THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY IN THE UNITED REPUBLIC OF TANZANIA

FINAL REPORT
VOLUME 2 : MAIN REPORT

JULY 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of the United Republic of Tanzania, the Government of Japan decided to conduct a study on the rehabilitation of Dar es Salaam water supply and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team headed by Mr. Heiichiro Makino, Tokyo Engineering Consultants Co. Ltd., 3 times between November 1989 and March 1991.

The team held discussions with the officials concerned of the Government of Tanzania, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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

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

July, 1991

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

THE STUDY
ON
REHABILITATION OF DAR ES SALAAM WATER SUPPLY
IN THE UNITED REPUBLIC OF TANZANIA

July, 1991

Mr.Kensuke YANAGIYA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

It is our pleasure to submit herewith the Final Report of "THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY IN THE UNITED REPUBLIC OF TANZANIA".

This report has been prepared by the Study Team in accordance with the contract signed on 9 November 1989, 20 June 1990 and 31 May 1991 between the Japan International Cooperation Agency and the Joint Venture of Tokyo Engineering Consultants and Pacific Consultants International.

The report consists of Summary, Main Report, Supporting Report and Data Book. The Summary provides the summary of the Study and recommendations. The Main Report describes the results of the study and analysis. The Supporting Report contains the details of various studies. In addition, a Data Book has been prepared and submitted herewith.

Finally, we take this opportunity to express our sincere gratitude to Japan International Cooperation Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Health and Welfare, and Embassy of Japan in Tanzania, and also to officials concerned of the Government of the United Republic of Tanzania which gave useful advice to the Study Team during the study period.

Respectfully yours,

H. Makino

Heiichiro Makino
Team Leader

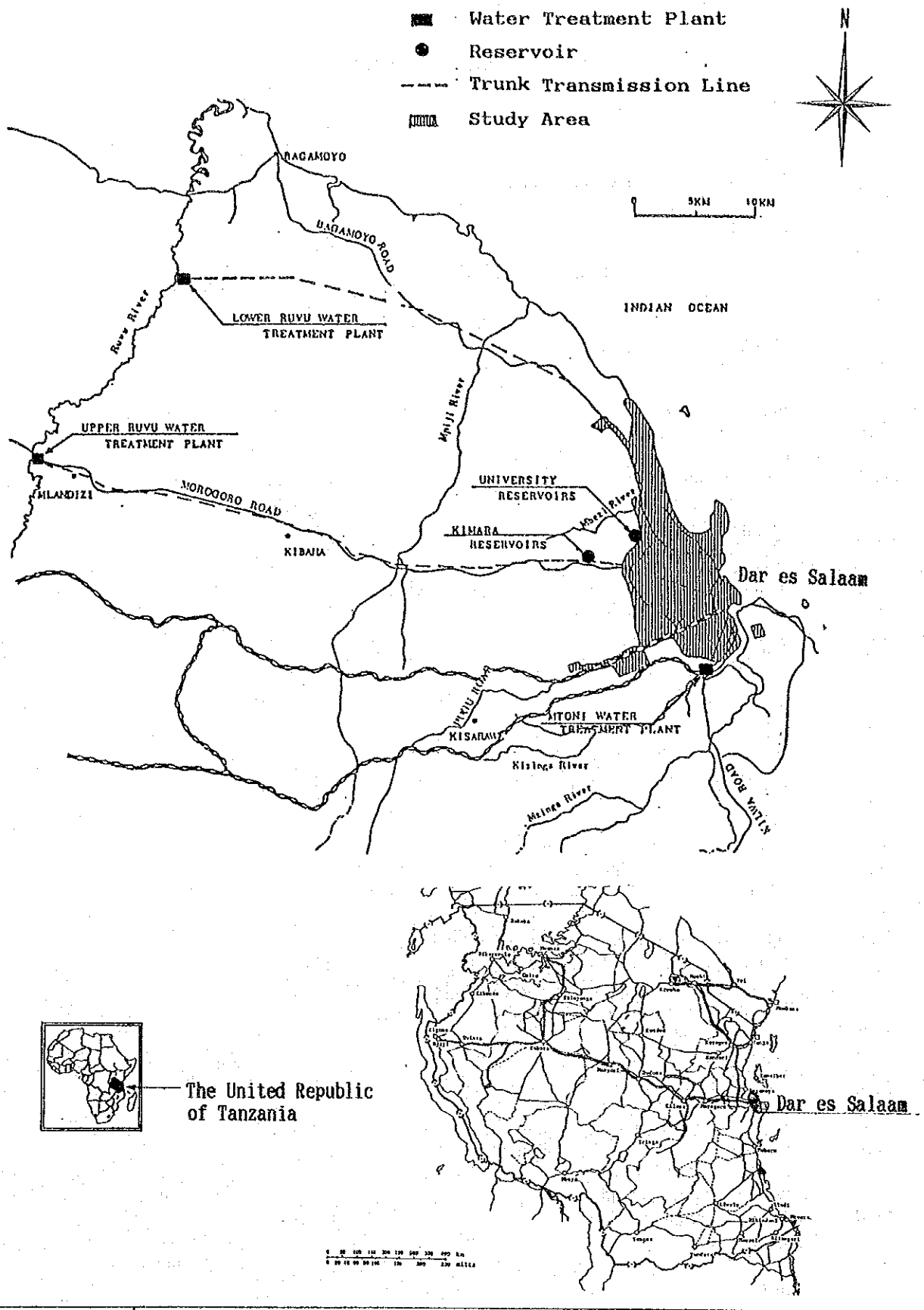

FIG. 1	LOCATION MAP OF THE PROJECT

THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY

ABBREVIATIONS

AC	advisory committee
AOM	NUWA accounts operating manual
"	inch = 25.4 mm
B/C	benefit cost ratio
BHN	basic human needs
BM	Dar es Salaam branch manager of NUWA
BS	British standard
CCM	Chama Cha Mapinduzi (revolutionary party)
CIP	cast iron pipe
cu.m	cubic meters
d	day
DI	ductile iron pipe
DIP	ductile iron pipe
DF	director of finance
DG	director general
DE	distribution engineer of NUWA
DPS	data processing section
DSM	Dar es Salaam
DSMB	Dar es Salaam branch of NUWA
DTC	Technical Colleges in Dar es Salaam
F.C.	foreign currency portion
EL	elevation
FIRR	financial internal rate of return
F.R.P.	fibered-glass reinforced pipe
ft	foot = 30.5 cm
FTC	full technician certificate
gallon	British gallon = 4.546 liters
GDP	gross domestic product
GP	galvanized steel pipe
gpm	gallons per minute
ha	hectare = 10,000 m^2
HP or hp	horse power = 0.746 kw
HQ	headquarters
hr	hour
IDA	International Development Association
IDM	Institute of Development Management
IDWSS	International Drinking Water Supply and Sanitation Decade
IMF	International Monetary Fund
IRR	internal rate of return
ISO	International Standards Organization
JICA	Japan International Cooperation Agency
JTU	Jackson Turbidity Unit
km^2	square kilometer
KW or kw	kilowatt
L.C.	local currency portion
lcd	liter per capita per day
lpcd	liter per capita per day
l.s.	lump sum
m	meter
min	minute
m^2	square meters

m^3	cubic meters
ME	mechanical engineer of NUWA
mg/l	milligrams per liter
mgd	million gallons per day = 4,546 m^3 per day
MLD	million liters per day
mm	milimeter
MNF	minimum night flow
MB	megabyte
MOW	Ministry of Water
n.a.	not available
No.	number
NPV	net present value
NUWA	National Urban Water Authority
NSTI	Nyengezi Social Training Centre
NVTC	National Vocational Training Centre, Ministry of Labour & Manpower Development
OECD	Organization for Economic Cooperation and Development
PE	plant engineer of NUWA
PGS	"parastatal general scale" pay scale
POS	"parastatal operational scale" pay scale
PRS	"parastatal rare scale" pay scale
PSCP	pre-stressed concrete pipe
PSS	"parastatal special scale" pay scale
PVC	poly-vinyl chloride pipe
RWSD	Rural Water Supply Department
s	second
SAP	Structural Adjustment Programme
SCOPO	Standing Committee of Parastatal Organization
SIDA	Swedish International Development Agency
SP	steel pipe
sq.km	square kilometers
sq.m	square meters
TAC	Tanzanian Audit Corporation
TANESCO	Tanzania Electric Supply Company Limited
TBS	Tanzania Bureau of Standards
TF	Task Force
T.Shs.	Tanzanian Shillings (U.S.$1=T.Shs.200 at November,1990)
UWASA	Urban Water Supply Act
WHO	World Health Organization
WRI	Water Resources Institute, Ministry of Water, Energy and Minerals

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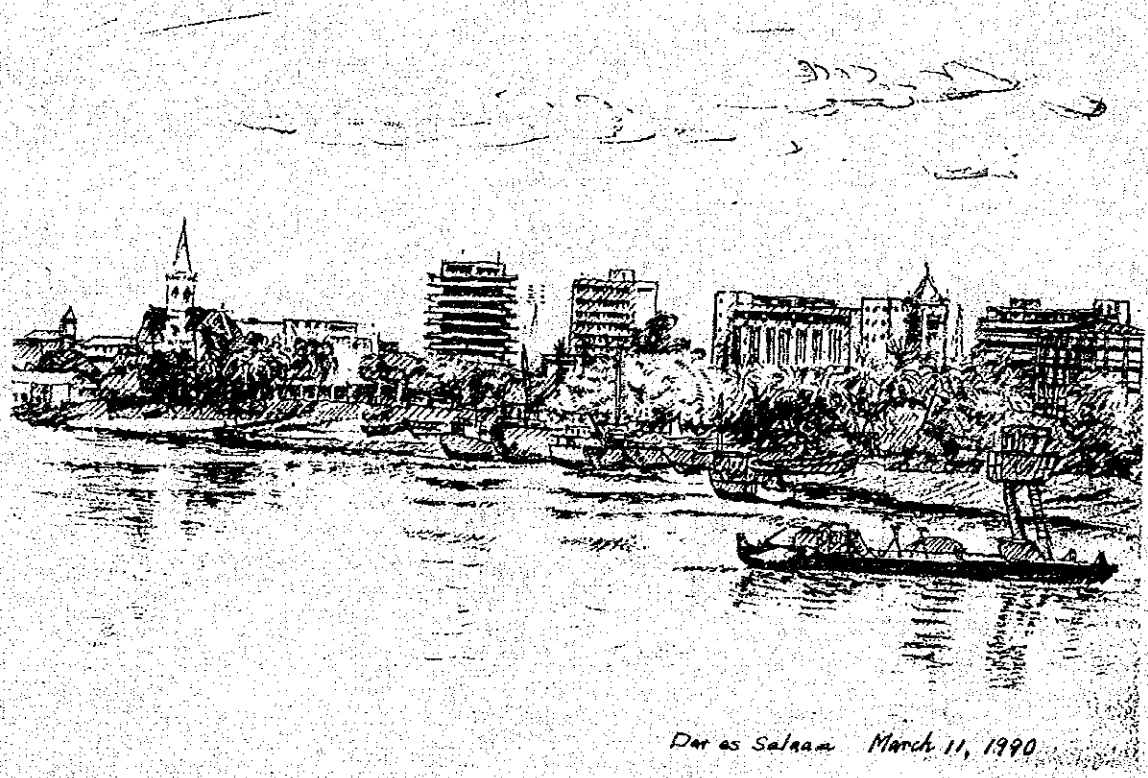
INTRODUCTION



CHAPTER 1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Improvement of water supply in Tanzania is one of the most important issues in the "National Economic Development Plan" because it will improve the quality of life, increase stability and increase industrial output. However, lack of manpower, information and financial resources pose as barriers towards realization of this goal. Improvement of the water supply of Dar es Salaam (DSM) also suffers from the same constraints.

Although the water supply system has now been operational for a long period of time and has been supplying water to an increasing population, it suffers from the following problems :
- insufficient water supply
- insufficient utilization of existing water treatment plants
- unsatisfactory quality of treated water and
- heavy water loss through leakage from the distribution system.

These problems arise from the advanced age of the system and from inadequate maintenance. Procurement of spare parts has also been quite difficult. Lack of sufficient financial resources is the root cause of this malaise, and this has even affected the day-to-day operation at the National Urban Water Authority (NUWA). To overcome this, NUWA revised its water tariff, effective from July 1988.

The Government of Japan, in response to a request from the Government of the United Republic of Tanzania (GOT), decided to conduct a Study on the Rehabilitation of the DSM Water Supply System (hereinafter referred to as "the study"). Accordingly, Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan, undertook the Study, in close cooperation with the authorities concerned of the GOT.

In June 1989, JICA dispatched a mission headed by Mr.Haruo Iwahori to Tanzania to do a preliminary study, as well as hold discussions on the scope of work of the Study. The scope of work was agreed upon between the GOT and the JICA mission on June 7,1989. Based on the scope of work, Tokyo Engineering Consultants Co. Ltd., in association with Pacific Consultants International, was selected by JICA for conducting the Study. The study commenced from November 9, 1989 and ended on May, 1991.

1.2 OBJECTIVE OF THE STUDY

1) to prepare improvement plan for strengthening the NUWA's management and operation aspects to ensure sustainable development of NUWA.

2) to identify scope and the size of the rehabilitation of the existing water supply system aiming at potable, sufficient and steady water supply throughout the service area and to formulate timely and orderly implementation toward the overall rehabilitation.

3) to prepare preliminary design of the immediate rehabilitation work proposed above together with cost estimates and to verify viability of the rehabilitation from the aspects of costs and benefits.

Although expansion of the DSM water supply system in the future would appear inevitable, given the growing demand, rehabilitation and improvement of the existing system to enable fuller utilization is expected to be more effective and produce immediate results. The success of the rehabilitation and improvement, combined with more efficient day-to-day operations of facilities, financial and organizational resources, will result in the expansion of the available facilities that will be operational for a longer time period. This will result in capital savings, and will enable NUWA to maintain financial autonomy. With this in mind, the above-mentioned objectives have been formulated.

1.3 SCOPE OF THE STUDY

The Study covers the water supply system for the city of DSM, excluding the areas along the transmission pipelines. The study of water resource development, except for the Mtoni system, is not included in the Study. The water resource development study of the Mtoni system is conducted to evaluate whether the plant is worth rehabilitating.

In order to achieve the objectives mentioned above, the study has covered the following items:

1. Data collection and review
(1) Socio-economic and natural condition
(2) Ongoing water supply and other relevant projects
(3) Water supply and other related plans

2. Study of the existing water supply system
(1) Design criteria
(2) Structure, capacity and performance of water supply facilities

3. Study of the institutional, management and financial aspects
(1) Institutional
(2) Management
(3) Financial

4. Study of water treatment plant rehabilitation plan
(1) Intake facilities
(2) Treatment facilities
(3) Water quality

5. Study of the distribution system rehabilitation plan
(1) Distribution pump and reservoir
(2) Distribution pipe

6. Study of the service system rehabilitation plan
(1) Service pipes
(2) Water meters

7. Study of the cost recovery strategy
(1) Water charge collection system
(2) Financial plan

8. Formulation of a maintenance plan
(1) Management
(2) Water treatment plant
(3) Distribution system
(4) Service system
(5) Leakage prevention strategy
(6) Repair-shop

9. Formulation of a training plan
(1) Overall training program

10. Formulation of a rehabilitation plan
(1) Identification of scope and size of rehabilitation
(2) Formulation of an implementation schedule
(3) Identification of the high priority projects

11. Preliminary design of immediate rehabilitation work
(1) Preliminary engineering design
(2) Cost estimation
(3) Financial evaluation

1.4 COMPONENTS OF THE REPORT

A number of reports have been prepared and submitted to NUWA during the period of the Study, covering all the work performed under the Study. All reports culminate in the Final Report, which is composed of the following three volumes;

(1) Volume One	SUMMARY
(2) Volume Two	MAIN REPORT
(3) Volume Three	SUPPORTING REPORT

Collection of information and data, with special emphasis on field data in order to understand the present condition of the DSM water supply system, are compiled and presented in the Supporting Report primarily, and appropriate details have been illustrated and discussed in the relevant chapters.

Items 1 through 7 in the scope of the study are given in chapters 2 to 4, while formulation of rehabilitation plans covering items 8 through 11 of the scope are presented in chapter 5 and onwards.

It should be noted that during the Study period, the Study Team obtained data from different sources, and the different sets of data did not always match with each other. Inevitably, discrepancies appeared and the Study Team has used its best judgment in presenting information throughout this report. While there may, therefore, be some inaccuracies in detail, the features which emerge in drawing up a consolidated picture are indicative of the real situation and the conclusions drawn will be considered as valid.

1.5 ORGANIZATION AND STAFFING

The study was carried out by the JICA Study Team under the direction of an Advisory Committee. The Study Team and the Advisory Committee are composed of the following members respectively:

Member of Study Team

Heiichiro MAKINO	: Team Leader, Tokyo Engineering Consultants (TEC)
Kazufumi MOMOSE	: Acting Team Leader/Facilities Planning (TEC)
Katsutoshi IWASAKI	: Facilities Planning (TEC)

Kaoru SUZUKI	: Distribution Pipes Planning (TEC)
Wataru SAIKA	: Distribution Planning, (TEC)
Yuuichi HASHIMOTO	: Distribution Planning, Pacific Consultants International (PCI)
Akira TAKECHI	: Water Resources and Water Quality (PCI)
Fumiaki ONODA	: Organization and Management (PCI)
Chizuko IHARA	: Socio-economy and Finance (PCI)
Hisamitsu TANAKA	: Cost estimation (TEC)
Kazuo KOJIMA	: Distribution and Service Pipes(TEC)
Hiroshi WATANABE	: Distribution and Service Pipes(TEC)

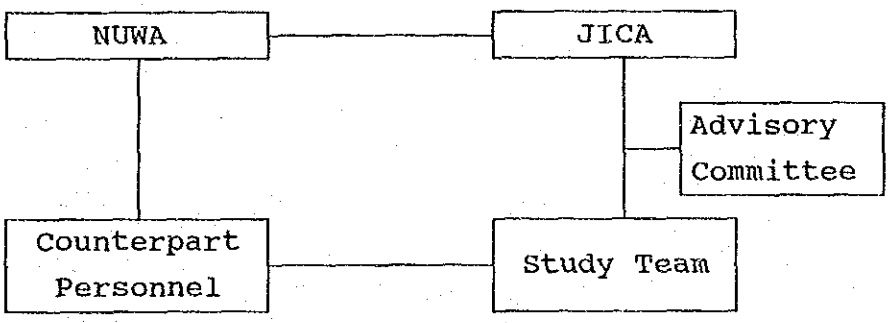
Member of Advisory Committee

Dr.Yasumoto MAGARA	: The Institute of Public Health
Mr.Katsuyoshi TOMONO	: Japan Waterworks Association
Mr.Haruo IWAHORI	: JICA
Dr.Kiyoshi YAMADA	: Ritsumeikan University
Mr.Sadao SEKIGUCHI	: Yokohama Waterworks Bureau
Mr.Mitsuaki FURUKAWA	: JICA

NUWA acted as the counterpart agency to the JICA Study Team and, provided the Study Team with the following counterpart staff.

Mr. Mathias Mulagwanda	: Project Engineer
Mr. Jackson Midala	: Executive Engineer
Mr. Issa Mizunguli	: Executive Engineer

The overall concept of the organizational structures is shown below.



CHAPTER 2

GENERAL CONDITIONS

CHAPTER 2 GENERAL CONDITIONS

DSM is the largest city in Tanzania, with a population of approximately 1,360,000 in 1988, and is politically, economically and culturally the national centre. It is situated on the eastern coast of Africa at a latitude of 6 ° 45 ' south and a longitude of 39 ° 18 ' east. Inland from the coast lies the coastal plains bordering the Pugu Hills which rise up to an altitude of 200 meters.

2.1 NATURAL CONDITIONS

2.1.1 TOPOGRAPHY

A coastal plain backs out from the coastline and is clearly defined west and northwest of DSM. It is about 10 kilometers wide in the west of DSM, but further north at Kawe it narrows to a width of two kilometers, widening again to 8 kilometers at the Mpiji river. In the southeast of DSM, it is between 5 and 8 kilometers wide. Southwest of the City, the coastal plain gradually merges inland into the more elevated zones associated with the head-waters of the Mzinga. The coastal plain is an area of fairly uniform relief with slopes generally less than three percent.

Some sections of the coastal plain are heavily dissected particularly in the Msimbazi, Mzinga and Kizinga river catchments and in the Mbezi and the Mpiji valleys. Other sections show a very open drainage network. Inland of the coastal plain rises a zone of hills forming the boundary of an extensive plateau.

2.1.2 SUBSOIL CONDITIONS

Most of the area inland of DSM consists geologically of fluviatile marine deposits of sands, gravels and/or silts. These are predominantly sedimentary rocks of recent origin, and along the coast, coral deposits occur.

2.1.3 CLIMATE

The temperature in the city is usually high, ranging between 17 and 32 degrees centigrade, with humidity between 50% and 90%. The main winds are the monsoons, blowing to and from the Indian Ocean. The bulk of the rain falls between March and May, but continued showers throughout the year are common. The total rainfall per year is between 1,000 and 1,400 mm.

TABLE 2.1 METEOROLOGICAL DATA

	Rainfall Mean(mm) 1982-1987	Temperature Mean Max. 1985	Mean Min.	Relative Humidity 1982-1986 AM9	PM3	Potential Evapo-ration (mm)
January	72.9	31.7°C	23.3°C	79%	64%	200mm
February	61.6	31.0	22.9	79	62	184
March	133.5	31.8	21.9	83	67	183
April	266.5	30.7	21.8	88	74	142
May	178.3	29.8	20.2	86	66	155
June	37.0	29.8	18.3	84	58	142
July	30.0	28.5	18.2	85	56	146
August	25.8	29.8	17.6	84	54	169
September	26.5	30.7	17.7	78	53	179
October	62.2	31.1	19.3	74	56	204
November	122.5	31.4	20.4	76	62	195
December	107.6	32.0	22.8	78	65	205
Annual	1,124.4	30.8	20.4	81	61	2,104

(source: Meteorological Department)

2.2 SOCIO-ECONOMIC CONDITIONS

2.2.1 SOCIAL ASPECTS

Unlike Uganda and, on a smaller scale, Kenya, Tanzania has experienced very little ethnic tension since its independence.

On the other hand, the absence of big ethnic groups has adverse effects, (though they are outweighed by the benefits) in running enterprises, especially in the area of information flow. Information tends to accumulate in individual memories rather than become common heritage. This psychology has been further aggravated by the lack of hardware for an information management system.

DSM shows the bulge in its population growth rate due to a high birth rate, coupled with an exodus from the remote countryside. There has been a pressing need for new water connections.

2.2.2 ECONOMIC POLICY

Since 1961, when Tanzania became independent, the Government has been making efforts to achieve self-reliance. In June 1982, the Government adopted a 3-year comprehensive structural adjustment programme (SAP) to address the country's structural problems and to rehabilitate the country.

The economic recovery program (1986/87 to 1988/89) represents a continuation of the structural adjustment effort which will enable the country to achieve sustainable growth in real incomes and welfare improvements. The emphasis of the programme is to channel resources to raise the productivity in

smallholders' agriculture because of its importance to the economy; 80% of the agricultural output and 46% of the gross domestic product (GDP) comes from this sector.

Over the years, the pressure on available resources has made it difficult for the Government to allocate sufficient resources to maintain the social and physical infrastructure created in the last two and a half decades. Consequently, water supply systems, roads, railways, schools and hospitals now require substantial rehabilitation, for which external assistance is being actively sought. Resources will mainly be directed towards rehabilitation and reactivation.

TABLE 2.2 CLASSIFICATION OF CENTRAL GOVERNMENT EXPENDITURE

(Unit: T.Shs. million)

TYPE OF EXPENDITURE	1985/86	86/87*	87/88*	88/89**
1)ECONOMIC SERVICES				
- General Administration	805	953	1,252	3,394
- Agriculture,Forestry, Hunting and Fishing	1,810	3,198	3,884	9,336
- Mining, Manufacturing and Construction	1,486	1,410	1,843	6,984
- Water Supply and Electricity	889	1,000	2,018	2,700
of which Water Supply	609	803	1,815	2,206
- Roads and Bridges	1,009	1,473	2,154	2,984
- Inland and Coastal water ways	29	104	49	204
- Other Transport and Communications	738	1,107	1,245	2,471
- Other Economic Services	3	38	21	39
- TOTAL	6,369	9,283	12,466	28,112
2)OTHER PURPOSES				
- Public Department	6,699	12,391	22,976	41,820
- Financial and Capital Subscriptions	17	17	74	254
- Pensions and Gratuities	336	223	295	354
- TOTAL	7,052	12,631	23,345	42,428
3)TOTAL RECURRENT & DEVELOPMENT EXPENDITURE				
3)-1 RECURRENT EXPENDITURE				
- Economic Services	2,452	3,894	5,153	6,928
of which Water Supply	339	452	631	940
- Social Services	4,101	5,890	8,631	11,502
- General Administration and Defense	13,476	18,448	25,198	29,414
- Other Purpose	7,052	12,631	23,345	42,428
- SUB-TOTAL	27,081	40,863	62,327	90,272
3)-2 DEVELOPMENT EXPENDITURE				
- Economic Services	3,917	5,389	7,313	21,184
of which Water Supply	270	351	1,184	1,266
- Social Services	713	1,120	1,594	2,965
- General Administration and Defense	1,393	2,350	2,888	4,251
- SUB-TOTAL	6,023	8,859	11,795	28,400
TOTAL	33,104	49,722	74,122	118,672
GRAND TOTAL	46,525	71,636	109,933	189,212

(Source: Bureau of Statistics) * Provisional ** Estimates

Since 1984/85, the Government has enacted measures directed towards reducing the size of the Government and improving the operation of parastatal organizations. The institutional reforms and other complementary measures should enable these parastatal organizations to reduce their dependence on

public funding.

Real per capita income, as measured by GDP at fixed 1976 prices, fell steadily as population growth outpaced the increase in GDP; in 1984, it was estimated at $240, 17% less than in 1980.

Table 2.2 shows that the share of water supply expenditure to total economic service was about 10% and the share of development expenditure increased by about 40% to 60% from 1985/86 to 1988/89.

2.2.3 INSTITUTIONAL BACKGROUND

Tanzanian socialism, i.e. creation of egalitarian village communities, decentralization, and self-reliance proclaimed by the Arusha Declaration in 1967, guides politics and government, which has been controlled by the Revolution Party (CCM).

As the Government has now accepted the loan terms set by the IMF, i.e. introduction of market economy, turmoil prevails in the economy when these two principles collide with each other. The change is also sharply felt in the social service sector, like water supply. The conflict notwithstanding, its effort to improve human resources is clearly visible, while political targets are somewhat blurred.

2.3 WATER DEMAND*

2.3.1 POPULATION

In DSM, the population and the urbanized areas have increased rapidly in recent years (see Figure 2.1). In 1946, it was 45,000 and in 1957, it had risen to 128,000, with an average annual growth rate of 10 percent. At almost the same growth rate, the population had risen to 356,000 in 1967. Since then, the annual growth rate has decreased as shown below and in the census results released in 1988, the population was 1,360,850.

Greater DSM encompasses an area of 1,393 km^2, with a population of 1,360,850. It is divided into three administrative districts, viz., Kinondoni, Ilala and Temeke. Each of the districts is further subdivided into wards.

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* Details are shown in Appendix A.1.

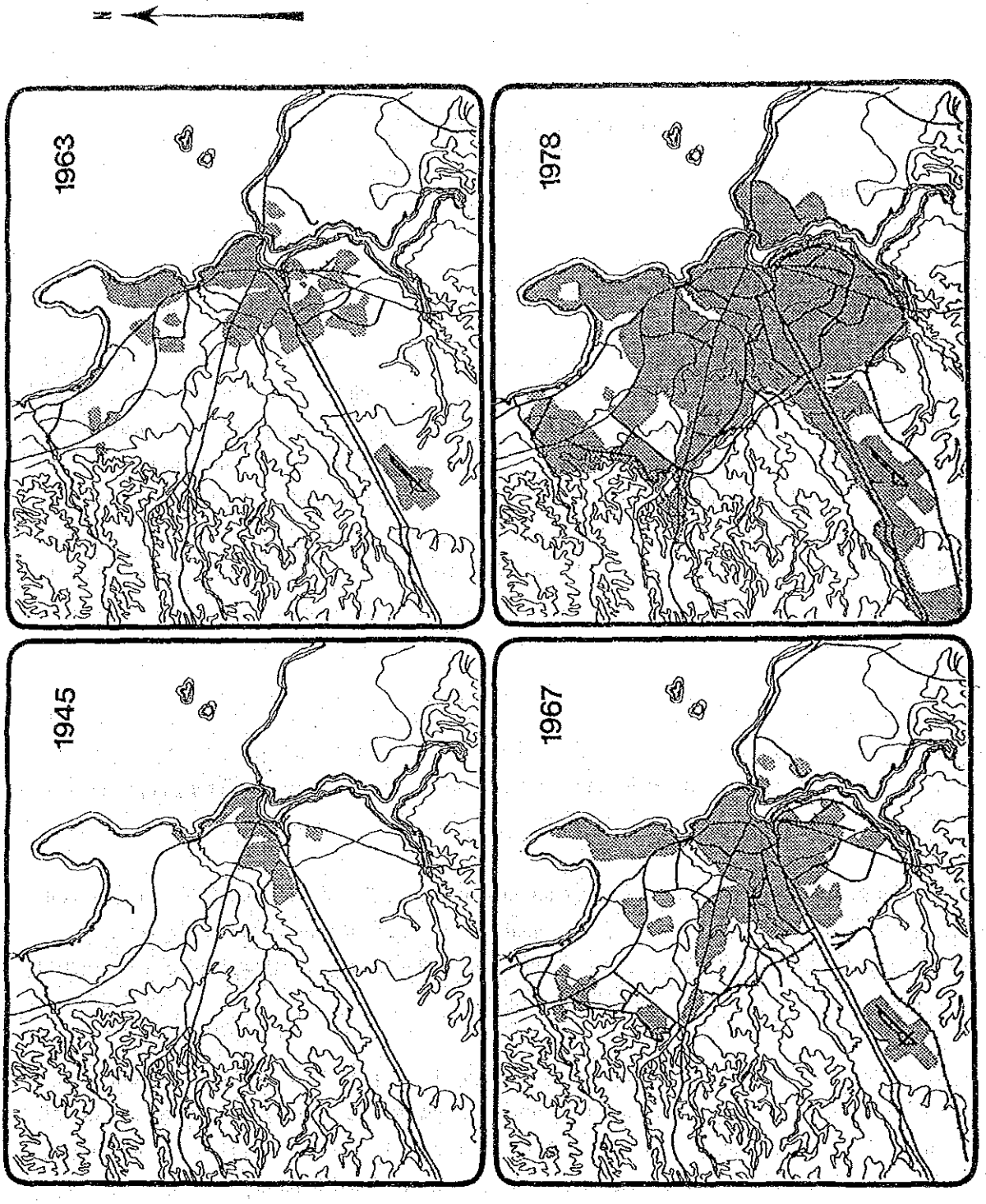

FIG. 2.1 URBAN GROWTH FROM 1945 TO 1978

THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY

TABLE 2.3 POPULATION AND GROWTH RATE

POPULATION	1967	1978	1988
Dar es Salaam	356,286	843,090	1,360,850
Tanzania	12,313,469	17,512,610	23,174,336

ANNUAL AVERAGE GROWTH RATE (% per annum)	1967-78	1978-88
Dar es Salaam	7.8	4.8
Tanzania	3.2	2.8

2.3.2 SERVED AREA AND SERVED POPULATION

Water supply for most of the densely populated areas of DSM is managed by the NUWA, a parastatal organization, with more than 50 % governmental ownership, through a distribution network supplied from reservoirs at the University of DSM, Kimara and Mtoni. The service area in DSM encompasses 321 km^2, extending 25 km from north to south and 15 km from the east to the west. In the northern region, along the Bagamayo road, transmission mains convey water treated at the Lower Ruvu water treatment plant to the university reservoir. In the western region, along the Morogoro Road, transmission mains convey water treated at the Upper Ruvu Water Treatment Plant to the Kimara Reservoir. In the southern region, a small amount of water is treated at the Mtoni Treatment Plant and pumped to the distribution network.

Some wards in the northern and western regions are served, in part, by pipelines tapped from these two transmissions. Apart from these, outlying wards in the northern, western and southern regions are also served by a system of shallow wells, under the administration of the DSM Rural Water Supply Department (RWSD).

Table 2.4 gives pertinent information about districts and wards of DSM - area size, 1988 population, 1988 population density. It also gives an idea of which of the three sources supplies water to the ward - 1)the NUWA distribution system from the three reservoirs, 2) the Lower and Upper Ruvu feeder mains and 3) shallow wells, under the administration of RWSD.

The prime concern of this study is with the distribution system under NUWA administration. Figure 2.2 gives an idea of the areas in DSM that come under the purview of this system and those that fall outside this. Areas outside include Tare Pugu, Msongola, Kibada, Bunju, Kisarawe II, Somangira, Kimbiji, Chamazi, Charambe, Toangoma, Goba, Kunduchi, Mbweni and Kibamba.

Table 2.5 gives population and households according to service levels within the distribution system of NUWA.

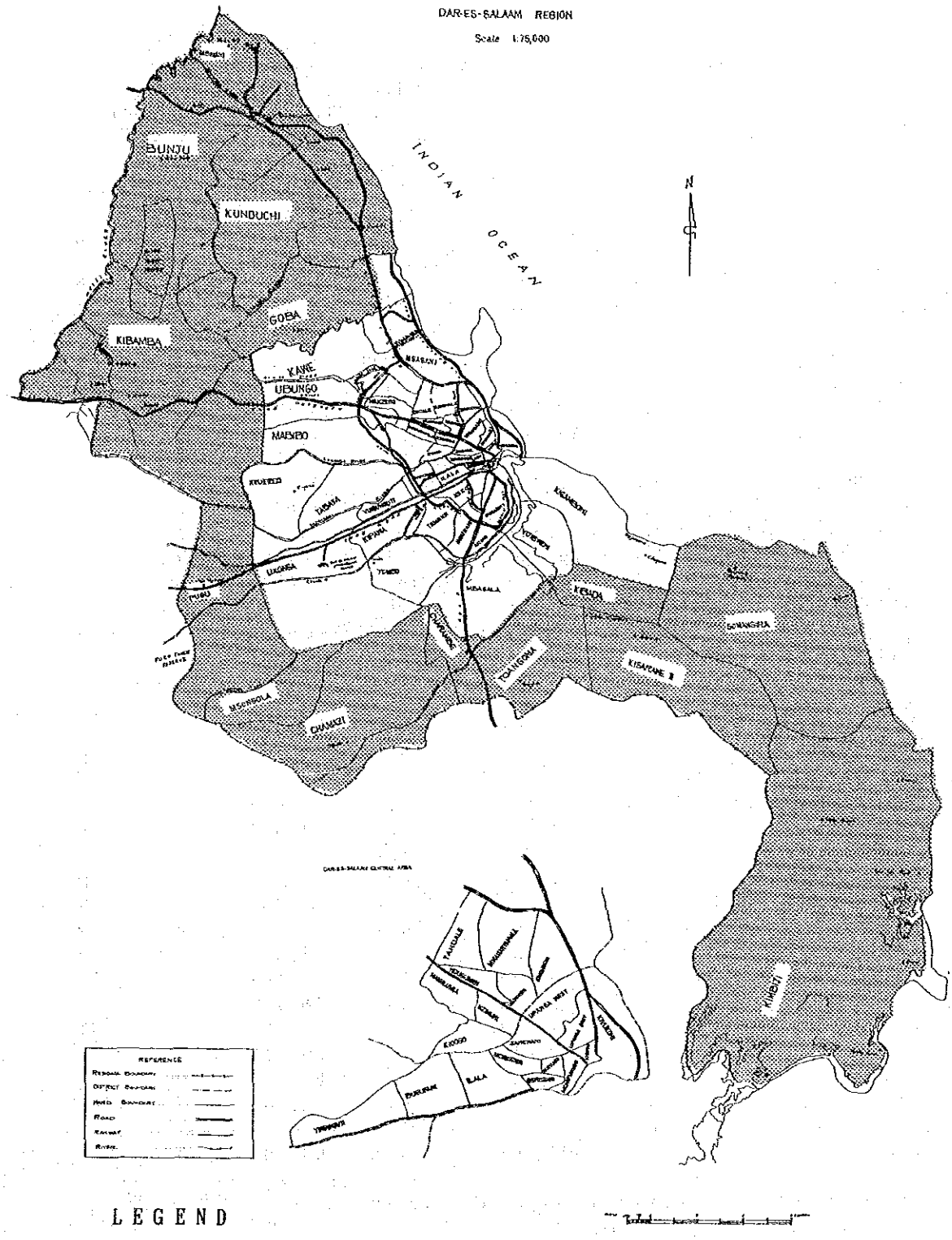

FIG. 2.2 WARDS OF DAR ES SALAAM INSIDE AND OUTSIDE OF DISTRIBUTION NETWORK

THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY

TABLE 2.4 GENERAL FEATURES OF GREATER DAR ES SALAAM (1988)

Sr. No.	Ward	Type	Area, sq.km.	Population (1988)	Population Density	Number of of House-holds	Source of Water Supply		
ILALA SUB-BRANCH									
101	Ukonga	M	47.2	45,203	958	10,127	#		
102	Pugu	R	51.8	6,226	120	1,178	#	T	R
103	Msongola	R	18.3	13,351	730	3,058			R
104	Tabata	U	5.5	18,465	3,357	3,780	#		
105	Kinyerezi	R	17.4	3,048	175	730	#		R
106	Ilala	U	2.2	35,048	15,931	8,241	#		
107	Mchikichini	U	1.1	15,040	13,673	3,372	#		
108	Vingunguti	U	49.3	33,690	683	8,731	#		
109	Kipawa	U	8.8	36,910	4,194	9,282	#		
110	Buguruni	U	3.5	48,247	13,785	13,198	#		
111	Kariakoo	U	0.4	12,569	31,423	2,499	#		
112	Jangwani	U	0.9	15,320	17,022	2,908	#		
113	Gerezani	U	0.9	7,487	8,319	1,557	#		
114	Kisutu	U	0.4	8,358	20,895	1,699	#		
115	Mchafukoge	U	0.5	8,547	17,094	1,604	#		
116	Upanga East	U	1.2	9,807	8,173	752	#		
117	Upanga West	U	1.5	11,020	7,347	1,633	#		
118	Kivukoni	U	2.1	5,372	2,558	781	#		
SUB-TOTAL			213.0	333,708	1,567	75,130			
TEMEKE SUB-BRANCH									
201	Kigamboni	M	33.8	26,078	772	6,197	#		R
202	Vijibweni	R	12.4	2,557	206	520	#		R
203	Kibada	R	14.2	3,003	211	752			R
204	Kisarawe 11	R	49.6	2,821	57	697			R
205	Somangira	R	98.9	6,730	68	1,596			R
206	Kimbiji	R	199.6	6,465	32	1,457			R
207	Mbagala	M	24.3	40,866	1,682	9,539	#		R
208	Chamazi	R	66.5	5,452	82	1,261			R
209	Yombo Vituka	R	13.1	13,408	1,024	2,876	#		R
210	Charambe	M	6.9	18,624	2,699	3,974			R
211	Toangoma	R	37.4	6,652	178	1,553			R
212	Miburani	U	44.2	72,892	1,649	16,793	#		
213	Temeke 14	U	44.2	91,144	2,062	22,271	#		
214	Mtoni	U	2.6	39,417	15,160	9,745	#		
215	Keko	U	43.9	42,868	976	10,493	#		
216	Kurasini	U	48.2	26,776	556	5,781	#		
SUB-TOTAL			739.8	405,753	548	95,505			

Note: Type U = Urban, R = Rural, M = Mixed
Source of Water Supply
# = NUWA distribution system,
T = NUWA feeder mains,
R = Rural Water Supply Department

TABLE 2.4 CONTINUED

Sr. No.	Ward	Type	Area, sq.km.	Population (1988)	Population Density	Number of House-holds	Source of Water Supply	
KINONDONI SUB-BRANCH								
301	Msasani	U	15.2	51,293	3,375	10,839	#	
302	Kinondoni	U	3.3	42,387	12,845	9,526	#	
303	Mwananyamala	U	3.5	72,508	20,717	16,943	#	
SUB-TOTAL			22.0	166,188	7,554	37,308		
KAWE SUB-BRANCH								
401	Goba	R	54.4	4,753	87	1,186		T
402	Kawe	U	27.4	44,085	1,609	10,527	#	T
403	Kunduchi	R	75.8	22,743	300	5,452		T
404	Mbweni	R	22.6	2,159	96	551		T
405	Bunju	R	83.0	9,977	120	2,493		T
SUB-TOTAL			263.2	83,717	318	20,209		
MAGOMENI SUB-BRANCH								
501	Magomeni	U	8.3	16,944	2,041	4,361	#	
502	Makurumla	U	2.2	53,991	24,541	12,987	#	
503	Ndugumbi	U	1.1	32,736	29,760	7,933	#	
504	Tandale	U	4.1	58,413	14,247	13,380	#	
505	Mzumuni	U	0.9	23,985	26,650	5,807	#	
506	Kigogo	U	1.2	21,222	17,685	4,693	#	
507	Mabibo	U	2.1	45,963	21,887	10,761	#	
508	Manzese	U	3.8	54,499	14,342	12,834	#	
509	Ubungo	U	18.9	46,980	2,486	9,521	#	
510	Kibamba	R	112.1	16,751	149	3,875		T
SUB-TOTAL			154.7	371,484	2,401	86,152		
TOTAL			1,393	1,360,850	977	314,304		

Note: Type U = Urban, R = Rural, M = Mixed
Source of Water Supply
# = NUWA distribution system,
T = NUWA feeder mains,
R = Rural Water Supply Department

TABLE 2.5 POPULATION & HOUSEHOLD CLASSIFIED BY SERVICE LEVEL IN DAR ES SALAAM (1990)

Type of Connection	Population	Household
House Connection		
High	69,663 (5%)	12,757 (4%)
Middle	24,467 (2%)	4,486 (1%)
Low	334,721 (25%)	77,467 (25%)
Yard Connection	315,482 (24%)	74,150 (24%)
Kiosk/Standpipe	590,695 (44%)	139,410 (45%)
(no connection)		
Total	1,335,028 (100%)	308,270 (100%)

2.3.3 1990 UNSUPPRESSED WATER CONSUMPTION

Water consumption for the system can be divided into its component parts, viz., domestic consumption and other consumption, e.g.industrial, commercial and institutional. These component parts are evaluated individually.

(1) DOMESTIC WATER CONSUMPTION

The social structure in DSM, as in many third world cities, gives rise to a water consumption pattern that lends itself to division roughly based on the socio-economic status of the residents. Consequently, three types of water service levels exist in DSM. These are based on the availability of water connection on the premises of the consumer (see Figure 2.3) and the number and location of taps within the premises.

a) House connection
b) Yard connection
c) No connection

Estimation of liters per capita water per day (lpcd)* of consumers at each service level was estimated from observation of monthly water consumption values in selected 'model' areas of DSM. The lpcd values, according to each service level, is given below.

- House connection:
  - high 400 lpcd
  - middle 250 lpcd
  - low 160 lpcd
- Yard connection: 85 lpcd
- No connection: (kiosk/standpipe) 22 lpcd

Table 2.6 gives the water consumption in the service area. The domestic water consumption for the entire service area is 128,180 m^3/day in 1990.

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* Per capita consumption is explained in section 2, Appendix A.

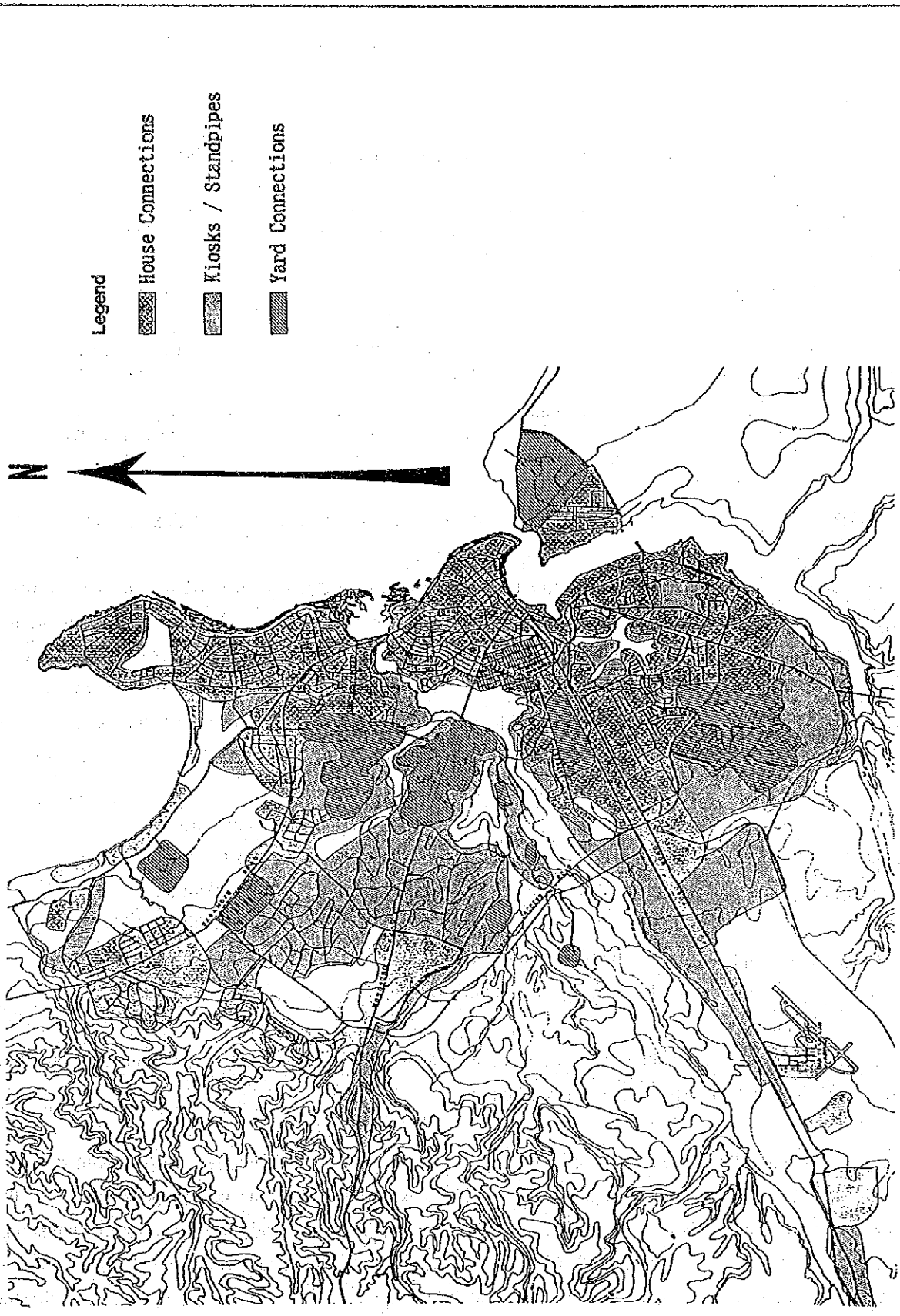


FIG. 2.3 WATER SERVICE LEVEL

THE STUDY ON REHABILITATION OF DAR ES SALAAM WATER SUPPLY

TABLE 2.6 DOMESTIC WATER CONSUMPTION (1990)

(Unit: m^3/day)

Type of Connection	Domestic Water Consumption	Population
House Connection		
High	27,865 (22%)	69,663 (5%)
Middle	6,117 (5%)	24,467 (2%)
Low	53,555 (42%)	334,721 (25%)
Yard Connection	27,648 (21%)	315,482 (24%)
Kiosk/Standpipe	12,995 (10%)	590,695 (44%)
(no connection)		
Total	128,180 (100%)	1,335,028 (100%)

(2) INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL WATER CONSUMPTION

Estimation of water consumption by industrial, commercial and institutional consumers is clubbed together, as the methodology used is very similar. The meter readings of the 750 establishments for 1989 were used as the basis for estimation of water consumption by industrial, commercial and institutional establishments. NUWA, however, does not include non-domestic consumers in the above-mentioned categories. Therefore, the Study Team classified all this data into the three categories, to facilitate data analysis. Consumption by all metered establishments, in each category, are as follows;

	Total metered	Large* metered	Small* metered
Industrial	2,003 m^3/d	1,705 m^3/day	298 m^3/day
Commercial	900 m^3/d	411 m^3/day	490 m^3/day
Institutional	928 m^3/d	685 m^3/day	243 m^3/day

(*) Large: consumption more than 50 m^3/day/establishment
Small: consumption less than 50 m^3/day/establishment

All 'large' consumers in all three categories are included in the 750 metered establishments, hence this consumption is obtained from the meter records.

In the case of 'small' consumers, since there may be a number of establishments which are not metered, a water consumption rate was calculated. This value was derived from the consumption values of the metered establishments. However, for the sake of matching the magnitude of consumption, consumption by establishments greater than 50 m^3/d were excluded, so as to ensure that the calculated value is representative of smaller establishments. This was done separately for each of the three categories and the results are as follows ;

Industrial consumer	-	6.2 m^3/day/consumer
Commercial consumer	-	1.2 "
Institutional consumer	-	4.1 "

'Small consumers' consumption is determined by multiplying the aforementioned per consumer value by the difference between the total number of account holders and 'large' consumers. When this figure is added to the actual consumption figures of 'large' consumers, it gives the total water consumption for industrial and institutional consumers, and they are shown in Tables 2.7 and 2.8, respectively.

In the case of industrial and institutional consumers, NUWA billing accounts include all consumers in each category, i.e. there are no unregistered consumers. Since industrial units have to be registered before setting up shop, it is difficult for such industries to tap lines illegally. In the case of institutions, it is even more unlikely that there are unregistered, illegal connections.

In the case of commercial consumers, it appears that there are a considerable number of unregistered consumers. Therefore, determination of the commercial consumption by 'small' consumers involves the estimation of the number of 'small' consumers over and above those registered with NUWA.

According to a survey conducted by the Ardhi Institute in 1990, the ratio of the total number of commercial consumers to the total number of registered commercial consumers (i.e. with account numbers) is 1.8. Therefore, the total number of commercial consumers can accordingly be estimated as 1.8 times the total number of commercial accounts. The breakup of commercial water consumption is given in Table 2.9.

TABLE 2.7 INDUSTRIAL CONSUMPTION (1990)

	Consumption	Number
Metered consumers	2,003 m^3/day	54
large	(1,705 m^3/day)	(6)
small	(298 m^3/day)	(48)
Unmetered consumers	2,610 m^3/day#	421
Total	4,612 m^3/day	475

Note: (#) 2,610 m^3/day = 298 * (421/48)

TABLE 2.8 INSTITUTIONAL CONSUMPTION (1990)

	Consumption	Number
Metered consumers	928 m^3/day	61
large	(685 m^3/day)	(2)
small	(243 m^3/day)	(59)
Unmetered consumers	4,427 m^3/day#	1,080
Total	5,355 m^3/day	1,141

Note: (#) 4,427 m^3/day = 243 * (1,080/59)

TABLE 2.9 COMMERCIAL CONSUMPTION (1990)

	Consumption	Number	Note
Registered consumers		2,724	
Metered large consumers	411 m^3/day	5	
Metered small consumers	490 m^3/day	415	
Unmetered consumers			
Unregistered consumers	5,379 m^3/day	4,482	
Total	6,282 m^3/day	4,902 = 2,724 x 1.8	

(3) TOTAL CONSUMPTION

In the previous sub-sections, the water consumption for each component of consumption - domestic, industrial, commercial and institutional - was determined. The total consumption is the sum of the individual components which is shown in Table 2.10.

TABLE 2.10 WATER CONSUMPTION, 1990 (UNSUPPRESSED)
(Unit: m^3/day)

DOMESTIC	INDUSTRIAL	COMMERCIAL	INSTITUTIONAL	TOTAL
128,180	4,612	6,282	5,355	144,429

2.3.4 1990 SUPPRESSED CONSUMPTION

At the present time, consumption is suppressed in some areas in DSM due to the unavailability of sufficient water pressure and water volume. This suppression affects all components of water consumption - domestic, industrial, commercial and institutional - and has to be accounted for in the calculation of the present water consumption figures.

Theoretically, the degree of water consumption suppression is a direct function of the effective water pressure (absolute pressure minus ground level elevation) in the distribution system.

However, due to insufficient water pressure and flow round the clock, residents and establishments in DSM have circumvented their water shortage problems by installing pumps and storage tanks on their premises and pumping water into the tanks during periods of water availability. This has an effect on the degree of water demand[1] suppression.

Water pressure measurements were made in January and August 1990 on the primary distribution system in DSM (refer to section 4.2, Appendix C). The measured values were superimposed on the map of DSM, so as to enable evaluation of the water pressure profile within each ward. Based on the effective water pressures in the different wards of DSM, and taking into consideration the suppression circumvention mentioned earlier, suppression factors have been developed for each ward in DSM.

The condition used was that an effective pressure of 10 m and above would ensure that sufficient water was available and therefore, demand suppression would be non-existent. Lower effective water pressures would impose demand suppression, the magnitude of which would increase progressively with decreases in effective pressure. Wards having sufficient pressure were assigned a factor of 0.95, implying small suppression. Factors of 0.8, 0.7, 0.6 and 0.5 were assigned for decreasing effective pressures. Wards having no consumption at present (Gongo La Mboto Pumping Station and Yombo-vituka ward) have been assigned a factor of 0.0, implying that there is no demand in that ward. On the basis of the factors so developed, the actual water consumption (suppressed consumption) in DSM in 1990 is shown in Table 2.11.

TABLE 2.11 SUPPRESSED (ACTUAL) AND UNSUPPRESSED WATER CONSUMPTION, 1990

(Unit: m^3/day)

CATEGORY	Unsuppressed consumption	Suppressed consumption
DOMESTIC	128,180	111,056
INDUSTRIAL	4,612	4,120
COMMERCIAL	6,282	5,697
INSTITUTIONAL	5,355	4,854
TOTAL	144,429	125,727

Note : suppression factor = 87%

1.Demand is used here instead of consumption. Demand = consumption + leakage

2.3.5 PEAK FACTOR

(1) PRESENT PEAK FACTOR

Estimation of the peak factor in the distribution system was from the total flow from the three reservoirs at University, Kimara and Mtoni, which were available from NUWA records and Study Team investigations.

According to the measurements at all the three reservoirs (refer to section 4.7 in Appendix C), the outflow volume is 182,000 m^3/day (7,600 m^3/hour) and the hourly peak factor is 1.47, which was obtained on 3rd, August,1990.

The Kimara curve reflects the condition when the valve is open. It is flat at all other times. The period when the valve is closed is the period when demand suppression occurs.

(2) PEAK FACTOR FOR UNSUPPRESSED DEMAND

Since the rehabilitated system will eliminate demand suppression, peak factors for unsuppressed demand in each component of demand - domestic, industrial, commercial and institutional - were developed. The peak factor is calculated to be 1.50.

2.4 HISTORY OF WATER SUPPLY SYSTEM

2.4.1 DEVELOPMENT UP TO 1950

The first water supply system in DSM was planned in 1891. However, few details are available about the system prior to 1919. At that time, water came from four separate systems, drawing water from shallow wells at Gerezani, Kurasini, Upanga and Raisinoff (now Kariakoo). All four areas are now in or very near the city center.

In 1929, underground sources near Gerezani Creek were investigated. By 1931, 11 boreholes had been sunk and water from this source was added to the system. The separate distribution systems were then interconnected. By 1933, a piped water supply system was available to the greater part of DSM.

In 1938, a chlorinator was installed to disinfect the water from the Gerezani Creek. In 1939, increases in water demand made the installation of booster pumps on what had previously been an artesian system at Gerezani Creek necessary . This resulted in over-pumping and increased the salinity and hardness of the water, much to the dissatisfaction of household and industrial users.

In 1939 and 1942, infiltration galleries were constructed in Msakara and Keko Creeks, in an effort to both increase the supply and minimize salinity intrusion in the Gerezani area boreholes. From these galleries, water was taken to the Gerezani pumping station, where it was mixed with water from the borehole and pumped to storage tanks on Gerezani street.

In 1949, a treatment plant, rated at 30,000 gallons per hour, was constructed for the treatment of the water from all the sources at Gerezani. At that time, the wet season output was 1.2 million gallons a day (mgd) or 5,551 m^3/day, which reduced to 1.0 mgd (4,550 m^3/day) during the dry season.

In 1949, a water shortage made it necessary to develop three temporary sources at Kurasini, Yombo and Msimbazi Creeks. These sources were later abandoned when the Mtoni system came into operation.

2.4.2 DEVELOPMENT AFTER 1950

The development of the source for the Mtoni system was completed in 1952, which yielded about 5,915 m^3/day (1.3 mgd) from the Kizinga river and infiltration galleries in nearby Yombo and Kerenguru Creeks. Construction of a small impounding reservoir (Buza dam) on Kilungule Creek was completed in 1961 or 1962, resulting in increased dry weather output for Mtoni. At the Mtoni treatment plant, the water is clarified, filtered and chlorinated. From the two million gallon (9,100 m^3) clear-well reservoir, the water is pumped into the distribution system.

By 1953, it became apparent that Mtoni would soon be insufficient to meet the growing demand and a decision was made to develop the Ruvu river as a water source, which would be able to supply DSM for the foreseeable future. The Ruvu River has a large catchment area of about 15,190 km^2 and an annual mean discharge of about 60 m^3/sec in the intake profile.

Designing Upper Ruvu system commenced in 1955 and operations started in 1959. The initial facilities included intake works on the downstream side of the Morogoro road bridge, a treatment plant at Mlandizi, three miles east of the intake structure, and two 8,000 m^3 (1.75 million gallon) reservoirs at Kimara, nine miles west of DSM. The initial system had a capacity of about 18,200 m^3/day (4.0 mgd), with some facilities oversized to accommodate future expansion.

Expansion of the Upper Ruvu system started in 1963. This included additional treatment and pumping capacity, ten miles of parallel transmission mains, and a four million gallon (18,200m^3) surface reservoir at Kimara. Construction was completed in July 1966, increasing the capacity of the system to about 25,500 m^3/day (5.6 mgd).

By 1967, increasing water demand made further expansion necessary and plans were made to increase the capacity of the system to 49,000 m^3/day (10.8 mgd). Construction started in 1968 and was completed in 1972.

Subsequently, a decision was made to develop Lower Ruvu as an additional water source. The 82,000 m^3/day (40 mgd) treatment plant was put into operation in 1976. With the addition of this new source, a new reservoir at the University and principal distribution mains of 54" (1,350 mm) to 30" (750 mm) diameter were also constructed by 1976.

Negotiations on budgetary allocation for the Lower Ruvu system was expected to take time, although the water shortage had become a pressing problem. Hence, the expansion of the Upper Ruvu system was initiated, and this was completed in 1975.

TABLE 2.12 HISTORY OF DAR ES SALAAM WATER SUPPLY SYSTEM

YEAR	SYSTEM	DESCRIPTION	
1919	OTHER SYSTEM	: Started System (4 shallow wells)	
1931	" "	: 11 boreholes in Gerezani Creek	
1933	" "	: Separate distribution systems were interconnected	
1939	" "	: Infiltration galleries	
1942	" "	: in Msakara and Keko Creeks	
1949	" "	: Treatment Plant for combined sources at Gerezani	
		Output: 1.22 mgd (wet season)	
		1.00 mgd (dry season)	
1949	MTONI SYSTEM	: Mtoni System Construction Starts	
1952	" "	: Mtoni System Operation Starts (1.5 mgd)	
1959	UPPER RUVU	: Operation Starts	
	" "	: 1st Stage (4.0 mgd)	Aided by Britain
1964	" "	: 2nd Stage (2.0 mgd)	Aided by Britain
1966	" "	: 3rd Stage (2.0 mgd)	Aided by Britain
1971	" "	: 4th Stage (4.0 mgd)	Aided by Britain
1975	" "	: 5th Stage (6.0 mgd)	Aided by Germany
1976	LOWER RUVU	: Operation Starts (40 mgd)	Aided by Canada

2.5 SUPPLY TO THE CITY

The chief source of water for DSM is the Ruvu river flowing northwards on the west of the city towards the Indian ocean. The supply is supplemented, to a small extent, by tapping water from the Kizinga river at Mtoni.

Water is drawn from two different intakes in the Ruvu river, located 20 kilometers apart. The older intake, for the Upper Ruvu System, is located about 65 km west of the city, along the Morogoro road. The second intake, for the Lower Ruvu System, is located near Bagamoyo town, downstream of the older one and about 18 km upstream from the mouth of the river. The total installed capacity of the three water plants is 270,800 m^3/day (59.5 mgd).

However, the design capacities have never been attained in practice, particularly in the case of the Upper Ruvu system (which has been rehabilitated and whose output has reached the installed capacity at the end of 1990). The Mtoni system, which resumed operation in August 1989, again stopped operation in February 1990. Thus the current production capacity is 234,000 m^3/ day (51.4 mgd).

Two-thirds of the water delivered by the Upper Ruvu system and between 10 and 20% of that delivered by the Lower Ruvu system are consumed or lost by leakage along the transmission mains before reaching the reservoirs in the city. As a result, water available to the city at present is approximately 181,000 m^3/day (40 mgd), i.e., two-thirds of the design capacity.

The water supply and demand/consumption balance for DSM is as given in Table 2.13. From this, it can be seen that the overall leakage within the NUWA distribution system is 35 %. This calculated leakage ratio based on the suppression factor is similar to the measured leakage ratios in the three model areas in January and August, 1990 (refer to section 4.5, Appendix C).

TABLE 2.13 WATER SUPPLY AND DEMAND BALANCE (1990, DAILY AVERAGE BASE)

(A) Gross Supply:		296,300 m^3/day
(Lower Ruvu Treatment Plant)	207,500 m^3/day	
(Upper Ruvu Treatment Plant)	82,000 m^3/day	
(Mtoni Treatment Plant)	6,800 m^3/day	
(B) Net Supply:		193,400 m^3/day
(C) Leakage Ratio:		35 %
(D) Unsuppressed Consumption		144,429 m^3/day
(E) Unsuppressed Demand: (D)/{1-(C)}		222,200 m^3/day
(F) Overall Suppression Factor: (B)/(E)		87 %

(source: JICA Study Team)
Note: Difference between gross supply and net supply is consumed or leaked out along the transmission lines.

The overall current suppression factor for DSM is estimated as 87%, signifying that in 1990, insufficient water pressure causes the water consumption to drop 13 % from what would normally be consumed had insufficient water pressure not been a constraining factor. It is noted that 87% is a value on a daily average base.

2.6 RELEVANT WATER SUPPLY PROJECTS

The following projects are on-going or were completed recently.

1) Operational Improvement
2) Rehabilitation and improvement of the Upper Ruvu treatment plant- 1st phase
3) Rehabilitation of the Lower Ruvu treatment plant
4) Strengthening of the Ministry of Water, towards achieving IDWSSD objectives

2.6.1 OPERATION IMPROVEMENT

This is intended to improve the operational efficiency at NUWA, because water supply services in the city has been disrupted very often by damage to treatment plants, pumps, heavy leakage in the reservoirs and distribution lines.

Activities envisaged in the "Operations Improvement" project are:
- operation and maintenance of pumps and treatment plants with a minimum of breakdown to avoid disruptions in supply;
- operating a system-wide leakage detection programme and follow-up repairs in order to reduce the leakage and increase the quantity of water in supply;
- improving revenue collection to increase cash collection;
- identifying the operational database of NUWA and keeping accurate records of production, water supply, leakage, consumers and accounts; and
- proper operations and maintenance of vehicles and plants of NUWA with minimum downtime to enable the above activities to be undertaken as quickly as possible.

These activities were estimated in 1987 to require approximately US$ 1.6 million. The following items were provided by IDA credit:
- 1 seven-ton lorry
- 10 pick-up trucks
- split collars, couplings, valves, pipes, etc. for leakage and repair works to mains
- leakage detection equipment
- pipe locating equipment
- spares to rehabilitate meters
- special units for installation of meters
- water repair and testing workshop/equipment
- communication system
- source and bulk meters

The items awaiting financial assistance are: spares for pumps/treatment plants, compressors, generators, arch welding machines, sludge pumps, drilling and tapping machines etc.

2.6.2 REHABILITATION AND IMPROVEMENT OF THE UPPER RUVU SYSTEM

This project, which started in November 1988, is expected to take 25 months and cost approximately US$ 27 million. It is financed by the Italian and Tanzanian governments, sharing 85 and 15 percent of the costs, respectively. It aims to rehabilitate and restore the plant to its original capacity. More specifically, the objective of the project are:

1) to satisfy an average daily demand of 105,000 m^3/day (23 mgd) in areas along the rising (transmission) mains from the Upper Ruvu treatment plant to the Kimara reservoir and the Upper zone of DSM;
2) to guarantee that the treated water quality conforms to WHO standards for domestic use;
3) to reorganize supply mains so that unregistered connections such as kiosks will be reduced by discouraging direct connections. Instead, metered pipes will be provided to each village.
4) to ensure that the system provides uninterrupted supply during ordinary interruptions or break-down by means of 100% standby raw water pumping and high lift pumping stations and;
5) to ensure full-time operation of the main portions of the existing installations and restoring it to its original design capacity of 23 mgd raw water and 18 mgd clear water.

The project includes :

1) Rehabilitation of existing installations
- Intake: removal of existing sheet piles in the river, repairs and replacement of intake gates and accessories.
- Low Lift Pumping Station: pumps, gates, screen, electrical equipment
- Raw Water Mains (Dia. 24" - 26" - 30"): drains, air valves, water outlets
- Water Treatment Plant: flocculators, settling basins, filters
- High Lift Pumping Station: pumps, civil works
- High Lift Water Mains (Dia. 24" and 30"): drains, air valves, water outlets, service truck
- Kimara Reservoir: leak-proofing
- Upper Zone Distribution Network: drains, air valves, water outlets, repair of leaks

2) New Facilities
- River works (construction of a groyne on the left river bank, stabilization of the river bed and the right bank across the intake)
- Intake and anti-deposit structure: to attain maximum capacity of 176,000 m^3/day (46 mgd)
- Pre-lift Pumping Station and Settling Basins: design capacity 1.21 m^3/sec (23 mgd)

- Raw Water Pumping Station: design capacity 1.09 m^3/sec (20.7 mgd)
- Water Treatment Plant: flash mixer, 4 settling basins,filters, chemical house, post-chlorinator
- Clear Water Pumping Station: design capacity 0.947 m^3/s (18 mgd)
- Clear Water Main: Dia. 900 mm, length 21,606 m
- Reservoirs: design capacities
  3 Nos X 500 m^3 + 1 No. X 1,500 m^3 in towns along the transmission line
- Electrical Substation

3) Improvement of the Distribution Network
- New Pipeline along the Nelson Mandela (Port Access) road from Ubungo to Pugu Road: Dia. 600 mm, length 7,600 m
- New Pipeline from Nelson Mandela (Port Access) road to Tabata East: Dia. 400 mm, length 3,600 m

4) Supporting services
- supply and install pressure and flow monitoring devices at strategic points such as reservoir outlet and main distribution lines.
- construction of a complete workshop and installation of the necessary equipment
- construction of workshop for meters
- supply and installation of meter testing equipment
- supply of maintenance equipment; excavator, mobile generating set, dewatering pumps, pipe specials of different assortment, tools, transport and dragline

2.6.3 REHABILITATION AND IMPROVEMENT OF THE LOWER RUVU SYSTEM

A study on ways to rehabilitate the Lower Ruvu water treatment plant was conducted in 1986 by Gores & Storrie Consultants, funded by the CIDA. The proposed rehabilitation/improvement would require US$ 2.3 million.

1) Raw water pumping station
- Complete spare parts for pumping unit, including rotating pump element, right angle drive, electric motor, auto transformer starter and miscellaneous bearings
- Stub shafts for two variable speed drive conversions
- Calibration of raw water pump gauges and flow meters
- Pump tests
- Supply and installation of float gauge level alarm systems

2) Clarifiers
- Sludge sampling pipes and appurtenances
- Plastic sludge line inserts

3) Filter plant
- Manual operators replacing hydraulic cylinders
- New underdrain (ceramic) system
- Surface wash piping valves and pump system
- Third washwater pump, piping, valves and electrical
- Manometers, loss of head and flow
- Sand eductor and box
- Supply and installation of filter gravel and sand

4) High pressure pumping station
- Calibration of high pressure pump gauges and flow meters
- Pump tests

5) Laboratory equipment

6) Carry out friction tests on the 54" diameter feeder main

2.6.4 STRENGTHENING OF THE MINISTRY OF WATER, ENERGY AND MINERALS, TOWARDS ACHIEVING IDWSSD OBJECTIVES

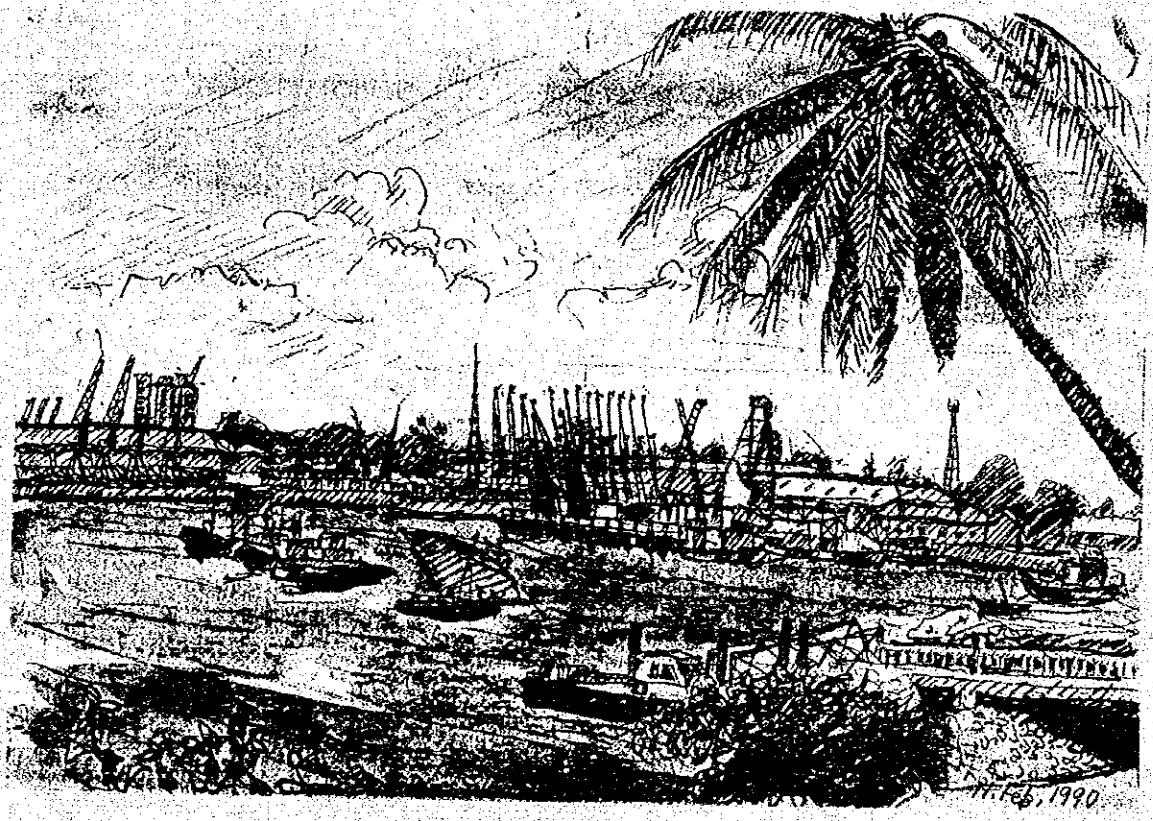
The project is being carried out by UNDP, co-sponsored by FINNIDA. It is a follow-up to UNDP project in 1984 to the National Action Committee responsible for the IDWSSD programme. The project is an institution building and investment planning project, which will develop and install efficient organizational structures, technical, financial and information management systems as well as human resources development plans in the Ministry of Water, Energy and Minerals and NUWA.

The agreement on the project was bound July, 1990. The project will last for two years and at present four experts are working in the Ministry of Water. They are:

1) Investment Planner/Economist,
2) Organization and Human Resources Development Expert,
3) Financial and Information Management Specialist, and
4) Project Preparation Expert.

CHAPTER 3

ORGANIZATION AND FINANCE OF NUWA



CHAPTER 3 ORGANIZATION AND FINANCE OF NUWA

3.1 PRESENT ORGANIZATIONAL CONDITIONS

3.1.1 LEGISLATIVE AND LEGAL CONSIDERATIONS

Before the creation of the DSM Water Corporation Sole in 1977, the regional water engineer or the manager of DSM water supply of the Ministry of Communication, Labour & Works, then the Ministry of Water, Energy & Mineral had been looking after the system. DSM Water Corporation Sole was established under Corporation Soles (Establishment) Act of 1974. It was a parastatal body, and was placed under the City Council of DSM, which was defunct till then. The City Council failed to show that it could live up to the government's expectation to run the enterprise.

On the other hand, administrative structures at the national level changed with the promulgation of the Urban Water Supply Act, No.7 in 1981, when NUWA was established as a parastatal organization *, responsible to the Ministry of Water, Energy & Minerals. (NUWA was established by Section Four of the Urban Water Supply Act). The major objective of the act is to establish NUWA and to delineate functions and corresponding powers of the authority.

The Authority took over all the activities of the DSM Water Supply Corporation Sole and all the assets and liabilities of the latter were taken over by the former on 1st October 1984. On that date, the DSMB of NUWA was formed in order to discharge its responsibility as the exclusive caretaker of the water supply system for the city of greater DSM. Its statutory ground is expressed in Section 12 of the same act.

Section 13 of the Act gives the foundation for the provision of a Branch Advisory Committee for each branch of NUWA, in anticipation of the need to strengthen coordination with the city council. Section 14 of the act provides the committee with the necessary power for this coordination role. The advisory committee is not set up in DSMB. A director of City Council is appointed as a member of NUWA

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* All the industries which belong to the public sector are run by so-called parastatal organization in Tanzania. There are about four hundred organizations.
"Parastatal" is a general term. Specific organizations in the public sector were established under specific acts; NUWA by the urban water supply act, DSM Water Corporation under the Corporation Sole Act. In other industries, the government owned 100 percent of some organizations, or only a minor portion of the organization. This usage of the term is found in some Commonwealth countries in describing government agencies. Yet the word, parastatal is not found in ordinary dictionaries. "Para-" signifies that it is being connected with something and helping it. The parastatals have been advised to get rid of another connection of "para",i.e. very similar to, in the context of productivity.

Board by the Minister of Water, Energy and Minerals. The City Council is also responsible for water quality surveillance, which is carried out jointly with the government central laboratory and NUWA.

DSMB is extending its activities beyond the boundaries of the DSM Region, into the districts of Bagamoyo and Kibaha in the Coast Region.

Before the introduction of the urban water supply act, all the water supply areas of the country had been defined by the Waterworks Ordinance, Cap.281, and had been administered by the Water Utilization (Control and Regulation) Act, No.42 of 1974. Now, when any area is declared as a specified town under this legislation, all water entities in the area are immediately superseded by NUWA. Any water rights granted by the previous act in areas where NUWA is to supply water are to be re-registered with NUWA. Both the ordinance and the act were amended as in section 52 of the urban water supply act. In areas outside NUWA's jurisdiction, issues like water rights (claimed under the principle of the riparian doctrine), water quality etc., NUWA has to abide by these two laws.

In practice, there is direct abstraction of water from the transmission mains before water reaches DSM. Under sections 7 (d) and 27 of the urban water supply act, a two kilometre zone on both sides of the mains and the districts of Bagamayo and Kibaha are to be under the service area. Each of these two areas are administered by district water engineers.

ENVIRONMENTAL ASPECTS

The Water Utilization Act of 1974 was amended in 1981, when the urban water supply act was promulgated, to make better provision for the control of water pollution. Four sections of the urban water supply act are devoted to conservation and protection of water. It also provides penalty clauses for offenses resulting in pollution of water.

For the DSMB, management of catchment area of the Ruvu river require a lot of coordination with other government organizations. At the same time, downstream integration with sewerage service is envisaged at the national level. Hence, the authority has to prepare for merger.

3.1.2 STRUCTURE OF THE DAR ES SALAAM BRANCH

(1) HEADQUARTERS OF NUWA

The Board of Directors consists of a Chairman, a Director-General, two officials from the Ministry of Water, Energy and Mineral, six members from the concerned ministries (1.Finance, 2.Health, 3. Industries, 4. Land, 5. Housing & Urban Development and the 6. Prime Minister's office), the Tanzanian

Electricity Supply Co. Ltd., and four more members - one of whom is a director of city council, DSM. The first two are presidential appointees, while the rest are appointed by the Minister of Water, Energy and Minerals.

The Director-General of NUWA is responsible to the Board, which supervises the overall activities of NUWA. There are four directorates - Operations, Project Planning & Implementation, Manpower Development & Administration, and Finance, which are all under its charge. The organizational structure of NUWA is given in Figure 3.1.

(2) DAR ES SALAAM BRANCH

The branch manager (BM) of the DSMB is answerable to the Board of NUWA through the Director General, according to Section 28 (3) of the Urban Water Supply Act; yet in practice, he is under the Director of Operations, as per the schedule of service of NUWA, which is in force at present. The organizational structure of the DSMB is given in Figure 3.2.

DSMB is responsible for the three treatment plants, two reservoirs, five sub-branch offices and six payment counters. Warehouses, workshops and a dispensary are located in its Pugu Road compound; the transport, maintenance, supplies and stores, and medical care sections also have their offices there. The construction section of the project implementation department also has its workshop there.

The current office in Gerezani accommodates the entire data processing section of the Directorate of finance, along with the hardware and a part of the implementation division of the Directorate of planning and implementation. A public relation officer belongs organizationally to HQ but functionally to BM. He is to report directly to BM.

The branch manager is the chief administrative officer of the branch. The branch consists of three departments - Personnel & Administration, Operations and Finance. Some minor activities related to the branch are carried out by the construction section of Project Department, who also report to the branch manager.

1) OPERATION DEPARTMENT

The operations engineer, who is responsible to the branch manager, is in charge of running the department, which consists of four sections - treatment & source, distribution, maintenance, and supply & stores.

The three treatment plants supply water to DSM. There is no section chief in the treatment & source

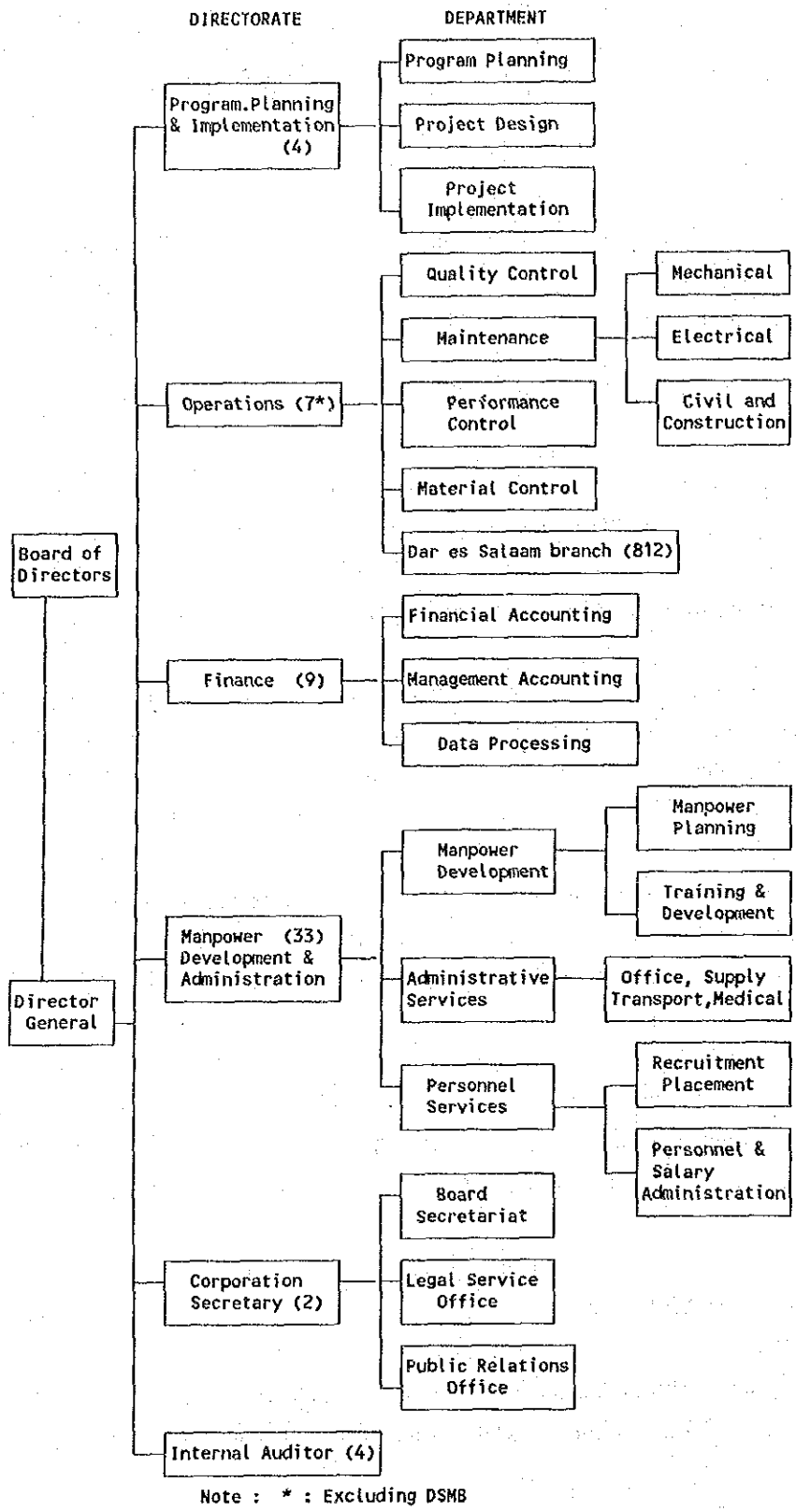
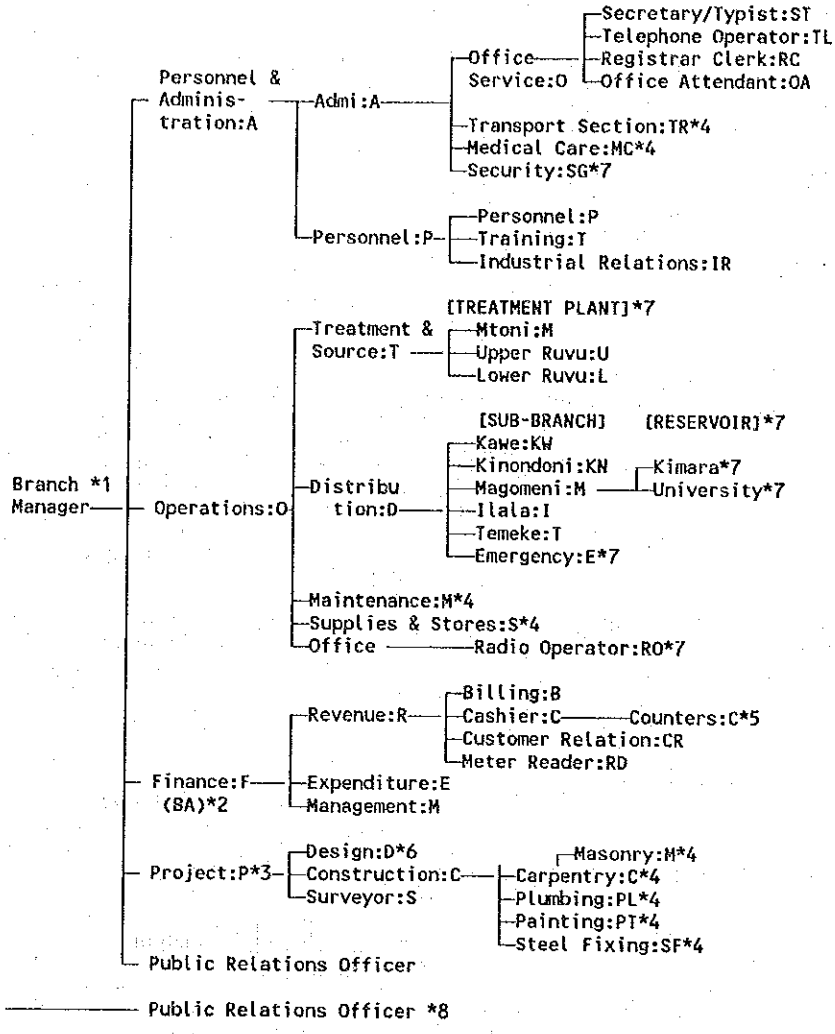
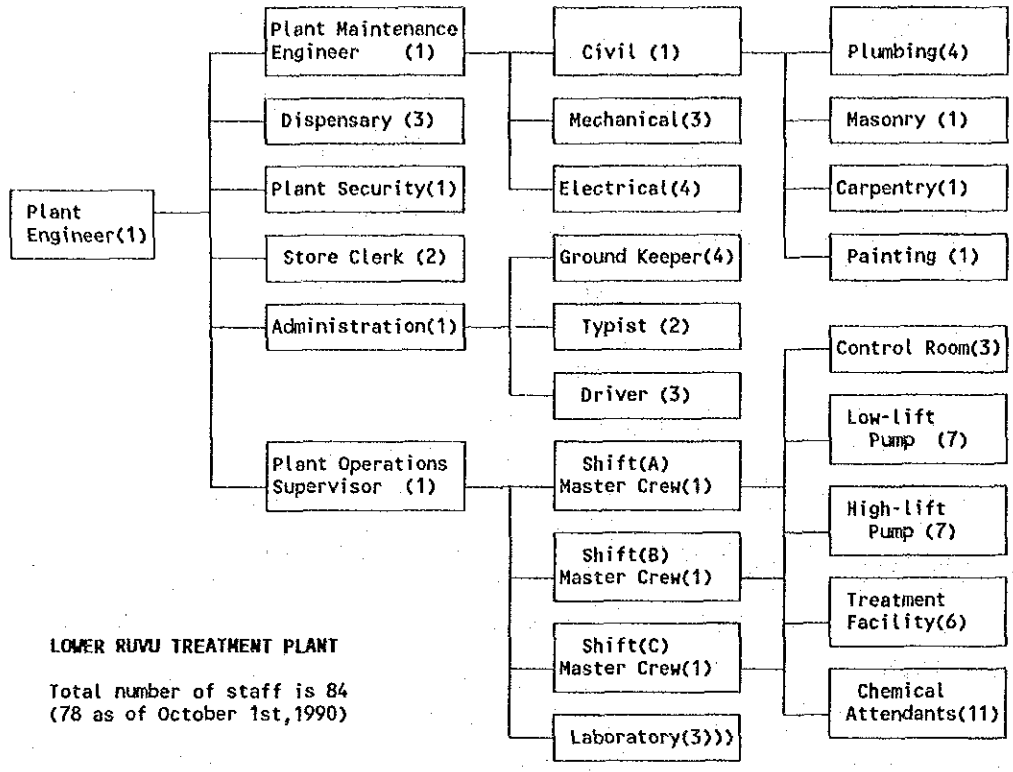


FIGURE 3.1 ORGANIZATIONAL STRUCTURE OF NUWA



*1 Branch Manager is responsible to the Director General according to Urban Water Supply Act.
*2 The head of the Finance Department is called Branch Accountant.
*3 The Head of the Project Department is also responsible to the Director of Program Planning & Implementation.
*4 Office/Workshop is located at Pugu Road Compound (.P).
*5 They are at the main office at Gerezani, City Centre along Market Street, and all the sub-branches except Kawe.
*6 He is stationed at the site of the Upper Ruvu Treatment Plant rehabilitation work at the moment.
*7 Three shifts a day. In some places, two shifts a day, due to shortage of transport.
*8 The manager of Data Processing is responsible to Director of Finance.

FIGURE 3.2 ORGANIZATION OF DSMB, NUWA



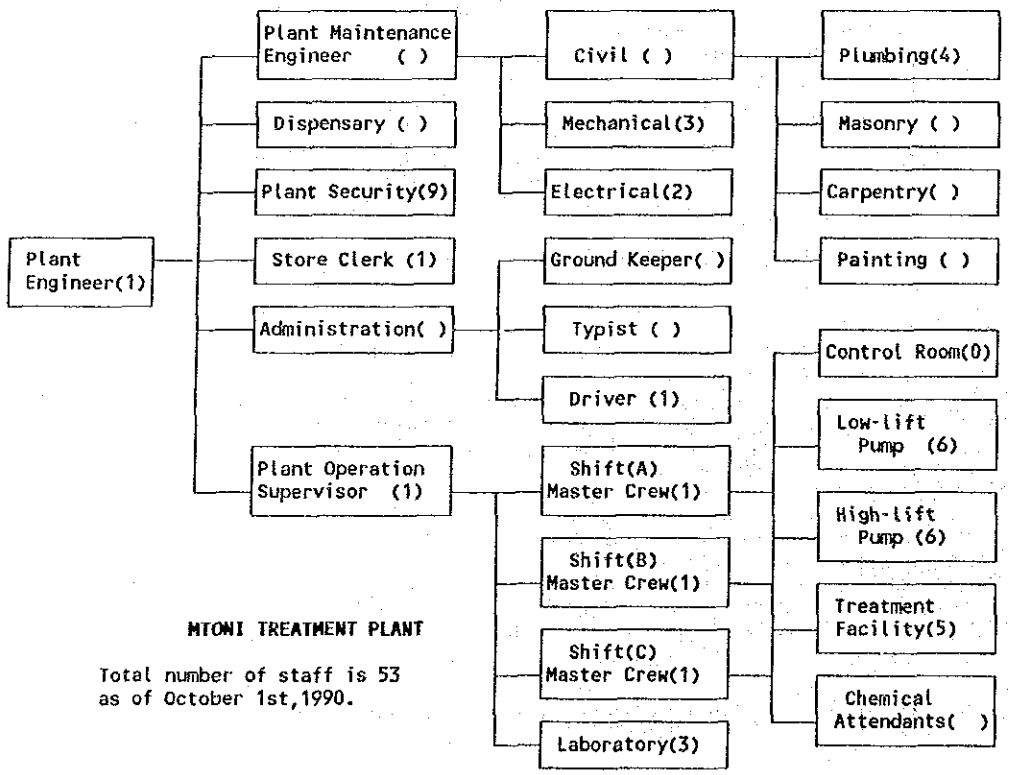


FIGURE 3.3 ORGANIZATION OF TREATMENT PLANTS

section, at present; the operations engineer gets a report directly from the plant engineer (PE) of each treatment plant. The daily report on the quality of water goes through the plant engineer to the operation engineer, but the laboratory analyst in charge of each plant is also responsible to the quality control manager of NUWA HQ.

The distribution section consists of five sub-branches and an emergency unit. Two reservoirs are maintained by units, which are responsible to a sub-branch manager. The section is under complete responsibility of a Distribution Engineer (DE). He is assisted by a civil engineer.

The maintenance section consists of 3 units, i.e., electricity, civil works and workshop; the workshop, of automobile workshop and meter repair shop. The maintenance engineer (ME) has his office in the Gerezani compound. He is supported by an electric engineer (EE) and a technical advisor (civil) to manage the section, at present. But the rest of his staff are at the Pugu Road workshop. The workshop supervisor oversees the daily activities of the workshop. A team of mechanics maintain the old fleet of vehicles. An omnipresent meter repair foreman looks after meter repairs. Some electricians and civil technicians are also attached to the workshop.

The office of the Supplies & Store Section is located in the Pugu Road compound, because most of the material, with the exception of chemicals are stored there.

2) PERSONNEL & ADMINISTRATION DEPARTMENT

This department has two sections, administration and personnel.

Transportation and medical care units belong to the administration section. The office of the transport units located at Pugu Road compound, are headed by a transport officer. He is to control all movement of drivers and petrol consumption.

The day-to-day office affairs of the DSMB is supervised by an office services supervisor, who is responsible to the section chief for administration. The staff of the sections consist of personal secretaries/typists, registrar clerks, telephone operators/receptionists and office attendants.

The Medical Care unit has its office and a clinic in the Pugu Road compound. The clinic takes care of the staff of NUWA and their family members. A medical doctor attends to the patients there. The unit operates clinics at the Upper Ruvu and Lower Ruvu treatment plant sites. They also extend rural health services there.

The Security unit also comes under the administration section. The Gerezani and Pugu Road com-

pounds, all three treatment plants, two reservoirs, and five sub-branches are guarded on a 24 hour basis in two or three shifts. The office of the Security officer is located at Gerezani.

The Personnel section is headed by a senior personnel officer and consists of three units - training, personnel and industrial relations.

3) FINANCIAL DEPARTMENT

This department consists of three sections - revenue, expenditure, and management. The Branch Accountant takes responsibility for the department.

The Revenue section is sub-divided into billing, cashier, meter reader and validation run & moribund. Recently,a customer relations unit was created to attend to customer complaints and to facilitate clearance of unpaid bills.

The chief cashier is in charge of all cash transaction, which include cash paid by the consumers at payment counters. There are six counters for the convenience of the consumers - at the Gerezani branch office, in Market Street in central area, and at all the sub-branch offices.

The Data Processing Manager of the Directorate of Finance has his office in Gerezani with all his staff and hardware, as the processing of consumption data and billing the consumers of the DSMB service area is the major activity of this unit, at present.

4) PROJECT DEPARTMENT

This department consists of two sections, i.e. construction and survey & drawing. The construction section has its workshop in the Pugu Road compound.

5) HQ AND DSMB

The head of the project department, DSMB, has dual lines of reporting - to the director of project planning & implementation for those works under direct HQ supervision, and to the BM for minor work under the jurisdiction of the DSMB.

6) NUMBER OF STAFF MEMBERS

The number of staff members of NUWA as of November 1990 is 872; 60 in the HQ and 812 in the DSMB. A further breakdown is given in Tables 3.1 and 3.2.

Besides regular staff members, there are labourers on a daily wage basis working at the sub-branch offices.

TABLE 3.1 STAFFING LEVELS OF NUWA DSMB (as of November 1990)

Description	Operational			Admi. + Maintenance + Finance			Security		Total
	Engineer	Technician	Artisan	Officer/ Accountant	Sub	Support	Officer	Guard	
Administration	1	0	1	6	74	-	2	12	96
Finance	-	1	-	2	45	-	-	3	51
Project	3	20	8	-	-	-	-	-	31
Operations	6	33	21	6	19	-	-	-	85
Upper Ruvu	2	26	46	-	-	19	-	15	108
Lower Ruvu	3	26	31	-	-	7	-	11	78
Mtoni	1	22	19	-	-	3	-	8	53
Ilala	0	22	31	-	-	7	-	4	64
Temeke	0	27	27	-	-	2	-	7	63
Magomeni	0	23	27	-	-	6	-	14	70
Kinondoni	0	19	28	-	-	5	-	6	58
Kawe	0	24	25	-	-	1	-	5	55
Sub total	16	243	264	14	138	50	2	85	812

TABLE 3.2 NUWA STAFF CLASSIFIED BY SALARY SCALE

	P A Y S C A L E													
POS	3	4	5	6	7	8	9	–	–	–	–	–	–	POS–
PGS	1	2	3	4	5	6	7	8	9	10	11	12	13	PGS
PRS	–	–	–	–	1	2	3	4	5	6	7	8	9	PRS
PSS	–	–	–	–	–	–	–	–	–	–	–	–	–	PSS
	N U M B E R O F S T A F F													TOTAL
POS	74	64	321	207	45	7	3	–	–	–	–	–	–	721
PGS	–	28	40	16	16	7	7	4	1	2	–	–	–	121
PRS	–	–	–	–	5	3	2	8	1	0	4	3	–	26
PSS	–	–	–	–	–	–	–	–	–	–	–	1	1	2
n.a.	–	–	–	–	–	–	–	–	–	–	–	–	–	2
TOTAL	74	92	361	223	66	17	12	12	2	2	4	4	1	872

PSS (Parastatal Special Scale), PRS (Parastatal Rare Scale)
PGS (Parastatal General Scale), POS (Parastatal Operational Scale)

3.2 PRESENT MANAGEMENT CONDITIONS

3.2.1 ECONOMIC BACKGROUNDS

The Tanzanian economy is stabilizing after the partial introduction of a market economy, with the effects of adjustment still apparent. The move towards increased free market principles will get added momentum in the future.

Some of the staff members, whose jobs require overtime work can get overtime pay and meals allowance. A number of staff members have been taking up a second job before and after their working hours to augment their income.

Workers of parastatal organizations assert rightly that corruption cannot be eliminated in the country as long as workers do not get sufficient remuneration. On the other hand, money should not simply be printed, as this increases inflation. It should be backed by increase in productivity. The aim of this study, which is towards bettering management practices in the DSMB is in line with this, while taking the welfare of the employees into account.

3.2.2 STAFF OF THE DAR ES SALAAM BRANCH

(1) SCHEDULE OF SERVICE

NUWA provides its employees with a well defined career path. It is described in the schedule of service. Generic job descriptions to each category are also given in it.

The scheme encourages employees to strive to improve performance, over and above that required by their job descriptions, and outstanding service may be rewarded by promotion.

A summary of the scheme of service is given in Table 3.3. Functions/duties of the branch manager, department heads, section chiefs of the operation department and sub-branch managers of DSMB are given in section 1, Appendix B. A summarized job description for all staff positions in the DSMB is given in section 1, Appendix F, Staff Database (field name: job description).

TABLE 3.3 SCHEME OF SERVICE

PSS (Parastatal Special Scale)	--	--	--	--	--	--	--	--	--	--	--	1	2	PSS
PRS (Parastatal Rare Scale)	--	--	--	--	1	2	3	4	5	6	7	8	9	PRS
PGS (Parastatal General Scale)	1	2	3	4	5	6	7	8	9	10	11	12	13	PGS
POS (Parastatal Operational Scale)	3	4	5	6	7	8	--	--	--	--	--	--	--	POS
Job Designation	--	Assis-tant 2	Assis-tant 1	III	II	I	Senior 2	Senior 1	Princ-ipal 2	Princ-ipal 1	Manager	Director	Director General	Job
1.Internal Auditor	--	Clerk	**	**	**	**	**	**	**	**	Chief	→		1.
2.Stock Verification	--	**	**	**	**	**	**	**	**	**	→	→		2.
3.Legal Service	--	--	--	**	**	**	**	**	**	**	Corpo-	→		3.
4.Board Secretary	--	--	--	**	**	**	**	**	**	**	-ration	→		4.
5.Public Relation	--	--	--	**	**	**	**	**	**	**	Secretary	→		5.
6.Man Power - Management	--	--	**	**	**	**	**	**	**	**	MP Devlop Personnel	Man-po-wer		6.
7.Administration	--	**	**	**	**	**	**	**	**	**	Ad-			7.
8.Registrar Clerk	--	**	**	**	**	**	Su-				mi-			8.
9.Gardener	III	II	I	Senior	→	→	per-	→	→		ni-	De-		9.
10.Office Attendant	III	II	I	Senior	→	→	vi-				st-	ve-		10.
11.Telephone Operator/Reception	--	III	II	I	Senior	→	sor				ra-	lop-		11.
12.Typist	--	III	II	I	Senior	Of Mg	Of Mg	→	→		ti-	ment		12.
13.Secretary	--	--	III	II	I	As 2	As 1				ve			13.
14.Nurse	--	**	**	**	**	**	:					and		14.
15.Medical Assistent	--	--	**	**	**	:					Ser-			15.
16.Medical	--	--	--	--	**	: **	**	**	→	→		Ad-		16.
17.Vehicle Attendant	II	I	Senior	:							vi-	mi-		17.
18.Driver	III	II	I	:Senior2	Senior1	:						ni-		18.
19.Transport	--	--	--	**	**	: **	Senior	→	→	→	ce	st-		19.
20.Security Guard	III	II	I	Senior2	Senior1	:						ra-		20.
21.Security	--	--	--	**	**	: **	**	**	→	→	→	tion		21.
22.Meter Reader	--	II	I	Senior2	Senior1	Chief	:							22.
23.Accountant	--	AcCl	AcAs	AsAc	**	**	: **	**	**	**	Chief	Finance		23.
24.Data Process	--	Clrk2	Clrk1	PrgSp	SyAn2	SyAn1	**	**	**	**	**			24.
25.Planning	--	--	--	**	**	**	**	**	**	**	Chief	Plan-		25.
26.Implementation	--	--	--	**	**	**	**	**	**	**	Chief	ning		26.
27.Store	Hand	**	**	Clerk	Clerk	Clerk	Clerk	:						27.
28.Supply	--	--	**	**	**	**	**	: **	**	**	Chief	Op-		28.
29.Chemist	--	--	--	**	**	**	**	**	**	**	Chief			29.
30.Artisan	III	II	I	Senior	:							ra-		30.
31.Technician	--	--	IV	**	: **	**	**	**	**	:				31.
32.Engineer	--	--	--	--	**	**	**	**	**	: **	SnPrEngn	tion		32.
33.DSMB	--	--	--	--	--	--	--	--	--	--	**			33.

The 5th row: Numbers (both 1, 2 series and I, II, III series) denote those of grades.

In the Job-Designation Matrix: OfMg = Office management, Ac = Accountant, Cl/Clrk = Clerk, PrgSp = Programme Supervisor, SyAn = System Analyst, As = Assistant, Pr = Principal.

Matrix of Designation and Job Names:

1.1 When a job name denotes the person who does it, Desig*Job gives the name, and "**" is shown in the post applicable. Example: Sr2*Engineer= Senior Engineer grade 2.

1.2 In the other cases, the term of "officer" will be added to the combination of two terms of job and designation. Example: I*Transport= Transport Officer Grade 1.

2. When a different name is given to a post from the combination of two terms of job-designation, the term used is given in the post.

Examples: As1*Technician (instead of "***", IV is given to the post)= Technician Grade 4, I*Meter Reader= Chief Meter Reader.

3. "-" means that the post is not existed in the scheme of service of NUWA.

(2) RECRUITMENT, APPOINTMENT AND TRANSFER

The Director General is appointed by the President of Tanzania. Staff members above the PGS (Parastatal General Scale Grade) 6 pay scale are appointed by the board of directors. Those in PGS 5 & 4 pay scales are appointed by a committee and those in PGS 3 and below are appointed by the director-general. Therefore, the branch manager has no power to recruit new staff members.

Suitable candidates for an opening are selected directly from outside, from those possessing the required qualifications or through promotions of those who have served successfully in the previous grade for a minimum of three years.

NUWA has successfully appointed able and energetic senior staff members to the financial directorate and department in an effort to rescue itself from the financial quagmire it has found itself in.

At the level of technicians, several people holding Full Technician Certificate (FTC) have been recruited.

A few transfers between the HQ and the DSMB have taken place; within the distribution section, a number of technicians and artisans are periodically transferred among sub-branches and emergency units. Some transfers involve promotion.

Some employees were dismissed for disciplinary reasons.

(3) TRAINING

The following is the list of institutions which have been producing graduates or qualified personnel for the water industry.

i) Engineering
a) Faculty of Civil Engineering, University of DSM.
b) Technical Colleges in DSM (DTC) and Arusha.
c) Water Resources Institute, Ministry of Water, Energy & Minerals (WRI).
d) National Vocational Training Centre, Ministry of Labour & Manpower Development (NVTC).

ii) Supporting
a) Relevant Faculties, University of DSM.
b) Institute of Finance Management.
c) Institute of Development Management (IDM).

d) Nyengezi Social Training Centre (NSTI), Mwanza.
e) DSM School of Accountancy.
f) Institute of Accountancy, Arusha.

At present, two technicians are being trained abroad at the BE level in the USSR.

Four staff members are being trained in the three-year advanced diploma courses in accountancy and material management at Nyegezi Social Training Institute of Mwanza.

NUWA is currently planning to send two engineers to the DSM University for a post-graduate course in engineering. It is also planning to send one employee to the DTC for a National Higher Diploma course and another for the Full Technician Certificate course at DTC in the next fiscal year.

NUWA has been sending its middle level technicians and craftsmen regularly to intensive course in their respective fields for upgrading their respective skills. About 200 workers participate in such courses every year. Those who clear the tests are awarded certificates ranging from FTC to Trade Test Grade I-III.

Courses and tests are conducted at the Water Resources Institute for the water-related sector subjects and at the National Vocational Training Center for a wider range of professions. The latter does not have tests for the FTC grade. At the same time, several short courses are provided to supporting staff members.

The DSMB conducts plant maintenance courses at the Lower Ruvu Plant in collaboration with the CIDA. CIDA built the Lower Ruvu plant and has been providing operations and maintenance training, along with spare parts. Several engineers and a training officer have been invited to Canada during the course of this assistance scheme.

(4) OTHERS

Salaries have been paid on time. 12.5 % of the base salary is deducted as income tax, with another 1 % deducted as the fee for the Union Tanzanian Workers. Water is free and rent allowance of 10 % at the minimum, as well as a transport allowance is provided. The top four staff members of the DSM Branch are provided with staff quarters. Employees at the 3 treatment plants are also provided staff quarters. Buses are provided for commuting to work and back. There are also provisions for overtime, uniform, meals, travel expenses, etc., according to the requirements of the work.

The present parastatal salary scale, effective since 1st July 1990 is shown in section 2, Appendix B.

3.2.3 DAR ES SALAAM BRANCH OPERATION

(1) DEPARTMENTS OF PERSONNEL & ADMINISTRATION AND FINANCE

When NUWA started to function, Crown Agents prepared guidelines for day-to-day operations. In 1986, Crown Agents prepared manuals and recommendations for daily transactions in the directorate of finance, which includes the data processing section (DPS). It covers a part of the material control section in the directorate of operation. The data processing section is presently handling water billing by means of a mini-computer.

The branch accountant is managing his department energetically, though some of his staff members have become victims of money's charm; the DPS manager is minimizing the processing time required for issuing the water bill, though the capacity of mini-computer is limited.

The personnel section is presided over by a senior personnel officer. As the recruitment of staff is the responsibility of the HQ, he is to study the present staffing position of the DSMB and analyze the need for recruiting of staff members, so that the succession of management personnel at the DSMB can be smooth.

The training officer concurrently holds the post of the acting chief of the administration section, at present; the office service unit does not have a chief, currently. Since office service activity is supportive in nature, and three other units, i.e. transport, medical care and security, are headed by competent staff, processing of daily business has not been unduly delayed. Even the transport unit has no transport of its own, and drivers on duty whose vehicle have broken down have to find other means to return to the office to report the matter.

(2) TREATMENT PLANTS, OPERATION DEPARTMENT

Canada Spare Parts Project under CIDA, which aims to supply essential spare parts for the operation of the Lower Ruvu treatment plant in time of need (excluding vehicles' spare parts).

CIDA has recently prepared a manual and a training programme for the operation of treatment plants of the DSMB. For 15 years, the manpower development team has tried to motivate the plant staff, who have tried to formulate specific job descriptions for plant operations, to edit a operation and maintenance manual, and to initiate training programme for all the staff members of the treatment plants of the DSMB.

Even though facilities are old, the treatment plants are being well-maintained by the plant engineers.

(3) OTHER SECTIONS OF OPERATION DEPARTMENT

The detailed structure of the three sections of the operations department, i.e. distribution, maintenance and supplies & stores, and their inter-related activities are given here, in order to highlight them in the distribution system rehabilitation programme of the DSM water supply system.

a) DISTRIBUTION SECTION

Daily routine operations/maintenance of distribution and service systems is conducted by the distribution sections, along with the five sub-branch offices. Their activities are described below:

AT THE DAR ES SALAAM BRANCH

i) Receive information and give instruction by radio;

* after getting the above-mentioned information, relay it and give instructions for operation of sluice valves and/or gates.
* predict possible water shortage areas by the previous day.
* Receive reports from all sub-branches and, in turn, give instructions to sub-branches about line problems, consumers' complaints and location of troubles encountered on the previous day.

ii) Emergency Measures

The emergency section deals with emergencies and accidents, informing each sub-branch through radio and/or direct telephone line after receiving information. There are twelve technicians with one pick-up car, available all 24 hours, in three shifts.

All activities and actions are reported in the "Daily Report Sheet", to analyze the cause of emergency matters.

Operation of main valves, greater than 300 mm in diameter, is under control of this section, while valves with diameters less than 200 mm are operated by the respective sub-branches.

iii) Arrangement for Materials

Materials required for repairs and for new connections are under the control of the distribution section. After collecting the "Daily Report Sheet" from the five sub- branches, the required materials are arranged to be supplied to the sites.

iv) Monthly Meeting

A monthly meeting between the distribution department and all sub-branch manager is held to dis-

cuss current problems and activities aimed at supplying better quality water at sufficient pressure during the following month.

AT SUB-BRANCH

v) Report and Inform Daily Activities
Each sub-branch reports and informs about activities of the previous day both by radio and through the "Daily Report Sheet".

vi) Repairs
Repairs are done in compliance with instructions from the DSMB.

vii) Service Pressure
Staff carry out daily checks and patrol within their service areas to monitor service pressures and respond to consumer requests.

viii) Meter reading
ix) New service pipe connections
x) Disconnection of illegal service pipes

A total of 33 wards are serviced by the five sub-branches. Table 3.4 gives the scale of the services rendered.

TABLE 3.4 TYPES OF CONSUMERS CLASSIFIED BY SUB-BRANCHES (as of Dec.'89)

Sub-Branch	Ward	Domestic(%)	Standpipe	Commercial	Industry	Institution
Ilala	14	16,336 (30)	0	1,129 (41)	77 (16)	548 (45)
Temeke	6	10,111 (18)	3	376 (13)	331 (66)	284 (23)
Magomeni	7	14,482 (27)	1	493 (18)	21 (4)	50 (4)
Kinondoni	3	8,702 (16)	1	643 (23)	7 (1)	139 (12)
Kawe	3	4,882 (9)	2	145 (5)	66 (13)	191 (16)
Total	33	54,513 (100)	7	2,786 (100)	502 (100)	1,212 (100)

b) EMERGENCY SUB-SECTION

The emergency sub-section consists of eight staff members. It consists of three teams, each headed by a distribution supervisor or a shift supervisor, operating on three shifts a day. The morning shift starts at 6 am.

c) SUB-BRANCHES

i) GENERAL

There are five sub-branches. Sub-branch managers have problems related to distribution pending for many years at a time. They are under the control of the distribution engineer in the operation department, according to the existing organizational chart.

The sub-branch offices consist of four or five operating units, i.e. maintenance with leak survey, new connections, meter room, meter reader and pump attendants when booster pumps are installed in their ward.

The number of staff members shown in Table 3.5 handle the range of services given therein.

The sub-branch manager is to give daily reports to the distribution engineer about the day-to-day activities of the branch. The report consists of 24 items of information. They are:

- Communication Means:
  1. telephone,
  2. transport.
- Energy:
  3. electricity.
- New Connections:
  4. number of applications received,
  5. number of estimates done,
  6. number of new connexions made,
  7. actual amount paid.
- Leaks:
  8. number of leaks detected by leak survey team,
  9. number of leaks detected by other means,
  10. number of leaks repaired,
  11. number of leaks under repair,
  12. number of leaks waiting fittings (line disconnected),
  13. number of maintenance estimates done,
  14. amount paid for maintenance.
- Maintenance:
  15. number of sluice valves serviced,
  16. number of air valves serviced,
  17. number of fire hydrant repaired,

18.number of washout serviced.

- Meter:

19.number of meters read,

20.number of new meters installed.

- Consumer:

21.number of consumers visited (for payment of bill, complaint etc),

22.number of consumers disconnected,

23.number of consumers reconnected,

24.number of illegal connections discovered.

TABLE 3.5 NUMBER OF STAFF IN SUB-BRANCHES & RESERVOIRS NUMBER OF NEW CONNECTIONS & LEAKAGE

(average per month)

	Spv	NwCx	Main	PumpM/Rd	M/Rm	Spt	Grd	TTL	NeCx	Lkg
Ilala	2	13	21	2	4	11	7	4	64	60	300
Temeke	3	6	29	3	6	7	2	7	63	50	50
Magomeni	3	11	19	0	4	7	5	5	54	50	100
Kinondoni	2	11	21	0	5	8	5	6	58	25	20
Kawe	2	10	16	11	3	7	1	5	55	50	50
Sub-total	12	51	106	16	22	40	20	27	294	235	470
Kimara	1	--	2	--	--	--	0	5	8		
Univers.	1	--	2	--	--	--	1	4	8		
Sub-total	2	--	4	--	--	--	1	9	16		
TOTAL	14	51	110	16	22	40	21	36	310		

Legend:
Spv = Supervisory, NwCx= New Connection, Main= Maintenance,
M/Rd= Meter Reader, M/Rm= Meter Room, Spt = Support,
Grd = Guard, TTL=Total
NeCx=Number of New Connection, Lkg=Number of Leakage repair

ii) New Connections

Formerly, it was the responsibility of the branch office to handle applications for new connections from potential customers, and the responsibility of the project department to make a cost estimate for the new connection. It was the responsibility of the appropriate sub-branch to install the connection. Now, all these have been decentralized and the sub-branch concerned deals with all aspects of new connection.

The person in charge of the meter reading unit assists the applicant in completing the application form

and passes it on to the manager. The matter is then transferred to the new connection unit, which will conduct surveys and make estimates. The applicant will then pay a connection fee, if the connection takes place at the distribution mains of NUWA property *, following which, the manager will open a new file with a work number. The actual work of connecting is done by a private contractor. The manager will forward the file to the chief meter reader of the revenue section in the finance department. He will allocate an account number and then the number will be registered in the master file of the billing sub-section.

iii) Maintenance

Besides daily maintenance, the unit also has a leakage detection team. Unfortunately, the team is hampered by the lack of suitable transportation.

iv) Meter Room, and Meter Reader

Originally the duties of meter room unit and meter reader unit were as follows:

- Meter Room:
  a. To keep meter records,
  b. To disconnect service pipes and reconnect them.
  c. To examine customers' complaints about meter reading,
  d. To replace malfunctioning meters, and
  e. To install meters.

- Meter Reader:
  a. To read meters,
  b. To report water supply problems within customers' premises,
  c. To update records of readings.

Except for b. of the meter room, these units are not active at the moment, as very few meters are installed. Therefore, the team is usually called on to support the maintenance team when they attend to leakage problems. Nevertheless, they are the people to get in touch with customers.

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* As the secondary distribution system has not reached areas where new housing development is occurring spontaneously, consumers themselves service connections. In the case where mains are too far, the newcomers negotiate with their neighbours who already have service pipes. The sub-branch concerned gives technical advice to the party.

This knowledge of the actual condition of the facilities at the consumers' end comes in handy in resolving disputes over water billings between consumers and the DSMB, as there is no data that is mutually acceptable to both sides. This is in the case where the consumer who claims that his bill is greater than what he is consuming. (No consumer, whose water bill is less than the amount he feels he has consumed, will come forward voluntarily.)

v) Others

The trunk main is to be patrolled periodically for inspection and repair. The Magomeni sub-branch team patrols a part of the Upper Ruvu trunk main, i.e., within the boundary of Greater DSM, from Kibamba downwards. The Kawe team takes care of the Lower Ruvu trunk main, from the Mpiji river bridge downwards. The rest are done by the teams from the two treatment plants. Effective patrolling is made difficult by the lack of staff and equipment, as well as other factors. For example, the area above the Mpiji river bridge, where the trunk main is not running alongside a road, is virtually impassable due to the growth of vegetation.

If the treated water in the mains were not diverted through off-takes en route to the reservoirs, the problem would not be serious. But there are many offtakes. Due to the high pressures, any leakage from the diversion pipes may result in bursts. If this is not attended to immediately, tremendous loss of treated water would result.

The Magomeni sub-branch also monitors the two reservoirs. All the sub-branch offices have payment and complaint counters. All the sub-branch offices also have a shed to keep fittings. Pipes are kept out in the open. All the offices are owned by NUWA, except at Ilala, where space is rented on the ground floor of a two storey commercial building. A small shed is attached to it at the back.Thanks to the generosity of the next-door neighbour, the pipes stretch into the neighbour's backyard also. The four other sub-branch offices are housed in temporary structures.

4) MAINTENANCE SECTION

The maintenance engineer is supported by a mechanical engineer, an electrical engineer, and a technical advisor to civil works. A workshop supervisor is in charge of the Pugu Road workshop, under whom patrol foreman leads 15 automobile mechanics, three automobile electricians and a vehicle attendant, and a meter repair foreman with a repairman. The meter repair foreman is not at the Pugu Road Workshop at present when there are few meters to repair, but at Gerezani, where he is trying to reconcile with customers complaining about their water bills. There are 20 civil works technicians, but only one electrician under the electrical engineer.

Among all the maintenance activities, vehicle maintenance is most adversely affected. NUWA has 49 vehicles as of July 29, 1989. Twelve were for use at the headquarters. The DSMB has five. Nine have been allocated to the operations department, five to the three treatment plants and ten to the five sub-branches. Three vehicles are for the project department and one for the data processing section. The NUWA car pool consists of a tipper carrying gravel for filters, a lorry and two buses.

Once a vehicle breaks down, spare parts are not available in the market, and consequently, it becomes idle. Mechanics are also idle. If a similar type of vehicle also breaks down, one of the two should be scavenged to repair the other. The road conditions are bad, and the fleet is aging. Minor repairs have to be attended to in an expeditious manner. The supply officer is always frantically sending out search missions to the Kariakoo market to look for parts.

As of March 23, 1990, the number of registered vehicles had decreased to 44, of which 21 vehicles were in working order.

The workshop has barely enough tools to cover ordinary automobile repair works and civil works, but has no machine tools. There, behind the workshop, is a shack where rehabilitation work has been suspended for some time ; machine tools like a lathe machine is lying idle without being used. A tiny and deserted old site of the meter repair workshop is located farther behind.

At the moment, a shack of 50 m^2 is being built in the Gerezani compound by an Italian project team, which has just finished work on rehabilitating the Upper Ruvu system. It is for use as a meter repair shop.

5) STORES & SUPPLIES SECTION

This section has its office in the Pugu Road Compound where the NUWA warehouse is located. All materials, with the exception of chemicals, are stored here. Pipes and valves of large sizes are kept in an open yard. As the workshops of both maintenance and operation departments and the construction section of the project department are located in the same compound, it is convenient for delivery of goods.

Figure 3.4 shows the organization chart of the Stores & Supplies Section (SSS).

When materials required are not in stock in the sub-branch sheds or in the depot of SSS, the end-user will have to send out a requisition (The procedure is the same for any user of the other sections). The flow chart of this process is shown in Figure 3.5. Cash purchase is discouraged, as much as possible.