

CHAPTER - III

SURVEY OF KOLHAPUR MUNICIPAL SOLID WASTE

The present project aims at systematically collecting the data of solid waste from the city of Kolhapur. This is representative survey and the purpose of the survey is two-fold. Firstly, it can be adopted as a report on all aspects of the waste on time basis with an eye on composition, management and economics and secondly it can serve as a model for a middle sized industrial township of which waste disposal problem is to be tackled. In our country even though diversity of customs leads to severe variations, our socio-economic pattern is fairly uniform throughout the country, and deductions from the representative township may be adoptable to any city of comparable size. Of course, it is true that some of the areas are extremely backward such as Bihar State and some others are fairly advanced such as Punjab, Maharashtra and Kerala states. There may be some variations because of this and other similar factors and it may be true that over-generalization may make the solution impracticable, nevertheless a rough picture is enough for giving an idea of approximate state of affairs. In that sense this may be regarded as, on one hand, a case study, and on the other a model system.

3.1 Management

3.1.1 Location of city

Kolhapur is a city covering about 66.84 km² of municipal area. The National Highway No.4 is passing through it. After Bombay, Nagpur and Pune, Kolhapur is one of the cities in Maharashtra State which is fast growing. The climatic condition is very good. The area surrounding Kolhapur city is irrigated. Due to lot of employment potentiality Kolhapur attracts people from adjacent districts and states who seek better prospects. The adjacent districts namely Solapur in Maharashtra State and Bijapur in Karnataka State are drought prone areas. This boosts the influx of people to Kolhapur in search of their living. This resulted in the faster growth of city and created a problem of strain on the facilities. Kolhapur has been considered as birth place of small scale enterprenuership. It is also well known that cooperative movement and its extension into almost every walk of life has been possible around Kolhapur. Over the last 30 years irrigation, industrialization and cooperative movement are the code words of growth of almost all cities in Maharashtra.

The permanent population of Kolhapur city was 3,40,306 as on 30-6-1985 (Municipal Corporation yearly report).¹ It is expected that by the end of the present century the population may well cross over 8 lacs mark. Due to this growing population of city, new residential colonies and slum areas are coming up. Housing societies have come up to meet the residential demands. Most of the cultivating land in the outskirts of city is being converted for non agricultural use and for residential colonies.

The expansion of municipal area and faster growth of population adds up lot of problems like providing drinking water, electricity, education and other amenities. The central city area covering Laxmipuri, Shahupuri, surroundings of Mahalaxmi shrine, Gangavesh area are becoming more and more crowded.

Alongwith the increase in population and expansion of city limit, the problem of keeping the city clean and the public health is becoming an acute problem. The production of solid waste has increased considerably. Thus cleaning of the roads and gutters and removal and transportation of solid waste is becoming difficult. The central area of city has got narrow roads and lanes and is thickly populated. Most of commercial establishments are situated in the city area. All these factors are making the task of collecting and disposal of the solid waste more and more difficult. The new colonies like Rajarampuri, Ruikar Colony, Samrat nagar, Saloke nagar extensions are well planned and have got wider roads. The collection and transportation of solid waste in these areas are relatively easy.

3.1.2 Work force

For the ease of administration and for efficient collection and disposal of waste, the entire Kolhapur Municipal area is divided into nine units (Map 1). Each division is headed by a Sanitary Inspector. To assist in administrative work, supervisors and mukhadams work under Sanitary Inspectors. These supervisors and mukhadams assign the areas to be swept and cleaned to the sweepers. The roads are swept by the sweepers (manual labour). They also supervise the cleaning, collection and transportation of waste from their division.

The sweepers are mainly divided into two categories depending on the nature of work (1) Dry sweepers, who sweep the roads and (2) Wet sweepers, who clean the gutters and drainage system. Both categories enroll men and women. Apart from the permanent sweepers appointed, few relieving sweepers are also working who are not permanently appointed. As and when the need for extra personnel arises, these relieving sweepers are appointed on daily wages (figure in brackets - Table 3.1).

Totally about 1200 permanent sweepers do the collection, transportation and disposal of solid waste. On an average a sweeper is assigned 4000 m² area of road. In the view of the expansion of city limit and the growing population, the number of sweepers currently working is far less than required and hardly the sweepers are able to manage the collection of waste in the areas assigned to them.

3.1.3 Collection and Disposal of Waste

The citizens deposit the household waste into the dust bins at nearby road corner but careless throwing of waste on the roadside is common. This garbage is swept everyday and is dumped into roadside dust bins. These dust bins are provided in every street at a distance of 100 m apart. Majority of garbage is carried to dust bins as head loads. In exceptionally few cases it is carried to dust bins in wheel barrows.

The dust bins used in Kolhapur Municipal area are of three types :

- (1) Circular dust bins of 0.75 m in height and 0.75 m in diameter
- (2) Square dust bins of 0.75 m in height, 0.75 m in width and 1.5 m in length
- (3) Constructed dust bins of 0.75 m in height, 0.75 m in width and 1.5 m in length of masonry work.

There are 533 circular dust bins, 236 square dust bins and 13 constructed dust bins in use. Although total dust bins are 782, they are insufficient to hold the solid waste produced everyday. Most of the dust bins are overflowing and creating health hazards around them. The influx is more than what can be held and further piling of waste leads to scatter on all sides of the dust bin. Once this happens the maid servants start pouring the household collection of waste on the road itself.

The waste thus collected in these dust bins is removed everyday and carried away by garbage trucks. At present, the solid waste is being dumped into low land areas and khans along with mud and other waste materials. 15 trucks are in service to transport the garbage from collection points to dumping sites. 7 sweepers work with each truck for removing the waste from dust bins and emptying the trucks at dumping sites. A truck usually carries waste from collection points to disposal sites twice a day. The garbage transported by these trucks is about 4.5 to 6.5 metric tons/trip-truck.

Since the transportation of waste from collection points to the outskirts of city became difficult and costly, the garbage is dumped into low land areas and quarries within the city limit. The practice of disposing the waste by dumping into low land areas is

creating lot of health hazards in surrounding areas. The low land areas which are already filled with waste have been occupied by slum dwellers. 13 slums are thus existing in Kolhapur Municipal area.

Previously, the garbage was being carried away to outskirts of city and dumped alongwith night soil into shallow pits specially dug for that purpose. Once in a year, this waste was being sold as organic manure to farmers. The revenue derived from this sale was meager Rs.15 to 20 thousands. During the year 1980, an effort was made to convert available solid waste into mechanical compost. The Municipal Corporation made a contract with Kolhapur Chemicals & Fertilizers Private Limited. The manufacturers had taken the advice from Dr.C.K. Bhaskare for production of good quality manure and the analyses of the process control and finished goods were done in Shivaji University Inorganic Chemistry laboratories. This was a good process and the finished goods was a suitable substitute for Dung-compost manure. In this process solid waste was sieved and spread in a layer and repeatedly sprinkled with drainage liquid and dried. Due to financial and technical problems the production of mechanical compost using solid waste stopped very next year.² Since 1982, the solid waste produced within the city limit is totally being dumped into quarries and low lying areas. To date, 22 quarries within the municipal city limit have been thus filled with solid waste.

The production of solid waste is around 120 metric tons/day (excluding that produced by industrial establishments). Due to population increase and expansion of dwelling areas, this is expected to cross 200 metric tons day⁻¹ mark by the end of the century. Since most

of the quarries and low land areas are already filled to their brim the problem of disposal of solid waste is becoming more and more acute.

The problem of disposal of night soil is also severe. Most of the lavatories were basket preveys. Recently, these basket preveys are converted into aquaprevy and flush out lavatories wherever the drainage facility is adequate. Even then lot of basket prevey laboratories are existing in old residential areas. The public lavatories are cleaned at regular intervals. The night soil collected in tanks constructed at the bottom is sucked out by suction tankers whenever it is filled and sent to a sewage treatment plant situated in Ward No.E₄.

Almost all the sewage water flows through the road side gutters. In newly built residential colonies the lavatories are flush out lavatories and they are connected to underground drainage system. Apart from the network of open gutter system, a NALA provides passage to sewage water of the city. Most of the gutters drain sewage water into this NALA (Map 1). The sewage water flowing in the NALA is filtered using iron bar grizzlies to remove suspended solids of size more than 5 cm diameter. Before the year 1983 there were two sewage treatment tanks which were used one after the other. The sewage water was being mixed with night soil and allowed to undergo biological degradation to produce biogas. At present, these treatment tanks are not in use. So the sewage water alongwith night soil is being mixed and collected into sludge drying beds. There are 20 sludge drying beds. The size of each bed is 30 m by 10 m. The sewage water, relatively free of suspended solids is drained out of these beds and supplied to agric-



cultural fields. The sewage sludge and night soil thus collected in these beds are allowed to dry and the compost obtained in this fashion is sold to farmers. The revenue derived from the sale of compost is about Rs.20,000/- a year.

3.2 Economics

The collection and disposal of waste and keeping the city clean is primary duty of any municipality. But this task is non productive. Financial burden on the municipalities is huge. Kolhapur Municipal Corporation is spending nearly two crore rupees every year for this purpose. Major share of this expenditure goes to the salary of sweepers and public health administrative personnel. When compared with the total expenditure, the revenue derived from the sale of compost, which is around Rs.20,000 a year, is negligible. Year by year this expenditure is increasing alarmingly. Often, due to shortage of funds, the fresh appointments of sweepers and public health personnel is not possible. This is resulting in an inefficient working conditions, total collapse of machinery, inefficient removal and disposal of garbage.

In the financial year 1982/83, the total amount spent for this purpose was Rs.1,22,57,828.00 (Corporation yearly report). The amount granted for the financial year 1986/87 is 1,63,82,200.00. The rate of increase in expenditure is about 9.5% every year except during 1984/85 when the rate of expenditure increase was 1.9%.

Details of the expenditure for each financial year starting from 1982/83 to 1986/87 is given in table 3.2.

3.3 Status of People and Quantity of Waste

The total quantity of waste produced in Kolhapur Municipal area is around 120-130 metric tons a day.

E₁ Division : It comprises mostly of housing colonies like Ambai Society, Ideal Housing Society, Pratibhanagar Society, Torna Society etc. and well-planned extension of Rajarampuri. Alongwith these well-planned extensions slum area like Daulatnagar Zopadpatti also exists in this Division. Total waste produced in this Division is around 18-20 metric tons/day. Two trucks are in operation to transport the garbage from collection points to the disposal sites. One of the truck is utilized in this area for three days. Other three days, it is used to transport garbage from E₂ Division. It amounts to 1.5 truck for this section. Each truck transports around 4.5 to 5.5 metric tons per trip and there are two trips per truck a day. Removal of the garbage from Rajarampuri and housing colonies is on each day but in slum areas the removal is on every alternate day. There is possibility of expansion of residential area as new colonies are coming up so in near future the waste produced will increase considerably. At present, the collected waste is dumped into low lying areas in this division.

E₂ Division : It is relatively small compared with E₁ division, but is more thickly populated. It comprises of Shahupuri, S.T.Stand area, Railway Station surroundings, Shahu Road and Shivaji Park surroundings. Several commercial establishments are situated here. The residential area comprises of 35% of the total. There is no possibility of expansion of residential area. Only the renovation of old buildings is

going on. There is daily removal of garbage in this division. The total waste obtained in this division is around 14-15 metric tons per day. One truck is solely utilized in this area, another truck which is shared by E₁ division is used for three days in a week to assist in removal of solid waste. The solid waste collected in this area dumped alongwith mud behind the Shahu College situated in E₃ division.

E₃ Division : This contains both colonies like New Shahupuri, Tara-bai Park area, Ruikar Colony, LIC Colony, Mukta Sainik Vasahat, Sadar Bazar and slum areas like Ambika slum, Temblaiwadi slum, Kadamwadi and Bhosalewadi. A regulated wholesale market is also situated in this division. Nearly 50% of the total area comprises of unplanned residential area. A slaughter house is also present here. The total waste produced in this division is around 18-20 metric tons per day. 2 trucks are in service. Expansion of well planned residential area is least except for the slum areas.

E₄ Division : This division, although big enough is thinly populated. Residential area covers only 25% of the total area. It consists of Kasaba Bavda, Line Bazaar, ST Workshop, Nagala Park area and New Palace area. Most of the area is consisting of agricultural land. Most of the residents are farmers. The nature of waste obtained comprises of grass, agricultural waste and cowdung. A sewage treatment plant is situated in this division. The tonnage of waste produced is around 10 metric tons per day. One garbage truck is in service. Expected residential area expansion is less, slum dwellers are more.

B Division : Residential status of this division is similar to E₄ division, except that it contains a few well-planned housing colonies like Sambhaji nagar, Y.P.Pawar nagar, Nehru nagar and Jawahar Housing Society. This division is also thinly populated with respect to total area. Around 35% of the total area is residential. Leather home industries are situated here. Much of the area is occupied by the slum. The total waste produced is around 12-14 metric tons per day. Two trucks are in service for transportation of garbage from collection points to disposal site behind Phatkar industry in Jawahar nagar society. Agricultural and leather waste form major portion of the waste produced.

C₁ Division : This division is of the smallest area. It comprises of Laxmipuri, Bindu Chowk area, Shahu Market, Shivaji Chowk and Municipal Office surroundings. Centrally situated, it consists of more commercial establishments than residential houses. The roads are narrow and poses problem for collection and transportation of garbage. The waste comprises of all sorts of materials from paper, rags to food wastes. A fish market is situated here. Since it is centrally situated, there is no possibility of expansion. Total waste produced is around 10-12 metric tons per day. One truck is solely utilized in this division and another truck is shared by adjacent division C₂ for three days in a week. Disposal site is nearly 5-6 km from this division (behind Shahu College, Sadar Bazar, E₃ division). All the sewage water flowing through open gutters is drained into a NALA.

C₂ Division : This division is also small and similar to C₁ division, compares with other divisions. It comprises of Town Hall surroundings,

Shahu Statue area, Dasara Chowk, Gangavesh and Rankala Vesh ST Stand. The residential area constitutes 50% of the total. Remaining 50% area is commercial. Entire division is having narrow winding roads. It is very difficult to collect and transport the solid waste in this area. This area is thickly populated. There is no possibility of expansion of residential area. Only renovation of the old buildings is going on. A wholesale vegetable market is situated in this area (beside Laxmi Theatre). Inevitably vegetable waste also constitutes the garbage. Total solid waste produced in this division is around 12-15 metric tons per day. One truck is solely used in this division and another truck is shared by C₁ division for three days in a week.

A Division : Areawise it is larger than C₁ and C₂ divisions. A few well built colonies like Solukenagar, Nale Colony, Sambhajinagar and thickly populated residential areas like Sonya Maruti area, Padmaraje Girls High School surroundings are present in this area. Around 50% of the area is residential. Remaining area is bareland. A timber market is present in this division. Population comprises of more middle class and low class people than elite class. Total solid waste produced in this division is around 18-20 metric tons per day. Two trucks are in service to collect and transport the solid waste.

D Division : This division comprises of Uttreshwar Peth, Shahu Police Chowky surroundings, Shingnapur MPL Naka, Sane Guruji Housing Society and Rankala tank surroundings. Only a part of it is residential and major portion is thinly populated. The residential area is thickly populated and having very narrow roads. A crematorium is situated on the bank of river Panchaganga. Population comprises of

low class and middle class people. Expansion of residential area is least. Total waste collected is around 16-17 metric tons per day. Two trucks are in service. Almost all the sewage water flows in open gutters and is let out into the river Panchaganga without any pre-treatment.

The amount of waste produced per unit area varies. Thickly populated areas in the heart of city have more population and hence the collection of waste is more in these areas. Depending on major activity in a chosen area, the nature and composition of waste shows some specific pattern, for example residential areas show more of household waste, business area shows paper and commercial commodities and industrial areas show more of metal residues.

Data relating to work force, dust bins, trucks, lavatories and waste produced is given in table 3.1.

3.4 Composition and Nature

The municipal solid waste is most heterogeneous mixture comprising paper, plastics, rags, wastefood, vegetable discards, rags, stones, mud from dmolition of old building, nails, metallic scrap etc. in varying proportion. The sorting technique of the municipal solid waste is not a well developed technique. Most of the present method of sorting to assign the composition is manual.

Williams et al.³ have described the method of sorting of household waste which is suitable for different types of utilization of solid waste like landfilling, land fill methane generation, incineration, composting, pyrolysis, material recovery and refuse derived fuel manufacture.

Whalley⁴ has discussed the sorting method of household waste which is suitable for the production of waste derived fuel.

Mortensen⁵ has discussed the manual sorting of household waste and correlated the results with the type of dwelling and household size.

Sastry et al.⁶ have discussed the sampling and analysis of Madras city solid waste in regard to the status of the dwellers.

Patil et al.⁷ have analysed the Pune city solid waste which showed relatively higher amount of organic matter and higher paper content which is suitable for composting.

Terashima Yutaka et al.⁸ have discussed the optimum strata sampling technique for the municipal solid waste.

3.4.1 Sampling and sorting of Kolhapur Municipal waste

Since the Kolhapur city has extensive area, and the large amount of waste is produced (120 metric tons/day), the entire municipal area is divided into 20 small parts (Map 2), irrespective of the 9 administrative divisions. The criterion for this division is to have nearly equal production of waste from each small divisions and covering nearly equal population. The areas which are thinly populated are big and the areas which are thickly populated but have more production of waste are small. The amount of waste produced in these small divisions is same i.e. nearly 5-6 metric tons a day irrespective of status of the people residing within that area.

3.4.2 Collection of the waste for sorting

From each division, three collection points were selected at random and from each of these collection points 3-4 kg of garbage was collected. Using random sampling technique the waste thus collected was always from the waste present in dust bins. The collected waste was carried from collection point to University department in polythene bags of 24" by 14" size. The waste was being kept in these polythene bags closed air tight until the sorting is done. Thus the waste collected in three bags each from the same division were mixed before being sorted. Since the production of incineration gas from waste and its calorific value is studied in the present project. The type of sorting method is that for the incineration gas production specified by Williams et al.¹. According to this method entire waste from each small division is classified as

- (1) Oversize/Bulky
- (2) Vegetable/Putrescible
- (3) Paper and cardboard
- (4) Plastics
- (5) Metals
- (6) Textiles
- (7) Unclassified fines
- (8) Stones

The waste from all these twenty divisions of the city was collected between 12-2-87 to 20-2-87. After the waste was sun dried, it was sorted as above on weight basis. The sorting of the waste was done between 22-2-87 and 24-4-87. After sorting except the stones and metals which are discarded, all the waste was again stored in closed

polythene bags, till it was crushed to fine powder in disintegrator specially designed for the purpose.

This waste stored in polythene bags were assigned the number of the corresponding area from which these were collected. The results of the sorting of waste are mentioned in table 3.3 and the areas from which the material was collected are listed in the table 3.4.

As it is evident from the sorting analysis, the paper, plastics and metals form negligible percentage of the total waste produced. Around 200 rag pickers are present in Kolhapur city area who hand pick and sell all that which fetches them their living. They roam around the city roads and pick the paper and all salable constituents which can be reused or used in making cardboard. Although, 50% of the milk supply to the Kolhapur city is in plastic bags (Warana milk, Gokul milk etc.) the proportion of plastic bags in the waste available is very less as these rag pickers pick the plastic bags also.

Petty businessmen roam around the city and purchase the bottles and metal tins at burgler's price. Thus the percentage of metal present in solid waste available is also negligible. Most of the metal present in garbage is in the form of safety blades, rusted nails and small metal scraps and bottle caps.

As shown in the above sections in this chapter the samples of the waste are collected by following recommended procedure and only cursory remarks regarding the origin distribution pattern are put. It will be evident that the average nature of the waste is more or

less comparable in all divisions with some indication of variation in composition, definite trends are not observed. In general the nature of waste is independent of locality. This probably indicates that there is diffusion of classes of society in all areas or that there is no much difference in the origin of waste.

TABLE 3.1 : DATA RELATING TO WORK FORCE, DUSTBINS, TRUCKS, LAVATORIES AND WASTE PRODUCED

| Details | Area | A WARD | B WARD | C ₁ WARD | C ₂ WARD | D WARD | E ₁ WARD | E ₂ WARD | E ₃ WARD | E ₄ WARD | TOTAL |
|-------------------------------------|------|---------|--------|---------------------|---------------------|--------|---------------------|---------------------|---------------------|---------------------|---------|
| 1. Sanitary Inspectors | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 2. Supervisors | | 1 (vac) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 3. Mukhadam | | 5 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 30 |
| 4. Rat killers | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 5. Sweepers | | | | | | | | | | | |
| (a) Total | | 163 | 142 | 79 | 125 | 150 | 143 | 110 | 149 | 118 | 1179 |
| (b) Dry sweepers | | 133 | 113 | 68 | 69(18) | 94 | 123 | 91 | 116 | 93 | 918 |
| (c) Wet sweepers | | 30 | 29 | 11 | 15(23) | 21(35) | 20 | 19 | 20(13) | 25 | 261 |
| 6. Dust bins | | | | | | | | | | | |
| (a) Total | | 84 | 127 | 36 | 33 | 79 | 194 | 82 | 105 | 42 | 782 |
| (b) Square | | 28 | 61 | 14 | 11 | 20 | 51 | 38 | 7 | 6 | 236 |
| (c) Circular | | 56 | 65 | 13 | 22 | 56 | 143 | 44 | 98 | 36 | 533 |
| (d) Constructed | | - | 1 | 9 | - | 3 | - | - | - | - | 13 |
| 7. Trucks | | 2 | 2 | 1+1* | 1+1* | 2 | 1+1* | 1+1* | 2 | 1 | 15 |
| 8. Water tanker | | 1* | 1* | 1 | 1* | 1* | 1 | 1 | 1 | 1 | 7 |
| 9. Suction tanker | | 1 | 1 | - | - | 1 | 1 | - | 1 | - | 5 |
| 10. Public lavatories | | | | | | | | | | | |
| a) Seats | | 283 | 235 | 75 | 98 | 126 | 443 | 214 | 292 | 272 | 2038 |
| b) Points | | 29 | 32 | 12 | 16 | 31 | 39 | 23 | 43 | 9 | 234 |
| 11. Waste produced per day (m.tons) | | 18-20 | 12-14 | 10-12 | 12-14 | 16-17 | 18-20 | 14-15 | 18-20 | 10 | 128-142 |

Note : 1. Figures mentioned in bracket indicate the number of temporary sweepers.

2. * mark indicates that the same truck is shared by another division.

TABLE 3.2 : DETAILS OF EXPENDITURE

| S.No. | Heads of Accounts | 1982/83 | 1983/84 | 1984/85 | 1985/86 | 1986/87 |
|-------|--|-----------|-----------|-----------|-------------|-------------|
| 1. | Public health and others | | | | | |
| | a. Salary of Health Inspectors and Sanitary Inspectors | 2,56,684 | 3,04,853 | 3,23,494 | 3,59,300 | 3,63,700 |
| | b. Payment of Administrative staff | 4,59,333 | 6,30,456 | 7,36,055 | 5,67,600 | 7,09,700 |
| | c. Stationery and others | 28,184 | 34,168 | 25,620 | 50,100 | 75,500 |
| | Total | 7,44,201 | 9,69,477 | 10,85,169 | 9,77,000 | 11,48,900 |
| 2. | General Conservancy Account | | | | | |
| | a. Payment of servants | 58,64,674 | 71,61,773 | 75,47,796 | 1,01,14,200 | 92,89,700 |
| | b. Truck drivers payment | 1,84,530 | 2,27,791 | 2,86,174 | 3,04,600 | 3,45,500 |
| | c. Dress for sweepers, servants, purchase of brooms etc. | 7,74,941 | 7,16,997 | 5,39,507 | 9,07,800 | 7,13,800 |
| | Total | 68,24,145 | 81,06,561 | 83,73,477 | 1,13,26,600 | 1,03,49,000 |
| 3. | Special Conservancy Account | | | | | |
| | a. Payments of public lavatory Account | 7,15,105 | 7,41,964 | 8,75,946 | 7,40,000 | 8,63,900 |
| | b. Payment of private lavatory servants | 9,05,478 | 11,96,557 | 13,30,673 | 15,54,000 | 16,25,300 |
| | c. Payment of Night soil truck servants | 1,07,195 | 1,29,437 | 1,48,997 | 1,89,500 | 2,27,900 |

...contd.

Table 3.2 contd...

| S.No. | Heads of Accounts | 1982/83 | 1983/84 | 1984/85 | 1985/86 | 1986/87 |
|-------|--|-------------|-------------|-------------|-------------|-------------|
| 3 | d. Payment of compost plant servants. | - | - | 48,529 | - | - |
| | e. Dress for truck workers, sweepers soap, basket, truck spare parts purchase etc. | 4,69,441 | 3,01,361 | 2,33,139 | 4,96,700 | 5,63,200 |
| | TOTAL | 21,97,219 | 23,69,313 | 26,37,284 | 29,80,280 | 32,80,300 |
| 4. | Gutters, urinals account | | | | | |
| | a. Payment of Drainage workers | 4,20,305 | 3,82,315 | 4,11,859 | 2,29,500 | 4,84,000 |
| | b. Gutter, urinal repair, electric expense and maintenance expenditure | 20,76,538 | 16,31,044 | 12,12,880 | 14,25,170 | 11,31,000 |
| | Total | 24,96,843 | 20,13,359 | 16,24,739 | 16,54,670 | 16,15,000 |
| | GRAND TOTAL | 1,22,57,858 | 1,34,51,019 | 1,37,12,642 | 1,49,75,970 | 1,63,82,200 |

TABLE 3.3 : SORTING OF HOUSEHOLD WASTE FOR INCINERATION

| BASE CLASSIFICATION | BATCH 1 | | BATCH 2 | | BATCH 3 | | BATCH 4 | | BATCH 5 | | BATCH 6 | | BATCH 7 | |
|------------------------------|--------------|--------|--------------|--------|-------------|--------|--------------|--------|--------------|--------|--------------|--------|--------------|--------|
| | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. |
| 1. Oversize/Bulky | 2604 | 24.325 | 1336 | 12.691 | 651 | 6.988 | 1092 | 9.840 | 3472 | 22.731 | 1883 | 13.767 | 3168 | 21.027 |
| 2. Vegetable/ Putrescible | 2303 | 21.513 | 4529 | 43.023 | 4282 | 45.968 | 3458 | 31.161 | 4830 | 31.622 | 3889 | 28.434 | 1632 | 10.832 |
| 3. Paper and cardboard | 336 | 3.138 | 462 | 4.388 | 336 | 3.607 | 182 | 1.640 | 945 | 6.187 | 231 | 1.689 | 342 | 2.270 |
| 4. Plastics | 18 | 0.168 | 102 | 0.969 | 16 | 0.172 | 21 | 0.189 | 154 | 1.008 | 49 | 0.358 | 12 | 0.079 |
| 5. Metals * | 34 | 0.317 | 24 | 0.228 | 18 | 0.193 | 35 | 0.315 | 91 | 0.595 | 14 | 0.102 | 72 | 0.477 |
| 6. Textiles | 322 | 3.008 | 126 | 1.197 | 63 | 0.676 | 44 | 0.396 | 168 | 1.099 | 189 | 1.382 | 84 | 0.557 |
| 7. Unclassified fines | 3628 | 33.890 | 3024 | 28.726 | 3454 | 37.079 | 4809 | 43.336 | 3003 | 19.660 | 4958 | 36.250 | 7488 | 49.701 |
| 8. Stones * | 1460 | 13.638 | 924 | 8.777 | 495 | 5.314 | 1456 | 13.120 | 2611 | 17.094 | 2464 | 18.015 | 2268 | 15.054 |
| Total | 10705 | | 10527 | | 9315 | | 11097 | | 15274 | | 13677 | | 15066 | |

contd...

TABLE 3.3 (contd.): SORTING OF HOUSEHOLD WASTE FOR INCINERATION

| BASE CLASSIFICATION | BATCH 8 | | BATCH 9 | | BATCH 10 | | BATCH 11 | | BATCH 12 | | BATCH 13 | | BATCH 14 | |
|--------------------------|---------|--------|---------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. |
| 1. Oversize/Bulky | 2492 | 23.934 | 4301 | 31.875 | 1440 | 11.461 | 1757 | 11.739 | 2646 | 18.862 | 1035 | 4.593 | 1656 | 11.867 |
| 2. Vegetable/Putrescible | 3439 | 33.029 | 1364 | 10.109 | 4680 | 37.249 | 3990 | 26.660 | 3759 | 26.796 | 1620 | 15.016 | 3784 | 27.117 |
| 3. Paper and cardboard | 200 | 1.920 | 374 | 2.772 | 398 | 3.167 | 511 | 3.414 | 945 | 6.736 | 362 | 3.355 | 479 | 3.432 |
| 4. Plastics | 17 | 0.163 | 55 | 0.407 | 46 | 0.366 | 98 | 0.654 | 340 | 2.423 | 46 | 0.426 | 84 | 0.602 |
| 5. Metals * | 22 | 0.211 | 33 | 0.244 | 36 | 0.286 | 56 | 0.374 | 168 | 1.197 | 14 | 0.129 | 11 | 0.078 |
| 6. Textiles | 273 | 2.622 | 57 | 0.422 | 42 | 0.334 | 35 | 0.234 | 308 | 2.195 | 91 | 0.843 | 38 | 0.272 |
| 7. Unclassified fines | 2611 | 25.077 | 5060 | 37.500 | 5670 | 45.129 | 5740 | 38.353 | 3283 | 23.403 | 6165 | 57.146 | 5658 | 40.547 |
| 8. Stones * | 1358 | 13.042 | 2249 | 16.668 | 252 | 2.005 | 2779 | 18.568 | 2579 | 4.127 | 1455 | 13.487 | 2244 | 16.081 |
| Total | 10412 | | 13493 | | 12564 | | 14966 | | 14028 | | 10788 | | 13954 | |

contd....

TABLE 3.3 (contd.): SORTING OF HOUSEHOLD WASTE FOR INCINERATION

| BASE CLASSIFICATION | BATCH 15 | | BATCH 16 | | BATCH 17 | | BATCH 18 | | BATCH 19 | | BATCH 20 | |
|------------------------------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. | Wt(g) | P.C. |
| 1. Oversize/Bulky | 3570 | 27.908 | 2072 | 13.945 | 3752 | 24.530 | 1736 | 12.801 | 3728 | 28.174 | 1568 | 11.077 |
| 2. Vegetable/ Putrescible | 2976 | 23.264 | 4228 | 28.456 | 4480 | 29.290 | 5887 | 43.411 | 3150 | 23.805 | 4494 | 31.748 |
| 3. Paper and cardboard | 816 | 6.379 | 179 | 1.204 | 1120 | 7.322 | 574 | 4.232 | 312 | 2.358 | 238 | 1.681 |
| 4. Plastics | 164 | 1.282 | 35 | 0.235 | 224 | 1.464 | 133 | 0.980 | 52 | 0.393 | 14 | 0.099 |
| 5. Metals * | 94 | 0.734 | 14 | 0.094 | 203 | 1.327 | 91 | 0.671 | 14 | 0.105 | 98 | 0.692 |
| 6. Textiles | 138 | 1.078 | 154 | 1.036 | 112 | 0.732 | 128 | 0.943 | 30 | 0.226 | 22 | 0.155 |
| 7. Unclassified fines | 2922 | 22.842 | 5572 | 37.501 | 7548 | 16.659 | 3920 | 28.906 | 4748 | 35.882 | 5111 | 38.226 |
| 8. Stones * | 2112 | 16.510 | 2604 | 17.526 | 2856 | 18.672 | 1092 | 8.052 | 1198 | 9.054 | 2310 | 16.319 |
| Total | 12792 | | 14858 | | 15295 | | 13561 | | 13232 | | 14155 | |

* Metals and stones are removed before disintegration and incineration.

TABLE 3.4 :

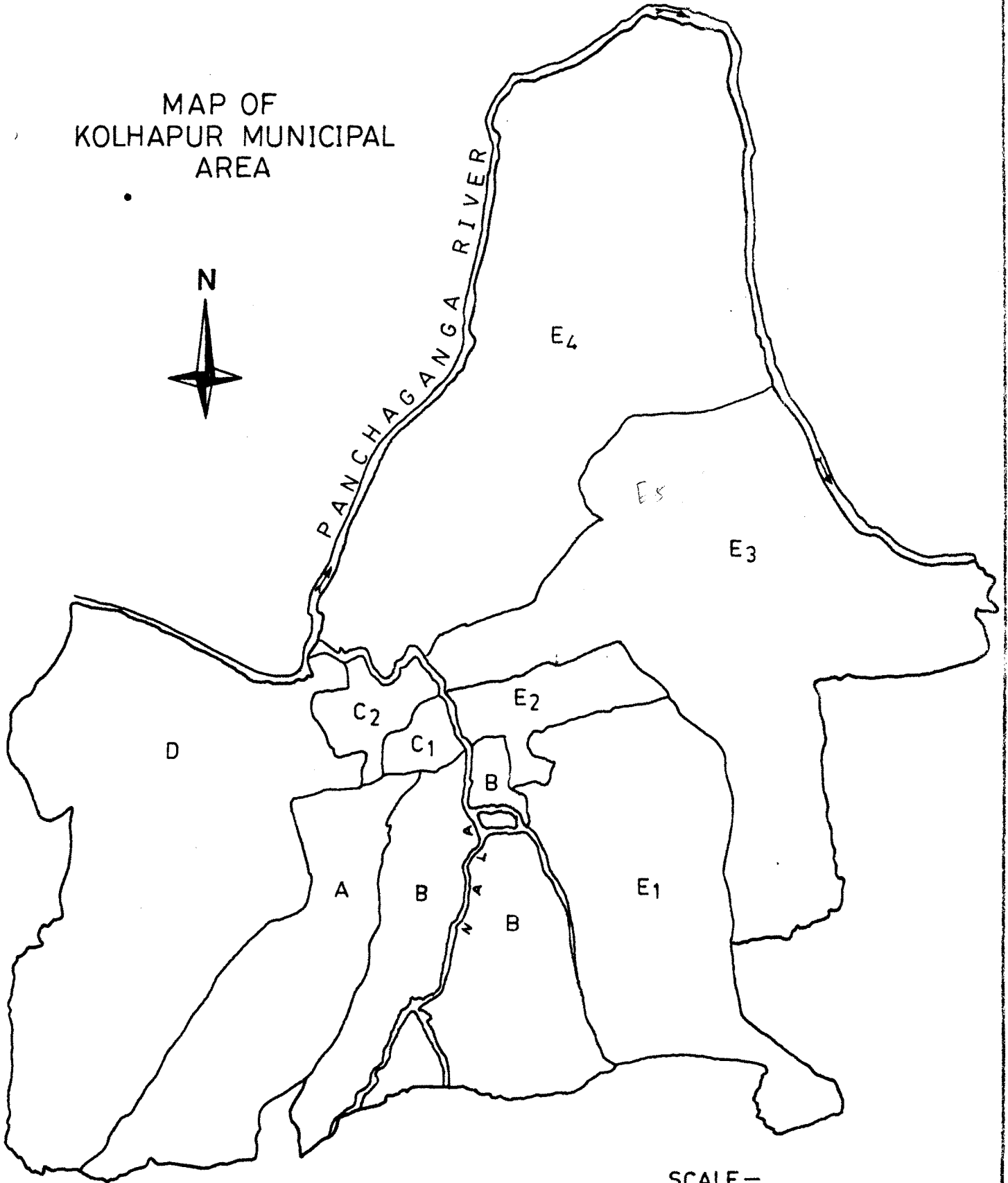
| Batch No. | Area from which solid waste is collected for analysis |
|-----------|--|
| 1 | Sagar Mal, Ambai Society, Jagrutinagar Society, Ideal housing society, Torna society, Pratibha nagar society, Daulat nagar Zopadpatti. |
| 2 | Rajarampuri extension, Tararani Vidyapeetha, Rajaram College area. |
| 3 | Temblai Naka, S.T.Colony, Vikram Nagar, Rajaram Rifle area, Temblai temple area. |
| 4 | Shahu mill surroundings, Chaya Society, KDCC Bank surroundings, B.T.College area, Rajaram Road. |
| 5 | Udyam Nagar, Hutatma Park Surroundings Extension Udyam nagar. |
| 6 | Jawahar nagar society, Subhash nagar, Nehru nagar society, Yellama temple surroundings. |
| 7 | Belbag, Shahu Stadium surroundings, Temple road, Khasbag area. |
| 8 | Sambhaji Nagar, Kalamba Filter house surroundings, Nale Colony, Tapowan area. |
| 9 | Old Palace, Ambabai Temple surroundings, Tarabai Road, Gadge Maharaj Chowk, Padmaraje Girls School surroundings, Timber market. |
| 10 | Bhosale Vidyalaya Surroundings, Margai Galli, Rankala S.T.Stand area. |
| 11 | Salukhe nagar, Phulewadi Society, Shalini Palace surroundings, Rankala tank area. |
| 12 | Dudhalei T.P.2, Shahu garden surroundings, Darubnatti area, Mira garden surroundings. |
| 13 | Gangavesh S.T.stand, Municipal office surroundings, Shivaji statue circle, Shahu market, Shahu statue area. |

....contd.

Table 3.4 (contd.)

| Batch No. | Area from which solid waste is collected for analysis |
|-----------|---|
| 14 | Una talkies surroundings, Laxmipuri area. |
| 15 | Sonya Maruti, Singnapur Naka, Uttareshwar Peth, Snahu Police Chowky, Dasara Chowk. |
| 16 | Shahupuri, Railway Station surroundings, Bagal Chowk, Snahu Road. |
| 17 | S.T. stand, Shivaji Park, Ruikar colony, Market Yard |
| 18 | Sadar Bazar, Shivraj colony, Ex-servicemen Society, Kumbhar Vasahat, New Shahupuri. |
| 19 | Kasaba Bavda, Line Bazar, Collector's residence surroundings. |
| 20 | Collector's office surroundings, New Palace area, S.T.workshop, Nagala Park, Mahavir Garden area. |

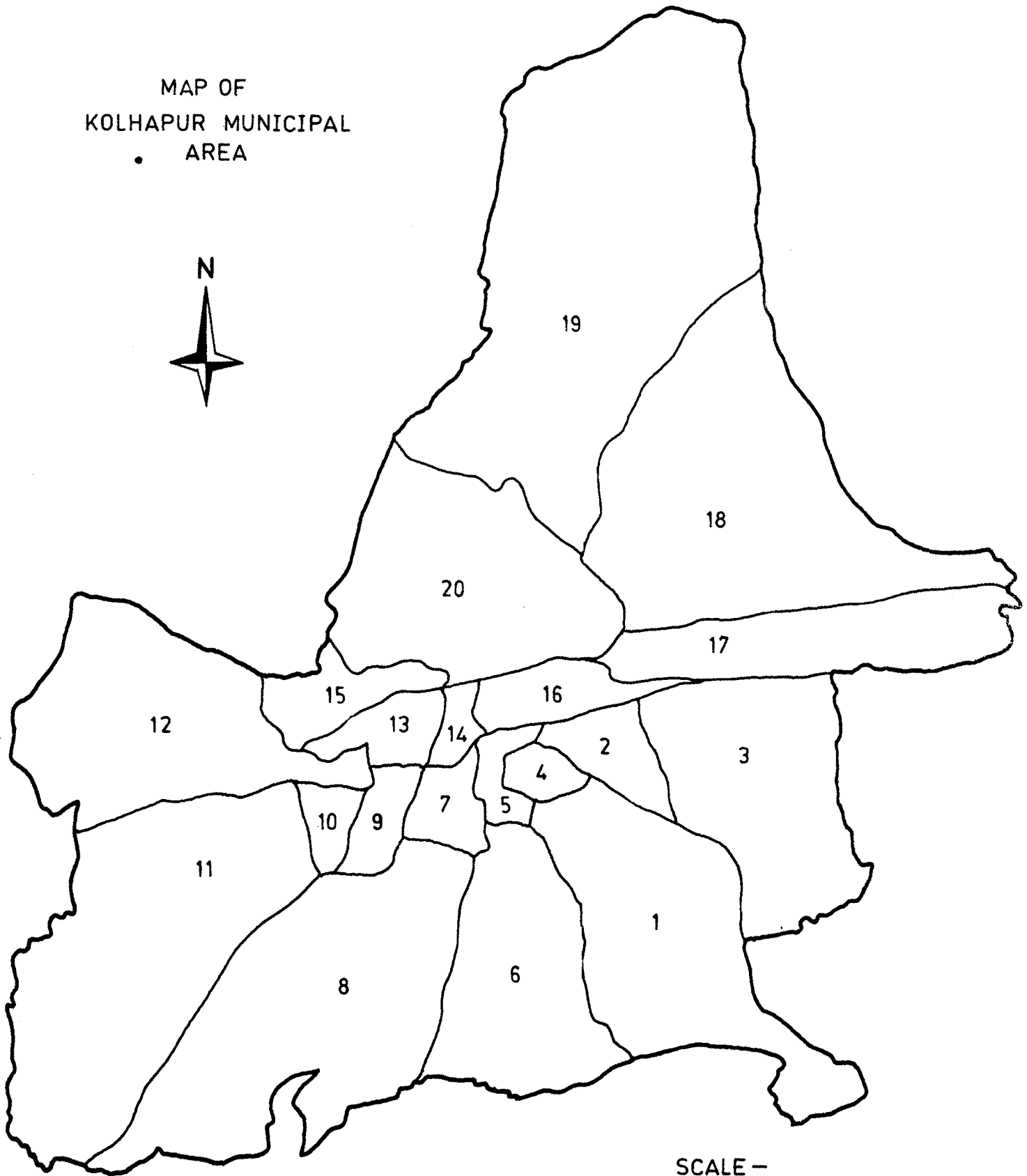
MAP OF
KOLHAPUR MUNICIPAL
AREA



SCALE -
805m 0 805m 1610m

MAP - 1

MAP OF
KOLHAPUR MUNICIPAL
• AREA



SCALE -
805m 0 805m 1610m

MAP - 2

REFERENCES

1. Kolhapur Municipal Corporation Yearly Report, 1985-86.
- 2. A report submitted to World Bank by Kolhapur Municipal Corporation, 1986.
3. H.E.Williams and R.C.Haines : "Sorting of Household waste and Thermal Treatment of Waste" Elsevier Applied Science Publishers 36 (1985).
4. L.Whalley : "Sorting of Household Waste and Thermal Treatment of Waste" Elsevier Applied Science Publishers 12, (1985).
5. H.Mortensen : "Sorting of Household Waste and Thermal Treatment of Waste" Elsevier Applied Science Publishers 62 (1985).
6. C.R.Sastry and B.V.S. Gurunadha Rao : Conserv Recycle, 7, 249 (1984).
7. A.D.Patil, B.Z. Alone and A.D.Bhide : Curr. Pollut Res India 189, 186 (1985).
8. Terashima, Yutaka; Urabe, Shinro; Yoshikawa, Katsuhiko : Conserv Recycle, 7, 245 (1984).