia's Agenda 21, it is appropriate for PDK-Bandung to explore possibilities for establishing regional landfill sites along with the district government of Kabupaten Bandung. For the Municipality of Bandung, having joint regional landfill sites offers one major benefit: overcoming the difficulties in finding landfill sites in the future, especially when the sites are located in the administrative area of Kabupaten Bandung.

This study expects initial implementation of IMSWPM in the Municipality of Bandung to be accomplished in three years after which partnerships of stakeholders in various initiatives, including waste reduction and reuse, source separation, service provision, recycling, composting, and environmentally-sound waste disposal, will evolve into routine activities. The accomplishment of those recommendations is summarized in Table 72.

9.3. Future Research Directions

Desirable directions for further research on integrated urban solid waste planning and management (IMSWPM) in Indonesia, as well as other developing countries, from the experience in the Municipality of Bandung, are:

Table 72. Implementation plans of IMSWPM in the Municipality of Bandung

Programs for the First Year:

1. Findings initiators-promoters of IMSWPM
2. Promoting IMSWPM to key officials of the municipal government and PDK-Bandung
3. Seeking political support for IMSWPM from the mayor
4. Establishing partnerships of stakeholders in IMSWPM
5. Asking DJCK to publicize technical guidelines about 4Rs (reduce, reuse, replace, recycle)
6. Asking PDK-Bandung to incorporate waste reduction and reuse and composting as part of its long-term (master) plan
7. Asking the Department of Health to revise its policy regarding waste burning
8. Asking the municipal government to raise the existing service fees by 20% and to provide more subsidies
9. Asking the Department of Industry and Trade to ban imports of wastes
10. Finding sponsors to support promotion of composting

Programs for the Second Year:

1. Asking the State Ministry of the Environment and the municipal government to promote Agenda 21
2. Seeking sponsors to assist the promotion of source separation and to assist PDK-Bandung and to provide credits for the informal waste sector for recycling units
3. Promoting source separation and composting to households, communities and students
4. Asking PDK-Bandung to modify collection vehicles to suit to source separation
5. Conducting a feasibility study about the involvement of private contractors in service provision
6. Asking PDK-Bandung to conduct a study about viewing composting as part of waste treatment processes
7. Promoting to the public about recycled products and products made from recycled materials
8. Enforcing laws pertaining to environmentally-sound waste disposal practices

Programs for the Third Year:

1. Asking the municipal government to make source separation mandatory
2. Conducting a feasibility study regarding regional service provision for Bandung Metropolitan Region
3. Conducting a feasibility study about joint regional landfill sites

1. Implementing the proposed partnerships of stakeholders for various initiatives such as waste reduction, source separation, composting (household, community, and municipal levels), recycling, and safe disposal. Action research to establish partnerships among various stakeholders in certain initiatives, in particular source separation and composting, will be very important.
2. Exploring the possibility of contracting some services to the private sector. An in-depth study will be valuable in justifying the necessity of the private sector's involvement in service provision, for instance in collection and transportation service and composting.
3. Developing schemes for long-term credit provision to the informal waste sector, in particular waste pickers, for recycling and composting initiatives. These should be emphasized more on sustaining the efforts by waste pickers rather than just giving donations to them.
4. Exploring the prospects for regional service provision and joint regional landfill sites among the municipal government of Kotamadya Bandung and the district government of Kabupaten Bandung.

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Appendices

Appendix A.

Interview form for government agencies, private sector, professors, foreign agencies, and non-governmental organizations

A. Urban Environmental Management

1. Do you know about sustainable development? What do you think of it?

2. Do you know about IUDP (Integrated Urban Development Planning)? What do you think of it?

3. What do you think of urban planning in Indonesia (this city)?

B. Urban Solid Waste Planning and Management

1. What do you think of urban solid waste planning and management in Indonesia (this city)?

2. What are the major problems or issues challenging the local authorities in Indonesia (this city)?

3. What are your comments about:
   a. Waste reduction initiatives in Indonesia (this city)?
   b. Source separation initiatives? What are the barriers of these efforts?
   c. Service provision? What is your opinion concerning privatization of service?
   d. Recycling? Do you support the involvement of waste pickers in recycling businesses?
   e. Composting? How can we promote composting in this city?
   f. Disposal? In your opinion, what criteria should be used in selecting appropriate technology for disposal?

4. What do you think of public education in urban environmental management and in urban solid waste management in this city?

5. What do you think of environmental law enforcement in Indonesia (this city)?

C. Integrated Urban Solid Waste Planning and Management

1. Do you have any ideas what an integrated approach to urban solid waste planning and management in Indonesia (this city) should be?

2. What do you think of the objectives of an integrated approach to urban solid waste planning and management in Indonesia (this city)?

3. What kind of benefits do you expect from an integrated approach to urban solid waste planning and management in Indonesia (this city)?

4. What is your opinion regarding the idea of partnership (involving and giving roles to various actors) in any aspect of urban solid waste planning and management?

5. Based on your knowledge or experiences, what will be the anticipated barriers to implementation of an integrated approach to urban solid waste planning and management in Indonesia (this city)?

6. Based on your experiences, what mechanisms were frequently used in coordinating various stakeholders engaged in any partnership in urban environmental management or urban solid waste planning and management?

7. Based on your experiences, what kinds of approaches were usually used to resolve any conflict among stakeholders involved in any partnership in urban environmental management or urban solid waste planning and management?

Appendix B.

Interview form for chiefs of neighbourhood unit (Ketua RT)

1. What are the major problems associated with solid waste management in your community area?

2. Do you do waste burning in your community area? If yes, how often?

3. Is there any problem about waste dumping to drains (canals) and rivers in your community area?

4. What kind of efforts have you done to deal with those problems?

5. What kind of obstacles do you face in order to increase participation from your members?

6. Do you support the idea of separating waste into the wet (organic) and dry (inorganic) streams?

7. Do you support the idea of composting?

8. What are your suggestions for promoting composting at your community area?

9. Do you agree with the presence of waste pickers in your community area? Why?

10. What do you think of the performance of PDK-Bandung in providing service to your area?

11. In your opinion, who should be involved in public education programs in order to increase your community's awareness on cleanliness?

Appendix C.

Questionnaire for university (undergraduate) students

1. In general, what do you think of the cleanliness of the City of Bandung?
   - ☐ Satisfactory
   - ☐ Less than satisfactory
   - ☐ Bad

2. What is your opinion about the performance of PDK-Bandung?
   - ☐ Satisfactory
   - ☐ Less than satisfactory
   - ☐ Bad

3. In general, What do you think of the greenness of the City of Bandung?
   - ☐ Satisfactory
   - ☐ Less than satisfactory
   - ☐ Bad

4. What is your opinion concerning the "flowery" aspect as mentioned in the City' slogan "Bandung Berhiber" to the real condition of the City?
   - ☐ Very appropriate
   - ☐ Appropriate
   - ☐ Inappropriate
   - ☐ Very inappropriate

5. Do you support separation of waste into the wet (organic) and dry (inorganic) streams at your home?
   - ☐ Extremely agree
   - ☐ Agree
   - ☐ Disagree
   - ☐ Extremely disagree

6. Do you support waste pickers as decent occupation?
   - ☐ Extremely supportive
   - ☐ Supportive
   - ☐ Not supportive
   - ☐ Extremely not supportive

7. Is there any regular community's cleanliness activity in your area?
   - ☐ Yes
   - ☐ No
   - ☐ Do not know

8. In the last sixth months, have you ever participated in any community's cleanliness activity in your area?
   - ☐ Yes
   - ☐ No

9. Are you aware of the efforts of the municipal government of Kotamadya Bandung to get the Adipura Award for the City?
   - ☐ Very aware
   - ☐ Aware
   - ☐ Do not aware (do not care)

10. Would you be willing to participate in any public education programs about waste management?
   - ☐ Very enthusiastic
   - ☐ Will be willing to participate
   - ☐ Will not participate

Appendix D.

Interview form for households

A. Identification of Household Status

Check where applicable:

a. Home appearance:
   - ☐ Permanent
   - ☐ Semi permanent
   - ☐ Non permanent

b. Garage:
   - ☐ Yes
   - ☐ No

c. Location
   - ☐ Wealthy (rich people)
   - ☐ Middle income
   - ☐ Low income
   - ☐ Difficult to be determined

B. Questions

1. Do you burn your waste? If yes, how often do you do it in each week or month?

2. What do you think of the amount of the current retribution fee?
   - ☐ Too much
   - ☐ Sufficient
   - ☐ Too small

3. Would you be willing to pay more for the retribution fee in order to have better service from PDK-Bandung?
   - ☐ Yes
   - ☐ No

4. Who is the person most responsible for handling your in your home:
   - ☐ Mother
   - ☐ Father
   - ☐ House sitter
   - ☐ Son/daughter
   - ☐ Can be anybody

5. Would you be willing to separate your waste into two parts: the wet and dry one?
   - ☐ Yes
   - ☐ No

6. Do you support the making of the wet waste into compost?
   - ☐ Yes
   - ☐ No

7. Would you allow waste pickers to enter your area to sort out some valuable materials?
   - ☐ Yes
   - ☐ No

8. Is there any regular community's cleanliness activity in your area?
   - ☐ Yes
   - ☐ No

Appendix E.
Results of Statistical Tests

- Hypotheses:

  H_0 : Response about the city's cleanliness and student's origin are independent

  H_1 : Response about the city's cleanliness and student's origin are dependent

- Test of statistics:

Category of response	Origin						Total	(%)
	ITB		Itenas		Unyani			
	f_o	f_e	f_o	f_e	f_o	f_e		
Satisfactory	49	47.01	47	47.84	48	49.09	144	(41.6)
Less than satisfactory	43	52.88	59	53.82	60	55.22	162	(46.8)
Bad	21	13.11	9	13.34	10	13.69	40	(11.6)
Total	113	113.00	115	115.00	118	118.00	346	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{3} (f_0 - f_e)^2 / f_e$$

j = number of category of respondents

i = number of category of responses

$= (49-47.01)^2/47.01 + (43-52.88)^2/52.88 + (21-13.11)^2/13.11 + (47-47.84)^2/47.84 + (59-53.82)^2/53.82 + (9-13.34)^2/13.34 + (48-49.09)^2/49.09 + (60-55.22)^2/55.22 + (10-13.69)^2/13.69 = 0.08 + 1.85 + 4.75 + 0.01 + 0.50 + 1.41 + 0.02 + 0.41 + .99$

$= 10.02$

- Rejection region: with degree of freedom (df) = (3-1)(3-1) = 4, $X^2_{df=4,\alpha=0.01} = 13.277$
- Conclusion: because $X^2 < X^2_{df=4;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, students' response about the city's cleanliness is not associated with their origin (university).

- Hypotheses:

  H_0 : Burning frequency and income level are independent

  H_1 : Burning frequency and income level are dependent

- Test of statistics:

Frequency of burning/month	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
0	76	53.65	84	53.65	3	55.76	163	(52.6)
1	26	29.99	16	29.99	49	31.17	91	(29.4)
2	0	1.94	2	1.94	4	2.01	6	(1.9)
3-4	0	4.90	0	4.90	15	5.09	15	(4.8)
5-8	0	8.56	0	8.56	26	8.90	26	(8.4)
≥ 9	0	2.96	0	2.96	9	3.07	9	(2.9)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{6} (f_0 - f_e)^2 / f_e$$

$= (76\text{-}53.65)^2/53.65 + (26\text{-}29.99)^2/29.99 + \ldots\ldots + (0\text{-}2.96)^2/2.96$
$+ (84\text{-}53.65)^2/53.65 + (16\text{-}29.99)^2/29.99 + \ldots\ldots + (0\text{-}2.96)^2/2.96$
$+ (3\text{-}55.76)^2/55.76 + (49\text{-}31.17)^2/31.17) + \ldots\ldots + (9\text{-}3.07)^2/3.07$
$= 9.31 + 0.53 + 1.94 + 4.9 + 8.56 + 2.96 + 17.17 + 6.53 + 0.002 + 4.9 + 8.56 + 2.96 + 49.92 + 10.20 + 1.97 + 19.29 + 32.86 + 11.45$
$= 194.012$

- Rejection region: with degree of freedom (df) = (6-1) (3-1) = 10; $X^2_{df=10;\alpha=0.01} = 23.209$

- Conclusion: because $X^2 > X^2_{df=10;\alpha=0.05}$, therefore H_0 is rejected.
  In other words, households' burning frequency is associated with their income level.

- Hypotheses:

  H_0 : Burning frequency and availability of service are independent

  H_1 : Burning frequency and availability of service are dependent

- Test of statistics:

Frequency of burning/month	Households				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
0	163	142.29	3	23.87	166	(45.9)
1	91	78.74	1	13.21	92	(25.4)
2	6	7.75	3	1.3	9	(2.5)
3-4	15	23.87	13	4.0	28	(7.7)
5-8	26	42.78	24	7.18	50	(13.8)
≥ 9	9	14.57	8	2.44	17	(4.7)
Total	310	310.00	52	52.00	362	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{6} (f_0 - f_e)^2 / f_e$$

$= (163\text{-}142.29)^2/142.29 + (91\text{-}78.74)^2/78.74 + \ldots\ldots + (9\text{-}14.57)^2/14.57$
$+ (3\text{-}23.87)^2/23.87 + (1\text{-}13.21)^2/13.21 + \ldots\ldots + (8\text{-}2.44)^2/2.44$
$= 3.01 + 1.91 + 0.40 + 3.30 + 6.58 + 2.13 + 18.25 + 11.29 + 2.2. + 20.25 + 9.40 + 12.67$
$= 121.39$

- Rejection region: with degree of freedom (df) = (6-1)(2-1) = 5; $X^2_{df=5;\alpha=0.01} = 15.086$

- Conclusion: because $X^2 > X^2_{df=5;\alpha=0.05}$, therefore H_0 is rejected.

  In other words, households' burning frequency is associated with the availability of service in their areas.

- Hypotheses:

  H_0 : Response to fee and household's income are independent

  H_1 : Response to fee and household's income are dependent

- Test of statistics:

Category of response	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
Low	16	8.88	11	8.88	0	9.23	27	(8.71)
Sufficient	86	91.80	91	91.80	102	95.40	279	(90)
Too high	0	1.32	0	1.32	4	1.37	4	(1.29)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{3} (f_0 - f_e)^2 / f_e$$

$= (16\text{-}8.88)^2/8.88 + (86\text{-}91.8)^2/91.8 + (0\text{-}1.32)^2/1.32 + (11\text{-}8.88)^2/8.88 + (91\text{-}91.8)^2/91.8 + (0\text{-}1.32)^2/1.32 + (0\text{-}9.23)^2/9.23 + (102\text{-}95.4)^2/95.4 + (4\text{-}1.37)^2/1.37 = 5.71 + 0.37 + 1.32 + 0.51 + 0.007 + 1.32 + 9.23 + 0.46 + 5.05$

$= 23.98$

- Rejection region: with degree of freedom (df) = (3-1)(3-1) = 4, $X^2_{df=4;\alpha=0.01} = 13.277$

- Conclusion: because $X^2 > X^2_{df=4;\alpha=0.05}$, thus H_0 is rejected.

  In other words, households' response to the existing waste collection fee is associated with their income.

- Hypotheses:

  H_0 : Willingness to pay more fee and household's income are independent

  H_1 : Willingness to pay more fee and household's income are dependent

- Test of statistics:

Category of response	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
Willing to pay more	46	32.54	34	32.54	19	33.81	99	(31.9)
Refused to pay more	56	69.46	68	69.46	87	72.19	211	(68.1)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (46\text{-}32.54)^2/32.54 + (56\text{-}69.46)^2/69.46 + (34\text{-}32.54)^2/32.54 + (68\text{-}69.46)^2/69.46$
$+ (19\text{-}33.81)^2/33.81 + (87\text{-}72.19)/72.19 = 5.57 + 2.61 + 0.07 + 0.03 + 6.49 + 3.04$
$= 17.81$

- Rejection region: with degree of freedom (df) = (2-1)(3-1) = 2, $X^2_{df=2;\alpha=0.01} = 9.210$

- Conclusion: because $X^2 > X^2_{df=2;\alpha=0.05}$, therefore H_0 is rejected.

  In other words, households' willingness to pay more the waste collection fee is associated with their income.

- Hypotheses:

  H_0 : Support for source separation and availability of service are independent

  H_1 : Support for source separation and availability of service are dependent

- Test of statistics:

Support for source separation	Chiefs of neighbourhood units				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
Yes	33	35.93	16	13.07	49	(81.67)
No	11	8.07	0	2.93	11	(18.33)
Total	44	44	16	16	60	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (33-35.93)^2/35.93 + (11-8.07)^2/8.07 + (16-13.07)^2/13.07 + (0-2.93)^2/2.93$
$= 0.24 + 1.06 + 0.66 + 2.93$
$= 4.89$

- Rejection region: with degree of freedom (df) = (2-1)(2-1) = 1, $X^2_{df=1;\alpha=0.01} = 6.635$

- Conclusion: because $X^2 < X^2_{df=1;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, support for source separation from chiefs of neighbourhood units is not associated with the availability of service in their areas.

- Hypotheses:

  H_0 : Support for source separation and income are independent

  H_1 : Support for source separation and income are dependent

- Test of statistics:

Support for source separation	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
Yes	65	62.53	71	62.53	54	64.98	190	(61.3)
No	37	39.47	31	39.47	52	41.02	120	(38.7)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (65-62.53)^2/62.53 + (37-39.47)^2/39.47 + (71-62.53)^2/62.53 + (31-39.47)^2/39.47$
$+ (54-64.98)^2/64.98 + (52-41.02)^2/41.02$
$= 0.10 + 0.15 + 1.15 + 1.82 + 1.86 + 2.94$
$= 8.02$

- Rejection region: with degree of freedom (df) = (2-1)(3-1) = 2, $X^2_{df=2;\alpha=0.01} = 9.210$

- Conclusion: because $X^2 < X^2_{df=2;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, support for source separation by households is not associated with their income.

- Hypotheses:

  H_0 : Response to source separation and student's origin are independent
  H_1 : Response to source separation and student's origin are dependent

- Test of statistics:

Category of response	Origin						Total	(%)
	ITB		Itenas		Unyani			
	f_o	f_e	f_o	f_e	f_o	f_e		
Extremely agree	46	53.90	61	54.85	58	56.29	165	(47.7)
Agree	61	53.90	50	54.85	54	56.29	165	(47.7)
Disagree	3	4.18	4	4.26	6	4.36	13	(3.7)
Extremely disagree	3	1.02	0	1.04	0	1.06	3	(0.9)
Total	113	113.00	115	115.00	118	118.00	346	(100)

Note: f_o : observed frequency
f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{4} (f_0 - f_e)^2 / f_e$$

$= (46\text{-}53.9)^2/53.9 + (61\text{-}53.9)^2/53.9 + (3\text{-}4.18)^2/4.18 + (3\text{-}1.02)^2/1.02 +$
$(61\text{-}54.85)^2/54.85 + (50\text{-}54.85)^2/54.85 + (4\text{-}4.26)^2/4.26 + (0\text{-}1.04)^2/1.04 +$
$(58\text{-}56.29)^2/56.29 + (54\text{-}56.29)^2/56.29 + (6\text{-}4.36)^2/4.36 + (0\text{-}1.06)^2/1.06$
$= 1.16 + 0.94 + 0.33 + 3.84 + 0.69 + 0.43 + 0.50 + 1.04 + 0.05 + 0.09 + 0.62$
$+ 1.06$
$= 10.75$

- Rejection region: with degree of freedom (df) = (3-1)(4-1) = 6, $X^2_{df=6;\alpha=0.01} = 16.812$

- Conclusion: because $X^2 < X^2_{df=6;\alpha=0.01}$, therefore H_0 is accepted.
  In other words, students' response to source separation is not associated with their origin (university).

- Hypotheses:

  H_0 : Support for composting and availability of service are independent

  H_1 : Support for composting and availability of service are dependent

- Test of statistics:

Support for composting	Chiefs of neighbourhood units				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
Yes	27	30.8	15	11.2	42	(70)
No	17	13.2	1	4.8	18	(30)
Total	44	44	16	16	60	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (27\text{-}30.8)^2/30.8 + (17\text{-}13.2)^2/13.2 + (15\text{-}11.2)^2/11.2 + (1\text{-}4.8)^2/4.8$

$= 0.47 + 1.09 + 1.29 + 3.01$

$= 5.86$

- Rejection region: with degree of freedom (df) = (2-1)(2-1) = 1, $X^2_{df=1;\alpha=0.01} = 6.635$

- Conclusion: because $X^2 < X^2_{df=1;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, support for composting from chiefs of neighbourhood units is not associated with the availability of waste collection service in their areas.

- Hypotheses:
  H_0 : Support for composting and income are independent
  H_1 : Support for composting and income are dependent

- Test of statistics:

Support for composting	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
Yes	69	78.34	73	78.34	96	81.41	238	(76.8)
No	33	23.66	29	23.66	10	24.59	72	(23.2)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency
f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (69\text{-}78.34)^2/78.34 + (33\text{-}23.66)^2/23.66 + (73\text{-}78.34)^2/78.34 + (29\text{-}23.66)^2/23.66$
$+ (96\text{-}81.41)^2/81.41 + (10\text{-}24.59)^2/24.59$
$= 1.11 + 3.67 + 0.36 + 1.21 + 2.61 + 8.66$
$= 17.62$

- Rejection region: with degree of freedom (df) = (2-1)(3-1) = 2, $X^2_{df=2;\alpha=0.01} = 9.210$

- Conclusion: because $X^2 > X^2_{df=2;\alpha=0.01}$, therefore H_0 is rejected.
  In other words, support for composting from households is associated with their income.

- Hypotheses:

  H_0 : Support for composting and availability of service are independent

  H_1 : Support for composting and availability of service are dependent

- Test of statistics:

Support for composting	Households				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
Yes	238	245.83	49	41.24	287	(79.3)
No	72	64.17	3	10.76	75	(20.7)
Total	310	310.00	52	52.00	362	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (238\text{-}245.83)^2/245.83 + (72\text{-}64.17)^2/64.17 + (49\text{-}41.24)^2/41.24 + (3\text{-}10.76)^2/10.76$

$= 0.25 + 0.96 + 1.46 + 5.60$

$= 8.27$

- Rejection region: with degree of freedom (df) = (2-1)(2-1) = 1, $X^2_{df=1;\alpha=0.01} = 6.635$

- Conclusion: because $X^2 > X^2_{df=1;\alpha=0.01}$, therefore H_0 is rejected.

  In other words, support for composting from households is associated with the availability of service in their areas.

- Hypotheses:

  H_0 : Support for waste picker and availability of service are independent

  H_1 : Support for waste picker and availability of service are dependent

- Test of statistics:

Support for waste picker	Chiefs of neighbourhood units				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
Yes	22	24.2	11	8.8	33	(55)
No	22	19.8	5	7.2	27	(45)
Total	44	44	16	16	60	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (22-24.2)^2/24.2 + (22-19.8)^2/19.8 + (11-8.8)^2/8.8 + (5-7.2)^2/7.2$

$= 0.2 + 0.24 + 0.55 + 0.67$

$= 1.66$

- Rejection region: with degree of freedom (df) = (2-1)(2-1) = 1, $X^2_{df=1;\alpha=0.01} = 6.635$

- Conclusion: because $X^2 < X^2_{df=1;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, willingness of chiefs of neighbourhood units to allow waste picker to enter their areas is not associated with the availability of waste collection service in their areas.

- Hypotheses:

  H_0 : Support for waste pickers and income are independent

  H_1 : Support for waste pickers and income are dependent

- Test of statistics:

Support for waste pickers	Households						Total	(%)
	High Income		Middle Income		Low Income			
	f_o	f_e	f_o	f_e	f_o	f_e		
Yes	59	59.57	66	59.57	56	61.90	181	(58.4)
No	43	42.43	36	42.43	50	44.10	129	(41.6)
Total	102	102.00	102	102.00	106	106.00	310	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{3}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (59\text{-}59.57)^2/59.57 + (43\text{-}42.43)^2/42.43 + (66\text{-}59.57)^2/59.57 + (36\text{-}42.43)^2/42.43$
$+ (56\text{-}61.9)^2/61.9 + (50\text{-}44.1)^2/44.1$
$= 0.005 + 0.008 + 0.69 + 0.97 + 0.56 + 0.79$
$= 3.02$

- Rejection region: with degree of freedom (df) = (3-1)(2-1) = 2, $X^2_{df=2;\alpha=0.01} = 9.210$

- Conclusion: because $X^2 < X^2_{df=2;\alpha=0.01}$, therefore H_0 is accepted.

  In other words, households' willingness to allow waste pickers to enter their areas is not associated with their income.

- Hypotheses:

  H_0 : Support for waste pickers and availability of service are independent

  H_1 : Support for waste pickers and availability of service are dependent

- Test of statistics:

Support for waste pickers	Households				Total	(%)
	With service from PDK		Without service from PDK			
	f_o	f_e	f_o	f_e		
Yes	181	175.46	24	29.43	205	(56.6)
No	129	134.54	28	22.57	157	(43.4)
Total	310	310.00	52	52.00	362	(100)

Note: f_o : observed frequency

f_e : expected frequency

$$X^2 = \sum_{j=1}^{2}\sum_{i=1}^{2} (f_0 - f_e)^2 / f_e$$

$= (181\text{-}175.46)^2/175.46 + (129\text{-}134.54)^2/134.54 + (24\text{-}29.43)^2/29.43$
$+ (28\text{-}22.57)^2/22.57 = 0.17 + 0.23 + 1.00 + 1.31$
$= 2.71$

- Rejection region: with degree of freedom (df) = (2-1)(2-1) = 1, $X^2_{df=1,\alpha=0.01} = 6.635$

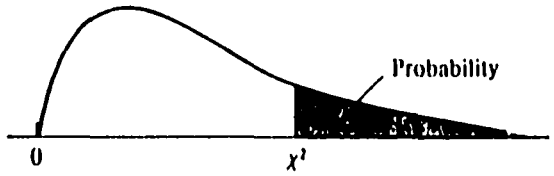
- Conclusion: because $X^2 < X^2_{df=1;\alpha=0.01}$, therefore, H_0 is accepted.

  In other words, households' willingness to allow waste pickers to enter their areas is not associated with the availability of service in their areas.

Appendix F.
Chi-Square Table
(Source: Agresti and Agresti, 1979, 523)

Table C χ^2 distribution

Values for various right-hand tail probabilities



df	.99	.98	.95	.90	.80	.70	.50	.30	.20	.10	.05	.02	.01	.001
1	$.0^3157$	$.0^3628$	.00393	.0158	.0642	.148	.455	1.074	1.642	2.706	3.841	5.412	6.635	10.827
2	.0201	.0404	.103	.211	.446	.713	1.386	2.408	3.219	4.605	5.991	7.824	9.210	13.815
3	.115	.185	.352	.584	1.005	1.424	2.366	3.665	4.642	6.251	7.815	9.837	11.341	16.268
4	.297	.429	.711	1.064	1.649	2.195	3.357	4.878	5.989	7.779	9.488	11.668	13.277	18.465
5	.554	.752	1.145	1.610	2.343	3.000	4.351	6.064	7.289	9.236	11.070	13.388	15.086	20.517
6	.872	1.134	1.635	2.204	3.070	3.828	5.348	7.231	8.558	10.645	12.592	15.033	16.812	22.457
7	1.239	1.564	2.167	2.833	3.822	4.671	6.346	8.383	9.803	12.017	14.067	16.622	18.475	24.322
8	1.646	2.032	2.733	3.490	4.594	5.527	7.344	9.524	11.030	13.362	15.507	18.168	20.090	26.125
9	2.088	2.532	3.325	4.168	5.380	6.393	8.343	10.656	12.242	14.684	16.919	19.679	21.666	27.877
10	2.558	3.059	3.940	4.865	6.179	7.267	9.342	11.781	13.442	15.987	18.307	21.161	23.209	29.588
11	3.053	3.609	4.575	5.578	6.989	8.148	10.341	12.899	14.631	17.275	19.675	22.618	24.725	31.264
12	3.571	4.178	5.226	6.304	7.807	9.034	11.340	14.011	15.812	18.549	21.026	24.054	26.217	32.909
13	4.107	4.765	5.892	7.042	8.634	9.926	12.340	15.119	16.985	19.812	22.362	25.472	27.688	34.528
14	4.660	5.368	6.571	7.790	9.467	10.821	13.339	16.222	18.151	21.064	23.685	26.873	29.141	36.123
15	5.229	5.985	7.261	8.547	10.307	11.721	14.339	17.322	19.311	22.307	24.996	28.259	30.578	37.697
16	5.812	6.614	7.962	9.312	11.152	12.624	15.338	18.418	20.465	23.542	26.296	29.633	32.000	39.252
17	6.408	7.255	8.672	10.085	12.002	13.531	16.338	19.511	21.615	24.769	27.587	30.995	33.409	40.790
18	7.015	7.906	9.390	10.865	12.857	14.440	17.338	20.601	22.760	25.989	28.869	32.346	34.805	42.312
19	7.633	8.567	10.117	11.651	13.716	15.352	18.338	21.689	23.900	27.204	30.144	33.687	36.191	43.820
20	8.260	9.237	10.851	12.443	14.578	16.266	19.337	22.775	25.038	28.412	31.410	35.020	37.566	45.315
21	8.897	9.915	11.591	13.240	15.445	17.182	20.337	23.858	26.171	29.615	32.671	36.343	38.932	46.797
22	9.542	10.600	12.338	14.041	16.314	18.101	21.337	24.939	27.301	30.813	33.924	37.659	40.289	48.268
23	10.196	11.293	13.091	14.848	17.187	19.021	22.337	26.018	28.429	32.007	35.172	38.968	41.638	49.728
24	10.856	11.992	13.848	15.659	18.062	19.943	23.337	27.096	29.553	33.196	36.415	40.270	42.980	51.179
25	11.524	12.697	14.611	16.473	18.940	20.867	24.337	28.172	30.675	34.382	37.652	41.566	44.314	52.620
26	12.198	13.409	15.379	17.292	19.820	21.792	25.336	29.246	31.795	35.563	38.885	42.856	45.642	54.052
27	12.879	14.125	16.151	18.114	20.703	22.719	26.336	30.319	32.912	36.741	40.113	44.140	46.963	55.476
28	13.565	14.847	16.928	18.939	21.588	23.647	27.336	31.391	34.027	37.916	41.337	45.419	48.278	56.893
29	14.256	15.574	17.708	19.768	22.475	24.577	28.336	32.461	35.139	39.087	42.557	46.693	49.588	58.302
30	14.953	16.306	18.493	20.599	23.364	25.508	29.336	33.530	36.250	40.256	43.773	47.962	50.892	59.703

Source: From Table IV of R. A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group Ltd., London, 1974. (Previously published by Oliver & Boyd, Edinburgh.) Reprinted by permission of the authors and publishers.