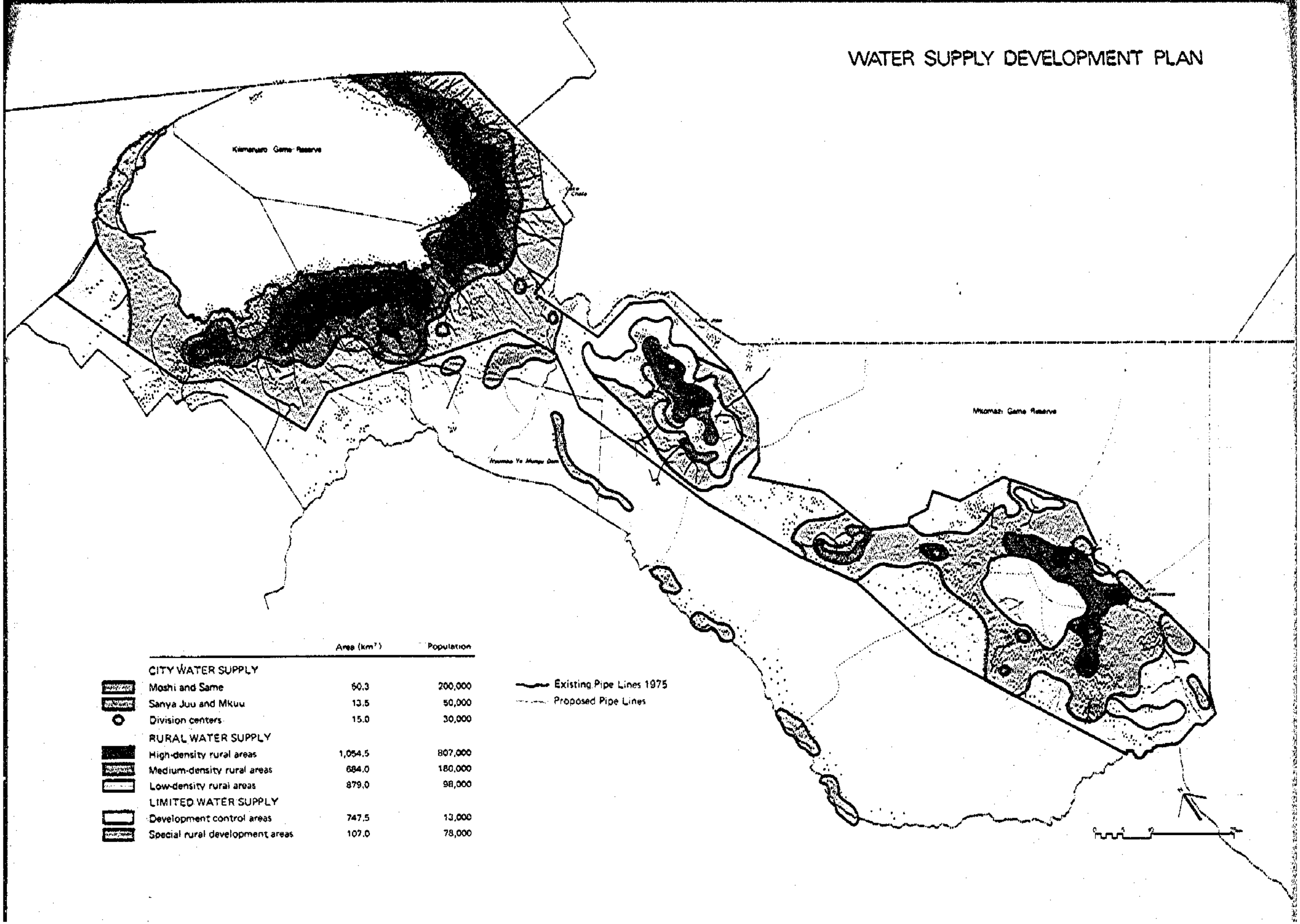
KILIMANJARO IDP

PUBLIC UTILITIES

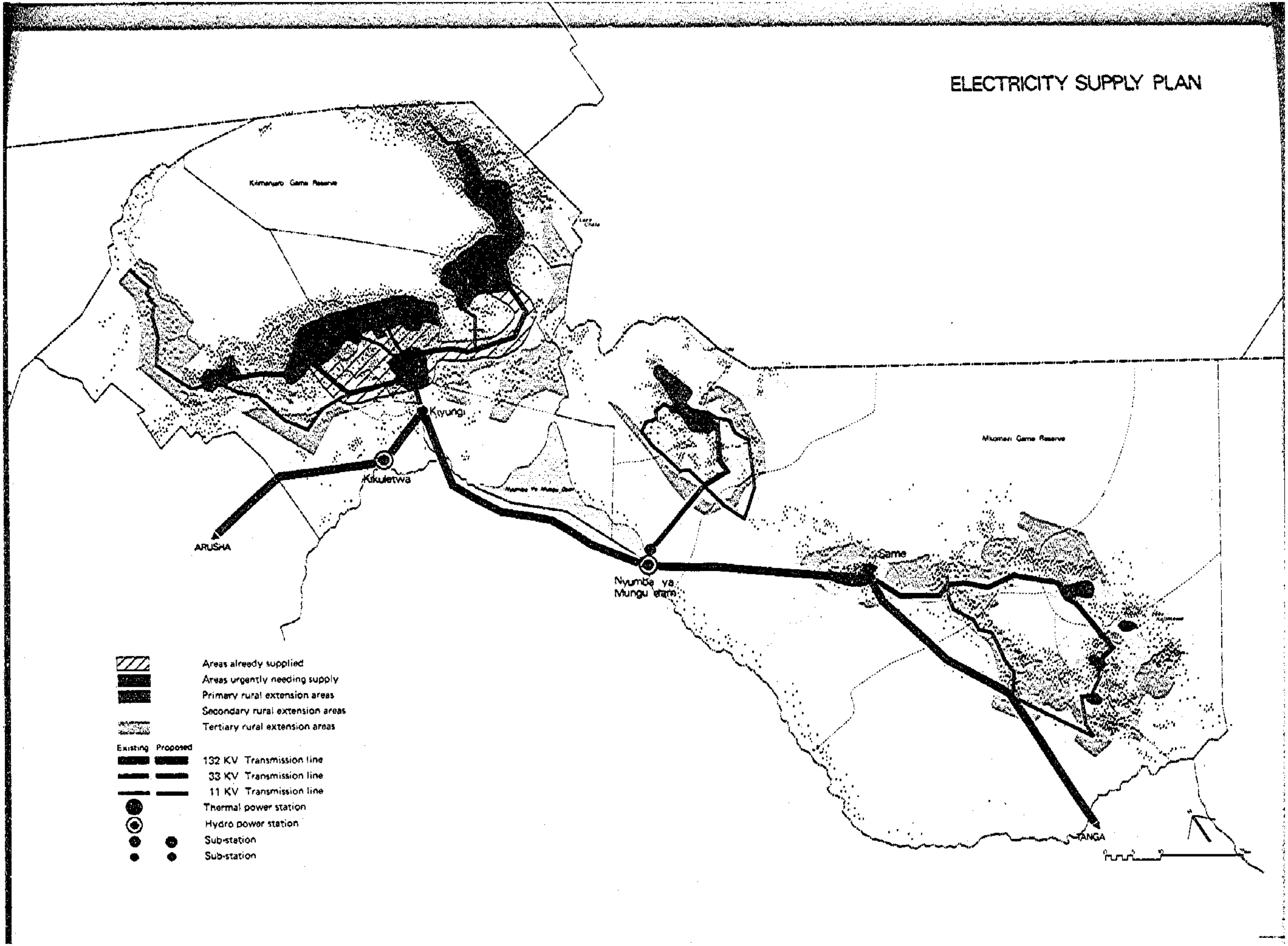
13

WATER SUPPLY DEVELOPMENT PLAN



	Area (km²)	Population
CITY WATER SUPPLY		
Moshi and Same	60.3	200,000
Sanya Juu and Mkuu	13.5	50,000
Division centers	15.0	30,000
RURAL WATER SUPPLY		
High-density rural areas	1,054.5	807,000
Medium-density rural areas	684.0	180,000
Low-density rural areas	879.0	98,000
LIMITED WATER SUPPLY		
Development control areas	747.5	13,000
Special rural development areas	107.0	78,000

ELECTRICITY SUPPLY PLAN



PUBLIC UTILITES

Contents

1. RURAL WATER SUPPLY

1.1 Existing Condition of Rural Water Supply

(1) General

The rate of rural water supply in the region in 1976 was 44% in comparison to an average of 20% for the entire country. (Table-1)

Various projects for stabilizing water supply in rural areas are being promoted in different regions. The principal characteristics of the rural piped water supply project (Table-2) in this region can be summarized as follows:

(i) River streams and springs account for a considerable portion of water resources.

Ease of water resource development and water intake.

(ii) 90% of water distribution systems depend on gravity - economy of water distribution.

(iii) Water-supplied population per project in this region is 3,164 persons versus an average of only 2,355 nationwide - efficiency of water supply.

In addition to abundance of water, the quality of the water, too, is good. Raw water from springs and rivers does not have to be treated much, and therefore it has not been necessary to build treatment plants. A recent survey, however, has revealed the danger of pollution of the water through human activities. Protection of in take areas is, therefore, now emphasized.

Stage of Water Supply in Different Regions (Table-1)

Region	Area(km²)	Population	Total number of piped water projects	Piped water projects in townships	Piped water projects in rural areas	Rural population with piped water	% of rural population with piped water
Arusha	82,103	801,000	136	8	128	139,565	20
Coast	32,825	582,000	49	4	45	140,000	25
Dar es Salaam	975	517,000	9	1	8	5,250	-
Dodoma	41,311	853,000	168	3	165	313,052	40
Iringa	56,850	886,000	54	4	50	99,720	12
Kigoma	37,037	534,000	40	4	36	119,895	25
Kilimanjaro	13,200	850,000	110	2	108	348,000	44
Lindi	66,050	483,000	38	4	34	109,000	23
Mara	21,756	719,000	26	4	22	55,320	8
Mbeya	60,350	939,000	51	6	45	126,095	15
Morogoro	73,000	804,000	46	4	42	75,338	10
Mtwara	16,740	878,000	18	2	16	280,000	33
Hwanza	19,684	1,308,000	59	6	53	193,415	16
Rukwa	68,635	360,000	21	2	19	47,185	14
Ruvuma	61,245	491,000	38	3	35	66,465	14
Shinyanga	50,765	1,106,000	40	5	35	120,445	12
Singida	49,340	513,000	73	3	70	81,735	17
Tabora	76,145	666,000	39	3	36	102,930	17
Tanga	26,810	955,000	75	7	68	105,000	12
West Lake	28,749	774,000	51	4	47	159,125	21
Totals and average	883,570	15,019,000	1,141	79	1,062	2,687,535	20

Characteristics of Water Supply in Different Regions (Table-2)

Region	Number of rural piped water supply projects	Pumped (%)	Gravity (%)	% breakdown of water sources: Ground water: B/H	Wells	Springs	Surface water: Rivers stream	Lakes & dam	% rural treatment plants
Arusha	128	33	67	23	1	44	29	3	1
Coast	45	100	0	13	42	0	13	32	4
Dar es salaam	8	100	0	12.5	12.5	0	75	0	0
Dodoma	165	90	10	90	0	10	0	0	0
Iringa	50	66	34	6	4	20	70	0	4
Kigoma	36	92	8	3	0	25	58	14	0
Kilimanjaro	108	10	90	9	0	40	44	7	0
Lindi	34	91	9	42	22	5	28	3	5
Mara	22	95	5	31	5	5	0	59	15
Mbeya	45	56	44	0	22	24	51	3	4
Morogoro	42	71	29	26	7	5	60	2	6
Mtwara	16	75	25	12.5	25	25	12.5	25	22
Mwánza	53	94	6	21	2	0	0	77	5
Rukwa	19	42	58	5	0	5	74	16	19
Ruvuma	35	94	6	0	11	14	66	9	3
Shinyanga	35	100	0	23	37	17	0	23	0
Singida	70	100	0	99	0	0	0	1	1
Tabora	36	78	22	19	14	3	0	64	23
Tanga	68	63	37	25	19	4	41	11	1
West lake	47	77	23	6	9	21	45	19	0
Totals and average	1,062	70	30	33	9	16	28	14	3-1/2

(2) Rural Population with Piped Water

Piped water supply in this region was commenced in the early 1960s, with clean water being supplied to about 300,000 people by 1975. This was made possible by improvement of water works in the early 1970's. It seems that the regional government has further plans for various rural water supply projects for the purpose of increasing the population supplied with water by about 400,000 by 1980, for a rate of supply of 66.7%, assuming that the present high rate of progress can be maintained.

Population with piped water (Table-3)

	Hai	Moshi	Rombo	Pare	Totals
-1960	0	0	0	9,500	9,500
1961-1965	800	2,400	0	3,300	6.500
1966-1970	19,000	39,050	7,300	23,400	88,750
1971-1975	18,810	98,170	34,220	49,190	200,390
1976-1980	73,200	148,300	80,910	75,550	377,960

	Hai	Moshi	Rombo	Pare	Totals
Up to 1960	0	0	0	9,500	9,500
Up to 1965	800	2,400	0	12,800	16,000
Up to 1970	19,800	41,450	7,300	36,200	104,750
Up to 1975	38,610	139,620	41,520	85,390	305,140
Up to 1980	111,810	287,920	122,430	160,940	683,100

(3) Distribution by District

The percentages of population with water accounted for by the respective districts are Moshi 45.8%, Rombo 13.6%, Hai 12.7%, and Pare 28.0%.

The water supply rates in 1975 were 46.4% in Moshi, 28.4% in Rombo, 24.0% in Hai, and 47.5% in Pare. Thus the supply rate of 48%, the target of the Third 5-year Development Plan, was already nearly reached in Moshi and Pare.

The percentage of water-supplied villages is highest in Rombo and lowest in Pare, as shown in the table-4.

Number of villages supplied with piped water (Table-4)

	Hai	Moshi	Rombo	Pare	Totals
No. of villages	71	126	55	96	348
Water supplied villages	32 (45.1%)	76 (60.3%)	40 (72.7%)	34 (35.4%)	182 (52.3%)
Population supplied with water	38,610	139,620	41,520	85,390	305,140

Length of pipelines (km) (Table-5)

	Hai	Moshi	Rombo	Pare	Totals
Existing	110.3	204.0	80.3	157.9	552.5
Planned	123.9	209.3	110.0	195.6	638.8
Totals	234.2	413.3	190.3	353.5	1,191.3

Number of domestic points (Table-6)

	Hai	Moshi	Rombo	Pare	Totals
Existing	220	406	158	315	1,099
Planned	247	416	218	389	1,270
Totals	467	822	376	704	2,369

1.2 Present Development of Water Supply

(1) Rural Water Supply Projects

The clean water supply projects in the Killimanjaro Region are as shown in Fig.1 and Table 8 and the progress of construction of Pipelines is summarized in following tables on the bases of the 1975 annual report for the Kilimanjaro Region.

As of 1975, 326.4km of pipeline was laid in Moshi, 128.4km in Rombo, 176.5km in Hai, and 256.2km in Pare for a total of 887.5km. By 1980 the total length will be approximately 2,000km.

Preliminary investigations and surveys have been completed for most of these pipelaying plans.

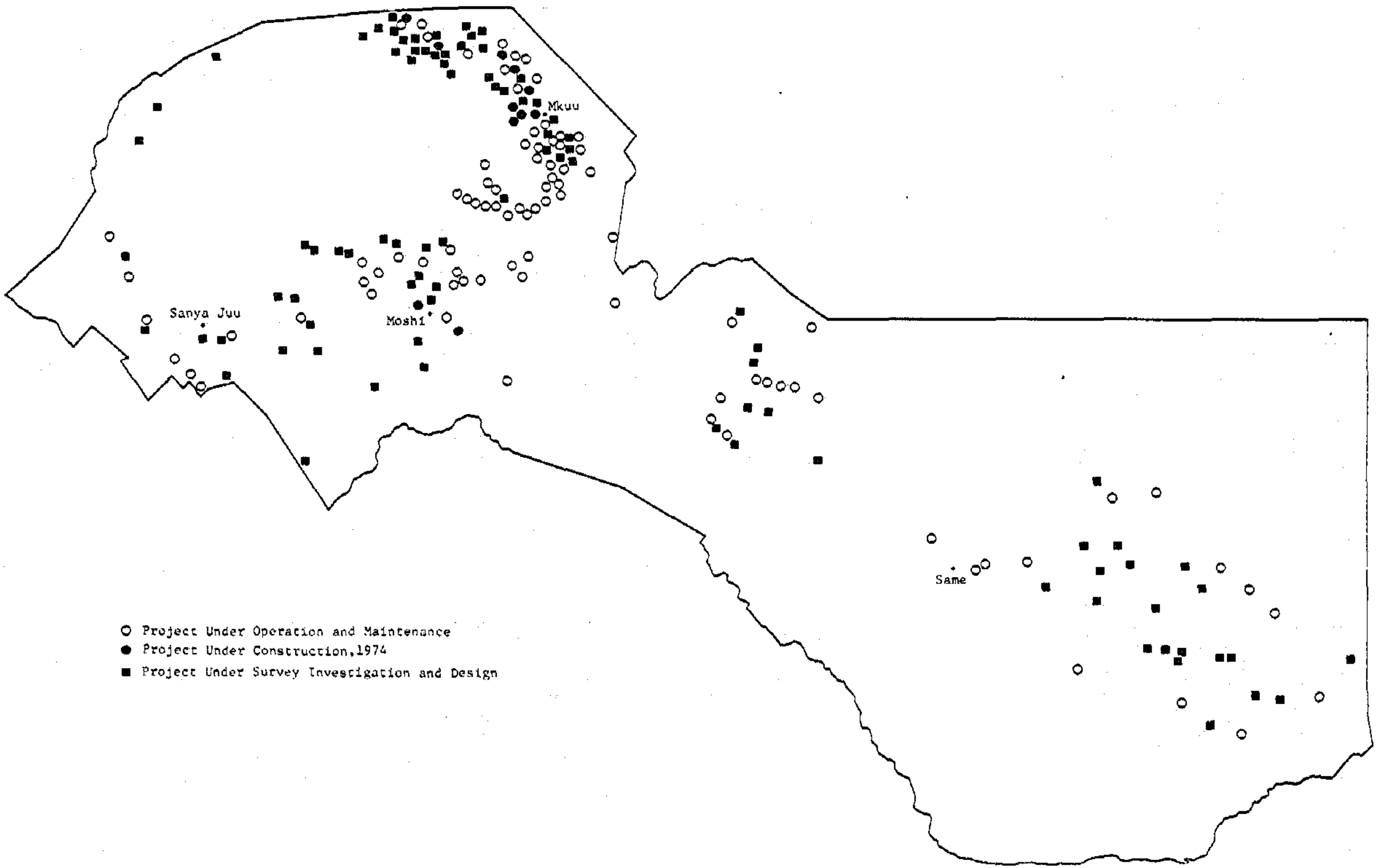
Length of pipes laid (Table-7)

(Unit:km)

	Hai	Moshi	Rombo	Pare	Totals
-1960	0	0	0	7.5	7.5
1960-1965	5.4	16.5	0	7.5	29.4
1965-1970	55.6	76.3	13.3	67.9	213.1
1970-1975	115.5	233.6	115.05	173.3	637.45
1975-1980	198.25	334.82	176.0	312.9	1,021.97

	Hai	Moshi	Rombo	Pare	Totals
Up to 1960	0	0	0	7.5	7.5
Up to 1965	5.4	16.5	0	15.0	36.9
Up to 1970	61.0	92.8	13.3	82.9	250.0
Up to 1975	176.5	326.4	128.35	256.2	887.45
Up to 1980	374.75	661.22	304.35	569.1	1,909.42

Water Supply Projects in Kilimanjaro Region (Fig.-1)



○ Project Under Operation and Maintenance
● Project Under Construction,1974
■ Project Under Survey Investigation and Design

Water Supply Projects (Table-8)

Moshi District

Name of Pipeline	Division or village	Approx. pop. served	Length of Pipeline (km)	Year laid
1.Moroworo sholo dam	Kirua v. north	-	-	1961
2.Ukyashi P/L	Vonjo	1,000	11.4	1962
3.Marangu Baraza P/L	West vonjo	1,000	3	1965
4.Marangu Disponsary P/L	Vonjo	400	2.1	1964
5.Sholo P/L ph. II	Kirua v. south	4,000	7.5	1969
6.Mwika Matara P/L	West vonjo	3,500	13.8	1967
7.Sholo P/L.ph. III	Kirua v. west	4,000	3.6	1968
8.Mbokomu P/L	Old moshi west	5,000	21	1969
9.Miwaieni B/H	Kirua v. south	1,000	0.3	1969
10.Kahe B/H	Kahe	1,000	0.2	1969
11.Sholo Phase V.	Old moshi mdawi	3,000	3	1970
12.Marera Lote	Kwika	6,300	10.8	1970
13.Una Phase I.	Maraugu/namba	2,800	8.1	1970
14.St. James Seminary	Uru north	500	3	1970
15.Komaka Mandaka ph. I	Old moshi shia	7,550	5	1970
16.Umbwe Phase I.	Kibosho	9,200	5.7	1971
17.Mahida Mawanda	Mwika N.E. shouth	10,500	19.2	1971
18.Lotima W/S	Mwika south	1,200	7.8	1971
19.Una Phase II.	Mamba/marangu	10,600	22.2	1971
20.Chekereni/mtakuja	Kahe	2,500	9.3	1972
21.Manu School ph. I	Kirua north	1,000	3	1972
22.Uru-Kishomboko	Uru	2,000	3.9	1972
23.Umebe Phase II.	Kibosho	10,400	27.6	1972
24.Mtakuja Irrigation Sch.	Chekereni	1,500	3	1972
25.Uru Materuni	Uru	2,600	4.8	1972
26.Manu School ph. II	Kirua north	1,000	3	1972
27.Komaka Mandak ph. II	Old moshi east	6,020	14	1973
28.Kwewere Kom Ela	Kikua south	4,100	27.3	1973

Name of Pipeline	Division or village	Approx. pop. served	Length of Pipeline (km)	Year laid
29.Marangu West	Marang west	5,800	9.3	1973
30.Kisombo Kitandu Chini	Uru south	800	5.5	1973
√31.Mweka Phase I.	Kibosho Mweka	1,200	3.5	1973
32.Mokohu Mission	Marangu west	1,500	3.8	1973
33.Komaka Mandaka	Old moshi shia	1,050	2.8	1974
34.Masanga	Old moshi mbokomu	900	3.7	1974
35.Shiri Matunda	Kibosho south	1,500	4.2	1974
36.Masaranga Extn.	Masaranga	400	0.5	1974
37.Kilemarunta Clinic	Old Moshi T	1,000	3.5	1974
38.Una Phase III	Fast vunjo	8,000	19.7	1975
39.Uru Kask.D Sponsary W/S	Uru north	1,200	3.7	1974
40.Umbwe Mkomongo P/L	Kibosho south	800	2.2	1974
√41.Kilema Kytic	o Kilema	2,200	4.2	1975
42.Kilimanjaro National Parks W/S	Marangu north	200	6.5	1975
43.Kiboriloni W/S Kwajuma Spring	Old moshi Mbokomu	6,000	1.8	1975
44.Mwika Kiruweni	Mwika	3,000	7.9	1975
45.Kilena Phase II-M		11,000	2.2	Design approved
46.Una Phase IV-M		6,000	21	Survey comp
47.Nganjoni W/S-M		3,000	10.4	Design app.
48.Kidia Kilemapunda-M		11,400	30.5	"
49.Materuni Phase II-M		18,000	20.9	Survey comp.
50.Mabogini Kahe W/S-M		10,000	54.7	Under const
51.Utaruni W/S-M		17,000	40.2	Design app.
52.Uru Mawella-M		13,600	20.1	Design comp.
√ 53.Mweka Phase II-M		8,000	16	"
54.Mengeni W/S-M		25,000	32.1	Survey comp.
55.Mbokomu West W/S-M		10,000	13.6	Design comp.
56.Natiro B/L from Mbokomu W/S-M		4,000	8	"
57.Materuni W/S Ext.-M To Kirukuna & Kimaila		-	2	"

Name of Pipeline	Approx. pop. served	Length of Pipeline (km)	Year laid
58.Usoro Kisomachi W/S-M	10,500	32.5	Design app.
59.Moshi Town W/S-M	Town	14.4	Design comp.
60.Mango Nission W/S-M	600	1.17	Design app.
61.Kilacha Farm W/S-M	Irr.&Done	9.6	"
62.Magereza Irr., Canal-M	50 acreas	1.95	"
63.B/L to Mloma Estate from Magadini W/S	200 people & 600 cattle	3.5	"

Water Supply Projects (Table-9)

Pare District

Name of Pipeline	Division or village	Approx. pop. served	Length of pipeline (km)	Year laid
1.Lombeni B/H	Same Mbaga	1,500	3	1954
2.Same W/supply B/H	Same Town	8,000	4.5	1960
3.Ndea B/H	Usangi	800	3	1961
4.Kamori B/H	Usangi	800	3	1961
5.Kwanga W/S	Ugweno	2,000	1.5	1964
6.Kisangiro B/H	Ugweno	500	3	1965
7.Kincondi B/H	Same Mbaga	1,000	1	1966
8.Kihurio P/L Phase I&II	Mamba	4,100	10.8	1968
9.Ndungu P/line	Mambe	2,000	9	1969
10.Kishiwani P/line	Same Mbaga	5,000	8.4	1969
11.Gonja P/line	Gonja	2,600	13.5	1969
12.Kwkoa Mgigili P/L	Usangi	2,500	5.1	1969
13.Kiruru P/L	Usangi	4,500	12.6	1970
14.Kileo P/L	Ugweno	1,700	7.5	1970
15.Mgagano B/H	Ugweno	1,000	2.7	1971
16.Lwami Ujamaa Village	Ugweno	1,500	3.3	1971
17.Suji	Chome Suji	400	4.2	1971
18.Kigondigondi P/L	Usangi	2,500	6.9	1971
19.Vuma-ri P/L	Usangi	7,000	15.9	1972
20.Lambo P/L	Ugweno	2,100	10.2	1972
21.Chanjale P/L	Usangi	7,000	38.7	1973
22.Usangi Chini P/L	Usangi	8,900	26.8	1974
23.Njiro P/L	Same Mbaga	1,120	8.6	1973
24.Mkomazi B/H	Same Mbaga	100	0.7	1973
25.Mpirani P/L	Gonja	1,200	7.3	1973
26.Hedaru P/L	Mamba	5,200	10.3	1974
27.Kimunyu Makanya	Chome Suji	8,370	24	1975
28.Kwakoa Ngulu	Usagi	600	2.7	1973

Name of Pipeline	Division or village	Approx. pop. served	Length of pipeline (km)	Year laid
29.Kivisni B/H	Ugwino	800	1	1975
30.Toloha P/L	Usangi	1,000	8	1975
31.Njoro W/S	Same mbaga	400	2	1973
32.Mwembe Masandare		13,000	32	Design & estimate app.
33.Vuble Nyika		2,100	11.3	Design app.
34.Usangi Juu		2,800	13.8	"
35.Vulue W/S		14,600	64	Under const.
36.Kalimawe Ndungu Ext.		1,200	8	Design comp.
37.Chome W/S		3,400	24	Survey comp.
38.Chebaru W/S		8,800	27.2	Survey & design comp.
39.Ndea W/S		3,000	16	Survey comp.
40.Mkanka W/S-Ext. from Kimunyu		3,000	12	Survey & design comp.
41.Vudee juu		2,000	16	Design comp.
42.Mtii Bomba		6,000	28.8	Preliminary investi-gation comp.
43.Vuje Bomba		5,000	15	"
44.Vunta		2,650	4.8	"
45.Mpiji		3,000	16	"
46.Mamba		5,000	24	"

Water Supply Projects (Table-10).

Hai District

Name of pipeline	Division or village	Approx. pop. served	Length of pipeline (km)	Year laid
1.Masama Phase I.	Masama	1,000	12	1966
2.Lawate P.L	Masama South	800	5.4	1962
3.Masama Phase II.	Masama South	2,900	12.3	1969
4.Machame Phase II.	Machame North	8,950	14.7	1973
5.West kilimanjaro forest W/S	Engare Nairobi	400	1.2	1972
6.Naibili W/S	Sanya Juu	1,700	10.5	1970
7.Machame Phase II.	Machame Centre	13,400	20.8	1970
8.Losaa Phase II.	Masama West	8,260	49.8	1975
9.Magadini & C. mission W/S	Sanya Juu	1,200	49.8	1975
10.Machame ph. III		6,000	21	Design comp.
11.Machame ph. IV		7,000	19.4	"
12.Loss ph. I		9,800	59.5	Under const.
13.Lyamungo W/S		22,000	37.8	95% Survey comp.
14.Kishisha Fuka W/S		12,400	27.3	Design comp.
15.Magadini R.C. mission		3,000	11.2	"
16.Sawe sonu W/S		10,000	20.1	"
17.Kibongoto W/S to Hai District.		3,000	1.95	"

Water Supply Projects (Table-11)

Rombo District

Name of pipeline	Division or village	Approx. pop. served	Length of pipeline (km)	Year laid
1.Shoshoro B/H	Usseri	500	0.5	1967
2.Chala B/H	Mansera	500	0.5	1967
3.Mriti Mansera ph. I	Mansera	3,500	4.8	1968
4.Mriti Mansera ph. II	Mansera	2,800	7.5	1970
5.Ringachi Mlembea	Usseri	1,300	3.7	1972
6.Kinyalvua	Mwika	900	1.5	1972
7.Ek-T-M4A Mashati	Mengwe	6,000	12.3	1972
8.Marua Mashati	Mkuu	8,000	12	1972
9.Mriti Mansera Chala	Mengwe	500	5.1	1973
10.	Mengwe	1,200	6.5	1973
11.Ektm ph. I	Mvika/Mkuu	—	15	1972
12. " ph. II		8,960	22	Under const.
13.Kikelelwa Main	Trakea	3,560	10.8	1973
14.Onya ph. II	Mengwe	2,100	2.4	1973
15.Kikelelwa B/LS	Tarakea	600	5.6	Under const.
16.Rua P/L	Ussri Kati	450	3.7	1974
17.Kiraeni W/S	Mashati/Kisini	1,100	2.6	1974
18.Kilampua Ibukeni	Mkuu	1,250	4.0	1974
19.Kinagachi Extn.	Usseri Kati	500	3.7	1974
20.Extm 10B Kasuruwa	Mashati	1,700	4.2	1974
21.Kaseni B/Line	Mengwe	200	1.05	1974
22.Shala B/Line	Mengwe	500	5.1	1974
23.Mashami Makaviti	Mengwe	600	4.5	1975
24.Mengwe P/L	Mengwe	2,460	6.4	1975
25.Reha P/L	Usseri Kaskazini	1,900	10.5	1975
26.B.K.T.M. 9B-Mashati		1,800	1.6	Under const.
27.E.K.T.M. 9D-Kasuruwa		1,700	3.5	"

Name of pipeline	Approx. pop. served	Length of pipeline (km)	Year laid
28.E.K.T.M. 10A-Usaranga	2,000	4.2	Design app.
29.E.K.T.M. 11A-Kiwandjuu	1,600	3.2	"
30.E.K.T.M. 6-Masaseni	12,400	7.0	"
31.E.K.T.M. 5B-Makidi	4,800	8.0	"
32.E.K.T.M. 6A-Useri	1,700	4.2	"
33.E.K.T.M. 7- rao	4,600	9.6	"
34.E.K.T.M. 8A-Kuruajuu	400	1.6	Under const.
35.E.K.T.M. 9A+C-Kitale & Kisale	5,200	8.0	"
36.E.K.T.M. 12-Kirongo Chini	2,300	6.4	"
37.E.K.T.M. 13-Kirongo Juu	1,400	3.5	"
38.E.K.T.M. 14-Kahe Chini	1,000	3.2	Design app.
39.E.K.T.M. 15 & 16 Kahe Ulena	1,050	4.8	"
40.Ngaseni W/S	1,700	3.4	Survey comp.
41.Manda Keni W/S	3,500	11	Design app., funds not yet forthcoming
42.Shimbi Mashami	2,500	4.8	Survey comp.
43.Hakwa W/S	6,000	6.7	Reserved
44.Holili W/S-Marisha ph.IV	1,000	5.6	Survey comp.
45.Ushiri W/S	5,000	26.6	Preliminary investi- gation comp.
46.Masama (Keni B/C)	1,900	5.6	"
47.New Keni P/L	2,000	3.5	"
48.Mfuru (Mriti Mausera B/C)	1,500	3.4	"
49.Macuyo Usseri	1,400	3.4	"
50.Keni Mamba-B/C of Keni	2,900	5.6	"

(2) Design Criteria and the Present State of Service ability

The first design criteria for Tanzania were set by the Water Development and Irrigation Division (WDID) of the Ministry of Agriculture and were applied in the First 5-year Plan and the first year of the Second 5-year Plan.

In 1970 WDID adopted several new design criteria in order to reduce project unit cost. In April 1970 a study was made and recommendations were presented by O. Rimer and Associates for rural water supply water supply programmes, and some of these recommendations were applied to the WDID design criteria.

The existing design criteria are given in the table below.

Design Criteria I, II (Table-12)

Organization	First criteria WDID (1969)	Second criteria WDID (1970)
Design period	5 years, with 50% pop. increase; or 10 years, with 100% pop. increase	Designed to meet demand over 20-year period.
Water allowance per-capita, per-day	People, 10 gal. Cattle, 10 gal.	Standpipes = 30 litres
Water allowance for specific types of water use/ca/day		
Peak flow	max hour = 4 x average hour	
Storage capacity	24-hour supply for 5-year demand	24-hour supply for maximum day
Maximum and minimum pressures	Standpipes: Max = 60' Min = (15') 20' House connections: min = 10' (20')	
Maximum and minimum pipes sizes (distribution) pipes	rising main: Min = 2" rising main Max = 5 ft/sec.	
Standby pumping requirements	One reserve pump and engine set	Two pumps and engine set work simultaneously with no reserve sets provided.
Water rate	Charge only for individual connections	

Design Criteria III (Table-13)

Design period	Present	Over 20-year period
Population growth	-	3% a year 350 pupils/school
Water allowance per capita per day (demanding time in hours)	people 45 lit (6h) school 22.5 lit (10h) teachers 45 lit (6h) - liverstock 22.5 lit (10h)	people 30 lit (6h) school 22.5 lit (10h) teachers 30 lit (6h) dispensary 22.5 lit (10h) livestock 22.5 lit (10h)
Maximum and minimum demand	peak flow 6 am to 6 pm 4 x average hour	peak flow from 6 am to 6 pm 4 x average hour
Storage capacity	2/3 demand	Increase storage capacity to meet increasing demand
Pressure	min. 5.0 m to 6.0 m	
Pumps	present demand pumping 10 hours/day	Increase pumping hours, change pumps and replace them with some bigger capacity
Main factors for planning and design	communal standpipes minor distribution piping quality tes	intake well quantity borehole test gravity rising main/ distribution main
Domestic points	100 people/domestic point	200 people/domestic point

(3) Water Quality Requirements

The standards for rural water supply in Tanzania are those tentatively proposed by The Tanzanian Water Health Standard Committee.

In 1975, physical and chemical tests on water were carried out in the Kilimajaro Region the results being presented in an annual report. Thease test indicated that most of the water is suitable for domestic use, though some of it requires chlorination and removal of iron. Comparison of these results with the aforementioned recommended standards, hoever, must await necessary bacteriological tests.

(4) Present State of Service ability

In the case of rural water supply, 305,140 persons in the region fall within the existing design criterion of being within 500m of a water supply point. The remaining 494,860 persons either get their water from natural sources or walk a distance of more than 500m to get piped water. Since this accessibility criterion ought to be consistent with the criterion of having one domestic point for every 100-200 persons, it will be necessary to devise different criteria of this kind for different areas in view of the fact that in areas with low population density it is inevitable that walking distances of more than 500m will be involved for some of the people if only one domestic point is to be provided for every 100 persons.

Water Quality Standards (Table-14)

Substance	Unit	International standard		Proposed std. for W/S in Tanzania
		Acceptable	Allowable	
Lead (Pb)	mg/l	-	0.05	0.1
Fluoride (F)	"	-	1.5	8.0
Nitrate (NO_3)	"	-	30.0	not limited
Colour	mg Pt/l	5.0	50.0	50.0
Turbity	mg SiO_2/l	7.0-8.5	6.5-9.2	30.0
p^H	-	-	-	6.5-9.2
Total hardness	mg $CaCo_3$/l	-	-	600.0
Chloride (Cl)	mg/l	200.0	600.0	800.0
Iron (Fe)	mg/l	0.3	1.0	1.0
Manganese (Mn)	mg/l	0.1	0.5	0.5
BOD_5	mgO_2/l	-	6.0	6.0
$KMnO_4$-cons.	mg/l	-	10.0	20.0
Coiltorm count/ 150 ml at 37 C	each	-	1-3	1-3
E. coil count/ 100 ml at 44 C	each	0	0	0

Water Samples Tested (Table-15)

Source		Remarks
Mworoworo Dam	Pipe Line to Kirua North Coffee Factory	Suitable for domestic use after chlorination
Nworoworo Spring		Suitable for domestic use
Kimarari Spring	Old Moshi Water Supply - Moshi District	Suitable for domestic use
Banker Dril B/H	Ruvu Mferejini - Same District	Suitable for domestic use
Nsere Spring Shiri Spring	Moshi Water Supply - Moshi District	Suitable for domestic use
Mzee River Mgembo River	Chome Water Supply - Same District	Suitable for domestic use
Jums Spring	Kiboriloni Water Supply - Moshi District	Suitable for domestic use
Rundugai Springs No.1&2	Rundugai Water Supply - Hai District	Suitable for domestic use
Matikinya Spring	Matikinya Water Supply - Moshi District	Suitable for domestic use
Vulue River	Vulue Water Supply - Same District	Suitable for domestic use after removal of iron

(5) Water Use and Water Development

The basic characteristics of clean water supply and water use in Tanzania and Kilimanjaro Region are abundance of water resource and ease of water intake in each area, which to a large extent determine the land-use and population distribution patterns of the region.

A district with a high water-use potential has a high land-use density, which in turn results in greater demand for water. The water-use and water-development patterns of the region are as follows.

Mountain areas have abundant rainfall, which facilitates agricultural land use. In these areas clean water, which also served as irrigation water, used to be supplied through traditional furrows. In foot land areas the water use pattern includes both surface water and subsoil water. The former is used by means of storage tanks, and the latter by means of bore holes, etc. Along the Pangani River the water comes mostly from the river.

The water-supply and water-use system of the Kilimanjaro Region can basically be divided into these three patterns, whereby the structure of population distribution is determined. In mountain areas population is of high or medium density as a result of abundant rainfall and high agricultural productivity. In foot areas, on the other hand, the natural water supply is generally limited, with concentrations of population (Moshi, Same, Himo, etc.) only at the few points where use of surface water or subsoil water from mountain areas is possible. Construction of a large-scale irrigation system is a prerequisite to water development of the Pangari River, and as things stand now, this area has a very low rate of water use and few population concentrations.

The following is a summary of the state of water use in each district.

(i) Moshi (mountain area)

This district has abundant water resources and highly concentrated population as well as a well developed clean water supply system primarily serving the main villages and consisting of high-density distribution pipelines laid with a line-to-line distance of about 1 km.

In the past the surface water of Mt. Kilimanjaro was taken in through traditional furrows and distributed for irrigation and drinking. The four reasons below can be given for replacement of the traditional furrows with a pipeline system:

(a) Improvement of Accessibility to Water

The small rivers running in the Mr. Kilimanjaro area cut deep into the ground, causing longer walking distances to water surfaces and inconvenience in water use. For this reason, improvement of accessibility to water has been a subject of administrative study.

(b) Water Pollution Due to Population Increase

Since the possibility of water pollution in the course of distribution of clean water has been increasing, it is necessary to eliminate such pollution by adopting a pipeline system.

(c) Effective Use of Water

In order to improve the inefficiency of the traditional furrow system (leakage caused by complicated structure of the system and water loss due to evaporation) it is necessary to devise effective means of use of limited water resources.

(d) Development of Water Resources

A system that provides for effective transportation of water from its sources to demand areas is most necessary for development of new water resources.

For the above-mentioned reasons, a clean water supply system by means of pipelines was first adopted in this district. The equipment of the rural water supply system, including pipelines, having been concentrated in this district, it would appear that the improvement plan for main villages has nearly come to the end of its initial stage. Elsewhere, however, water works construction must continue to be positively promoted.

(ii) Rombo, Hai, and North Pare Mountain Areas

The piped water system started in the above-mentioned Moshi mountain areas was extended to these districts after 1970 with positive promotion of a clean water supply system.

In the Kilimanjaro Region development of water resources and construction of distribution systems for supplying or distributing the developed water have covered a comparatively small area. The development of water resources in the region has been promoted to a considerable extent, and distribution systems in the initial stage of construction are making satisfactory progress.

(iii) South Pare Mountain Area

Among mountain areas in the region, this area lags farthest behind in terms of water supply system.

According to the Water Supply Plan of 1975, a water resource development plan involving dams, etc. is to be implemented prior to development of a distribution system.

(iv) Moshi, North Pare, and South Pare Footland Areas

(a) In areas other than towns, there has been some water development and settlement using residual surface water from mountain areas or subsoil water. However, the water supply system in this area must be further stabilized, and the distribution system utilizing bore holes and springs further improved.

(b) As for towns securing of adequate water resources and laying of pipelines have been generally completed in Moshi, and in Same provision of urban water works is in progress.

(v) River Areas

Development of the Pangani River for use of its water has made little progress except for construction of Nyumba ya Mungu dam because it requires large-scale facilities of a high technical level.

(6) Problem in Water Supply

(i) Qualitative and Quantitative Charge in Water Demand

Needless to say, the most important consideration in clean water supply planning for the region is the need to supply water to those who are not yet supplied with it. However, this matter must be carefully studied from a long or medium-range point of view because a hasty increase of water-supplied population might deteriorate or wear out the facilities concerned. This problem is pointed up by the supply of clean water on the slopes of Mt. Kilimanjaro. Although the water service level in this area has been considerably improved by adoption of pipelines, this improvement (shortening of walking distance and adoption of private connections) is causing an increase of water consuption per person consequently upsetting the various design criteria.

This phenomenon has been accelerated by an increase in population in this area together with improvement in the standard of living, and as a result, the existing facilities have become overloaded. Furthermore, excessive population would worsen water pollution and increase the necessity of water purification.

In the planning and construction of water works, therefore, the above-mentioned qualitative changes in water demand must be taken into account in order to be able to establish proper design criteria and future service levels for different areas, and in this connection, it will obviously be necessary to provide water works of the urban type for high- and medium-density areas on the slopes of Mt. Kilimanjaro in the future.

(ii) Stabilization of Water Supply

Most of the population concentrations in the Kilimanjaro Region are in mountain areas, with the exception of the towns. Of these densely populated areas, the mountain areas in South Pare are relatively backwards in terms of water works. As already mentioned, the development of water resources in itself is most urgently required in this South Pare area, and stabilization of water supply is necessary before a sufficient supply of water can be obtained.

For an area such as South Pare where population is comparatively concentrated but the water supply is not stable, stabilization of the supply of drinking water must be given first consideration even if quality and quantity are sacrificed to a certain extent.

(iii) Tightness of Water Supply Due to Increase of Urban Population and Reorganization of Existing System

The increase in urban population raises the following two points in respect of clean water supply:

(a) Due to local concentration of population, systems channeling water to urban areas and water resource development become inefficient or difficult in areas such as the Kilimanjaro Region where utilization of large rivers is difficult, the high rate of water consumption per person in urban areas making this all the more so. The use of private connections is wide-spread in urban areas, with the result that water consumption per person exceeds that in rural areas by a considerable extent.

(b) Considerable local concentration of population strikingly accentuates the problems that would be resolved through a natural process if it were a rural area. If population is distributed according to the natural limitations of each area (i.e., if water is used within the capacity of natural purification), artificial facilities would not be required.

However, sewage treating facilities will be required if population increases in excess of the natural limitations. In areas with a lower rate of land use employment of waste treatment systems such as pit latrines is possible, but in population-concentrated urban areas employment of such systems is more difficult, making urban sewerage facilities and treating systems necessary.

Therefore, when an increase in urban population is considered inevitable from the viewpoints of industrial policy, etc., a comparatively high-level engineering system as well as drastic reorganization (upgrading) of the existing system will become necessary.

(iv) Water Use Systems in Newly Developed Areas

To supply clean water to permanent residential areas with fixed population is a basic requirement.

It is also considered necessary to provide a positive water supply system for areas where new land development is required in order to facilitate future regional development, social development, industrial development, and so on. In order to estimate the feasibility of agricultural development or village development with a view to obtaining effective land use in footland and river areas (present wasteland must also be considered for development), it is absolutely necessary to consider a clean water supply system as one of the high-level social services that will be required.

In such areas development of water resources is usually for land development purposes at first. Only after population settles as a result of land development, does it become necessary to supply the population with clean water. At first, therefore, a part of the water for irrigation purposes is used for domestic purposes, with 100% reliability.

(v) Rehabilitation

All existing schemes are not necessarily operating effectively, particularly those with fairly old facilities. This being the case, the problem of rehabilitation will become very important, especially since there is to be a great increase in the total stock of facilities. One factor standing in the way of stable supply is the problem of power, which can be satisfactorily overcome only by switching from diesel to electric power. Also necessary will be early detection and repair of local damage and a systematic renewal and upgrading program.

1.3 Water Development Plan for up to 1995

(1) Planning Policy and Strategy:

The basic policies of water development to be included in the integrated development plan for the Kilimanjaro Region are as follows:

(i) Planning Targets in Terms of Rates of Service Coverage

In accordance with the national policy, 1990 is the target year for obtaining 100% clean water service coverage.

The interim targets are 66.7% by 1980 and 89.2% by 1985 (inclusive of urban water supply).

(ii) Planning Targets in Terms of Serviced Population

The total additional population requiring a supply of clean water in the future will consist of the presently unserved population (865,000 - 341,140 = 523,860) plus the amount of future population growth (1,456,000 - 865,000 = 591,000).

The equipment volume and cost for water works will fluctuate largely according to distribution. Since land-use plans place more emphasis on development of existing areas of population concentration where water is comparatively abundant and easy to use and there is still room for development than on development of poor land at a tremendous development cost, future population growth will be absorbed in areas of existing population concentration.

Water development plans prescribe equipment strategy as follows on the assumption that the rearrangement of population will occur after Phase I, i.e., after 1980.

Phase-I 1970(75)-80	Phase-II 1981-90
* Water development plan emphasis to be placed on agricultural districts with high population density, i.e., areas of existing population concentration.	* Reorganization of existing systems (Reorganization of population in areas of existing population concentration.) * W.D.P. for medium and low population density areas.

Projected population with piped water (Table-16)

	1967	1975	1980	1990	1995
Population					
Urban	-	65,000	91,000	175,000	200,000
Rural	-	800,000	931,000	1,167,000	1,256,000
Totals	652,722	865,000	1,022,000	1,342,000	1,456,000
Population supplied with clean water					
Urban	-	36,000	68,550	175,000	200,000
Rural	22,500	305,140	612,790	1,167,000	1,256,000
Totals	-	341,140	681,340	1,342,000	1,456,000

Percentage of population supplied with clean water (Table-17)

	1967	1975	1980	1990	1995
Urban	-	55.5	75.3	100.0	100.0
Rural	-	38.1	65.8	100.0	100.0
Totals	-	39.4	66.7	100.0	100.0

(2) Long-term Development Plan for Rural Water Supply

(i) Conception of Stage Plan

The design period must be set so roughly 10 years instead of assuming a definite year for the following reasons:

(a) Adoption of a long design period would be inefficient, require large-scale facilities, and entail capital costs.

(b) Too many unknown factors exist.

The design period for the clean water facilities to be completed by 1980 is up to 1985 (10 years from 1975) with the exception of the projects mentioned in "Proposed Schemes of Administrative Office."

Transfer from the former period to the latter period means reorganization of the existing water supply systems against the rearrangement of population in population-concentrated agricultural districts, as indicated in the case of Pare.

(ii) Projected Population with Piped Water

Table-18 shows the planned water-supplied population estimated on the assumption that clean water will be 100% supplied in all districts by 1990, the target year. For the whole region, the figures are 308,000 for 1976-1980, 304,000 for 1981-1900, and 251,000 for 1986-1990. Considering that the increase of water-supplied population during 1970-1975 was 200,000, this estimate indicates that it is necessary to speed up construction by 50% in order to meet the 1990 target.

(iii) Design Criteria

Referred to in this Long-term Plan are: (a) accessibility to water, (b) water allowance per person per day, and (c) quantity.

(a) Accessibility to water is classified as follows:

Accessibility to water (Table-18)

	Distribution system	Accessibility (Distance to water tap)
Town & quasi-urban areas	Private house connections	0
High-density areas & division centers	Cluster connections*	250m
Medium-density areas	Communal stand pipes (domestic water points)	500m
Low-density areas	"	1,000m (Max. distance)

Connections to clusters each consisting of scores of households.

(b) The design criteria concerning water consumption allowances are as follows:

Such project components as intakes, bore holes, rising mains, gravity mains and/or distribution mains are to be designed for the estimated population in twenty years at the rate of 30 litres per capita per day. This twenty-year estimate may not exceed the present population by more than 100%. Such project components as domestic points, monor distribution piping, storage tanks and/or pumps are to be designed for the present population at the rate of 45 litres per capita per day.

The water comsumption allowance in determined by the water resource conditions each area. For the areas to which Distribution Systems 1 and 2 are mainly applicable, the following water consumption allowances have been estimated within the water resource limitations:

Water consumption allowance (Table-19)

	1975	1980	1985	1990	1995	(litre)
Private house connection*	150	175	200	225	250	
Cluster connection	45	70	95	120	165	

* As a result of urbanization and higher standards of living, the annual growth of average daily water consumption per person has been estimated at 5 litres.

(iv) Water Quality

Water sample tests carried out in the Kilimanjaro Region indicate that water quality is comparatively good and suitable for domestic use.

The following problems, however, will have to be resolved in the future:

(a) It is necessary to investigate the quality of all drinking water over a comparatively long period of time.

(b) Bacteriological tests are necessary in addition to physical and chemical tests.

(c) In towns and high-density areas in particular:

- The rate of raw water pollution by human beings and domestic animals is high and could eventually exceed the proposed quality standards.

- There is extensive prevalence of infectious diseases due to high-density population. The water supply system being unified, a large number of people will contract such diseases if the germs get into the water supply.

Therefore the substances contained in raw water must be checked by means of physical and chemical tests at the stage of water resource development to determine suitability for use for drinking purposes.

In districts water pollution is a possibility the following will be necessary in the future:

(a) Protection of intake areas (fencing)

(b) Treatment plants (sinple chlorination and sand filtering)

(v) Water Development Plan for up to 1995 (Figure 2 and 3)

The main types of rural water supply distribution systems are as follows:

(a) A system of domestic water points within 500m walking distance will be available in high and medium-density areas by 1980 and in low-density areas later on.

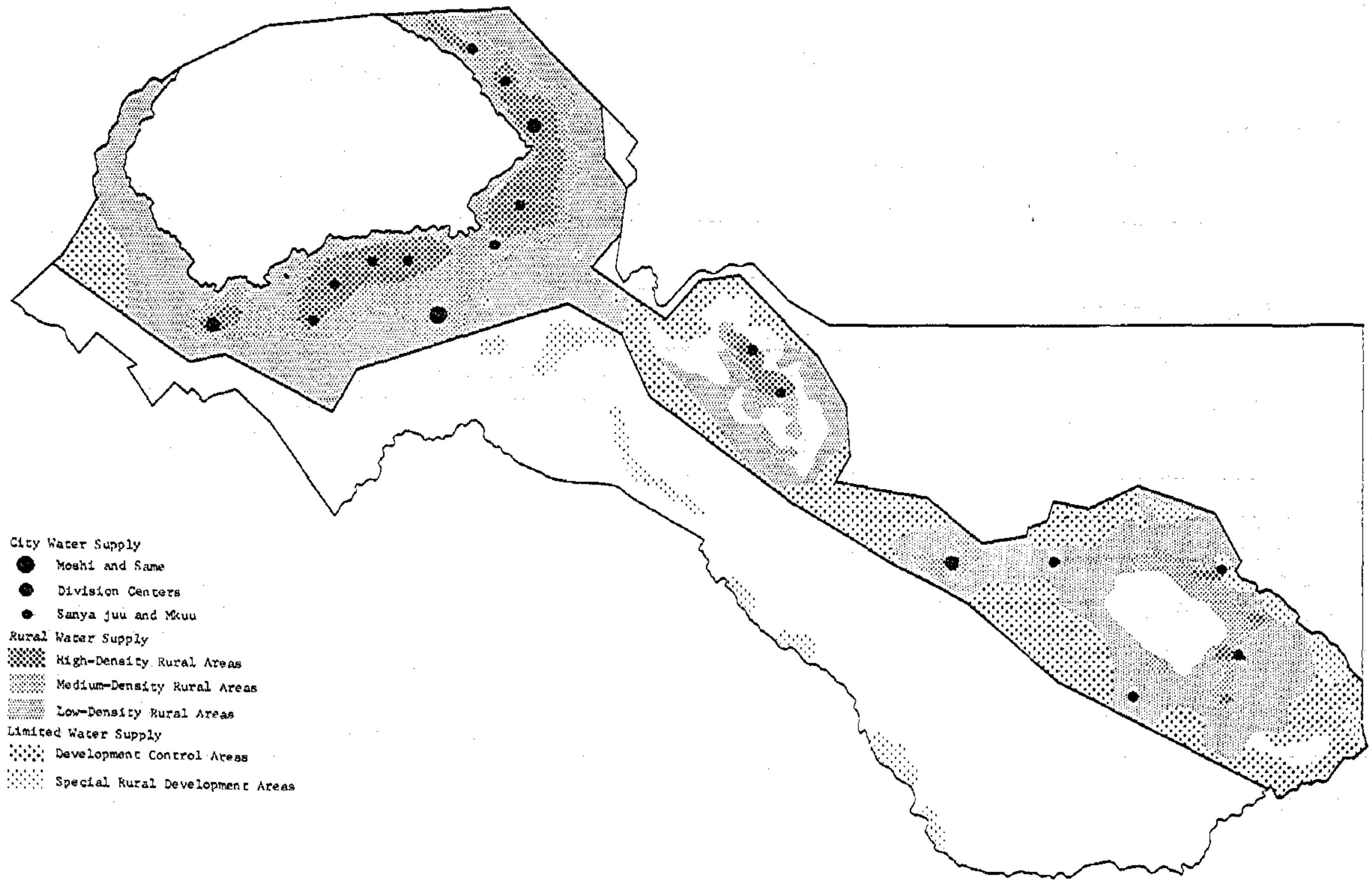
(b) A system of cluster connections within 250m walking distance will be available in Sanya Juu and Mkuu after 1980, in division centers after 1985, and in high-density areas after 1990.

(c) A system of private connections will be available in Sanya Juu and Mkuu after 1985 and in division centers after 1990.

Water treatment is presently required in Sanya Juu and Mkuu and in division centers for main public facilities (hospitals, schools, dispensaries, etc.) and is also necessary in Moshi and Same Town. After 1980, several water treatment systems will be employed in high-density areas.

The distribution systems, purification, capacity and rural water-supplied population to be increased through new and reorganized water systems during each period are proposed in the "Rural Water Development Plan for up to 1995."

Water Development Plan (Fig.-2)



Rural Water Development Plan for Up to 1995 (Fig.-3)

Year	1975	1980	1985	1990	1995
Rural population	300,000	931,000	1,060,000	1,167,000	1,256,000
Rural population increase		131,000 ('75-'80)	129,000 ('80-'85)	107,000 ('85-'90)	89,000 ('90-'95)
Projected rural population with piped water	305,000 (38.1%)	612,000 (65.8%)	917,000 (86.5%)	1,167,000 (100.0%)	1,256,000 (100.0%)
Distribution systems					
Private house connections				41,000 *2 ('86-'90) Sanya Juu, Mkuu	41,000 9,000 *2 ('91-'95) (Sanya Juu, Mkuu) 30,000 *2 ('91-'95) (division centers) 587,000 *2 (High-density Areas)
Cluster connections (250m accessibility to water)			30,000 *2 ('81-'85) Sanya Juu, Mkuu	25,000 *2 ('96-'90) Division centers	
Domestic water point connections (500m accessibility to water)	305,000 ('71-'75) Already water supplied population	305,000 307,000 *1 ('76-'80)	582,000 85,000 *3 220,000 *1 ('81-'85)	852,000 93,000 *3 156,000 *1 ('86-'90)	587,000 80,000 *1
Within 1,000 m	495,000	319,000	143,000	0	0
Purification system		Partly Sanya Juu, Mkuu	* Division centers	Wholly Partly High-density Areas	
		Existing	PHASE I / PHASE II	Design period for the water supply from 1975 - 1980.	100% of rural population with piped water.

*1 Rural water supplied population to be increased by new water system during each period.

*2 Rural water supplied population to be increased by reorganized water supply system during each period.

*3 Additional population to be served by the water supply system constructed previously.

1.4 Proposed Projects

The principal projects as given below are proposed on the basis of "The Development Plan for Rural Water Supply for up to 1995":

(1) Distribution Pipeline Construction Project (including W/S)

Priority of pipeline construction.

Total length (km) of P/L construction will be:

	1976-1980	1981-1985
Main	1,022	733
Minor	-	15

(Sanya Juu and Mkuu)

Assuming that the efficiency of each project is indicated by served population/construction P/L length and the project is to be carried out in order of priority as indicated by that value, the priority of the projects for the respective districts will be as shown in Fig.- 4-7.

(2) Simple Treatment Plants (rural water)

Simple chlorination and filter units will be provided in Sanya Juu, Mkuu, and the 15 division centers, where main public facilities and utilities are located (unit capacity: 1.5 - 10.0 t/h.)

Simple treatment unit

1976-80 17 units

1981-85 14 units

To increase capacity of Sanya Juu and Mkuu and of some high-density areas

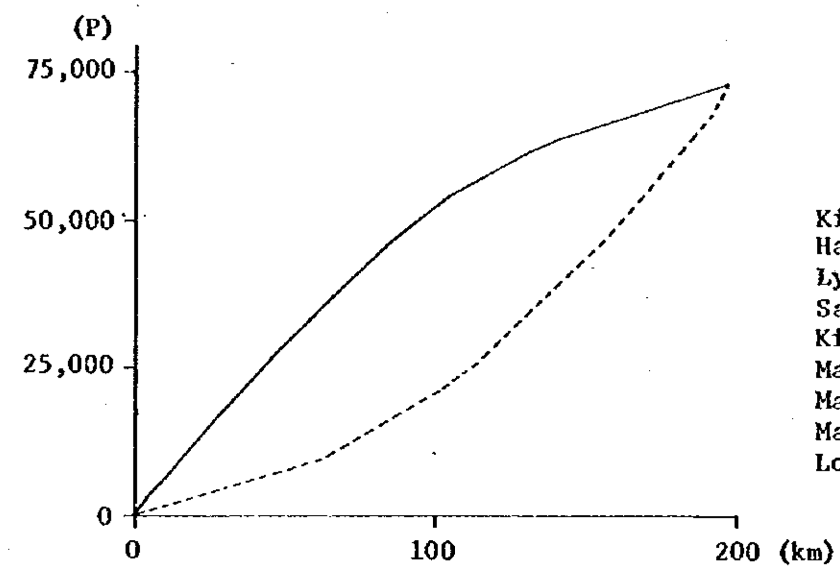
(3) Facilities for Regular Water Analysis

1976-80 Mobile laboratories

1981-85 Central laboratories serving Kilimanjaro and Arusha Regions.

Cumulative Population With Clean Water (Fig.-4)

Hai District

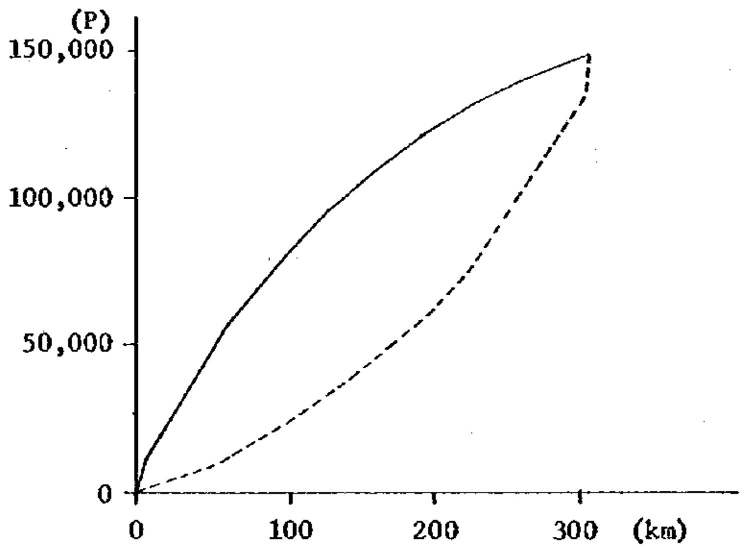


Cumulative length of pipelines

Kibongoto W/S to Hai District	1,538.5
Lyamungo W/S	582.0
Same Sonu W/S	497.5
Kishisha Fuka W/S	454.2
Machame PH. IV	360.8
Machame PH. III	285.7
Magadini R.C. Mission	267.9
Loss PH. I	164.7

Cumulative Population With Clean Water (Fig.-5)

Moshi District

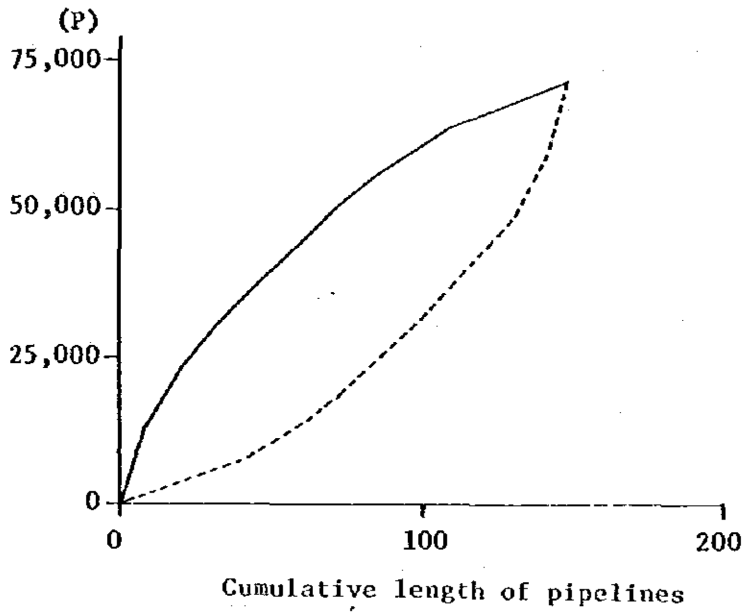


Cumulative length of pipelines

Kilema Phase II-A	5,000.0
Materuni Phase II-M	861.2
Mengeni W/S-M	778.8
Mbokomu West W/S-M	735.3
Uru Mawella-N	676.6
Mango Mission W/S-M	512.8
Mweka Phase II-M	500.0
Natiro B/L from Mbokomu W/S-M	500.0
Utaruni W/S-M	422.0
Kidia Kilenapunda-M	373.8
Usoro Kisomachi W/S-M	323.1
Nganjoni W/S-M	288.5
Una Phase IV-M	285.7
Mabogjni Kahe W/S-M	182.8

Cumulative Population With Clean Water (Fig.-6)

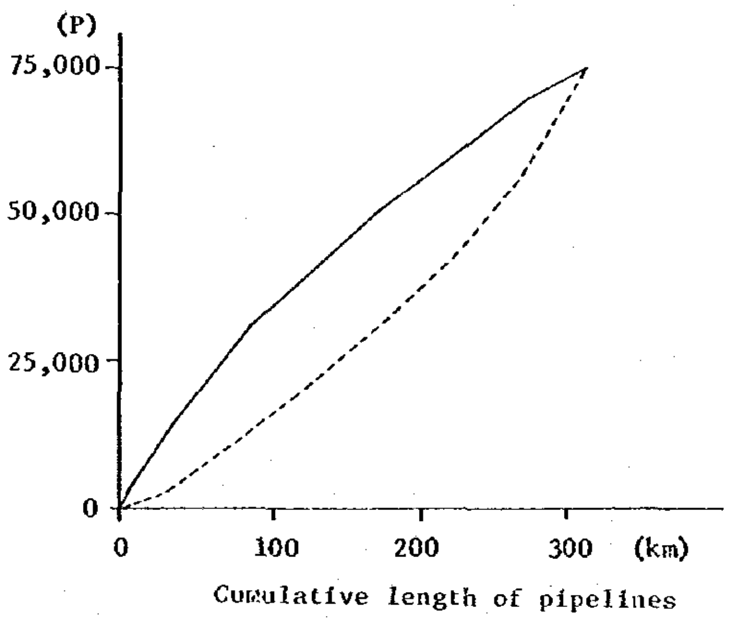
Rombo District



E.K.T.M. 6-Masaseni	1,771.4
E.K.T.M. 9B-Mashati	1,125.0
Hakwa W/S	895.5
B.K.T.M. 9A+C-Kitale & Kisale	650.0
B.K.T.M. 5-Makiki	600.0
New Keni P/L	571.4
Shimbi Mashami	520.8
Keni Mamba-B/C of Keni	517.9
E.K.T.M. Jja-Kiwandjuu	500.0
Ngaseni	500.0
E.K.T.M. 9D-Kasuruwa	485.7
E.K.T.M. 7-Mrao	479.2
E.K.T.M. 10A-Usaranga	476.2
Masama (Keni B/C)	441.2
Mamcuyo Usseri	411.8
E.K.T.M. 6A-Usseri	404.8
E.K.T.M. 13-Kirongojuu	400.0
E.K.T.M. 12-Kirongo Chini	359.4
Masama (Kent B/C)	339.2
Handa Keni W/S	318.2
E.K.T.M. 14-Kahe Chini	312.5
E.K.T.M. 8A-Kiruajuu	250.0
E.K.T.M. 15 & 16 Kahe Ulena	218.8
Ushiri W/S	188.0
Holili W/S-Marisha Ph.IV	178.6

Cumulative Population With Clean Water (Fig.-7)

Pare District



Vunta	552.1
Mwembe Masandare	406.3
Vuje Bomba	333.3
Chebaru W/S	323.5
Mwanka W/S-Ext. from Kimunyu	250.0
Vulue	228.1
Mtii Bomba	208.3
Mamba	208.3
Usangi Juu	202.9
Ndfa W/S	187.5
Mpiji	187.5
Vudee Nyika	185.8
Kalimawe Ndungu Ext.	150.0
Chome W/S	141.7
Vudee Juu	125.0

Case I : effective construction of pipelines

Case II : ineffective construction of pipelines

2. URBAN WATER SUPPLY

2.1 Existing State of Urban Water Supply

In the Kilimanjaro Region there is an urban water supply in the towns of Moshi and Same. The change in water-supplied population in these towns over the years is as shown in the table below, the figures being 30,000 (60% of total pop.) for Moshi and 6,000 for Same (40%) in 1975.

There are two supply patterns in urban water supply, one being private house connections delivering water to each household and the other being kiosks, the community water supply facilities.

The water supply situation for private house connections has been as follows:

Changing urban water supply population (Table-20)

Year	Moshi		Same		Totals	
	(A)	(B)	(A)	(B)	(A)	(B)
1972	26,000	26,000	3,500	3,500	28,500	28,500
1973	1,000	27,000	1,000	4,500	2,000	31,500
1974	1,000	28,000	500	5,000	1,500	33,000
1975	2,000	30,000	1,000	6,000	3,000	36,000
1980	40,000	70,000	-	-	-	-
1985	30,000	100,000	-	-	-	-
1990	44,000	144,000	-	-	-	-
1995	56,000	200,000	-	-	-	-

Remarks: The population with clean water from 1980 to 1995 is based on the "Moshi Master Plan."

(A) Additional urban population with clean water

(B) Cumulative figures

The present state of water supply facilities in Moshi Town is as follows:

Water intake (about 9 miles to the west of the town)	Nsere and Shiri springs: Capacity, 8,000-10,000 cu.m. (physical/chemical tests--suitable for domestic use) (By utilizing some other springs in the area, the total output of this water source could be as high as 25,000-30,000 cu.m. per day - Moshi Master Plan)

Feeder pipes	Gravity feeder pipes, 2 x ø250mm, from water intake to tanks
Water reservoirs	2 storage tanks (reservoirs) - 1,350 and 2,250 cu.m.
Distribution pipes (covering about 7.5 km^2)	Main water distribution pipes: 3 x 250 ø 1 x 150 ø Local distribution pipes: Covering the central areas of the town and the area between town center and K.C.M.C. hospital. Same extensions to Pasua and Majengo. Progress of extension to block D.D.D. Karanga area.

As for Same, little data are available, but the Kilimanjaro Regional Directorate of 1975 describes the urban water supply situation in the town as follows:

> "There were occasional interruptions of water supply to Same Town due to the failure of existing engines and also due to lack of immediate availability of spare parts. Lack of proper qualified maintenance staff for this scheme is also a reason for such failure. Hence, maintenance staff should be given proper training."

In brief, the urban water works in Same Town are still in the process of equipment improvement while those of Moshi Town have been completed although it is necessary to take follow-up measures to cope with future increase in demand.

2.2 Planning Policy and Strategy

(1) The urban population water supply rate is to be raised to 100% by 1990, just as in the case of rural water supply.

Clean water supply in urban areas is just as important as in agricultural areas. This is not only because of the advancement of urbanization and living standards in urban areas but also because of health problems-- infectious diseases in particular, which are a major concern in urban areas.

The piped water supply rate will rise as per the table below. Since in urban areas people without private connections are not able to obtain nonpiped drinking water as in rural areas, such persons are supplied with drinking water at public kiosks (in other words, in urban areas there is 100% piped water supply).

Water supply rate (Table-21)

	1980	1985	1990
Moshi	77.9%	87.5%	100%
Same	67.8%	89.3%	100%

(2) Purified water shall be supplied to Moshi and Same towns.

Both towns have water resources of comparatively good quality at present. There are, however problems such as the following.

(i) Development of new water sources will become necessary in order to meet future increaseing demand and one cannot be sure that it will be possible to obtain raw water that does not require treatment.

(ii) Pollution is worsening at the existing intake areas.

(iii) Because of high-density population, it is absolutely necessary to improve health conditions and prevent infectious diseases.

(3) For Sanja Juu, Mkuu, and the division centers water purification will have to be studied on a long-term basis in order to cope with future increase in population and population density.

(4) For Moshi and Same towns; water supply areas shall be expanded, step by step, to meet future expansion of town area.

Step-by-step reorganization of the existing supply system and expansion of capacity of existing facilities will be necessary in order to cope with increasing demand.

2.3 Urban Water Development up to 1995

(1) Water Demand

Future water demand has been estimated on the following assumptions:

- Water-supplied population will increase along with the rise in the rate supply foreseen in the preceding paragraph.
- Average daily water consumption will increase by 5 litres per person each year (it stood at 150 litres per person in 1975, which is the average value when public kiosks are included.)
- Max. hourly consumption will be 7.5% of max. daily consumption.

Water demand estimation (Table-22)

Moshi Town	1975	1980	1985	1990	1995
Max. hourly consumption, cu.m/h	439	886	1674	2542	3094
Max. distribution demand, l/s	122	246	465	706	859

Same Town	1975	1980	1985	1990	1995
Max. hourly consumption, cu.m/h	98	246	522	834	1031
Max. distribution demand, l/s	24	68	145	232	286

(2) Prospect for Water Supply Facilities

The table-23, 24 compares the future demand for and the present capacity of the facilities of water intake and distribution systems.

The following applies to Moshi Town:

1975-80	Need to provide additional water intakes (or increase capacity)
	Need to expand distribution areas.
1980-85	Need to build gravity feeder pipes.
	Need to build water reservoirs
	Need to build main water distribution pipes.

As for Same, establishment of a new urban water works system is necessary, construction of which must be commenced sometime during 1975-1980.

(i) Water Intake

There is a proposal for drilling two new boreholes for Same Town, and a drill rig from Dodoma is expected in early 1976.

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(ii) Gravity Feeder Pipes

It will be necessary to build gravity (or pump) feeder pipes from the intake.

(iii) Water Reservoirs

Water reservoirs are needed to balance the fluctuation of hourly water consumption between day and night hours in Same Town.

(iv) Water Distribution Pipes

The expansion of township areas will necessitate new water distribution pipes.

(3) Kiosks Vs. House Connections

In rural areas river, spring, and other nonpiped water can be used, but in urban areas only newly "developed" water is available. Accordingly the rate of piped water supply has to be 100% in urban areas. There are two types of such urban water supply: private house connections and public kiosks for joint use by residents. (In this report the "rate of urban water supply" refers only to the percentage of residents with private house connections.) While water supply network plans are formulated basically in terms of private connections, it is possible to provide public kiosks at any point along the pipelines as required and at little expense. The number and locations should be determined after detailed survey and analysis of the state of population and building in urban areas.

Comparison of Existing Capacity and Future Water Demand, Moshi Town (Table-23)

	1975	1980	1985	1990	1995
Water intake					
Max. total daily demand (cu.m)	6,200	12,100	22,400	33,900	41,300
Existing capacity (cu.m)	10,000	10,000	10,000	10,000	10,000
Additional capacity needed (cu.m)	0	2,100	12,400	23,900	31,300
Gravity feeder pipe					
Required max. feeding capacity (l/s)	70	140	260	390	480
Existing capacity	200	200	200	200	200
Additional capacity needed (cu.m)	0	0	160	190	280
Water reservoirs					
Required storage capacity	960	1,940	3,740	5,900	7,500
Existing capacity	3,600	3,600	3,600	3,600	3,600
Additional capacity needed (cu.m)	0	0	140	2,300	3,900
Main water distribution pipes					
Max. distribution demand (l/s)	130	250	470	710	860
Existing capacity	330	330	330	330	330
Additional capaciaty needed (cu.m)	0	0	0	380	530
Local water distribution pipes					
Distribution demand area (km^2)	7.5	13.5	23.3	32.8	37.5
Existing distribution area	7.5	7.5	7.5	7.5	7.5
	0	5.0	15.8	25.8	30.0

Comparison of Existing Capacity and Future Water Demand, Same (Table-24)

	1975	1980	1985	1990	1995
Water intakes					
Max. total demand (cu.m)	1,200	3,300	7,000	11,200	13,800
Gravity feeder pipes					
Required max. feeding capacity(l/s)	14	38	81	130	160
Water reservoirs					
Required storage capacity (cu.m)	10	525	1,160	1,935	2,500
Main water distribution pipes					
Max. distribution demand (l/s)	24	68	145	232 212	286
Local water distribution pipes					
Distribution areas (km^2)	1.5	4	7	11	13

(3) Urban Water Development Plan for up to 1995

The development of water intakes or gravity feeders for urban water facilities must be planned with a target period of 15-20 years, and water reservoir or main and local distribution pipes with a target period of 10 years.

The facilities to be planned and constructed in the first period (1975-1985) are as follows:

(i) Moshi Town

Gravity feeder pipes, main and local distribution pipes.

(Water intakes come under the category of water resources and therefore excluded from this public utility plan. Main water distribution pipes do not have to be constructed before 1985.)

(ii) Same

Gravity feeder pipes, water reservoirs, main and local distribution pipes.

As a rule, urban clean water must be treated. Treatment plants, therefore, shall be provided in both Moshi and Same towns for simple chlorination and sand filter treatment.

Urban water development plan, Moshi Town (Fig-8)

	1975	1980	1985	1990	1995
Gravity feeder pipes	160 l/s to be increased			220 l/s to be increased	
Water reservoir		2,300 cu.m to be increased			
Main water distribution pipes	According to the expansion of town				
Local water distribution pipes	5.0 km^2 distribution area to be increased		9.8km^2	19.0km^2	4.7km^2
Treatment plant	23,000 cu.m capacity			19,000 cu.m increased in capacity	

Urban water development, Same Town (Fig-9)

	1975	1980	1985	1990	1995
Gravity feeder pipes	67 l/s to be increased		79 l/s to be increased		
Water reservoirs	1,160 cu.m to be built		1,340 cu.m to be increased		
Main water distribution pipes	According to the expansion of town,				
	145 l/s to be built		123 l/s to be increased		
Local water distribution pipes	2.5km^2 distribution areas to be increased		3.0km^2	4.0km^2	2.0km^2
Treatment plant	7,000 cu.m to be built		7,000 cu.m to be increased		

2.4 Proposed Projects

Given below are the projects necessary for urban water supply selected on the basis of a long-term plan:

(1) Moshi Town

Gravity feeder pipes: ϕ400 l = 14.4 km

Main distribution pipes: ϕ600 - 400 l = 5.0 km
ϕ300 - 200 l = 10.0 km

Local distribution pipes: ϕ150 - 100 l = 50.0 km

Treatment plant: (Capacity 23,000 cu.m.)

(2) Same

Gravity feeder pipes: ϕ300 l = 5.0 km

Water reservoir: (Capacity 2,000 cu.m.)

Main distribution pipes: ϕ500 - 400 l = 2.1 km
ϕ300 - 200 l = 4.2 km

Local distribution pipes: ϕ150 - 100 l = 21.0 km

Treatment plant: (Capacity 7,000 cu.m.)

3. SEWAGE DISPOSAL

3.1 Existing Sewage Disposal Situation

There is only one sewage disposal system in the Kilimanjaro Region, that of Moshi Town. So far, 30% of the existing dwellings in the town have been connected to this system.

The existing sewage disposal system consists of a sewage treatment plant and a sewer network which covers the central areas of the town, the K.C.M.C. hospital, the police training college, and some of the national housing quarters.

The disposed water is discharged into Rau River. Other towns in the region do not yet have sewage disposal systems.

3.2 Planning policy and strategy

Expeditious treatment of sewage discharged from houses and factories not only is beneficial to the those homes incorporated in the sewerage system in terms of both sanitation and living environment but also is extremely important from the stand point of maintaining a good environment in entire urban areas and throughout the region.

In Moshi Town and Same Town in particular it is absolutely necessary that the rate of sewerage service be raised if they are to have a comfortable living environment and an acceptable level of urban amenities, especially in view of the following facts:

(i) Qualitative and quantitative expansion of water use will detract from the amenity of sewerage drainage at an accelerating pace.

(ii) Since there is little flow of water to the surface, the natural purification capacity of sewerage drainage is low.

(iii) Deterioration of the environment and of sanitation conditions can be expected because of increasing density of housing.

Under conditions of rapid urbanization, as in Moshi Town, the existing sewage disposal system has to be reorganized and in Same Town this kind of system will have to be newly installed.

Planning policies are laid down as follows:

(1) The total population will be served by a sewage disposal system by 1995.

Population Served by Sewage Disposal Systems (Table-25)

	1975	1980	1985	1990	1995
Moshi Town					
Percentage of population served	30%	47.5%	65%	82.5%	100%
Population served	15,000	32,800	65,000	108,000	150,000
Same Town					
Percentage of population served	0	25%	50%	75%	100%
Population served	0	5,400	16,300	32,600	50,000

(2) The most economical and effective purification system should be employed.
Sewage lagoons are an effective method of sewage treatment, particularly in the tropics, where the climate is most suitable for the process and where sufficient land is usually available.

In developing countries, lagoons will continue to be the most popular form of sewage treatment for many years to come since they have a considerable cost advantage over other forms of sewage treatment.

(3) The sewer network should be extended effectively in relation to the growth of high-density areas in the towns.

Furthermore, particular attention will have to be given to the following in expansion of sewer networks:

(i) Priority provision of sewerage service in densely populated areas that are becoming slums.

(ii) Provision of sewerage facilities in areas where urban facilities are located and in high-class residential areas for the sake of maintaining the quality of the environment at an acceptable level.

(iii) Provision of sewerage facilities in advance of residential sprawl in peripheral urban areas.

Table-26 gives the plan for extension by stages of sewerage dishcarge areas as geared to plans for expansion by stages of urban areas.

Areas covered by sewer network (Table-26)

(ha)

	1975	1980	1985	1990	1995
Moshi Town	375	820	1,625	2,700	3,750
Same Town	0	134	406	816	1,250

3.3 Sewage Disposal Plan for up to 1995

(1) Quantity of Sewage

The calculation of the amount of sewage is based on the following assumptions made in the Moshi Master Plan, 1974:

80% of fresh water consumed will be discharged into sewage disposal system.

30% of existing dwellings have already been connected to public sewers. It is assumed that the number of connections will increase steadily, so that the entire urban population will be served by public sewerage by 1974.

The amount of water leakage (ground water, storm water) into sewers through manholes and pipe joints is estimated to be 0.05 l/s/ha.

Quantity of sewage (Table-27)

(cu.m)

	1975	1980	1985	1990	1995
Moshi Town	2,700	6,900	15,600	29,300	45,000
Same Town	0	1,100	3,900	8,900	15,000

Estimated existing quantity of sewage

(2) Quality of sewage

BOD of the existing flow should actually be measured. Often, however, there is no existing flow and BOD must be assessed theoretically.

For purely domestic wastes the following equation can be used:
- L_i = influent BOD_5, mg/l

$$L_i = \frac{BOD_5 \text{contribution/person/day(g)} \times 1{,}000}{\text{effluent flow/person/day(litres)}}$$

The per capita BOD_5 contribution is assumed to be about 30-50g/person/day in tropical conoutries.

Influent BOD_5 (Table-28)

	1975	1980	1985	1990	1995
Moshi Town & Same	250	250	250	250	250
L_f	30	35	40	45	50
Effluent flow/ person/day	120	140	160	180	200

Effluent standards

Although effluent standards have not been legally promulgated, it is still desirable to design a lagoon system to produce a certain standard for effluent quality. The following effluent quality criteria are suggested as minimum design guidelines---

BOD_5(inclusive of algae)	25 mg/l
Faecal coliform count	5,000/100 ml

(3) Types of Sewage lagoons

There are three types of sewage lagoons--facultative, maturation, and anaerobic lagoons

(i) Facultative Lagoons

The term "facultative" means a combination of aerobic and anaerobic conditions. As the waste enters the lagoon the heavier solids settle and form a sludge layer where they undergo anaerobic digestion.

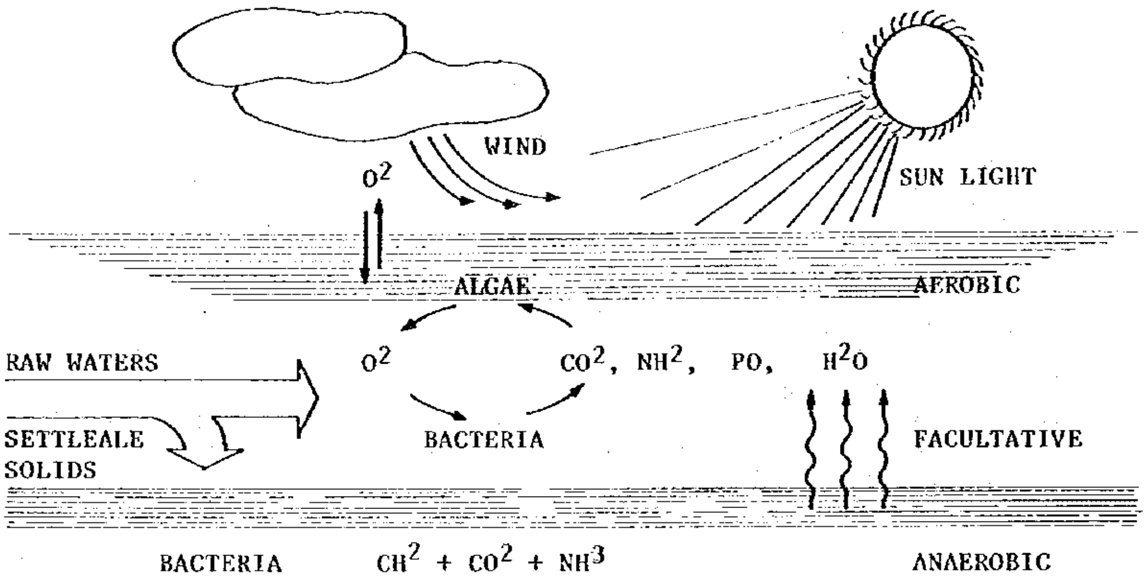
The soluble fraction of the waste is oxidized aerobically by the lagoon bacteria according to the general equation of aerobic biological waste treatment.

$$\text{Waste} + \text{Oxygen} \xrightarrow{\text{bacteria}} \text{Oxidized Waste} + \text{New bacteria}$$

In a facultative lagoon most of the oxygen is supplied by algae photosynthesis. The algae need carbon dioxide, which is a product of bacterial metabolism.

Thus there is a symbiosis of algae and bacteria in the lagoon--the algae supply oxygen for the bacteria, which in turn provide carbon dioxide for the algae.

Schematic Diagram of the Mechanism of BODRemoval in Facultative Lagoons (Fig.-10)



(ii) Maturation lagoons

These should be wholly aerobic. They are used as a second stage to facultative lagoons, and their prime function is to destroy pathogenic bacteria, viruses and the cysts and ova of intestinal parasites. This function is particularly important in tropical countries where the water courses which receive sewage effluent are often used close downstream as sources of drinking water.

As a general rule, two maturation lagoons in series are required to produce a bacteriologically acceptable effluent with a BOD_5 of less than 25mg/1.

(iii) Anaerobic Lagoons

These are open pretreatment units for raw wastes. They act in a similar manner to septic tanks, although in order to minimize odour release, the liquid retention time is usually longer.

Algae are frequently absent or confined within a few cm of the surface.

This type of lagoon has in the past been unpopular with sanitary engineers because of the risk of odour release and the extra maintenance required. The relationship between odour development and organic loading is now reasonably well understood so that this problem can usually be overcome at the design stage. The tremendous economies of land that are achieved by the use of anaerobic lagoons will often influence their inclusion in large schemes (Q 10,000m^3/day) where adequate maintenance should be provided in any case.

Finally, lagoons are expected to be the most suitable process of sewage treatment in developing countries for the following reasons:

- They can achieve any required degree of purification at the lowest cost.

- The removal of pathogens is much more effective than in other methods of sewage treatment.

- They are well able to withstand both organic and hydraulic shock loads.

- They are able to remove toxic compounds present in industrial wastes by precipitation, absorption, and sedimentation.

- Operation and maintenance are simple and cheap.

- They can be designed so that the degree of treatment is readily altered.

- The method of construction is such that should at some future date the land be required for some other purpose, it can be easily reclaimed.

(4) Sewage disposal plan for up to 1995

Sewage disposal plant for up to 1995-Moshi Town (Fig-11)

Moshi Town	1975	1980	1985	1990	1995
Main sewer (including areal collector sewer)	Expansion of the existing sewer network with ø600-500mm pipes		Switchover to new sewer system with ø1,000mm pipes		
Local sewer	Newly served area	445ha	805ha	1,075ha	1,050ha

Sewage disposal plan for up to 1995-Same Town (Fig-12)

Same Town	1975	1980	1985	1990	1995
Main sewer (including areal collector sewer)	New sewer system with ø300 200			Switchover to new sewer system	
Local sewer	newly served area	134ha	272ha	410ha	434ha

In Moshi Town a huge amount of sewage will be dishcarged. Therefore the following sewage disposal system should be adopted. (Though in the Moshi Master Plan an oxidation pond(33ha), and maturation pond(17ha) have been proposed for the Moshi sewage disposal system.)

Soil permeation treatment process

As pretreatment (primary treatment)		As secondary treatment
Anaerobic lagoon	+	Soil disposal system

The several merits of this process include the following:

Vegetation in the treatment becomes possible (using the treated water in mid process).

Economical use of land and an efficient construction system are possible.

Because of the comparatively small area of the site the system can be located near town, reducing the length of main sewer conduits.

3.4 Proposed Projects

The following projects are proposed on the basis of the long-term sewage disposal plan.

Moshi Town		1970-80	1980-85
Main sewer	∅600-400	4.45 km	8.05 km
	∅300-200	8.9 km	16.1 km
Local sewer	∅150-100	45 km	80.5 km

Sewage disposal treatment plant — 1970-85

Soil permeation treatment plant

(primary) $\frac{15{,}600^{cu.m} \times 5^{day}\text{(retention time)}}{2.5\ \text{(depth m)}} = 3.0$ ha

(secondary) + $65{,}000^{person} \times 1.5\ m^2/\text{person} = 9.8$ ha

Same Town		1970-80	1980-85
Main sewer	∅300-200	1.3 km	2.7 km
Local sewer	∅150-100	13 km	27 km

Sewage disposal treatment plant — 1970-85

Facultative and maturation lagoons

facultative lagoon 8.0 ha
+
maturation lagoon $1.8 \times 2^{plants} = 3.6$ ha

$$\frac{3{,}900^{cu.m} \times 7^{day}\text{(retention time)}}{1.5\ \text{(depth m)}} = 1.8$$

4. POWER SUPPLY

4.1 Actual State of Electrification and Electricity Use in Tanzania

Power consumption in the whole of Tanzania in 1975 was 486 million KWH, and the number of consumers in the same year was 74,000.

These figures represent increases of 170% and 99%, respectively, in comparison with 1965.

Leading regions in power consumption in 1975 were Dar es Salaam, Tanga, Arusha, Mwanza, Morogoro and Kilimanjaro, in that order, each exceeding 10 million KWH/year

All of these regions, except for Mwanza, are included in the area of the Coastal Grid System (referred to in the following pages).

The percentages of total power consumption in Tanzania represented by these regions have been as follows:

The percentages of total power consumption by region (Table-29)

	Areas	1965	1975
Coastal system	Dar es Salaam	53.6%	56.9%
	Morogoro	5.9%	4.1%
	Tanga	23.1%	14.1%
	Subtotals	82.6%	75.1%
Arusha/Moshi system	Arusha	3.9%	6.9%
	Moshi	3.8%	3.3%
	Subtotals	7.7%	10.2%
	Totals	90.3%	85.3%

The above figures indicate the following:

(i) Although the Coastal Grid System and Coastal System accounted for 90% and 80%, respectively, in 1965, the figures were declining.

(Progress in electrification of inland areas)

(ii) Only Dar es Salaam and Arusha were accounting for increasing percentages of total power consumption.

(Moshi's (the Kilimanjaro Region's) percentage was on the decrease.)

(iii) The Tanga Region's percentage was decreasing drastically.

The breakdown of power consumption in Table-31 shows that 70% of nationwide consumption was accounted for by industry in 1975 and that industrial use was on the increase while domestic use was on the decrease, as shown by the figures for consumption during years 1967-1975.

Sales and Consumers (Table-30)

Towns	1965		1975		1975/1965	
	Consumers	Sales ,000 KWH	Consumers	Sales ,000 KWH	Consumers %	Sales %
Arusha	2,494	7,651	4,067	33,640	63	340
Bukoba	966	1,069	1,466	2,540	11	138
Dar es Salaan	15,701	79,273	34,841	276,790	122	249
Dodoma	1,116	1,926	2,446	7,700	119	300
Iringa	819	3,382	1,620	4,540	98	34
Kigoma	419	666	751	1,610	79	142
Lindi	702	601	950	1,880	35	213
Mbeya	772	1,870	1,482	3,820	92	104
Morogoro	1,739	10,974	2,661	20,160	53	84
Moshi	2,285	8,893	3,858	15,990	69	80
Mpwapwa	-	-	336	410	-	-
Mtwara	469	649	1,249	2,690	166	314
Musoma	-	-	1,011	1,770	-	-
Mwanza	2,305	4,849	4,076	32,200	77	564
Nachingwea	-	-	280	840	-	-
Shinyanga	-	-	901	2,790	-	-
Singida	-	-	719	920	-	-
Tobora	1,106	1,921	2,121	4,790	92	149
Tanga	6,363	56,329	8,091	68,510	27	22
Tukuyu	-	-	287	1,380	-	-
Mafia	-	-	117	650	-	-
Songea	-	-	677	770	-	-
Totals or average	32,256	180,053	74,007	486,390	99	170

Percentage Breakdown of Electricity Sales by Category of User (%) (Table-31)

Towns	Year	Domestic	Commercial	Industrial	Public lighting
Arusha	1967	29.3	21.0	47.9	1.8
	1975	15.5	11.4	72.1	1.1
Bukoba	1967	31.5	41.5	21.5	4.6
	1975	27.7	42.0	27.5	3.2
Dar es	1967	24.0	13.4	61.6	0.9
Salaam	1975	21.5	10.2	67.6	0.7
Dodoma	1967	20.2	33.6	43.2	3.1
	1975	14.7	20.2	63.2	1.9
Iringa	1967	18.5	19.6	58.8	2.5
	1975	22.2	28.2	44.6	5.0
Kigoma	1967	21.0	42.0	29.6	7.4
	1975	26.2	34.7	33.0	6.0
Lindi	1967	43.9	40.4	10.5	5.3
	1975	19.4	24.0	53.0	3.7
Mbeya	1967	42.6	44.1	10.4	2.5
	1975	33.6	41.1	22.2	3.2
Moshi	1967	30.6	22.4	44.9	1.9
	1975	21.9	16.9	60.0	1.2
Mpwapwa	1967	22.2	55.6	--	22.2
	1975	31.0	47.2	16.8	5.0
Mtwara	1967	29.4	25.7	43.1	1.8
	1975	23.1	34.7	41.4	0.7
Musoma	1967	34.6	50.0	7.7	7.7
	1975	24.5	46.5	30.7	5.2
Mwanza	1967	32.3	28.2	36.1	3.4
	1975	9.5	8.3	81.1	1.1
Nachingwea	1967	22.7	63.6	13.6	13.6
	1975	14.6	57.9	25.3	2.1
Singida	1967	21.1	5.3	63.2	10.5
	1975	23.9	39.2	27.5	1.7
Shinyanga	1967	7.0	13.4	78.5	1.7
	1975	14.9	25.9	53.5	5.7
Tobora	1967	26.9	44.0	24.1	5.6
	1975	22.2	42.1	33.3	2.4
Tukuyu	1967	28.6	57.1	-	4.3
	1975	8.6	11.2	78.6	1.7
Morogoro	1967	6.6	8.3	83.9	1.1
	1975	10.7	12.1	75.7	1.4
Tanga	1967	10.3	8.0	81.0	0.7
	1975	8.5	6.3	83.9	1.3
Mafia	1967	-	-	-	-
	1975	4.5	8.0	-5.7	1.8
Songea	1967	-	-	-	-
	1975	26.9	65.6	4.7	2.8
Tanzania	1967	20.5	14.2	64.0	1.2
	1975	17.7	11.6	69.6	1.0

4.2 State of Electrification and Electric Power Supply in Kilimanjaro Region

(1) Electrification

The rate of increase of power consumption between 1965 and 1975 was only 80% in this region, or less than half of the average for the whole country of 170%. The only lower figure among leading power consumption regions as cited above was Tanga's 22%.

The table-32 gives a breakdown by region and category of consumption. The Kilimanjaro Region's percentage declined from 3.8% in 1967 to 3.3% in 1975. The principal characteristics of the Kilimanjaro Region's share of nationwide power consumption can be summarized as follows:

(i) Although the overall share of the Kilimanjaro Region was only 3.3% in 1975, in the individual consumption categories with the exception of the industrial category, percentages were higher: domestic 4.0%; commercial 4.7%; and public, 3.6%.

(Although the Kilimanjaro Region ranked sixth in overall share, its share in the domestic category was the fourth largest, behind those of Dar es Salaam, Tanga and Arusha.)

(ii) Although the Kilimanjaro Region's share of nationwide power consumption in the industrial category was below its share of all nationwide power consumption, this was the only category in which its share rose between 1967 and 1975.

From the above, the electrification of this region can be considered as follows:

The rate of domestic electrification is high in comparison with that of the whole country, but it has been rising more slowly recently. The rate of industrial electrification, on the other hand, although the lowest among the six principal regions, has been increasing.

Breakdown of Electricity Sales by Region and by Category (Table-32)

Town	Year	DOMESTIC (KWH)	(%)	COMMERCIAL (KWH)	(%)	INDUSTRIAL (KWH)	(%)	PUBLIC LIGHTING (KWH)	(%)	TOTALS (KWH)	(%)
ARUSHA	1967	2,742	5.6	1,965	5.7	4,482	2.9	168	5.8	9,357	3.9
	1975	5,214	6.0	3,835	6.7	24,254	7.2	370	6.9	33,640	6.9
BUKOBA	1967	408	0.8	538	1.6	279	0.2	60	2.1	1,296	0.5
	1975	704	0.8	1,067	1.9	699	0.2	81	1.5	2,540	0.5
DAR ES SALAAM	1965	30,895	62.6	17,250	50.4	79,296	51.5	1,159	40.0	128,728	53.6
	1975	59,510	68.0	28,233	49.6	187,110	55.6	1,937	36.3	276,790	56.9
DODOMA	1965	536	1.1	891	2.6	1,146	0.7	82	2.8	2,652	1.1
	1975	1,132	1.3	1,555	2.7	4,866	1.4	146	2.7	7,700	1.6
IRINGA	1967	670	1.3	710	2.1	2,129	1.4	91	3.1	3,620	1.5
	1975	1,088	1.2	1,280	2.2	2,025	0.6	227	4.3	4,540	0.9
KIGOMA	1967	171	0.3	341	1.0	241	0.2	60	2.1	813	0.3
	1975	422	0.5	559	1.0	531	0.2	97	1.8	1,610	0.3
LINDI	1967	252	0.5	231	0.7	60	0.0	30	1.0	573	0.2
	1975	365	0.4	451	0.8	996	0.3	70	1.3	1,880	0.4
MBEYA	1967	859	1.7	889	2.6	210	0.1	50	1.7	2,017	0.8
	1975	1,284	1.5	1,570	2.8	848	0.3	122	2.3	3,820	0.8
MOSHI	1967	2,827	4.0	2,079	6.0	4,148	2.7	176	6.1	9,238	3.8
	1975	3,502	4.0	2,702	4.7	9,594	2.8	192	3.6	15,990	3.3
MPWAPWA	1967	21	0.0	52	0.2	-	-	21	0.7	94	0.0
	1975	127	0.1	194	0.3	69	0.0	21	0.4	410	0.1
MTWARA	1967	321	0.7	280	0.8	470	0.3	20	0.7	1,091	0.5
	1975	621	0.7	933	1.6	1,114	0.3	19	0.4	2,690	0.6
MUSOMA	1967	90	0.2	130	0.4	20	0.0	20	0.7	260	0.1
	1975	434	0.5	823	1.4	543	0.2	92	1.7	1,770	0.4
MWANZA	1967	2,003	4.1	1,748	5.1	2,238	1.5	211	7.3	6,200	2.6
	1975	3,059	3.5	2,673	4.7	26,114	7.8	354	6.6	32,200	6.6
NACHINGWEA	1967	50	0.1	141	0.4	30	0.0	30	1.0	221	0.1
	1975	123	0.1	486	0.9	213	0.1	18	0.3	840	0.2
SINGIDA	1967	59	0.1	15	0.0	177	0.1	29	1.0	280	0.1
	1975	220	0.3	361	0.6	253	0.1	86	1.6	920	0.2
SHINYANGA	1967	120	0.2	231	0.7	1,351	0.9	29	1.0	1,721	0.7
	1975	416	0.5	723	1.3	1,493	0.4	159	3.0	2,790	0.6
TOBORA	1967	581	1.2	950	2.8	520	0.3	121	4.2	2,158	0.9
	1975	1,063	1.2	2,017	3.5	1,595	0.5	115	2.2	4,790	1.0
TUKUYU	1967	22	0.0	44	0.1	-	-	11	0.4	77	0.0
	1975	119	0.1	155	0.3	1,085	0.3	23	0.4	1,380	0.3
MOROGORO	1967	938	1.9	1,180	3.4	11,929	7.8	156	5.4	14,218	5.9
	1975	2,157	2.5	2,439	4.3	15,261	4.5	282	5.3	20,160	4.1
TANGA	1967	5,716	11.6	4,440	13.0	44,953	29.2	388	13.4	55,498	23.1
	1975	5,823	6.7	4,316	7.6	57,480	17.1	891	16.7	68,510	14.1
MAFIA	1967	-	-	-	-	-	-	-	-	-	-
	1975	29	0.0	52	0.1	557	0.2	12	0.2	650	0.1
SONGEA	1967	-	-	-	-	-	-	-	-	-	-
	1975	207	0.2	505	0.9	36	0.0	22	0.4	770	0.1
TANZANIA	1967	49,371	100.0	34,250	100.0	153,859	100.0	2,899	100.0	240,085	100.0
		87,510	100.0	56,929	100.0	336,736	100.0	5,336	100.0	486,390	100.0

The table below gives a percentage breakdown by category of increase in power consumption in principal regions between the years 1967 and 1975. The figures for the Kilimanjaro Region does not differ very much from the average for other regions than Dar es Salaam, which has special characteristics as the capital (somewhat higher percentages in the domestic and industrial categories and lower percentages in the commercial and public categories). The figures for the Kilimanjaro Region are extremely close to these for Arusha, particularly in the domestic and industrial categories.

Therefore the slower rate of increase in power consumption in the Kilimanjaro Region during 1967-1975 was not due to a fall in an particular category.

% Breakdown by Category of Increase in Power Sales in Each Principal Region Between 1967 and 1975 (Table-33)

	Domestic		Commercial		Industrial		Public lighting		Totals	
	(KWH)	(%)	(KWH)	(%)	(KWH)	(%)	(KWH)	(%)	(KWH)	(%)
Nationwide	38,139	15.5	22,679	9.2	182,877	74.3	2,427	1.0	246,132	100.0
Nationwide Dar es Salaam excluded	9,524	9.7	11,696	11.9	75,063	76.6	1,659	1.7	97,942	100.0
Arush	2,473	10.2	1,870	7.7	19,772	81.3	202	0.8	24,316	100.0
Dar es Salaam	28,615	19.3	10,983	7.4	107,814	72.8	778	0.5	148,190	100.0
Dodoma	596	11.8	664	13.2	3,720	73.8	64	1.3	5,044	100.0
Moshi	675	10.0	633	9.4	5,446	80.4	16	0.2	6,770	100.0
Mwanza	1,056	4.1	925	3.6	23,876	91.8	143	0.6	26,000	100.0
Morogoro	1,219	20.5	1,259	21.2	3,332	55.1	126	2.1	5,936	100.0
Tanga	107	0.8	-124	-1.0	12,527	96.3	503	3.9	13,013	100.0

The cosumption levels of sales/Consumer are 1700 KWH/year for domestic use, 2400 KWH/year for commercial and business use and 300,000 KWH/year for industrial use.

Sales/Consumer by User (Table-34)

	Domestic	Business/Trade commercial	Industrial	Pubic lighting	Totals
Sales (Million)	3.62	3.00	9.31	0.22	16.15
Sales/Consumer (KWH/year)	1,100	2,400	300,000	36,700	3,600

(2) *Costal Grid System and Kilimanjaro Region*

In the past the Kilimanjaro Region adopted a regironal power selfsupply system together with Arush known as the Arusha/Moshi System.

The power development and consumption in this Arusha/Moshi System area up to 1975 were as shown in the table-35.

However, it became difficult to maintain a satisfactory balance between power supply and demand under this self-supply system, mainly due to the following reasons:

(i) A decrease of power generating capacity due to lowering of *water level for hydraulic power generation paaticularly,* MYM DAM POWER STATION.

(ii) An increase of power demand in Arusha.

For the above reasons, a new system as adopted to ensure widerange balance between supply and demand by laying 132 KV power transmission line from Hare in 1976 to provide an integrated power supply with costal regions.

This is called the "Coastal Grid System", by which a steady supply of power to this region from large-capacity hydraulic power stations in Hale and Kidatu along the coast has been made possible. (Fig.-13)

Power supply and demand in this region as of 1976 were as shown below. Through this 132 KV transmission line, the region is receiving 3.16 MW of power from Hale.

	Existing capacity		M.D.
Moshi N.Y.M.	4.0 MW	(8.0)	4.26 MW
Kik	0.8	(1.16)	
Moshi Dessel	0.5	(0.8)	
Arusha	3.0	(3.7)	7.20
Totals	8.3		11.46 (from Moshi Branch)

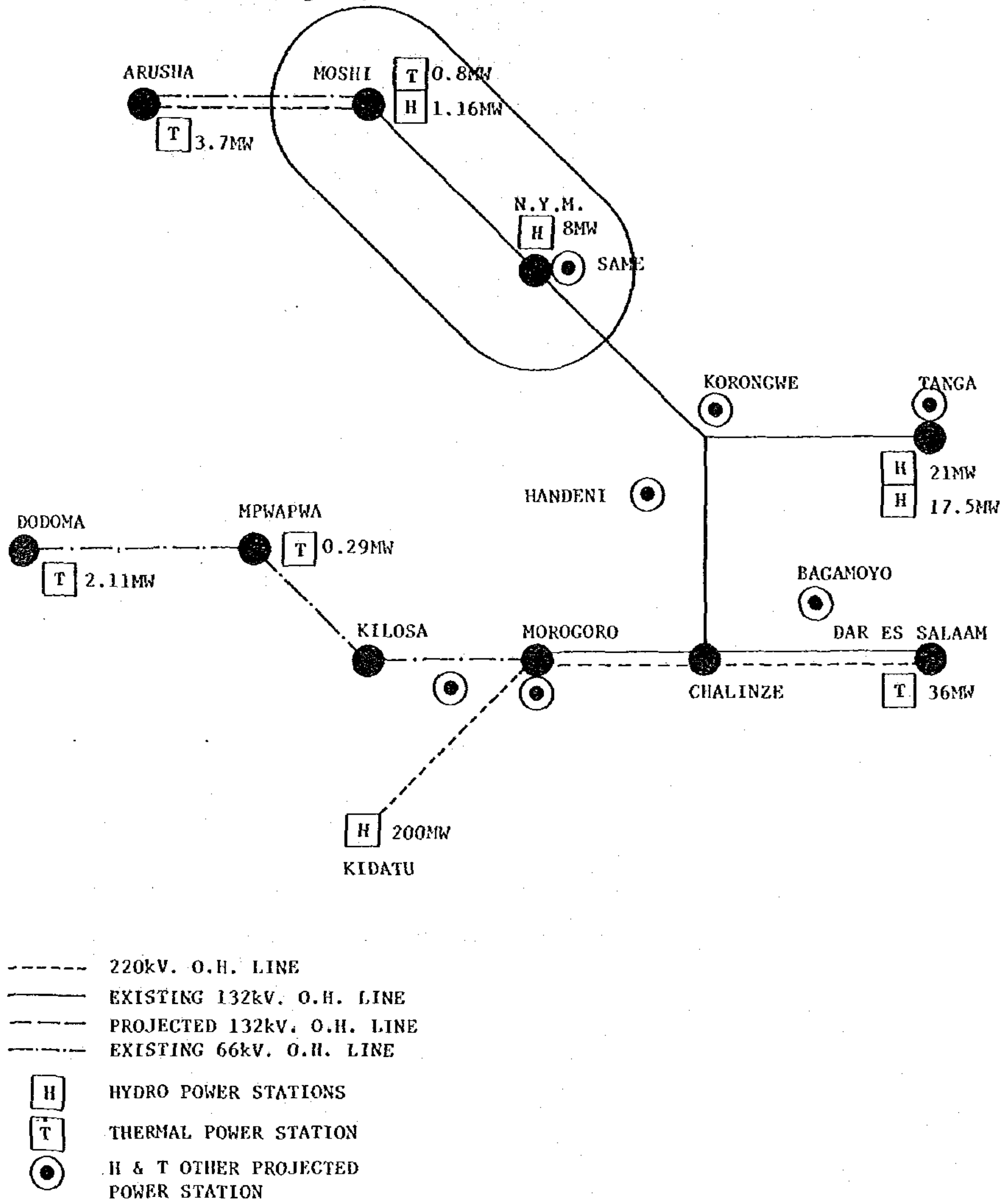
In this Coastal Grid System area, various power development projects have been in progress, of which the Kidatu Power Station is largest in capacity after having it increased from 100 MW to 200 MW.

Electric Power Installation and Sale (Table-35)

AREAS	Power installed (megawatts)				Power sales (million Kwh)			
	1972	1973	1974	1975	1972	1973	1974	1975
COAST								
Dar es Salaam	54.46	77.46	77.46	69.20	234.90	224.46	258.67	276.79
Morogoro	-	-	-	-	14.96	15.70	16.76	20.16
Tanga	-	-	-	-.	60.06	67.39	68.14	68.51
Pangani Falls	17.50	17.50	17.50	17.50	-	-	-	-
Hale	21.00	21.00	21.00	21.00	-	-	-	-
Subtotals	93.44	115.56	115.96	107.70	309.92	327.55	343.57	365.46
ARUSHA/MOSHI								
Arusha	5.20	3.70	3.70	3.70	25.93	27.00	32.23	33.64
Moshi	9.96	9.96	9.96	9.96	16.28	17.72	16.78	15.99
Subtotals	15.16	13.66	13.66	13.66	42.21	44.72	49.01	49.63
OTHER BRANCHES								
Bukoba	0.80	0.81	0.80	1.15	2.37	2.43	2.53	2.54
Dodoma	1.71	1.73	2.56	2.43	4.83	5.13	6.00	7.70
Iringa	1.67	1.91	1.97	1.97	4.38	4.74	4.74	4.54
Kigoma	0.72	0.60	0.77	0.91	1.27	1.42	1.54	1.61
Lindi	0.44	0.42	0.44	0.64	0.93	1.18	1.34	1.88
Mbeya	1.04	1.06	1.52	1.54	2.80	3.31	3.88	3.82
Mpwapwa	0.29	0.22	0.29	0.29	0.33	0.37	0.40	0.41
Mtwara	2.18	2.24	2.08	3.36	1.60	1.71	2.46	2.69
Musoma	0.65	0.71	0.65	0.76	1.09	1.32	1.45	1.77
Mwanza	9.66	9.66	9.66	9.66	24.00	27.33	30.40	32.20
Nachingwea	0.40	0.40	0.40	0.60	0.56	0.52	0.76	0.84
Shinyanga	-	-	-		2.37	2.77	2.72	2.79
Singida	0.36	0.43	0.36	0.36	0.80	0.88	0.92	0.92
Songea	0.38	0.41	0.36	0.66	0.40	0.52	0.61	0.77
Tabora	1.61	0.60	2.00	2.32	3.50	4.13	4.67	4.79
Tukuyu	0.23	0.52	0.77	1.20	0.23	0.54	1.17	1.38
Mafia	0.68	0.82	0.78	0.78	0.67	0.63	0.66	0.65
Subtotals	22.82	22.84	25.41	28.63	52.13	59.13	66.25	71.30
Totals	131.42	152.46	155.03	149.99	404.26	431.40	458.83	486.39

Source: Tanzania Electric Supply Company Ltd.

Coastal Grid System (Fig.-13)



(3) Condition of Equipment of Power Facilities in Kilimanjaro Region

The power system in the Kilimanjaro Region is as shown in Fig.-14.

Power stations: Nyumba ya Mungu Hydro. Power Station (8MW)
Moshi Thermal Station (0.8 MW)
Kikuletwa Hydro. Power Station (1.16 MW)

Substations: Kiyungi Substation (132/66 20 MW)
(66/33 10 MW)
(33/11 2.5 MW)
Moshi Trad. School Substation (33/11 5 MW)
Same Substation (132/66/33/11)

Transmission and distribution lines:

132, 66, 33, 11 KV 0.4 KV

The areas able to use the above power system are urban areas such as Moshi and Same and the main villages and estates on the slopes of Mt. Kilimanjaro such as Machame, Lambo, Tchibo es estate, Mahangu, Himo, Mawanzi, etc.

Besides the above power system provided by TANESCO, there are the following private generating facilities, whose capacities, however, are not so large:

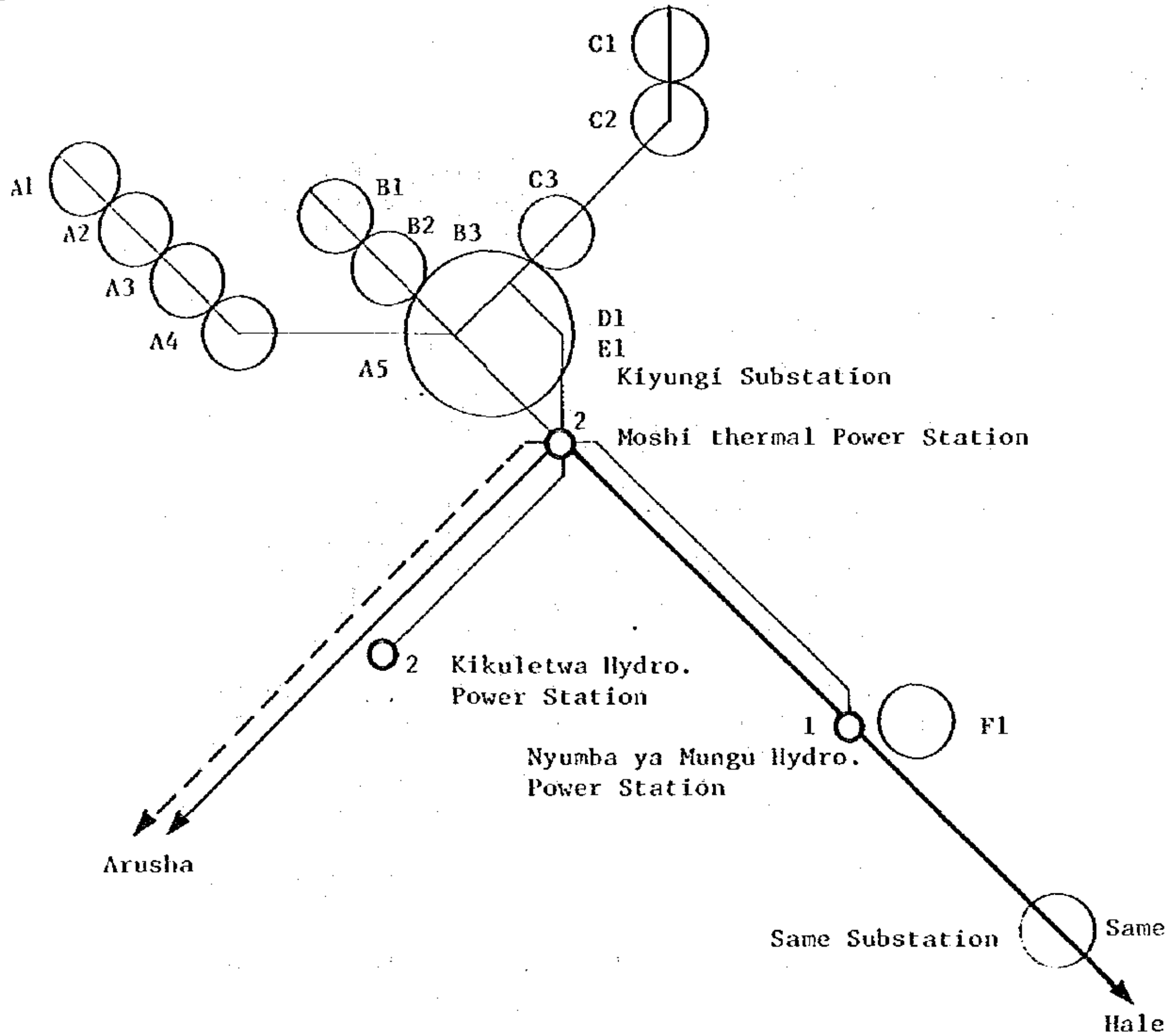
KOME Hospital	92 KW
International Airport	
Kibo Match	160 KW
KCMC	92 KW
Sikh Saw Mills	84 KW

The number of TANESCO electric power customer in each category in each district of the region is given in the table below, 90% of them being concentrated in Moshi Town.

Breakdown of Consumers by Category and District (Table-36)

	Domestic	Business/ Trade	Commercial	Industrial	Public light	Totals
Hai	273	43	NIL	5	NIL	321
Pare	56	39	NIL	NIL	2	97
Rombo	NIL	NIL	NIL	NIL	NIL	NIL
Moshi	2,906	1,116	72	26	4	4,124
Totals	3,235	1,198	72	31	6	4,542

Power Systemin the Region (Fig.-14)



A 1	190	B 1	412.5	C 1	625.0	D 1		F 1	
A 2	575	B 2	485.0	C 2	50.0	E 1			
A 3	830	B 3	335.0	C 3	840.0				
A 4	545			C 4	1,600.0				
TOTALS	2,315 KVA		1,232.5 KVA		3,115.0 KVA		5,375.0 KVA		75 KVA

4.3 Power Development Plan

(1) Power Demand

In order to work out the scope of construction for the power supply system, power demand has been roughly estimated as follows.

(i) Annual Power Demand

The estimation of the quantity of electric power is based on the following assumptions:

(a) The average consumption of electricity per capita per annum in the areas involved in the coastal grid system other than Dar es Salaam will steadily increase as between the years 1965 and 1975 in all categories of consumption.

(Dar es Salaam is excluded because of its different pattern of power consumption as the capital city.)

(b) The Kilimanjaro Region will catch up with the average in terms of consumption per capita per annum by 1985.

The table-39 gives a rough outline of power supply in the future.

According to this estimate, demand for electricity with double by 1980 and quintuple by 1995.

Estimating the future total electricity demand for all areas in the coastal grid system on the basis of past trends, one foresees a rise in the Kilimanjaro Region's share from the present 3.85% to 8.61% by 1995.

No. of Customers and Sales in Coastal Crid System Areas (Table-37)

	Population		Customers		Power sales		Power sales/person	
	1967	1975	1967	1975	1967 (1,000kwH)	1975 (1,000kwH)	1967 (kwH)	1975 (kwH)
Dar ea Salaam	272,821	571,827	17,467	34,841	128,728	276,790	471.8	484.0
Morogoro	685,104	803,565	1,641	2,661	14,218	20,160	20.8	25.0
Tanga	771,060	1,108,787	5,367	8,091	55,498	68,510	72.0	61.8
Arusha	610,474	801,484	2,353	4,067	9,357	33,640	15.3	42.0
Kilimanjaro	652,722	865,000	2,187	3,858	9,238	15,990	14.2	18.5
Coastal Grid Areas	2,992,181	4,150,663	29,105	53,518	217,039	415,090	72.5	100.0
Coastal Grid System Other Than Dar es Salaam	2,719,360	3,578,836	11,638	18,677	88,311	138,300	32.5	38.6

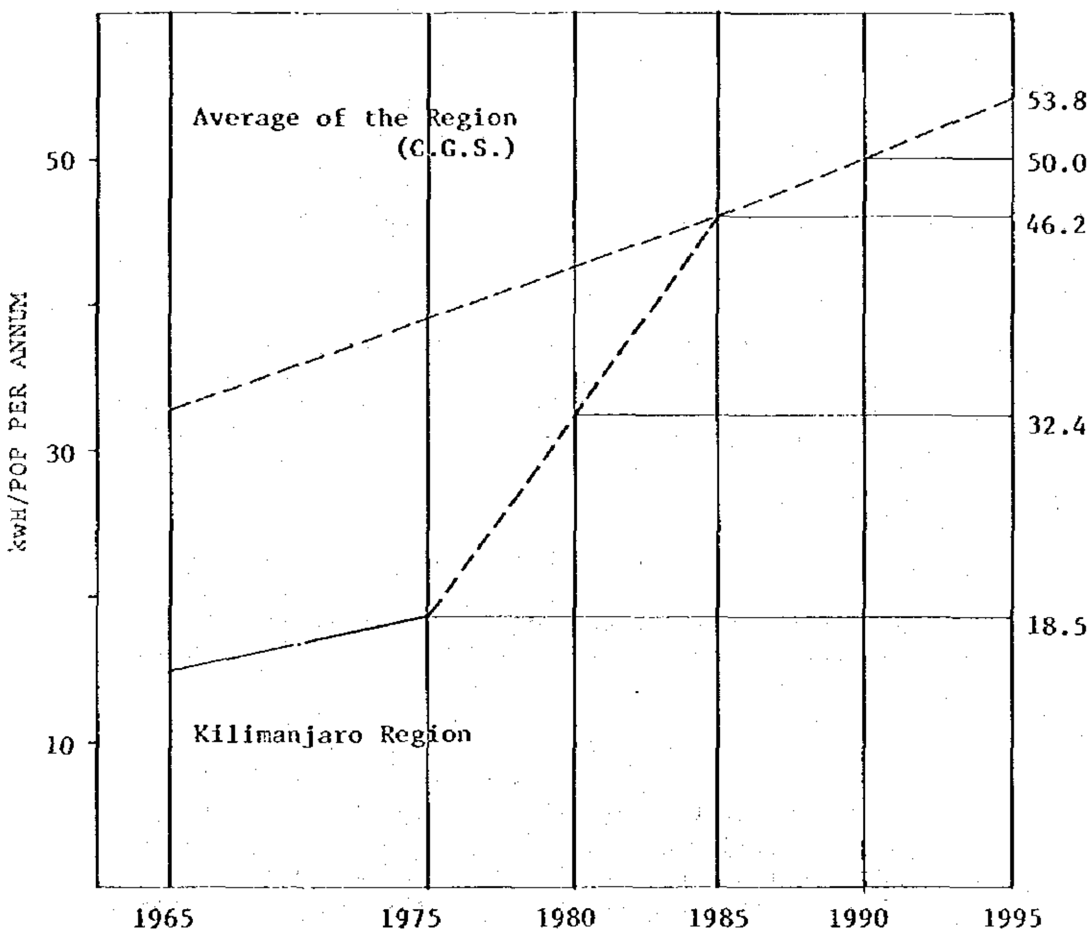
Estimation of Electricity Demand by District (million kwH) (Table-39)

Year	1980 POP.	1980 Demand	1985 POP.	1985 Demand	1995 POP.	1995 Demand
MOSHI TOWN	69,246	14.50	100,636	21.02	150,000	31.42
SAME	21,528	4.51	32,506	6.79	50,000	10.47
SANYA JUU	9,500	1.99	14,835	3.10	25,000	5.24
MKUD	9,500	1.99	14,835	3.10	25,000	5.24
Subtotals	109,774	22.98	162,812	34.00	250,000	52.36
HAI DISTRICT						
WEST HAI	110,019	1.22	126,580	2.60	150,609	3.24
GENERAL HAI	69,181	0.77	76,785	1.57	87,991	1.90
MOSHI DISTRICT						
CENTRAL HAI	82,149	0.91	88,338	1.81	95,495	2.06
EAST HAI	102,496	1.14	114,535	2.35	132,084	2.84
TPC	5,654	0.06	6,630	0.14	8,095	0.17
WEST VONJO	67,687	0.75	76,906	1.58	90,856	1.96
EAST VONJO	101,268	1.12	113,655	2.33	131,970	2.84
ROMBO DISTRICT						
MENGWE	37,997	0.42	41,813	0.86	47,265	1.02
MKUU	34,917	0.39	39,653	0.81	45,003	0.97
MASHATI	37,736	0.42	42,244	0.87	49,015	1.05
USSERI	43,505	0.48	49,556	1.02	58,969	1.27
TARAKIA	7,695	0.09	9,499	0.19	12,548	0.27
PARE DISTRICT						
UGWENO	35,426	0.39	40,755	0.84	49,441	1.06
USANGI	43,064	0.48	49,635	1.02	60,287	1.30
MWENBE/MBANGA	36,307	0.40	41,810	0.86	50,689	1.07
CHOME/SUJI	21,184	0.23	24,467	0.50	29,746	0.64
MANBA/VUNTA	43,860	0.49	50,458	1.03	61,221	1.32
GONJA	32,081	0.36	36,869	0.75	44,716	0.96
Subtotals	912,226	10.13	1,030,188	21.12	1,206,000	25.97
Totals	1,022,000	33.11	1,193,000	55.12	1,456,000	78.33

Electricity Consumption Per Capita Per Annum (Table-38)

Year	1975	1980	1985	1990	1995
Kilimanjaro total sales (Million kwH)	15.99	33.11	55.12	67.10	78.33
Index	100	210	340	420	490
Coastal grid system total sales	415.09	538.87	662.65	786.45	910.22
Kilimanjaro/ coastal grid system	3.85%	6.14%	8.32%	8.53%	8.61%

Electricity Consumption per Capita per Annum (Fig.-15)



(ii) Maximum Demand

On the basis of the preceding estimate of future electric power demand future maximum demand is estimated as per the table-40

The following was taken into consideration:

Distribution losses: 25% at present but will be improved to 10% in the future.

Load factor: 58% at present but 60% in the future.

Estimation of Maximum Demand (KW) (Table-40)

		1980	1985	1995
Hai		840	1,535	2,191
Moshi	Subtotals	3,900	6,170	8,715
	Town	3,060	4,437	6,632
	Rural	840	1,733	2,083
Rombo		800	1,446	2,073
Pare	Subtotals	1,448	2,489	3,555
	Town	952	1,433	2,210
	Rural	496	1,056	1,345
Totals of the region		6,988	11,640	16,534

(2) Power Development Plan for up to 1995

The basic policies and priorities for power supply in the Kilimanjaro Region were established as follows, taking into account such factors as activity patterns, economic strength of individual against cost bearing by beneficiary, etc.:

(i) Planning Policy

(a) Energy Supply for Public Services

This is the most urgent requirement with the highest priority in terms of raising overall level of social services in the region.

Included there are direct utilities such as public security, and crime prevention (e.g., street lighting) and indirect utilities that indirectly maintain assembly halls, etc. and further more make possible and facilitate the construction and maintenance of urban facilities such as waterworks, sewerage systems, etc..

Especially in fixed residential areas widely scattered and with low population density, most of the above-mentioned public services or urban facilities are maintained by diesel power.

A stable energy supply to these public services, however, has been difficult because of poor maintenace and operation and uneconomical mess of diese equipment, and hence the strong desire for replacement by electrical power.

This, therefore, is now a most important social policy consideration.

(b) Promotion of Industries

Since the region consists mostly of rural areas and rural population, particular emphasis must be placed on promotion of agricultural industries.

(c) Improvement of Ling Standards

Due to such factors as the activity patterns of agricultural life, lack of widespread use of home electrical appliances (Only electric lights and the like), and self cost bearing, etc., domestic electrification has been little motivated. Thus, electric power supply has been limited only to townships and some well-to-do villages (Machame, Marango) and estates.

However, it is expected that the desire for a higher living standard will result from an increase in individual economic capability in the future and will being about a considerable increase in demand for electricity for domestic use. A sufficient supply of electricity will, therefore, have to be planned for.

(ii) Planning Strategy

The strategies for power supply system construction have been established as follows on the basis of the above-mentioned priorities:

(a) Since the majority of the public facilities in the region are to be located in the four towns and 15 division centers, these points must first be electrified. The power supply network of the region shall also have the transmission line connecting these towns and divisions as its axis. (Primary orientation of electric network).

(b) A balance between the following factors will have to be achieved with respect to domestic electrification.

- Receiving side: Level of household income and orientation toward electricity.

- Supplying sie: distribution efficiency: (1) demand density and collection of demand over a certain limit, and (2) transmission efficiency--distance between station and demanding area and possibility and economy of expansion.

  As the pattern of population density in the region reflects land productivity (individual income), areas with higher population density make likely to obtain a better balance between these factors.

  Priotity of domestic electrificatón shall therefore be given to areas with highest population density.

(c) Since the areas, other than towns, with the highest population density (those on the slopes of Mt. Kilimanjaro) also have highest agricultural development potential, as indicated in Land Use Plan, the category where these areas are involved will not differ too much from that of the electric supply areas as determined in accordance with the above-mentioned priority.

(iii) Estimate of Domestic Electrification

The rate of domestic electrification has been estimated in order to work out the scope of power supply system construction.

This estimation is based on the following assumptions:

(a) The past trend in the percentage of ratio. total power consumption of the Coastal Grid System represented by domestic use was used as the criterion to determine the percentage of total domestic power consumption in the Kilimanjaro Region which will be represented by the areas concerned in the future.

(b) The average amount of domestic power consumption per household per year was estimated to be 300 KWH.

Electric Power Supply Forecast (Table-41)

Year	1975	1980	1985	1990	1995
Population supplied with power	16,175	28,300	77,900	125,400	231,000
Rate (%)	1.9	2.8	6.5	9.3	15.9

(iv) Supply/Demand Balance of Power Facilities

(a) Distribution shall be divided into two areas for the sake of balance:

- Moshi area (Moshi, Rombo, Hai)

- Pare area (Pare)

(b) Substation Facilities

- The Moshi area will have sufficient capacity since 132/66 has 20 MAV capacity, and, in addition, power will be directly transmitted to Arusha by 132 KVA line.

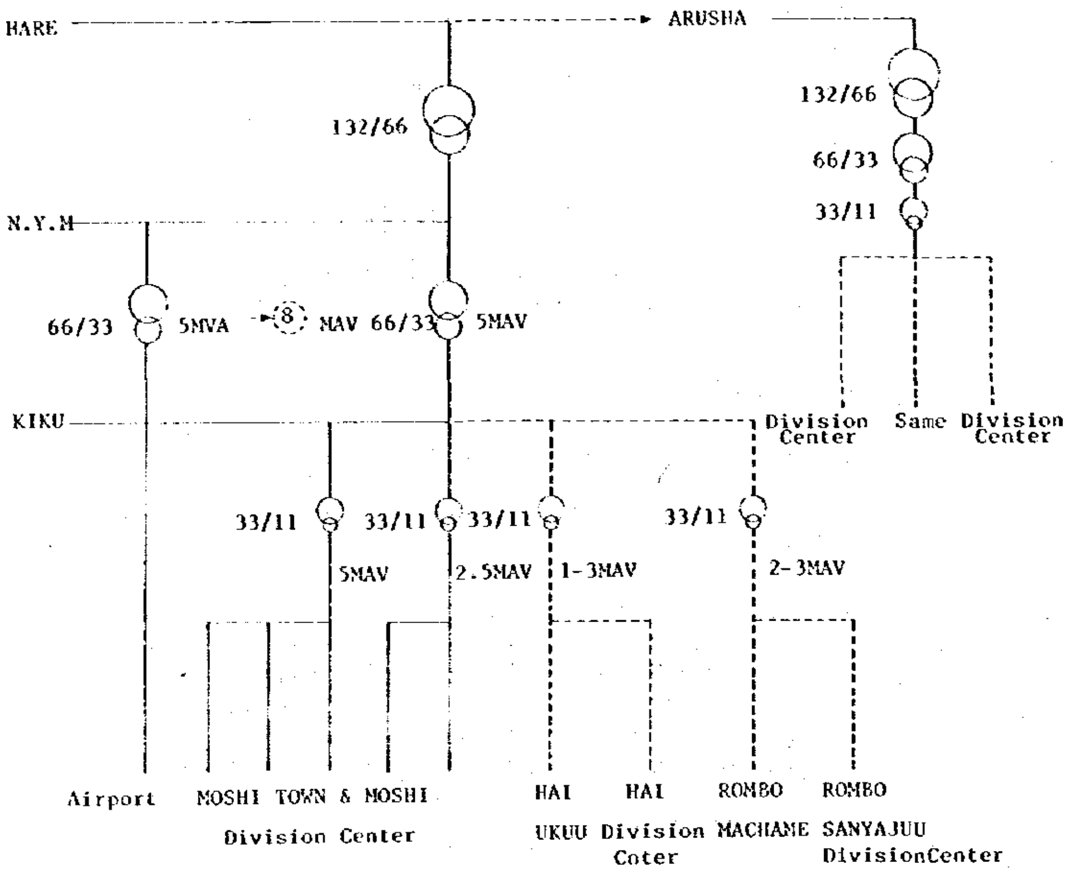
- 66/33: 2 units are presently provided in Moshi, each having a capacity of 10 MAV. These will be sufficient for maximum demand in the Moshi area. A capacity increase of about 3 MAV, however, will be necessary by 1995. Since there is not enough power demand to require direct transmission by 66KV line from the KIYUNGI Substation, the capacaity increase of the substation facilities presently available in Moshi will be sufficient.

  In the Pare area the existing 132/66/33 facilities shall be used.

- 33/11: As the present capacity is 7.5 MAV, and the capacity required in the future in the Moshi area will be 13 MAV, a 33/11 substation with a difference of 5.5 MAV will be necessary. Maximum demand in the Hai and Rombo districts will covered by 33/11 substations with 2-3 MAV capacity in order to receive electric power by 33 KV line from the above-mentioned 66/33 KIYUNGI Substation in Moshi.

  (The substations shall be located in Machame in Hai and Mkuu in Rombo)

Power System (Fig.-16)



(v) Power Development Plan for up to 1995

(a) Power shall be supplied to all 4 towns and 15 division centers.

Domestic power shall be individually distributed to each house.

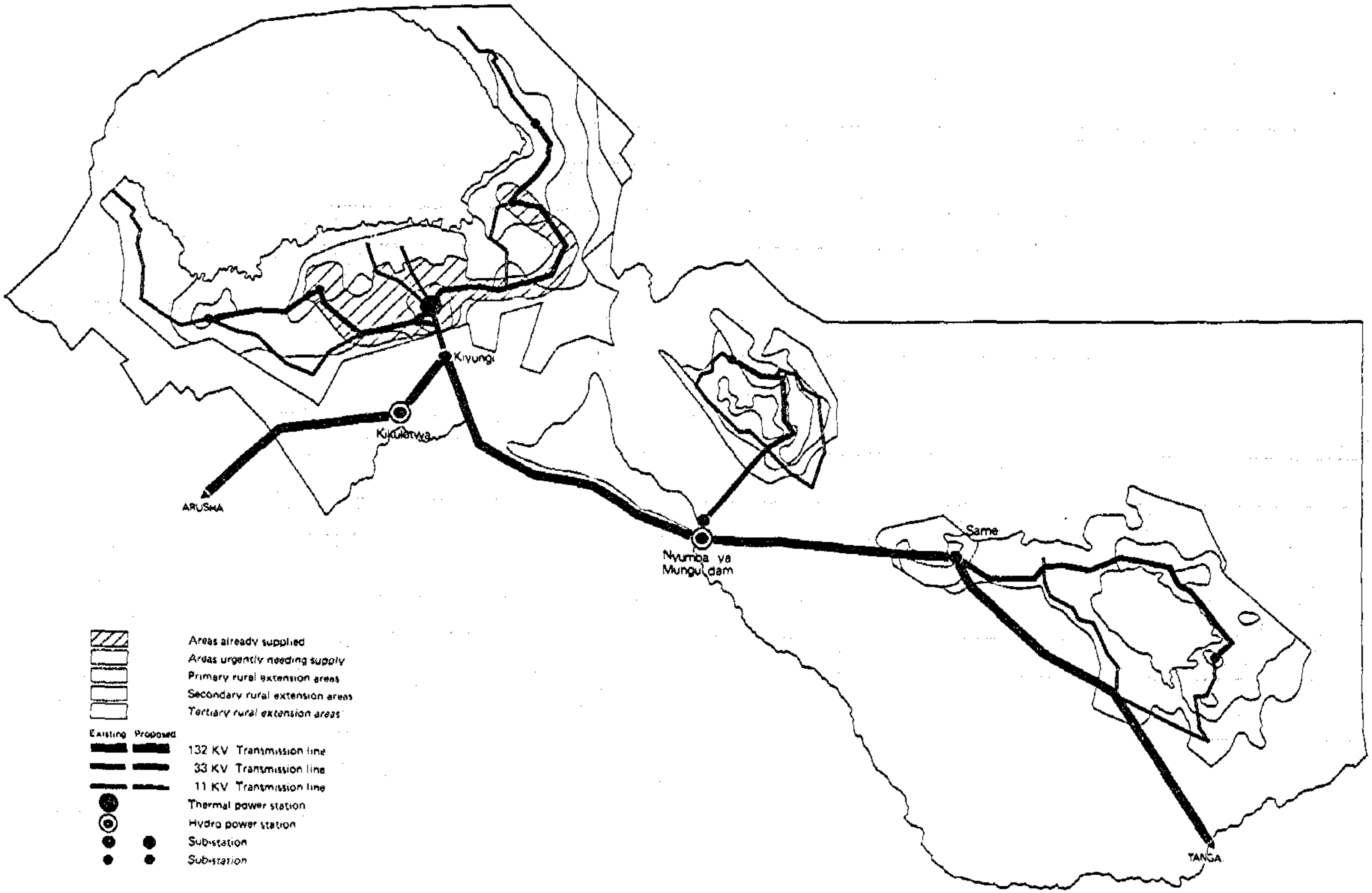
(b) The range of agricultural areas to be electrified shall be expanded, step by step.

(c) The majority of electric power for rural areas shall be consumed in the above 15 division centers.

(d) For individual projects (unpredicable at present), power distribution shall be based on the primary orientation set by the planning strategy.

(e) The power distribution areas shall be Moshi (including Hai and Rombo) and Pare, and the latter shall be further divided into North Pare and South Pare.

Power Development Plan (Fig.-17)



Power Supply Plan for Up to 1995 (Fig.-18)

Year	1975	1980	1985	1990	1995
Moshi District	Intensification of electrification in Moshi Town		Low-density areas		
	4 division centers	Medium-density areas			
	High-density areas				
Rombo District	Mkuu and 2 division centers	Medium-density areas			
	High-density areas		Low-density areas		
	Sanya Juu		Low-density areas		
	High-density areas				
		Medium-density areas			
Pare District	Intensification of electrification in Same Town				
North Pare	2 division centers	Medium-density areas			
	High-density areas		Low-density areas		
South Pare		4 division centers	1 division center		
		High- & Medium-density areas		Low-density areas	

Review and revision of the exisiting system

1) Towns, division centers and high-density areas

2) Policy for low-density areas

4.4 Proposed Project

(1) Transmission Lines and Substations

		1977-80	1981-85
1.	Transmission line	Moshi-Machame (20) (33)	Machame-Sanyajuu
	Substation	Machame substation (33/11 2MVA)	Sanya Juu substation (33/11 2MVA)
2.	Transmission line	Maranga-Mengue (16)	Mengue-Mkuu (10)
	Substation	Marangu substation (33/11 2MVA)	Mkuu substation (33/11 2MVA)
3.	Transmission line	Myumba ya Mungu-North Pare (30) (11)	

(2) Distribution network (km)

	1977-80	1981-85
Town areas	55.8	156.6
Rural areas	72.4	199.3

5. PLAN INPLEMENTATION

5.1 Expenditures and Revenues

(1) Expenditures

In the past public utility expenditures have been as shown in Table-42. The greatest amount of expenditures have been for the water supply, the next largest amount for electricity, and the least for sewerage. Particularly noteworthy is the fact that since 1974 the annual amount of investment in water supply has been more than double what it was before then.

Future expenditures on public utilities are given in Table-43 as estimates as estimates on the basis of the projects set in preceding sections of this report.

(i) Water Supply

Annual investment in the rural and urban water supplies will be approximately double the 1974/75 figures in the period 77/78-70/81 and triple them in the period 81/82-85/86. Furthermore, per-capita development expenditures will increase from the 99/- of 1971-1975 to 281/- in the period 1976-1981 and 402/- in the period 1981-1986. In the past water has been developed where the construction work has been easiest and the cost has been lowest, which has made for comparatively low-cost water supply. In the future, however, as water resources become scarcer and scarcer, per-capital development costs will become increasingly high.

(ii) Sewerage

Sewerage service, quite justifiably, is generally given a lower priority than water supply, but some investment will be called for during the period of the Third 5-year Plan, the amount increasing as time goes on.

(iii) Electricity

TANESCO, which supplies the Kilimanjaro Region with electricity through its Moshi Branch, is a wholly government-owned company. In 1976 its expenditures for supply of electricity to the region are estimated to have been approximately 5.8 million shs. Since it is operated on a company financial basis, such expenditures include 34.3% for depreciation and 30.6% for interest. As for recurrent expenditures, they can be expected to increase to about twice what they are now.

Expenditure (Table-42)

Water supply (in thousands of sh.)

Year	Development	Recurrent	Total expenditures
1970	2,081	2,594	4,675
1971	1,453	2,550	4,003
1972	2,710	2,708	5,418
1973	1,783	1,581	3,364
1974	8,004	2,636	10,640
1975	6,621	2,502	9,123

(1971 ∿ 1972) 20,571

Sewerage

Year	Development	Recurrent	Total expenditures
1975	160	150	320

Electricity (1976)

Generation	1,790	23.5%	0.11 shs/1 KWH)
Cost of unit distribution	549	7.2%	
Distribution	279	3.6%	
Achninistration	1,071	14.1%	
Depreciation	1,996	26.2%	
Interest	1,780	23.4%	
Statutary expenses	146	1.9%	
Training expenses	-		
Total cost	7,611	100%	

Note: Estimated on basis of TANESCO FINANCE MANAGER'S REPORT (1976).

Estimated Expenditures (Table-43)

(thousands of sh.)
( ): per annum

	Develop-	Recurrent	Total	Develop-	Recurrent	Total
Water supply	88,833	18,744	107,576	132,945	27,718	160,663
	(22,208)	(4,686)	(26,894)	(26,589)	(5,514)	(32,133)
Urban	27,833	5,860	33,693	56,825	10,574	61,399
	(6,958)	(1,466)	(8,423)	(10,165)	(2,115)	(12,280)
Rural	61,000	12,883	73,883	82,120	17,144	99,264
	(15,250)	(3,220)	(18,470)	(16,424)	(3,429)	(19,853)
Sewerage	10,581	2,515	13,096	20,145	6,250	26,395
	(3,527)	(838)	(4,365)	(4,029)	(1,250)	(5,279)
Electricity	18,202	36,911	55,114	20,550	49,236	69,786
	(4,551)	(9,228)	(13,779)	(4,110)	(9,847)	(13,957)

(2) Revenues

All public utilities other than rural water are revenue-producing, and even rural water has some revenue from the charges on private connections. On the basis of the current rates shown in Table-44', the present income (Table-45) is 5.6 shs./1,000 gal. of urban water, 0.1 sha./1,000 gal. of rural water, and 0.39 shs./1 KWH of electricity.

Rates for Public Utilities (Table-44)

Urban Water

- All metered water is supplied at the rate of 10/- per 1,000 gallons (or 4,546 litres). (6/- in 1972 ~ 1975, 2/- up to 1972)

- The minimum monthly charge per meter for metered supplies is also 10/-.

- Meter charge : 1.5 shs. per month

- Connection charge: Depends on length of local pipe.

Rural Water

- No charge except for private connections.

Sewerage

- Equivalent to water rates.

Electricity

- Tariff No.1 : applicable to premises used exclusively for domestic and private residential purposes.

Stop 1	0	10 units	minimum charge Shs. 13.00
Stop 2		10 units	@1/05 cents per unit
Stop 3		80 units	@-/45 cents per unit
Stop 4		400 units	@-/35 cents per unit
Stop 5 in excess of		500 units	@-/30 cents per unit

- Tariff No.2 : applicable to all premises other than those used exclusively as a private residence, or factories engaged solely in production, and specifically includes residential premises in which any form of business or trade is conducted. (Maximum demand does not exceed 75 KVA)

Stop 1	0	10 units	minimum charge Sha. 22.00
Stop 2		10 units	@ Shs. 2.25 per unit
Stop 3		180 units	@ 2.00 per unit
Stop 4		800 units	@ 1/50 cent per unit
Stop 5 in excess of		1,000 units	@1.00 per unit

- Tariff No. 3 : applicable to all factories and workshops having a maximum demand of less than 75 KVA and solely engaged in the production of some article or commodity

Stop 1	0	100 units	minimum charge Shs. 91.00
Stop 2		400 units	@-/80 cents per unit
Stop 3		1,500 units	@-/70 cents per unit
Stop 4		3,000 units	@-/65 cents per unit
Stop 5 in excess of		5,000 units	@-/55 cents per unit

- Tariff No. 4 : may apply to any installation where the maximum demand exceeds 40 KVA and will apply to all demands in excess of 75 KVA.

  The KVA demand indicator will be read each month.

  For the first 40 KVA minimum charge Shs. 3,000.00
  Each additional KVA in excess of 40 Shs. 30.00 per KVA
  Tariff No. 4

Stop 1	0	10,000 units	@-/22 cents per unit
2 the next		10,000 units	@-/20 cents per unit
3 in excess of		20,000 units	@-/18 cents per unit

  Tariff No. 5 : Public Lighting
  unit charge 75 cents per unit.

- Applicants will be required to pay in advance a contribution towards the cost of a service line required for the of electricity.

Revenue per unit and per consumer (Table-45)

Year	Total revenue (1,000 shs.)	Revenue per 1,000 gal. (shs.)	Revenue per consumer per year (shs.)	Water consumption per consumer (gal.)
1972	1,413	2.7	472.9	480
1973	2,992	5.3	962.6	498
1974	2,686	4.9	837.0	464
1975	3,021	5.6	911.7	445

* New water connection charge included.

Rural Water

Year	Total revenue (1,000 shs.)	Annual revenue per person of population with piped water (shs.)	Revenue per 1,000 gal. (shs.)
1972	1,065	-	-
1973	512	-	-
1974	455	-	-
1975	109	0.36	0.10

Electricity

Year	Total revenue (1,000 shs.)	Revenue per consumer per year (shs.)	Revenue per KWH (shs.)
1975	6,200	1,607	0.398
1976	8,300	-	-

* Tariff	Revenue per unit (shs.)
Domestic	0.39
Commercial	0.86
Light industrial	0.54
Industrial (KWH)	0.13
Industrial (KVA)	27.05
Public lighting	0.49

The following table compares the revenues and expenditures for each public utility.

Expenditures and Revenues (Table-46)

	Expenditures	Revenues	
Water supply	9,123	3,130	(1975)
Sewerage	320	no data	(1975)
Electricity	7,611	8,300	(1976)

As one can see, urban water revenues come to about one-third of all water supply expenditures, or roughly the level of recurrent expenditures. As for sewerage service revenues, there is no data available on the present situation, but considering the fact that 30% of the urban population is being serviced, some 1.8 million shillings should be collectable on the basis of the indicated rates. Moreover, expenditures for sewerage service have been very low in recent years because there has been no expansion of existing systems. Under this situation one can presume that expenditures and revenues in this category just about balance out, but as it become necessary in the future to expand or reorganize the existing systems, it will also be necessary to come up with new revenue-producing schemes.

Electricity is the big earner, with every KWH consumed in 1976 producing a 4.3 cent surplus.

The figures for revenue per consumer are: urban water, 911.7 shs.; rural water, 0.36 shs.; and electricity, 1607 shs.

5.2 Same Financial Aspects

(1) Water Supply

In the Kilimanjaro Region safe water is available to an estimated 55.4% of the urban population and to an estimated 38.1% of the rural population.

The government has decided to give top priority to a stepped-up program of water supply with the objective of making water reasonably available to the entire population in 20 years (by 1990). In order to achieve this objective water will have to be provided 66.7% of the population by 1980 and 89.2% of the population by 1985.

The estimated average annual investment necessary to achieve this is 26.9 million shs. in 1977 ~1981 and 32.1 million shs. in 1982 ~ 1986.

One of the most difficult problems in this respect will be that of assuring sufficient growth in local funds for surveys, feasibility studies, and engineering and for construction, operation, and maintenance of the new systems.

This problem is made all the greater by the fact that priority is to be given to rural water supply, which currently does not produce any revenue at all.

In order to increase the amount of local funds available for the program, increasing emphasis needs to be placed on the ability of water supply to generate revenues through user charges.

The net demand on the government budget for funds for recurrent expenditures should be minimized by setting adequate rates for Urban (revenue-producing) systems and by gradually upgrading rural (non revenue-producing) systems to the urban category. By introducing depreciation as a cost to be covered by charges, revenues can also be made to contribute towards future capital expenditure.

The recommendation that rural consumers should start to pay something for the water they consume is justified for the following reasons:

(i) In the present situation the burden on the government budget is getting progressively heavier.

(ii) By having to pay for their water supply, rural consumers will have more respect and appreciation for the facilities, and this will reduce operation and maintenance problems.

(iii) By having to pay, rural consumers will refrain from wasting precious water, and this will help keep water clemand from growing too rapidly.

Table-47 gives estimates of the water prices and total expenditures for water supply in 1980/81 and 1985/86 on the basis of such a system. According to this estimate, urban water will cost 4.3 shs./1,000 gal. in 1980/81 and 4.2 shs./1,000 gal. in 1985/86, asopposed to 5.6 shs./1,000 gal. at the present time, and rural water will cost almost the same as urban water by 1985/86.

The following matters will have to be considered in order to determine what the supply of funds should be for such future water prices.

(i) Household Budgets

The annual per-capital household expenditure for urban water can be estimated at 67.5 sh. (daily per-capital consumption of 33 gal. x 5.6 sh./1,000 gla x 365 days), which represents 5.1% of the annual per-capital income of 1,318 sh. in 1975.

As personal income increases along with the economic progress of the region, people will be cable to pay more for their water, and such increase in personal income should be taken into account in determining the amount that benefit from water supply service should appropriately pay for it.

A major problem in this respect is the income gap between urban and rural areas. The future water prices indicated in Table-47 were estimated separately for urban water and rural water. At the present time, however, there is only one single account system for the two categories, which means that the urban populations, which are economically better off, are paying for a part of the water supply of rural populations.

As we have already seen, the urban and rural populations would both have a water price of about 4 sh./1,000 gal. if their account systems were separate. At this rate, the urban consumer would pay 60-70 sh. a year for water versus the 13-16 sh. of his rural counterpart since he uses about four times as much water (175-200 liters a day vs. 45 liters).

Since the supply of water to rural areas is important in terms of social policy and the rural population is less capable of bearing the cost of such service than urban populations, it is necessary either to subsidise the rural water supply with public funds or to use some of the money collected from urban water supply service for the supply of water in rural areas. Accordingly, Table-44 indicates an urban water charge that will result in surplus revenue to be used for this purpose, the rate for 1977 being set at 10 sh./1,000 gal.

(ii) The Importance of the Social Policy Consideration

Since the supply of water is a matter of life and death and a basic factor in social progress, its national policy priority is high. Hence the need for public investment in the water supply system even when those that benefit from it are unable to bear the economic cost thereof and the fact that up to now the rural population in the region has in fact been exempt from any such burden.

Even if the system of having those that benefit from water supply service bear the cost thereof is introduced, it will be necessary to keep the rates charged low enough that even people in the lowest income brackets can afford to pay them and to make up the difference between prime cost and water supply revenues with other public funds. Then again, considering the fact that if the water supply rates are raised to a level sufficient to cover prime cost, some people can be expected to be unable to afford water service, it is worth considering some sort of new tax system relating to water supply whereby people will be better able to afford such comparatively high rates.

In any case, for the sake of introduction of a system of having those that benefit from water service bear the cost thereof with respect to m the rural water supply, it is necessary to begin by charging rural populations for at least recurrent expenditures or depreciation or by setting the above-mentioned kind of policy rate for the urban water supply.

The following are three possible cases of water supply charges (sh./1,000 gal.) for covering all water supply expenses:

	Case-I	Case-II	Case-III
Urban water	4.3	10.0	12.8
Rural water	3.7	1.2	0

In Case-I the two categories of supply will each cover their own expenses, in Case-II the urban water supply charge is the rate currently in effect, and in Case-III all expenses are to be covered by the urban water charge alone.

(2) Sewerage

The future cost of sewerage service will be very high, even higher than that of the water supply (about five times as high as that of the urban water supply, as indicated in Table-47).

Society as a whole benefits more from sewerage disposal than the persons directly serviced in terms of both sanitation and living environment, and that is why there should be active public investment in this field and the amount that those serviced pay should be kept at about the present level of urban water supply rates.

(3) Electricity

In 1976 the cost of 1 KWH of electricity supplied to the Kilimanjaro Region was 0.36 sh., and the revenue therefrom was 471.0 sh., for a surplus of 96.1 sh. It is expected to be 386.3 sh. in 1980/81 and 232.4 sh. in 1985/86.

In 1975 annual electricity consumption per customer in the household category was 1,120 KWH at a cost of 0.39 sh./KWH. The average household consumer therefore had an electricity expenditure of 438.7 sh. in that year. One suspects that electricity consumption in the home is considerably greater among higher income groups since this represents a substantial outlay. In the future people in lower income groups can be expected to enter the ranks of household electricity consumers, and this will have the effect of lowering per-consumer annual consumption to, say, about 300 KWH. This being so, the average household electricity consumer will probably have an electricity expenditure of about 116 sh. in 1980/81 and 70 sh. in 1985/86.

Estimated prices (Table-47)

		Recurrent	Depreciation *1	Interest *2	Total expenditures	Per unit		Per capita per annum. *3
Water supply				(1,000 sh.)	(1,000 sh.)			
(Rural)	1980/81	3,260.0	2,033,3	2,907.0	8,200.3	3.7	sh./1,000 gal.	13.4 sh.
	1985/86	3,428.8	4,770.8	6,231.0	14,430.6	4.5	"	16.3 "
(Urban)	1980/81	1,850.0	927.7	1,332.6	4,110.3	4.3	"	60.4 "
	1985/86	2,114.8	2,621.7	3,472.7	8,209.2	4.2	"	67.4 "
Sewerage	1980/81	854.0	352.7	514.7	1,721.4	22.7	"	319.0
	1985/86	1,250.0	1,024.2	1,366.6	3,640.8	14.0	"	224.8
Electricity	1980/81	11,320.0	606.8	864.4	12,791.2	0.386	sh./KWH	116
	1985/86	9,847.2	1,291.8	1,671.9	12,810.9	0.232	"	70

*1 Over 30-year period and by the declining-balance method (no depreciation, however, of past investment in water supply and sewerage systems).

*2 5% per annum.

*3 Assuming per-capita consumption level of 175 ℓ./day in 1980/81 and 200 ℓ./day in 1985/86.

5.3 Estimation of Income From Utilities

(1) Utility Rate Setting Policy

Urban water :	No change in rates until 1980/81. With receipts exceeding annual costs, it will be possible to provide some funds for rural water supply. Lowering of rates thereafter to cover only urban water supply costs so as to make it possible for low-income town dwellers as well to have private connections.
Rural water :	Continuation of free water supply up to 1980/81.
Sewerage :	Continuation of present rates, which are the same as those for urban water.
Electricity :	Continuation, for the most part, of present rates.

Future Utility Rates (Table-48)

	1977/78 ∿ 1980/81	1981/82 ∿ 1985/86
Water		
Rural	0	1.2 sh./1,000 gal.
Urban	5.6 sh./1,000 gal.	4.3 sh./1,000 gla.
Sewage	Same as Urban water	Same as Urban water
Electricity	0.388 sh./KWH	0.386 sh./KWH

(2) Proportion of Total Household Expenses Represented by Utility Expenses

As indicated in Table-49, in 1969 water (urban) and electricity each accounted for an average of 1% of private household expenditures, as opposed to 12% (urban) and 8% (rural) in the case of housing. Only those households with an income in excess of 6,000 sh. were able to afford such a level of water supply expenditures and only those with an income of over 8,000 sh. were able to spend 2% of their income on electricity.

Table-50 indicates the annual expenditures per household for different utilities that are anticipated in the future on the basis of the rates mentioned above.

Against an average annual per capita income of 1,520 x 5 sh. in 1980, these expenditures will represent the following percentages of total household expenditures: rural water, 0.3%; urban water, 4%; sewage, 4%; and electricity, 1.5%.

This figure of 4% for urban water is considerably higher than the 1% in 1969 indicated in Table-49. Nevertheless, an annual expenditure per household of about 300 sh. for urban water supply is considered reasonable in view of the fact that in 1980, as now, only households with comparatively high incomes will have private water connections, although the rate of water supply can be expected to rise.

Percentage Breakdown of Annual Expenditures in Private Households, 1969 (Table-49)

[9 towns, including Moshi]

Income groups: (sh.)	0~ 999	1000~ 1999	2000~ 3999	4000~ 5999	6000~ 7999	8000~ 9999	10000~ 24999	Over 24999	Average
Housing	10	13	10	13	9	17	15	-	12
o Rent and Water Costs	3	4	4	7	3	11	10		-
(Water)	-	-	-	-	1	1	1		1
o Fuel and Light	7	7	4	4	4	5	3		4
(Electricity)	-	-	-	-	1	2	2		1
o Furniture	-	-	-	-	1	-	1		-
o Linen, Bed Clothes	-	2	1	1	-	1	1		1

[Asusha, Kilimanjaro and Tanga Regions, with the exception of Arusha, Moshi and Tanga Towns]

(%)

Income groups: (sh.)	0~ 999	1000~ 1999	2000~ 3999	4000~ 5999	6000~ 7999	8000~ 9999	10000~ 24999	Over 24999	Average
Housing	12	9	7	6	5	-	7	12	8
o Rent and Water	-	-	-	-	-	-	-	-	-
(Water)									
o Fuel and Light	11	7	5	3	2	-	2	1	5
(Electricity)	-	-	-	-	-	-	-	-	-
o Furniture	-	-	-	-	-	-	-	2	-
o Linen, Bed Clothes	1	1	1	2	2	-	4	1	1

- indicates a figure of less than 1%.
Source: Household Budget Survey, 1969.

Annual Expenditures Per Household (sh.) (Table-50)

	1977/78 ∿ 1980/81	1981/82 ∿ 1985/86	(at present)
Water			
Rural	0	22	0
Urban	337	302	911.7
Sewerage	337	302	–
Electricity	116	116	438.7

(3) Anticipated Utility Income

Table-51 indicates the income that is expected from different utilities up to 1985/86 on the basis of the rates mentioned above.

Anticipated Utility Income (Table-51)

(1,000 sh.)

	77/78	78/79	79/80	80/81	81/82 ∿ 85/86
Water supply					
Urban	3,527	4,120	4,742	5,394	32,855
Rural	0	0	0	0	8,144
Sewage	1,746	2,147	2,565	3,004	20,633
Electricity	8,859	10,185	11,511	12,837	85,208

5.4 Organization and Staff

(1) Water Supply

In Tanzania the Ministry of Water Energy, and Minerals, the basic organization of which is indicated in Fig.-19, is responsible for the supply of water. This ministry has a regional office in each region, the organization of the regional office in the Kilimanjaro Region being as indicated in Fig.-20.

The Ministry of Water Development Energy and Minerals (Fig.-19)

Minister - Principal Secretary

- Research Training Division
- Planning & Project Prep. Division
- Construction Division
- Operation & Maintenance Division

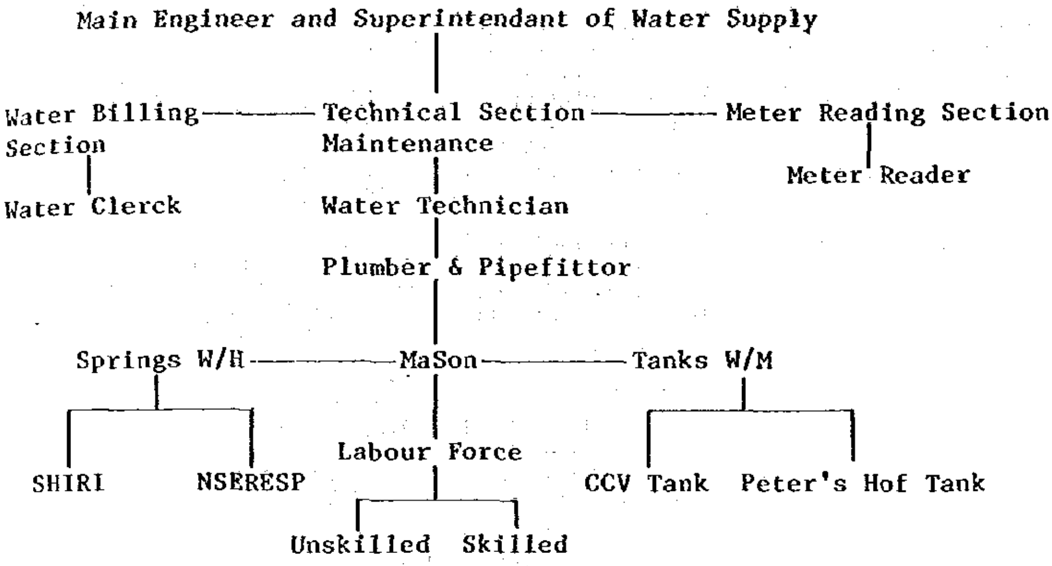
The Regional Office (Fig.-20)

Regional Water Engineer

- Finance and administration
  - Administration
  - Account
  - Stores
- Planning and project preparation
  - Water Supply (Rural, Urban) (investigation, survey, design astimate)
  - Regional Hydrological unit
  - Drawing Office
- Construction
  - Construction Team
  - Costing Evaluation Unit
- Operation and Maintenance
  - Regional Maintenance Unit
  - Maintenance of Moshi Water Supply
  - Maintenance of Rural Water Supply
  - Maintenance of Dams

Administration and accounts control is under the supervision of the Regional Development Director, and technical control is under the supervision of the Ministry of Water, Energy, and Minerals. Urban water operation and maintenance is the responsibility of the town council, its organization being as indicated in Fig.-21.

Running Maintenance of Moshi Water Supply (Fig.-21)



Tables-52 and -53 indicate the staff that makes up such water supply organization.

As water supply operations expand in the coming years, it will naturally be necessary to increase staffing. The to now, there has been considerable dependence on expatriate staff with higher technical skills in Tanzania and other regions of the country, but henceforth a greater role will water supply operations will have to be played by Tanzania technicians, and this will entail training programs for acquisition of necessary skills.

Another urgent manpower requirement is expansion of the ranks of construction and maintenance technicians on the district level. (With decentralization in 1975, these function were transferred to the district level, but the corresponding organizational and staffing measures have been inadequate, particularly with respect to maintenance, there being numerous cases of difficulty in maintaining a constant water supply because of a shortage of technicians in this field.)

Another problem is the fact that technicians are too busy with routine administrative and technical matters to be able really to put their technical abilities to maximum use. This kind of work should be done by assistants who have completed simple training in short courses and who can achieve technical up-grading through on-the-job training.

Table-54 indicates the manpower requirements corresponding to expansion of water supply operation in the region as described above.

Regional Office Staff (Table-52)

1. Finance and Administration	Regional Water Engineer	1	
	Office Supervision	1	
	Account Assistant	1	
	Clerical Officer	1	
	Clerical Assistant	16	(Same 1)
	Personal Secretary III	1	
	Stores Assistant III	2	
	Others	19	
2. Planning and Project Preparation	Executive Engineer		
	Senior Water Technician I	2	(1. Acting as D.W.E. of MOSHI & Hai)
	Senior Water Technicial II	2	(1. D.W.E-Rombo 1.D.W.E-Pare)
	Water Technician II	8	(2. Moshi , 1. Hai, 2. Rombo. 2. Pare)
	(HYDROLOGY)		
	. Regional Hydrological Team		
	Senior Water Technician II	2	
	Water Technician 00	2	
	Clerical Assistant	1	
	Water Guard	1	
	· National Hydrological Team		
	S.W.T I	1	
	W.T	3	
	W.T	4	
3. Construction	Ag. Inspector of Work	1	
	Water Technician I	8	(2. Moshi, 2. Hai, 1. Pare, 3. Rombo)
	Senior Water Technician I	1	(1. Pare)
	Senior Water Technician II	2	(1. Hai, 1. Rombo, Rombo)
	Senior Water Technician III	1	(Pare)
	(Costing and Job Evaluation Team)	1	
4. Operation and Maintenance of Urban and Rural Water Supply			
. Moshi urban Water Supply	Senior Water Technician I	1	
	Senior Water Technician III	1	(training)
	Water Technician I	2	
. Same Water Supply			
. Maintenance of Rural Water Supply			
. Operation and Maintenance of Dams	Senior Water Technician I	1	
	Water Technician III	2	
	Clerical Assistant	1	
	Plumber	1	
	Watchman	1	
	Office Cleaner	2	
. Regional Maintenance and M.T.	Senior Mechanical Inspector	2	
	Foreman	2	
	Transport Officer	2	
	Asst. M.T. Clerk	1	
	Head Driver	1	
	Mortor Drivers	30	
	Tractors Drivers	6	
	Mechanics	14	
	Compressor Operator	6	
(Training)	Driver Training Course	3	
	Mechanic Course	3	
	Metal Work Course	1	

Staff of Moshi Urban Water Supply (Table-53)

Superintendant		1
Senior Water Engineer III		1
Water Technician		2
Plumber		3
Labourer skilled		14
unskilled		12
Meter Reader	I	1
"	II	2
Water Clerk (accountant)		8 (1)
Watchman		8
Driver		2

Manpower for Water Supply (Table-54)

Rural Water	No.	Post	Region	Districts (Moshi)	Districts (Hai)	Districts (Rombo)	Districts (Pare)
Maintenance team of pumps, pipeline	5	Water Technician I ∿ II as instructor to foreman		1	1	1	2
(periodical investigation)	5	Water Technician III		1	1	1	2
(check of leagage)		mechanical inspector					1
Operation and Maintenance of Community Plant (water treatment)	2	Instructor & Self-help					
Mobile Laboratory (Central Laboratory)	1	Inspectors of water	1				
. Water-testing and water analyses	1	Senior Water Technician I	1				
. Observe and protect intakes	4	Water Technician II		1	1	1	1
Casting and Job Evaluation Team	1	Senior Water Technician	1				
Construction Team	5	Water Technician III		1	2		2
Urban Water							
Construction Team	2	Urban Water Engineer I	1				1
	2	Technician III	1				1
Maintenance and Operation of Treatment Plant	2	Technician I	1				1
Maintenance and Operation of Urban Water Supply	1	Senior Water Technician II					1
	3	Mechanic	1				2

Manpower for Sewage Disposal (Table-55)

Rural Water	No.	Post	Region	Districts (Moshi)	Districts (Hai)	Districts (Rombo)	Districts (Pare)
Maintenance and Operation of Lagooms	2	Technician I ∿ II	1				1
	3	Mechanic Operator	1				2
	1	Technician III	1				1
Planning and Project Preparation	2	Senior Water Engineer	2				
Construction Team	4	Technician I ∿ II	2				2

(2) Sewage

At present the personnel in the sewage field consist of a supervisor on the town council, five pump attendants, and six laborers.

Table-55 indicates technical personnel will have to be trained and employed in order to meet the additional staff requirements that will result from expansion of sewage operations in Moshi and commencement there of in same in the coming years.

(3) Electricity

Table-56 indicates the number of TANESCO employees in recent years. With further electrification in the Kilimanjaro Region, it will be necessary to hire approximately 80 new employees, including 24 engineers and the same number of skilled laborers.

Employees of TANESCO (Table-56)

1972	1973	1974	1975
2,412	2,661	3,480	3,304

Staff Requirements (Kilimanjaro region)

Engineers	24
Skilled Laborers	24