WMP, Iringa, Ruvuma and Mbeya Regions

STUDY OF WATER USE

Draft of Technical Part of Study

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6. METERING OF WATER CONSUMPTION

6.1. Introduction

The present study came about as a supplement to the sociological study on water use to provide up to date background information to the proposed evaluation mission due in May/June 1987.

The study has therefore takenplace during the last monthsof the rainy season, which is unfortunate, because higher consumption figures should be expected in the dry season. Concequently it has been decided that the metering programme described in this chapter shall be repeated in the dry season (September/October 1987). Furthermore, it has been decided to expand the dry season programme to cover all three regions, and two villages have been identified in Ruvuma Region for that purpose in addition to the four villages included in the present programme. As stated above higher consumption figures are expected in the dry season so it is considered premature at this stage to perform thorough statistical analysis of the results of the metering programme. Similarily results of metering of water use at a Health Centre and some individual connections are not evaluated at this stage and no calculation of storage requirements performed.

6.2. Methodology

Before commencing the actual programme a pilot study was carried out at Kiponzelo village at 2 DP's. The purpose of the pilot study was to test the ability of villagers to act as meter leaders, to check suitability of forms for recording and to try out suitability of different meter installations. The conclusion was that only minor adjustments were required and that the water meters could be installed at the tap and still maintain an accuracy within $\pm$ 1 %.

The meters used are ordinary house installation meters with a nominal capacity of 2.5 m^3 per hour, showing cubic metre readings with digits, and fractions (down to 0.0001 m^3) on 4 "clock type" counters. The meter readers (villagers employed by the project for that purpose) should not interpret the readings, but only copy the m^3 reading and the position of the arms on the "clock" counters (copy of form for meter readers is enclosed in Appendix 1). The meter readers were issued with forms, ballpen, torch and digital watch , and recorded readings every hour from o6.00 to 21.00 hours. The meter readers performed well and only a few readings were wrong.

The meter readers were supervised by 2 hydrologists per village made available for the programme by Regional Water Engineer, Iringa. The hydrologists collected meter reader forms every day and also took readings at the master meter installed on the outlet pipe from the village storage tank.

The master meters used are 50 mm Meineckemeters with a capacity range from 1.5 to 35 m^3/hour and with readings down to 0.01 m^3 (Accuracy $\pm$ 5 % from 0.18 m^3/h to 1.5 m^3/h and $\pm$ 2 % above 1.5 m^3/h). The master meters were read every quarter hour from 06.00 to 21.00 and at 3 hour intervals for some nights to determine system losses. (copy of form for master meter recording is enclosed in Appendix I page 2).

The hydrologists were very dedicated to the programme and fulfilled the task in the most excellent way. Supervision of the programme in general by senior researcher was carried out 3-4 times for each village.

6.3. Population Counts

It is equally important to get reliable population figures as reliable water consumption figures. The last population census was in 1978, so census figures are not applicable. It was therefore decided to carry out household interviews at all households using water from the system investigated, so as establish total population using the water and also how the population is distributed on various DP's. At the same time people were asked whether or not they used water for other than domestic purposes and if they use other water sources.

Household interviewswere carried out in Kiponzelo and Mbalamaziwa villages, and the resulting population figures are considered reliable. Indicators of total population such as Nos.of Primary School Children confirm the results of the household interviews, so the method is considered good, but very time demanding.

The use of alternative water sources and/or the use of water for other than domestic purposes appeared insignificant for this study.

For the villages in Mbeya Region (Mlangali and Kasumulu) another approach was tried out. Each 10 cell leader (balozi) was requested to supply information on the households he/she represented.Unfortunately the information received appears inaccurate. The ratio adults/children is strange, and comparison with Nos. of primary school children is also quite different from normal.

It cannot be stated categotically that the figures for the last two villages are unreliable, but they should certainly be used with caution. For the dry season metering household interviews will be carried out in all villages.

The population figures used in the sub-chapters below are the following:-

Kiponzelo	:	2237 (from household interviews)
Mbalamaziwa	:	1146 (from household interviews)
Mlangali	:	1314 (from balozi) (The estimated population in Mlangali is probably on the high side, as school children only constitutes some 19% of total population)
Kasumulu	:	1280 (increased from the figure of 1146 given by balozis. Without increasing population figure school children would be 27.3% of total population which is unlikely).

6.4 Definitions

The following definitions are used:

o	Total daily consumption:		The water used between 21.00 the day before and 21.00 on the day in question.
o	Day usage	:	The water used between 06.00 and 21.00.
o	Night usage	:	The water used between 21.00 the day before and 06.00 on the day in question.
o	System losses	:	Water being lost through leakages in pipes and fittings between the storage tank and the DPs.
o	Water waste	:	Water wasted at DP's from not closing bibcocks properly or leaving the water running (water used for cleaning the buckets is not waste).
o	Net daily consumption:		Total daily consumption less system losses and waste.

o	Peak flow	:	The highest flow on that particular day within a specified time.
o	Peak factor	:	The peak flow divided by the average flow(a factor used for design purposes).
o	Average daily consumption	:	The average of all the consumptions recorded per village.
o	Maximum day consumption	:	The highest daily consumption recorded per village.
o	Factor for max day	:	The maximum day consumption divided by average day consumption.

The system losses were determined by reading the master meter at night, if no flow, no losses. For villages with losses, the losses have been calculated as the difference between DP meter readings and master meter readings.

The water waste has been estimated from all night use at DP's exceeding 50 litres and from hours with excessive use during daytime. This method is considered giving a fair indication of the water waste.

6.5. Computation of Results

Back in office the readings of DP meters were changed to digits and hourly consumption worked out . For each day and each DP a computation sheet (see Appendix I page 3) was completed showing:

- o Total daily consumption,
- o Day usage,
- o Night usage,
- o Consumption per household,
- o Consumption per capita,
- o Hourly peak flow and time for it,
- o Peak hour factor.

Similarily a compution sheet was completed for the master meter for each day (see Appendix I page 4) showing:

- o Total daily consumption,
- o Day usage,
- o Night usage,

- Consumption per household,
- Consumption per capita,
- 1/4 peak flow and time for it,
- 1/4 hour peak factor.
- Night losses (if any).

For villages with no system losses (leakages) the summary of total daily consumption at DP's has been compared with the summary of total daily consumption recorded by the master meter with the result that in both cases (2 villages) the summary of DP readings was 1.7 % higher than the summary of master meter readings. This is an excellent result, which proves that the meters are working satisfactory.

6.6. Water Consumption per Village

The programme was carried out concurrently in two villages in Iringa Region and later in two villages in Mbeya Region. For general information on individual villages please refer to chapter 3 above.

6.6.1. Kiponzelo Village

The water supply system is an old pumped supply, which has been changed so a gravity system and extended with additional DP's to serve more people. It was realised during the programme, which took place from 4th to 13th March, that the old system has numerous leakages and some pipe bursts occured as well. Furthermore, the master meter was out of function a few days due to dirt from the intake, so the master meter readings are not very useful from this village. However, the meters at DP's performed well, although supply to some DP's was interrupted during pipe bursts.

More than 50 % of the water recorded at the master meter was lost in the old pipe system before reaching the DP's, so rehabilitation work appears necessary.

Figure 6.1 shows the water consumption in Kiponzelo village for each day of metering at all DP's.

FIGURE 6.1 : KIPONZELO, DAILY CONSUMPTION (in m^3)

DP \ DATE	4 MAR WED	5 MAR THU	6 MAR FRI	7 MAR SAT	8 MAR SUN	9 MAR MON	10 MAR TUE	11 MAR WED	12 MAR THU	13 MAR FRI
No. 1	2.294	[2.533]	1.729	2.224	2.105	1.394	2.199	1.989	2.029	1.596
" 2	2.057	1.766	1.593	1.977	[2.075]	1.659	2.069	1.372	1.497	1.412
" 3	2.838	2.023	2.749	3.210	[4.136]	2.283	3.141	2.713	2.680	2.333
" 4	2.815	2.326	1.435	3.615	[4.475]	1.796	2.197	2.661	2.007	2.381
" 5	2.995	2.740	2.401	2,331	[3.375]	2.084	2.098	2.598	2.374	2.187
" 6	3.618	1.252	3.431	2.811	[4.206]	1.015	1.310	1.537	1.430	1.731
" 7	2.097	2.325	2.490	1.484	2.055	1.284	2.082	3.326	2.187	[2.557]
" 8	1.468	0.938	1.109	1.750	[3.271]	0.722	1.669	0.940	1.153	1.346
" 9	[2.639]	1.731	2.173	1.067*	0.783*	2.635	1.362	2.004	1.270	1.508
" 10	1.044	0.730	0.704	1.225	[2.008]	0.352	0.339	0.504	0.466	0.849
" 11	[3.366]	1.898	2.240	1.369*	1.573*	1.870	2.716	2.301	2.484	1.853
" 12	[2.066]	1.316	1.294	1.677	1.677	0.968	1.603	1.176	1.098	1.282
" 13	[2.423]	1.960	1.818	1.405*	1.458*	1.789	1.908	1.786	1.500	1.957
" 14	1.229	0.975	0.816	0.899*	1.077*	[1.279]	0.902*	0.681	0.557	0.931
TOTAL	32.949	24.513	25.982	27.044	[34.274]	21.130	25.595	25.588	22.732	23.923
EST. WASTE	0.250	1.000	0.400	0.000	0.000	0.100	0.200	0.850	0.750	0.250
DAILY NET CONSUMPTION	32.699	23.513	25.582	27.044	[34.274]	21.030	25.395	24.738	21.982	23.673

* INTERRUPTIONS TO SUPPLY

[ ] PEAK DAYS INDIVIDUAL DP'S

It can be seen that there is a destinct maximum day on Sunday 8th March, although when looking at individual DP's only 7 out of the 14 has their maximum on the same day. The waste is not significant being 1.4 % only on average for the 10 days.

The average daily net consumption is 25.993 m^3 and the maximum day net consumption 34.274 m^3, which is 32 % higher than average (.i.e max. day factor = 1.32). This is illustrated in Figure 6.2.

No overall peak factor have been calculated due to the excessive losses in the system.

6.6.2. Mbalamaziwa Village

The water supply system is new and has been in operation for about a year. The metering programme took place from 3rd to 13th March, and there were neither interruptions to supply nor malfunctioning of meters. There were no leakages in the system and the water waste was neligible. From a technical point of view Mbalamaziwa has provided the best results of all four villages.

Figure 6.3 shows the water consumption for each day of metering at all DP's.

Also in Mbalamaziwa there was a distinctmaximum consumption on Sunday 8th March, which then dropped to less than half on Monday. It should be noted that only 4 DP's out of a total of 8 has maximum consumption on the day of maximum consumption for the whole village.

The average daily net consumption is 19.706 m^3 and the maximum day net consumption 27.316 m^3, which is 39% higher than average. Figure 6.4 illustrates the consumption pattern.

The overall peak factor in relation to net consumption has been calculated both for 1/4 hour peak flows and 1 hour peak flows. The correlation between the peak factors and the daily consumption is shown in figure 6.5, and it can be seen that apart from a single odd case, there is a clear tendency to lower peak factors with higher consumption. Quarter hour peak factors vary from 3.1 to 4.7 and one hour peak factors from 2.6 to 3.8 (based on net consumption).

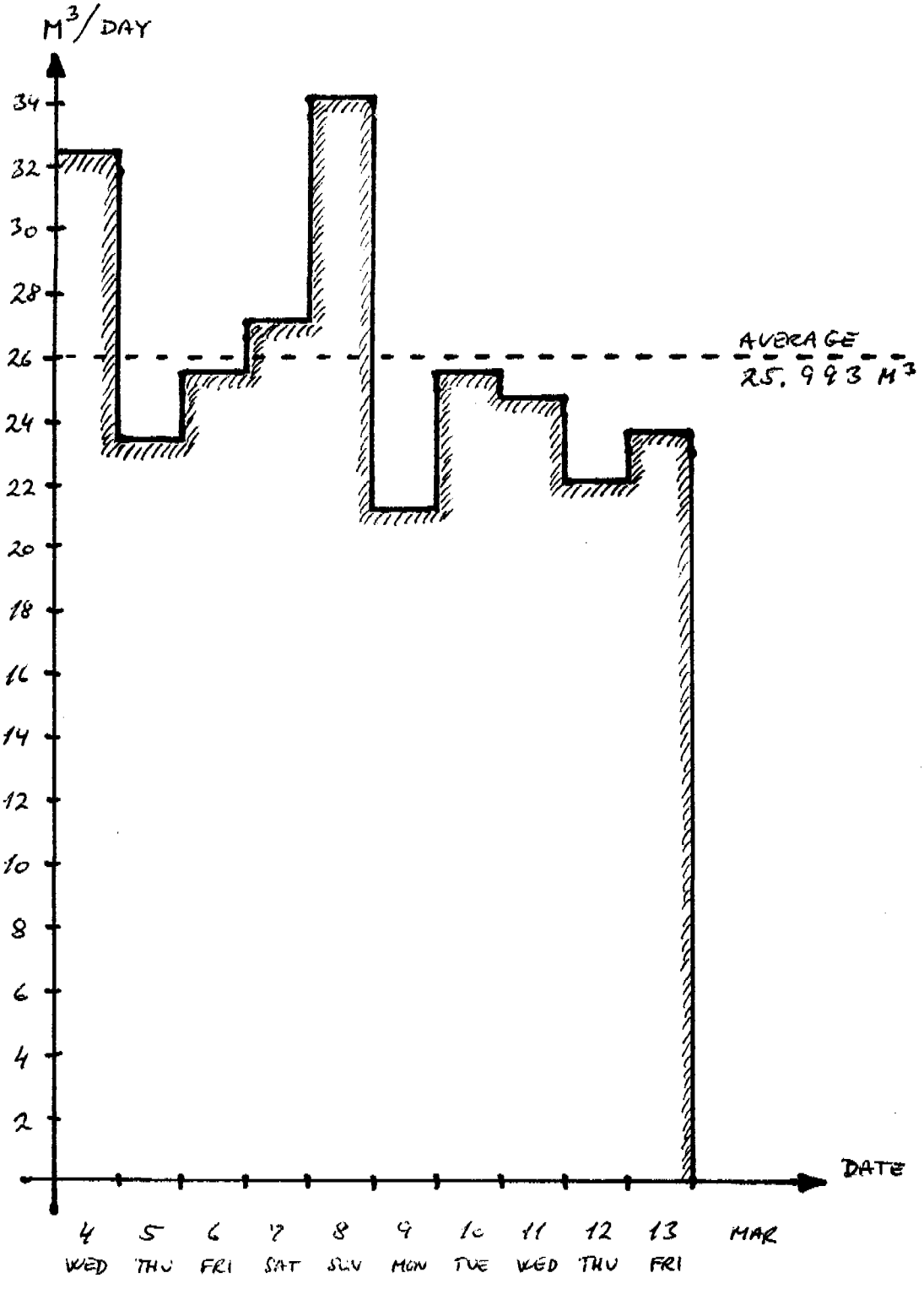

FIGURE 6.2 : KIPONZELO, VARIATIONS IN DAILY NET CONSUMPTION

FIGURE 6.3 : MBALAMAZIWA, DAILY CONSUMPTION (in m^3)

DP \ DATE	3 MAR TUE	4 MAR WED	5 MAR THU	6 MAR FRI	7 MAR SAT	8 MAR SUN	9 MAR MON	10 MAR TUE	11 MAR WED	12 MAR THU	13 MAR FRI
No. 1	2.249	2.832	1.964	2.604	2.644	[3.075]	1.279	2.080	2.341	2.650	2.473
" 2	5.506	5.064	4.168	6.754	7.022	[7.357]	3.495	4.183	3.756	5.914	4.469
" 3	3.166	[3.751]	1.886	1.879	1.865	3.387	0.794	2.005	1.150	1.367	1.669
" 4	1.717	2.483	1.988	2.335	3.126	[3.347]	1.105	1.694	2.588	2.806	2.139
" 5	2.487	3.303	3.099	[4.765]	4.288	3.498	2.036	3.042	2.167	3.395	3.385
" 6	0.660	1.504	1.225	1.536	2.254	[3.253]	1.978	1.598	1.276	0.927	1.152
" 7	1.413	[3.586]	0.708	0.644	1.046	1.044	1.490	1.004	0.590	0.655	1.480
" 8	1.933	1.620	1.570	1.470	[2.446]	2.355	1.184	1.604	1.074	1.097	1.801
DAILY NET CONSUMPTION	19.131	24.143	16.608	21.987	24.691	[27.316]	13.361	17.210	14.942	18.811	18.568

[ ] PEAK DAYS INDIVIDUAL DP's

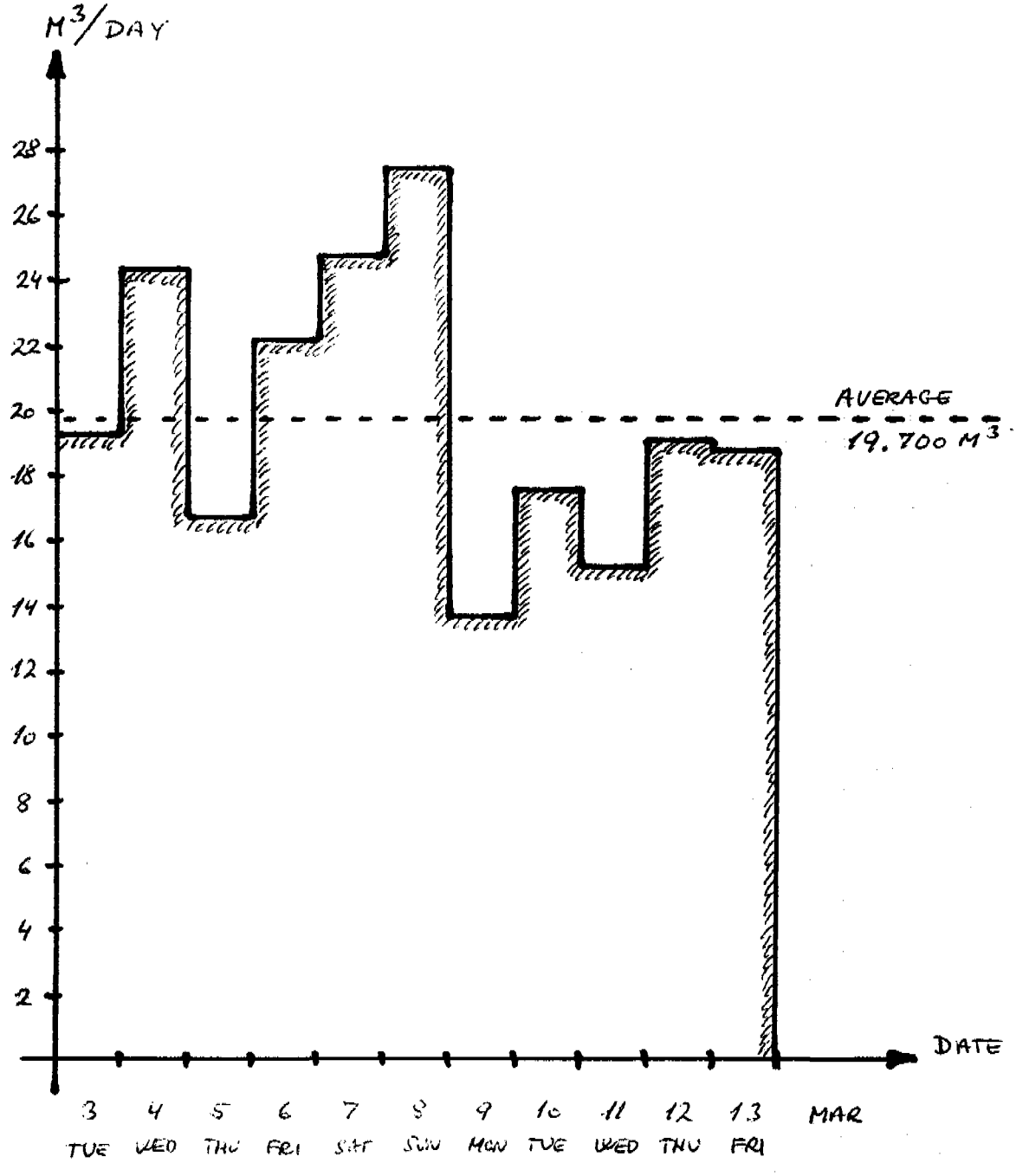

FIGURE 6.4 : MBALAMAZIKA, VARIATIONS IN DAILY NET CONSUMPTION

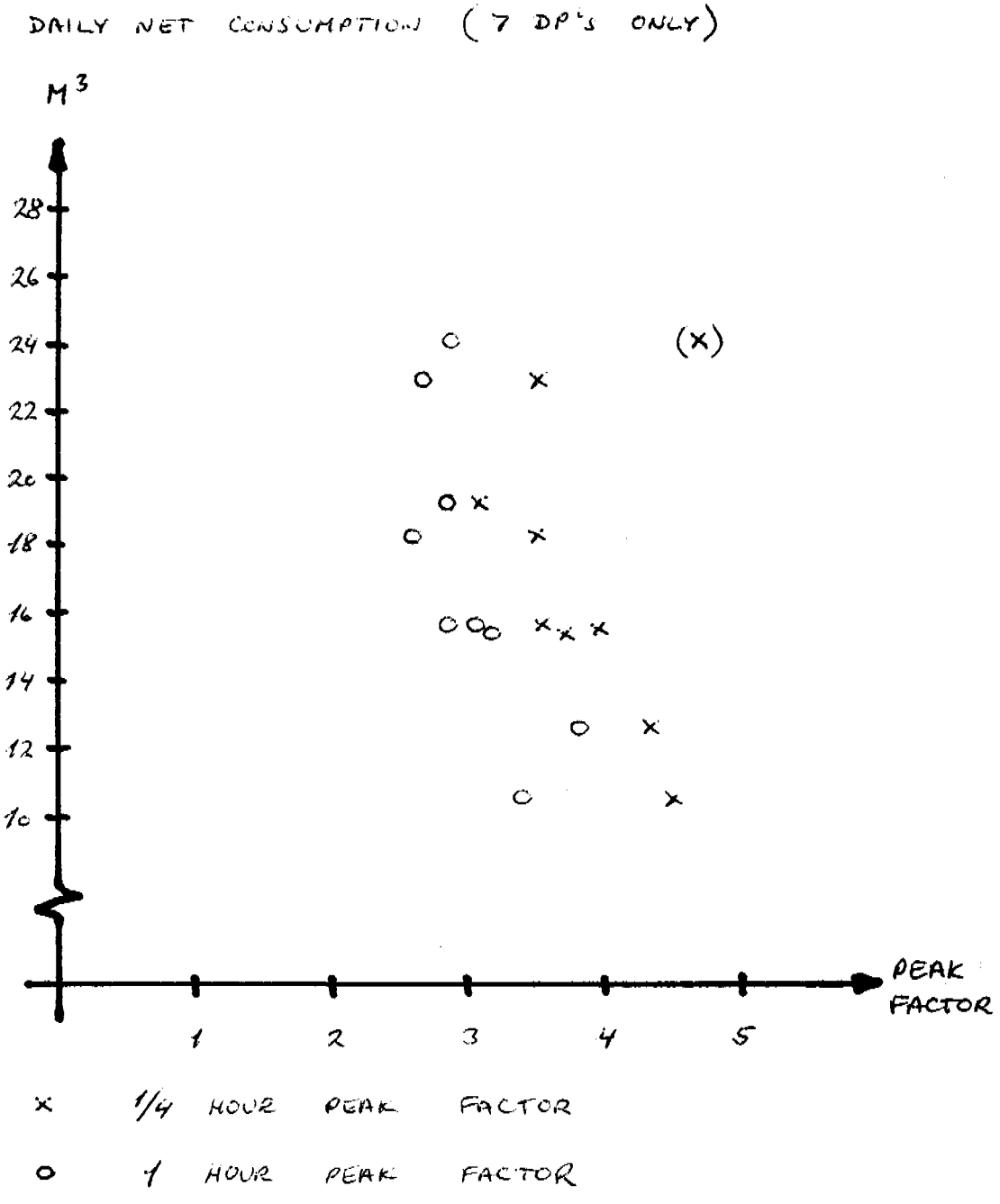

FIGURE 6.5 : MBALAMAZIWA, PEAK FACTORS BASED ON NET CONSUMPTION

6.6.3. Mlangali Village

The water supply system has been in operation for about 3 years, and the metering programme took place from 24th March to 1st April. There was an interruption to the supply on the first day, due to a silted up intake and during the night between 30th and 31st March 2 meters and bibcocks were stolen. A spare meter was fixed on one DP, but the other remained closed for the last two days of the programme.

There were no leakages in the system, but in this village water waste amounted to some 11 % of the total daily consumption, a unreasonable high figure.

Figure 6.6 shows the water consumption for each day of metering at all DP's.

The maximum day occured at Saturday 28th March, although only 4 DP's had their maximum on that day. The average daily net consumption is 24.600 m^3 and the maximum day net consumption 31.730, which is 29 % higher than average. Figure 6.7 illustrates the pattern of variation.

The overall peak factor in relation to net consumption, has been calculated both for 1/4 hour peak flows and 1 hour peak flows. The correlation between the peak factors and the daily consumption is shows in Figure 6.8. There is a slight tendency to lower peak factors with higher consumption, but not such a clear tendency as in Mbalamaziwa. Quarter hour peak factors vary from 3.3 to 4.2 and one hour peak factors from 2.2 to 3.4.

FIGURE 6.6 : MLANGALI ; DAILY CONSUMPTION (in m^3)

DP \ DATE	24 MAR TUE	25 MAR WED	26 MAR THU	27 MAR FRI	28 MAR SAT	29 MAR SUN	30 MAR MON	31 MAR TUE	1 APR WED
No. 11	1.495	1.522	1.537	2.560	3.694	2.936	2.355	[4.285]	3.028
" 12	1.473	[2.648]	2.498	1.924	2.250	2.318	1.755	METER STOLEN	1.621
" 13	2.063	2.201	2.999	2.571	[4.532]	2.795	3.815	METER STOLEN	METER stolen
" 14	2.369	4.320	[3.859*]	2.639	2.947	6.425	2.446	3.025	2.708
" 15	1.769	1.638	1.818	3.632	[3.653]	1.460	1.421	1.638	0.588
" 16	1.435	1.156	1.338	1.158	[2.245]	1.463	0.905	0.701	0.952
" 17	2.163	2.828	5.059	[4.480*]	3.184	2.083	2.102	2.085	2.478
" 18	[5.007]	4.364	3.600	3.458	3.283	4.954	3.616	4.192	2.838
" 19	1.429	2.798	2.216	2.901	[2.754*]	4.265	2.056	2.146	2.011
" 20	2.225	1.635	5.968	2.024	2.870	[3.058*]	2.269	2.382	2.100
AT TANK	1.129	1.278	1.359	0.661	1.968	1.205	[9.582]	1.283	1.107
TOTAL	22.557	26.388	32.251	28.008	[33.380]	32.962	32. 322	21.657	19.431
EST. WASTE	0.400	2.570	5.130	0.990	1.650	6.100	8.540	0.790	1.380
DAILY NET CONSUMPTION	22.157	23.818	27.121	27.018	[31.730]	26.862	23.782	20.867	18.051

* AFTER WASTE IS DEDUCTED FROM OTHERS

[ ] PEAK DAYS INDIVIDUAL DP's

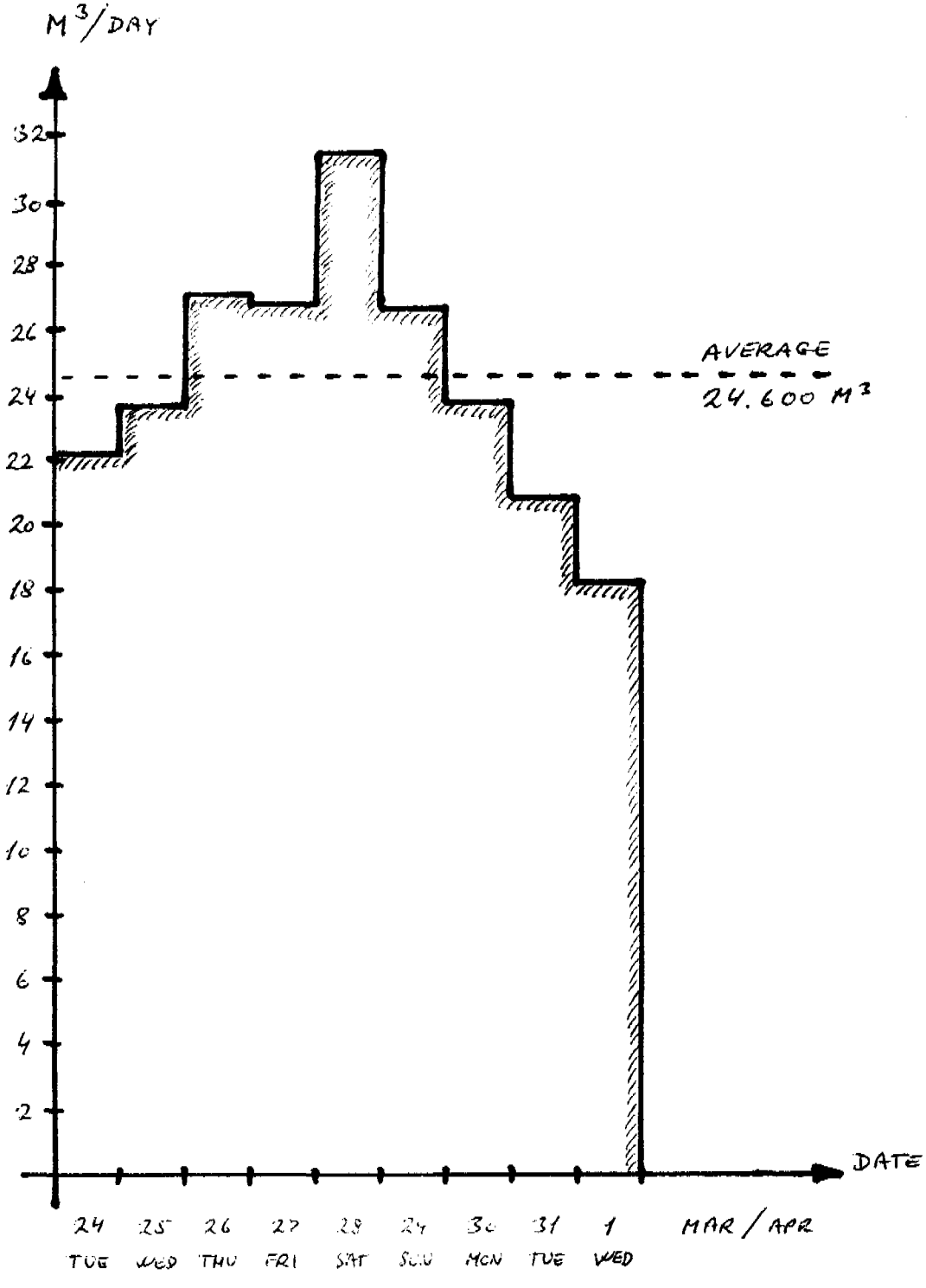

FIGURE 6.7 : MLANGALI, VARIATIONS IN DAILY NET CONSUMPTION

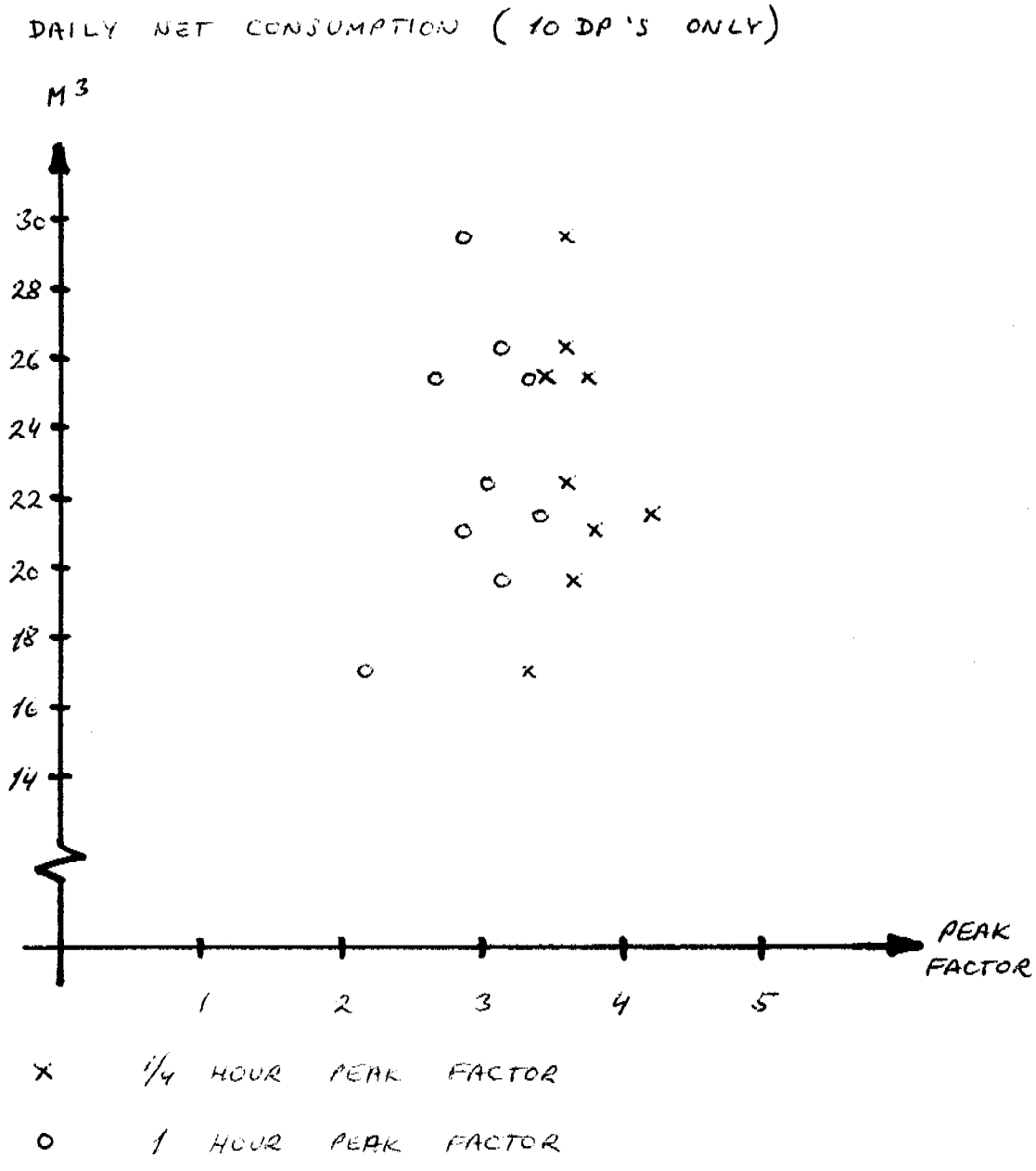

FIGURE 6.8 : MLANGALI , PEAK FACTORS BASED ON NET CONSUMPTION

6.6.4 Kasumulu Village

The water supply system has been in use for about 2 years, and the metering programme took place from 24th March to 1st April. There were no interruptions to the supply, but a major leakage was observed, which accounted for a loss of about 29 m^3 per day. This loss has been eliminated from the calculations.

Figure 6.9 shows the water consumption for each day of metering at all DPs.

The variations in daily water consumption are not so large in Kasumulu as in the other villages, maybe because of very little rain during the programme. The maximum day was on Tuesday 31st March, but the consumption was almost constant from 29th March to 1st April. There are, however, large variations in consumption at individual DP's and maximum days for DP's are spread over the whole time interval. Only 2 out of 14 DP's had maximum consumption on the same day as the maximum day for the whole village.

The average daily net consumption is 26.561 m^3 and the maximum day net consumption 29.162 m^3, which is only 10 % higher than average. Figure 6.10 illustrates the consumption pattern.

The overall peak factors in relation to net consumption are shown in Figure 6.11. The correlation between peak factors and daily consumptions indicates a slight tendency towards smaller peak factors with higher consumption. Quarter hour peak factors vary from 3.5 to 5.4, and one hour peak factors from 2.8 to 4.3. These factors are higher than for other villages, a point which is discussed in chapter 6.7 below.

6.6.5. Peak Factors

So far all peak factors have been calculated based on net consumption. When applying peak factors during design, they are normally used on total consumption including allowances for losses and waste. Losses occur for 24 hours and it is unlikely that major waste of water takes place during peak flows, so with a normal allowance of 20 % to 25 % for waste and losses the above calculated peak factors can be reduced by some 20 % before being used for design purposes.

It is the peak factors on the maximum days, which are significant for design. These peak factors have in this study been found to be the following before and after reduction by 20 %:

FIGURE 6.9 : KASUMULU, DAILY CONSUMPTION (in m^3)

DP \ DATE		24 MAR TUE	25 MAR WED	26MAR THU	27 MAR FRI	28MAR SAT	29 MAR SUN	30 MAR MON	31 MAR TUE	1 APR WED
NO	1	0.389	0.859	0.593	0.610	0.610	0.598	0.864	[0.991]	0.542
"	2	1.437	1.527	1.433	1.875	1.677	1.847	[1.913]	1.691	1.275
"	3	0.999	0.686	1.148	0.975	[1.217]	0.895	0.624	0.802	0.942
"	4	1.003	1.441	1.327	1.131	[1.496]	1.258	1.152	1.252	1.060
"	5	0.905	[1.265]	0.958	0.934	0.955	1.208	1.181	1.045	1.225
"	6	1.429	1.353	1.342	1.196	2.237	3.037	1.844	2.896	[2.340*]
"	7	2.608	2.537	3.006	2.813	3.024	2.900	3.057	[3.538]	3.301
"	8	[3.554]	2.497	1.817	1.327	1.908	3.135	2.200	2.758	3.296
"	9	2.375	2.805	2.781	3.292	2.325	[3.405]	2.941	2.999	1.889
"	10	1.965	2.687	1.576	1.692	2.098	2.239	2.627	2.459	[2.916]
"	11	1.977	1.832	1.995	1.936	2.023	2.072	2.535	2.191	[2.947]
"	12	1.816	1.773	2.990	1.449	2.271	2.343	[2.764*]	2.422	2.319
"	13	1.752	1.936	2.468	2.097	1.822	[2.636]	2.581	2.244	2.195
"	14	1.830	2.242	2.240	2.136	2.277	2.290	2.001	2.474	[2.476]
TOTAL		24.036	25.440	25.674	23.468	25.945	[29.863]	28.284	29.762	22.723
EST. WASTE		-	-	0.500	0.100	-	0.950	-	0.600	-
DAILY NET CONSUMPTION		24.036	25.440	25.174	23.368	25.945	28.913	28.284	[29.162]	28.723

* AFTER WASTE HAD BEEN DEDUCTED FROM OTHERS

[ ] PEAK DAYS INDIVIDUAL DP's

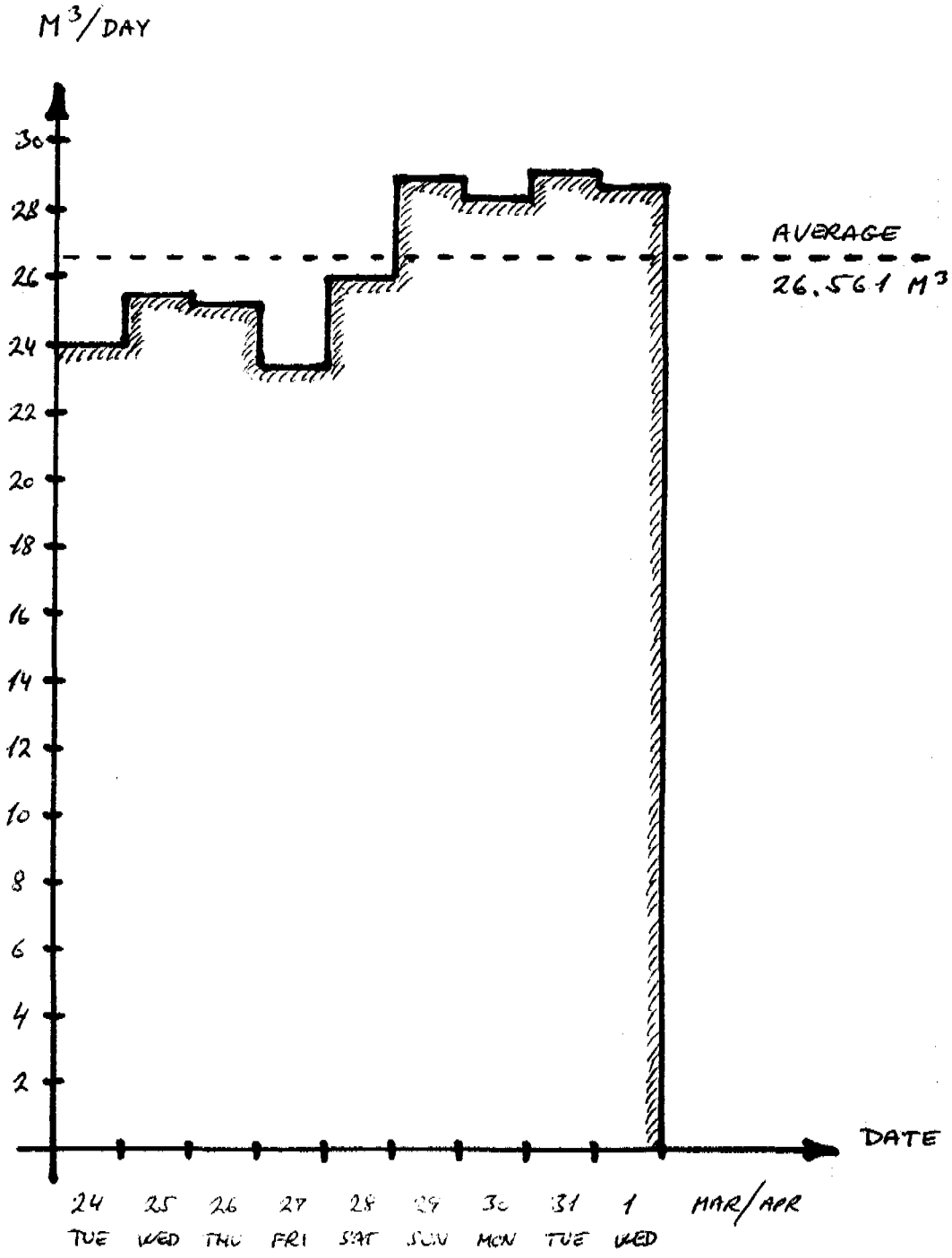

FIGURE 6.10 : KASUMULU, VARIATIONS IN DAILY NET CONSUMPTION

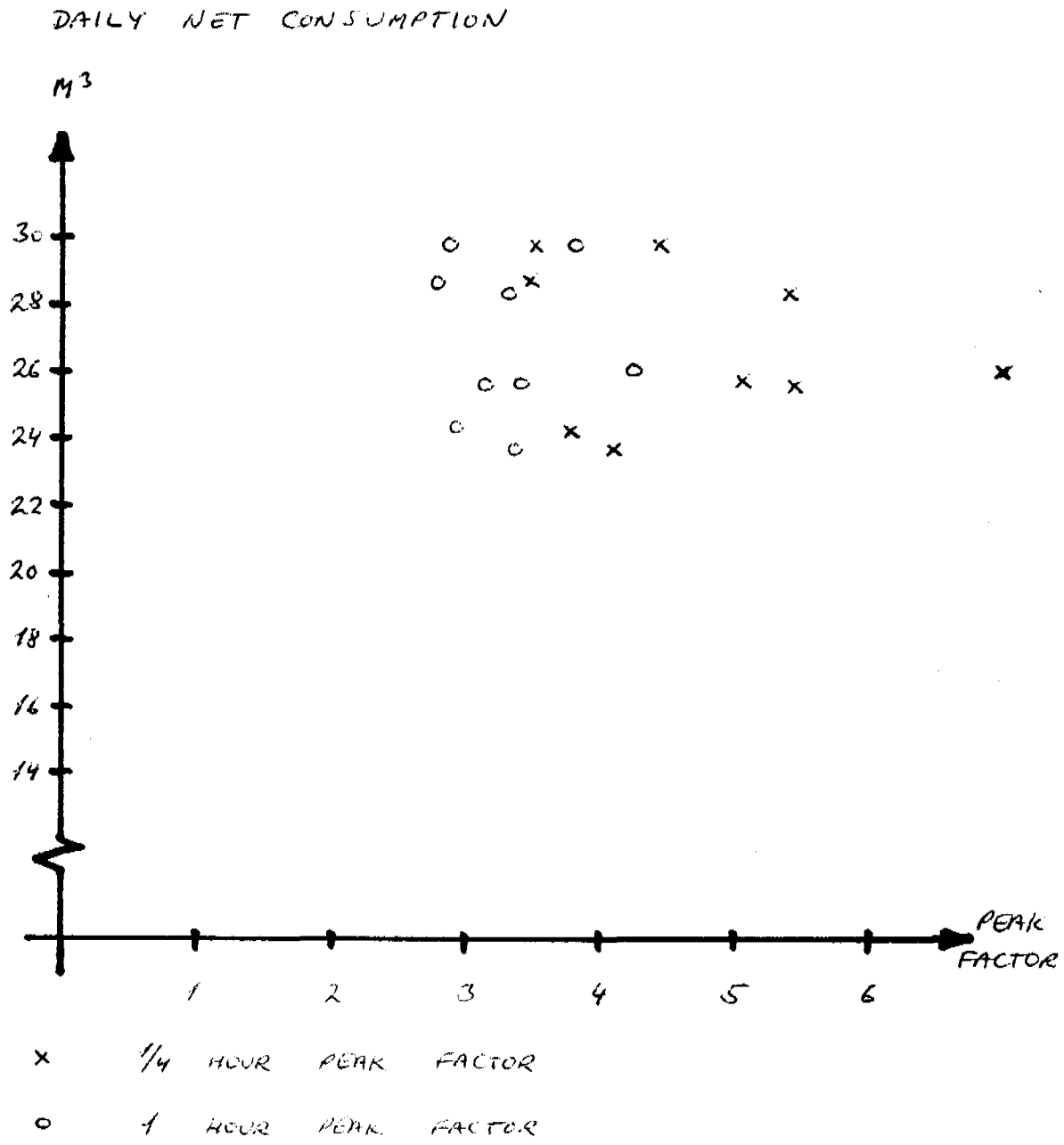

FIGURE 6.11 : KASUMULU, PEAK FACTORS BASED ON NET CONSUMPTION

VILLAGE	1/4 HOUR PEAK FACTOR	DESIGN PEAK FACTOR
Mbalamaziwa	3.5	2.8
Mlangali	3.6	2.9
Kasumulu	3.6 - 4.4	2.9 - 3.5

It should be expected that peak factors will decrease when the water consumption increases in future. The factor of 3.0 suggested in WMP is thus likely to be on the safe side.

6.6.6 Conclusion

A significant outcome of the metering programme is the determination of the daily variations in water consumption. If the variations are of the same order of magnitude during the dry season, then it will be necessary to extend the duration of metering in order to secure a high probability for recording maximum day or near maximum day.
When studying figures 6.1, 6.3, 6.7 and 6.9 it is obvious that metering with a master meter on some randomly chosen days will give a low probability of useful results. From the same figures it can also be seen that extrapolation of village water consumption from consumption at a few DP's is extremely risky and should not be applied. The large variations at individual DP's and that the consumption pattern for most DP's does not correlate with the pattern for the whole village renders such a method highly unreliable. However, the situation might be different in the dry season.

Since only storage for balancing peak flow is provided at villages, the water supply system should be designed for the maximum day consumption.

6.7 Water Consumption at DP's

The programme has confirmed the general impression that people are mainly collecting water from DP's during daylight hours. However, it might not be so well known that a considerable amount of water is collected between 19.00 and 20.00 (it is dark after 19.00 hours), and even some between 20.00 and 21.00. Between 21.00 and 06.00 next morning most DP's are not used at all and the ones used are only supplying the equivalent of some 2 to 3 buckets. For some villages most of the water collected after darknes is drawn between 19.00 and 19.30, but in Kasumulu and Mlangali

considerable amounts of water are drawn after 20.00.

Variations in consumptions at DP's from day to day are much larger than for the village as a whole. Maximum days at DP's do not necessarily correlate with the maximum day of the village, but apart from Kasumulu village there are more DP maximum days on Sunday than on other days. (See figures 6.1, 6.3, 6.6 and 6.9).

From evaluation of individual DP's it is found that the hourly peak flows are not falling at the same time every day. Peak flows are in fact scattered over all hours of the day, which is illustrated in Figures 6.12 to 6.15.

Kiponzelo and Mlangali villages (Figure 6.12 and 6.14) has peak flows spread fairly even over the day with highest numbers of peak flows occuring between 14.00 and 15.00 in Kiponzelo and 13.00 and 14.00 in Mlangali.

Mbalamaziwa village (Figure 6.13) has the majority of peak flows in afternoon and evening, and most peaks from 18.00 to 19.00

Kasumulu village (Figure 6.15) has a fairly even number of peaks during the day, but some very significant peak hours from 07.00 to 08.00 in morning and 18.00 to 20.00 in evening. These very distinct peak hours are the ones causing generally higher overall peak factors at Kasumulu village than at the others (see chapter 6.6.5 above)

The calculated hourly peak factors for individual DP's are not significant for design purposes, and no peak flows metered are anywhere near the flow capacities of individual DP's. It can therefore be concluded that if any queuing is taking place it would be of short duration only.

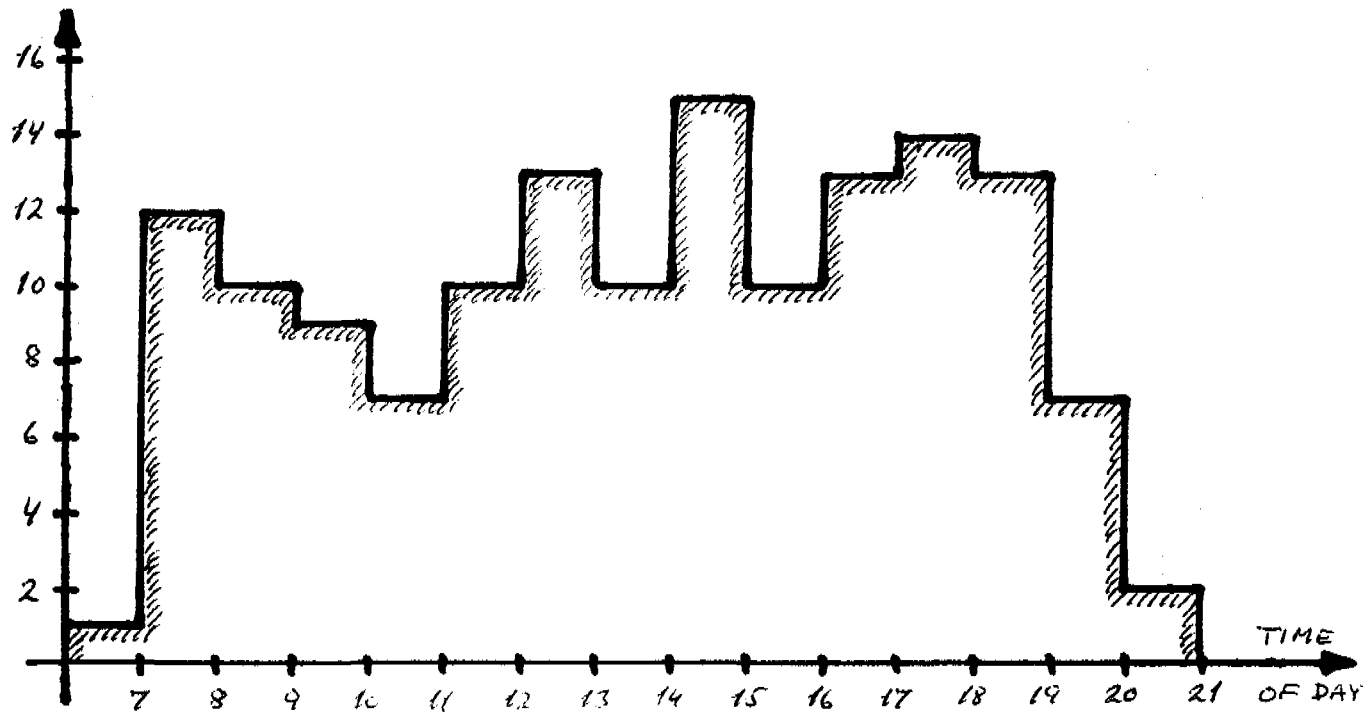

FIGURE 6.12 : KIPONZELO, DISTRIBUTION OF HOURLY PEAK FLOWS AT ALL DP'S

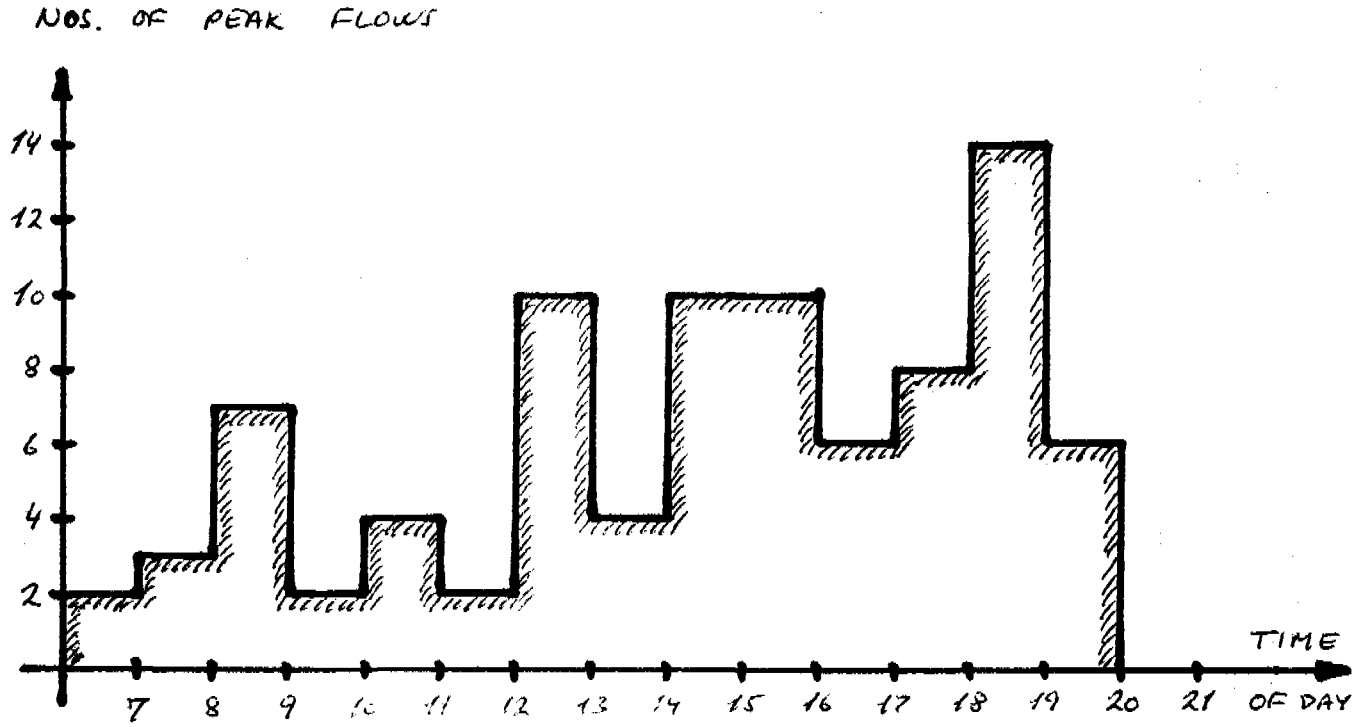

FIGURE 6.13 : MBALAMAZIWA, DISTRIBUTION OF HOURLY PEAK FLOWS AT ALL DP'S

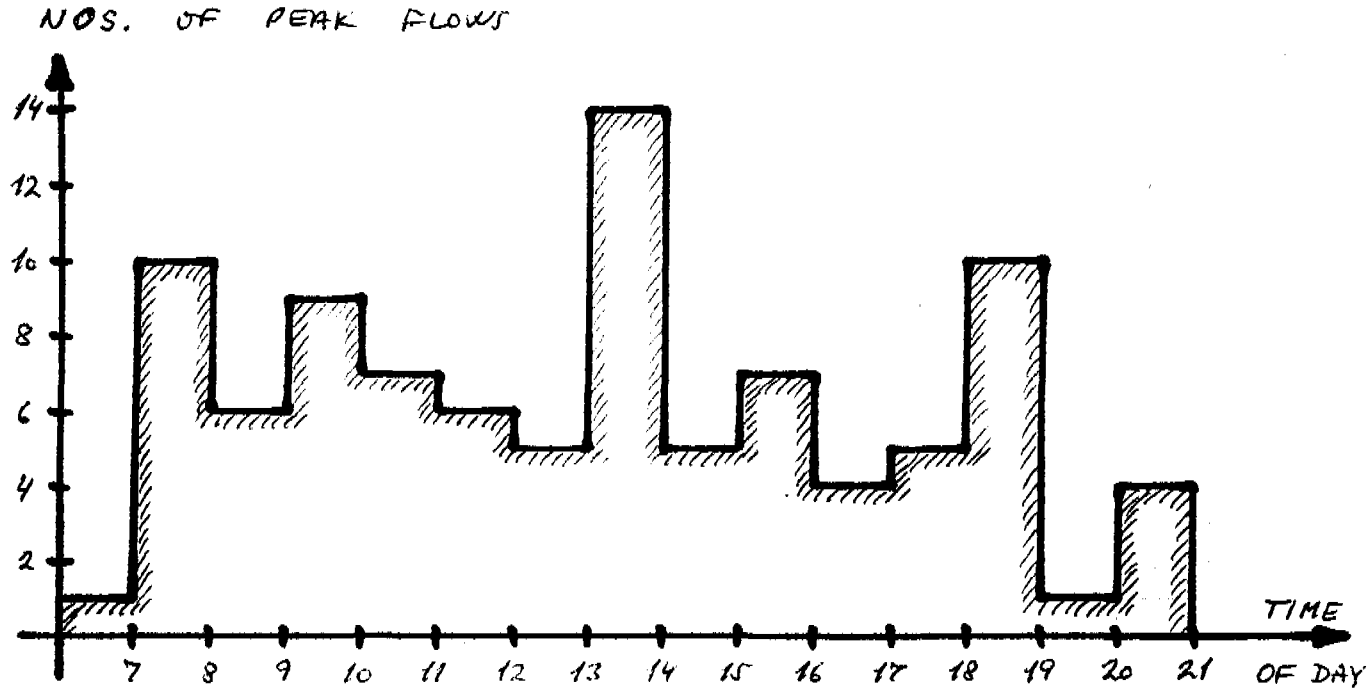

FIGURE 6.14 : MLANGALI, DISTRIBUTION OF HOURLY PEAK FLOWS AT ALL DP'S

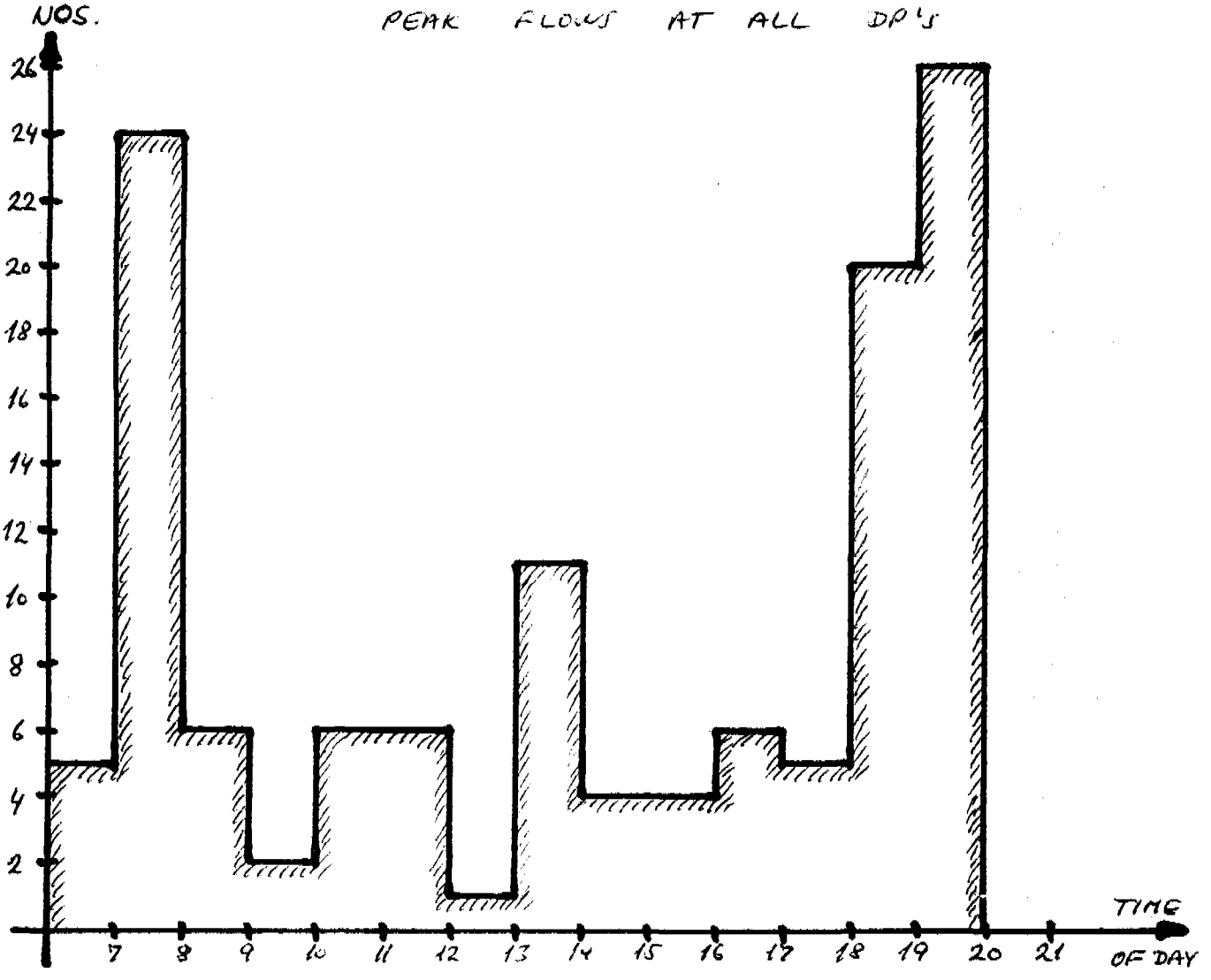

FIGURE 6.15 : KASUMULU, DISTRIBUTION OF HOURLY PEAK FLOWS AT ALL DP'S

6.8. Per Capita Water Consumption

Based on the daily net consumption figures given in Chapter 6.6. and the population figures in Chapter 6.3 the following can be worked out:

Village	Minimum Day	Average	Maximum Day
Kiponzelo	9.4 l	11.6 l	15.3 l
Mbalamaziwa	11.7 l	17.2 l	23.8 l
Mlangali	13.7 l	18.7 l	24.1 l
Kasumulu	18.3 l	20.8 l	22.8 l

NET CONSUMPTION PER CAPITA PER DAY (Litres)

6.8.1. Kiponzelo Village, Comments to per Capita Consumption

The per capita consumption at Kiponzelo is lower than for the other villages, which is supprising as the village has had water supply for longer time than the others.

At the time of metering a large part of the adult population left the village for their fields in early morning and came back in the evening, which surely will effect the water use. Furthermore, there were many interruptions to the supply caused by pipe breakages and cleaning of master meter, which will also have an effect on the water use. It is therefore most likely that, at times where people are in the village and the supply is well functioning, the per capita consumption would be higher than the results of the programme shows. How much higher cannot be stated.

The supply to the Primary School DP is included in the figures, but the Health Centre and doctor's and nurses' houses are not.

6.8.2. Mbalamaziwa Village, Comments to per Capita Consumption

There are some low standard hotels serving people travelling on the main road and using water from DP 2. These hotels might account for some 6-7 % of the total water consumption, but such activities are part of the village life, just as beer brewing on Saturday/Sunday, and water should be supplied in sufficient quantity to cover such uses. The Primary School is situated away from the village and is not using water from the system.

The results of the metering are considered reliable.

6.8.3 Mlangali Village, Comments to Per Caipta Consumption

The village is situated at a gentle sloping area along the old Dar es Salaam - Zambia road. The ditches along the old road are small water streams, with water that by appearance is looking as good as the water supplied through the pipelines in the rainly season. Many people have therefore shorter distance to the road ditches than to the DP's. As a consequence of this it was quite common to see laundrying taking place in the streams.

With the above in mind it is supprising that Mlangali has a high per capita consumption. There are no water consuming institutions or hotels in the village, but the Primary School has a DP. The figures are, however, quite similar to Mbalamaziwa and Kasumulu and should be considered of the right order of magnitude.

6.8.4 Kasumulu Village. Comments to Per Capita Consumption

Kasumulu is situated at an altitude of about 500 m, whereas the other villages are situated at altitudes higher than 1500 m. It is considerably warmer in Kasumulu, which might be the reason for the high water consumption and probably also the reason for the distinct peak periods in morning and evening. There are no water using institutions in the village, but 2 Primary Schools each of which has a DP. There are some doubt on the size of population, but the correct population is most likely within $\pm$ 10 % of the population figure used. The results must be considered useful.

6.9 Conclusion

Conclusions should not be drawn before the dry season metering is completed. However, the results received from the present metering programme are significantly higher than the ones on which the present design criteria are based, so an adjustment to the design criteria should be made eventually.

A design per capita consumption of some 35 litres per day appears more reasonable, when allowance is made for increased future use, water waste and water losses.

APPENDIX 1 PAGE 1

KIJIJI MBALAMAZIWA.. TAREHE ..7/3/87.....

KITUO MUHOHA NO.1... MSOMAJI LEUKABIA MUHOHA.

METER NO. ZR.8652066/. UKARASA 1.

SAA YA KISWAHILI	SAA YA KIZUNGU	METER	READING	CONSUMPTION
12.00 (ASUBUHI)	6.00	00011	11.4338	
				0.0491
1.00	7.00	00011	11.4829	
				0.2543
2.00	8.00	00011	11.7422	
				0.0713
3.00	9.00	00011	11.8135	
				0.1003
4.00	10.00	00011	11.9138	
				0.0680
5.00	11.00	00011	11.9818	
				0.2081
6.00	12.00	00011	12.1899	
				0.4782
7.00	13.00	00012	12.6681	
				0.1005

APPENDIX 1 PAGE 2

VILLAGE MBALAMAZIWA DATE 7/7/87

PLACE TANK READER KALOKOLA/KAJURUNGA

MASTER METER NO. 2368790 PAGE 1

TIME	READING / CONSUMPTION	TIME	READING / CONSUMPTION
06.00	365236	09.45	365628
	000		027
06.15	365236	10.00	365655
	008		019
06.30	365244	10.15	365674
	020		017
06.45	365264	10.30	365691
	030		045
07.00	365294	10.45	365736
	041		031
07.15	365335	11.00	365767
	039		025
07.30	365374	11.15	365792
	033		024
07.45	365407	11.30	365816
	031		055
08.00	365438	11.45	365871
	026		052
08.15	365464	12.00	365923
	024		069
08.30	365488	12.15	365992
	020		066
08.45	365508	12.30	366058
	026		044
09.00	365534	12.45	366102
	023		039
09.15	365557	13.00	366141
	022		083
09.30	365579	13.15	366224
	049		067

VILLAGE MBALAMAZIWA . . DATE OF READINGS 7/3/87.

DP MHOHA . NO. 1 . . METER NO. ZR . 8652066 .

I. CONSUMPTION IN M³ (INCL. UNSTAGE)

READING AT 21:00	14·076	14·076			(1)
READING AT 06:00	11·434		11·434		(2)
READING AT 21:00 THE DAY BEFORE		11·432	11·432		(3)
DAY USAGE (1) − (2)	2·642				(4)
NIGHT USAGE (2) − (3)			0·002		(5)
TOTAL DAILY CONSUMPTION (1) − (3)		2·644			(6)
NOS. OF HOUSEHOLDS USING DP		(ESTIMATE)	30		(7)
CONSUMPTION PER HOUSEHOLD	2·644 / 30	(6)/(7)	=	0·088	(8)
NOS. OF CAPITA USING DP		(ESTIMATE)	160		(9)
CONSUMPTION PER CAPITA	2·644 / 160	(6)/(9)	=	0·017	(10)

II. FLOWS IN M³/HOUR

DAY FLOW PER HOUR (4)	2·642	× 1/15	=	0·176	(11)
NIGHT FLOW PER HOUR (5)	0·002	× 1/9	=	0·000	(12)
AVERAGE FLOW PER HOUR (6)	2·644	× 1/24	=	0·110	(13)
PEAK HOUR FLOW BETWEEN 18.00 AND 19.00				0·487	(14)
PEAK HOUR FACTOR	(14) 0·487 / (13) 0·110		=	4·43	(15)
MAX. PEAK FLOW MEASURED AT DP OVER 5 MIN.				0·315	(16)
MAX. PEAK FACTOR	(16) 0·315 / (13) 0·110	× 12	=	34·4	(17)

COMPUTATIONS BY ELIAS T. KAJURUGA DATE 17/3/87. . .