No. 4

BASIC DESIGN STUDY
ON
PUBLIC HEALTH PROJECT
IN
THE UNITED REPUBLIC OF TANZANIA

January, 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a basic design study on the Public Health Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Tanzania a study team headed by Mr. MICHIO SAKAMOTO, Technical Supervisor, Sanitation Bureau, Kyoto City Government from October 7 to 21, 1985.

The team had discussions on the project with the officials concerned of the Tanzania Government and conducted a field survey in Dar es Salaam, Moshi and Arusha areas in Tanzania. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

January, 1986.

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

Location Map

SUMMARY

The urban population of Tanzania has rapidly increased recently, and the population growth rate shows roughly 6% annually in the capital city, Dar es Salaam. The population growth rates of Moshi and Arusha where the field survey was conducted show 7.2 and 5.9%, respectively. Although such rapid increase in population brings the increase of refuse and sewage disposal amount, the counter measures for it have been delayed. As a result, uncollected refuse is left on streets and vacat lots and sewage overflowed discharges into lowland and side ditches, creating insanitary conditions.

Tanzania is experiencing the severe economic situation and the Government established the SAP (Structural Adjustment Program) to adjust the 4th 5-year plan and other development projects in order to reconstruct sound national economy. At present the government is forced to postpone investments on refuse collection/disposal and sewage treatment projects and other elements for maintaining public health conditions.

The public health and cleansing services in this country are operated by the Public Health Department and the Engineering Department of each council in a city, municipality or town which is a regional administrative unit.

In order to improve cleansing service and to maintain public health conditions as mentioned above, the Government of Tanzania requested to the Government of Japan for supply of 1) 50 refuse collectors, 2) 50 cesspit emptiers and 3) a set of spare parts for these vehicles in the grant aid program.

In response to the request, the Government of Japan decided to conduct a basic design study for this project, and the Japan International Cooperation Agency dispatched a basic design study team on the project to Tanzania from October 7 - 21, 1985. The Team conducted a field survey in the capital city, Dar es Salaam, and at the regional

cities, Moshi and Arusha, as well as discussions with the officials from the Prime Minister's Office of Tanzania. Based on analyses of data and information collected in the field survey, a basic design was carried out in Japan.

As the result, it is decided that the following equipments are proper for this grant aid project.

- refuse collector with the loading capacity of 8 tons
- cesspit emptier with the capacity of 6,000 litres
- portable tools and machinery for work shop and necessary spare parts for vehicles

The vehicle allocation plan for 3 cities is stated below.

	Solid Waste Amount (t/day)	Number of Refuse Collectors	Sewage Amount (l)	Number of Cesspit Emptiers
Dar es Salaam	488	44	819,000	29
Arusha	60	5	100,800	4
Moshi	65	4	109,200	4
Total	613	53	1,029,000	37

After signing the Exchange of Notes (E/N), 13.5 months is required for project implementation, which consists of tender procedure, contract procedure with suppliers, procurement, transportation and delivery of vehicles and equipment, etc.

The operation and maintenance cost of all equipments for the 3 cities, which is considered as local responsibility, is estimated approximately 7.4 million Tanzanian Shilling (90 million yen). The project executing body is each city council under the Prime Minister's Office.

The realization of the Project directly contributes to strengthening cleansing service and to improve the maintenance ability of collection vehicles in the 3 cities. In addition to them, it can obtain the cooperation of citizens and it is expected to execute sound cleansing service by the collection charge. Therefore, the implementation of the Project is expected to strengthen the public health service in Tansania and to improve the sanitary conditions in the country . Thus, the project is expected to bring about great benefits and is highly eligible for the grant aid program.

CONTENTS

Contents

Contents

CHAPTER 1 INTRODUCTION

To respond to the rapidly increasing urban population in recent years, the United Republic of Tanzania has attempted to improve the means and facilities to maintain the environmented sanitation in the urban areas. Never the less, the capacity of refuse/sewage collection and disposal falls far below the demand, so that a large amount of refuse and sewage is left or discharge in the backyards of building, streets and side ditches, creating insanitary conditions and affecting the public health. 3,000 tons of refuse and 1.7 million liters of sewage are left ancollected each day in the urban areas.

Because of its difficult financial conditions, to procure necessary equipment, the Tanzanian Government requested the Japanese Government to provide, 1) 50 refuse collectors, 2) 50 cesspit emptiers and 3) a set of spare parts under the grant aid program.

In response to the request, the Japanese Government decided to conduct a basic design study, and JICA sent a basic design study team headed by Mr. Michio Sakamoto, Technical Supervisor of Sanitation Bureau of Kyoto City Government, to the country for 15 days between October 7 to 21, 1985. The Team studied the technical and economic viability project under a grant aid program and conducted a basic design study for contents and size of the project.

The final report contains the results of analyses and evaluation on data and information collected from discussions responsible officials of with the Prime Minister's Office of the Tanzanian Government and through the field survey, evaluation on the background and contents of the project, establishing of plans, contents and size of the project, selection of suitable equipment and together with vehicle allocation plan, project cost estimation, and establishing of operation and maintenance plan. The related data collected at the time of field survey and minutes of discussion describing the contents of discussion with Tanzanian side are attached to the end of this report.

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Socioeconomic Conditions

2-1-1 Natural environment

City of Dar es Salaam is located in the eastern part of the United Republic of Tanzania, facing the Indian Ocean on the east and west in the State of Dar es Salaam. It contains roughly 44,800 hectares of urban area including center.

The city which is mostly located in a flat seashore area, and roughly 67,300 hectares of rural area which is gradually elevating towards Pugu Hill, with average elevation of 20 - 30 m above the sea level. This city has the largest commercial port in Tanzania, containing a 16 km long coastal zone and a number of inlets which divide the zone. The port is a natural port formed by Kizinga and Mzinga rivers which are originated in Puge Hill.

The city, has two rainy seasons between March to May, and October to December. The monthly precipitation ranges between 100 - 300 mm, and the mean annual precipitation is 1,125 mm. The temperature is generally low in June - September, and high in December to February. The daily mean and minimum temperatures February 4 to 7 are 33°C and 23°C respectively.

Moshi Town and Arusha Municipal are located in the northern part of Tanzania near the border with Kenya. Moshi is a city developed on a large stretch of a mountain foot (890 m above the sea level) in the south of Mt. Kirimanjaro, the highest mountain in Africa. Arusha is, located 1,540 m above sea level on a wide stretch of a mountain foot in the south of Mt. Meru, one of the highest mountains in Africa, 80 km in the west of Moshi. Both cities are world famous tourist spots.

The cities have two rainy seasons between March to April and from October to December. The monthly precipitation ranges between 100 - 250 mm, and the annual precipitation in October to March and low in April to September. The daily mean and minimum temperatures are 25.4°C and 13.8°C respectively.

2-1-2 Population

According to 1978 Census, Tanzania had population of approximately 17,500,000, with the annual average growth rate of 3% between 1971 to 1978. According to a bulletin of the Statistics Bureau of Tanzanian Government, the population after the census was 19,871,000 in 1983 and 20,506,000 in 1984.

The population in Dar es Salaam accounted for 0.92% of the total population in 1984, in 2.72% 1967 and 4.52% in 1978, showing a steady increase. Projected and actual population between 1948 to 1978 are shown in Fig. 2-1. Also, contained in the master the population projections of the city plan for Dar es Salaam prepared by the Ministry of Land, Housing and Urban Development are shown in Table 2-1.

Based on the above criteria, population in the urban area of Dar es Salaam is estimated to reach about 1,623,000 in the year 1990 (the target year established for the project, which is a half way point of 1987 and 1994, 7 years assumed as service life of the equipment supplied under the project.

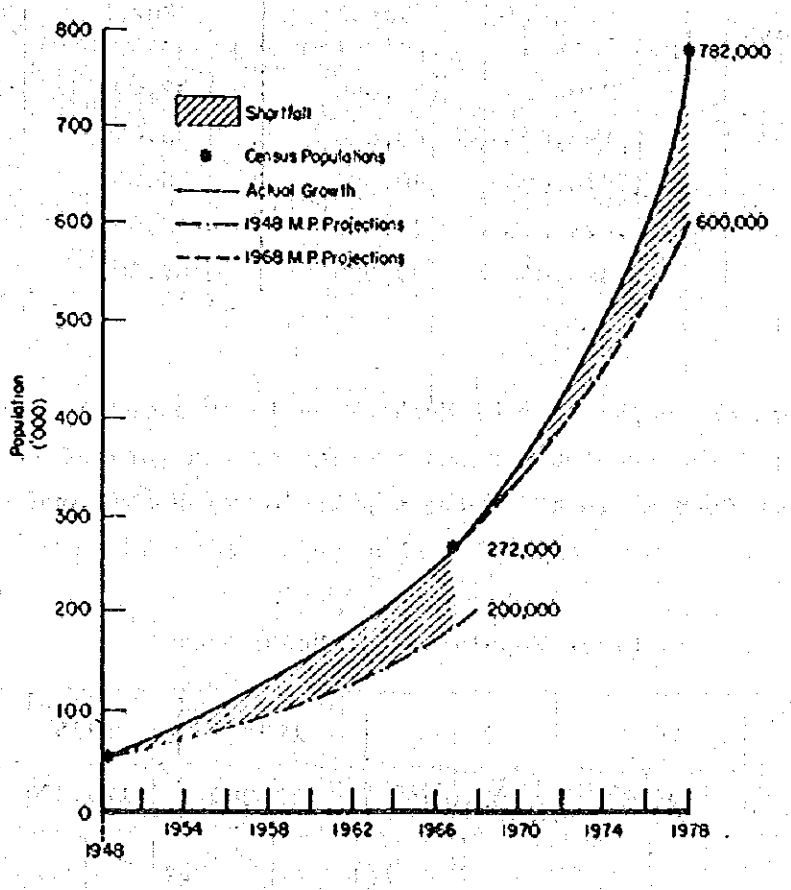


Fig. 2-1 Population Projections of the Previous Master Plans

Table 2-1

Year	Urban population	Rural population	Rural planning area	Total region
1979	849,000	51,000	32,000	932,000
1984	1,183,000	48,000	38,000	1,269,000
1989	1,546,000	50,000	46,000	1,642,000
1990	1,623,000	48,000	48,000	1,724,000
1999	2,368,000	29,000	64,000	2,461,000

Based on the population of Moshi Town in 1978 Census and the population and the previous annual average growth rate of 7.2% announced by Moshi Town Council in 1975, the population of Moshi Town was projected as follows:

Urban Population of Moshi Town

Item \ Year	1978	1983	1984	1985	1990
Population	52,046	105,000	112,000	120,000	170,000
Growth rate (%)		15	7.2	7.2	7.2

Similarly, based on the population of Arusha in 1978 Census and the population and the previous annual average growth rate of 5.9% announced by the Arusha Municipal Council, the population of Arusha was projected as follows:

Urban Population of Arusha Municipality

Item \ Year	1978	1983	1984	1985	1990
Population	55,223	116,000	123,000	130,000	173,000
Growth rate (%)		16	5.9	5.9	5.9

Current Population 1985

Item / Calculation formula / City name	Population of municipal area (persons)	Population served by refuse collection (persons)	Population served by sewage collection (persons)
	①	② Same value as column ①	*2 ③ = ② x 70%
Dar es Salaam	1,300,000	975,000*1	682,500
Moshi	120,000	120,000	84,000
Arusha	130,000	130,000	91,000
Total	1,550,000	1,225,000	857,500

*1: Only 75% of the population of the administrative district for Dar es Salaam (based on the response from the government official)

*2: Percent of population not served by public sewage system

Population in Target Year (1990)

Item / Calculation formula / City name	Growth rate (%)	Population of municipal area (persons)	Population served by refuse collection (persons)	Population served by sewage collection (persons)
	④	⑤ = ① x ④^7	⑥ Same value as column ⑤	*5 ⑦ = ⑥ x 70%
Dar es Salaam	----	1,623,000*3	1,217,000*4	851,900
Moshi	7.2	170,000	170,000	119,000
Arusha	5.9	173,000	173,000	121,100
Total	----	1,966,000	1,560,000	1,092,000

*3: Calculated based on the population in Item 2-1 (2).

*4: Only 75% of the population of the administrative district for Dar es Salaam (based on the response from the government official)

*5: Percent of population not served by public sewage system (assumed to remain same as in 1985)

2-1-3 National socioeconomic development plans and environmental health conditions

The Tanzanian Government is currently implementing the 4th five-year plan (July 1981 - June 1986), and has a new long-term plan (1981 - 2000) to achieve of self-supply of foods and industrial products. Because of its extremely unfavorable economic situation in recent years, however, the Government is forced to cut low priority projects as well as departments with poor financial condition in order to halt further worsening of economic situation, instead of implementing development projects: the Government has established, 3 year Structural Adjustment Program (SAP), in an attempt to reconstruct the national economy. Moreover, it is reported that another crucial task of the Government is to implement a new agricultural policy (starting in March 1983) effectively.

Under these circumstances, planned investments on environmental sanitation project - solid waste sewage collection and disposal - are inevitably delayed, together with various development projects. It should be noted that development project have not contributed much to present insanitary condition in urban areas. Rather, environmental problems caused by rapid increase in urban population due to migration from rural areas are the most services issue. According to the master plan for Dar es Salaam, public sewage system is planned as a social development project. When implemented, the project will help reduce sewage collection requirements. On the other hand restoration and repair for sewage treatment systems are planned in Moshi and Arusha, which are expected to alleviate the situation condition as in Dar es Salaam.

2-1-4 Government budget

Budgets of the Government of Tanzania in decent years are summarized in the table below.

Unit: million shillings (shs)

	1981/1982 (budget)	1982/1983 (budget)	1983/1984 (budget)	Remarks
1. Revenue	10,949.0	13,541.0	16,250.0	
2. Expenditure	17,387.0	18,950.0	21,450.0	
Current expenditure	12,930.0	14,554.0	15,620.0	
Development expenditure	4,484.0	4,396.0	5,830.0	
Ordinary public service	3,108.7	3,198.2		
Expenditure for public health	962.4	1,019.8		

Although the direct investment on environmental sanitation in these budgets are not known, master plan for Dar es Salaam on environmental improvement serving 1.30 million people:

I. Solid Waste Projects

Code	Project description	Cost (shs)
IV Solid waste projects		
R1	Development of Kimara sanitary landfill site	1,840,000
R2	Closure of Tabata dump	1,000,000
R3	Collection equipment	6,450,000
R4	New sanitary landfill sites	3,020,000
R5	Additional collection equipment	9,600,000
Sub-total solid waste projects		27,910,000

II. Sewage Disposal Program

Code	Project description	Cost
II Sewage projects		
S1	Central area sewers	n/a
S2	Sewage collection and disposal in Mbezi	10,510,000
S3	Msimbazi trunk sewer, pre-treatment and ocean outfall	78,970,000
S4	Sewage collection and disposal for Changombe/Keko	26,590,000
S5	Trunk sewers in Tabata east	7,150,000
S6	Sewage collection and disposal in Mbagalla	4,010,000
S7	Msasani trunk sewer	23,850,000
S8	Trunk sewers in Sinza/ Msgonani/Kinondoni	8,160,000
S9	Kigamboni pumping main	4,000,000
Sub-total sewage projects		163,240,000

2-1-5 Present state of refuse collection and problems

The total amount of refuse produced in urban areas throughout the country is estimated 3,000 tons per day. Of the total, only 700 tons are collected by the councils, leaving the rest on streets or in vacant lots. The situation is partly attributable to a insufficient investment on refuse disposal project, and partly attributable to rapid increase in urban population migrated from rural areas for job opportunity. Many of the migrants are living in squatter settlement to hinder the local government to take appropriate measures on refuse collection. Moreover, although the final disposal site was selected near the city boundary, was surrounded by the settlement as a result of the rapid increase in population, and the new site was selected in a place remote from the city, resulting in a lack of refuse collectors and containers as well as increase in damage and repair work of vehicles.

In addition, disposal project has to enuisaze lease of vehicles and other services the refuse if refuse produced from markets vegetables, fish and meat, charcoal, paper and string are collected and transported by a market cooperatives or if industrial wastes are collected and transported by producing companies or factories.

At the disposal sites, refuse are discarded in hills and valleys, without sanitary treatment such as landfill and compaction and watering. This has already caused contamination in the lower course of river, and the proper treatment is highly desirable.

2-1-6 Organization of local government

The Tanzanian Government is composed of 24 ministries. Among these ministries the Minister of the Prime Minister's Office (responsible for local government and cooparateves) controls environmental sanitation policy and administration at the local government level. The local administrative units are classified into the following types, according to the size of population.

a) City
b) Municipal
c) Town
d) District

Each of these administrative units is operated by council. Only Dar es Salaam is classified as the city and Arusha and Moshi as municipal and town as respectively. The whole country is divided into approximetly 20 regions, and each of which as the Regional Commissioner and the Regional Development Director (RDD).

The Regional Commissioner is the leader of CCM (revolutionist party) party in each region, but has no authorities on public administration and is merely an honarary position. RDD is a government employee responsible for control of in each region development projects as well as coordination of local government authorities in each region. A subsidy, is provided by the Prime Minister's Office to each RDD which distributes it to each council. The city of Dar es Salaam constitutes one region and has no RDD. The city director is responsible for jobs performed by RDD in other regions.

The City Council comprises 7 departments, among which the Department of Health is in charge of refuse disposal project. In other regions the councils are in charge of the project. Therefore, operation, maintenance and repair services for the supplied vehicles will be the responsibility of conseious effort by the Government.

In terms of vehicles, a majority of refuse collectors and cesspit emptiers were purchased in 1960's, with only roughly 40% of them being at present in service in 1970s. As result, while 3,000 tons of refuse are produced in major cities every day only 700 tons are properly collected and disposed. Similary, only 200 kilolitters out of 1,700 kilolitters of sewage produced are properly collected and treated. The uncollected refuse and sewage are left on roadsides and vacant lots, operating extremely insanitary conditions and hazards to out break of cholera, dysentery, malaria and other epidemics. To cope with this situation, the government of Tanzania requested the Government of Japan to provide the following vehicles and equipment under the grant-aid program because of its difficult financial situation.

- Description of the request -

Vehicles and equipment requested by the Government of Tanzania are:

(1) 50 refuse collectors

(2) 50 cesspit emptiers

(3) a set of spare parts for above vehicles.

2-2 Refuse and Sewage Disposal in Dar es Salaam

(1) Refuse disposal

Refuse produced in the city is mainly domestic wastes produced from houses, stores, public offices and manufacturing establishments. These are collected by council operated refuse collectors and discardded at disposal site in Tabata, 8 km west of the city. The counsil is not responsible for collection and disposal of industrial wastes, which are carried out by each industry. Although the disposal of industrial waste at the Tabata disposal site is permitted, a the most of companies are disposing their wastes at nearby places or burn it in the field, due of a lack of carrying vehicles.

The capacity of Tabata disposal site has already reached the limit, and thus the wastes are disposed near Luhanga River, creating a risk of water pollution in the lower course of the river. In 198=78 a landfill site was acquired in Kimara land preparation work started. However, because of oppositions from local residents, the use of the site was postponed and, the Tabata disposal site has been used to date. Later a new disposal site was acquired in Mbagara district and preparation works for landfilling are underway without any opposition from local residents.

In order to avoid further deterioration in public health and environmental conditions, the city counsil plans to increase the number of refuse collectors as well as waste containers in markets and squatter settlement areas to improve the squality of refuse collection services.

The City Health Department is responsible for refuse collection and transport, while the City Engineering Department is responsible for maintenance and repair of refuse collectors. The refuse collection service is financed by tax alone, and no collection charges are imposed.

(2) Sewage disposal

9 areas the center city, Regent Estate, Lugalo Barracks, a college, Ubungo Industrial District and airport have their own sewage collection systems through which raw sewages are carried to a sewage treatment plant, or directly discharged into the ocean. The most of houses, cooffices, government offices and stores are equipped with septic tanks, from which sewage is collected and carried by cesspit emptiers to discharge outlets connected to the treatment plant.

Sewages carried to the treatment plant are aerobic treated in oxidation ponds and discharged into rivers or the ocean.

According to the master plan for the city, the treatment plants will be connected through trunk sewers to discharge treated sewages from the outlets in the Oyster Bay and Kwenda Peninsula to the ocean. In the 1st phase of the project, it is scheduled to build a Oyster Bay outlet (the daily discharge capacity of 1.30 million litres and with the pipe diameter of 2,500 mm). This project, duced in the city, including of center the city, into the ocean. The budget for the project is shown as follow:

STAGE III DEVELOPMENT COSTS

(Millions of Shillings)

Item	Costs			
	Stage I	Stage II	State III	Total
Sewage				
Outfalls and pre-treatment	31.40	84.90	73.40	189.70
Temporary treatment	7.26	5.24	0	12.50
Trunk collection system	119.28	54.18	51.04	224.50
Pumping stations	5.3	16.62	56.68	78.60
Local servicing	28.58	53.76	178.34	260.68
Sub-total	191.82	214.70	359.46	765.98
Storm drainage				
Existing problem areas	11.65	0	0	11.65
Local servicing	12.01	17.24	51.37	80.62
Sub-total	23.66	17.24	51.37	92.27

The project may be financed by the World Bank. The project, when completed, will reduce loads of cesspit emptiers; according to the official data, 800,000 litters of sewage is produced in the city every day and 3,000 litres are collected and carried by the cesspit emptiers.

(3) Number of vehicle

The number and conditions of refuse collectors and cesspit emptiers owned by the city counsil are summarized as follows:

Descriptions / Vehicles	Total number	Condition of truck		Specificati
		Favorable	Disabled	
Refuse collector	20	6	14	7 t
Cesspit emptier	3	0	3	6,000 ℓ

According to the field survey, 2 cesspit emptiers (the capacity of 8,000 litres) have been procured by the loan given by the World Bank and are waiting for usage permission. As to the present stock, even the vehicles graded as of "serviceable" are extremely worn out and appear to be serviceable for a limited period of time.

(4) Access roads

Roads and streets of Dar es Salaam form radial or circular networks around the center city where houses, commercial and public facilities are concentrated. Most roads are 2 or 4 lanes, and the Tabata final disposal site is located along the Port Access Road which is a 4-lane ring road. As shown in the map, all roads are connected to the Port Access Road. Wide open spaces are reserved for future expantion streets, so that refuse collectors can stop or park without difficulties. Also, refuse collected Lugolo and Mbezi, in the northern part of the city, can be transported to the disposal city through the Port Access Road, without

entering the center city. The feeder roads leading form the main roads to the disposal site are paved with asphalt and gravels, which ensure undisturbed traffic during rainy seasons.

Existing Sewage Collection and Disposal Systems

Legend

- Existing Sewer and Direction of Flow
- Proposed Sewer by Others
- Existing Oxidation Pond(s)
- Proposed Oxidation Pond(s)
- Existing Pumping Station
- Proposed Pumping Station
- Existing Forcemain
- Proposed Forcemain

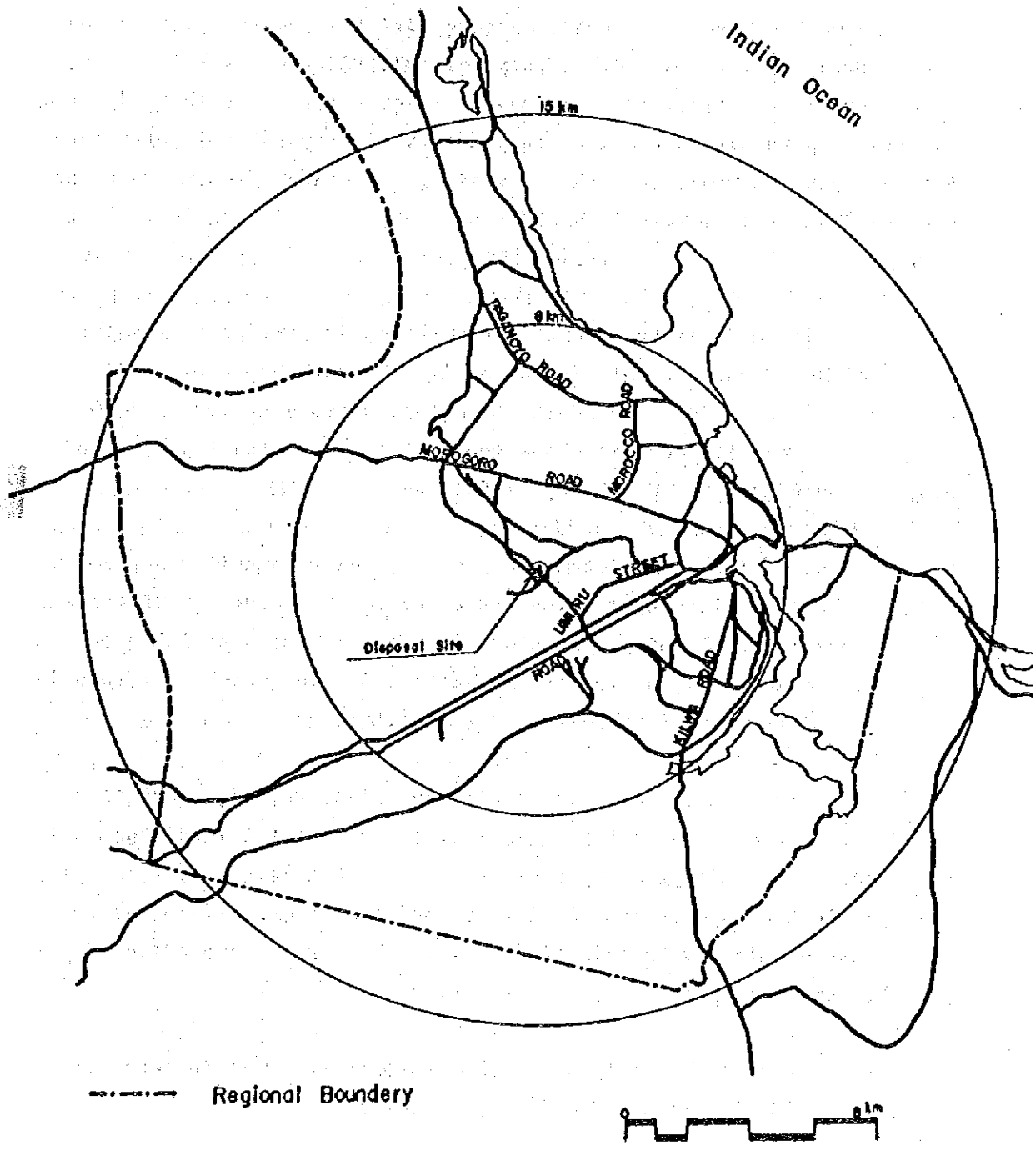


Fig. 2-2 Access Roads

(5) Workshop

The workshop for maintenance and repair of refuse collectors and the vehicles is located in the Hanayamara District, a few kilometers northwest of the city. It contains a warehouse for equipment and materials, a repair shop and a heavy-duty vehicle yard. Disabled cars include rather new ones, which are waiting for spare parts. Equipment such as chain block, welding machine and compressor is considerable worn out.

Operation and maintenance of the workshop is carried out by the Technical Department of the City Council. The workshop employs 2 engineers, 8 mechanics, 3 welders, 5 smiths, 5 store keepers and 10 labourers. The city counsil plans to implement new cleaning service project including the a workshop as follows:

- As a operation and maintenance plan, the city counsil plans to establish a cleaning section headed by the Cleaning Superintendent comprising a cleaning inspector, foremen, headmen and labourers. The section will control the Mechanical Section which is responsible for maintenance of vehicles and facilities.

- As a personnel training and assignment plan, the city counsil requests to build training facilities for cleaning inspectors. In addition, it is planning to improve technical levels of the foremen, public health officers, assistants and inspectors. In order to finance this new organization, 25% of the current expenditure will be obtained from cleaning services.

It seems that this city's workshop is operated well in terms of operation and maintenance of ordinary vehicles.

2-3 Refuse and Sewage Disposal in Moshi Town

Moshi Town, the capital city of the Kilimanjaro Region, is located in the mountain foot of Mt. Kilimanjaro, roughly 660 km north of the opital, and is tourist center well known in the country.

As Moshi Town is managed by the Town Council under the supervision of the Prime Minister's Office. The counsil has 6 departments 1) Finance and Administration, 2) Engineering, 3) Public health, 4) Education, 5) City planning and 6) Commerce and Trade the Public Health Department is responsible for collection and disposal of refuse and sewage.

The present population of Moshi Town has a population of 120,000, with the annual average growth rate of 7.2% due to immigrants migrants commuters from subarbs to such as for leather, factory cotten vefinery, coffee refinery and matche factory as well as 7 food markets which collect agricultural products in the subarb an areas.

(1) Refuse disposal

Refuse produced in town is collected and transported directly by the Town Council, including domestic wastes, vegetables in markets, wood pieces, cloth, leather pieces, metal shreds of automobile, lumber cutting. The collection services are operated mainly by a refuse collectors with 6 operators, twice per month from each house and establishment on two-shifts.

The collection services are provided with free of charge for residents, companies and hospitals, but the markets are required to pay certain charges. Collected wastes are dumped into a disposal site which is approximately 4 hectares in size and is located about 4 km south of the center town. Only several leather factories are located near the disposal site, causing little problems for the living environment. According to the survey results the daily amount of refuse is estimated approximately 120 tons, while 30 tons are collected disposed.

(2) Sewage disposal

The sewage treatment plant in Moshi Town serves only 16% of the town population, and the rest being treated in septic tanks. The daily amount of discharge is approximately 70,000 litres and while 20,000 litres are collected and disposed. It is difficult to excavate the soil for septic tanks in some areas because of rook zone. On the other hand some places are situated on permeable ground, causey contamination of ground water. Sewage collected from each septic tank by cesspit emptiers is discharge into outlets built in the suburb, 2-3 km form the center city, and thereafter led into the sewage treatment plant through sewage where the sewage is chloric-disinfected and finally discharged into Njoro River.

At present, there is a demand for improvement and expansion of the existing sewage system, because the system constructed in 1964 is partially incomplete. The original plan was to construct a plant with the daily transport capacity of 200,000 gallons. With the present population which increased 10 times that of 1964, however, a new plant with the daily capacity of 2.5 million gallons is needed. The construction cost is estimated approximately 21.6 million Tsh, and is appears difficult to implement the project due to a lack of government finance.

(3) Vehicles owned by the city counsil

The number and conditions of refuse collectors and cesspit emptiers owned by the city are summarized as follows:

Descriptions / Vehicles	Total number	Condition of truck		Specifications
		Favorable	Disabled	
Refuse collector	5	3	2	7 t
Cesspit emptier	3	2	1	6,000 ℓ

(4) Access roads

The town contains a business district with stores, banks and hotels, a government office district and 6 markets and 7 hospitals. The streets are developed in a grid pattern, with sufficient road width and open spaces reserved for road expansion, providing smooth collection and transportation by refuse collectors. Away from the approximately 4 km long main road, 20 - 30 meters of the access road, to the disposal site is still unpaved but the section has gentle gradient and well leveled to ensure smooth traffic.

(5) Workshop

In the Moshi Town Workshop located in the southern part of the town along the main road, old-type vehicles and deteriorated vehicles with only body were obserbed. Repair tools, machines and equipment appear to be insofficient both in quantity and quality.

The Workshop is operated under the supervision of the Engineering Department of the Town Council. The workshop employs 2 mechanical engineers, 10 workers including mechanics, welders and smiths, 5 store keepers and 20 labourers. They have sufficient experience in maintenance and repair of ordinary vehicles. However, for maintenance and repair work of new-type special-type vehicles, provision of maintenance manuals, training and education for technical servicemen, short-term overseas training and employment of skilled workers are required.

2-4 Refuse and Sewage Disposal in Arusha Municipal

Arusha Municipal, is located on a pleaton in the foot of Mt. Meru, roughly 80 km west of Moshi Town. Arusha is the capital of Arusha State and well-known for tourist attraction and a famous international conference center. Around the city are several national parks such as Serengeti National Park and Kilimanjaro International Airport which serves as a transportation hub. The city also a market for coffee, tea and hemp and othe agricultural products, attracting many people from the suburbs.

The administrative system of Arusha Municipal is similar to that of Moshi Town. It has a population of 130,000 million, with the annual population growth rate of 5.9%, due to immigrants from rural areas and othe countries and commuters from the suburbs to the city for working at factories producing wood chips, tires, coffee and hemp and food markets to which agricultural products are collected.

(1) Refuse disposal

Refuse produced in the city includes domestic wastes as well as kitchen garbage, paper, waste of agricultural products and produced from stores, government offices, research institutes, hospitals, hotels and 6 markets. These are collected and carried by refuse collectors owned by the city counsil. Industrial wastes such as tires and wood chips are collected by Parastaral Organization, a satellite organ, which then transport and dump them to Njiro Hill in the southern suburb, approximately 9 km from the city. Then, dumped wastes are burned in the field. Vast Njiro Hill, has no houses, Causing no problem to the living environment. According to the survey results, the daily amount of refuse produced in the city is estimated 1.70 million tons, and of which 30 tons are collected, and disposed.

(2) Sewage disposal

In Lemara South in the southern suburb of Arusha, there are 5 oxidation ponds having the size of 2 hectares. The treatment capacity of these ponds is 3.4 million litres per day, and waste water treated is discharged into Temi River. Sewage produced from houses and various facilities is collected by cesspit emptiers and discharged into outlets in the suburb. Thereafter the sewage is led into the disposal site through sewers and open ditches. The daily discharge amount of sewage is approximately 70 thousand litres and of which 20 thousand litres are treated.

(3) Vehicles owned by the municipal counsil

The number and conditions of refuse collectors and cesspit emptiers owned by the municipal counsil are summarized as follows:

Descriptions / Vehicles	Total number	Condition of truck		Specifications
		Favorable	Disabled	
Refuse collector	5	2	3	7 t
Cesspit emptier	4	2	2	6,000 ℓ

(4) Access road

Refuse are carried to Njiro Hill, roughly 9 km south of the center city, where they are dumped and burned in the field. Ample road width and open spaces reserved for road expansion are provided in the city to ensure smooth collection by refuse collectors. The main road leading to the disposal site is asphalt-paved, having 2 lanes, but the surface road is damaged in many sections affecting smooth flow of traffic. The municipal counsil states that budget for maintenance of the road is allocated and repair works will be carried out soon. Roads leading from the main road to the disposal site are gravel-paved or compacted, ensuring smooth transportation of refuse.

(5) Workshop

Arusha Depot (workshop) contains a warehouse for materials and tools, a repair shop and a heavy-duty machinery yard.

The depot is operated under supervision of the Engineering Department of the Municipal Council. the workshop employs 20 office workers for general affairs, labour management, warehouse keeping and maintenance, 5 skilled workers for repairing heavy-duty machinery and vehicles, as well as 6 workers for welding, smith and electrical work.

Additional experienced engineers and skilled workers for operation and maintenance of this type of workshop are required.

CHAPTER 3 CONTENTS OF PROJECT

3-1 Objective

To grasp the contents and background of the request and thereby make a necessary and optimal basic design for the purpose of executing this project in a reasonable and effective manner.

3-2 Study on Contents of Request

The contents of the request for this project proposed by the Government of Tanzania, when JICA's basic design survey team was stayed in Tanzania are stated in Table 3-1 as follows:

However, there is great gap between this and the previous requisition of the Government of Tanzania to the Government of Japan namely 1) 50 refuse collectors 2) 50 cesspit emptiers and 3) a set of spare parts.

Meanwhile, a neutral plan for seven (7) regional cities was studied, but in the result, it was decided that the grant aid with no-reimbursable funds should be executed focusing on 3 cities, Dar es Salaam, Moshi and Arusha which enable them to make a basic design and possess basic data for refuse and sewage.

Table 3-1

No.	Town	Number required Refuse collection truck	Number required Cesspit emptier
1	D'Salaam	50	50
2	Arusha	17	10
3	Tanga	20	16
4	Mwanza	15	9
5	Dodoma	15	9
6	Moeya	15	23
7	Iringa	8	4
8	Lindi	6	7
9	Mtwara	6	3
10	Musoma	5	3
11	Tabora	6	3
12	Sumbawanga	5	3
13	Singida	4	3
14	Mosi	15	7
15	Morogoro	9	6
16	Songea	5	3
17	Shinyanga	5	3
18	Bukoba	5	3
19	Kigoma	6	3
Total		217	164

CHAPTER 4 BASIC DESIGN

4-1 Design Policy

To select the equipment which can be tasily operated and maintained.

4-2 Study on Design Conditions

4-2-1 Roads

The surface of roads from the collections up to the final disposal site are mostly in good condition, with sufficient width.

4-2-2 Bridges

According to on-site inspection, it was found that the bridges satisfy the Japanese 1st-class bridge standard, T-20 load, and no weight restriction will be required for the vehicles.

4-3 Basic Design

4-3-1 Discharge rate

The discharge rate for refuse was set at 0.5 kg/monday, based on the answer to the questionnaire from Mr. Hiroshi Murakami, A.R.R. for JICA, and M.S. Chillo, City Health Officer, Dar es Salaam City Council (hereinafter referred to as "Answer"), which was asked by the survey team to the city counsil for the basic design study. In addition, the Answer stated that, in Dar es Salaam, 3-5 tons of refuse are produced daily from 49 small markets. Therefore, based on this data the mean value of 4 tons/day, was be set as the basic discharged unit for small markets.

Table - Basic Discharge Unit of Refuse

City name	Classification	Unit	Original unit
Dar es Salaam	For household	kg/man day	0.5
	Small market	t/day	4
Moshi	For household	kg/man day	0.5
Arusha	For household	kg/man day	0.5

The discharged amount of sewage varies with age, sexes, daily diet and season. Since the city counsil has not conducted an accurate measurement for amount of sewage, 1.2 litres (♯) per man and day, adopted in Japan was used as the basic discharge unit of sewage/

(♯) Source: "Sewage Guidebook Treatment",
Institute of Environmental Engineering

4-3-2 Amount of refuse and sewage discharge

The discharge amounts of refuse and sewage were calculated based on the basic discharge unit determined in Item 4-3-1.

Discharge Amount of Domestic Wastes (1985)

Item / Calculation formula / City name	Original unit (kg/man day)	Population served by refuse collection (persons)	Refuse amount (t/day)
	①	②	① x ② x 10^{-3}
Dar es Salaam	0.5	975,000	488
Moshi		120,000	60
Arusha		130,000	65
Total		1,225,000	614

DIscharge Amount of Small Market Refuse (1985)

Item / Calculation formula / City name	Original unit (t/day)	Number of small market	Refuse amount (t/day)
	①	②	① x ②
Dar es Salaam	4	49	196

Discharge Amount of Sewage (1985)

Item / Calculation formula / City name	Original unit (ℓ /man day)	Population served by refuse collection (persons)	Sewage amount (ℓ /day)
	①	②	① x ②
Dar es Salaam	1.2	682,500	819,000
Moshi		84,000	100,800
Arusha		91,000	109,200
Total		857,500	1,029,000

The total amount of refuse produced in Dar es Salaam in 1985 can be obtained as follows: 488 t/day (for domestic wastes) + 196 t/day (for refuse produced from small markets) = 684

Discharge Amount of Domestic Waste in Target Year (1990)

Item / Calculation formula / City name	Original unit (kg/man day)	Population served by refuse collection (persons)	Refuse amount (t/day)
	①	②	① x ② x 10^{-3}
Dar es Salaam	0.5	1,217,000	609
Moshi		170,000	85
Arusha		173,000	87
Total		1,560,000	771

Discharge Amount of Small Market Refuse in Target Year (1990)

Item / Calculation formula / City name	Original unit (t/day)	Number of small market	Refuse amount (t/day)
	①	②	① x ②
Dar es Salaam	4	49	196

Item / Calculation formula / City name	Original unit (t/man day)	Population served by refuse collection (persons)	Sewage amount (t/day)
	①	②	① x ②
Dar es Salaam	1.2	851,900	1,022,280
Moshi		119,000	142,800
Arusha		121,000	145,200
Total		1,092,000	1,310,280

The total amount of refuse produced in Dar es Salaam as of the target year, 1990, can be calculated as follows:.

609 t/day (for domestic refuse) + 196 t/day (for refuse produced from small markets) = 805 t/day

4-3-3 Quality of Refuse

According to the Answer given by the city counsil, refuse include:

(1) garbage,

(2) ash,

(3) charcoal,

(4) empty tins and broken bottles,

(5) paper,

(6) industrial wastes, and

(7) remains of old building materials.

Item (1) ∿ (3) account for approximately 75% of the total amount of refuse, as reported in the Answer. Garbage accounts for the largest percentage among ordinary wastes, followed by paper. This is similar to that in many other cities. Significant characteristics are that a large amount of ash and charcoal is contained in the refuse.

4-3-4 Vehicle allocation plan in Dar es Salaam

Solid wastes will be collected and carried by refuse collection trucks to the final disposal site. Sewage will be collected from pits in each house by cesspit emptiers and carried to the sewage treatment plant.

(1) Establishing of design criteria

Design criteria ucre established as follows:

Item		Rationale	Setting conditions
Population growth rate		According to the statements in the master plan *	6%
Target year		As the middle year from 1987 to 1994	1990 year
Service hours		8:00 AM - 2:00 PM	6 hours
No. of trips		Judged by service hours	Twice
Refuse	Loading amount	Due to change in refuse quality and restrictions of service hours	80%
	Delivery distance		3 km
	Delivery speed		25 km/h
Sewage	Coverage of sewage systems	Based on survey of locale	30% of population served by refuse collection
	Per-house population	(population in municipal area) / (no.of homes in rural area) + (no.of homes in urban area) = 1,300,000 / (19,129 + 188,405) = 6.26	6 peoples
	Frequency of collection		Once/two months
	Collection hours	Suction time - 3 minutes Pre- and post-work preparation time - 3 minutes Transfer time - 2 minutes Total 8 minutes/house	8 minutes/house
	Delivery distance to the final disposal site		3 km
	Delivery speed		25 km/h
	Delivery time	3 km ÷ 25 km/h = 7.2 minutes	7 minutes
	Discharge time		10 minutes
	Capacity of emptier		6,000 ℓ
	Sewage amount per house (1 month)	1.2 ℓ/man day x 6 persons x 30 days	216 ℓ/house per month
	Sewage amount per house (2 months)	216 ℓ/house x 2 months	432 ℓ/house per 2-month interval
	Collectable time for a trip	(Service hours=6 hours÷2) - (Delivery hour x 2=7 min.x 2) - Sewage discharge time=10 min.) = 156 minutes	2 hours and 36 minutes
	Collectable houses for one trip	(Collectable time=156 min.)÷(Time required for raw sewage collection per houses=8 min.) = 19 houses	19 houses

*Dar es Salaam Master Plan Marohall Macklin Mongaham Limited

(2) Refuse

Number of Trucks Required for Collecting Domestic Wastes

Calculation formula	① Population served by collection	② Refuse amount (t/day) Value in column ① ×0.5 kg/man day ×10⁻³	③ Number of trucks needed Value in column ② ÷ (8 tons×0.6×2 trips)
At present (1985)	975,000	488	39
In target year (1990)	1,217,000	609	48

Number of Trucks Required for Collecting Small Markets Wastes

Calculation formula	① Refuse amount (t/day)	② Number of trucks needed Value in column ① ÷ (8 tons × 0.8 × 2 trips)
At present (1985)	196	16
In target year (1990)	196	16

(3) Sewage

Calculation formula	① Population served by collection	② Number of houses collected per month Value in column ① ÷ per-house population ÷ 2	③ Number of houses collected per day ② ÷ 25	④ Number of trucks needed ③ ÷ (19 × 2)
At present (1985)	682,500	56,875	2,275	60
In target year (1990)	851,900	70,992	2,840	75

4-3-5 Vehicle allocation plan in Moshi

Refuse will be collected and carried by refuse collectors to the final disposal site. Sewage will be collected from pits in each house by cesspit emptiers and carried to the sewage treatment plan.

(1) Establishing of design criteria

Design criteria were established as follows:

	Item	Rationale	Setting conditions
	Population growth rate	Released by Town council	5.9%
	Target year	As the middle year from 1987 to 1994	1990 year
	Service hours	8:00 AM - 2:00 PM	6 hours
	No. of trips	Judged by service hours	Twice
Refuse	Loading amount	Due to change in refuse quality and restrictions of service hours	80%
Refuse	Delivery distance		3 km
Refuse	Delivery speed		25 km/h
Sewage	Coverage of sewage systems	Based on survey of locale	30% of population served by refuse collection
Sewage	Per-house population	(Population / no. of houses) 130,000 ÷ 18,877 = 6.9	7 peoples
Sewage	Frequency of collection		Once/two months
Sewage	Collection hours	Suction time - 3 minutes Pre- and post-work preparation time - 3 minutes Transfer time - 2 minutes Total 8 minutes/house	8 minutes/house
Sewage	Delivery distance to the final disposal site		3 km
Sewage	Delivery speed		25 km/h
Sewage	Delivery time	3 km ÷ 25 km/h = 7.2 minutes	7 minutes
Sewage	Discharge time		10 minutes
Sewage	Capacity of emptier		6,000 ℓ
Sewage	Sewage amount per house (1 month)	1.2 ℓ/man day x 7 persons x 30 days	252 ℓ/house per month
Sewage	Sewage amount per house (2 months)	126 ℓ/house x 2 months	504 ℓ/house per 2-month interval
Sewage	Collectable time for a trip	(Service hours=6 hours÷2) - (Delivery hour x 2=7 min.x 2) - Sewage discharge time=10 min.) = 156 minutes	2 hours and 36 minutes
Sewage	Collectable houses for one trip	(Collectable time=156 min.)÷(Time required for raw sewage collection per houses=8 min.) = 19 houses	19 houses

(2) Refuse

Number of Trucks Required for Collecting Domestic Wastes

	①	②	③
	Population served by collection	Refuse amount (t/day)	Number of trucks needed
Calculation formula		Value in column ① ×0.5 kg/man day ×10⁻³	Value in column ②÷ (8 tons×0.6×2 trips)
At present (1985)	120,000	60	5
In target year (1990)	170,000	75	6

(2) Sewage

Calculation formula	①	②	③	④
	Population served by collection	Number of houses collected per month	Number of houses collected per day	Number of trucks needed
		Value in column ① ÷ per-house population ÷ 2	② ÷ 25	③ ÷ (19 × 2)
At present (1985)	84,000	6,000	240	7
In target year (1990)	119,000	8,000	340	9

4-3-6 Vehicle allocation plan in Arusha

Refuse will be collected and carried by refuse collectors to the final disposal site. Sewage will be collected from pits in each house by cesspit emptiers which and carried to the sewage treatment plant.

(1) Establishing of design criteria

Design Criteria were established as follows:

Item		Rationale	Setting conditions
Population growth rate			5.9%
Target year		Based on service life of trucks (7 years later)	In 1990
Service hours		8:00 AM - 2:00 PM	6 hours
No. of trips		Judged by service hours	Twice
Refuse	Loading amount	Due to change in refuse quality and restrictions of service hours	80%
	Delivery distance		3 km
	Delivery speed		25 km/h
Sewage	Coverage of sewage systems	Based on survey of locale	70% of population served by refuse collection
	Per-house population	(Population) / (No. of houses) 130,000 ÷ 18,877 = 6.9	7
	Frequency of collection		Once/two months
	Collection hours	Suction time - 3 minutes Pre- and post-work preparation time - 3 minutes Transfer time - 2 minutes Total 8 minutes	8 minutes/house
	Delivery distance to the final disposal site		3 km
	Delivery speed		25 km/h
	Delivery time	3 km ÷ 25 km/h = 7.2 minutes	7 minutes
	Discharge time		10 minutes
	Capacity of emptier		6,000 ℓ
	Sewage amount per house (1 month)	1.2 ℓ/man day x 7 persons x 30 days	252 ℓ/house per month
	Sewage amount per house (2 months)	126 ℓ/house x 2 months	504 ℓ/house per 2-month interval
	Collectable time for a trip	(Service hours-5 hours÷2) - (Delivery hour x 2=7 min.x 2) - Sewage discharge time=10 min.) = 156 minutes	2 hours and 36 minutes
	Collectable houses for one trip	(Collectable time=156 min.) ÷(Time required for raw sewage collection per houses=8 min.) = 19 houses	19 houses

(2) Refuse

Number of Trucks Required for Collecting Domestic Wastes

Calculation formula	① Population served by collection	② Refuse amount (t/day)	③ Number of trucks needed
		Value in column ① ×0.5 kg/man day ×10^{-3}	Value in column ② ÷ (8 tons×0.6×2 trips)
At present (1985)	130,000	65	6
In target year (1990)	173,000	87	7

(3) Sewage

Calculation formula	① Population served by collection	② Number of houses collected per month	③ Number of houses collected per day	④ Number of trucks needed
		Value in column ① ÷ per-house population ÷ 2	② ÷ 25	③ ÷ (19 × 2)
At present (1985)	91,000	6,500	260	7
In target year (1990)	121,100	8,605	346	10

4-3-7 Planned allocation of vehicle (for the planned target year, 1990)

The required number of trucks for each city is calculated in Items 4-3-4 - 4-3-6.

(1) Refuse collectors

In consideration of local characteristics of Refuse, including weight loss due to evaporation of moisture, improvement of transport capacity, due to improved maintenance and combination there of, roughly 70% of the required number of trucks in considered as a suffice ient allocation.

(2) Cesspit emptiers

In consideration of local characteristics of sewage, including evaporation rate, seepage into the ground, and increased transport capacity and self-treatment, as well as improvement of sewage treatment facilities in the three cities, approximately 40% of the required number of cesspit emptiers, which is lower than that for refuse, is considered as a sufficient allocation.

City name	Refuse amount (t/day)	Supplied No. of frucks	Necessary No. of frucks	Rate of which meet demands
Dar es Salaam	805	44	64	70%
Moshi	85	4	6	"
Arusha	87	5	7	"
Total	977	53	77	"

City name	Sewage amount (t/day)	Supplied No. of frucks	Necessary No. of frucks	Rate of which meet demands
Dar es Salaam	1,022,280	29	75	40%
Moshi	142,800	4	9	"
Arusha	145,200	4	10	"
Total	1,310,280	37	94	"

The following figures are calculated out of 1985 when the survey was conducted. Based on figure stated in Items 4-3-4 - 4-3-6, the required number of vehicles for each city is calculated. Ratio of the number of vehicles to be supplied under the project to the required number of refuse collectors in 1985 is approximately 80%.

City name	Refuse amount (t/day)	Supplied No. of frucks	Necessary No. of frucks	Rate of which meet demands
Dar es Salaam	684 [85]	44	55	80%
Moshi	60 [7]	4	5	"
Arusha	65 [8]	5	6	"
Total	810[100]	53	66	"

Likewise, ratio of the number of vehicles to be supplied under the project to the required number of cesspit emptiers in 1985 is approximately 50%.

City name	Sewage amount (t/day)	Supplied No. of trucks	Necessary No. of trucks	Rate of which meet demands
Dar es Salaam	319,000 (80)	29	60	50%
Moshi	100,800 (10)	4	7	"
Arusha	109,200 (10)	4	7	"
Total	1,029,000(100)	37	74	"

4-3-8 Outline of project

(1) Vehicles and materials to be supplied

Quantity of Machines and Materials
to be Provided and their Allocation Plan

	Refuse collection truck (Vehicle)	Cesspit emptier (Vehicle)	Spare parts
Dar es Salaam	44	29	1 set
Moshi	4	4	"
Arusha	5	4	"
Total	53	37	

(2) Operation system of supplied vehicles and materials

In order to operate vehicles and equipment to be supplied in the project, the following number of workers will be required:

	Vehicle operator	Assistant	Labour	Total
Refuse collection truck (Vehicle)	1	1	2	4
Cesspit emptier (Vehicle)	1	-	2	3

4-3-9 Equipment specifications

As a result of study on capacity, capability, etc., based on design policy and criteria, specifications for vehicles and materials were established as follows.

(1) Refuse collection trunk

Type: Rear dump truck specially designed for refuse loading

Maximum loading capacity: No less than 8,000 kg,
Approximately 16 m^3

Drive type: 4 x 2

Engine: Diesel engine with maximum output of 225 Ps or more

(2) Cesspit emptier

Type: Cesspit emptier

Maximum loading capacity: No less than 6,00 kg

Tank containing capacity: No less than 6,00 litters

Drive type: 4 x 2

Engine: Diesel engine with the maximum output of 160 Ps or more

4-3-10 Others

Spare parts for vehicles and portable equipment and tools required at the workshops.

CHAPTER 5 PROJECT IMPLEMENTATION PLAN

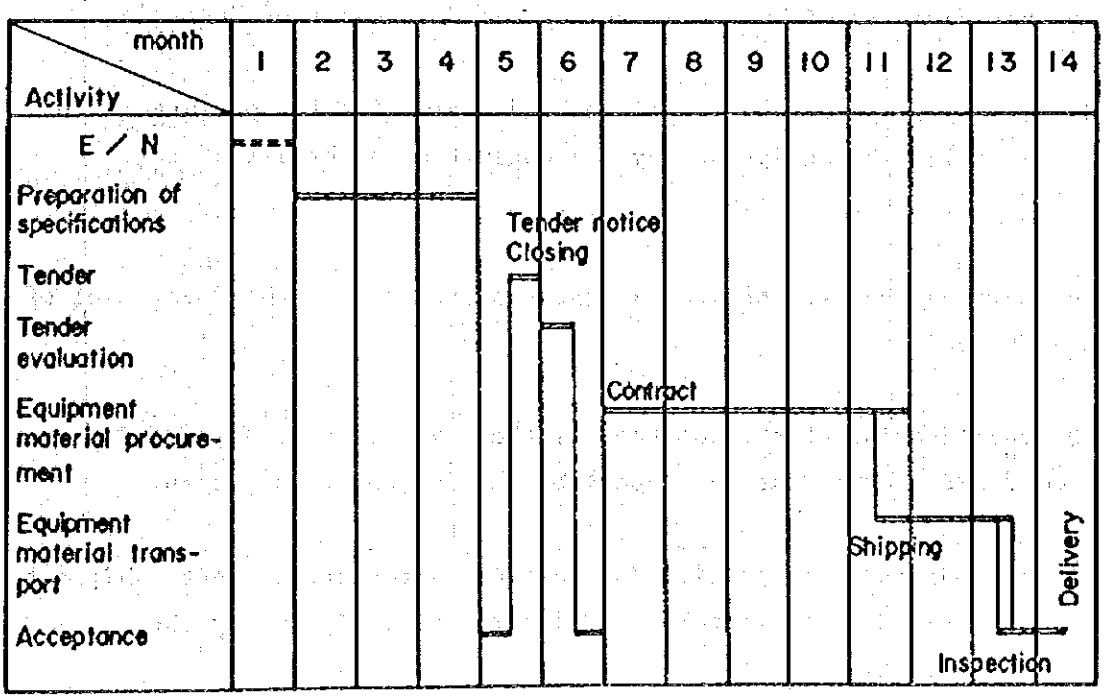
5-1 Project Implementation Body

The project will be implened by the City Councils of each city, and the Prime Minister's Office.

5-2 Project Implementation Schedule

The period required for implementation of the project is approximately 13.5 months after exchange of official agreement (E/N), including 5 months be for procurement of vehicles and equipment.

Table 5-1 Preliminary Implementation Schedule



5-3 Consulting Services

The project will be implemented in accordance with the schedule shown in Table 5-1, starting after the signing of official agreement (E/N). Consulting services will be Japan's Grand Aid system as follows:

(1) Consultant contract with the Government of Tanzania

- o verification of the contract by the Government of Japan.
- o issuance of A/P (Authorization to pay) by the Government of Tanzania to a Japanese bank dealing with foreign currency exchange.

(2) Preparation of special specifications and tender documents by the consultant

- o verification of the documents by the Government of Tanzania

(3) Tender preparation, procedure, and evaluation for procurement of vehicles and equipment, by the consultant on behalf of the Government of Tanzania

- o service contract between Japanese suppliers and the Government of Tanzania
- o verification of the contract by the Government of Japan and issuance of A/P (authorization to pay) by the Government of Japan.

(4) Attendance at inspection and delivery after procurement, shipment and unloading of vehicles and instrument equipment by the consultant.

NOTE:

denotes services to be provided by the consultant.

5-4 Operation and Maintenance

5-4-1 Manpower plan

The cleaning services will be provided by each City or Town Council, and the Health Department will directly operate the project. The manpower plan is shown below.

Type of work \ City	Dar es Salaam	Moshi	Arusha
Sanitation department			
Chief sanitation engineer	1	1	1
Controller	1	1	1
Operation officer	3	2	2
Supervisor	3	3	3
Person in charge of collection and transportation			
Vehicle operator	73	8	9
Assistant	44	4	5
Labour	46	16	16
Workshop			
Engineer	2	1	1
Mechanic	16	10	10
Welder Smith Electrician			
Store keeper	5	5	5
Labour	20	20	20

5-4-2 Direct Operating Costs

The cost item includes the depreciation cost for vehicles and equipment, which accounts for major portion of the total cost, and operation cost (the labor cost for operation is stated in the following item).

(1) Estimation basis

1 Cost for fuel and oil

The unit price of light oil is estimated in Tanzanian schilling per 1 litre as of October 1985, while the cost for oil is calculated as 10% of the fuel cost.

2 Cost for maintenance and repair work

Since parts are supplied and the labor cost is included in the general labor cost item, the cost for maintenance and repair work is calculated at 10% of the actual repair work cost.

3 Administration

The control cost, mainly insurance expenses, is calculated at 5% of the basic price (the remaining undepreciated value).

(2) Results

Estimated direct equipment and material costs are summarized in Table 5-2. The annual costs will be approx. 1.6 million Ts for Dar es Salaam, approx. 200,000 Ts for Arusha and approx. 200,00 Ts for Moshi.

Summary of Annual Equipment and Material (unit: Ts)

Dar es Salaam

	Fuel and grease	Cost for maintenance and repairs	Control cost	Subtotal
Refuse collection truck	657,000	65,000	217,000	939,000
Cesspit emptier	471,000	47,000	141,000	659,000
Total	1,128,000	112,000	358,000	1,598,000

Arusha

	Fuel and grease	Cost for maintenance and repairs	Control cost	Subtotal
Refuse collection truck	85,000	8,000	28,000	121,000
Cesspit emptier	71,000	7,000	22,000	100,000
Total	156,000	15,000	50,000	221,000

Moshi

	Fuel and grease	Cost for maintenance and repairs	Control cost	Subtotal
Refuse collection truck	71,000	7,000	23,000	101,000
Cesspit emptier	71,000	7,000	22,000	100,000
Total	142,000	14,000	45,000	201,000

5-4-3 Labor cost disposal

(1) Estimation base

1 Unit labor cost

Labor cost is comprised of the following items: (basic salary) + (allowance for livelihood) + (overtime allowance) + (allowance for sanitation) Items other than basic salary are indicated as a percentage of the basic daily salary (100% for allowance for livelihood, 20% for overtime work charges and 10% for allowance for sanitation). In other works, per-day labor cost is 2.3 times that of daily salary. Based on this calculation, the unit labor cost was established below.

Table 5-3 Unit labour Cost

	Basic salary	Unit of labour cost
Operator	24 TS	55 TS
Assistant	22 TS	51 TS
Labour	17 TS	39 TS

Currency exchange rate: 1 US$ = 202 yen
1 US$ = 16.44 Ts

2 Manpower requirements

Manpower requirements were determined for each type of work and city follows: (Refer to 4-3-8, P.47)

Dar es Salaam

	Operator	Assistant	Labour	Subtotal
Refuse collection truck	44	44	88	176
Cesspit emptier	29	-	58	87
Total	73	44	146	263

Arusha

	Operator	Assistant	Labour	Subtotal
Refuse collection truck	5	5	10	20
Cesspit emptier	4	-	8	12
Total	9	5	18	32

Moshi

	Operator	Assistant	Labour	Subtotal
Refuse collection truck	4	4	8	16
Cesspit emptier	4	-	8	12
Total	8	4	16	28

(2) Results

Based on the above conditions, the estimated labor cost for operation is summarized in Table 5-5. The annual labor cost necessary for operation of vehicles and instruments for this project is approx. 4.3 million Ts for Dar es Salaam, approx. 530,000 million Ts for Arusha and approx. 460,000 million Ts for Moshi.

Table 5-5

Dar es Salaam

	Annual labour cost (T.S)
Refuse collection truck	2,955,000
Cesspit emptier	1,407,000
Total	4,362,000

Arusha

	Annual labour cost (T.S)
Refuse collection truck	268,000
Cesspit emptier	194,000
Total	462,000

Moshi

	Annual labour cost (T.S)
Refuse collection truck	268,000
Cesspit emptier	194,000
Total	462,000

5-4-4 Per-unit disposal cost

The annual operating cost required for vehicles and equipment is summarized in Table 5-6. (totaling figures in Tables 5-2 and 5-5)

Table 5-6

	Total cost (T.S.)	
	Refuse collection truck	Cesspit emptier
Dar es Salaam	3,894,000	2,066,000
Arusha	456,000	294,000
Moshi	369,000	294,000

Based on the above operation cost the treatment cost per ton of refuse and sewage for each district was calculated. The amount of refuse for each type of work planned in CHAPTER 4, and summarized in Table. The amount of sewage was expressed as the annual amount of sewage carried by cesspit emptiers.

Table 5-7

	Dar es Salaam	Arusha	Moshi
Refuse collection truck (vehicle) (t/day)	805	87	85
Cesspit emptier (vehicle) (ℓ/day)	1,022,280	145,200	142,800

From on the above table, the collection cost of refuse and sewage is was destimated as shown in Table 5-8.

Table 5-8

	Total cost (T.S.)	
	Refuse collection truck (per ton)	Cesspit emptier (per kilolitters)
Dar es Salaam	13	6
Arusha	12	6
Moshi	12	6

CHAPTER 6 PROJECT EVALUATION

6-1 Validity of the Project

Since 1980, Government of Tanzania has been forced to substantially reduce imports, due to the decrease in output of the primary-industry, chiefly agricultural products, and due to the increase of oil price throughout the world. The cleansing services in Tanzania has been established and prepared for necessary equipment at the time when the national economic condition was well and it can be said that the cleansing services in Tanzania have the potential capacities on the operation and maintenance of the collection vehicles including manpower required such as mechanics. However, the above-mentioned economic situation causes severe lack of necessary vehicles and their spare parts for maintaining the sound public health conditions.

Therefore, it is conceivable that this Japan's Grant Aid Program will bring about possitive effects on the promotion of systematic improvement for cleaning services; namely, strengthening of department of each city council in charge of the cleansing service, favorable turnout of environmental health conditions due to operation of collection vehicles, streamlining of repairing works for disable vehicles, implementation of training program for engineers and mechanic as well as the cooperation of citizens in improvement of public health as a result of better cleaning service.

It has direct effects on the life of citizens whether the cleansing service is stagnant or activated. Therefore, the realization of the Project by this grant aid program is expected to provide an opportunity for creating favorable cycle, using the revenues of collecting the cleansing service charge and improvement of establishing sound wastes management.

6-2 Feasibility on Effective Use of Vehicles and Materials

All vehicles to be supplied to Tanzania through this grant aid program have the same function as that of vehicles presently used in cities, and thus can be operated without any special training. For maintenance of the vehicles, since portable repair and adjustment tools will be attached as well as spare parts for the vehicles, the effective utilization of the vehicles can be expected.

6-3 Adequacy of Manpower Plan

Each city council, which is the project executing body, will supplement manpower for the maintenance and repair of the vehicles to be granted according to the training plan in addition to the existing staffers. In this manpower plan, therefore, direct operation stuffers such as drivers, assistants and workers for the vehicles are calculated. For this reason, this manpower plan is considered to be proper for this grant aid project.

6-4 Pertinency of Operation and Maintenance Plan

For the operation and maintenance plan fuel and lubricants maintenance and repair and operation cost for the vehicles to be provided by this project are estimated in addition to the present operation and maintenance structure of each City Council. This operation and maintenance plan is considered to be adequate.

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7-1 Conclusion

It is considered that the basic design study for this Grand Aid Program will greatly contribute to the promotion of improvement of refuse management in the 3 cities where this study was actually conducted, as well as to that of other cities which are under the same conditions as these 3 cities in terms of organization, operation and maintenance of refuse management. It is desirable to continuously promote the improvement of refuse management, taking into account the annual increase in population. The establishment of financial foundation is essential for proper preparation of vehicles, personnel training and highly-efficient operation of the cleansing service. It is considered that essential elements in this regard are stated in this report through the basic design study study.

It can be said that the refuse management frame in Tanzania has been already established and has experience and achievements in the field of operation and maintenance in its own way. Therefore, this basic design study is expected to contribute to improve the present refuse management.

If this project steps in implementation stage, the improved cleansing services can obtain the cooperation of citizens. As a result, sound circulation such as the increase of the government revenue and improvement of cleansing services is expected. Moreover, a balanced cleansing service will contribute not only to improve refuse management but also to better public health conditions.

7-2 Recommendations

Based on the results of this basic design study on public health in the United Republic of Tanzania, the recommendations are stated as follows:

(1) Recommendation on collection charge for refuse

In many of advanced countries their collection charge systems for refuse are presently based on a beneficiary-pay principle, and per-capita cost has been increasing year by year. In order to promote improvement in refuse collection service, it is essential to establish the financial basis. Therefore, it is necessary to introduce this principle in Tanzania. Specifically, the charge should be increased according to the hike in prices.

(2) Recommendation concerning recruit and training of personnel

It is prerequisite to assign well-experienced and efficient personnel for highly-efficient operation of the cleansing service. In this regard regular personnel training should be provided in school and government organizations.

(3) Recommendation concerning storage of spare parts

Since a large amount of spare parts are supplied by this project at once, it is important to establish a proper control system of these parts in order to make sure of efficient and continuous operation of vehicles and materials to be provided. In this regard a maintenance system, including spare parts control, should be established.

(4) Other programs to be performed by Tanzanian side.

a) Improvement and expansion of warehouse for spare parts

b) Public education on environmental health

c) Successive performance of scientific study and analysis of refuse composition.

I. MEMBER LIST OF THE STUDY TEAM

Mr. Michio Sakamoto: Team Leader
Technical Superviser, Sanitation Bureau
Kyoto City Government

Mr. Takashi Sasaki: Planning/Supervision
Senior Advisor
Mechanical & Industrial Engineer
JICA

Mr. Hirokazu Itoh: Waste Collection and Transportation Plan
Kokusai Kogyo Co., Ltd.

Mr. Yukiomi Nakagawa: Waste Disposal Plan
Kokusai Kogyo Co., Ltd.

Mr. Junichi Aoki: Equipment Supply Plan
Kokusai Kogyo Co., Ltd.

II. Study Schedule

Schedule No.	Date	Day	Description	
1	Oct. 7	Mon.	Departure from Narita	
2	Oct. 8	Tue.	Arrival at Amsterdam	
	Oct. 9	Wed.	Departure from Amsterdam	
	Oct. 10	Thu.	Arrival at Dar es Salaam	
5	Oct. 11	Fri.	Courtesy visit at the Japan Embassy	
			Courtesy visit at the Ministry of FInance	
			Courtesy visit at the Prime Minister's Office	
6	Oct. 12	Sat.	Courtesy visit at the CITY COUNCIL	
			Field Survey	
7	Oct. 13	Sun.	Departure from D.S.M. Airport	Discussion with the Officials of the Prime Minister's Office and the CITY COUNCIL
			Arrival at MOSHI	
8	Oct. 14	Mon.	Courtesy visit on the TOWN DIRECTOR	
			Courtesy visit on RC*, RDD*, RPLO*	Field survey
			Field survey and discussion with the officials concerned	
			Arrival at ARUSHA	

*RC Mr. Paul Kimiti, Regional Commissioner

*RDD Mr. S. K. Masinda, Regional Development Director

*RPLO Mr. M. A. Suya, Regional Planning Officer

II. Study Schedule (Cont'd)

Schedule No.	Date	Day	Description
9	Oct. 15	Tue.	Courtesy visit on Municipal Director and RC, RDD, RPLO Field survey and discussion with the officials concerned Departure from ARUSHA by DIA Arrival at D.S.M.
10	Oct. 16	Wed.	Discussion with the officials of the Prime Minister's Office and others concerned.
11	Oct. 17	Thu.	The same
12	Oct. 18	Fri.	Sighing the "Minutes" at the Prime Minister's Office visit to the JICA office and the Japan Embassy to report on.
13	Oct. 19	Sat.	Data collection
14	Oct. 20	Sun.	Data collection
15	Oct. 21	Mon.	Departure from Dar es Salaam

MINUTES OF DISCUSSION
ON
PUBLIC HEALTH PROJECT
IN
THE UNITED REPUBLIC OF TANZANIA

In reponse to the request made by the Government of the United Republic of Tanzania for a Grant Aid of the Public Health Project (hereinafter referred to as "The Project"), the Government of Japan has despatched, through the Japan International Cooperation Agency (JICA), a survey team headed by Mr. Michio Sakamoto, Technical Supervisor of Sanitation Bureau, Kyoto City Government (hereinafter referred to as "The Team") to conduct the basic design study on the Project for 13 days from October 9th to 21st October, 1985.

The Team has carried out a field survey, had a series of discussions and exchanged views with the Tanzanian authorities concerned with the Project.

As a result of the survey and discussions, the Team and the Tanzanian authorities have agreed to recommend to their respective Governments that the results of the discussions attached herewith should be examined towards the realization of the Project.

Dar es Salaam, October 18, 1985.

18/10/1985.

M. Sakamoto

Mr. Michio SAKAMOTO
Team Leader
Japanese Survey Team

AG. PRINCIPAL SECRETARY
PRIME MINISTER'S OFF
DAR ES SALAAM.

ATTACHMENT

1. The objective of the Project is to provide vehicles for implementation of solid waste disposal and sewage disposal services so as to improve the public health conditions in urban areas in Tanzania.

2. Tanzanian authorities concerned will have the total responsibility to implement the Project on Tanzanian side.

3. The Team will convey the desire of the Government of Tanzania to the Government of Japan that the latter will take necessary measures to cooperate in implementing the Project within the scope of Japan's Economic Cooperation Programme in Grant form.

4. The Tanzanian authorities concerned have confirmed that the Government of Tanzania will take necessary measures as listed in Annex II on condition that the Grant Aid by the Government of Japan is extended to the Project.

5. The Tanzanian authorities concerned have understood and confirmed Japan's Grant Aid System explained by the Team.

6. The objective urban areas of the Project are as follows: Dar es Salaam, Arusha, Tanga, Mwanza, Dodoma, Moshi and Mbeya.

7. Vehicles including spare parts to be provided will be finalized by the Team based on the request of the Tanzanian side and the result of the study.

ANNEX I

Vehicles requested by the Government of Tanzania whose cost will be borne by the Government of Japan are :

57 refuse collection trucks with hydraulic tipping device with 7 to 10 tons loading capacity and 43 cesspit emptiers with 6,000 litre or larger container capacity.

These vehicles are to be distributed to the city/town councils of the urban areas according to the following distribution plan :

CITY/TOWN	REFUSE COLLECTION TRUCK	CESSPIT EMPTIER
Dar es Salaam	25 units	16 units
Arusha	6	5
Tanga	5	4
Mwanza	5	5
Dodoma	5	5
Moshi	6	4
Mbeya	5	4

ANNEX II

Following measureas are to be undertaken by the Government of Tanzania :

1. To provide data and information necessary for basic design .

2. To ensure prompt unloading, tax exemption and customs clearance at the port of disembarkation in Tanzania and prompt internal transportation of the imported vehicles and materials for the project.

3. To exempt Japanese Nationals concerned from custom duties, internal taxes and other fiscal levies which may be imposed in Tanzania with respect to the supply of the products and services under the verified contracts.

4. To provide and accord necessary permission, licences and other authorisation required for the Project.

5. To bear all the expenses other than those to be borne by the Grant, necessary for the supply of the vehicles.

6. To maintain and use properly and effectively the vehicles for the Project.

IV List of Discussion Attendants

(1) Arusha

Ally I. Lesian	Mayor, Arusha Municipal Council
Francis J. Omari	Deputy Municipal Director
Jumanne Mtemvu	Acting Regional Devleopment Director
S. Z. Myinga	Municipal Treasurer
R. P. Msika	Municipal Engineer
L.L.S. Mollel	Acting Municipal Agricultural Officer
M. A. Suya	Acting Municipal Planner
L. N. Kirway	Municipal Trade Officer
I.R.C. Wiboga	Municipal Land Development Officer
A.F.C. Ndimbo	Municipal Economist
Dr. J.E.K. Mngava	Municipal Officer of Health
T. Mhandi	Minicipal Health Officer
U.M. Jonathan (MRS)	Manpower Management Officer

(2) Mosi

A. S. Malya	Chairman, Mosi Town Council
A. N. Tasha	Town Director, Mosi Town Council
Paul Kimiti	Regional Commissioner, Kilimanjaro
S. K. Masinde	Regional Development Director, Kilimanjaro
Dr. J. D. Nyalusi	Chairman of The Health and Social Welfare Committee

G. S. Mrutu	Town Health Officer
K.C.J. Kuyonza	Town Engineer
O. S. Kivuyo	Town Treasurer
M. S. Mkumba	Public Health Engineer
G.L.S. Benne	Town Planner
A. Rushohora	Inspector Cleasing
Vicent Minja	Mechanical Inspector

(3) Prime Minister's Office

J. N. Mallya	Senior Finance Management Officer
P.G.L. Affa	Planning Officer
B. G. Moses	Director, Manpower Dev. and Administration
Emil F. B. Sengati	Commissioner for Urban Authorities Chief Advisor
P. O. Chikira	Director of Disaster, Emergency and Parliamentary Affairs
Lucy Paul	Legal Officer
B. T. Achimpota	Local Government Finance Advisor

(4) Ministry of Finance

S.K.A. Mturi	Asst. Commissioner, External Finance
P. J. Mbena	Finance Management Officer, External Finance

(5) City Council - P.H.D.

M. S. Cuilla	City Health Officer
G. R. Limbumba	Deputy City Director
Dr. Moshi E.E.	Medical Officer of Health