

# An Approach to Development of the Informal Sector : The Case of Garbage Collectors in Bandung\*

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Garbage, the volume of which increase in proportion to the increase in the number of residents and to the increase in their income levels, is a problem, especially in large cities. *Hasan Poerbo*, Chairman PPLH-ITB, *Daniel T. Sicular*, a student at the University of California, Berkeley, currently carrying out research for his Ph.D, at PPLH-ITB, and *Vanny Supardi*, Special Assistant in the Architecture/Technical Faculty at the Parahyangan University, Bandung, describe the project conducted in Bandung; an attempt to find a solution, largely through increasing the self-esteem of those involved in garbage collection, and suggest various possibilities for reducing the actual amount of garbage.



The case presented in the following article is based upon the findings of research carried out in Sukabumi, Cianjur and Bandung concerning those involved in garbage collecting. The research referred to was preceded by a study of the structure and situation of the garbage collecting system in these three cities by the Centre for Environmental Studies *Pusat Pengembangan Lingkungan Hidup* (PPLH) at the Bandung Institute of Technology (ITB) in conjunction with the Institute of Social Studies, Netherlands, between 1980 and 1982. Since the end of 1982 this work has been continued by PPLH - ITB in conjunction with various institutions for the development of community resources (the Institute of Development

Studies, the Young Resources Foundation, the Manunggal Jaya Cooperative, the UNISBA Da'wah Institute and the Borromeus Foundation) and certain government agencies (the Cooperative Office, the Department of Social Welfare, DK3 and DK2) in an informal manner, the purpose being to guide a group of garbage collectors in Bandung as a 'field laboratory'.

The background to research into the system of garbage collection lies in the problem of urban garbage, especially in the big cities where there are signs that this problem will not be overcome by the methods now used, that is, by methods wherein the approach to the handling of garbage is that of a service function performed by the local government. The literature indicates that garbage represents a source of income for groups of scavengers and thus forms an activity within the informal sector of the city. If this is so, can these

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people not be regarded as a potential that will assist in the utilization of garbage and thus reduce the city government's burden in the handling of urban waste?

The above question gives rise to a number of other questions that require investigation, such as: the identity of these garbage collectors, the nature of the discarded items that they utilize, their distribution throughout the cities, the marketing of the items that they collect and the structure of their trade.

The following article presents a picture of the question of urban garbage as a contextual framework for a study of the role of the garbage collector. It is followed by a report on the findings of research into the scavenging system in three cities. From this research enough of a picture was obtained to permit selection of a group of garbage collectors who could be involved in participation-level research directed towards development of existing potential to improve utilization of garbage. The results of this participation-level research have been used as the basis for the development of a different approach to the handling of garbage wherein garbage is viewed as material with economic value. The article concludes with a report on the results of a preliminary study into the possibility of involving the informal sector in attempts to overcome the garbage problem and at the same time to create jobs that, with a very small investment, bring in reasonably good incomes.

### The Problem of Urban Waste

A study of the available literature shows that the volume of garbage increases in proportion to the increase in the number of urban residents and to the increase in their income levels. In

TABLE 1. Average level of waste production per capita in developed and developing countries.

City/Country	Average production level (per person per day)
<b>A. Developing countries:</b>	
Jakarta, Indonesia	0.65 kg
Bandung, Indonesia	0.50 kg (0.82 kg)*
Surabaya, Indonesia	0.52 kg
Singapore	0.87 kg
Calcutta, India	0.51 kg
Cairo, Egypt	0.50 kg
<b>B. Developed countries:</b>	
New York, U.S.A.	1.80 kg
Hamburg, West Germany	0.85 kg
Rome, Italy	0.69 kg

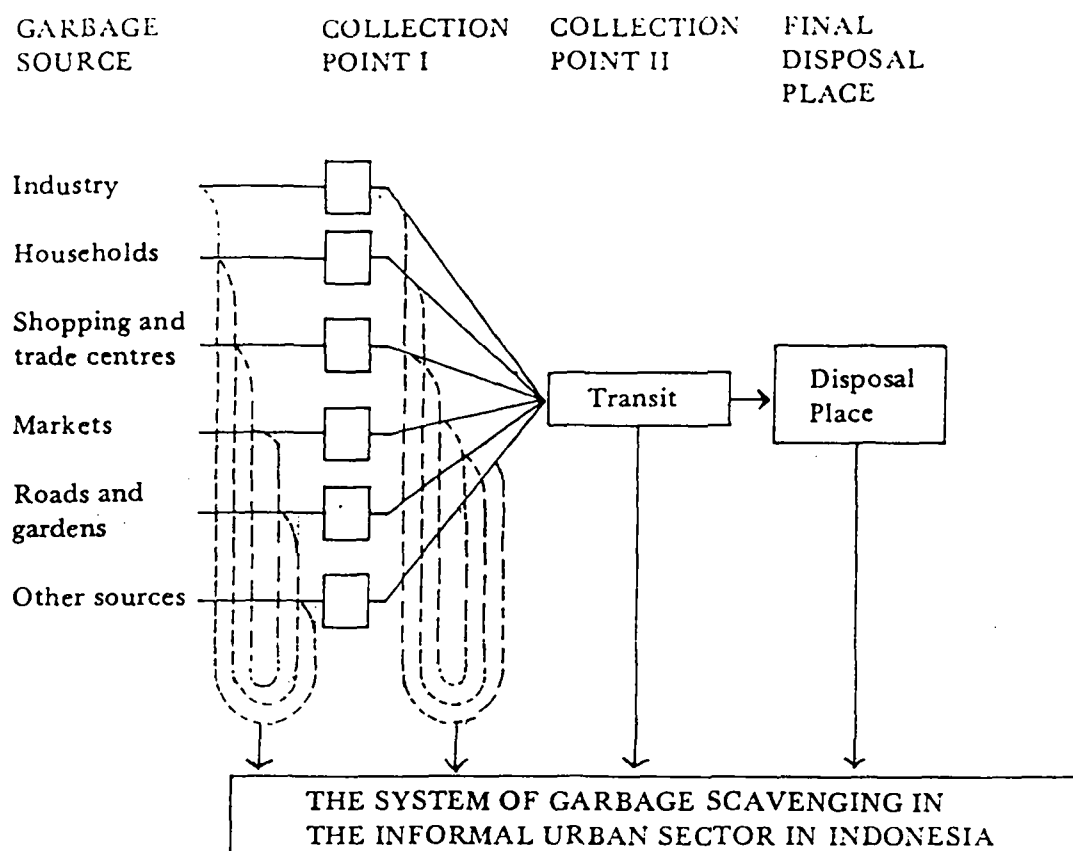
SOURCE: Cointreau 1982

\*) BUDP 1984, estimated average of all kinds of rubbish.

Indonesia the level of waste production per family is still relatively low but there is potential for an 'explosion' in quantity if there is a continuous increase in incomes within the urban community. Table 1 presents a comparison of the production of garbage per family per day in certain selected cities.

The capacity of the local governments in large cities to collect and dispose of garbage has been estimated at around only 60 per cent of the quantity produced each day. On the whole these governments experience difficulty in providing a garbage service because of trouble in collecting the garbage-service fee, the location of many houses which, because of the density of settlement, cannot be reached by garbage vehicles, the number of families that cannot afford to pay for this service, the high cost of investment in and maintenance of equipment used to transport and dispose of garbage and also the

DIAGRAM 1. The system for the handling of urban garbage



difficulty of obtaining men willing to work as garbagemen. The existing system by which garbage is now handled is shown in a simple way in the above diagram (Diagram 1).

Within the above system there is a 'sub-system' of garbage scavenging with an already complex structure. It has been estimated that from the point of view of volume its contribution to a reduction of the waste that has to be disposed of is not very big, being approximately 10 – 20 percent. This can be readily understood since the scavenger can utilize only those kinds of waste that have a recycling value, such as paper, plastic, glass and metal. The greater part of the garbage of the cities consists of organic materials. The following table (Table 2) gives details of the composition of garbage in two cities.

TABLE 2. A comparison of the physical composition of urban waste in Brooklyn and Bandung (% by weight).

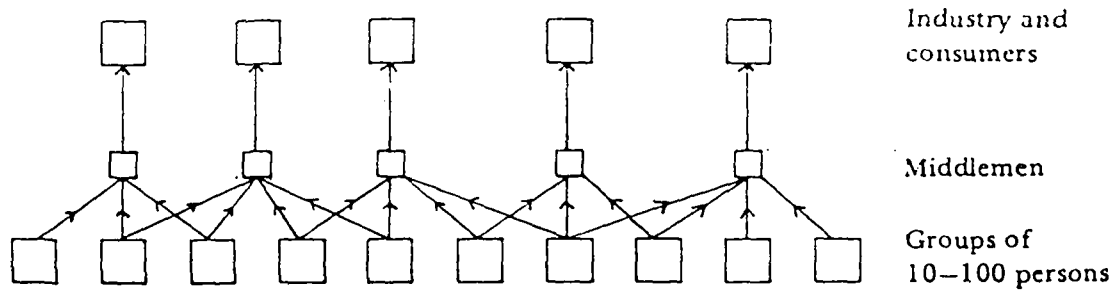
Type of material	Brooklyn, New York	Bandung*
Paper	35**	9.7
Glass	9	0.3
Metals	13	1.3
Plastic and rubber	10	4.8
Textiles	4	2.5
Bones	4	0.7
Other materials	4	6.1
Total of non-food materials	78	25.4
Vegetables and materials that can decay	22	74.6
Total	100	100.0

\* Figures for Bandung refer only to domestic waste.

\*\* All figures in this column have been rounded.

Source: Cointreau 1982 and BUDP 1984.

DIAGRAM 2. The system of urban garbage scavenging



### The System of Urban Garbage Collection

Studies made of the system of garbage scavenging in various parts of the world reveal similarities in structure. In broad outline this can be illustrated as in the above: diagram, (Diagram 2).

Studies undertaken in Sukabumi, Cianjur and Bandung indicate that this general picture is valid even for smaller cities like Sukabumi and Cianjur.

The anthropological research carried out by the PPLH-ITB in conjunction with ISS provides a more detailed picture of the characteristics of this system of garbage scavenging. To obtain this information the techniques of participant observation and open interview were adopted. In brief the findings were as follows :

- For most of the scavengers this job represented the final alternative.
- The scavengers regarded themselves not as homeless loiterers (*gelandangan*) but as persons employed in legitimate work.
- None originated from the city wherein they were working as scavengers.
- Places of origin were widely distributed and there was no fixed pattern in this matter.
- On the whole educational background was of a low level but there were one or two who had completed Senior High School.
- Many were originally landless agricul-

tural labourers.

- On the whole their attitude was one of 'easy living' in the sense that when they had acquired a certain amount of money they gave up working until their money was exhausted and only then did they resume their jobs.
- Their income was between Rp 45,000 and Rp. 75,000 per month in 1982.
- They had a strong sense of inferiority and were suspicious of 'outsiders' because of the times they had experienced eviction and the arbitrary treatment to which they had been subjected.
- There was strong competition among them to maintain their own individual existence.
- Many experienced illness because of their dirty work and environment.
- Their relationship with the market for the items that they collected showed a high degree of dependence. Price manipulations by middlemen and traders (*bander*) often pushed the unorganized scavengers into a corner.
- The basic structure of the trade in items obtained by scavengers is as follows:



- The middlemen are often members of a group of scavengers, whom they 'dominate'.

dertakings, especially the marketing aspect, so that they would not fall victim to drastic fluctuations. For this reason there was need for a cooperative.

Among the researchers there was some doubt about whether the regional government would be willing to alter those policies that did not provide support for the existence of the scavengers.

In addition, there was also some doubt as to whether a cooperative could be made to grow since it would be in direct conflict with existing structural interests (the middlemen and traders). The practical question of how to select and involve a group so as to begin the process of development of a cooperative also arose. It was apparent to all that this undertaking would have to commence with a very small unit and that it would not be able to take in the whole system.

Since it proved impossible to overcome these doubts among the researchers, it was decided to proceed without any hypotheses or desires on the part of the researchers. The concept of participation-level research was accepted as an open-ended process in expansion of the target group's capacity to 'remove the shackles binding them to poverty' through a process of interaction with the researcher, a process that was to be a learning process for all involved. This had to be done through continuous visits and evaluation which of its very nature would involve participation by the researcher and the target group.

The first step was to report to the BAPPEDA (*Badan Pengembangan Pembangunan Daerah*, Regional Development Body), office in the Municipality of Bandung about the wish to carry out participation-level research and to obtain approval. The second step was to

select a target group that met certain criteria which had been established on a basis of the objectives drawn from research results. The third step was to place a participant observer in the selected group to identify the most urgent needs felt by the group so that these needs could be used as the point of entry to involve the target group. After that the process was an open-ended one.

From the above ideas agreement was reached upon action to carry out the participation-level research. BAPPEDA was informed; a target group was chosen in a location close to the PPLH-ITB so as to facilitate communication; the objective of the undertaking, as far as the PPLH-ITB was concerned, was to obtain empirical data on a micro scale concerning the development of a target group in handling garbage and its dynamics; cooperation with the Institute of Development Studies (*LSP - Lembaga Studi Pembangunan*) was undertaken to obtain an experienced researcher as a participant observer, and finally the research began at the end of 1981.

The participant observer who was seconded for the purpose was a woman who was well qualified in Social Science and who had already had experience in Jakarta. She began by introducing herself to the target group in an informal fashion until her presence was accepted. After that she purchased a place to live and stayed with the target group for three months. In this way she was able to report on the characteristics of the target group and to involve the group in efforts to identify the most pressing needs, the solution of which could be helped by the PPLH-ITB. As it turned out, this led to a wish on the part of seven couples who had been living together as men and wives get married, something that had not

- The traders are persons from outside the environment of the scavengers and can be described as well-to-do.
- Many of the markets for the items that are collected are located outside the cities (Jakarta, Cirebon).
- The pattern of distribution of groups of scavengers within a city follows 'service areas', use being made of pieces of land which they occupy illegally as squatters (along train lines, alleys intended as fire-breaks, the banks of rivers and unoccupied land owned by the State).
- For this last reason regional governments usually adopt a harsh attitude towards scavengers and regard them as *gelandangan* who are associated with crime, prostitution and pollution of the city.

This brief picture of the life of scavengers would appear to be equally valid for the cities of Indonesia and for those of other developing countries. It is hard to estimate the number of persons employed as scavengers but in Bandung and Cimahi together there are approximately 1,000 families, which means 2,500 persons if dependants are included. This relatively small number is perhaps a consequence of local government policies which are repressive in nature, as far as scavengers are concerned. In certain other countries the opposite policy is adopted. Scavengers are given a 'right' or franchise to collect garbage items in certain designated places. This is done, for example, in Manila, Mexico City and other places where the 'right' can be given to a group if that group pays a certain sum of money to the city government.

### Participation-level Research with a Group of Garbage Scavengers in Bandung

Participation-level research is an

aspect of Applied Social Science. As a method it is still controversial since its epistemological basis is somewhat unclear. Nevertheless, the PPLH-ITB was prepared to attempt it, after consultation with an expert provided by ISS. In brief, participation-level research formed the means by which a target group could be involved as the subject in a study of its own existence within its own environment (social, economic, political and physical). Through this method the group experienced a social learning process that led them towards the capacity to lift themselves to a better standard of living. This was done through development of the structures supporting their activities in all fields of life, through improvement of their capacity to identify the problems hindering their development and to find solutions to those problems through expansion of their knowledge and skills. This process can also be described as one of awareness or of freeing themselves from the shackles that had curbed their progress. In this process the researcher (with or without the function of a go-between) took the role of motivator, facilitator and catalyst.

Before the participation-level research was undertaken, a discussion was held among the researchers. Research findings concerning the garbage collectors indicated that there was potential for increasing their role in the utilization of waste materials through recycling or the making of compost.

But this would require certain measures:

- a) Creation of a climate that would provide more guarantee of their continued existence, in terms of more positive policies on the part of the regional government;
- b) Creation of institutions capable of assisting them to improve their un-

problems associated with waste disposal in large cities like Jakarta, Surabaya, Bandung and Medan as well as in other smaller cities. The various levels of government responsible for administration of the big cities have experimented with various techniques and technology for the handling of waste, imported from abroad via the foreign consultants who have been brought to Indonesia in connection with loans from the World Bank and ADB (Asian Development Bank).

Much progress has been achieved but many problems have also been 'imported' from overseas, such as the extraordinary increase in the investment required for the handling of waste in general, the increased need for disposal locations which are becoming progressively more distant and more scarce, expensive equipment for the transportation and processing of waste and the cost of the supporting system. All of this requires greater subsidies. Even in the countries from which waste-processing technology originates people are beginning to seek alternatives to existing methods in the interests of reducing costs for waste disposal. This has led to a new approach, namely the system known as integrated materials' recovery (IMR).

Stated briefly, IMR is a waste-handling strategy wherein at each stage in the handling of waste materials (storage, collection, transport, processing and final disposal) the aim is not to discard or destroy waste but rather to re-utilize materials that are still of value. In a system of this kind each step actually improves rather than obstructs the capacity of the system to produce goods that can be marketed. This synthesis offers the possibility of using more simple technology and cheaper investments than the present

system requires because of its decentralized nature.

The main advantages of IMR are as follows:

- a) The sale of goods made from waste materials can subsidize and perhaps even pay for the whole waste-handling system.
  - b) All materials that can be marketed are taken from the waste disposal route. A reduction of 50 to 90 per cent in the weight and volume of the waste that requires a disposal site can be expected, which means a drop in transport costs, the need for space for disposal and maintenance costs for equipment.
  - c) The IMR system is labour-intensive because handling is extremely intensive. But the cost of workers can be financed from the sale of the goods made from utilized waste, which means an increase in employment without any increase in expenditure.
  - d) Goods made from waste materials support the network of service and manufacturing/processing industries, both large and small, such as industries that produce small cooking stoves, the paper industry and large steel industries.
  - e) Secondary materials taken from garbage can replace materials that are mined or imported such as iron, aluminium, glass and the like. This has a positive effect upon the economical utilization of non-renewable resources, upon the environment and upon foreign exchange.
  - f) Since the energy required to reprocess secondary materials of this kind is only a small fraction of the energy needed to process pure, newly extracted materials, there will be a disguised benefit in the form of economy in the use of energy.
- If there are limitations in Indonesia upon the use of waste-disposal techno-

hitherto been possible as they did not have identity cards (KTP, *Kartu Tanda Penduduk*), or finance. The marriages were conducted with the assistance of the PPLH – ITB and this too became a point of entry for involvement in the community. The confidence that grew within the target group later resulted in a series of other activities. The community was encouraged to make a 'school' for children in the afternoon hours and this was later managed by the Young Resources Foundation. The existing prayer-house was enlarged and made active with help from the UNISBA Da'wah Institute. With the presence of these two elements a communication forum was established through meetings concerning school guidance, through religious contacts and through discussions of a 'neutral' nature, until the whole community was involved in informal, open discussions. The whole process took three months.

It was only after that the PPLH–ITB dared to put forward the concept of forming a cooperative, a process that contained many conflicts of-interests because of the existence of a middleman who had his own associates in the target group. Material competition between the two led to difficulty in obtaining agreement about the formation of a cooperative. In the end the cooperative was established in a situation of some slight compulsion. The person chosen as chairman was the field worker from the LSP, (*Lemba-ga Studi Pembangunan*), who was expected to be the mediator in the conflicts that continued to occur. The deputy chairman was the middleman (Mr. A), who was regarded as the oldest figure in the group, while the treasurer was Mrs. B, who was also a middleman within the group and who was in competition with Mr. A. The cooperative

was formed at the beginning of 1983. became a legal entity in the middle of 1983 and was registered with the Cooperatives Office. Guidance of the managers and members was done through training which was provided by the LSP and the Cooperatives Office. It was only at the end of 1984, however, that the clash of interests could be settled.

The participation-level research had been carried out since 1982 without any special budget from the PPLH–ITB, using only one full-time field worker and several other researchers for monitoring purposes.

Experience with the target group in Bandung, supported by continuous visits and evaluation, convinced the PPLH–ITB that the system of garbage scavenging offers future prospects for a change in the handling of urban waste from the present service function to a production function of economic proportions. This shift can dramatically reduce investment and handling costs for the disposal of waste; at the same time it can create employment in the informal sector of the cities on a fairly large scale and at a relatively low cost, providing jobs that bring in an income equal to or greater than the incomes earned by those with the same level of skills in the modern sector.

The characteristics of the group at the beginning of the participation-level research, the development process that the group experienced and the activities and results achieved can be seen in Appendix I.

### **Towards the Idea of Waste Industry Zones : A Conceptual Approach**

During the period of the present New Order, Indonesia has taken important steps in the handling of urban garbage in the context of overcoming



660 million per month. If this could be carried out and the results sold without any investment, it would provide the opportunity for about 8,250 persons to obtain an income of Rp. 80,000 per person per month (prices are based upon those that apply at the level of the scavengers). With an investment of Rp. 3.4 billion the Municipal Government could buy land and equipment for the utilization of garbage by developing a processing system in the form of scattered production units (a decentralized system) capable of using around 80 per cent of urban waste. This would yield a gross income of Rp. 20 million per day, would provide work for 3,000 scavengers and would give a net profit of around Rp. 9.9 million per day or Rp. 3.5 billion per year. These funds could be used to improve other sections of the waste-processing system and to develop secondary processing and manufacturing industries that could provide jobs for an additional 5,000 persons with an average salary of Rp. 80,000 per person per month. This would mean an investment of approximately Rp. 1.2 million for a worker *in situ* and if outside workers are included in calculations, then the investment could be as low as Rp. 425,000 per person. This would also imply a return of more than 100 per cent per year upon the original investment. These figures are most impressive if a comparison is made with industrial investment in the modern sector. Per worker investment in industrial estates averages between Rp. 5 million and Rp. 10 million in medium and somewhat smaller industries and the average level of incomes is probably about the same as in the waste-disposal field.

Apart from the initial investment the IMR system really requires only a minimum involvement on the part of the Regional Government for decentraliza-

tion is already easy because of the existing collection system at RW and RT levels. It would be necessary only to add garbage-processing places at the next higher administrative level (the *kelurahan*, village or ward administrative unit). In this way the transportation of garbage over long distances and the need for disposal sites would be almost entirely done away with. The IMR system has the potential to economize about Rp. 5 billion in project costs if it is applied in the Municipality of Bandung and perhaps another Rp. 1 billion in annual project budgets. The activities of the DK3 organization could then be shifted primarily to cleaning of the streets, the replanting of trees and beautification of the city.

Scavengers could organize themselves in cooperatives that controlled and handled Waste Industry Zones at the *kelurahan* level and then with these zones as the base they could further expand their economic activities in related fields and in other undertakings. The following diagram (Diagram 3) presents a picture of the potential role of Waste Industry Zones in the re-utilization of waste materials and in the reduction of transportation costs for their disposal.

## Conclusions and Recommendations

5.1. From the case described above, the following conclusions can be drawn:

- a) A review should be made of the present system of handling urban waste wherein the approach to disposal of garbage is that of a community service;
- b) The IMR system is an alternative with great potential for the solving of the garbage problem;
- c) In Indonesia the IMR system can involve garbage scavengers

logy from advanced countries such as compost factories, incinerators and sanitary land-fill, can the IMR system replace this technology? Since IMR represents a strategy of waste management that is not associated with any given kind of technology, the answer to this question lies not in the possibility of acceptance or use of a technological group but rather in the possibility of applying a certain idea or philosophy to the existing situation and to the existing system of dealing with waste.

In the Indonesian context there are several points that should be put forward as arguments for the acceptance of IMR as an alternative to the existing system of waste management:

- a) The system of re-utilization of waste materials is a traditional one, already carried out by scavengers in a profitable way.
- b) The physical qualities of garbage in the cities of Indonesia suggest that the 'import' of waste-handling technology from industrialized countries is ineffective and inappropriate but at the same time this means that the utilization of materials obtained from garbage can be feasible. These physical qualities include the following:
  - 1) Garbage in Indonesia has a far higher density than in the developed countries, which means that compaction-based systems are unsuitable and not very effective.
  - 2) The garbage contains a lot of organic materials and much water, which means that incinerators are not suitable. It would be better to use such garbage for the production of compost.
  - 3) Even though the quantity or percentage of high-value non-organic material is low by comparison with the situation in developed countries, cheaper labour in In-

donesia makes the use of these materials not only feasible but also very profitable.

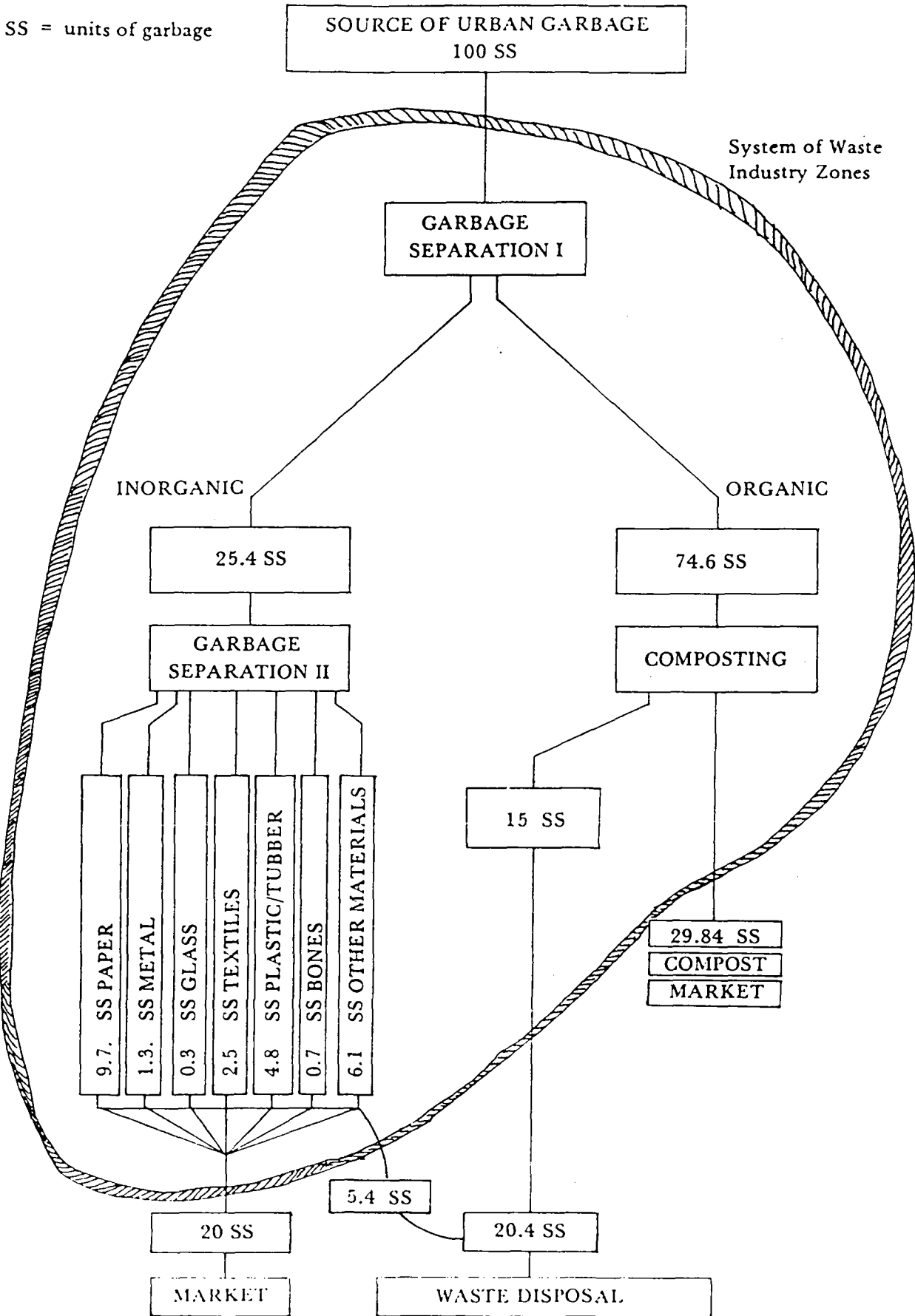
- c) The present system of garbage handling in most Indonesian cities is far more decentralized than it is in industrialized countries. For example, garbage collection is usually handled by RWs and RTs (local neighbourhood associations). Decentralization of this kind means that the Regional Government's responsibility for the most expensive stage in the handling of waste can be kept low. However, this also means that the task of collecting fees from the general public to pay for the system is becoming increasingly difficult. For that reason, the budget is usually obtained from the Central Government.

Hence the use of advanced technology such as incinerators, compactors and balers is neither effective nor efficient because they are designed for garbage disposal in advanced countries where conditions are different and therefore are not suitable in the Indonesian situation at the present time.

The possibilities for development of the scavenging system in the informal sector can be illustrated by a concept like IMR, which is based upon empirical figures obtained from the research undertaken by the PPLH-ITB with a target group in Bandung. For example, if the Municipality of Bandung made an investment in urban-waste handling on a basis of the decentralized IMR system and not the disposal system in common use at the present time, the way would be open for scavengers to enter into more formal garbage collection activities.

It has been estimated that the total value of all Bandung garbage could reach Rp. 20 million per day or Rp.

DIAGRAM 3. The System of Waste Industry Zones at the Kelurahan Level (Figures for units of garbage are preliminary estimates).



in a successful manner and four objectives can be met at the same time:

- a. A reduction in the burden of garbage disposal
- b. The creation of jobs in the informal sector with a relatively low investment.
- c. A reduction in the investment requirements now borne by the government in the present system of garbage disposal and maintenance of the system.
- d. A decentralized system of garbage processing at the *kelurahan* level through the IMR approach, which involves Waste Industry Zones owned by cooperatives of garbage scavengers.

#### 5.2 Measures that are recommended take in:

- a) Development of a Waste Industry Zone as an urban pilot project that has already been prepared.
- b) Careful monitoring and evaluation in order to obtain feedback before further steps are taken.
- c) Involvement of the Regional Government, universities and community-resource institutions in the planning and implementation of the pilot project.
- d) The provision of an estimated Rp. 35 million as the initial capital that will later be used in a circular fashion for one pilot project.

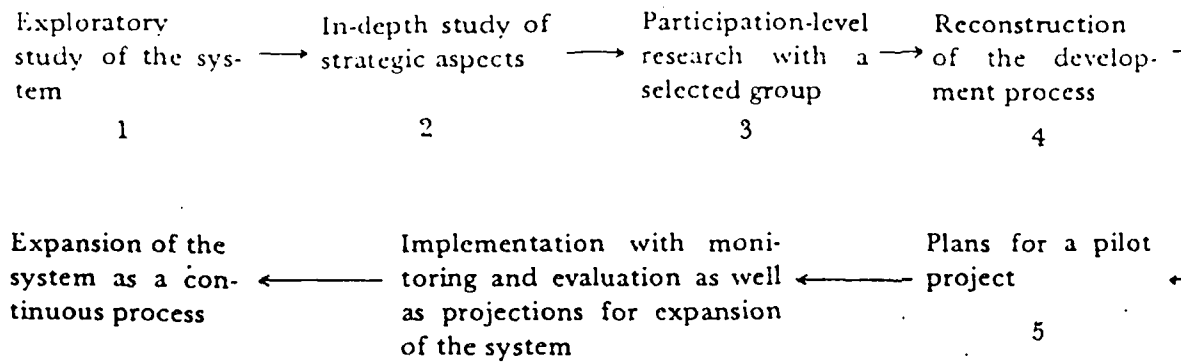
#### 5.3 Some closing remarks :

- a) It is fully appreciated that there are many constraints which make it impossible to apply all aspects of the above concept at one and the same time. These constraints include the difficulty of acquiring land, marketing

of products and the political climate which provides little support for the presence of garbage scavengers in the midst of the urban community on an official basis. For that reason application of the IMR concept and the idea of Waste Industry Zones must be regarded as a long-term process (5 – 10 years). The pilot project is a means by which to learn. It can then be expanded in keeping with capacities and opportunities but the basic philosophy of handling urban waste in a system that uses scavengers as its backbone must be firmly maintained.

- b) As a method to develop any project, especially in a situation where there is no previous experience, where the situation is of its very nature always specific (as is the case with the informal sector) and where planning must be based upon information from the field, the experience acquired through a case study provides guide-lines for the planning of further steps in the expansion of a project of this kind. The methods normally adopted in a feasibility study cannot be used because they are too assumptive and deterministic. In matters relating to the handling of the informal sector the development process is in nature open and cannot be anticipated until new structures of a permanent type have been established. The procedure that is recommended from case studies of scavengers is as follows (see diagram).

A number of points should be put forward so that the procedure described



above can be carried out:

- a) A political climate that accepts the presence of scavengers must be created;
- b) The system of financing must be flexible and capable of adaptation to unexpected developments;
- c) The expansion must be participative and based upon interaction between the various parties involved at each stage;
- d) There is need for an intermediary who can function in relationships with the target group as a motivator, facilitator and catalyst. This function should be undertaken by a community-resources institution.
- e) The whole process represents a synthesis of 'top-down' and 'bottom-up' development.

## Appendix I

### Some Brief Details of the Target Group in Bandung:

#### A. Community Profile:

- At the end of 1981: about 100 persons or 40 families.
- At the end of 1984: about 150 persons or 50 families.
- Place of origin: West Java, Central Java, East Java, Madura.
- Most family heads formerly convicted criminals.
- Low levels of education (usually elementary school).
- Area of land about 2 ha. initially

covered in bushes up to 2.5 metres in height with dwelling-places made from cardboard among the bushes.

#### B. Results as of December 1984:

1. 18 couples officially married.
2. Growth of a school:
  - From an irregular play-group into 3 elementary-level classes.
  - On the whole the marks of children attending a private elementary school (outside) are above class averages.
3. Expansion of the prayer-house:
  - From infrequent use to intensive, regular usage.
  - Many speakers from outside (UNISBA).
4. Cooperative:
  - From 40 members in 1982/1983 to 75 members at the end of December.
  - From deposits of Rp. 200,000 in the middle of 1982 to Rp. 1.3 million at the end of December 1984.
  - Status: Official as a legal body.
5. Activities:
  - An increase in recycling.
  - Rabbits: from 14 (1983) to more than 100 at present, with 28 donated to Ciamis.
  - Integrated agriculture.
  - Fisheries.
  - Compost production.
  - Nursery for seedling: 3000 pe-

TABLE 3. Potential value of the waste produced daily in the Municipality of Bandung.\*

Population of Bandung : 1,500,000  
 Daily production : 0.82 kg per person  
 Total production : 1,230 tons per day

<i>Composition</i>	<i>Weight (%)</i>	<i>Output (in kg per day)</i>	<i>Market value (in Rp. per kg)**</i>	<i>Daily value (in Rp. per day)</i>
Organic/compostable	62.8	193,110***	20	3,862,200
other organic ****	9.9	121,770	17.1	2,082,267
paper	9.1	111,330	9	1,007,370
metal	1.1	13,530	11.2	151,536
glass	9	11,070	8.7	96,309
textiles	1.3	15,990	—	—
plastic/rubber	10.1	124,230	6.75	838,552
bones	5	6,150	14.9	91,635
other materials	4.6	56,580	—	—

SOURCE : BUDP; PPLH-ITB

- NOTE :
- \* The value of waste depends upon its composition, which can alter dynamically.
  - \*\* These prices have been taken from the lowest level of the scavenging system in the target group in Bandung.
  - \*\*\* This figure represents organic waste after it has been processed into compost; actual daily production is 922,800 kg; the compost produced from this is 276,840 kg per day (25% of total weight).
  - \*\*\*\* Other organic includes fruit tree seeds and material suitable for consumption by animals.

rennials sold to Pagerwangi and Rp. 850,000 of mango slips sold to Garut.

- Family planning, health/nutrition and the family-welfare program (PKK, *Pendidikan Kesejahteraan Keluarga*, Family Welfare Education).
  - A WC demonstration project from UNDP.
  - An excellent security system.
6. The whole undertaking is ready to be transferred from the old illegal site to a new location if there is a place of which the local government approves.

## Appendix II

Financial calculations for the development of a Waste Industry Zone in an urban *kelurahan* (a preliminary concept).

The Zone has been designed to process approximately 17 tons of waste per day and to serve approximately 20,000 – 25,000 residents (a small *kelurahan*), shopping centres and a market. It consists of one compost-processor and places for the recycling of inorganic materials. Estimated costs and yields are given for each unit of production (compost and recycling separately).

1.	Compost processor (capacity 12.5 tons per day)	
A.	Capital costs	
	Land 2,500 m <sup>2</sup> @ Rp. 5,000 per m <sup>2</sup>	Rp. 12.5 million
	Barracks 500 m <sup>2</sup> @ Rp. 10,000 per m <sup>2</sup>	± Rp. 5.0 „
	Facilities	Rp. 7.0 „
	Machinery and other equipment	Rp. 5.0 „
	Reserve fund	Rp. 2.0 „
	Total	Rp. 31.5 million
B.	Annual production costs	
	Depreciation	Rp. 1.0 million
	Workers (22 persons @ Rp. 80,000)	Rp. 21.1 „
	Utilities	Rp. 3.0 „
	Maintenance and improvements	Rp. 2.0 „
	Total	Rp. 27.1 million
C.	Production costs	
	Based on <u>360</u> days per year	Rp. 75,300.00
D.	Investment per worker	Rp. 1.43 million
E.	Performance	
	input per day	12.5 tons
	output per day	3.2 tons
	discarded waste	2.5 tons (20 % of input)
F.	Income per day	
	3.1 tons @ Rp. 20 per kg.	Rp. 62,000.00
	0.3 ton @ Rp. 150 per kg.(special)	Rp. 15,000.00
	Gross daily income	Rp. 77,000.00
G.	Net daily profit	Rp. 1,700.00
H.	Net annual profit	Rp. 612,000.00
2.	Processing of materials/inorganic (capacity 4.5 tons per day)	
A.	Capital costs	
	Land 225 m <sup>2</sup> @ Rp. 5,000 per m <sup>2</sup>	Rp. 1.1 million
	Barracks 150 m <sup>2</sup> @ Rp. 10,000 per m <sup>2</sup>	Rp. 1.5 „
	Facilities	Rp. 2.0 „
	Machinery and other equipment	Rp. 8.0 „
	Reserve fund	Rp. 1.0 „
	Total	Rp. 13.6 „

B.	Annual production costs	
	Depreciation	Rp. 1.1 million
	Workers (18 persons @ Rp. 80,000/month)	Rp. 17.2 ,,
	Utilities	Rp. 2.0 ,,
	Maintenance and improvements	Rp. 2.0 ,,
		<hr/>
		Rp. 21.8 ,,
C.	Production costs per day	Rp. 60,500
D.	Investment per worker	Rp. 0.75 million
E.	Performance	
	input per day	4.5 tons
	output per day	3.5 tons
	discarded waste	1.0 ton (25 % of input)
F.	Gross income per day	
	3.5 tons @ Rp. 55,000	Rp. 192,500.00
G.	Net daily profit	Rp. 130,000.00
H.	Net annual profit	Rp. 46.8 million
3.	Total of (1) and (2)	
A.	Investment	Rp. 45.1 million
	Annual production costs	Rp. 48.9 ,,
	Annual profit	Rp. 47.4 ,,
B.	Investment in workers	Rp. 1.12 ,,
	number of workers	40 persons
4.	Example for Bandung	
A.	Number of Zones required (1.5 million people) = 75	
B.	Profit from 75 Zones per year = Rp. 3.4 billion	
C.	Number of workers 3,000 persons	
	Investment per worker Rp. 1.12 million	
D.	Amount of land 20.4 ha.	
E.	Performance	
	Daily input	1,275 tons
	Daily output	502.5 tons
	Daily waste	262.5 tons
	Waste as percentage of input = 20%	
F.	Daily gross income	Rp. 20.2 million
G.	Net daily profit	Rp. 9.9 million
H.	Net annual profit	Rp. 3.55 billion
I.	Net annual profit as a percentage of investment	100 %