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INSTITUTIONAL AND MANAGEMENT APPROACHES TO SOLID WASTE DISPOSAL IN LARGE METROPOLITAN AREAS*

Carl R. Bartone

Urban Development Division, The World Bank, 1818 H Street, N.W., Washington, D.C., 20433 U.S.A.

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There are significant advantages to a consolidated institutional approach to the management of municipal solid waste transfer and disposal in large metropolitan areas. Both operational and environmental benefits can be achieved. On the other hand, it is argued that collection services do not necessarily benefit from centralization, since there are only limited economies of scale. Furthermore, there is abundant evidence that the private sector can provide conventional collection services more efficiently than the public sector. This paper examines a model of decentralized collection and centralized transfer and disposal that is in place at Norfolk, Virginia, U.S.A. and which is being applied in Monterrey, Mexico. The partial application of this model in the Federal District of Mexico City is also examined. Lessons are drawn for the application of such a model to metropolitan areas in other developing countries.

Key Words—municipal solid waste management, transfer operations, landfill operations, institutional models, economies of scale, environmental protection, cost recovery

1. Introduction

The provision of municipal solid waste management (MSWM) services in many large Third World cities typically is limited to about half the urban population. The services frequently suffer from severe operational deficiencies, and rarely result in environmentally acceptable disposal. Where these problems exist they are almost always found to be rooted in the inefficient institutional arrangements and inadequate finance common to municipal governments in the developing world.

If solid waste collection, transport and disposal services are to be expanded and improved to keep pace with rapid urbanization and industrialization, the responsible institutions must be strengthened and, in many cases, new institutional models tried. There also exists an increased opportunity for private sector involvement through the creation of contestable markets (Baumol & Lee 1991). Whatever the institutional form adopted, its overall goal should be to collect and dispose of solid wastes generated by all population groups in an environmentally and socially satisfactory manner using the most economical means available. Priority objectives for meeting this goal should be to:

- improve the efficiency of existing collection and transport systems;
- expand collection services into low-income areas using affordable approaches;
- adopt environmentally sound disposal practices;

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- institutionalize system planning, budgeting and accounting processes;
- secure financial resources needed for sustainable operations; and
- hire, train, motivate and manage needed staff to provide service.

For large metropolitan areas (greater than 1 million population) comprising several municipalities, special institutional models can be developed to take advantage of the characteristics of different phases of MSWM service provision. In particular, the following distinctions are important:

(1) Experience shows that there are almost no economies of scale for collection districts of greater than 50 000 population (Stevens 1977). Therefore, it makes sense to maintain responsibility for domestic refuse collection at the local jurisdictional level.

(2) As a rule of thumb, transfer stations should be considered when haul distances from the collection area to the disposal site are greater than 15–20 km or 30 min one-way travel time, as is common in large cities, otherwise the productivity of collection vehicles and crews may be greatly reduced, being tied up transporting rather than collecting wastes. Also, wear and tear on collection vehicles may be excessive, reducing their useful life.

(3) The main concern of the population is getting their wastes collected and keeping the neighbourhood clean and healthy. Thus, householders generally ignore the importance of transfer/transport, processing and disposal operations except when a facility is likely to be located nearby (the "not in my backyard," or NIMBY, syndrome). Similarly, municipalities give lower priority to these operations since most negative impacts take the form of externalities. These attitudes are too often reflected in the poor management of such operations, and especially in the lack of environmentally acceptable disposal.

(4) Finally, there are considerable economies of scale in transfer/transport and landfill disposal operations, but optimization requires taking a system-wide viewpoint when locating, sizing and scheduling such facilities.

2. Metropolitan area-wide approaches

In order to provide for more efficient transfer and disposal operations, and especially to achieve any improvements in current disposal practices and some measure of environmental protection, it is often advantageous for a large city to establish a metropolitan area-wide or regional MSWM authority.

Since the municipality is most often the political jurisdiction assigned by law responsibility for MSWM, the establishment of a regional authority requires that all affected municipalities agree and are able to transfer some or all of their responsibility. Furthermore, an equitable formula must be found for financing the regional operations.

It is not so clear if responsibility for collection services should also be regionalized. Since there are few economies of scale, the only apparent justifications would be to improve efficiency, particularly of fleet management and maintenance, and to extend coverage. However, there are other means of increasing efficiency, for example by privatizing collection services or by providing technical assistance and training to municipalities in such areas as collection vehicle routing and maintenance, and centralized procurement of equipment and spares. The latter are all examples of support services that could be provided by a regional authority without directly assuming responsibility for primary collection. With respect to extending coverage, which means providing services to low-income areas, non-conventional community-based approaches are needed. In this regard a metropolitan area service authority is unlikely to have any comparative advantage over the member municipalities.

Both approaches—totally centralized MSWM services versus decentralized collection with centralized transfer and disposal—have been tried with varying degrees of success. This paper will concentrate on examples of the latter type of institutional and management arrangements. Three cases are presented: Mexico City, Mexico, with a hybrid, somewhat *ad hoc* approach; the Norfolk–Portsmouth, Virginia area (U.S.A.), which has a well-known and successful public service corporation; and Monterrey, Mexico, which is establishing a municipal company similar to the Norfolk model. The descriptions of the three cases are based primarily on field visits and interviews.

3. Mexico City Metropolitan Area (MCMA)

The urbanized area of the MCMA (Fig. 1) currently has a population of about 17 million, with some 10 million located in the 16 "delegaciones" of the Federal District, and another 7 million in 12 contiguous "municipios" of the State of Mexico. In 1986, the MCMA produced an estimated 11 000 metric tons per day ($t\,d^{-1}$) of municipal solid wastes (MSW), of which 6800 $t\,d^{-1}$ originated in the Federal District and 4200 $t\,d^{-1}$ in the rest of the metropolitan area (Dagh-Watson 1987). In addition some 7000 $t\,d^{-1}$ of industrial and special wastes are collected mainly by private haulers (about 70% of industrial solid wastes are recycled). Average per capita generation of MSW in the MCMA is estimated at 0.83 $kg\,d^{-1}$, with a growth rate of 3% per year (although in recent years little growth in per capita generation has been observed due to the economic downturn).

Municipal solid waste collection is the responsibility of each delegation in the Federal District, and of each municipality in the State of Mexico. About 80% of the waste

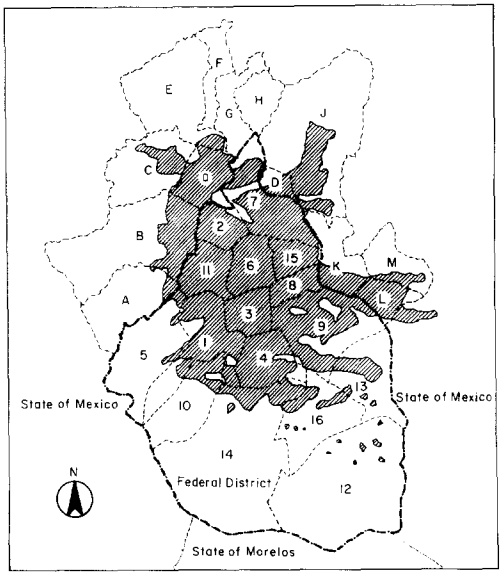

Fig. 1. Federal District and Metropolitan Area of Mexico City. Federal District: 1. Alvaro Obregón. 2. Azcapotzalco. 3. Benito Juárez. 4. Coyoacán. 5. Cuajimalpa. 6. Cuauhtemoc. 7. Gustavo A. Madero. 8. Iztacalco. 9. Iztapalapa. 10. Magdalena Contreras. 11. Miguel Hidalgo. 12. Milpa Alta. 13. Tláhuac. 14. Tlalpan. 15. Venustiano Carranza. 16. Xochimilco. State of Mexico: A. Huixquilucan. B. Naucalpan. C. Atizapán de Zaragoza. D. Tlalnepantla. E. Cuautitlán Izcalli. F. Cuautitlán de Romero Rubio. G. Tultitlán. H. Coacalco. J. Ecatepec. K. Nezahualcóyotl. L. Los Reyes La Paz. M. Chimalhuacán. .... State boundary, -·-· Federal district boundary, —— "Delegación" and Municipality boundary, □ Metropolitan area of Mexico City, ▨ Urban area of Mexico City (part of metropolitan area). (From Dagh-Watson 1985)

generated is collected routinely, the rest by special collection (e.g. campaigns for cleanup of litter and illegal dumpsites).

The Federal District has 11 transfer stations in operation and wastes go to three sanitary landfills (Fig. 2). The General Directorate of Urban Services (DGSU) of the Federal District is responsible for operating the landfills, and also provides support to some of the delegations for the operation of transfer stations and transport (about 60% of these operations are performed by DGSU). In addition, the DGSU operates the San Juan de Aragon resource recovery plant. A major achievement of the DGSU in recent years has been the closure of several open dumps and establishment of controlled landfill operations at a new landfill (the Bordo Poniente landfill which is operated under contract by a private company—SISSA). Reportedly, the three existing landfills have 15 years capacity remaining.

In the State of Mexico, each municipality is responsible for the disposal of solid wastes generated within their respective areas. Seventeen municipalities in the metropolitan region operate no transfer stations and most have their own landfill. Only two shared a regional landfill run by another municipality, and three dispose of solid wastes in a DGSU landfill. In 1984 there were 12 landfills in operation, of which four were open dumps as listed in Table 1 (Dagh-Watson 1985). Considerable economies of scale and environmental benefits could be realized if transfer stations and shared landfills were used.

The fleet operated by the Federal District delegations and the municipalities is

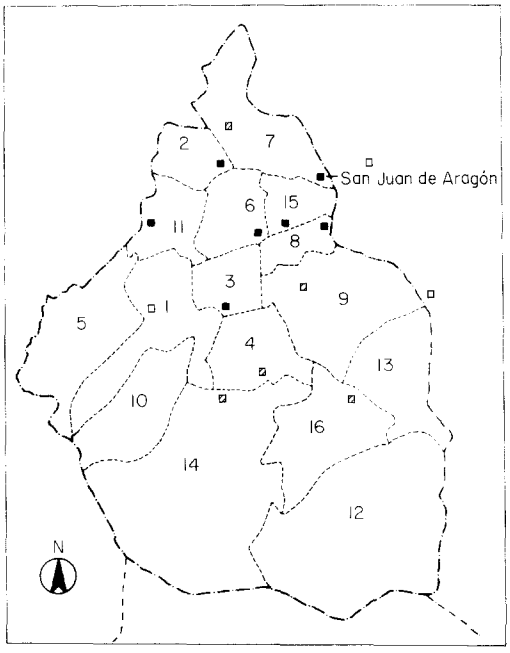

Fig. 2. Solid waste transfer stations—Mexico City Federal District. 1. Alvaro Obregón. 2. Azcapotzalco. 3. Benito Juárez. 4. Coyoacán. 5. Cuajimalpa. 6. Cuauhtemoc. 7. Gustavo A. Madero. 8. Iztacalco. 9. Iztapalapa. 10. Magdalena Contreras. 11. Miguel Hidalgo. 12. Milpa Alta. 13. Tláhuac. 14. Tlalpan. 15. Venustiano Carranza. 16. Xochimilco. Transfer stations: ■ Transfer stations in operation or about to be commissioned (7 No.) (including San Juan de Aragon transfer station/solid waste recovery–processing plant in Gustavo A. Madero); ▨ Proposed additional transfer stations (5 No.). □ Current landfills (3 No.). (From Dagh-Watson 1985)

TABLE 1
Disposal sites for solid wastes generated by State of Mexico Municipalities in metropolitan Mexico City (from Dagh-Watson 1987)

Municipality	Open dumps (OD) or sanitary landfill (SL)	Useful life (years from 1986)	Municipal sites	Regional sites
Atizipán de Zaragoza (11 ha)	SL	5	—	1
Coacalco	OD	10	1	—
Cuautitlán*	—	—	—	1
Cuautitlán Izcalli (6 ha)	SL	20	—	1
Chalco†	—	—	—	—
Chicoloapán	OD	2	1	—
Chimalhuacán	OD	1	1	—
Ecatepec	SL	5	1	—
Huixquilucán	OD	5	1	—
Iztapaluca†	—	—	—	—
Los Reyes La Paz†	—	—	—	—
Naucalpán	SL	5	1	—
Nezahualcóyotl	SL	5	1	—
Nicolas Romero	SL	5	1	—
Tecamec	SL	15	1	—
Tlalnepantla‡	—	—	—	—
Tutlitán (10 ha)	SL	3	1	—

* Solid wastes deposited at Cuautitlán Izcalli regional site.
† Solid wastes deposited at Santa Catarina DDF site.
‡ Solid wastes deposited at A. de Zaragoza regional site.

considerable—almost 1900 vehicles—and over 10 000 employees engaged in MSW activities. The situation in 1984 was as shown in Table 2 (Dagh-Watson 1985).

It was estimated that 38% of the Federal District and 19% of the State of Mexico fleet was out of service for maintenance and repair at the time these data were obtained. This aggravates an already serious vehicle shortage, and is a priority area needing improvement. An acceptable figure would be in the order of 10–15%.

The efficiency of both collection and landfilling operations are greatly reduced by scavenging activities, which recover and recycle an estimated 10% of the overall MSW volume. Some 10 000 "pepenadores" (scavengers) live and work at landfills, impeding controlled landfill operations. They are highly organized in two separate unions, whose

TABLE 2
MCMA Municipal Solid Waste Fleet (1984) (from Dagh-Watson 1985)

	Federal District	State of Mexico
Collection vehicles	1136	359
Transfer vehicles		
Cab units	62	—
Trailer units	67	—
Mechanical street sweepers	233	31
Employees	9000	1400

leaders have great political power. A *de facto* situation exists giving the informal sector a major role in MSW operations, but only recently have the authorities taken steps to formalize and to rationalize such operations both to improve efficiency and working conditions for scavengers. However, much remains to be done in both areas.

Overall the average cost of collection, transport and disposal in the MCMA is estimated by DGSU at about U.S.$20 per ton. However, because accounts are not consolidated and the delegations and municipalities do not maintain separate cost accounting centres for MSW operations, an exact cost is impossible to calculate. DGSU's budget for 1988 was M.P.$56 000 million (about U.S.$24 million in February 1988 prices), but does not include general budget allocations from the Federal District government to the delegations that are used for collection, street cleaning, and partial operation of transfer stations and transport.

Environmental problems in the Valley of Mexico cannot be resolved without a coordinated approach by all political jurisdictions. In the case of solid waste disposal, a total regional approach could lead to significant economic and environmental improvements. Long-term disposal solutions, such as long distance rail haul, would become more feasible under a coordinated approach. At present, however, only a partial consolidated disposal operation exists covering the Federal District as described above. A single regional authority for the entire MCMA would be preferable in the view of the author, and could be built up from the existing institutional base provided by the DGSU. Obtaining the political consensus of all of the delegaciones and municipios, the Federal District, the State of Mexico and the Federal government, and reaching a workable financial agreement for servicing the whole of the MCMA, would be a major hurdle to overcome.

4. Southeastern Public Service Authority of Virginia (SPSA)

The Southeastern Public Service Authority of Virginia (SPSA) was created in 1973 as a public body politic and corporate in accordance with powers granted by the Virginia Water and Sewer Authorities Act. The SPSA serves eight member local governments—the Cities of Chesapeake, Franklin, Norfolk, Portsmouth, Suffolk and Virginia Beach, and the Counties of Isle of Wight and Southampton. SPSA is governed by a board of directors consisting of one board member and alternate appointed by each of the participating cities and counties.

The functions of the SPSA as stated in its articles of incorporation are to acquire, finance, construct, operate and maintain a garbage and refuse transfer and disposal system (SPSA 1987). The SPSA serves the rapidly growing solid waste disposal needs of a metropolitan area of one million inhabitants, each generating about one U.S. ton (0.9 tonnes) of MSW annually (2.86 kg capita^{-1} d^{-1} in 1987). The area served includes 2000 square miles (approximately 5184 km^2) of Southeastern Virginia. The authority operates eight transfer stations spread throughout Southeastern Virginia, a refuse-derived fuel (RDF) plant, a regional MSW landfill, an ash landfill, and a fleet of 84 tractors, 85 trailers, and 27 ash trailers. It has a work force of over 225 staff.

Solid wastes are delivered by city, county or private collection vehicles to either a transfer station, the RDF plant or the regional landfill. A uniform tipping fee of $26.50 per ton is charged at all sites. About 65% of the total solid wastes is transferred. Another 16% of the solid waste is processed at the RDF plant (capacity 2000 t d^{-1}) where aluminum and ferrous metals are recovered for recycling purposes, and RDF is produced for sale to an adjacent Navy power plant. The Navy uses it as a substitute for

coal and pays 80% of the equivalent British thermal unit (BTU) value. The SPSA is obligated to dispose of the ash generated by the Navy power plant. (Figure 3 provides a complete overview of the SPSA system.)

Public information is a major activity of SPSA. A voluntary household recycling program was initiated this year, including separation and curbside collection of newspaper, aluminum, glass, plastics and tin cans. The authority recently opened a household hazardous waste transfer facility within the service area and also runs two well-publicized Household Hazardous Waste Cleanup Days each year, and collects some 17 tons (15.3 tonnes) of hazardous wastes which are disposed of by a special hazardous waste contractor. No other hazardous wastes are handled by SPSA.

Financing of the regional facilities was made possible through the sale of bonds. SPSA's assets are valued at $171 million, and the authority has an outstanding long-term debt of $168 million. Operating revenues are derived entirely from charges for services, and totalled $22 million in 1988. Net operating income was $8.9 million, but financial expenses led to a net loss for the year of $2.2 million (SPSA 1989). Tipping fees were raised in 1989 from $23 per ton to the current level of $26.50 in an attempt to balance the budget. The cities and counties that deliver their solid wastes to SPSA pay their collection expenses and tipping fees from earmarked property tax revenues.

The creation of the SPSA has allowed the Southeastern Virginia area to meet its rapidly growing solid waste disposal needs in a cost effective manner, while at the same time meeting state and national environmental standards for municipal solid waste disposal. It provides a model which should be studied closely for possible adoption and adaptation in other metropolitan areas whose waste disposal needs are increasing either due to population growth or economic development. Anyone contemplating the establishment of such an institution should study the statement of goals and objectives of the SPSA, which are reproduced in Table 3 (SPSA 1987).

5. Monterrey Metropolitan Processing and Disposal Systems (SIMEPRODE)

Under an existing World Bank loan for the Mexico Pilot Solid Waste Management Project, Monterrey is developing a pilot system quite similar to SPSA. A public

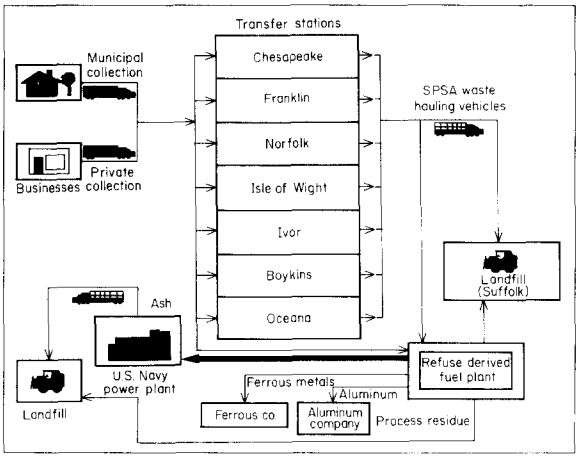

Fig. 3. SPSA's solid waste disposal system (from SPSA 1987).

TABLE 3

Goals and objectives of the SPSA: "In adherence with the ideals and principles set forth by the Board of Directors, SPSA has adopted the following list of goals and objectives . . ." (SPSA 1987)

Goal I

To provide adequate disposal facilities which incorporate state-of-the-art technologies in order to maximize protection of the environment and to enhance efficient use by users of the disposal system

Objective A

To monitor development throughout the service area to anticipate changing disposal practices and needs

Objective B

To develop strategies to prevent the disposal of hazardous waste at facilities of the disposal system

Objective C

To identify, plan and construct additional facilities and improvements to accommodate the waste disposal needs of the region

Objective D

To encourage use of the disposal system by making it convenient to use, and consistent with sound management and business practices

Goal II

To ensure that the staff to the Board of Directors provides necessary and appropriate information to the Board in order to facilitate their decision-making process

Objective A

To keep the Board of Directors informed, on a regular and continuous basis, of policy matters which require Board action

Objective B

To keep the Board of Directors informed, on a regular and continuous basis, of the general affairs of the Authority

Objective C

To offer staff assessments and recommendations to the Board of Directors as may be necessary to enhance the Board's decision-making process

Goal III

To operate the disposal system in the most cost effective manner possible so as to reduce the financial burden to users of the system

Goal IV

To employ, train and retain a highly competent work force

Objective A

To maintain a merit–pay system that compares favorably with salaries paid by other well-managed organizations for like work by establishing and maintaining competitive salary ranges

Objective B

To stimulate individual growth and maximum contribution, as well as development and promotional opportunities through the administration of a performance evaluation program that compensates employees for their performance

Objective C

To administer a benefits program which provides the employee with reasonable protection from life's emergencies and disasters

Objective D

To provide a work environment for employees that is conducive to the successful completion of their work assignments

Goal V
To provide attractive physical facilities in order to improve the image of the waste collection and disposal industry

Objective A
To design and construct buildings and facilities which blend with or improve upon the quality of development in the areas where such facilities are to be located

Objective B
To practice stringent litter control at the facilities of the Authority

Objective C
To maintain a continuous and expeditious flow of solid waste from transfer stations in order to eliminate the build-up of unpleasant odors

Objective D
To coordinate with the staffs of the member communities on litter control and waste disposal programs

Objective E
To maintain the Authority's over-the-road rolling stock so as to present a clean and well-kept appearance

Goal VI
To develop a hazardous waste management program which offers maximum protection of the public health through the provision of public information and the separation of hazardous waste from solid waste generated in the area

Objective A
To develop a public information program which stresses the proper use, handling and disposal of hazardous materials

Objective B
To identify generators of hazardous waste within the service area and to develop a permitting program to ensure that hazardous waste is not included with municipal solid waste for disposal

Objective C
To provide technical assistance to both the residential and other generators of hazardous waste and to study the feasibility of providing disposal facilities for both

Goal VII
To develop alternative disposal programs which will reduce the quantity of solid waste and power plant ash to be landfilled

Objective A
To monitor and, as appropriate, recommend implementation of a technologically sound recycling program for selected components of the waste stream

Objective B
To encourage the development of private markets for re-use of various waste products

Objective C
To support selected studies and development of new technologies in the reuse of various waste products including ferrous metals, non-ferrous metals and other materials

Goal VIII
To provide a governmental accounting system that presents fairly and with full disclosure the financial position and results of financial operations of the fund and account groups of the Authority in conformity with generally accepted accounting principles

Objective A
To account for all financial resources and expenditures through a self-balancing set of accounts, recording cash and other financial resources, together with all related liabilities

Objective B
To maintain and demonstrate compliance with the finance related legal and contractual obligations of the Authority

Objective C
To develop, monitor, and manage the financial resources of the Authority in a sound professional manner to ensure the maximum return on reserve funds, idle cash and daily receipts

Goal XI
To promote and assist in developing surplus refuse derived fuel as a source of energy by both public and private sector agencies and industries

Objective A
To make potential fuel customers aware of the advantages and qualities of refuse derived fuel as a source of energy and to promote the utilization of the energy source

Goal X
To maintain active liaison and communications with waste industry, federal, state and local authorities concerned with solid waste disposal and refuse derived fuel

Objective A
To anticipate potential problems and coordinate with proper authorities to minimize such problems

Objective B
To offer testimony regarding potential legislation or policies that can affect regional waste disposal of water supply

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decentralized (i.e. state-level) company has been created to dispose of the solid wastes of a population of almost 3 million in eight municipalities forming the Monterrey metropolitan area in the State of Nuevo Leon. The metropolitan area is growing at about 5% per year. Known as SIMEPRODE (Sistema Metropolitano de Procesamiento de Desechos), the company was created in 1987 and scheduled to enter into operation in October 1989. It has a Board of Directors whose president is the State Governor and is made up of representatives of the eight municipal mayors, the labor union, the chamber of commerce and the industrial association.

SIMEPRODE will handle 1100 $t\,d^{-1}$initially, serving about 80% of the population. Per capita waste generation rates are low, estimated at 0.44 kg $capita^{-1}\,d^{-1}$. The company will operate four transfer stations, a fleet of 24 transfer trailers, and a sanitary landfill. An existing composting plant and recycling center will be shut down because of labor problems and converted to serve as one of the transfer stations. Several of these facilities were still under construction at the time of interviews (May 1989). Hazardous wastes will not be accepted, but should instead go to a privately owned and operated confinement site (RIMSA). The consolidation of disposal operations under SIMEPRODE will permit the closure of the existing precarious landfills and dump sites previously run by individual municipalities. Several of these are being converted to transfer stations.

Each municipality will be responsible for collecting and delivering the wastes to SIMEPRODE installations. SIMEPRODE will, however, run a special program for one municipality to collect solid wastes in low-income periurban zones. The company will also sign technical assistance agreements with the municipalities and advise on such matters as equipment selection and micro-routing. Private contracting for collection services is being considered in at least one case where the Municipality of Monterrey has called for bids (one U.S. and several national firms have responded). A tipping fee will be paid by all vehicles delivering wastes, municipal or private.

The investment for establishing SIMEPRODE made during 1987–88 is on the order of M.P.$23 100 million (U.S.$10 million), with 43% financed through the World Bank loan, 32% in the form of federal grants, and 25% from state and municipal sources. Operational revenues will come primarily from tipping fees. The amount is not yet established, and SIMEPRODE will operate for 1 year with state grant funds in order to calculate the level of fees required. The municipalities will pay the tipping fees out of earmarked property tax revenues.

The major difficulties encountered in setting up SIMEPRODE are not technical, but institutional and financial. To help resolve these difficulties, an institutional development program is being carried out by Price-Waterhouse. One of the major concerns is labor relations. Many of the previous dump sites supported scavenger recycling activities, and closure means loss of employment. Since the "pepenadores" (scavengers) are members of small unions that are affiliated with very powerful national labor unions, SIMEPRODE has studied the possibility of incorporating recycling operations at transfer stations but decided against it. With the agreement of the unions a training program for the pepenadores will be initiated to prepare them for carpentry, bricklaying and other skilled trades. It remains to be seen if this is a realistic solution.

Although SIMEPRODE has yet to initiate operations and the verdict is still out, the advances to date are being carefully observed by the national Urban Development and Ecology Ministry (SEDUE). If the Monterrey experience proves successful, this model may be copied in at least two other large metropolitan areas of Mexico—in Tampico with a population of about 1 million, and in Guadalajara with over 3 million inhabitants.

6. Conclusions

The above cases illustrate many of the advantages of having a consolidated approach to municipal solid waste transfer and disposal in large cities. Both operational and environmental benefits can be achieved, irrespective of whether collection activities are centralized or decentralized. The SPSA model is a particularly good one to study with a long history of operation.

In a rapidly industrializing country like Mexico which is seeking to improve environmental management, the model also appears to provide a functional solution. Although the Mexican experience is limited to a partially consolidated disposal authority in the Federal District of Mexico City and a newly established metropolitan authority in Monterrey, a number of useful lessons can be extracted. In particular, the Mexican experience shows that in attempting to apply such a model in large Third World cities several points need close attention:

(1) Are the member municipalities strong enough to provide efficient collection service? Or can collection efficiency be improved with minimal technical support from a strong regional disposal authority?

(2) Can agreement be reached regarding payment of tipping fees from the member municipalities and other users to ensure the sustainability of the disposal operations? Would central government transfers be needed, and are they justified on environmental grounds? (As long as landfills are recognized to be a priority for environmental protection reasons, it may be counterproductive to insist on total elimination of central subsidies, or to attempt to recover all costs through tipping fees—since clandestine dumping may be the result.)

(3) Will labor interests, particularly of scavenger groups, be in conflict with the goals

and objectives of the disposal authority? If so, can the conflicts be resolved by incorporating affected persons into the staff? Or by "buying them out"?

(4) Can an institution be developed that will be capable of performing or contracting out and supervising the expected operations, be self-financing, and be strong enough to regulate uncontrolled disposal by others?

With adequate attention to the above issues, it should be possible to strengthen existing institutional arrangements for municipal solid waste transport, processing and disposal in developing country metropolitan areas. The consolidation of metropolitan responsibility is a vital step, in turn, for expanding and improving these services to keep pace with rapid urbanization and industrialization, and to introduce much needed environmental protection measures.

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