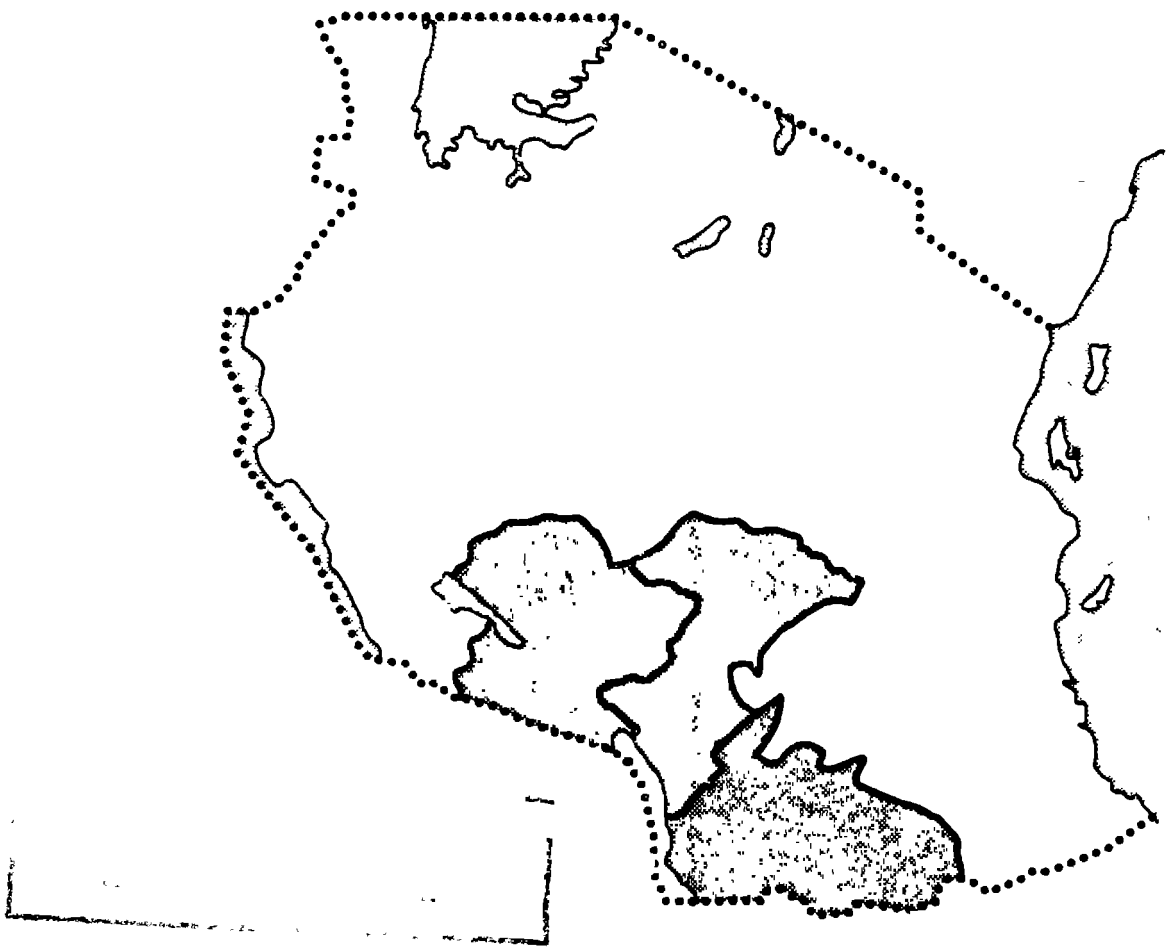
UNITED REPUBLIC OF TANZANIA

DANISH INTERNATIONAL DEVELOPMENT AGENCY • DANIDA

WATER MASTER PLANS FOR IRINGA, RUVUMA AND MBEYA REGIONS

SOCIO-ECONOMIC STUDIES
VOLUME 12



BUREAU OF RESOURCE ASSESSMENT AND LAND USE PLANNING
UNIVERSITY OF DAR ES SALAAM
CENTRE FOR DEVELOPMENT RESEARCH • COPENHAGEN 1982

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1. INTRODUCTION

1.1 Socio-economic Water Master Plan Study, Iringa, Mbeya, Ruvuma Regions

As part of the Tanzanian-Danish Government agreement on the Iringa, Mbeya and Ruvuma Water Master Plan Project it was established that a separate socio-economic study should be undertaken. The purpose of the socio-economic study is to feed relevant information and recommendations into the Water Master Plan preparation, as well as into the sector programme and possible supplementary programmes.

1.1.2 Executing institutions

The socio-economic Water Master Plan Study was subsequently accepted as a joint research project by Bureau of Resource Assessment and Land Use Planning (BRALUP) of the University of Dar es Salaam and Centre for Development Research (CDR) in Copenhagen.

1.1.3 Aims of the project

Within the framework of the government agreement the following aims of the project were specified in an agreement on cooperation signed by Prof. A. Mascarenhas, Director, BRALUP, and Prof. K.E. Svendsen, Director, CDR, in August 1979, after approval by DANIDA and Tanzanian authorities.

"The aims of the project are:

a) To study how rural water supply schemes can best be adapted to the varying local socio-economic conditions in the three regions, in order to yield to the people the maximum direct benefits in terms of provision of clean water to cover their day to day needs (e.g. distance to water points, washing places, bathing facilities, possibilities for small-scale irrigation, cattle dips, etc.).

b) To explore ways in which rural water supply schemes and other development efforts can provide mutual reinforcement and achieve a greater total impact through concerted action (e.g. health, nutrition, and other education, agricultural and other productive programmes, etc.).

c) To identify the opportunities for local participation in planning, implementation and maintenance of the water schemes, as well as in supplementary activities, and in the research project itself (e.g. general participation by a village as a whole, or specific mobilization of particular groups, such as women groups, adult education groups, parent groups etc.).

d) To prepare an evaluation plan/monitoring system and to provide information, which can be used as the basis for future evaluation of the impact of the rural water supply programme."

1.2 The socio-economic group

The socio-economic group consists of three regional researchers, Mr. Ole Therkildsen (Iringa), Dr. Kristian Laubjerg (Mbeya), and Mr. Benedict S. Kapinga (Ruvuma), supported by two senior researchers, Dr. Mark Mujwahuzi (BRALUP) and Mr. Jannik Boesen (CDR).

14 research assistants from the regions and 3 Danish assistants have been employed by the project for varying periods.

1.3 Cooperation

The project has cooperated with a large number of institutions and persons in and outside the overall Water Master Plan project. This cooperation is described in detail in the project Inception Report (May 15th, 1980) and subsequent Quarterly Reports. Here it suffices to outline briefly the cooperation with the other parties to the Water Master Plan.

1.3.1 Regional authorities

Socio-economic group members have participated as regular members in Regional Steering Committee meetings every 1 - 2 months, where they have reported on progress of work, and on preliminary study results and recommendations. Other meetings/seminars have also been held at regional level, and reports and other information have been exchanged in particular with Regional Planning Officers.

1.3.2 Regional Water Engineers office

Apart from the formal framework of the Regional Steering Committees, socio-economic group members have been in daily contact with staff at the Regional Water Engineers' office, on whose premises they have been situated (when not in the field). Special cooperation has taken place with MAJI staff in relation to implementation of DANIDA funded water schemes. The socio-economic group has here operated as a kind of provisional extension unit (see chapter 6 below), together with MAJI field personnel trying out new forms of village participation in planning, implementation, and operation and maintenance of water projects.

1.3.3 Villages

In all villages visited by the group full and essential support has been sought and received from villagers and their leaders, both with regard to provision of information and to the above mentioned participation in water project implementation.

1.3.4 Water Master Plan consultants

As laid down in the government agreement as well as in the BRALUP/CDR co-operation agreement, the socio-economic group has worked in continuous close contact with the Water Master Plan consultants.

Working plans have been coordinated, parts of the data collection (village inventory) planned and processed jointly, and preliminary study results shared between the two parties, as a current feature of the whole project.

Most of the research results and recommendations contained in this volume have been currently presented to and discussed with the Water Master Plan consultants through working papers, meetings, informal discussions etc. for their inclusion in the regional Water Master Plans, volumes 1 - 4.

1.3.5 DANIDA steering unit

Apart from the invaluable practical support provided by the steering unit, and the formal contacts through Regional Steering Committees, the socio-economic group/steering unit cooperation has specifically been concerned with the sector aid implementation projects funded by DANIDA through the steering unit.

The socio-economic study has provided information and comments for the use of the steering unit in its evaluation of proposed projects and the above mentioned "experiments" with village participation have been carried out in close coordination with and supported by the steering unit.

1.4 Sources of information

1.4.1 General

The research results and recommendations presented in this volume are partly based on secondary data sources, such as general water supply literature, earlier Tanzanian studies on water (including other Water Master Plans), regional development reports and plans, research reports on the involved regions etc.

The bulk of the volume, however, represents primary information collected during the Water Master Plan study. Here we shall briefly outline the different levels of data collection undertaken, while a more detailed account of the research methodology can be found in the appendix at the end of this volume.

1.4.2 Village inventory

General socio-economic information as well as data on the water situation for each single village in the three regions have been collected by the Water Master Plan consultants and their Tanzanian counterparts, using a questionnaire for village representatives, that was jointly designed by the consultants and the socio-economic study group. Processing likewise has been carried out in co-operation between the two study groups.

1.4.3 Household survey

A sample household survey has been carried out by the socio-economic study. A questionnaire on general socio-economic background variables as well as detailed information on participation, water, sanitation, and health was administered to men and women in the sample households.

The sample was selected in a stepwise procedure. Based on existing material each region was divided into major agro-ecological zones (see chapter 2). In each region the 4 most important zones (in Ruvuma 3 due to its smaller size) were selected. In each of the selected zones 6 villages, 2 with an existing water supply, 2 with a proposed water supply, and 2 having neither of these, were chosen for study, taking into account two considerations:

a) that they should be fairly characteristic for the main agro-ecological features of the zone, and

b) that for reasons of comparability and logistics they should not be too far away from each other.

The study areas are shown on maps 2.1, 2.2 and 2.3 in chapter 2.

In the villages chosen 30 households were selected randomly for the household survey, of which a few with no adult women were subsequently left out, as a major part of the questionnaire could only meaningfully be used with female respondents.

Because of time constraints in all three regions, and particularly delayed employment of the researcher for Ruvuma Region, the number of villages had to be reduced to 3 in one zone in Iringa and Mbeya and in two zones in Ruvuma.

Obviously this procedure represents a compromise between what would have been a strictly scientific selection of a representative sample, and the practical constraints in terms of time and manpower, and logistics, as seen in relation to the extreme agro-ecological variations existing in the three regions. Only aggregates on village level are therefore representative, strictly speaking, but we believe that also zonal and even regional aggregates can be taken as giving a fairly typical picture of the situation. Correlations etc. involving individual household variables should not be much affected by the selection procedure.

1.4.4 In-depth village studies

While the formal questionnaire survey was carried out in 6 villages in a zone (3 in some zones), the socio-economic researcher undertook supplementary in-depth studies in one of the villages, especially on participatory aspects, water, health and sanitation, through observation, informal discussions, meetings etc.

1.4.5 Participatory research

The socio-economic researchers have been deeply involved in the implementation of DANIDA funded water supply projects, following them from the very beginning and taking part especially in setting up new forms of village participation in the planning, implementation and future operation and maintenance of these projects. The information and experiences gained is included in this volume (chapter 6) on a preliminary basis, as this activity will continue throughout 1982, the final year of the socio-economic study, to be fully reported on in volume 13 (see below).

1.5 Organisation of the present volume

This volume, volume 12 of the Iringa, Mbeya and Ruvuma Water Master Plan study brings the detailed data and analysis which are the results of the first two years of the three year socio-economic Water Master Plan study.

Apart from chapter 2, which describes the study area region by region, the volume is organised by subjects, not geographically, since it was found that similarities in the results between areas would render an analysis by subject, across geographical areas more meaningful and less repetitive, taking geographically determined differences into account under the different subjects' headings.

Unfortunately it was not always possible to include the full Ruvuma results in the analysis, because the delayed start of the household survey in that region

has meant that in some cases computer processing of the results could also not be completed in time. It is believed, however, that the resulting recommendations are valid also for Ruvuma, since analyses for Iringa and Mbeya have shown only minor regionally determined variations in water related variables. Furthermore, those results that have been retrieved and analysed from the Ruvuma material, do not either exhibit major variations compared with the results from Iringa and Mbeya. All detailed results, including those for Ruvuma are obtainable from the computer tapes and printouts.

Each chapter in the volume includes as far as possible, a review of comparable research from other areas, proceeding with a presentation of the analysis based on the data obtained during the present study, and concluding with the recommendations which we believe can be drawn from these analyses. In some cases these are firm conclusions, in others we note that they are only preliminary suggestions, which will be further elaborated on during the second phase of the project (1982), which will be concluded with an additional volume 13 of the Water Master Plan in early 1983.

Those parts of the study that were finalised during the first phase of the project, on which we are reporting here, are those which were particularly needed for inclusion in the Water Master Plan itself. Other parts to be studied more in depth in the second phase, are those which deal with more specific implementation procedures (including village participation) and activities complementary to provision of water, such as health education, sanitation etc.

As most of the results presented here are included in summarised form in the consultant's regional Water Master Plan volumes 1 - 4, this volume is meant for readers with an interest in a more detailed account of the socio-economic aspects of the Water Master Plan study. Therefore we have not found it worthwhile to include here another overall summary of the findings in addition to the summaries found in individual chapters.

1.6 Phase 2 of the socio-economic study and volume 13 of the WMP report

Phase 2 of the socio-economic study will cover the period from February 1982 until March 1983. The major part of the study will concentrate on the on-going DANIDA Implementation Programme.

Particular emphasis will be given to the participatory aspects of the programme. Using this programme, studies will be made on community involvement in Water Supply Programmes.

Furthermore, the socio-economic impacts of various types of water supplies will be investigated and finally the role of supplementary programmes (health/ sanitation, education, agriculture etc.) will be studied (including in-depth health surveys).

A summarized outline follows below.

1.6.1. Main problem areas to be studied

Participation

a) The functioning of established Village Water Committees (VWCs);

b) Village involvement in operation and maintenance;

c) Further development of village participation in planning, implementation, and operation and maintenance, with involvement of Tanzanian authorities (Maendeleo Division) in the role as extension unit (hitherto provisionally carried out by the socio-economic group on an experimental basis);

d) Specific emphasis on the involvement of women in VWCs work and in supplementary programmes; their tasks and attitudes, and the role of UWT (Women's Organization);

e) Needs of training MAJI personnel for village participation;

f) Possibilities of mutual support between the participatory water approach and supplementary programmes, such as health education, small-scale irrigation etc.;

g) Problems in older existing schemes;

h) Possibilities of setting up or reviving VWCs in villages with older schemes, and villages without w.s. to improve traditional sources;

Health and sanitation

a) Health situation in general in the regions, particularly as regards water related diseases as compared with other diseases;

b) Detailed health situation in selected areas, presently and under the impact of improved water supply - possibly also with improved sanitation (Wang'ing'ombe sanitation project);

c) Pollution of drinking water and locally made beer (!) after collection at water source;

d) Hygienic patterns in general;

e) Extent and impact of health education, as well as "traditional" knowledge on health;

Other supplementary programmes

a) Time used for existing tasks, especially by women, and the impact of water supply. Potential use of time saved.

b) Productive use of water - existing, impact of w.s., and potential, (e.g. domestic, irrigation, livestock, house building, pombe)

1.6.2. Research design

A detailed research design will be worked out for each of the three main problem areas in January-February 1982.

Most of the points will, however, be investigated through case-studies, rather than attempts at further overall regional coverage.

Ongoing studies

Villages where the socio-economic group has already participated in establishment of VWCs will be visited regularly over the year for participation in committee meetings and discussions with members, water attendants and villagers. Existing material has been, and will be collected and analysed on the general health situation in the regions, and on existing water schemes from files, regional statistics, village inventory, hh. survey.

Participatory research on new schemes

Based on experience gained so far the socio-economic group will continue to co-operate actively in the participation aspects of planning and implementation of new DANIDA funded projects being started during the first 6 months of 1982.

This will be done with a view to the gradual take over of the extension unit functions by Tanzanian authorities (Maendelo Division) towards the second half of the year.

Health surveys

It is intended to carry out health surveys in selected villages, drawing on expertise outside the socio-economic study group, both in the planning and execution of these. It is hoped that it will be possible to study some "before-and-after" situations, but also to provide baseline material for later evaluation.

Time use and water use studies

Proposals for these studies will be prepared in January-February 1982, but also here it is hoped that it will be possible to map the patterns before and after the provision of water.

1.6.3. Outputs

Recurrent cooperation and communication

Outputs from the work will as hitherto partly take the form of recurrent co-operation and communication with others concerned in the regions and in Dar es Salaam.

Volume 13 of the Water Master Plans

The final results will be reported on in volume 12 of the Water Master Plans, to be published by February/March 1983, including a "manual" for village participation in Water Master Plan implementation and proposals for supplementary programmes to be implemented together with water projects.

Monitoring and Evaluation Systems

Together with Maji and the DANIDA steering unit the socio-economic study group will help in working out a monitoring and evaluation system for the future implementation of the Water Master Plans.

2. AREA OF STUDY

2.1 Introduction

This volume, and the study it is based on, covers the three southern regions of Tanzania, Iringa, Mbeya, and Ruvuma; an area of some 180000 sq.km. with a 1978 population of around $2\frac{1}{2}$ million people of which 95 % lived in rural areas (i.e. outside the three urban regional centres).

In terms of overall development and potential the three regions are not among the worse off parts of Tanzania, but with their great internal heterogeneity they almost resemble a miniature model of the whole country, with conditions ranging from prosperous, fertile, high rainfall, densely populated highlands, over lake shore fishing villages, to dry, sparsely populated areas of low to moderate fertility, some of them with a significant infusion of semi-pastoral and pastoralist people.

Again in general terms, Ruvuma has greater agricultural production and incomes than the two other regions, while the former is lagging far behind with regard to infrastructure, especially transport and distribution. But such generalizations cover great disparities also within each region. As a basis for planning it has been found most useful, therefore, to try to divide each region into agro-ecological zones, i.e. areas that are more homogeneous with regard to the major productive activity, agriculture, and its basis, ecology, resource endowment, etc., than regions and districts, which are delineated more according to administrative convenience.

The present planning study is based on such a division of the three regions into agro-ecological zones. For convenience the number of zones had to be limited, so there are still variations from one part of a zone to another. But for planning purposes this approach seems sufficiently refined to allow reasonable generalizations across zones, as well as to point to differences related to varying zonal characteristics.

As a background to the socio-economic Water Master Plan study presented in this volume the present chapter, then describes the general agricultural, ecological, and socio-economic characteristics of the zones studied in each region[1)]. Special emphasis is given to summaries of the health, water, and sanitary conditions. Finally a brief outline of existing development plans is given for each region[2)].

2.2 Iringa Region

2.2.1 General

Iringa region is surrounded by one country, Malawi, and five regions: Mbeya, Singida, Dodoma, Morogoro and Ruvuma. The region covers 56,949 km^2 and had 922,801 inhabitants in 1978 according to the census[3]. At that time the regional population density was 16.2 persons per km^2. Administratively the region is divided into six districts: Iringa Urban; Iringa Rural; Mufindi; Njombe; Ludewa and Makete. There are 32 divisions at the sub-district level - further divided into 113 wards. A total of 613 villages were recorded in 1981 by the regional authorities[4], while the Water Master Plan village inventory gave a preliminary figure of 630 villages - registered and unregistered.

Population

From 1967 to 1978 the annual population growth rate for Iringa Region has been significantly less (2.7 %) than for the mainland as a whole (3.3 %)[5], and this difference cannot be explained by differences in the regional fertility and mortality rates[6]. A considerable net out-migration has therefore taken place between the two censa of 1967 and 1978.

At a continued annual regional growth rate of 2.7 % the 1982 population will just exceed 1 million, of which half will be below 15 years of age. Some 93 % of the population live outside Iringa Urban District.

The rural economy[7]

Peasant agriculture is the backbone of the region's economy. It seems probable that around 85 percent of the population in the region are dependent on agriculture for their main source of livelihood.

Approximately one-third of the total land area in the region is of medium to high fertility and receive adequate rains in nine out of ten years. Thus the natural resource endowment is favourable for a wide range of agricultural activities.

Only five percent of the land area is presently under cultivation. Any problems in the rate of agricultural development in the region can therefore not "be attributed to the low inherent capability of the natural resources or to the unavoidable pressure of population on them"[8].

It is difficult to get a reliable picture of the region's agricultural performance. The production data vary significantly depending on the source of information. However, the overall picture - based on data on marketed production from the Regional Agricultural Officer up till 1981 - is, that maize production after small harvests from 1970 to 1974 is now picking up. Production of wheat and sorghum is also on the rise, whereas there has been a significant decrease in the amount of paddy sold through official channels. Only marketed potato production has shown an increase among the root crops. Cash crop production (tobacco, tea and coffee) has been increasing since 1970 to 1974, but pyrethrum output has fallen significantly. If these trends are correct, agricultural performance in Iringa region are much better than for the country as a whole.

Livestock is kept for a number of economic and cultural reasons. The livestock population is not known with any degree of accuracy. Official figures indicate that by 1978 there were 850,000 cattle; 69,000 sheep; and 101,000 thousand goats (see chapter 9).

Public infrastructure[9)]

An increasingly important aspect of quality of life in Tanzania is access to the consumption of services which are provided free of charge by the public sector. Three services are of utmost importance: education, health and water supply.

In 1980 there were a total of 655 primary schools in Iringa Region attended by around 160,000 pupils. Almost every village now has a primary school. A remarkable achievement in quantitative terms.

Access to health service is much lower. By 1980 there were 156 dispensaries, 12 rural health centres, and 13 hospitals in the region. The average distance for households to dispensaries and hospitals is 3 km. and 24 km. respectively for the rural population[10)].

During the seventies public development expenditure per capita in the water sector in Iringa Region was among the lowest of any region in the country[11)]. Only one region received a lower share of per capita investment during the third five year plan period. This unequal distribution of development funds is reflected in the low percentage of people (19 %) who had access to improved water in 1975[12)]. By 1981 this percentage had risen to 40 % according to official estimates[13)]. No doubt this figure significantly overestimates the true percentage (see table 2.5 and chapter 6.4). There is still a long way to go.

2.2.2 The agro-ecological zones[14)]

In the Rural Integrated Development Plan (RIDP) for Iringa Region it was recommended that future plans be disaggregated to agro-ecological zones. The demarcation of these zones is based on actual crop patterns and thus reflects the natural environment (rainfall, temperature and soils) and prevailing agricultural production methods.

Seven major agro-ecological zones were identified as shown in table 2.1, which also gives data on population, rainfall, altitude and the most common food and cash crops grown in each of them, according to the RIDP. Tables 2.2 and 2.3 give comperable figures derived from the Water Master Plan village inventory.

The findings on Iringa Region reported on in the following sections derive from household surveys and in-depth studies in the four largest zones by population and area (see tables 2.1 and 2.2). The locations of the four survey areas are shown in Map 2.1 and are described below. The study areas are, strictly speaking, not representative for their respective zones, but do give a typical picture of their socio-economic conditions (see chapter 1.4.3 and appendix).

2.2.3 The High rainlands zone

This zone covers the eastern fringe of Iringa Rural, Mufindi and Njombe Districts, and most of Makete District.

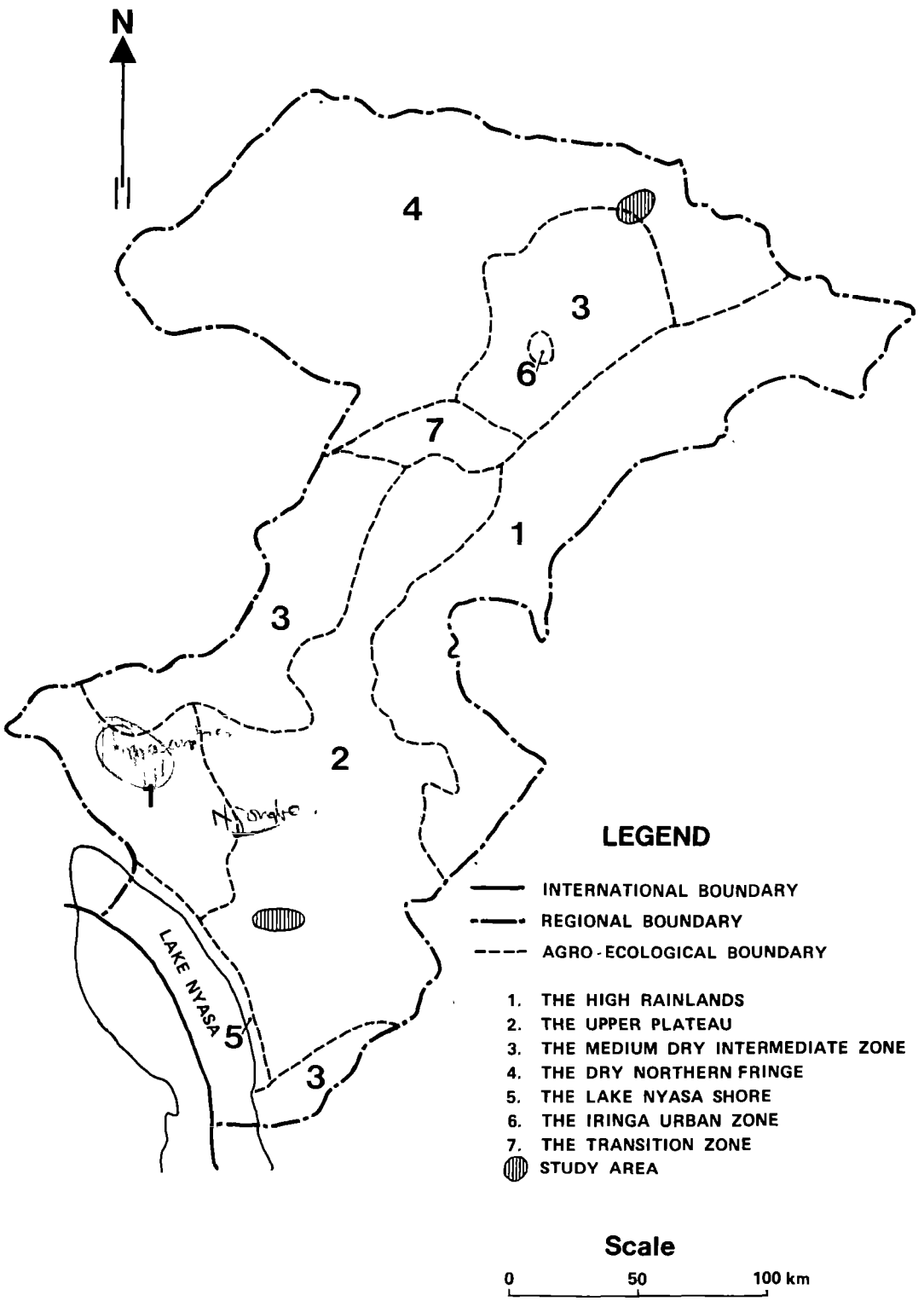
Over one-fourth of the regional population lives in this zone. The eastern part is mostly inhabited by the Hehe and Bena tribes. The household surveys were done in the Western part of the zone (see Map 2.1) where the Kinga and Wanji dominate. Population densities are relatively high (approximately 25 persons per km^2) and some out-immigration has taken place. This is reflected in the relatively small average household size (4.6 persons) and in the many households (37 %) with a female head.

The main crops in the high rainlands are maize, beans, pyrethrum, tea and wheat.

Maize is grown everywhere. Surpluses are consistently produced but transport of the crop out of the area is a major problem: the roads are very bad. Pyrethrum is grown in many parts of the zone. It was the most important cash crop among the households interviewed here.

Livestock is not very important for the peasant economy in this zone. About half of the households interviewed (47 %) owned some. Cattle owners had in average 7 cattle, and small livestock owners had equally small average herd sizes.

AGRO - ECOLOGICAL ZONES, IRINGA REGION



Map 2.1 Agro-ecological zones, Iringa Region, with sample survey areas for the present study

Zone	Area- ('000 sq.km)	Population 1975 ('000)	Rainfall category a)	Average altitude (m)	Major cash and food crops (present and potential)
The High rainlands	17	235	4	15-2,300	Maize, pyrethrum, wheat, tea.
The Upper plateaus	12	250	3	14-1,800	Maize, pyrethrum, wheat.
The Transition zone	n.a	n.a	3	1,600	Maize, pyrethrum, tobacco.
The Medium dry zone	11	301	2	13-1,500	Maize, sunflower, tobacco.
The Dry Northern fringe	17	36	1-2	9-1,100	Paddy, maize, oilseeds.
The Lake Nyasa shore	0.5	8	3-4	500	Cassava, paddy.
The Iringa Urban zone	0.1	46	2	1,500	Maize, vegetables

Source: United Nations Development Programme and Food and Agriculture Organization of the United Nations (1976). Iringa Region, Tanzania - Integrated Rural Development Proposals for the Third Five Year Plan 1976 - 1981, Vol. I, Tanzania Rural Development Bank Project URT /71/004; Table 2.1.1.

a) Probability of annual rainfall in 4 years out of 5: Category 1 (250 - 500 mm); category 2 (500 - 750 mm); category 3 (750 - 1,250 mm); 4 (over 1,250 mm).

Table 2.1 Agro-ecological zones, Iringa Region

In the household survey area rainfall is ample and the soil fertility good. Households cultivate in average 2 hectares of land. Around half of them (40 %) irrigate land mostly (in average 0.3 hectares) - mostly for maize. Gross cash household incomes average shs. 2,100, to which sales of pyrethrum and maize contribute significantly.

Due to the rather cold climate, the frequent rains and a deep penetration of the cash economy most peasants have houses of a good quality and almost half of these (44 %) have corrugated roofs. Every household (99 %) has a pit latrine and the claimed usage is very high.

Available health statistics from Matamba rural health centre are poor, but they indicate that 7 % of the out-patients had faecal-oral diseases; 6 % had water-washed diseases; and 8 % had malaria. No cases of water based diseases (bilharzia) were recorded in 1980[15]. Chest pains and common colds were

the most frequently observed diseases. They were also the most frequently mentioned by the households interviewed. Around 8 % of the households claimed to have had one or more members with diarrhoea the day before the interview.

Generally there is plenty of surface water in the High rainlands. But many villages are located on ridges. This means that unless there is an improved water supply water must be carried up-hill from the valleys - a very strenous task. Often the ridge locations cause long walking distances, too. On an average water drawers walked 1,300 to 1,450 m to fetch water at traditional sources in the villages included in the sample. Only perennial streams and dug holes were used by the respondents. Many respondents (55 %) complained that polluting activities (laundry washing, cattle watering) took place at or in the sources used for drinking water.

The one village in the survey with a water supply (Matamba) has an unusually high number of domestic points of which only few are out of order. Their locations are discussed in detail in section 6.4. All households interviewed in Matamba drew water from the scheme.

2.2.4 The upper plateau zone (2)

The Upper plateau covers central Mufindi and much of Njombe and Ludewa Districts.

The Bena tribe is the most numerous in this zone which is inhabited by approximately one-fourth of the regional population. In the southern part of the zone where the household surveyes were conducted (see Map 2.1) the Pangwa tribe is dominant. The population density is relatively low (15 persons per sq.km); the average household size is 5.3 persons and 39 % of the household has a female head.

Agricultural potential in the study area is modest to low due to the frequency of steep slopes and shallow soils of low fertility. Maize, beans, wheat, pyrethrum, sunflower, tea, timber and wattle are the main agricultural products. In the study area maize was the most frequently grown food and cash crop among the households interviewed. Coffee is now being introduced here on a small scale. Cash crop production in the study area is hampered by poor marketing possibilities.

The distribution of livestock is rather unequal among households. Only 40 % had some. The average cattle herd was 29 animals, while the small livestock herd consisted of 12 animals on an average.

Households cultivated an average of 1.5 hectares. Irrigation was not very widely used. Only 21 % of the households engaged in it - irrigating on an average 0.4 hectare, mostly with vegetables. Gross cash households incomes averaged a low shillings 1,500; with sale of crops and beer being the most important sources of income.

In the study area the housing quality if generally modest except among the non-agricultural population in the administrative centres. These are rather large (Lugarawa has 5,700 inhabitants; Mlangali has 2,700) and land shortage is a problem around them. Only one-third of all the houses had a corrugated roof. Almost every household has a pit latrine (97 %) and claims to use it.

Health statistics from St. John's Hospital, Lugarawa shows that 20 % of the out-patients attending the dispensary had faecal-oral diseases; 5 % had water-washed diseases; 0.1 % had water-based diseases and 9 % had malaria in 1980. Bronchitis and common flue were the most frequent diseases. Among the households interviewed diarrhoea was the most frequently mentioned disease and 11 % of all households claimed to have had this disease the day before the interview.

Ditches, springs, streams and dug holes were used by the households interviewed. Most households (92%) drawing water from traditional sources used perennial ones. The villages are mostly located closer to these sources than elsewhere in the region. Thus the average walking distance (970 m) to a permanent source is the shortest recorded for all four study areas in this region. One-third of the households using permanent traditional sources complained about the polluting activities that took place at or in them.

Two villages (Lugarawa and Mlangali) had water schemes in working order. However, only 16 % of the households interviewed here drew water from them. The villages have simply outgrown the schemes, which only serve the central parts of the settlements. Most villagers continue to draw water from traditional sources.

2.2.5 The Medium dry intermediate zone

This zone ranges from the Ismani plains in the north of Iringa Rural District over the central Iringa corridor, to the western rim of Mufindi and the northern rim of Njombe District. It is a zone of plateau steps and foot-hills.

Rainfall diminishes rapidly westward in the zone and ureliability increases. The soils are shallow sandy loams of low fertility. Yet over 25 percent of the people of the region live in this area which covers only 20 percent of the land area. The Bena in the south of the zone and the Hehe in the north are the

dominant tribes. The study area (see Map 2.1) belongs to one of the most heavily populated areas of the region (approximately 36 persons per sq. km). Family sizes are rather large (6 persons in average) but very many families (46 %) have female heads.

Maize, beans, sunflower and tobacco are the main crops grown in the zone. Much of the tobacco is grown on large capitalist farms, but this crop is also being introduced in the peasant economy. The villages in the study area, which are located from 20 to 50 km from Iringa town, export vegetables and peas to this urban market, which also received substantial amounts of local beer (Ulanzi) from them.

Households cultivate on an average 2 hectares of land. One-third of them use irrigation and grow mostly maize and vegetables by this method on plots that average 0.4 hectare. Gross cash household incomes average Shillings 1,900. The single largest source of income for the average household was beer brewing: approximately 94 % of the households interviewed engaged in this activity. Also wages were an important source of income, again reflecting the importance of Iringa town for the economies of the surrounding villages.

Only 31 % of the households interviewed had any livestock and the average herd sizes of cattle and small livestock were rather modest - 13 and 12 heads respectively.

Although - as explained above - the proximity of Iringa town has a major impact on the household economy of villagers living in the surrounding settlements, its influence on the communal economies is rather negative. Due to the high prices on crops sold on the black markets, work on the village communal fields is done with a considerable lack of enthusiasm.

Many houses in the surveyed villages are of a good standard, and several households (41 %) have more than one. Almost half of the houses (45 %) have a corrugated iron roof. 99 out of 100 households have a pit latrine - one household in ten even has two latrines. The claimed usage is very high.

Aveilable health statistics from Kiponzelo rural health center for 1980 indicate that 24 % of all out-patients had faecal oral diseases; 6 % had water-washed diseases; 0.1 % had water-based diseases, and 13 % had malaria. At this health center gastroenteritis and malaria were the most common diseases. According to the respondents interviewed diarrhoea was the most common disease; and 8 % of all the households claimed to have members with this disease the day before the interview.

Water holes and streams were the most used permanent traditional sources - used by 84 % of the households drawing water from non-improved sources. The mean distance to these sources by village vary between 650 m and 1,480 m (average 1,170 m). In some villages water holes dry out, so a shift to different water holes is necessary. There are widespread complaints about polluting activities at or around the sources.

Two villages (Kiponzelo and Nyambula) had water schemes that worked. Around 60 % of the households interviewed were using water from them. The rest draw water from traditional sources (water holes).

2.2.6 The Dry northern fringe (4)

Situated in the North and North Western part of the region this zone lies entirely within the Iringa Rural District.

5 - 10 % of the population of the region lives in this zone, which covers almost one-third of the region's area. Ruaha game park makes up 75 % of the zone. Population densities are very low - less than 3 persons per sq.km. People of Hehe and Bena origin dominate the population. The household surveys were conducted at the edge of the Ismani plain in the last villages before the Great Ruaha river at the border to Dodoma Region (see Map 2.1). Average household sizes are rather large (6.1 persons) and 19 % of the households have a female head.

Rainfall is low in this zone, and the sandy soils are of very low fertility. The landscape is rather flat in the survey areas. Maize, millet/sorghum, beans, paddy and oil-seeds are the most important crops. Rice is only grown on irrigated land. In the survey area only rainfed agriculture was practised.

During the last 40 years a steady in-migrating has taken place, starting on the Ismani plains near Iringa town and gradually moving north towards the virgin but increasingly marginal areas. In the fifties and sixties many large farms were established here. But in the early seventies Ujamaa villages took over the land formerly owned by capitalist farmers[16].

However, plot sizes in the study area are still substantial - on an average 3.5 hectares. Many households (12 %) cultivate more than 6 hectares. A similar skewness in the distribution of cultivated land is not found in the other areas surveyed. Mechanized production methods are also widespread. Almost 60 % of all households had oxen. A few tractors can also be seen.

Average gross cash household incomes were large (Shs. 2,100) with most of it coming from crop sales.

Cattle sale is another important source of income in the study area. Around 58 % of all households own livestock. The average size of the cattle herds is 42. Also the average small livestock herd size is fairly large. Pastoralists were not included in the survey, but during certain periods of the year they move into the area with substantial number of livestock as well. Overgrazing can now be observed in many parts of the study area - especially in the vicinity of villages.

Being a frontier area with many in-migrants, a large number of houses are of low quality. Only 22 % of them have a corrugated iron roof, and only 86 % of the households had built a pit. The claimed usage of pits was lower than in the other areas studied, but still well above 90 % of the respondents claimed that they were in full use.

Igula dispensary statistics from 1980 indicate that 14 % of the out-patients had faecal-oral diseases; 9 % had water-washed diseases; 0.3 % suffered from bilharzia, and 31 % from malaria. The latter is the most common disease treated at the dispensary. According to the respondents headache was the disease that their families suffered most from. Given the very poor water situation in the area (see below) it is surprising that the reported incidence of diarrhoea among families (6 %) was rather low.

People in the study area living in the villages without water schemes may have relatively easy access to land, but they certainly have poor access to water of a very bad quality. It is not without reason that the study area is called "Malenga Makali" in Kihehe - meaning salt water. Walking distances are sometimes extremely long. During the dry season women in one village draw water from domestic points in a neighbouring village almost 7 km away. It is a 3.5 hour trip. In another village salty, dirty water from holes dug in the bottom of a dry river bed 1.7 km away is drunk during the dry season. But this water is too salty for laundry purposes, so once a week somebody in the family (not necessarily the woman) walk 13 km to a water scheme in the next village to wash the clothes. In some villages formed during the villagization process the poor access to water has been aggrevated by ill conceived locations along roads. The pre-villagization settlements were located in the surrounding low mountain ranges where water is fresh but scarce. The population distribution at that time reflected this scarcity.

The two water schemes built in the survey area (in Igula and Kihorogotha) were used by all households interviewed in the villages - and by some from the neighbouring villages as well. No wonder. The salty traditional sources are far from attractive.

2.2.7 Summary of zonal descriptions

Selected indicators on income, agriculture and livestock by household are given in tables 2.3 and 2.4 below.

The Dry northern fringe stands out in several respects: Indicators on cultivated land, gross cash incomes, livestock and oxen ownership, and average cattle herds are all higher for this zone than for the three others. As explained above the history of capitalistic agricultural development in the Dry northern zone goes a long way in accounting for this situation.

The indicators on sanitation and health are given in table 2.6. Except in the Dry northern zone most villages surveyed in the other zones are saturated with pit latrines. And they are used (see chapter 11.4). The percentage of households reporting cases of diarrhoea among its members is surprisingly low in the Dry northern fringe - given the lower frequency of pit latrines and the very bad water situation in the area (see below). But the interviews here were conducted in the dry season and that may be part of the explanation.

The water situation in the zones, described in figures, is presented in table 2.5. The drastic differences in the water situation across zones is striking, both with respect to traditional sources and improved water supplies. Again the Dry Northern fringe stands out as the zone with very severe water problems for those households that are forced to draw water from traditional sources.

2.2.8 Regional development plans

While the potential long-term perspectives for the region are good the short-term possibilities are severely affected by the present serious conditions facing the country.

Short-term plans

To be implemented the proposal for the Fourth Five Year Plan for Iringa Region[17] for the period 1981/82 to 1985/86 requires Shs. 485 million in capital expenditures. Direct production activities (agriculture, livestock, natural resources, industries, and district development corporations) have been allocated Shs. 206 million (43 % of total requested funds). Plans for productive infrastructure investments (Ujamaa and cooperatives; construction; lands and housing, and agricultural infrastructure) requires Shs. 142 million (29 %) to be implemented. Social infrastructure investments (education, health and water) will get Shs. 137 million (28 %) of the total requested development funds.

Within the directly productive sector the main aim is to increase agricultural productivity considerably for all types of crops. The plan does not specify how this is to be done.

Most of the funds for productive infrastructure will be spent on road construction - especially repairs.

The water sector within the social infrastructure sector has been allocated Shillings 70 million according to the proposals - so that the number of beneficiaries can be increased from the present official estimate of 40 % to 75 % by 1986. The implicitely assumed per capita development cost (less than Shillings 200) is very low indeed.

The proposed Five Year Plan does not show the manpower and recurrent cost implications of the plans. Neither does it outline possible development plans made by parastatals and private investors. The regional proposals have not yet been approved and funds have not been allocated. Major reductions are to be expected.

Intermediate and longer term perspectives[18)]

In the immediate future and for many years to come, peasant agriculture will remain the backbone of the regional economy. The potential is vast for the production of food, cattle, high value export crops, timber and fish (see section 2.2.1). To be realized a supportive and consistent set of national politics are necessary, to improve the intermediate term prospects. Particularly important are decisions on prices for primary agricultural produce, production inputs and consumer goods and policies on the direct contributions to the capital and recurrent costs of providing an expanded range of services in the public domain (see chapter 6).

Two long-term development trends are possible. The prospects for a marked acceleration of industrial development in the region depends on the impact of the near completed Mufindi pulp and paper mill at Mgololo and upon the extraction of proven iron and coal deposits at Liganga and Mchuchuma/Ketewaka in Ludewa district. However, the economic activities related to the processing of primary agricultural and natural resource products and the provision of farm inputs, consumer goods, transport and other services to the rural population may prove equally important for industrial development.

Population growth is the second source of long-run change. The present population distribution does not match the distribution of high potential land resources very well. Population increases can therefore not continue to be

absorbed within their local vicinity without causing increasing pressure on soil and water resources. Two different strategies may be used to encounter this situation. Either the incremental population is encouraged to settle in the high potential areas of the High rainlands in Iringa and Mufindi Districts and in the Upper plateaus around Njombe town and east of it. Or small-scale irrigation projects are implemented that will enhance the deteriorating resource base around many villages in the Medium dry intermediate zone (see chapter 9.2) and thereby increase the land bearing capacity of this zone, which already now is relatively heavily populated.

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	High rainlands	Upper plateau	Medium dry zone	Dry northern fringe	Lake shore	Mixed zone	
DEMOGRAPHY							
No. of villages (v.i.) x)	222	154	176	42	7	18	630
Mean pop. 1978 village (v.i.)	1400	1550	1500	1500	1450	1650	1500
Median (v.i.)	1250	1450	1400	1350	1450	1500	-
App. total pop. 1978 '000 (v.i.)	310	240	260	60	10	30	930
Total pop. 1978 census '000	-	-	-	-	-	-	860
No. of hh. in sample (s.)	89	175	175	156	-	-	-
Mean hh. size (s.)	4.6	5.3	6.0	6.1	-	-	-
Mean child (under 15) /adult ratio (s.)	1.1	1.4	1.3	1.0	-	-	-
Hh. with female head; % (s.)	37	39	46	19	-	-	-
EDUCATION/SKILLS							
School ecucation of hh. head, mean No. of years (s.)	2.7	2.4	2.2	1.7	-	-	-
At least one adult with school education; % of hh. (s.)	70	76	70	52	-	-	-
At least one adult with adult education; % of hh. (s.)	93	85	89	86	-	-	-
% of villages with carpenter (v.i.)	82	90	87	64	100	72	86
% of villages with blacksmith (v.i.)	74	74	72	67	71	67	73
% of villages with mason (v.i.)	80	92	84	62	86	72	83
% of villages with mechanic (v.i.)	15	21	19	14	0	28	18
% of villages with plumber (v.i.)	12	12	10	7	14	6	11

x) 11 villages not yet processed - included in regional total only.

Table 2.2 Data sheet. Demography, education, and skills - Iringa Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						
	High rainlands	Upper plateau	Medium dry zone	Dry northern fringe	Lake shore	Mixed zone	Regional total (rural areas)
AGRICULTURE							
Crop most frequently mentioned as main or secondary crop (v.i.)	maize	maize	maize	maize	cassava	maize	maize
% villages (v.i.)	95	99	95	95	100	100	95
Crop second most frequently mentioned (v.i.)	beans	beans	beans	millet/ sorghum	millet/ sorghum	beans	beans
% villages (v.i.)	29	57	49	41	100	93	49
Crop third most frequently mentioned (v.i.)	wheat	wheat	sun-flower	beans	-	potatoes	millet/ sorghum
% villages (v.i.)	23	18	18	29	-	6	13
Complaints about land shortage; % villages (v.i.)	19	15	13	12	86	7	16
Grazing shortage; % villages (v.i.)	11	7	17	7	86	0	16
% of villages with irrigation (v.i.)	19	25	24	52	14	33	25
Mean cultivated land; hectares/hh. (s.)	2.0	1.5	2.0	3.5	-	-	-
% of hh. with more than ½ hour walk to most distant field (s.)	95	87	74	84	-	-	-
% of hh. irrigating (s.)	41	21	35	3	-	-	-
% livestock owners (s.)	47	39	31	58	-	-	-
% oxen owners (s.)	4	11	14	58	-	-	-
Mean No. of cattle/ owners (s.)	7	29	13	42	-	-	-
Insufficient grazing; % of cattle owners (s.)	59	34	32	45	-	-	-
Insufficient watering; % of owners (s.)	68	19	28	58	-	-	-

Table 2.3 Data sheet, agriculture - Iringa Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						
	High rainlands	Upper plateau	Medium dry zone	Dry northern fringe	Lake shore	Mixed zone	Regional total (rural areas)
ECONOMY							
Mean gross family income/year; shs. (s.)	2100	1500	1900	2100	-	-	-
% of which from:					-	-	-
Crops (s.)	48	31	19	47	-	-	-
Livestock (s.)	5	19	15	30	-	-	-
Agric. labour (s.)	9	20	25	6	-	-	-
Other (s.)	38	30	43	18	-	-	-
% of hh. with no cash income (s,)	1	10	15	10	-	-	-
Ownership of radio; % of hh. (s.)	33	39	44	35	-	-	-
House with corrugated iron roof; % of hh. (s.)	44	33	45	2	-	-	-
SERVICES							
% villages w. UWT branch (v.i.)	48	75	46	43	57	22	53
% villages w. shop (v.i.)	93	98	89	83	100	89	93
% villages w. bus connection (v.i.)	23	31	46	41	0	39	33
% villages w. grinding machine (v.i.)	51	77	75	60	0	56	64

Table 2.4 Data sheet, economy and services - Iringa Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	High rainlands	Upper plateau	Medium dry zone	Dry northern fringe	Lake shore	Mixed zone	
WATER							
% of villages w. water scheme (w.s.) (v.i.)	17	19	45	26	14	22	26
% of villages where over 60 % of pop. use w.s. (v.i.)	9	6	24	12	0	6	13
% of villages where over 60 % of pop. in main area live within 400 m of w.s. (v.i.)	9	9	20	7	14	17	12
% hh. in villages with w.s. using it (s.)	100	16	59	100	-	-	-
Mean distance to domestic point among users; m (s.)	310	700	490	650	-	-	-
% of users of traditional sources w. permanent source (s.)	100	92	84	1	-	-	-
Most frequent type of permanent traditional source (s.)	Dug hole	Stream	Dug hole	-	-	-	-
Mean distance; m (s,)	1370	970	1170	-	-	-	-
% with seasonal sources (s.)	0	8	16	99	-	-	-
Most frequent dry season source (s.)	-	Stream	Dug hole	Dug hole	-	-	-
Mean distance; m (s.)	-	900	1330	2970	-	-	-
Most frequent wet season source (s.)	-	Stream	Dug hole	Stream	-	-	-
Mean distance; m (s.)	-	760	800	1440	-	-	-
Mean household water collection; l/cap./day (s.)	9.6	10.7	10.4	9.0	-	-	-

Table 2.5 Data sheet, water - Iringa Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	High rainlands	Upper plateau	Medium dry zone	Dry northern fringe	Lake shore	Mixed zone	
SANITATION							
% of villages where over 80 % of hh. have latrine (v.i.)	95	99	90	89	86	86	94
% hh. with latrine (s.)	99	97	99	86	-	-	-
Claimed users of latrines (s.)							
Children; %	95	94	90	90	-	-	-
Men; %	100	99	100	95	-	-	-
Women; %	100	99	100	98	-	-	-
Lifetime of latrine; mean years (s.)	4.0	3.0	3.6	4.6	-	-	-
Latrine built by hh. itself; % of hh. (s.)	72	74	69	67	-	-	-
HEALTH							
Disease in hh. weak before interview; % of hh. (s.)	38	34	49	50	-	-	-
Most common disease (s.)	Caugh	Diar-rhoea	Diar-rhoea	Head-ache	-	-	-
% of hh. (s.)	21	17	25	33	-	-	-
Second most common disease (s.)	Diar-rhoea	Caugh	Caugh	Diar-rhoea	-	-	-
% of hh. (s.)	15	9	19	17	-	-	-
% hh. w. diarrhoea day before interview (s.)	8	11	8	6	-	-	-
Crude child death rate; % children no longer alive/all children born alive (s.)	31	22	28	39	-	-	-
% of villages w. cholera outbreaks last 3 years (v.i.)	0	1	7	26	0	0	4

Table 2.6 Data sheet, sanitation and health - Iringa Region

2.3 Mbeya Region

2.3.1 General

Mbeya Region is surrounded by two countries and four regions. The two countries are Malawi and Zambia, and the four regions are Rukwa, Tabora, Singida and Iringa. The region covers 60.387 km^2 and is populated by 1.080.241 people (1978 census). The regional population density is 17.9 per km^2. Administratively it is divided into six districts: Kyela, Rungwe, Ileje, Mbozi, Chunya and Mbeya, 22 divisions, 120 wards and 643 villages according to regional records[19]. Preliminary village inventory runs gave 622 villages, but some villages may not have been coded at that time.

Population

1967-78 annual growth is 3.3 % or equal to the overall national growth rate. 35 % are children below 15 years of age and the sex/ratio is 90 males/100 females with the female surplus concentrated in the productive age groups 15-55 years; indicating an outmigration of male labour.

2.3.2 The agro-ecological zones

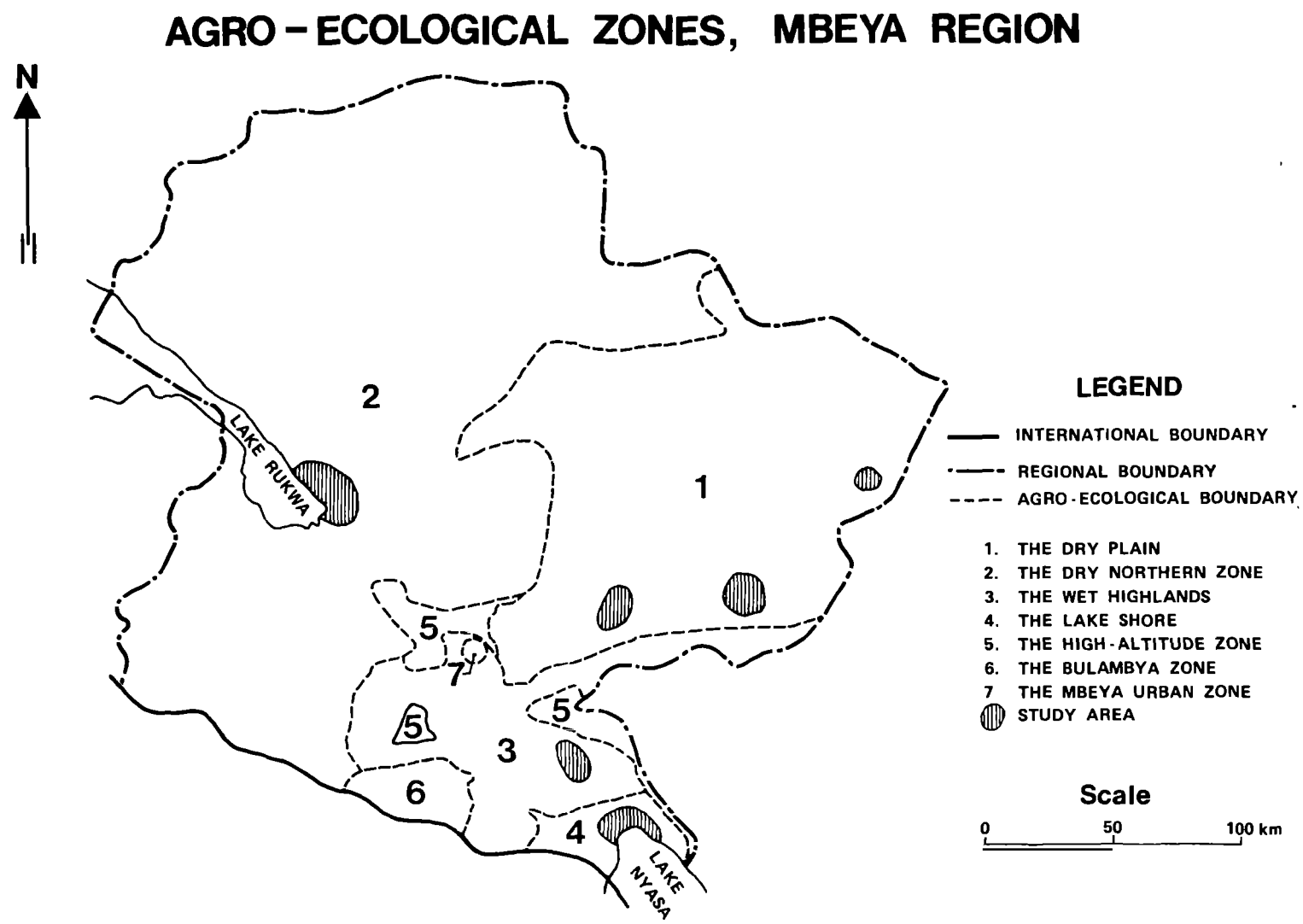
Mbeya region can be divided into 6 agro-ecological zones (see map 2.2):

a) The Wet highlands zone
b) The Lake shore zone
c) The Dry plain zone
d) The Dry northern zone
e) The High altitude zone
f) The Bulambya zone
g) The Mbeya urban zone

At least two of them, the Wet highlands and the Dry northern zone have areas exhibiting so diverse characteristics that they ought perhaps to be further subdivided. For the purpose of the present study, which could only survey four areas it was decided, however, to keep them as two of the study areas, together with the Lake shore zone and the Dry plain zone, thus leaving out the two smallest zones by population, as well as the Mbeya urban zone.

2.3.3 The Wet highlands zone

This zone covers most of the district of Rungwe, the southern part of Ileje District, the high altitude areas of Mbeya and Mbozi Districts. Most of the



Map 2.2 Agro-ecological zones, Mbeya region, with sample survey areas for the present study

zone receives an annual rainfall between 1300 mm and 2500. The north-eastern parts receiving least and the southern the highest amount of rain.

Topographically, this zone varies from the low foothills bordering Kyela to mountanous areas with altitudes up to approximately 2000 metres above sea level. There are several rivers in the zone. Those in the southern part flow into Lake Nyasa while those in the northern part of the zone have their outlet in Lake Rukwa.

In the southern part of the zone land scarcity is a problem, whereas the eastern and north-eastern part of the zone have enough land for cultivation. The population density in this area is approximately 35 people per km^2 whereas it is more than twice as high in the southern part of the zone.

The population in the zone comprises almost half the total regional population. It is primarily inhabited by Nyakyusa (to the south), Safwa, Malila, Ndali, and Nyiha. Due to the mentioned land shortage in the southern part of the zone there is a large inter-zonal migration as well as immigration to neighbouring areas outside the zone. Those migrating are primarily Nyakyusa. Some migration is seasonal. Many move into the Usangu area (the Dry plain) for cultivation and then return after the harvest.

The farming system within the zone is very heterogenous. According to the conducted household survey the most important food and cash crop is maize and coffee respectively. Bananas and potatoes are also grown. Other cash crops include tea and pyrethrum, the former mostly on large plantations, but it is also found on small holdings to supplement the income.

Livestock is kept throughout the zone. 58 % of the families interviewed had some livestock. The average number of cattle in a herd was, however, only five.

Data from the household survey showed the average gross cash income per family to be 1,100/= per year, the lowest reported in the survey. The reason probably has to be sought in pressure on good farming land. The best land is occupied by the large tea estates and coffee plantations. On an average the cultivated acreage per family is among the lowest in the region (2 hectares). However, the fact that only 9.5 % reported to be without any cash income suggests that income distribution is more evenly distributed in this zone than in the lake shore zone described below.

The homes in the areas surveyed in this zone (see map 2.2) are generally well-kept. Some families even keep a small garden in front of their houses. All the homes observed had a pit latrine, which in most cases were well built; 85 % of them had walls. Everybody claimed to use the pit latrines.

The health statistics from this zone are very limited. Based on information from Itete Hospital (1979) it was found that 17 % of the out-patients were diagnozed as having a water related disease.

Data from the household survey suggest that the water related disease frequency is higher. 20,7 % of the families reported that they had received treatment at a hospital or dispensary during the last month and 5 % mentioned that at least one family member had suffered from diarrhoea yesterday. In view of the water situation it is surprising that not more families reported stomack problems. 65 % of the families interviewed complained about polluting activities (laundry, bathing, cattle watering) taking place at or in the water source.

In two of the six villages surveyed in this zone, dug holes were the most used source for water collection. In two villages the main source for water collection were streams, two of the villages surveyed had a water scheme. However, in one village it was easier for 30 % to use a dughole for the whole year and in the other village with a water supply, 48 % had easier access to a spring. However, irrespective of the type of source used the water supply is reliable throughout the year. In the whole zone about 25 % of the population live in villages with a water scheme.

It is generally believed that water collection in this zone, particularly in the southern part is relatively easy. The main distance to the water source for the households in the zone as a whole is about 450 metres, but 15 % of the families in the survey had to walk more than 800 metres to reach the nearest drinking water source. Based on these findings the widespread assumption that everybody have easy access to domestic water from traditional surface water sources seems to be a myth.

2.3.4 The Lake shore zone

Apart from the easternmost part of the district the whole of this zone is equivalent with Kyela District. The zone covers approximately 850 km^2. It is a broad flood plain with four great rivers draining into Lake Nyasa.

The mean annual rainfall is more than 2500 mm. Every year from March to June large areas near the lake are flooded.

Based on the 1978 census and an estimated growth rate of 1.8 % the present population should be some 120,000. Almost all the people are of the Wanyakyusa tribe. They cultivate rice, maize and bananas for food crops. The most im-

portant cash crops are cocoa, rice and cashewnuts. Land scarcity is a problem throughout the zone, causing some migration to other areas within the region but also to other regions and neighbouring countries. This explains a sex ratio of 80.

Almost no crop rotation is used, which may explain a declining land productivity. More peasants in this zone than elsewhere in the region uses oxen for cultivation (40 %).

About 50 % of the peasants in this zone have some cattle, goats, sheep and pigs. The average number of cattle per cattle owning household is nearly 5. In this zone fishing is a complementary source of income for about 10 % of the families. The mean gross cash household income based on household survey data for this zone is approximately 1700 Shs per year. The fact that 22.4 % of the households in our sample reported that they did not have any cash income, reflects large inequalities within the zone. The land scarcity has in some places resulted in an almost feudal system of land-renting. One acre around Ipinda can be rented for 200 shs per year.

One of the biggest problems in this zone is the land scarcity aggravated by large areas of flooded land during periods of the year. During the last floods, about 35000 people had to be evacuated and damages for about 150 million shs. occurred.

The flood in particular and the heavy rain in general influence the health situation adversely. Since 1978 cholera has been endemic and every year between December and June outbreaks of cholera occur. Bilharzia and malaria are widespread throughout the zone for the whole year. Though almost everybody who were interviewed in the household survey were observed to have a pit latrine heavy pollution of water sources takes place as a result of non-use of the pit latrines during floods. Humidity and constant dampness cause the squatting plate material to rot. This in connection with the soil quality causes many squatting places to collapse and renders them obsolete.

Because of the high level of the ground water, pit latrines are located at the highest places, whereas the many handdug shallow wells naturally are found in the low situated places. In spite of this, many pit latrines will overflow during the rainy season with detrimental impact on the water quality and henceforth adverse health effect.

Based on statistics collected from three dispensaries in the zone, it was found that about 30 % of the patients suffered from malaria, 40 % from diarrhoea, 10 % suffered from bilharzia, 5 % from scabies and the remaining 15 % had various other diseases.

20 % of the families interviewed reported that they had received treatment of some kind at a hospital or dispensary during the last month. In 5 % of the families someone had suffered from diarrhoea 'yesterday'. As noted the dispensary statistics showed that the majority of diseases were water related. This is understandable when seen in context of the water situation.

Most of the population rely on water from traditional sources. All of them are perennial and the mean distance for the households surveyed is less than 400 metres. However in one village the mean distance to a stream was more than 400 metres. The traditional sources consist of river/streams, dug holes and springs. About 60% of the families thought that the sources were polluted, that is, that people bathed, did laundry and/or watered cattle in or at the source.

The traditional sources, primarily rivers and hand dug wells are so numerous that they are sometimes preferred to tap water. In one village with an improved scheme, 30 % of the interviewed families found it easier to use the nearby river[20)]. In another village with a scheme, more than 13 % of the families used the traditional sources. These figures emphasize one of the more serious water supply problems in this zone: that of distance to domestic point vis-a-vis to traditional sources. In almost all areas of the zone traditional sources will be nearer any present and future DP if present design criteria are used. In view of the sanitary condition mentioned above, this constitutes a serious threat to the health situation in the whole zone. In villages with a water supply scheme the health situation is in many places further aggravated by the topographic conditions. Excess water from the DPs has no outlet. It cannot run away and the high level ground water prevents it in many places from being absorbed into the ground. These pools of standing water make good breeding places for mosquitoes.

2.3.5 The Dry plain zone

This zone covers the Usangu plains. It is mainly flat except in Mapogoro and Ruiwa Wards where it is undulating. Areawise, the Dry plain covers approximately 15000 km^2. The zone receives less than 800 mm of rain annually. Most of the rivers are seasonal.

The population comprises about one tenth of the regional population. The population density is approximately 15 people per km^2. The biggest settlements are found along the Tanzam Road. The original people living in the zone are the Sangu, but large numbers of Hehe and Bena are also found in most villages. Baluchis make up an economically dominant group in many villages on the Usangu plains. Becaue of the abundance of land,other tribes have found their way

into the zone. These are first of all the Nyakyusa emigrating from Kyela and Rungwe who have come to farm seasionally or permanently in the southern part of the zone. In the northern part of the zone we meet the Masai and Sukuma who have brought their cattle for grazing. Many of them now live permanently here.

33 % of the families who took part in the household survey had livestock. Because of a few large livestock holders the mean number of cattle is 136 per owning family. Everyone does some farming, even the pastoralists (especially the Sukuma). The main food crops in the zone are maize and paddy, which is also the main cash crop among the households in the study.

Some families may supplement their income by selling livestock and charcoal. The mean gross cash household income in this zone is approx. 4000 shs. The mean size of cultivated land per family is 2.5 hectares.

The greatest constraint on development in this area is water. Around 35 % of the families interviewed irrigate, mainly for rice cultivation. In the southern part of the zone there is a government rice project at Mbarali.

Another obstacle to development in the zone is the poor infrastructure, especially roads. This explains the problems of marketing agricultural products. During the wet season almost the whole zone is inaccessible.

To alleviate some of the problems mentioned here, many people were moved together forming new villages during operation villagization. In some places the movements of people have not yet ended, since some people presently are in the process of returning to their pre-villagization homes.

The fact that some people are not yet settled in combination with the abundancy of land explains why only about 80 % of the families interviewed had a pit latrine. Twelve percent of the pit latrines do not have any walls. Five percent of the children do not use the pit latrines. Though this zone was surveyed at the end of the dry season 8 % of the families reported that at least one family member had suffered from diarrhoea yesterday and 19 % had received treatment at a hospital or dispensary during the last month.

Based on statistics from one health centre in the zone, it was found that water related diseases (excluding malaria) constitute 6 % of all diagnosed diseases. Malaria and upper respiratory tract infections each made up 43 % of diagnosed diseases. However, due to transport problems and general inaccessibility in the zone we suspect that most people will treat minor water related diseases themselves and only travel to the health centre or dispen-

sary for emergency cases. The data given by families on diarrhoea suggest that given easier access to health facilities, the actual number of water related diseases in the zone are much higher than the ones supplied by the health centre.

As noted above, water situation varies throughout the year. 45 % of the families interviewed in villages without water supply had different traditional sources in dry and wet season. The type of traditional sources are streams, dug holes and ditches in that order of importance. 55 % used the same stream all year round.

In the dry season the mean distance to the water source for those who use seasonal sources is approximately 540 metres, with one village in the sample having more than 1,700 metre to the water. In the wet season the mean distance for all users is 280 metres. The users who had to walk nearly 2 km in the dry season to fetch water only have to walk 350 metres in the wet season.

82 % of the dry season source users complain about the water source being polluted (laundry, bathing and watering of cattle). In the wet season "only" 64 % complained about the water being polluted.

98 % of the families who use the same source throughout the year complained of polluting activities taking place in and at the source. These data on polluting activities show that the water scarcity in the zone leads to competing use of the sources with consequent adverse effects on health.

2.3.6 The Dry northern zone

This zone covers most of Chunya District and the northern eastern part of Mbozi District. The zone is situated between 700 and 1500 metres. In the northern part (Chunya) it receives around 900 mm of rain annually and in the southern part around 1400 mm. The topography in the northern part of this zone is flat and undulating in some areas with stony hills. Towards the south of the zone the topography is mainly hilly. All the rivers drain into lake Rukwa. For the last ten years many of them have carried water throughout the year, however insufficient in the dry season.

The whole zone covers approximately 2700 km^2 with a population density in the northern parts as low as 4 people per km^2. In the southern part the population density is around 20 per km^2. About 20 % of the regional population live in this zone.

Land is abundant in most areas of the zone both for agriculture and for grazing of livestock. For this reason the zone receives migrants from more populated areas. These consist primarily of Nyakyusa and Ndali , who cultivate, and Sukuma , who first of all keep livestock and secondly cultivate. The original people of this zone are the Nyiha, Nyamwanga, Bungu and Guruka.

The zone suffers from a poor infrastructure, particularly in Chunya, where one village is more than 200 km from the district town.

The most important food crop is maize. In some places it is inter-cropped with groundnuts or beans. The important cash crops in the study area (see map 2.2) are millet and cotton. North of the study area and all along the eastern side of lake Rukwa, tobacco is the most important cash crop, while further south, in Mbozi, it is coffee.

The mean area of cultivated land per family in the study area is 1.5 hectares. The average income per family is 4,100 shs annually. Only about 7 % reported that they had not had any income during the last year. Income may thus be fairly equally distributed in the study area. Many families in the sample, supplement their income by fishing, gold digging and employment. However, though the number of livestock in this zone is the second highest in the region after the Dry plain, only one family in the sample reported to own livestock,which might be due to sampling bias.

Most homes (98 %) have a pit latrine. Observations show that they are well kept and clean. All of them have walls.

Though the most frequent reason for building a new latrine is that the old one is full, many people stated that their pit latrines collapsed because the soil quality in the study area was sandy. Possibly, this leads to non-use of the latrine. However, only an average of 3 % stated that they did not use the pit. It may thus be concluded that the sanitary condition in the study area is good including cleanliness of surroundings and place for food preparations. This may help explain the lowest frequency of diarrhoea found in the zones studies, as reported by the families interviewed. Only about 2 % mentioned that a family member had had diarrhoea yesterday, while 22 % had received treatment at a hospital/dispensary during the last month. However, water related diseases certainly do occur. At one dispensary within the study area 15 % of the patients were diagnosed as having diarrhoea. More conspicious diseases were the many observed signs of malnutrition among children: miscolouring of hair and protruding stomachs.

Generally, the water situation in the zone as a whole appears to be relatively good. Approximately 31 % of the villages have a water supply. However, in several areas the water quality is not good because of high mineral content.

In the dry season the water shortage is felt throughout the zone and affecting people and livestock as well as agriculture. In this respect the three villages studied in this zone appears to be somewhat uncharacteristic. In the two study villages with a water scheme 74 % of the respondents used the supply. In the third village, 93 % of the families interviewed used the same source - a well - throughout the year. This well was built by a foreign mining company some twenty years ago. Apart from some families who in the rainy season would collect their own water in hand dug holes near their homes, this well constituted the only source of water for the village. Consequently, it was used for all purposes with the risk of polluting the water. The mean distance to the well was 380 metres.

Comparing the two villages which have a water scheme it is noteworthy that the mean distance to the DP in the village with the oldest scheme (20 years old) is 340 metres while the mean distance in the village with a recently completed scheme is 145 metres.

2.3.7 Summary of zonal descriptions

Tables 2.8 and 2.9 show a summary of some of the data on agriculture and incomes discussed above. The income data may not reflect actual income, since most respondents have a tendency to state a lower income than actually received.

Probably the high mean incomes in the Dry plain and the Dry northern zone are biased by a few respondents with extremely high incomes. In the Dry plain this is caused by sale of livestock and in the Dry northern zone the relative high annual mean income is explained by the fact that a number of respondents were workers at a nearby mission hospital, others had received gifts from grown-up children.

The figures in the table indicate that the Wet highlands is the poorest of the four study zones. Because of the high population, the mountainous area, and the large tea and coffee plantations the mean size of the shamba per household is among the smallest in the region. Among the households selected in the present study, the mean hectarage cultivated per household were, however, smaller in the Dry northern zone despite the abundancy of land here. This could be explained by a number of respondents being of old age.

Table 2.11 summarizes the sanitation and health situation for the four study zones.

The figures presented show that sanitary conditions - using presence of pit latrines as an indicator - are quite good except in the Dry plain where almost 20 % state that they do not have a pit latrine. Not surprisingly, we also found the highest percentage of families here suffering from diarrhoea though the survey was conducted in the dry season. We thus suspect that this may increase in the wet season. The Dry northern zone, which was surveyed in the rainy season had the lowest, reported diarrhoea frequency attributable to the hygienic standard of the people. Though the table below does not show any significant differences between the Lake shore zone and the Wet highlands, observations made in selected villages in the zones suggested that the sanitation and health situation in the former zone in the wet season is worse than in any other zone. The climate in connection with existing topography causes the pit latrines in many areas at the lake shore to overflow with consequent detrimental impact on health.

In the zonal descriptions the water situation was presented in relation to the sanitation and health situation. In Table 2.10 appears a summary of the water situation in the four zones. It shows that the families interviewed in the Lake shore zone and the Wet highlands use the same source all year round. The data from the Dry plain indicate that the biggest water shortage compared with the other zones is found here. About 45 % of traditional source users in this zone change water source in dry and wet season. Approximately 20 % in the Dry northern zone use different sources in dry and wet season.

The burden of fetching water is bigger in the Dry plain where some families walk almost three km. Shorter distances were noticed in the Dry northern zone. However, it is believed that the mean distances found here are not that characteristic for the water situation in this zone, since many villagers in the dry season not only have to walk long distances to find water, but frequently have to wait a long time to collect the water needed, because it is only available in small quantities at the time.

The table furthermore shows that between 60 - 77 % of the households in villages with water supply fetch water at the domestic points (DPs). The mean distances to DPs for users of these are below the design figure of 400 metres. The lowest mean distance (150 m) was found in the Dry northern zone, where one village had just received a water supply.

In closing this section two zones stand out with more severe problems. From the point of view of water accessibility alone the dry plain is worse off than any of the other zones. Furthermore, the families here reported more cases

of diarrhoea than elsewhere. In passing we noted that this may be caused by the sanitary conditions aggravated by the water situation. From a health point of view alone the Lake shore zone is probably worse off than the other zones, particularly in the rainy season when the pit latrines overflow causing pollution of the water sources. For some years now, cholera has been endemic in the Lake shore zone.

2.3.8 Regional development plans

The information below on development plans for Mbeya Region is based on a draft of the 5-year plan 1st July, 1981 - 30th June, 1986[21] and the regional plan for 1981/82[22].

The draft five year plan is characterized by lack of details as to how, when and where a certain plan will be implemented. This is caused by the absence of funds and no information of how much funds will be allocated to the region for the planning period.

At the time of writing a RIDEP-study is still in progress. Thus, any recommendations for the future development of the region to be proposed by the RIDEP-study are not included in the brief review below.

We have primarily focused on development targets for agriculture, industry, and other relevant parts of the region's infrastructure.

Apart from the emphasis in the five-year plan on the need to raise agricultural production in the region in general, some areas in particular are identified for agricultural projects. In the five-year planning period (1981-1986) it is envisaged that rice production on the Usangu plains will grow as a result of irrigation projects in the area. It is estimated that the Usangu plains have a potential of 68,000 hectares for irrigated rice production. Presently approximately 17,000 hectares are irrigated (see chapter 9).

For the immediate planning period 1981/82 the region will repair village made irrigation ditches. 101 registered ditches have been made by different villages. These ditches supply water for 15,000 hectares of rice on the Usangu plains. The plan also considers to survey areas in Ileje and Mbozi in view of irrigation.

In order to increase rice production in Kyela, flood control will be introduced. The implementation of this in connection with irrigation schemes will according to regional agricultural experts enable the farms to cultivate rice two to three times annually.

Presently, an estimated 5 % of all crops are cultivated on communal farm land (Ujamaa). The target is to raise the production so that it makes up 25 % of all production. Except for recommending increased use of oxen, and tractors in the valleys the plans do not explain how this is to be done.

Traditionally, the bigger industries are situated in the urban areas. Since they usually depend on water and electricity, an expansion of these into the rural areas is not foreseen.

For the next 5-year period the region plans to start a fruit factory (Kiwanda cha matunda) and a soap factory in Kyela. In Mbozi, a timber factory will be started. In Chunya (Mkwajuni) a factory for extracting oil from sunflower has been planned. The five-year plan also discusses the need for expanding small industries in the villages. Particular emphasis will be given to the production of agricultural implements.

It is impossible to foresee how the region will develop. The outcome of existing plans will first of all depend on funds available for implementation of projects and next on population movements within the region. As shown above the Wet highlands and the Lake shore zone are almost saturated populationwise. Government policies on village development and the success of existing and future development plans may influence the migration targets for surplus population in these two zones.

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	Wet highlands	Lake shore	Dry plain	Dry northern zone	High alt. zone	Bulambia zone	
DEMOGRAPHY							
No. of villages (v.i.)	285	66	73	108	36	23	622[x]
Mean pop. 1978/ (v.i.)	1600	1750	1550	2000	1650	2100	1700
Median (v.i.)	1500	1600	1400	1850	1600	2000	-
App. total pop. 1978 '000	450	120	110	220	60	50	1060
Total pop. 1978 census '000	-	-	-	-	-	-	1000
No. of households (hh.) in sample (s.)	179	174	165	90	-	-	-
Mean hh. size (s.)	6.8	6.7	6.6	5.7	-	-	-
Mean child (under 15)/adult ratio (s.)	0.8	0.8	0.6	0.8	-	-	-
HH. with female head; % (s.)	5	9	3	19			
EDUCATION/SKILLS							
School education of hh. head, mean No. of years (s.)	1.0	1.7	2.4	2.6	-	-	-
At least one adult with school education; % of hh.(s.)	29	48	59	70	-	-	-
At least one adult with adult education; % of hh. (s.)	63	72	60	67	-	-	-
% villages with carpenter (v.i.)	61	76	60	72	61	83	65
% villages with blacksmith (v.i.)	45	59	56	66	53	83	54
% villages with mason (v.i.)	63	83	69	72	61	78	68
% villages with mechanic (v.i.)	17	18	16	22	6	12	17
% villages with plumber (v.i.)	9	12	4	15	3	13	9

x) 31 villages not yet processed - included in regional total only

Table 2.7 Data sheet. Demography, education and skills - Mbeya Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	Wet highlands	Lake shore	Dry plain	Dry northern zone	High alt. zone	Bulambia zone	
AGRICULTURE							
Crop most frequently mentioned as main or secondary crop (v.i.)	Maize	Rice	Maize	Maize	Maize	Maize	Maize
% of villages (v.i.)	75	86	97	93	100	87	78
Crop second most frequently mentioned (v.i.)	Coffee	Cocoa	Rice	Millet/ sorghum	Millet/ sorghum	Beans	Coffee
% of villages (v.i.)	35	36	75	41	28	35	23
Crop third most frequently mentioned (v.i.)	Bana- nas	Bana- nas	Millet/ sorghum	Coffee	Coffee	Millet/ sorghum	Rice
% of villages (v.i.)	21	33	8	21	22	26	22
Complaints about land shortage; % of villages (v.i.)	43	72	27	15	6	14	35
Grazing shortage; % of villages (v.i.)	38	72	21	14	15	14	33
% of villages with irrigation (v.i.)	7	0	15	6	8	9	7
Mean cultivated land, hectares/ hh. (s.)	2.0	2.0	2.5	1.5	-	-	-
% of hh. with more than ½ hour walk to most distant field (s.)	71	77	74	61	-	-	-
% of hh. irrigating (s.)	0	4	35	5	-	-	-
% of livestock owners (s.)	58	52	33	16	-	-	-
% of oxen owners (s.)	24	40	23	14	-	-	-
Mean No. of cattle/ owner (s.)	5	5	136	11	-	-	-
Insufficient grazing; % of owners (s.)	34	59	23	-	-	-	-
Insufficient watering.; % of owners (s.)	36	49	48	-	-	-	-

Table 2.8 Data sheet. Agriculture - Mbeya Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	Wet highlands	Lake shore	Dry plain	Dry northern zone	High alt. zone	Bulambia zone	
ECONOMY							
Mean gross family income per year; shs. (s.)	1100	1700	4000	4100	-	-	-
% of which from:							
Crops (s.)	54	39	29	6	-	-	-
Livestock (s.)	10	10	24	0	-	-	-
Agric.,labour (s.)	1	3	2	1	-	-	-
Other (s.)	35	47	45	93	-	-	-
% hh. with no cash income (s.)	10	22	9	7	-	-	-
Ownership of radio, % of hh. (s.)	17	28	41	40	-	-	-
House w. corrugated iron roof, % of hh. (s.)	15	12	26	13	-	-	-
SERVICES							
% villages with UWT branch (v.i.)	54	80	36	66	25	52	55
% villages with shop (v.i.)	84	97	88	72	81	91	84
% villages with bus connection (v.i.)	40	24	32	38	11	30	35
% villages with grinding machine (v.i.)	43	36	81	62	75	61	53

Table 2.9 Data sheet. Economy and services - Mbeya Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						
	Wet highlands	Lake shore	Dry plain	Dry northern zone	High alt. zone	Bulambia zone	Regional total (rural areas)
WATER							
% of villages with water scheme (w.s.) (v.i.)	23	14	26	31	11	22	23
% of villages where over 60 % of pop. use w.s. (v.i.)	9	8	16	20	6	13	12
% of villages where over 60 % of pop. in main area live within 400 m of w.s. (v.i.)	12	9	15	19	11	9	13
% of hh. in villages with w.s. using it (s.)	60	77	64	73	-	-	-
Mean distance to domestic point among users; m,(s.)	290	360	270	150	-	-	-
% of users of traditional sources with permanent source(s.)	99	99	55	62	-	-	-
Most frequent type of permanent traditional source (s.)	Dug hole	Stream	Stream	Well	-	-	-
Mean distance; m,(s.)	450	360	560	400	-	-	-
% with seasonal sources (s.)	1	1	45	38	-	-	-
Most frequent dry season source (s.)	-	-	Stream	Spring	-	-	-
Mean distance; m,(s.)	-	-	540	530	-	-	-
Most frequent wet season source (s.)	-	-	Stream	Spring	-	-	-
Mean distance; m,(s.)	-	-	280	460	-	-	-
Mean household water collection; l./cap./ day (s.)	9.7	9.6	10.7	11.6	-	-	-

Table 2.10 Data sheet. Water - Mbeya Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones						Regional total (rural areas)
	Wet highlands	Lake shore	Dry plain	Dry northern zone	High alt. zone	Bulambia zone	
SANITATION							
% of villages where over 80 % of hh. have latrine (v.i.)	92	97	76	82	94	91	89
% of hh. with latrines (s.)	100	100	81	98	-	-	-
Claimed users of latrines (s.)							
Children; %	100	100	95	95	-	-	-
Men; %	99	100	97	97	-	-	-
Women; %	100	100	97	97	-	-	-
Lifetime of latrine; mean years (s.)	3.1	3.6	3.5	3.4	-	-	-
Latrine built by hh. itself; % of hh. (s.)	87	85	79	88	-	-	-
HEALTH							
Disease in hh. weak before interview; % of hh.(s.)	23	31	29	47	-	-	-
Most common disease (s.)	fever	fever	fever	fever	-	-	-
% of hh. (s.)	11	16	11	28	-	-	-
Second most common disease (s,)	Diarrhoea	diarrhoea	diarrhoea/ headache	diarrhoea	-	-	-
% of hh. (s.)	6	7	7/7	11	-	-	-
% of hh. with diarrhoea day before interview (s.)	5	5	8	2	-	-	-
Crude child death rate; % children no longer alive/ all born alive(s.)	40	38	40	33	-	-	-
% of villages with cholera attacks last 3 years (v.i.)	8	65	42	34	6	0	23

Table 2.11 Data sheet. Sanitation and health - Mbeya Region

2.4 Ruvuma Region

1.4.1 General

Ruvuma Region is situated in the south-western part of Tanzania. In the south it borders on Mozambique, in the west on Malawi in Lake Nyasa, to the north are Iringa and Morogoro, and to the east Lindi and Mtwara Regions. The region covers an area of 64,233 km^2 including 2,978 km^2 of Tanzania's Lake Nyasa waters. It is the sixth largest region in Tanzania.

Ruvuma Region is divided into three districts namely Mbinga, Songea and Tunduru. Songea District includes the recently created Songea town council at the regional headquarters. The districts are subdivided into 21 divisions which are further subdivided into 82 wards and 311 villages having a total of 106,234 households.

Population

According to 1978 census the total population of the region is 564,113 of whom 90 % live outside the urban regional centre. Approximately 41 % of the population is in Songea District while 35 % and 24 % are in Mbinga and Tunduru Districts respectively. 46 % of the population is below 14 years old. Regional population density is 9.2 persons per km^2 (compared with the national figure of 19 per square kilometre). The annual population growth rate is 3.3 %. The regional sex ratio is 92.5 i.e. there is one male for 1.075 females.

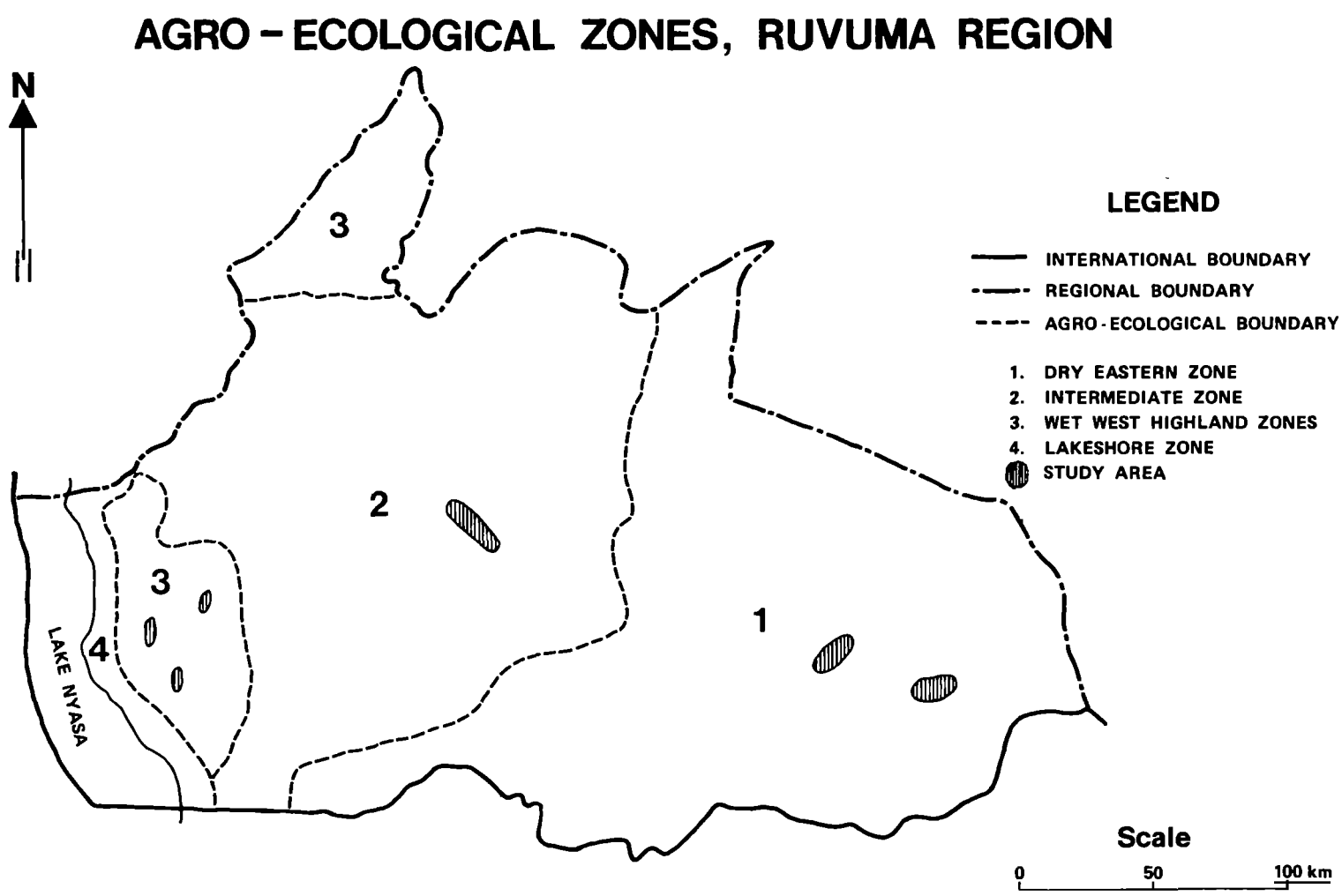
Land use

About 4.6 % of the land is presently cultivated while 10 % is heavy forest reserve and much of the remainder is light Miombo type woodland with some grass underlay. Grazing land is estimated 0.5 % (about 30,000 hectares).

The average size of landholdings is big, but cattle herds insignificant all over the region, compared to Iringa and Mbeya.

2.4.2 Agro-ecological zones

Ruvuma Region can be divided into four distinct agro-ecological zones on the basis of physical and economic conditions i.e. on the basis of altitude, climate and crops grown. The boundaries of the zones sometimes overlap with district boundaries (see Map 2.3).



Map 2.3 Agro-ecological zones, Ruvuma Region, with the sample survey study areas for the present study

2.4.3 The Wet western highlands zone

This is the high altitude area of Mbinga District and north western tip of Songea District (Wino ward) between 1,200 m - 2,000 m above sea level. In size, the zone covers about 15 % of the region. Most of the area is rolling and hilly in landform and there are high hills to the west of the zone which reach 2,000 m above see level. Soils are predominantly well drained fertile clay loams. The climate of these highlands is warm temperate having warm wet summers and rather cold dry winters. It has reliable rainfall and the average annual rainfall is some 1,200 mm.

The zone has 88 villages with a population of 136,819. The rural population density is 24 per square kilometre (compared with the regional population density of 9.2 per square kilometre). Some pockets in the Mbinga Highlands are so densely populated that they cannot support extra people. People are forced to migrate to the less populated area of the fertile Mbinga Highlands to the south. Sex ratio is about 90.2 and the average size of the household is about 6.9.

Soils and climate are suitable for coffee which is the main cash oriented farming enterprise and the main source of income. Maize, beans and wheat are grown for consumption on the farm and for local sale.

This area is of high agricultural productivity. Farming standards and crop husbandry standards are particularly high. Soil conservation techniques of local origin are unique and very impressive. Some livestock is kept by most families, but due to pressure on land, cattle is stall-fed in many places, and average herd size stands as low as 3 heads of cattle.

Agriculture is by far the most important economic activity, and with a mean cultivated area of 4 hectares and gross cash incomes of 5800 shs. among sample households, this zone stands out as top-ranking among all the zones studied in the three regions.

The rural housing improvement programme is very successful, and 61 % of the households interviewed had corrugated iron roof on their house. Ownership of pit latrines is universal.

Like in other highland areas, respiratory diseases were most frequently suffered from by respondents. 6 % of families complained about diarrhoea the day before the interview.

Perennial streams are abundant, and the water situation comparatively good in this zone. Many villages even have an indigenous system of ditches bringing water from hillside springs very close to the houses. Mean distances to traditional permanent sources are therefore quite short, just over 200 m, on an average. None the less taps are universally used in the study village with a water supply, as the mean distance to a tap is as small as 170 m.

2.4.4 The intermediate zone

This is the high plateau of Songea District and the eastern portion of Mbinga District lying between 900 m - 1,200 m above sea level. It is fairly hilly and some of the hills rise to 1,500 m. Covering about 40 % of the region it is almost equal in size to the Dry eastern zone.

It has a total of 106 villages with a total population of about 220,550 (as per 1978 census). The rural population density is as low as 5.7 persons per square kilometre. The average size of the household is very high with 9.0 family members in the sample households.

There is some migration from the north west of Songea town where road communications are very poor and where land is less productive to more productive land to the south east of Songea town and to the vicinity of Songea town.

This zone has a reliable rainfall falling over a period of five months December - April and the average annual rainfall is about 1,100 m. Summers are hot and wet while winters are cool and dry. Temperatures are quite favourable to growth of crops.

It has well drained fertile clay loams ideally suited for maize and tobacco. Maize is by far the most important food crop grown by all the farmers and is grown in a four to five year rotation with tobacco. Farming and agricultural standards are particularly high and fertilizers are widely applied. Average yield is about 2.2 tons per hectare.

Besides surplus maize, which is fast becoming a major income earner, tobacco is the dominant cash crop. This zone produces about 90 % of all the tobacco produced in the region. (Ruvuma Region produces 98 % of the fire cured tobacco marketed in the country). Due to high farming and cultural standards, tobacco yield is in excess of 1,100 kgs per hectare. The curing techniques however are poor and handling and marketing procedures are not efficient and as a result much damage is incurred, by some estimated to amount to over 30 % loss in produce. A tobacco handling project financed by the World Bank Group in 1978 aims to reduce these losses in crop handling and to improve marketing facilities, village transport and storage and support for tobacco authority personnel.

With rather large cultivated areas (3.5 hectares/hh.) the living standard of the peasants is improving drastically. The per household gross cash income is over shs. 4300/- . The peasants have embarked on rural housing improvement programme. Each household is supposed to build an improved house with walls built of burnt bricks and corrugated iron roofs. The government provides roofing material on credit basis. 42 % of the sample households already have iron roofs.

Diarrhoea and respiratory diseases (caugh) are claimed to be most common among respondents. The insidence of diarrhoea among families the day before the interview was 5 %. 95 % of households have a pit latrine and virtually everybody are claimed to use it.

The water situation is most critical towards the south-east, improving as one moves to the west. In the study area almost everybody use permanent sources, most frequently dug holes or - where they exist - taps, which are located very close to the sample households: 100 m on an average for tap users and 280 m for users of traditional sources.

2.4.5 The Dry eastern zone

This most easternly zone comprises the whole of Tunduru District and the eastern and southern low plateaus of Songea District with altitudes between 300 m - 900 m above sea level. It covers about 40 % of the total area of the region.

It consists of low plateaus which are fairly flat on the eastern side while rolling and hilly to the west. It has well drained light sandy loam soils and have relatively lower rainfall than the rest of the zones. The mean annual rainfall is less than 1,000 m. It is hot almost throughout the year.

This zone has 97 villages with a total population of about 150,000. Population density is about 7.7 persons per km^2, and sex ratio is about 92.0. The average size of family is 6.7.

The Dry eastern zone is suited for the growth of maize, oil seeds (sesame, groundnuts, sunflower), cassava and cashew nuts. Coconuts and rice are also grown for cash and domestic consumption. Oil seed production, particularly suited to this lower rainfall zone, is being actively encouraged especially in Tunduru District. At present it produces about 300 tons of sesame a year, and an oil seed crushing factory in Tunduru town handles about 2,000 tons of oil seeds a year and planned target is 4,000 tons per annum.

Cashew nut is the principal cash crop. The highest production level was realized in 72/73 when 10,115 tons were produced. Since then production fell to 4,000 tons in 75/76, and below 3000 tons in the last two years.

The government has launched a special campaign to increase production by improving plant husbandry especially weeding. A cashew nut processing factory is almost complete and is capable of handling 10,000 tons a year.

The government has launched a special anti-famine campaign KUNJATU by encouraging the planting of cassava 1980/81 and the response and outcome is very encouraging. Every household is supposed to have a two acre cassava shamba. The food situation will improve considerably if the peasants improve the existing relatively inferior farming standards and poor cultural practices.

Agriculture is very extensive with 5 hectares cultivated on an average per sample household. Only very few households had very small herds of livestock. Mean gross household cash incomes are the lowest in the region (1400/- shs), and only 7 % of the households have corrugated iron roofs.

Diarrhoea is claimed to be the most common disease and as many as 14 % of the households complained about having it on the day before the interview.

The water supply situation is particularly bad, with none of the water schemes in working order (lack of fuel) and 55 % of respondents having to use different seasonal sources, primarily streams and dug holes at average distances between 800 and 900 m. Sanitary conditions are not either as good as in the other zones.

2.4.6 Summary of zonal descriptions

Tables 2.12 to 2.16 summarize quantitative information on demography, education, agriculture, economy, service, water, sanitation and health. Only a few comments need to be added.

In most respects the Wet western highlands and to some extent the Intermediate zone are among the most favoured and prosperous areas in the three regions - in great contrast to the Dry eastern zone, which is among the poorer and less well served areas. This goes for education, agriculture, economy, water and sanitation.

Only in one respect does the whole region share a common plight, i.e. infrastructure - especially roads and transport. The village inventory, for example, shows that only 8 % of all villages in the region have a bus connection compared to 33 % and 35 % for Iringa and Mbeya.

2.4.7 Regional development plans

Here, as everywhere else, very fixed plans do not exist. As an approximation a summary of the regional proposals (not yet approved) for the fourth Five-Year-Plan 1981/82 - 1985/86 is presented below.

The objectives of the fourth Five-Year-Plan include:

a) Agriculture

To be self-sufficient in food crop production and at the same time to produce surplus for sale to other regions. The production of food can be increased through increase in acreage and improved and modern farming techniques so as to render the region self-sufficient in food with a surplus of 30,000 tons of food for the famine regions.

Production and sale of cash crops is expected to increase through increase in acreage and improved techniques,crop husbandry and crop handling. Such crops include coffee, tobacco, cashew and oil seeds.

To meet this target every family is expected to cultivate and plant a minimum of two acres for food crops and one acre for cash crop.

Increased agricultural production is expected to increase the regional gross product from the present shs. 1,354.5 m/ = (1980 prices) to shs. 1,760 m/ = (annual growth rate of 6 %) and to raise the annual per capita income from the present shs. 2,250/- to 2,486/-.

b) Social services

The social service sector aims at improving the life of the rural people through provision of better health amenities, consolidation of the universal primary and adult education and provision of safe potable water within easy access of villagers. National campaigns such as 'elimu haina Mwisho, Mtu ni Afya, Chakula ni Uhai" will be consolidated.

The total development budget for the fourth Five-Year Plan will be in the tune of T.shs. 246 m/- (compared to 122 m/- in the third Five-Year-Plan 1976/77 - 1980/81). The production sector will receive 23 % of the total development budget while the social service sector will receive 49 % of the total development budget while the economic infrastructure will receive 28 %.

Problems anticipated include constantly rising prices, and lack of sufficient foreign exchange, difficulty in transport and communication, lack of qualified field extension officer and poor farming crop husbandry techniques and lack of health personnel for a successful consolidation of MTU NI AFYA campaign, lack of building materials.

The region has embarked on the policy of mobilization of peasants in the villages to productive work, and through popular participation to effect development for themselves on the basis of self-help and self-reliance. The national campaign of KAZI NI UHAI will receive special emphasis while adult education and extension units in agriculture, health and rural development will help to develop values and attitudes compatible with modern development and improved living conditions.

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones				Regional total (rural areas)
	Wet western highlands	Intermediate zone	Dry eastern zone	Lake shore	
DEMOGRAPHY					
No. of villages (v.i.) x)	(29)	(94)	(88)	(16)	(227)
Mean pop. 1978/ village (v.i.)	1850	1800	1550	1500	1700
Median (v.i.)	1900	1500	1450	1500	-
App. total pop. 1978 '000 (v.i.) x)	(50)	(170)	(140)	(20)	(380)
Total pop. 1978 census '000	-	-	-	-	510
No. of hh. in sample (s.)	83	82	146	-	-
Mean hh. size (s.)	6.9	9.0	6.7	-	-
Mean child (under 15)/ adult ratio (s.)	1.0	1.0	0.8	-	-
Hh with female head (s.)	4	0	1	-	-
EDUCATION/SKILLS					
School education of hh. head; mean No. of years (s.)	4.6	3.0	2.4		-
At least one adult with school education; % of hh. (s.)	96	79	63	-	-
At least one adult with adult education; % of hh. (s.)	64	92	83	-	-
% villages with carpenter (v.i.)	97	98	84	100	93
% villages with blacksmith (v.i.)	97	90	93	100	93
% villages with mason (v.i.)	100	99	77	94	90
% villages with mechanic (v.i.)	41	34	7	19	23
% villages with plumber (v.i.)	21	31	8	25	20

x) Some 80 villages not yet coded and processed not included

Tqble 2.12 Data sheet. Demography, education and skills - Ruvuma Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones				Regional total (rural areas)
	Wet western highlands	Intermediate zone	Dry eastern zone	Lake shore	
AGRICULTURE					
Crop most frequently mentioned as main or secondary crop (v.i.)	Maize	Maize	Cashew nuts	Cassava	Maize
% of villages (v.i.)	96	98	70	100	73
Crop second most frequently mentioned (v.i.)	Beans	Tobacco	Maize	Rice	Cassava
% of villages (v.i.)	46	33	52	81	37
Crop third most frequently mentioned (v.i.)	Coffee	Cassava	Cassava	-	Cashew nuts
% of villages (v.i.)	29	28	45	-	27
Complaints about land shortage; % of villages (v.i.)	31	2	6	19	8
Grazing shortage; % of villages (v.i.)	28	3	2	25	7
% of villages with irrigation (v.i.)	7	3	1	-	3
Mean cultivated land; hectares/hh. (s.)	4.0	3.5	5.0	-	-
% of hh. with more than ½ hour walk to most distant field (s.)	79	73	95	-	-
% of hh. irrigating (s.)	18	54	21	-	-
% livestock owners (s.)	82	77	7	-	-
% oxen owners (s.)	11	2	1	-	-
Mean No. of cattle/owners (s.)	3	7	3	-	-
Insufficient grazing; % of cattle owners (s.)	50	31	22	-	-
Insufficient watering % of cattle owners (s.)	29	36	55	-	-

Table 2.13 Data sheet. Agriculture - Ruvuma Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones				Regional total (rural areas)
	Wet western highlands	Intermediate zone	Dry eastern zone	Lake shore	
ECONOMY					
Mean gross family income/year; shs. (s.)	5800	4300	1400	-	-
% of which from:					
Crops (s.)	69	70	61	-	-
Livestock (s.)	2	4	1	-	-
Agric. labour (s.)	3	6	6	-	-
Other (s.)	25	20	32	-	-
% of hh. with no cash income (s.)	1	0	3	-	-
Ownership of radio; % of hh. (s.)	59	59	38		
House with corrugated iron roof % of hh. (s.)	61	42	7		
SERVICES					
% of villages with UWT branch (v.i.)	93	96	84	100	91
% of villages with shop (v.i.)	93	95	83	100	90
% of villages with bus connection (v.i.)	3	14	5	0	8
% of villages with grinding machine (v.i.)	97	90	25	63	64

Table 2.14 Data sheet. Economy and services - Ruvuma Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones				Regional total (rural areas)
	Wet western highlands	Intermediate zone	Dry eastern zone	Lake shore	
WATER					
% of villages with water scheme (w.s.) (v.i.)	21	31	28	13	27
% of villages where over 60 % of pop. use w.s. (v.i.)	0	12	15	0	11
% of villages where over 60 % of pop. in main area live within 400 m of w.s. (v.i.)	3	14	19	6	14
% hh. in villages with w.s. using it (s.)	100	100	0 x)	-	-
Mean distance to domestic point among users; m (s.)	170	100	-	-	-
% of users of traditional sources w. permanent source (s.)	95	98	45	-	-
Most frequent type of permanent traditional source (s.)	Dug hole	Dug hole	Dug hole	-	-
Mean distance; m (s.)	220	280	710	-	-
% with seasonal sources (s.)	5	2	55	-	-
Most frequent dry season source (s.)	Stream	-	Stream		-
Mean distance; m (s.)	20	-	910	-	-
Most frequent wet season source (s.)	Dug hole	-	Dug hole		
Mean distance; m (s.)	170	-	810	-	-
Mean household water collection; l./cap/day (s.)	13.4	11.0	8.5	-	-

x) Nobody used w.s. at time of interview because of breakdown

Table 2.15 Data sheet. Water - Ruvuma Region

Village inventory (v.i.) and sample survey (s.) data	Agro - ecological zones				Regional total (rural areas)
	Wet western highlands	Intermediate zone	Dry eastern zone	Lake shore	
SANITATION					
% of villages where over 80 % of hh. have latrine (v.i.)	93	88	74	100	84
% hh. with latrine (s.)	100	95	86		-
Claimed users of latrines (s.)					
Children; %	83	98	88	-	-
Men; %	98	98	88	-	-
Women; %	99	98	88	-	-
Lifetime of latrine; mean years (s.)	4.5	6.6	3.9	-	-
Latrine built by hh. itself; % of hh. (s.)	71	67	88	-	-
HEALTH					
Disease in hh. week before interview; % of hh. (s.)	57	68	63	-	-
Most common disease (s.)	Caugh	Diarrhoea	Diarrhoea	-	-
% of hh. (s.)	27	29	25	-	-
Second most common disease (s.)	Headache	Caugh	Fever	-	-
% of hh.	14	17	16	-	-
% of hh. with diarrhoea day be fore interview (s.)	6	5	14	-	-
Crude child death rate; % children no longer alive/all children born alive (s.)	29	25	18	-	-
% villages with cholera outbreaks last 3 years (v.i.)	0	0	0	0	0

Table 2.16 Data sheet. Sanitation and health - Ruvuma Region

Notes:

1) The presentation is based on

   a) Existing descriptions and statistics, which vary a lot in quality and coverage.

   b) Village inventory information from the Water Master Plan study, which should include information on all villages within each zone. At the time of writing, however, not all villages had yet been included in the processing.

   c) Socio-economic sample household survey, from a limited number of villages in one part of each zone, which may not always be completely representative for other parts of the zones.

   See also Appendix on methodology.

2) In the present planning system specific, reliable plans are only made one year ahead. At the time of study, these sections had to be based on regional 5-year-plan 1981-86 proposals, which were rather general, and - above all - had not yet been approved by national authorities. With the looming economic crises this means that major reductions in regional requests must be expected.

3) Bureau of Statistics, (undated). 1978 Population Census. Preliminary Report. Ministry of Finance and Planning, Dar es Salaam. Table 1.

4) Mkoa wa Iringa, (1981). Mpango wa Maendeleo, 1981 - 1982. Ofisi ya Mkuu wa Mkoa, Iringa, Page 66 - 67.

5) Bureau of Statistics, (undated). op.cit., page 175.

6) Henin, R.A., ed., (1973). "The Demography of Tanzania", Vol. VI in 1973 National Demographic Survey. A joint publication of the Bureau of Statistics; Ministry of Finance, Planning; and the Demographic Unit, Bureau of Resource Assessment and Land Use Planning, Dar es Salaam. Chapters 5 and 11.

7) This section draws heavily on United Nations Development Programme and Food and Agriculture Organization of the United Nations, (1976). Iringa Region, Tanzania - Integrated Rural Development Proposals for the Third Five Year Plan, 1976 - 1981; Volume 1 and 2. Tanzania Rural Development Bank Project URT/71/004. Especially chapter 2.3, (Rural economy) and chapter 7 (public infrastructure).

8) Ibid, page 2.30.

9) Information from Mkoa wa Iringa, (1981). Op.cit. pg. 78 - 85.

10) The Health Nutrition and Population Office, (1979). Health in Tanzania, 1979, United States Agency for International Development, Dar es Salaam, page 32.

11) UNDP & FAO, (1976). Op.cit., table 2.3.7 and United Republic of Tanzania, (undated). Third Five Year Plan for Economic and social Development 1st July 1976 - 30th June 1981. Volume 1, tables 70 and 72.

12) UNDP & FAO, (1976). Op.cit., Vol. II, page 25.4.

13) Mkoa wa Iringa, (1981). Op.cit., page 83.

14) Information on agriculture in this and the following sections is taken from UNDP, FAO (1976) Op.cit., unless another source is explicitly mentioned.

15) The concepts faecal-oral; water-washed; water-based, and water-related diseases are explained in chapter 11.2.

16) See Awiti, A., (1975). "Ismani and the Rise of Capitalism"; and "The Development of Ujamaa in Ismani", in Rural Development Research Committee, (1975). Rural Cooperation in Tanzania. (Tanzania Publishing House; Dar es Salaam).

17) Mkoa wa Iringa, (1981). Op.cit.

18) This section draws extensively from UNDP and FAO (1976), op.cit., chapter 3.2.

19) Makadirio ya Mipango ya Maendeleo 1981/82. Mkoa wa Mbeya, Ofisi ya Mkua wa Mkoa, Mbeya - 1982.

20) The distance to the river was 142 metres but 325 metres to the DP for the interviewed families.

21) Mpango wa nne wa Maendeleo ya Miaka Mitano ya Kiuchumi na Kijamii 1 Julai, 1981 - 30 Juni, 1986.

22) Makadirio ya Mipango ya Maendeleo 1981/82, op.cit.

3. POPULATION PROJECTIONS

3.1 Aim and scope of population projections

The population projections presented here aim at indicating the scope of population growth in the areas with which the Water Master Plans for Iringa, Mbeya, and Ruvuma are concerned. They thus include all rural and semi-urban areas, including district towns, but exclude regional towns when possible, i.e. Iringa Urban and Mbeya Urban Districts, but not Songea Urban.

In principle, population projections for the purpose of the Water Master Plan should be broken down to the level of the individual villages. The relatively recent establishment of the villages, the available demographic data, and the existing information on other factors, such as resource base, production and economy, infrastructural development etc., has not, however, allowed such an exercise to be undertaken with acceptable accurateness, while keeping within a reasonable use of time and resources.

On a perceived cost-benefit basis, it was decided therefore to settle with the simplest possible type of projections, i.e. such that could be calculated basically on the basis of data from the 1967 and 1978 population censuses.

The basic assumption thus is that the dominant development trends of the past 10 years will persist well into the future, or at least, that we have no reliable indicators as to how much nor in which direction they are likely to change. Obviously, the further ahead we are looking, the more insecure the validity of the projections are.

The projections are calculated as means for geographical areas that often encompass wide internal variations. While we suggest that they can be used as reasonable approximations of expected population growth for such areas as a whole, their application to individual villages within an area should therefore be seen only as reflecting such a general trend. In cases where the village visits during the village inventory survey have shown definite indications of deviations from this general trend, the projections should therefore be used with an estimated adjustment upwards or downwards accordingly.

For overall planning purposes this approach should provide projections that are as good as any. It is clear, however, that they must be generally revised if major changes in existing development trends become apparent in the future, and that actual scheme implementation must be based on updated and more specific information, especially in the later part of the Water Master Plan period.

3.2 Assumptions and method of projection

The projections are based on the 1967 and 1978 population census figures, using the smallest possible geographical areas for which figures in the two are comparable. In most cases this means divisions. In some cases we have tried to adjust for boundary changes, in other this has not been possible, so a larger area had to be used, i.e. several divisions together or - exceptionally - the whole district, which of course reduces the validity of the figures, when used on smaller areas. In one district, Chunya, we have as elsewhere tried to adjust for boundary changes, but we believe that the resulting calculated 67-78 growth rates are still incorrectly influenced by such changes, so we have made a "guestimated" modification of the extremely wide variations between the divisional figures, on which we have then based our projections.

Basically assuming that past development trends, i.e. natural growth and migration patterns, will more or less persist into the future, the basis for the projections has then been the actual 1967-78 growth rate for each area (one or more division(s)) and for each district.

First projected future growth rates for districts were calculated as linear projections of 1967-78 growth rates, modified as follows:

a) For districts with close to average regional growth the projected future is the unmodified linear projection of past growth (Njombe, Ludewa, Ileje, Mbinga, Tunduru).

b) For districts with 67-78 growth rates considerably above the regional average, which are all known to be areas of immigration, the projected future growth rate has been reduced relatively to the linear projection of 67-78 growth, as it is assumed that immigration in absolute figures will not grow proportionally with total population in the long run (Mufindi, Mbeya Rural, Chunya, Mbozi, Songea (Rural and Urban)).

c) Districts with low population density and low 67-78 growth rates are expected to have higher future growth rates, on the assumption that emigration will decrease, as other areas get more populated, and infrastructure and economic opportunities are spread more evenly (Iringa Rural, Makete).

d) High density, low growth Rungwe District is expected to remain a major source of migrants to other districts, with a continuation of the past low growth rate (Rungwe).

e) The same is the case for the rural areas of Kyela District, but an expected decrease in the earlier very rapid growth of the town results in a pro-

jected future growth rate for the district which is lower than the linear projection of 67-78 growth.

Secondly, within each district modifications to the linear projections for divisions were made, so that together they would result in the projected district growth rate, and so that - as a rule of thumb - extremely high rates were reduced and extremely low rates increased towards the district average. This on the assumption that future population development may become somehwat more homogenous within districts as villages and populations get stabilized, and population densities less diverse.

The degree of modification has taken present population densities into account, but also in some cases a suspicion that the 67-78 growth rate may be over or underestimated due to uncertainty related to boundary changes.

3.3 Growth factors

Growth factors, i.e. projected population in a given year as percentage of the 1978 population, are calculated for:

a) 1986, being the mid-term year of the 1981-91 ten year implementation period for the Water Master Plans.

b) 1996, indicating the 10 year period for which distribution systems are planned; and

c) 2006, for the 20 year planning perspective for major works such as intakes etc.

The growth factors do not take into account that the reduction in projected growth rates relative to a strict linear projection in high immigration areas would be expected to take place gradually, not once and for all. Initially the population growth may therefore continue at a higher pace, only slowing down later.

3.4. Population densities

The population densities given in the tables are calculated on the basis of 1978 population figures and the areal figures given in the 1967 census report Vol. 1.

This means that where there are uncertainties regarding the exact overlap of areas between the two censuses also the population density figures should only be taken as indicators of the approximate levels of this factor.

3.5. Population projection tables

The tables below are organized district by district, beginning with Mbeya Region, then Iringa and Ruvuma. Figures are given by 1978 divisions with names of all 1978 wards attached to their appropriate divisons, and with 1967 figures as far as possible adjusted to present administrative areas (see above).

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
KALENGA & ISMANI Kalenga Nzihi Kihorogota Izazi Nduli Malenjamakali	61261	66062	18	0.7%	1.0%	108%	120%	132%
KIPONZERO & MLOLO Wasa Ifunda Maboga Magulilwa Mgama Mseke	65341	71206	36	0.8%	1.0%	108%	120%	132%
KILOLO Ukumbi Ukwega Bomalang'ombe Idete dabaga	46372	60245	20	2.4%	2.4%	121%	153%	194%
PAWAGA/KIMANDE & IDODI Itunundu Ilolo Mahuninga Idodi Mloa	16679	28657	2	5.0%	4.0%	137%	203%	300%
MAHENGE Mahenge Udekwa	9107	12296	2	2.8%	2.8%	125%	164%	217%
MAZOMBE Irole Image Ilula	32121	47897	36	3.7%	2.8%	125%	164%	217%
IRINGA RURAL DISTRICT	235527	286273	10	1.8%	2.0%	117%	143%	174%

Table 3.1 Population projections, Iringa Rural District, Iringa Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
NJOMBE MJINI	2527	16027	-	18.3%	(3%)?	127%	170%	229%
IMALINYI Imalinyi Igosi Wangama	25119	29170	27	1.4%	2.0%	117%	143%	174%
WANGING'OMBE & MAKAMBAKO Wanging'ombe Ilembula Luduga Saja Makambako Mahongole Igongole Mtwango Ikuna	68225	93173	28	2.9%	2.9%	126%	167%	223%
MDANDU Mdandu Usuka Lupembe Ikondo Idamba Kidegembye	40878	53581	16	2.5%	2.5%	122%	156%	200%
IGOMINYI & KIFANYA Uwemba Iwungilo Luponde Matola Yakobi Kifanya	40917	40802	11	0.0%	1.2%	110%	124%	140%
NJOMBE DISTRICT	177666	232753	20	2.5%	2.5%	122%	156%	100%
LUDEWA DISTRICT (all divisions and wards)	54200	75611	15	3.1%	3.1%	128%	173%	235%

Note: Growth rate for Njombe town has been arbitrarily reduced to 3 % as the past growth rate in a linear projection would give it a population of 1.8 million, which seems rather unlikely to happen !

Table 3.2 Population projections, Njombe and Ludewa Districts, Iringa Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor,% of 78 pop. 1986	1996	2006
MALANGALI & KASANGA Ihowanza Idunda Nyololo Kasanga Itandula Mgololo	57502	72342	22	2.1%	2.5%	122%	156%	200%
SADANI & IFWAGI Sadani Isalavanu Mafinga Ikononga Mtwango Ihanu	44677	77002	28	5.1%	3.5%	132%	186%	262%
KIBENGU Kidete Mapanda	16288	21582	22	2.6%	2.6%	123%	159%	205%
MUFINDI DISTRICT	118467	170926	24	3.4%	3.0%	127%	170%	229%
LUPALILO Lupalilo Iwawa Mangoto	17580	21078	22	1.7%	1.7%	114%	135%	160%
UKWAMA Lupila Ukwama	20415	18214	20	-1.0%	0.5%	104%	109%	115%
BULONGWA Bulongwa Kipagalo	13638	15324	40	1.1%	1.5%	113%	131%	152%
MAGOMA Imiho Ipelele Kigulu	10515	9344	35	-1.1%	0.5%	104%	109%	115%
MATAMBA Matamba Mlondwe Kitulo Ikuwo Mfumbi	24797	27414	15	0.9%	1.5%	113%	131%	152%
MAKETE DISTRICT	86945	91404	21	0.5%	1.3%	111%	126%	144%

Table 3.3 Population projections, Mufindi and Makete Districts, Iringa Region.

Division/Ward	Population 1967	Population 1978	Pop/km² 1978	Annual growth 67-78 projected future		Growth factor, % of 78 pop. 1986	1996	2006
ILONGO & RUJEWA Chimala Ruiwa Msangaji Usangu Rujewa Mawindi Madibira Mapogoro	56763	114315	7.4	6.6%	5.1%	149%	245%	403%
ILOMEA & ISANGATI Ilomba Igawilo Ulenje Tembela Ikukwa Ihango Ilembo Isuto Santilya Iwiji Mshewe Usongwe Igale	123445	140479	47.5	1.2%	1.2%	110%	124%	140%
MBEYA RURAL DISTRICT	180208	254794	13.8	3.2%	3.1%	128%	173%	235%

Table 3.4 Population projections, Mbeya Rural District, Mbeya Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
KIWANJA Chalangwa Mapogoro Ifumbo Makongolosi Ifwenkenya Sangambi Matundasi	13533	16474	5.2	(1.8%) 2.5%	4.0%	137%	203%	300%
KIPEMBAWE Mamba Lupatingatinga Nkung'ungu Luwalaje Mtanila Matwiga Mafyeko Kambi Katoto	8226	20469	1.8	(8.6%) 7.0%	6.0%	159%	285%	511%
KWIMBA Mkwajuni Mwambani Mbangala Kapalala Ngwala Gua Udinde	16019	16534	1.4	(0.3%) 2.0%	4.0%	137%	203%	300%
SONGWE Galula Magamba Ifuko Mbuyuni Kanga Tete Totowe Kibwawa Namkukwe	13442	29285	39.5	(7.3%) 5.5%	4.0%	137%	203%	300%
CHUNYA TOWN	2398	6353	-	(9.3%) 8.0%	5%	148%	241%	392%
CHUNYA DISTRICT	53618	89115	3.3	(4.7%) 4.7%	4.5%	142%	221%	343%

Note: Figures in brackets are calculated on the actual figures for 67 and 78. 67-78 growth rates not in brackets include our "guestimated" modifications for boundary changes, which it was not possible to incorporate in the summation of population figures.

Table 3.5 Population projections, Chunya District, Mbeya Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
UKUKWE Lufingo Isongole Katumba Kiwira Kinyala Ikuti Suma Nkunga Malindo	87343	97574	91.9	1.0%	1.0%	108%	120%	132%
BUSOKELO Kabula Lwangwa Kandete Mpombo Luteba Lupata Itete Lufilyo	64434	65884	79.5	0.2%	0.2%	102%	104%	106%
PAKATI Mpuguso Kisiba Kambasegela Kisondela Masukulu Bujela Masoko Ilima	56877	64051	122.5	1.1%	1.0%	108%	120%	132%
TUKUYU TOWN	4089	7323	-	5.4%	5.0%	148%	241%	392%
RUNGWE DISTRICT	212743	234831	97.3	0.9%	0.9%	107%	118%	129%

Table 3.6 Population projections, Rungwe District, Mbeya Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
BULAMBYA Bupigu Chitete Itumba Itale	27961	35717	30.0	2.3%	2.3%	120%	151%	189%
BUNDALI Mwalangali Kafule Ibungo Ikinga Ngulugulu	28264	35512	47.9	2.1%	2.1%	118%	145%	179%
ILEJE DISTRICT	56225	71229	37.6	2.2%	2.2%	119%	148%	184%
NTEBELA Mwaya Ikama Ipande Lusungo Ipinda Makwale Matema	46441	56356	123.6	1.8%	1.8%	115%	138%	165%
UNYAKYUSA Ikolo Ngana Kajunjumele Buyonde Katumba/Songwe Nkokwa/Ibanda	42612	48079	119.0	1.1%	1.1%	109%	122%	136%
KYELA TOWN	1950	9981	-	16.0%	5.0%	148%	241%	392%
KYELA DISTRICT	91003	114416	131.0	2.1%	1.8%	115%	138%	165%

Note: Kyela Town seems unlikely to grow to 637,000 inhabitants in 2006 (which is the linear projection figure). Consequently an arbitrary growth rate of 5% has been proposed for Kyela Town.

Table 3.7 Population projections, Ileje and Kyela Districts, Mbeya Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
KAMSAMBA Kamsamba Chilulumo Ivuna	17336	28210	15.2	4.5%	4.0%	137%	203%	300%
IGAMBA Nambinso Itaka Igamba	40114	72875	35.5	5.6%	4.5%	142%	221%	343%
VWAWA & IYULA Nsala Vwawa Ihanda Isandula Mlangali Iyula Nyimbili Ruanda	62145	84716	40.4	2.9%	2.9%	126%	167%	223%
NDALAMBO & MSANGANO Tunduma Kapele Ndalambo Myunga Msangano	27890	47617	13.8	5.0%	5.0%	148%	241%	392%
MBOZI DISTRICT	147485	233418	24.4	4.3%	4.0%	137%	203%	300%

Table 3.8 Population projections, Mbozi District, Mbeya Region.

Division/Ward	Population 1967	Population 1978	Pop/km² 1978	Annual growth 67-78	Annual growth projected future	Growth factor, % of 78 pop. 1986	1996	2006
NAMPUNGU & MATEMANGA Nampungu Kidodoma Kalulu Ligunga	26099	33630	5	2.3	2.3	120%	151%	189%
NALASI & LUKUMBULE Nalasi Mbesa Marumba Lukumbule Mtina	31572	43782	9	3.0	3.0	127%	170%	229%
NAKAPANYA, NAMASAKATA & MLINGOTI Ngapa Nakapanya Muhuwesi Namasakata Msechela Ligoma Mlingoti Magh. Mlingoti Mash.	39884	58115	9	3.5	3.5	132%	186%	262%
TUNDURU DISTRICT	97555	135527	7	3.0	3.0	127%	170%	229%
SONGEA RURAL DISTRICT (All divisions and wards)	145960	181562	5.3	2.0				
SONGEA URBAN	5430	48137						
SONGEA RURAL + SONGEA URBAN	151390	229699	6.7	3.9	3.5	132%	186%	262%

Note: Major boundary changes in Songea District between 1967 and 1978 makes it impossible to compare ward and division population figures for the two years. Even the above breakdown into rural and urban is invalid for purposes of establishing growth rates, since a large part of the apparent urban growth is due to area expansion for Songea urban district. Consequently it is proposed to use the overall rural + urban growth rate and factor as the best possible approximation for the whole district.

Table 3.9 Population projections, Songea and Tunduru Districts, Ruvuma Region.

Division/Ward	Population 1967	Population 1978	Pop/km^2 1978	Annual growth 67-78	Annual growth projected future	Growth factor,% of 78 pop. 1986	1996	2006
MBUJI Mbinga Matiri Kihangi Mahuka Utiri Kilimani Maguu Mkumbi Ukata Kigonsera Nyoni Mikalanga Litembo Mbangamao Kingiritiki	75262	123214	36	4.6	3.4	131%	183%	255%
MPEPO Tingi Liparamba	14378	11012	5	-2.4	2.0	117%	143%	174%
RUHEKEI Liuli Mbamba Bay Lipingo Mtipwili Chiwanda	30766	34468	38	1.0	1.5	113%	131%	152%
RUHUHU Lituhi Ngumbo Mbaha	16387	18559	36	1.1	1.5	113%	131%	152%
NAMSWEYA Ruanda Litumbandyosi	7305	8953	6	1.9	2.5	122%	156%	200%
MBINGA DISTRICT	144098	196140	23	2.8	2.8	125%	164%	217%

Note: Due to boundary changes between 1967 and 1978 it has not been possible completely to reconstruct comparable areas, so growth rates for divisions have a high degree of incertainty, especially between Mbuji and Mpepo divisions. For this reason, and because future growth is likely to be less biased between divisions projected growth rates have been modified, based on a linear projection for the whole district.

Table 3.10 Population projections, Mbinga District, Ruvuma Region.

4 FAMILY AND VILLAGE PROBLEMS AS PERCEIVED BY THE VILLAGERS

4.1 Introduction

A rural water supply programme is a one sector programme. It does not leave villagers free to choose other types of outside assitance. The present way of selecting villages for a rural water supply programme does not even give the selected villages the chance to opt out. The implicit assumption is , of course, that all villages - no matter what their situation is - would rather have an improved water supply than be without one.

In this chapter it has been attempted to place water problems in a more realistic perspective by considering water problems as just one of the sets of problems facing villagers. Furthermore, differences in perceptions of problems between men and women and between villages with and without a water supply scheme have been analysed.

4.2 Methodology

Female and male respondents were asked during the household survey to mention the problems (maximum three) which in their own view faced their family and their village. Both sexes mentioned in average slightly above two problems of each category. Men tended to put forward more problems than women. Around 10 % of the respondents (slightly more women than men) did not mention any problems. (Excluding Ruvuma Region, where results were not yet ready for analysis).

Three major sources of bias influence the results. Respondents will probably tend to over-emphasize their water problems when interviewed by people who explicitly have stressed their interest in water. (This bias is further discussed below). Secondly, respondents will tend to put forward problems for which they hope an outside agent is willing to provide a solution (the interviewer is regarded as the representative for this agent). Thirdly a water supply scheme is an almost free public good. Problems related to water are therefore bound to come out high on the list of problems compared to problems (such as village shops) for which villagers must make contributions in kind if they want them solved. Not much can be done to avoid these biases other than asking open-ended questions on family and village problems (as was done) and interpreting the data with caution.

4.3 The most frequently mentioned problems

Altogether around 20 different problems were mentioned by the respondents. However, if only the four most mentioned problems in each of the 8 agro-ecological zones surveyed in Iringa and Mbeya are considered, the number decreases to about 10. In each particular zone the four most mentioned problems were put forward by 10 % or more (up to 75 %) of the respondents.

Tables 2.1 and 2.2 list the most frequently mentioned village and family problems put forward by male and female respondents. They clearly show that problems related to water are regarded as very important by both men and women.

Village problems	Number of zones where a problem was among the four most frequent answers			
	Female respondents		Male respondents	
	Iringa zones	Mbeya zones	Iringa zones	Mbeya zones
Water far away	2	3	4	3
water dirty	4	2	3	3
No dispensary	3	3	2	3
No grinding machine	1	3	0	0
No transport	2	2	2	3
No shop	0	3	0	3
Few agricultural inputs	1	0	3	2
Bad health	1	0	0	0
Food shortage	1	0	1	0
Bad leadership	1	0	0	0
Total number of zones	4	4	4	4

Read: In 2 out of 4 zones "Water far away" was among the four village problems most frequently mentioned by the female respondents.

Table 4.1 Village problems most frequently mentioned by women and men in the agro-ecological zones of Iringa and Mbeya Regions.

Research by others have arrived at similar findings. In a survey of 75 villages in Iringa all wanted aid. Water was mentioned by 26 % of the surveyed villages, against 17 % for a dispensary, 14 % for a school and 12 % for fertilizer[1]. A survey in Mbeya region aimed at identifying agricultural problems - and thus not so likely to suffer to the same degree from the biases mentioned in section 4.2 - also revealed that improved water has top priority among villagers.[2]

Family problems	Number of zones where a problem was among the four most frequent answers			
	Female respondents		Male respondents	
	Iringa zones	Mbeya zones	Iringa zones	Mbeya zones
Water far away	4	4	4	4
Water dirty	4	3	4	3
No dispensary	2	0	2	0
No grinding machine	0	0	0	0
No transport	2	1	1	0
No shop	0	1	0	1
Few agricultural inputs	1	0	2	2
Bad health	2	4	2	3
Food shortage	1	3	1	3
Bad leadership	0	0	0	0
Total number of zones	4	4	4	4

Table 4.2 Family problems most frequently mentioned by women and men in the agro-ecological zones of Iringa and Mbeya Regions.

But water problems are by no means the only ones facing villagers. Also social infrastructure (dispensary, grinding machine and shops) are high on the list. So are bad transport facilities and problems of getting agricultural inputs - both related to productive infrastructure. This is in good agreement with the findings of the above mentioned UNDP/FAO study from Iringa.

One problem - sanitation - is conspicuously absent from the list of 20 problems which emerged from the survey. Sanitation is just not regarded as an important problem.

4.4 Gender differences in perception of problems

The results shown in tables 2.1 and 2.2 do not substantiate the claim that men should be less concerned with water problems than women. And in general both sexes tend to view the village and family problems in much the same way.[3] But there are, of course, differences. Thus, women are the only ones mentioning the lack of access to a grinding machine as a problem, while men seem more concerned than women about the lack of agricultural inputs. Women also tend to complain more about bad village leadership - maybe a reflection of their almost total exclusion from village governments.

Differences in the perception of general village and specific family problems are small. Men do, however, tend to make sharper distinctions between the two sets of problems than women.[4)]

4.5 Differences in perception of problems between villages with and without an improved water supply

There are interesting differences between the frequencies with which problems related to water, health facilities and land shortage are mentioned in villages with and without a water supply (see table 4.3).[5)]

Zones	% of respondents mentioning a particular problem							
	"Water far away"		"Water dirty"		"No dispensary"		"Land shortage"	
	ws[a)]	no ws[b)]	ws	no ws	ws	no ws	ws	no ws
IRINGA								
High rainlands	22	85	11	35	0	52	0	0
Upper plateau	33	52	70	37	(0	3)	40	7
Medium dry zone	39	49	24	54	0	21	21	3
Dry N. fringe	15	34	0	54	(5	0)	8	4
MBEYA								
Wet highlands	86	60	39	62	5	8	14	4
Lake shore	50	40	17	58	0	20	17	6
Dry plain	67	25	10	57	0	16	(4	3)
Dry N. zone	40	8	4	20	4	20	0	0

() Based on only 2 to 5 respondents

a) Villages with a water supply scheme

b) Villages with no water supply scheme

Table 4.3 Household problems mentioned by male respondents in villages with and without improved water supply; by agro-ecological zones.

Many respondents in villages with a water supply complain about the distance to water. In the Mbeya zones this complaint is even more frequent in villages with a water supply than in those without. This reflects the often poor match between the locations of domestic points and the settlement pattern. It points to the need for village participation in the planning of distribution systems. Also village expansion after scheme construction has contributed to the dissatisfaction with the present service level of water supply schemes which can only be removed by rehabilitation and expansion of existing schemes.

The water provided by existing schemes is in general regarded as less dirty than water from traditional sources.[6] The water quality tests tend to support the villagers' evaluation of the dirtiness of water (see chapter 5).

Complaints about "no dispensary" are most frequently heard in villages without a water supply, while "land shortage" is primarily a problem in villages with a water supply. This particular combination is not accidental. It reflects the way in which capital resources within the rural water sector have been allocated: priority has been given to villages with a relatively well developed infrastructure (i.e. dispensaries) and which are large (hence the problem of land shortage).

4.6 Conclusion

Several findings of relevance to a rural water supply and sanitation programme can be extracted from the results of the household surveys.

Problems related to water (distance and quality) are among the most frequently mentioned by both male and female respondents. The construction of a water supply scheme will therefore in general be met with enthusiasm - at least under the present policy of providing improved water as a free public good. If villagers are to contribute in cash and of their own will the situation may well be different. But this situation cannot be studied directly at present.

Villagers cannot in general be expected to be strongly motivated for improving their sanitary situation. A sanitation programme should therefore not be started prior to a health educational programme which, if successful, could motivate villagers for sanitary improvements. - but are they needed? Already high coverage of pit latrines (maybe only handwashing and hygiene needs to be improved!)

It is a common belief that women are much more interested in water improvements than men. The results of this survey do not support this belief. Men express as much concern for dirty and inaccessible water as women do.

In the villagers' opinion the present water schemes supply water which is less dirty than water from traditional sources. However many villagers complain about the poor access to domestic points. Thus, there is a need for improvements in the service level of existing schemes, and for introducing village participation in the planning of distribution system.

Notes:

1) UNDP/FAO, 1976

2) UYOLE Agricultural Centre, 1981

3) For each zone the frequencies by which problems were mentioned by men and women were ranked and correlated. Spearman's rank correlation co-efficients were highly significant ($P<1\ \%$) for both problem categories and in all zones except one.

4) This finding is based on the following analysis:
For each zone the frequencies of village and family problems were ranked and correlated. Spearman's rank correlation co-efficients were highly correlated ($P<1\%$) for both sexes and in all zones except one. Correlation co-efficients for women were consistently higher than for men.

5) Respondents from villages with a water supply scheme do not necessarily draw water from it.

6) The only exception is zone 2, Iringa Region. The explanation is simple. In the two villages in Zone 2 with a water supply only 9 out of the 58 randomly selected households drew water from taps at the time of interview.

5. VILLAGERS' EVALUATION OF WATER SOURCES

5.1 Villagers' evaluation and the Water Master Plan

In the engineering selection of sources for improved water supplies it is of some interest to know how villagers evaluate different water sources, and which criteria they use in such evaluations.

Secondly, if villagers' complaints about water quality correspond to the actual quality of the water then objective tests of water quality can be potentially useful priority criteria. For in that case objective water quality criteria also indicate a felt need for water improvements.

5.1.1 Methodology

All information on villagers' evaluation of water sources are based on household survey questions asked to wives about sources used in wet and dry season and about sources not used. These questions are open ended. The different categories of answers were first made during the analyses.

The analyses of the relationship between villagers' complaints about water and the objective water quality are based on female respondents' opinions on family problems and laboratory tests carried out by CCKK during the village inventory.

5.1.2 Villagers' ability to evaluate sources

In the literature on rural water, sanitation and health, one can sometimes meet statements like this:

"There is no disease which the people associate with water, whether used for drinking, cooking or bathing, or for washing and swimming. Dirty water or standing water is never associated with any health hazards".[1)]

As shown below the analyses of women's evaluation of the sources used and not used do not confirm this disbelief in villagers' abilities to evaluate their water sources. Quite the contrary. Villagers seem to use an elaborate set of criteria in their evaluations.

5.2 Permanent sources

Out of the approximately 1200 households interviewed in Iringa and Mbeya Regions, more than 900 drew water from a permanent source at the time of interview.[2)]

The wives from these households were asked to put forward the characteristics which they did not like[3] about the water from the permanent source that they were using. The range of answers - broken down according to source type - is given in table 5.1. Ten distinct - but not always mutually exclusive - types of dislikes could be identified.[4] They reflect three main criteria used by villagers in their evaluation of source, namely water accessibility, water quality and water use.

5.2.1 Accessibility

Due to the wide variety in accessibility to permanent source in the two regions it is only possible to make two generalizations about this factor. One is that water from improved sources (taps and lined wells) is regarded as more accessible than water from traditional sources.

The other is that accessibility is a very important criterion in villagers' source evaluation (see also section 5.3).

5.2.2 Water quality

Water quality is an equally important criterion for villagers. It has many aspects: dirtiness (colour), taste (sweet/salty), smell, temperature (warm/cold) and risk to health. The first and the last factor are the most frequently mentioned. Table 5.2 shows the ranking of the five source types listed in table 5.1 from best(1) to worst(5) based on the accumulated percentages of complaints with respect to water quality. In the right hand column is shown the evaluation of the same source types made by Brokonsult.[5] Their evaluation is based on analyses of water quality tests taken by MAJI (from all parts of the country) and by Brokonsult itself (the Lake regions).

Complaints mentioned	Types of permanent water sources used: Tap % of users	River/stream % of users	Spring % of users	Well, no lining % of users	Well, lined % of users
Water accessibility					
"Far away"	7	33	22	18	5
"Little/no water"	13	2	23	14	10
"Wait too long"	9	2	18	14	2
Water quality					
"Bad colour"	5	19	22	22	5
"Bad taste"	2	8	4	8	10
"Bad smell"	1	7	2	5	15
"Salty"	3	2	1	6	5
"Dirty"	14	67	34	64	46
"Health risk"	6	40	16	23	24
Water use					
"Problems with other users"	18	15	15	19	0
Other complaints	1	6	22	11	0
No complaints[x)]	18	2	10	0	-
No. of respondents = 100 %	276	346	94	182	41

x) Based on Iringa material only due to coding error in Mbeya

Table 5.1 Complaints about water by users of different types of permanent water sources, Iringa and Mbeya Regions.

Type of source	Villagers ranking	Brokonsult evaluation
Tapped water	1	depends on source
Well, lined	2	good quality water
Spring	3	moderate quality water
Well, no lining	4	worst type of un-improved source
River/stream	5	worst type of source for water supply

Table 5.2 Water quality by source: villagers' evaluation compared to results of water quality surveys.

The conclusion to be drawn from table 5.2 is that: poor, uneducated and uniformed as villagers may be, their ability to provide fairly accurate evaluations of the quality of water they use is unquestionable. The high ranking of tapped water is probably due to political salesmanship: piped water is always promoted as clean water (maji safi). Unfortunately villagers often take this literally while it is less often 100 % true.

Rivers/streams receive a low ranking by both villagers and Brokonsult. The villagers' evaluations are obviously based on the water quality at the locations where water is drawn (down-stream). This goes for the Brokonsult evaluation as well.[6)]

5.2.3 Water use

Finally, problems of water use enter the criteria after which villagers evaluate sources. Complaints about "problems with other users" were frequently heard (see table 5.1). The reasons for these complaints tend to vary with source type. Users of tapped water complain about unhygienic conditions around domestic points caused by improper use and children's play. Also queuing is a problem (due to poor water accessibility). At traditional sources queuing can likewise be a problem. Other water use problems relate to water quality: cattle, water drawers and children may pollute the source to the disconcern of other users.

No users of lined wells raised complaints related to water use. The reason is probably that each well - where they exist - is used by only a small group of households.

5.3 Seasonal sources

Wives in those families who use one source in the dry season and another in the wet season were asked to explain why they shifted from one source to another. Approximately 130 respondents answered this question. The shift from a dry season source to a wet season source tend, naturally, to be caused by the improved accessibility (smaller distance) to the wet season source. The shift from the wet to the dry season source is normally likewise related to accessibility: the wet season source runs dry. Also water quality (dirtiness) plays a role in these shifts.

5.4 Sources not used

Villagers tend to draw water from the most accessible source available to them. Only a limited fraction pass a nearby source to draw water further away (in total 11 % i.e. 137 out of 1203 households sampled in Iringa and Mbeya). Table 5.3 shows that this fraction is largest in the dry northern fringe, Iringa, where accessibility to water is most difficult. Although this conclusion is surprising, it is easily explained. In zones with low access to water, its quality tend to be poor as well, thereby causing users to by-pass nearby sources.

The two source types most often passed by the respondents in the sample are river/streams and unlined wells - the very sources that villagers rank as low in water quality (see table 5.2). These account for 84 % of the cases in which sources are passed. On the contrary a tap - that is working ! - is never bypassed to collect water further away.

The reasons for passing a nearby source are almost exclusively related to poor quality (water poses health risk, is dirty, salty, smelly, or has a bad taste). Table 5.3 also shows that when the nearby source is of such bad quality, some people (at least) are willing to walk very long extra distances to the next water source.

5.5 Villagers' evaluation of water accessibility and quality compared to objective criteria

In one already completed Water Master plan the following statement can be found:

"No correlation appeared to exist between villagers' opinion of the quality of water and the results of laboratory analyses. Consequently local opinion could not be used as a valid measure for the water quality of the sources".[7)]

The data presented here support the opposite conclusion. Villagers' evaluation of water accessibility and quality do correspond fairly well to objective measures of these two factors.[8)]

5.5.1 Water accessibility: villagers' evaluation versus distance measures

The percentage of households (wives) in each of the surveyed villages that mentioned "water far away" as a serious household problem[9)] is taken to be the quantitative expression of villagers' evaluation of water accessibility. No strictly objective measure of the actual distance or walking time to

Households not using nearest water source in one or both seasons	Agro-ecological zones							
	Iringa				Mbeya			
	High rainland	Upper plateau	Medium dry zone	Dry N. fringe	Wet high-land	Lake shore	Dry plain	Dry N. zone
Number of HH	3	8	19	62	2	20	13	10
% of total sample	3	5	11	40	1	12	8	11
Dry season								
Distance to unused source, m.	350	510	283	1052	41	78	83	194
Distance to source used, m.	383	647	1203	4231	302	345	420	540
Extra distance, m.	33	137	920	3179	261	267	337	346
" , %	9	21	315	302	636	342	406	178
Wet season								
Distance to unused source, m.	350	510	544	597	41	73	56	194
Distance to source used, m.	383	647	1084	1774	302	345	220	540
Extra distance, m.	33	137	540	1177	261	272	164	346
" , %	9	21	99	197	636	373	293	178

Table 5.3 Households not using nearest water source, by distances to water sources, and by zones; Iringa and Mbeya Regions.

% of wives in each village mentioning "water far away" as a serious household problem correlated with:	Rank correlation coefficient (rho)			
	Iringa		Mbeya	
	rho	P	rho	P
(a) Mean distance to source used at time of interview	0.33	8%	0.20	not sign
(b) Mean time to source used at time of interview	0.39	4%	0.69	$<1\%$
(c) Mean time to source used in dry season	0.38	4%	0.72	$<1\%$
(d) Mean time to source used in wet season	0.34	7%	0.71	$<1\%$

Table 5.4 Water accessibility: villagers evaluation correlated with distance measures.

sources exist. Both in the village inventory (carried out by the Water Master Plan consultants) and in the household surveys (carried out by the present study) distance and time to source are based on responses from villagers. However in both investigations the interviewer evaluated, whether the response given was reasonable or not. Thus, while the distance and time information are not strictly objective they are deemed sufficiently accurate to be used as good approximations of actual distances and walking times. As shown below the data analyses tend to support this assumption.

The proportion of households (wives) complaining about access to water ranges from 10 % to 72 % in the 21 Iringa villages and from 10 % to 88 % in the 21 Mbeya villages. The mean distance variable ranges from 309 m to 6860 m and from 127 m to 2395 m in the Iringa and Mbeya villages respectively. The mean time variable varies from 12 min to 200 min (Iringa) and from 23 min to 156 min (Mbeya).[10)]

The rank correlation co-efficients between villagers' complaints and distance and time measures are shown in table 5.4.

The table shows that the time measure is better correlated with villagers' evaluation of water accessibility than distance measures (compare a and b). The reason is that the latter measure also reflects typography (steep hills, sandy and slow paths, etc) and service level (waiting time due to queuing). There is also a slight tendency for walking time in dry season to be better correlated than walking time to wet season source. In both regions the time used for the trip to the source in the dry season is significantly related to villagers' evaluation of accessibility.

If the analyses described above are carried out for each of the 8 zones separately a subtle but interesting tendency shows up. Relatively more households complain about accessibility in villages where actual distances are fairly low, compared to the percentage complaining in villages where actual distances are rather high: It indicates that people in villages with low accessibility have to some extent adapted themselves to prevailing water conditions, while people in villages with water schemes (relatively low distances) have higher expectations.

5.5.2 Water quality: villagers' evaluation versus objective measurements

The percentage of households (wives) in each of the surveyed villages that mentioned "dirty water" as a serious household problem is taken to be the quantitative expression of villagers' evaluation of water quality. Since "dirty water" may reflect an evaluation of pollution (E. Coli) or water colour (Opt) or water turbidity (FTU) all three indicators have been used as objective criteria in the statistical analyses. Results of water quality tests carried out by the Water Master Plan consultants on the most used source in each particular village have been taken as representative for the water quality in these villages.

The objective measures of water quality are often zero in the sampled villages. Therefore Spearman's rank correlation co-efficient (used in section 5.5.1) is not appropriate to test the relationship between the objective measures and villagers' evaluation of water quality. Due to the many zero-observations the data have therefore been dichotomized into non-polluted (E-coli=0) - polluted (E-coli≠0); no colour (Opt=0) - colour (Opt≠0); no turbidity (FTU=0) - turbidity (FTU≠0). Correspondingly, the villages have been divided into two groups. Those villages where the percentage of complaints about dirty water is below and above average for the region. For each objective measure the observations can now be classified in 2x2 contingency tables. The Chi-square test is then used to find the direction of the relationship between the villagers' evaluation of water quality and the objective measures. The strength of this relationship is tested by the Fisher Exact Probability Test.[11] The results are shown in table 5.5.

% of wives in each village mentioning "dirty water" as a serious household problem correlated with:	Iringa		Mbeya	
	direction[a]	P[b]	direction	P
Water pollution (E-coli)[c]	positive	0.5%	positive	not sign.
Water turbidity (FTU)[d]	positive	2.5%	positive	not sign.
Water colour (Opt)[d]	positive	5%	positive	not sign.

Read: In villages where E-coli level is above zero, more villagers tend to complain about "dirty water" than in villages where there were no E-coli found in the tested water. This positive relationship holds for both Iringa and Mbeya regions. For the Iringa villages this relation is significant.

a) As found in Chi-square tests
b) As found in the Fisher Exact Probability tests
c) As measured by Millipore test. (Data from village inventory)
d) The measures for colour (Opt) and turbidity (FTU) are strongly correlated. A definition of each can be found in UNESCO, WHO (1978, pg 57). (Data from village inventory)

Table 5.5 Water Quality: Villagers' evaluation versus objective measures

The table shows that there is a positive relationship between villagers' evaluation and the objective measures of water quality. Since this holds for all three objective measures and in both regions the direction of the relationship must be said to be fairly well established.

The same degree of confidence in the strength of the relationship is not warranted. Only the Iringa data exhibit statistically significant relationships. This should not surprise:

- The household surveys were not performed at the same time as the water quality tests were taken.
- Both the surveys and the quality tests are subject to measurement errors.
- And finally the water tested was from the most used source at the time of testing. Whether the selected villagers drew water from this particular source is not known. Some probably did - others didn't.

However, the analyses above strongly suggest that if water quality tests and household surveys were carried out at the same time, and if the water tested was from the source actually used by the households interviewed then both positive and significant relationships between villagers' evaluation and objective measures of water quality could be expected - also in Mbeya Region.

5.6 Conclusion

Villagers (wives) use up to three main criteria when evaluating water sources.

One relates to water accessibility. It is a very important criterion. Only 11 % of the respondents by-pass nearby source to draw drinking water far away. It appears that very good reasons must exist before water drawers are induced to by-pass nearby sources.

Poor water quality is normally among these reasons. This is also a very important criteria. It consists of a number of sub-criteria: dirtiness (colour); taste (sweet/salty); smell; temperature (cold/warm); and risk to health. Villagers in the sample made the following ranking (from best to worst) of water sources with respect to quality.

1. Tapped water
2. Wells, lined
3. Springs
4. Wells, unlined
5. Rivers/streams.

This ranking corresponds very well with the ranking arrived at by Brokonsult in its analyses of water quality tests from the whole of Tanzania.

The water use criteria is not as important as the two others. It reflects the extent to which users experience problems with other users drawing water from the source (unhygienic conditions caused by other drawers, children, cattle etc.).

Villagers' expressed dissatisfaction with water accessibility and water quality reflects the actual water conditions fairly well. Distance measures (especially walking time in dry season) correlate well with complaints about water accessibility. A consistent relationship between water quality measures and complaints about water quality was also found.

5.7 Consequences for planning

The findings above have the following consequences for the planning of rural water supplies:

a) Domestic points and hand pumps located further away from a particular family than a traditional source are unlikely to be used for drinking water unless the water in the traditional source is of very clearly inferior quality.

b) If use of traditional sources for bathing and laundry is to be prevented then the accessibility of the improved water becomes even more important.

c) Disregard of villagers' views on water quality of proposed sources will increase the risk of non-acceptance.

d) A water supply project should be designed to avoid problems among users. Key factors are: a reasonable number of people per domestic point (DP); adequate water pressure at each DP; and adequate drainage around DP. Village participation should be relied upon to ensure peaceful use of improved water sources.

e) Walking time to the water source in dry season is an objective measure which reflects villagers' felt need for improved water accessibility. It should therefore be used as a priority criteria. As an approximation, distance and altitude difference source to village are proposed in chapter 12, as information on these were collected during the village inventory.

f) Water quality measures (E-coli, colour, turbidity) or a combination of them may also be considered as a priority criteria because they do reflect villagers' felt need for water quality improvements.

Notes

1) Mtavangu G.K. and I.V. Mbaga
"Promotion and Health Educational components of the Wanging'ombe Rural Sanitation Project", in Wright A.M (ed), Seminar for Key Project Personnel held at Soliwayo, United Republic of Tanzania, 24-25 February, 1981, Proceedings, Government of Tanzania, UNICEF, UNDP, TAG. (TAG/Ta/11) p. 40.

2) This fraction is not representative for the regions as a whole. The selection of villages was not random. Tap users are over-represented in the sample. (See Appendix).

3) Only 3 dislikes by each respondent were coded. Typically respondents put forward 2 dislikes. The percentages in the table therefore add up to over 100 %.

4) For instance "little or no water", "wait too long" and "problems with others" are overlapping complaints.

5) Brokonsult
Rural Water Quality Programme in Tanzania, Final Report
Main text. United Republic of Tanzania, Ministry of Water Development, Energy and Minerals. 1979 pp. 36-44.

6) Personal Communication with Peter Hawkins, June 10, 1980.

7) Shinyanga Water Supply Survey, Technical Annex D, Sociology, Final Report, October 1974, (The Hague: NEDECO). p. 67.

8) No statements on water accessibility were found in the Tanzanian literature known to us.

9) Household and village problems are further discussed in chapter 4.

10) Both distance and time measures refer to one-way trips.

11) Siegel
Nonparametric statistics for the Behavioral Sciences
(Tokyo: Mcgram - Hill Kogakusha). pp. 96-104.

6. PARTICIPATION IN WATER SUPPLY DEVELOPMENT

6.1 Introduction

The provision of adequate water supplies to rural areas has been given high priority in Tanzania on both economic and social grounds. Aside from the importance of water in agriculture and the livestock industry, the provision of water of good quality for domestic use is viewed as a necessity for the achievement of a better quality of rural life, both in health and convenience. In light of this thinking, Tanzania government has committed itself to the provision of adequate water to all rural inhabitants in a twenty year period starting with 1971; and major efforts have now been made to accelerate the development and supply of potable water.

The stated strategies for solving the rural water problem are of two basic types: one, to increase investment in machinery, equipment, and in the technical manpower necessary for water development; and another, to mobilize efforts of the local people in the development of water supply schemes[1)].

Tanzania prefers a participative approach in the development process because first, it is believed that that is the only way in which development can be achieved and, second, because it reflects the organizational patterns of most of the country's traditional societies. Thus, the country's development policy states clearly that any project that relates directly to the well-being of the people should be considered, planned and implemented by or with the cooperation of the people who are to benefit from it. According to this policy then one would for example, expect to find people participating fully in deciding and implementing their water projects.

The expected participation would have to be in all phases of a water project. In an attempt to understand how best rural communities can be effectively involved in the development and operation of water schemes, section 6.2 will review briefly Tanzania's experience with participation in water supply and see whether the actual practice of involving local people conforms to what the policy requires. Section 6.3 will examine MAJI organization and how it performs its duties. This section will be followed by a discussion of typical problems which affect rural water schemes (6.4). Willingness and capability of village communities to contribute to operation and maintenance of water schemes will be reviewed in section 6.5. Suggestions of how rural communities can be involved in water programms will be presented in section 6.6 to be followed by a review of experiments with participation which have been conducted in schemes which have been funded by DANIDA (6.7).

6.2 Country's past experience with participation

6.2.1 Planning

Planning involves essentially two activities: One is deciding what has to be done and the other is planning how to implement the decision. Some studies which have been conducted in Tanzania already indicate that in many cases the idea of building improved water supply schemes have originated from the local people[2)]. It is not difficult to understand why this has been so. Usually people who have experienced water problems tend to express their need of having an improved source of water to someone whom they expect to be in a position to solve their water problem. In a study of village participation which was conducted in some villages in Lushoto, Arumeru, and Masai districts it was found out that many people were aware of the need of having an improved water supply system. It was also found out that many of them had expressed the need and interest in the development of an improved water supply system in their villages.

The fact that village people have in the past expressed their need for improved water supply presupposes that there has been forums which local people have used to express their views. In many cases these forums have been village meetings.

It is, however, difficult to determine the nature of the discussions which have been taking place in villages on water development nor is it clear whether the village discussions covered all the aspects of scheme development or dealt simply with the expression of the need of an improved water supply scheme. It is highly probable that the people's involvement in decision-making was limited to expressing water needs. Very often when village people have been asked about their participation in the planning of the schemes, the answers given indicate that the local people are not involved in deciding the source of water to be used, the method to be used in the construction, location of storage tanks, pipes and taps or even how the operation and maintenance should be arranged.

It is obvious that although the village people may have been involved in the expression of the need for a better water supply system, the actual planning is usually carried out entirely by the staff of MAJI. The planning procedure followed by MAJI in the planning of water supply schemes does not allow for popular participation during the planning phase. Very often the survey of the source of water, the design of the storage tank and the distribution system are handled by the personnel from MAJI without any consulations with the village community.

Lack of consultations with village people may have been due to several reasons. First, the technical staff of MAJI view their function primarily in terms of

providing technical expertise which the rural people do not have. Therefore, they might have seen no reason why they should waste their time consulting with the rural people on technical matters which they are not well informed about. Second are the rigid procedures which the water technicians have to follow in designing water schemes. No technician is willing to depart from the standard design in order to incorporate the wishes of the villagers which may not conform to standard designs.

Thus at the planning stage rural people are not involved, not even in deciding on how they are to participate in the construction of the scheme. Lack of full participation of local people in decision-making about the different aspects of the schemes tends to reinforce two false opinions. First, that government has an obligation of constructing water supply schemes for the rural communities, and second, that water schemes are not the property of the village communities and as such the local people are not entitled to say anything.

People's involvement in planning can be increased since basically rural people are always eager to express their opinions on what is being done for them. There are great possibilities of involving local people effectively in deciding on which water source to use, on the capacity of schemes, on the layout of distribution systems and on the type of water use. This can be done by consulting with all interested parties in the village and letting their views and their water needs be known during the planning phase.

6.2.2 Construction

Of all the phases of a water supply scheme development, the greatest participation has been in construction. Several methods are known to have been used to mobilize people. The most common method has been to call a village meeting and inform the villagers in what way they have to contribute in the construction of the scheme.

There has been two main forms of participation in the construction of water schemes. The most common has been the contribution of physical labour. The other one, which has been less common, has been contribution of money. In very few places some people have participated by contributing cattle.

Participation by contribution of physical labour has involved performance of such jobs as collection of sand, stones, digging of trenches for pipelines and filling them up, carrying of pipes, making of bricks, mixing sand and cement and assisting masons when constructing such things as storage tanks.

Community participation in water schemes has mainly been in providing unskilled labour which has been supervised and directed by MAJI technicians or other technicians attached to agencies involved in the development of water supplies.

Tanzania's policy, as was mentioned in the preceding paragraphs, favours community involvement in all phases of water supply development. In practice, however, people who are entrusted with the responsibility of developing rural water supplies do not favour the use of voluntary labour especially during the construction phase because of coordination problems involved. They usually argue that it is difficult to have control of voluntary labour. Very often workers turn up late for work and leave for home early. Sometimes it is difficult to plan a day's work because of the unreliability of labour turn-up. The end result of these problems is slackness of work and delays in completing water schemes.

6.2.3 Operation and maintenance

Continued functioning of the existing rural water supplies depends very much on the way these schemes are operated and especially on the maintenance process in force. In many rural water schemes in Tanzania, operation and maintenance has been the responsibility of MAJI department. Due to the rate at which rural water supply schemes fall in disuse in spite of MAJI's efforts to keep them operating, community participation in both operation and maintenance is now viewed as being quite essential for continued operation of these schemes. There are already a few places where attempts have been made to delegate the responsibilities of operation and maintenance to local communities.

Community participation in operation has been in a form of, for example, the community paying the pump operator or in paying for the cost of collecting fuel to run the engine. The results of these attempts have not been very encouraging. Villages have in some cases failed to pay the pump operator or even failed to collect fuel (which was being given free by government). There has been numerous failures in involving communities in the operation and maintenance and as a result MAJI has been forced to take over the responsibilities of operating and maintaining the schemes already developed.

In spite of the failures of early attempts of involving local communities in operation and maintenance, it is clear that, given the number of water schemes in the country and the resources available to MAJI, there is no way in which MAJI can maintain all the existing schemes. Continued operation of existing water supply schemes and those that are to be built in future will depend on village participation in operation and maintenance. MAJI has no resources, be they financial or human, to fully operate and maintain all water schemes. Probably what is needed is a proper program or arrangement of involving local communities in the performance of these tasks. In section 6.6 suggestions on how community involvement can be enlisted will be put forward.

6.3 MAJI organization and operation in water projects

The use of resources for improvements of the rural water supplies is almost exclusively controlled by the government machinery. In this machinery the main agency is MAJI. The way MAJI is organized and works at the regional and district level is therefore to a large extent determining the degree to which village participation in the sector is possible at present. (The central ministry of water is only marginally involved except on national projects).

6.3.1 MAJI: The organizational set-up

Some of the constraints to village participation are to be found within the MAJI organization itself as illustrated by the description below.

The formal set-up

The organizational chart for MAJI (Iringa) - an abbreviated version of a chart prepared by the Regional Water Engineer's Office in August 1980 - is shown in figure 6.1[3)]. At the regional level there are six divisions: Finance and Administration; Construction; Planning and Project Preparation; Maintenance; Urban Water Supply; and Special Projects. Each division is formally divided into a number of subsections as is also shown in figure 6.1. The district level organization has, or is planned to get, the first four mentioned divisions. The expansion at the district level is proceeding but not yet complete.

One feature of this organizational set-up is striking: It is based on a formal - not a functional division of labour. Take the regional level organization: Construction activities are carried out by the Urban Water Supply Division; by the Construction Division; under the Special Projects; and by the Shallow Wells Programme under the Planning and Project Preparation Division. Parts of the maintenance of the rural water supplies (plumbing) is carried out under the Urban Water Supply Division, while part of Urban Water Supply maintenance is carried out under the Regional Maintenance Unit. Parts of Stores are under the Finance and Administration Division supplying the Administration and the Construction Division. However, the Regional Maintenance Unit has its own spare parts store. A final example is the Hydro - and hydrogeology sections that are under the National Projects although the main work of these two sections supposedly is to provide input for the Planning and Project Preparation divisions.

This proliferation of functions is probably a result of lack of a clear-cut strategy for the development of the rural and urban water supply sectors due to the ab-

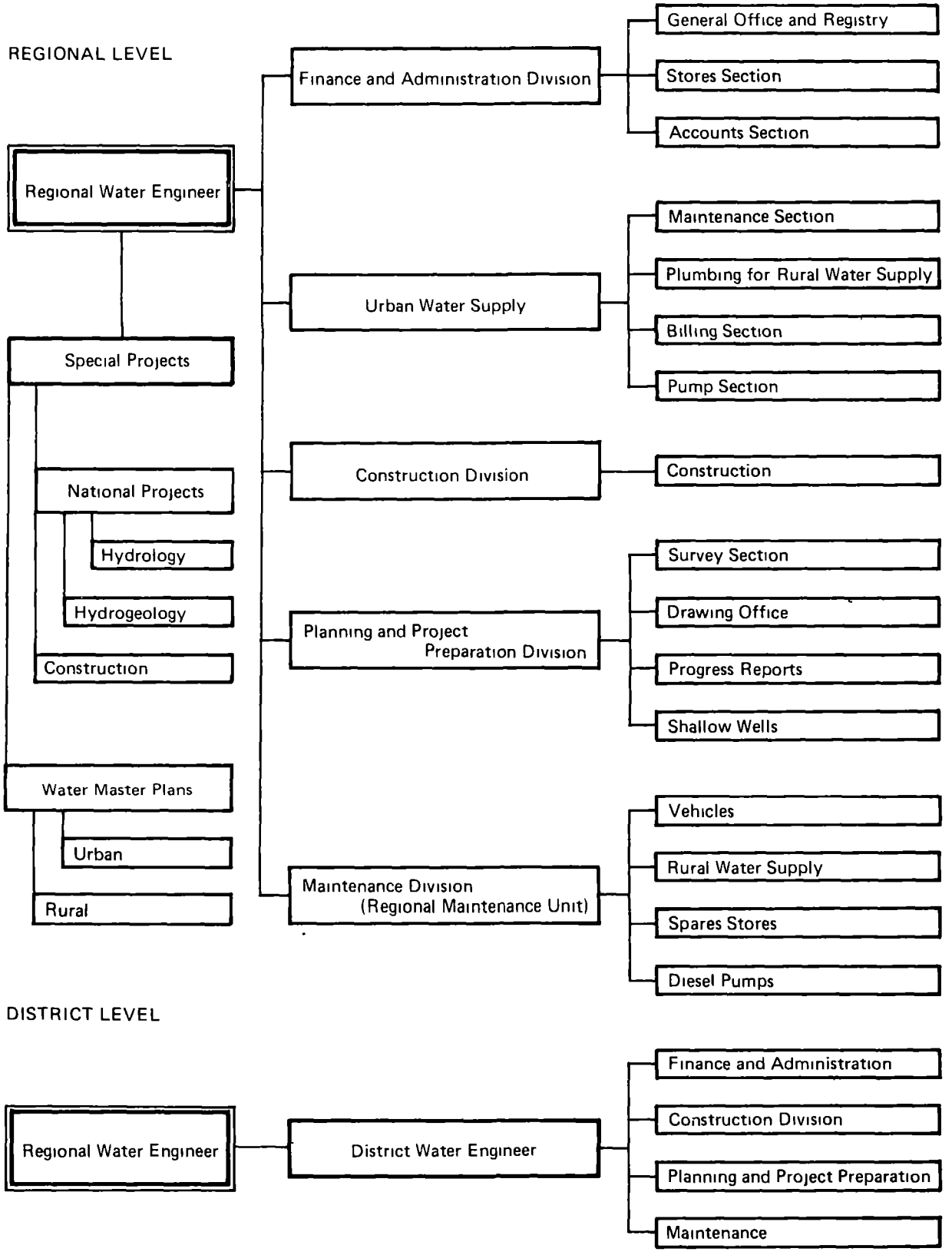


Figure 6.1 MAJI ORGANISATION CHART

sence of national and regional guidelines. Every new activity within the water sector (water master plans for the rural and urban sector; the shallow wells programme, etc) tends to be added onto the existing framework. Very little integration of activities takes place.

This system is difficult to manage for the senior staff and is confusing for the lower level staff. It is, of course, also confusing to outsiders. Village representatives requesting a maintenance job to be done might easily get lost in the intricacies of the system.

The actual set-up

Figure 6.1 pictures the formal organizational set-up. It suggests that - at least with respect to routine duties - the Regional Water Engineer has delegated specific responsibilities to the different divisions, and that responsibilities within divisions are delegated to the various sections.

This picture is partly deceptive. The Regional Water Engineer (or his deputy) is actually involved in most day-to-day decisions - especially those involving financial expenditures or transport. An organizational chart which more accurately presents the working of the system would resemble a spider's net. At the center is the Regional Water Engineer (and his deputy) surrounded by the different divisions and sections to which he has a direct line or command.

When so many decisions have to be made by one or two persons, decision-making is bound to be slow and tedious for everybody involved: the Regional Water Engineer himself, his staff and the ultimate customers - the water consumers.

But even the spider's net picture is partly deceptive. It suggests that each division/section has a fairly clear line of command to the Regional Water Engineer. Actually several sections and subsection heads are in doubt about how their functions and relationships to other sections and divisions are defined. It is common to find in the regions two section heads claiming that a certain (crucial) subsection is under their responsibility while the head of that subsection claims that he is directly under the Regional Water Engineer.

Another section head claims to be in charge of substantially fewer employees than he is actually assigned according to the staff listing and the organizational chart. He rejects responsibility for certain subsections.

Integrated planning of the activities of the different divisions and sections within MAJI does not take place to any significant degree. Thus the stores section is not informed about material requirements of projects that are under preparation in the Planning and Project Preparation division. Some planning does, however, take place at the Regional Water Engineer's Office. It is done without

much involvement of the heads of divisions and sections. Any forward planning involving government funds is unfortunately hampered severely by government regulations stipulating that funds are only available for one year at a time (sometimes just one quarter of a year)[4]. In a situation with severe shortages of building materials this system makes it impossible to avoid stop-go-stop construction of water schemes. A construction period on 3 - 4 years for a simple scheme is therefore not unusual.

Job descriptions for the higher level technical staff and for certain divisional and sectional staff do exist but are not always followed. It is partly due to the constant movement of personnel within MAJI and between MAJI and outside work places and institutions, which makes it necessary to make ad hoc changes in job responsibilities. Many of these movements are not controlled by the District or Regional Water Engineer's Offices. They are decided by the Ministry or by the Regional Authorities. This flux of personnel is confusing for the water customers who rarely, if ever all kept up-to-date on such changes. And it makes accountability harder to achieve: mistakes are of course the responsibility of the "predecessor".

It is paradoxical that an organization like MAJI, which is supposed to be deeply involved in the participation process, is itself an extremely hierarchial organization in which planning is non-flexible (to the extent that it takes place at all) and personal accountability by the lower and middle level staff is shunned (see below).

In a sense MAJI is like any other large public organization all over the world, which is organized in a hierarchial manner: the power of decision tends to be located in a blind spot. Those who have the necessary information do not have the power to decide, and those who have the power to decide cannot get the necessary information[5].

6.3.2 MAJI: How the organization works

A water supply project runs through four stages: selection, planning; implementation; and operation. The description which follows below of the present role of MAJI and of villagers in each stage will highlight some of the problems mentioned in Section 6.3.1. They influence the possibilities of village participation at each stage of the project cycle.

Selection of schemes

Some villages undoubtedly become candidates for a water supply scheme because their request has been forwarded through the proper channels (ward, division,

district, region, central government, parliament and back). But this route is complicated. Even before a request has been approved by the regional authorities it must go through seven different committees[6]. The regional demand for development capital must then be matched by the supply of capital from the central government - subject to parliamentary approval. Obviously many village requests go unheaded due to the general shortages of funds.

Village requests which do attract funds have often been forwarded long ago. Therefore few village leaders see any link between a previous request and the start of a water supply scheme in their village (see 6.7.1). The time lag is simply too big.

Ordinary villagers are not encouraged by this situation either: in villages without a water supply more than half of all female and male respondents in the three regions claimed that they had approached their village government to get it to do something about the water situation[7]. But when they are asked about the obstacles which had prevented their village from improving their water situation, the respondents partly point to their own lack of self-confidence and partly to their frustrations with government and leadership. Table 6.1 summarizes the obstacles to improvement of water situation for Mbeya Region (the Iringa and Ruvuma data look roughly similar).

Obstacles	Female %	Male %
Villagers have "no strength"[x]	26	22
Leadership problems	39	26
No help from government	23	33
Other	12	18

x) Includes "no ability"; "no money"; "no knowledge".

Table 6.1 Obstacles to improvement of water situation as perceived by male and female respondents in Mbeya Region.

Another reason why this bottom-up planning system fails to encourage village participation in resource allocation is that villages are very rarely told about the reasons for delays, rejections or even approvals of requests. Prompt information of this type is essential to make bottom-up planning processes work in a situation of resource scarcity where rejections of requests is the general rule.

When formal procedures are cumbersome they are often by-passed. Projects for which MAJI has made a survey (maybe even a design) stand a much better chance of approval than requests from non-surveyed villages. Often the District Water Engineer's Office will identify those villages that are to be surveyed. Also the Regional Water Engineer's Office may identify such villages. A politician or an influential individual may cause a village to be put on the survey list too. Although a village request for a water supply may also cause a survey to be made this seems to be an exception rather than the rule.

One District Water Engineer explained that his selection of villages to be surveyed was based on a principle of "areal equality": Villages in divisions with only a few existing schemes stand a better chance for selection than villages in divisions which already have many existing water schemes. This principle seems to reflect fairly well the political realities of rural development efforts in Tanzania[8]. The selection of villages that are surveyed and eventually receive a scheme also seems to be biased towards large villages with an otherwise well developed infrastructure[9].

Planning

Actual survey work is subject to approved funding. Resources for this purpose are allocated in the Five Year Plan - and more specifically in the yearly development plans for the regions and the districts. The smaller projects are surveyed by the District Water Engineer's Office, while large schemes - and National Projects - are surveyed by the Regional Water Engineer's Office[10]. Almost all designs and cost estimates are done by the Regional Water Engineer's Office. Only rarely are they done by the District Water Engineer's Office (small projects) or by the Ministry (very large or complicated projects). Final approval of the designs and cost estimates is sometimes done by the Ministry. The present trend is, however, that the Ministry is less and less involved in this aspect of technical and financial control.

The survey performed by MAJI is one of the most decisive events in the life of a project. Not only does a survey improve the chances of early funding as explained above. It is also during the survey that the main features of the project design are established: Location of intake, tanks, main lines and domestic points (in case of a gravity scheme). These decisions are normally made in the field by the surveyor.

The surveyor may be experienced but he is not an engineer. At best he only has basic knowledge of hydraulics. Yet he performs the most important job of the design engineer: the conceptualization of the scheme. The design engineer does

normally not visit the site before he starts design work. He has only the surveyor's maps of the project area to go by and he can therefore make no alternative scheme lay-outs. The time lag between survey, design and implementation is often considerable. The Image project, for example, constructed in 1981 (described in 6.7) was surveyed in 1974. Significant changes in settlement patterns may take place in the intervening period. They ought to lead to new surveys and/or changes in scheme lay-out, but they rarely do.

The planning of materials procurement ought to be an integral part of project planning. It is not. Due to government regulations it is difficult to purchase and stock materials. Materials are therefore purchased, only when project funds are approved (see below).

It is not required that a surveyor seeks advice from villagers on source selection, locations of main lines or even domestic points. Influential people may, however, be able to persuade the surveyor to locate domestic points close to their houses (see 6.4). According to the majority of survey maps most houses in villages are placed along the main roads and consequently the surveyor locates the majority of domestic points here (see 6.7). It is quite apparent that much more effort is put into the survey of main trunk lines and other technical features of the scheme than into a proper survey of settlement patterns. No wonder that there is often a considerable mismatch between the location of domestic points and settlement patterns - also in brand-new water supply schemes.

Implementation

If a project is approved by Parliament, funds will normally be released at the start of the Financial Year (early July). The approved funds must be spent within the Financial Year for which they have been approved. Unused funds go back to the Treasury at the end of the Financial Year. It is quite complicated to transfer unused funds from one project to the other. However, subject to approval by the Regional Development Director's Office and the Treasury it can be done.

It follows from the description above that materials procurement cannot start before project funds have been secured. Due to the general shortage of materials, it is therefore often difficult to get a project off the ground until late in the Financial Year. If a project is not finished within that year new funds must be secured by sending a renewed proposal through the funds allocation procedure once more.

Until recently the political pressure for starting new projects has been very strong. This has resulted in scores of unfinished projects, the completion of

which may take anywhere from two to six years. Such pressures together with the recurrent shortage of funds and/or materials result in a go-stop-go pattern of construction which is rather costly in economic terms and which is completely detrimental to attempts to encourage village participation in the implementation process. New government guidelines stipulate that completion of ongoing projects should be given first priority. To which extent this will be followed is not yet known.

Working under such conditions, it is quite understandable that MAJI is generally very reluctant to inform villagers about projects that are in the pipeline. This is done to avoid raising expectations which MAJI may be unable to meet. The news about a forthcoming scheme therefore often arrives to the village immediately before construction starts when MAJI people arrive to look for a camp site.

Actual construction work is shared between the District and the Regional Water Engineer's Office. The former normally implements smaller projects, while the bigger (national) projects are left to the latter. On-the-spot changes of designs appear to be frequent during construction, as they must be, when survey, design and implementation are done in an uncoordinated fashion and when the specified materials are often not available.

Many villagers perform unskilled jobs such as digging trenches during construction as table 6.2 shows. Men tend to be more frequent participants than women. Contributions in cash or kind have also been quite normal in the Mbeya villages. (Results from Iringa region show similar trends).

Contribution	Female	Male
None	38	24
Labour (unskilled)	49	61
Cash or kind	12	14
Other	1	1

Table 6.2 Contributions to construction of water scheme. Female and male respondents in villages with a water scheme. Mbeya Region.

Contribution of cash occurred more frequently during the pre-decentralization period, when district councils were responsible for securing a part of the development funds. After 1972 such contributions have become rare. (With the reintroduction of District Councils by July 1982, contributions in cash or kind may again become the order of the day).

Trench digging in itself does not teach villagers something new which they do not already know. Neither does it necessarily create any feeling of ownership among villagers. It all depends on who organizes trench-digging and how this is done.

There appear to be some problems in this organization and management of self-help labour at the point of work. On the one hand, MAJI-people often complain about great absenteeism, and poor workmanship when self-help labour is involved. On the other hand, villagers often feel they are being forced to work for free on a project which is not their own. In the end MAJI often pays unskilled labour from the villages for digging trenches, and filling them up after the pipes have been laid.

Apart from trench digging it is not usual that villagers are involved in other construction activities - unless they are paid.

Operation

Once schemes are completed they are taken over by the District Water Engineer's Office regardless of the size of the projects. Scheme attendants paid by this office look after the day-to-day operation of the schemes. Fuel for pumps is likewise paid for and provided by this office. Villagers are not involved - nor do they contribute towards the costs of operation.

Normally the District Water Engineer's Office does all maintenance work on gravity schemes - and pays the costs. Pumps and engines are normally maintained by the Regional Maintenance Unit. Funds for this activity are channelled through the Regional Water Engineer's Office.

The day-to-day work concerning operation and maintenance is done by scheme attendants. There is now a tendency to select scheme attendants from the villagers in the scheme area. But this is not and has not always been the case. Scheme attendants selected among villagers are normally trained during the construction phase. No refresher courses are given later[11)]. Many scheme attendants work under very difficult conditions, as illustrated by the example below of a complete list of stock of spare parts and tools shared by three scheme attendants on a group scheme serving approximately 7,000 people in 4 villages:

- 15 Nos. 4" p.v.c. pipes
- 1 No. 1½" p.v.c. connectors
- 2 Nos. 1" p.v.c. connectors
- 1 No. 1" G.S. union
- 5 Nos. 3/4" elbows
- 2 Nos. 3/4" elbows

- 1 No. 3/4" connector
- 1 No. 3/4" brass gate valve
- 6 Nos. 3/4" brass taps (out of order)

The problem of operation is also aggravated by the shortage of tools available to scheme attendants in the four villages. To serve the scheme mentioned above, the attendants had only the following tools:

- 2 Nos. large spanners (in working conditions)
- 1 No. 12" spanner (in working condition)
- 1 No. large spanner (out of order)
- 1 No. hacksaw (out of order)

It is interesting to note that this scheme was operating every day for the 3 weeks while household surveys were being conducted in the area.

Not all villages with a water scheme are in the same fortunate position. Some schemes have frequent breakdowns. No estimate of the prevalence of such breakdowns can be calculated from the household survey since only villages with schemes in working order were included in the sample. However, breakdowns occur in all schemes. Table 6.3 lists the reasons for them according to the male villagers interviewed. (Female responses were not significantly different).

Reasons for breakdowns	Iringa Region % of respondents	Mbeya Region % of respondents
Pipes/taps broken	49	15
Pump broken	10	2
No diesel	-	14
Source dries up	13	5
Bad maintenance/no scheme attendants	2	47
No spares	-	1
Other	26	16

Table 6.3 Reasons for water scheme breakdowns as perceived by male respondents in villages with a water scheme. Iringa and Mbeya Regions.

Broken taps and pipes, bad maintenance and lack of diesel all point to weaknesses in the maintenance organization of MAJI[12]. The problems include the following:

- No preventive maintenance is done
- No regular visits to schemes are undertaken
- Systematic records of corrective maintenance work are not kept - neither at the scheme site or in the MAJI Office.

- Shortage of recurrent funds
- No clearly defined channels which villages can use to get in contact with MAJI when their scheme needs repair, fuel or any other assistance.

To this should be added the tendency to downgrade the importance of maintenance in the face of political pressure for new projects and the lack of interest among some MAJI personnel for this type of work. But no doubt MAJI could perform better even with the present resources. As an old employee in the maintenance section sais: "Some years back we had our own vehicle. Today MAJI has more cars but we are rarely allowed to use them". The poor maintenance system is also a result of the low priority given to it.

When there is a problem with a scheme, villagers tend to approach the scheme attendant or the village government. But as table 6.4 also shows, many respondents take no action - especially the women (Iringa data look similar).

Complaints to:	Female %	Male %
None	55	27
Neighbours/friends	14	7
Scheme attendant	22	32
Village government	8	33
Other	2	0

Table 6.4 Agents to whom one complains when scheme breaks down; Mbeya Region. Respondents in villages with a water scheme.

Village governments, which according to the table receive a good share of the complaints, are generally not very active in getting something done - at least not according to the MAJI files. These files contain very few letters from village governments informing MAJI on breakdowns. And given the lack of spare parts and tools there might not be much point in asking the scheme attendants to do the repairs.

Operation and maintenance of schemes - not the construction of them - is the real problem in the rural water sector.

Evaluation

MAJI makes no periodic or systematic evaluation of the operational conditions of schemes. In the quarterly and annual reports from the District and Regional Water Engineers it is implicitly assumed that all schemes work and that each

scheme is used by all families in the villages covered. That is why official figures on the number of beneficiaries of water supply schemes are overestimated (see section 6.4). Files on each scheme are kept, but they are not up to date and they give no systematic information on the actual condition of the scheme. Neither are external evaluations (by regional authorities, CCM or others) undertaken.

So once a scheme has been built it is de facto taken over by the villagers: Little money to the maintenance of it is forthcoming; repairs that cannot be made by the scheme attendant(s) with spares left over from construction are rarely done; and MAJI inspection visits are only sporadic.

6.4 Typical problems of water schemes

In spite of great efforts and vast amounts of money which have been spent by government and other donor agencies to improve the conditions of water supply to rural communities yet there are still a lot of complaints even in areas where water schemes have already been constructed. Based on information collected in Iringa, Mbeya and Ruvuma regions, this section will examine briefly the problems which still affect a smooth functioning of water schemes in rural areas.

Typical problems of water schemes in rural Tanzania appear to be mainly of a planning, operation and maintenance nature. Because of the inherent weaknesses in the planning processes, it is found that in some areas there are very low usage of the water schemes. Furthermore, poor operation arrangements and especially unsatisfactory maintenance processes affect the number of potential beneficiaries of the schemes in question.

Reliable operation and convenient distances to domestic water points are the two main factors that determine whether or not a scheme will be used by villagers. Furthermore, the quality of the water at the source influences the health benefits that villagers could potentially get from drawing water from that source. Low usage of a scheme may be caused by problems with any one or more of these factors.

Tanzania design standards for rural water supply schemes, require that in any village with a water supply, no household should have more than 400 metres to walk to a domestic water supply point. The actual practice, however, seems to depart significantly from this design standard. Why is this so ?

6.4.1 Location of domestic water points

A total of 15 villages with a water supply scheme in working condition were visited by the socio-economic group in Iringa and Mbeya regions during the

household surveys. Only a part of the households in these villages were, however, provided with water according to the Tanzania design standards as shown in table 6.5

	Iringa[a]	Mbeya[b]
- Households using domestic points (%)	64	69
- Average distance to domestic points (m)	404	248
- Households less than 400 m to D.P. (%)[c]	61	85
- Households 400 - 800 m to D.P. (%)[c]	18	11
- Households above 800 m to D.P. (%)[c]	22	4
- Households not using D.P. (%)	36	31
- Average distance to traditional sources (m)	1,193	222
- Households served according to Tanzania design standards (%) (d)	39	59

(a) Matamba, Mlangali, Lugarawa, Kiponzelo, Nyambula, Igula, Kihorogota.

(b) Utengule, Rujewa, Mwambani, New Mbangala, Ikama, Katela, Lema, Kateela.

(c) Weighted mean of those households drawing water from a domestic water point.

(d) Households using domestic point less than 400 m away; water quality not considered.

Table 6.5 Distances to domestic water points (DPs) in villages with a working water supply scheme. Iringa and Mbeya Regions.

The percentage of households served with improved water within 400 metres walking distance is 40 % - 60 % in these villages - depending on the region. Here is also a significant variation between villages. Those receiving a lower level of service are households drawing water from domestic points located more than 400 metres away, and households drawing water from traditional sources located more conveniently or supplying water of a quality which users perceive to be better. Table 6.6 shows the usage of existing water schemes at the time when the study was made.

Iringa Region	Village usage % of respondents	Mbeya Region	Village usage % of respondents
Matamba	100	Wengule	36
Mlangali	0[X)]	Rujeva	93
Lugarawa	31	Mwanbani	47
Kiponzelo	66	New Mbangala	100
Nyambula	52	Ikama	70
Igula	100	Katela	50
Kihorogot	100	Lema	67
		Kateela	87
Average	64		69

x) Scheme working; no household in sample used it.

Table 6.6 Usage of water schemes at the time of interview; respondents in villages with working water schemes; Iringa and Mbeya.

Three main factors account for this rather discouraging situation. Although a scheme may be working as a whole, several taps may be broken or the water pressure at certain domestic points may be low causing excessive queing. In both cases traditional sources become more attractive alternatives.

Secondly the drawers of water are, in general, not prepared to walk past a traditional source to collect water from an improved source unless the latter is perceived as being of clearly superior quality (see chapter 5). The scheme may be poorly designed and/or old, so that the locations of domestic points no longer match the settlement pattern. Especially in villages which got a water supply scheme before the villagization process started around 1974 - 1975 is this a problem. Unfortunately, it is precisely the households that (were) moved to such villages - often due to the existence of a scheme - which today are most frequent among the non-users of schemes. The reason is simple: late-comers were by necessity forced to locate at the edges of existing settlements where domestic points are rarely located.

And this brings us to the third factor - the often striking mismatch between the locations of domestic points and housing settlements even in brand-new schemes. This mismatch is mainly caused by an almost total lack of village participation in the planning of the locations of domestic points as further discussed in section 6.7.

6.4.2 Accessibility as a function of economic status

Accessibility to water within the Tanzania design standards seems often to be a function of the households' economic status. Households that have access to improved water within 400 metres walking distance are not representative for the village population as a whole. The wealthier households have in general shorter to walk to a domestic point than the less wealthy. This relationship between wealth and distance to domestic point is significant for both the Iringa and Mbeya samples ($P < 0.1$ %).

At the micro-level, a survey of the settlement pattern in one village, Matamba, Makete district, Iringa Region, (the high rainlands) provides further evidence of this relationship. Matamba village has a total of 466 houses of which 169 (36 %) have corrugated iron sheet roofs. This roof type is a proxy indicator of wealth, roughly dividing households into the relatively poor and the relatively wealthy. Along the main roads half of the houses have a corrugated iron roof. Behind the main roads only one quarter (27 %) of the houses have this type of roof. Because all 17 domestic points in Matamba except 2 are located along the main road the relationship between relative wealth and access to domestic points is also visually striking.

Even the exact locations of domestic points along the main roads can be explainted by factors such as wealth, status and public activities, at least in Matamba which is a divisional headquarter and formerly the capital of the chiefdom. Out of the 17 domestic points (of which 11 were functioning at the time of study) the following were the locational characteristics:

- a total of 8 (47 %) are located in front of public buildings (school, court, kindergarden, rural health centre, village office and market place).
- a total of 6 (35 %) are located in front of houses belonging to civil servants, working in the village or elsewhere
- the last 3 (18 %) are located in front of a guest house, a store and an unidentified house respectively.

It is possible that the locations of domestic points along the main roads have made roadside plots more attractive thus attracting wealthier people to settle there. On the other hand domestic points may have been located along the main roads precisely because that is where the influential households tend to stay. Whether the locations of domestic points reflect the existing differentiation of settlement patterns within villages or they have contributed to it, is thus impossible to say without more detailed investigations.

What can be said with some certainty is, however, that the locations of domestic points as presently seen in existing schemes, would be very different if villagers had been involved in the planning of water schemes (see section 6.7).

6.4.3 Operation and maintenance

Another area that is beset with problems in rural water schemes is the operation and especially maintenance. Many schemes are found to be unoperational partly because of breakdowns and partly due to other factors such as lack of fuel. This state of affairs seems to have developed because of the following factors: First, operation and maintenance has not been given enough funds. There seems to be a tendency of giving high priority to the development of new schemes at the expense of those already developed. Second, there is a general lack of proper arrangements for operation and maintenance both at district and regional levels. Third, those who are responsible for operation and maintenance of water schemes are not properly equipped with either tools or spare parts necessary for proper performance of their duties.

As a result of these shortcomings, many schemes do not supply water to the intended consumers. Household interviews conducted by the socio-economic group have revealed frequent breakdown of water schemes. A summary of answers to the question of breakdown is presented in table 6.7.

Region	"Scheme works few times or never" % of respondents
Iringa	10
Mbeya	26

Table 6.7 Villagers' information on breakdowns; male and female respondents; in villages with water scheme; Iringa and Mbeya.

Although no unambiguous definition of a breakdown is available, table 6.7 clearly shows that many schemes often do not operate continuously although there appears to be significant differences between the two regions.

6.5 Villagers' willingness and capability to contribute to operation and maintenance of schemes

In section 6.6 it is suggested that villagers (or villages) should contribute to the operation and maintenance of their own schemes. The question is whether they are willing to and capable of doing so ?

Willingness to contribute depends on individuals' own evaluation of the benefits of a water supply versus their economic situation. Capability to contribute is the outsider's (here the SEC-group) evaluation of the ability of households and/or communities to pay. Each concept involves subjective judgements by the potential contributor (willingness) and by the analyst (capability) respectively. These judgements are even made about a hypothetical situation, since at present nobody (officially) pays for improved water in the rural areas of Tanzania.

There need not be any predictable relationship between willingness and capability to contribute. From other countries there is much evidence to show that even when customers are wealthy they often refuse to pay for water. Consequently the only way to address the issue of payment in practice is to test the procedure "by gradual introduction of new tariff policies, and then to observe consumer reaction"[13].

Below follows an analysis of villagers' willingness to pay. It assumes that contributions come from individual households. This is followed by an evaluation of the capability of households to pay. But contributions may also come from village governments and therefore communal incomes are investigated, too. All this information gives a preliminary picture of some of the problems involved, but it does not diminish the need for a (painful) trial-and-error process of introducing payment in order to arrive at a realistic and workable policy on this important issue.

6.5.1 Willingness of households to contribute

All male and female respondents in the surveyed villages were asked the following question; "If this village gets a water supply system sometimes in the future it will cost money to operate and maintain it. How much money would your household be willing to pay towards these costs every year ?" Appropriate changes in the question were made for villages with a scheme. Table 6.8 gives an example of the answers obtained.

Respondent	Region	Contribution (shs/household/year)		
		Nothing	1-20	21+
Females, %	Iringa	12	53	34
	Mbeya	8	45	47
Males, %	Iringa	10	43	47
	Mbeya	10	35	55

Table 6.8 Respondents' willingness to contribute to operation and maintenance in villages with no water scheme. Iringa and Mbeya Regions.

Two interesting patterns emerge from this table. Relatively few respondents in villages without a water scheme (less than one in eight) were unwilling to contribute. And secondly, male respondents were generally willing to contribute more than female respondents claimed they were. The refusal rate by respondents in villages with a scheme is of the same order of magnitude (from 5 % to 17 %), and again the males expressed willingness to contribute more than the females.

A number of factors influence the respondents' willingness to contribute as can be seen in table 6.9. The four socio-economic factors (income, wealth, formal school education and adult education) all have a positive (sometimes strong) influence on the willingness to contribute. At least the three first mentioned factors are intercorrelated. Their positive influence may therefore reflect that the better educated households appreciate an improved water supply and have the wherewithal to pay.

Also the water situation facing the respondents has an important impact on their willingness to contribute. Thus users of dug holes; users having more than 30 minutes to walk to the source in the dry season; and users complaining about pollution of the source are all positively inclined towards contributions.

Users of tap water do not in general express willingness to contribute more than users of traditional sources as table 6.9 shows. This should not be a surprise. The relative merrits of the two types of supplies vary from village to village depending on the natural availability and quality of traditional sources compared to the improvement that a water scheme might provide. And one thing is quite clear: if a water scheme does not work, villagers' willingness to contribute is drastically reduced. Both male and female respondents in the villages with a scheme in a working condition at the time of interview expressed willingness to contribute significantly more than villagers served by schemes that seldom worked. Few people want to pay for undelivered goods.

6.5.2 Capability of households and communities to contribute

Table 6.10 shows the order of magnitude of the mean gross cash incomes per household in the different agro-ecological zones in which the socio-economic group has conducted surveys. These averages vary from approx. shs. 1100 to approx. shs. 5800 per family. The percentages of families who claimed not to have had any cash incomes vary between 0 and 22.

The zonal averages hide the often significant differences in mean gross cash household incomes between villages and households within villages. Such diffe-

Independent variable	Cases included	No. of zones significant at 10% level in dominant direction	No. of zones with positive/ negative relation +	-	Conclusions[a]
Gross cash income per capita	Females no scheme	3	7	1	Higher income households express the highest willingness
Wealth[b]	-do-	4	6	2	Wealthier households express the highest willingness
School education; household head [c]	-do-	4	8	0	School education has a positive, significant influence on willingness
Adult education; household head	-do-	2[d]	5	3	Generally, adult education has a positive influence on willingness
Type of water supply; taps vs. traditional sources	All females	e)	4	4	Users of taps do not express greater willingness than users of traditional sources
	all males	f)	4	4	
Walking time to source in dry season	Females; no scheme	1	6	2	Generally long walking time has a positive influence on willingness
Complaints about pollution of source in dry season	-do-	1	6	2	Generally respondents complaining of source pollution express the highest willingness

a) All conclusions based on Kruskal-Wallis test (non-parametric one-way analysis of variance)

b) Corrugated iron roof used as proxy

c) Highly correlated with educational level of wife

d) Significant negative relation in one other zone

e) Significant negative relation in one zone; significant positive relation in two zones

f) Significant negative relation in one zone; significant positive relation in one zone

Table 6.9 Factors influencing willingness to contribute to operation and maintenance of water schemes. Iringa and Mbeya Regions.

rences are illustrated in table 6.11 which shows the results of a special survey conducted by the socio-economic group in the Wang'ing'ombe area (See Appendix). The four villages are located within the same division in the medium dry intermediate zone in Njombe District, Iringa Region.

The figures in tables 6.10 and 6.11 indicate an order of magnitude only. They are based on fairly short interviews, and totally rely on the memory of each respondent. Most likely the figures are underestimates of the true gross cash income. Obviously, data in net incomes are much more interesting because they indicate the level of disposable income. (See chapter 2 for discussion of mean zonal income figures).

Agro-ecological zone	Gross cash income per family (shs)	Gross cash income (shs) from				Families with no cash income %
		Crops	Livestock	Agricultural labour	Other x)	
Iringa Region						
High rainlands	2107	1007	115	189	796	1
Upper plateau	1484	461	281	297	445	10
Medium dry intermediate zone	1884	366	288	474	816	15
Dry northern fringe	2122	988	628	128	378	10
Mbeya Region						
Wet highlands	1122	601	113	14	394	10
Lake shore	1698	669	173	52	804	22
Dry plain	4002	1148	969	89	1795	9
Dry northern zone	4102	240	13	41	3809	7
uvuma Region						
Wet western highlands	5754	3989	128	201	1436	1
Intermediate zone	4336	3039	185	259	853	0
Dry eastern zone	1355	822	15	87	431	3

x) Mostly beer brewing; but also gifts, wages, and business.

Table 6.10 Average gross cash family incomes by zones; families with agriculture as main occupation; Iringa, Mbeya, Ruvuma Regions.

Village	Gross cash income per family (shs)	% Families in income bracket : 0	1-250	251-750	751-1750	1751-3750	3751-7750	7751+
Ilembula	5082	25	9	14	21	11	9	12
Wang'ing'ombe	3096	4	14	26	19	16	9	12
Igwachanya	1577	27	7	10	28	22	3	3
Magule	2737	7	18	18	18	23	13	4
All 4 villages	3105	16	12	17	22	18	8	7

Table 6.11 Average gross cash family income and its distribution: 4 villages in the medium dry intermediate zone. Iringa Region.

Similar data have been provided by Bo and Rasmussen[14] for 6 villages in Iringa Region, which are shown in table 6.12. The three villages in Iringa District are located in the intermediate zone. The three Njombe villages are located in the Upper Plateau (the Ubena Plateau). Average net cash incomes per household vary between 1000 shs. and 4400 shs. with a mean for all six villages around 2500 shs. Both the average level of net cash income and the variation between villages is worth noting.

	Net cash income per family (shs)	Net cash income (shs) from Crops	Livestock	Other agricult. a)	Communal activities b)	Wages	Other
Iringa District							
Masisiwe	2171	2107	- 18	80	-	-	2
Lulanzi	2072	558	59	354	-	120	981
Tagamenda	3794	664	198	367	-	1586	979
Njombe District							
Igagala	4368	3432	- 73	274	-	300	453
Ngalanga	1609	129	266	239	-	453	522
Ninga	984	355	- 80	198	43	421	47
Average	2500	1208	59	252	7	480	494

a) Mostly beer brewing

b) Surplus distributed to individuals

Table 6.12 Average net cash family incomes (shs) in 6 villages in Iringa Region.

Village incomes from communal activities

Villages undertake a wide range of potentially income generating activities. Among them are:

- Communal farms
- Maize mills
- Shops
- Godowns
- Tractor service
- Oxen/plough service
- Lumbering
- Guest houses

Villages can also generate incomes from:

- Crop levies
- Beer taxes
- Slaughtering fees

The most widespread activity is communal farming. Nearly all villages visited during the household surveys were engaged in it. Starting this year all villages must cultivate at least 100 acres communally[15]. Maize is the most frequently grown crop on communal farms in the three regions. Pure cash crops, such as pyrethrum, coffee, tea and tobacco, may, however also be grown.

Incomes from maize growing on communal farms vary widely between villages as illustrated in table 6.13. Some villages made handsome surpluses in 1979/80. Others lost money. In none of the villages visited the village authorities were aware of economic outcome of their maize growing activities[16].

Bo and Rasmussen[17] have made similar calculations for villages in Iringa and Njombe Districts. Their results are shown in table 6.14, which also indicates the level of income from crop levies.

Also table 6.14 indicates the wide range of incomes from communal farms. Crop levy income differentials appear to be smaller. In principle villages receive crop levy on all products they buy on behalf of the crop authorities, but these levies are not always promptly paid by the authorities[19]. However, table 6.14 shows that villages do in general, generate rather substantial incomes.

Village profit and loss accounts and village balance sheets are normally not available or they are rudimentary or unreliable. It is therefore difficult to get a comprehensive picture of the net income from the other sources listed above.

Village (10)		Acres cultivated	Yield bags/acre	Total net income shs. x)
Matamba	Iringa	22	6	4148
Mbela	"	6	23	10323
Kinyika	"	41	13	29243
Kiyombo	"	113	2	- 4277
Mlangali	"	75	8	36641
Milo	"	80	4	9656
Mawala		62	6	7615
Shaurimoyo	"	75	5	5827
Kitayawa		5	0	- 14490
Ndiwili		12	0	- 3489
Average		54	5	8121

x) Gross incomes less expenditures for seeds, fertilizer and insecticides. Labour costs are not considered.

Table 6.13 Incomes from communal maize cultivation 1979/80. Information from village authorities in selected villages – in Iringa Region

Income from	Villages in Iringa district		Villages in Njombe district	
Communal farms	10521	(n = 8)	19851	(n = 14)
Crop levy e) (agency fee)	6799	(n = 9) same villages or others?	9625	(n = 9)
Total	17320		29476	

Table 6.14 Average net village incomes from communal farms and from crop levy 1978/79. Selected villages in Iringa Region 18).

Maize mills appear to be an important source of income for most of the villages which have one. Village shop projects seem to vary widely, and many shops no doubt run at a loss. Finally lumbering should be mentioned. This activity can generate substantial income, but normally not many villages are engaged in it.

Villages also have different expenses. Among the common types are expenses for seasonal inputs; allowances to members of the village councils; transportation of commodities to the shop; and payments of "posho" (allowances; compensation) to the village personnel not paid by the government or COM, like bookkeepers, shop keepers, resident village agricultural assistants, maize mill attendants and watchmen.

It seems that villages showing the best economic performance "are also the villages having most functionaries and with highest average education among leadership and functionaries"[20].

6.5.3 Experiences with villagers' cash contribution to Rural Development Projects

In several types of rural development projects village and government funds are matched in order to get a project off the ground. What have been the Tanzanian experience with this type of projects ?

The National Food Credit Programme (NAFCREP)

The NAFCREP started in 1978/79. It is mainly providing seasonal inputs for maize growing in order to increase production. Briefly the programme works as follows: Prior to the agricultural season,inputs are delivered to the village by the Tanzania Rural Development Bank (TRDB) on credit terms. At the end of the marketing season the village council is collectively responsible for the repayment of the loan. The seasonal inputs received are distributed to individual villagers by the village either on cash or credit terms. Recovery of individual loans is the responsibility of the village council - not TRDB. The only sanction available to the bank in case of insufficient repayment is to refuse new input loans to the respective villages. Within the village, it is the council which decides the sanction(s) to apply to the individual household.

The TRDB is facing serious problems with respect to the repayment of NAFCREP seasonal loans. For instance, of the loans disbursed during 1978/79 only 41 % had been repaid by the end of June 1980 at the regional level[21].

Provision of modern inputs seems to have little impact on this situation. There appears to be no correlation between high yields and high loan repayment[22]. "Rather it looks as if the procedures followed and the sanctions applied by the village government (towards defaulting villagers) are crucial. High recovery rates were found where there is close laison between TRDB and local leaders, and particularly where an active support and presence from district leaders were forthcoming"[23].

Four main factors have been identified as responsible for the low recovery rates:[24]

- Inconsistent policies for rural credit and loan recovery and sudden changes in them, leading to confusion among the borrowers
- Reluctance to apply sanctions against defaulting borrowers and absence of rewards to villages with good recovery performance
- Bad leadership at village, ward, divisional and district level and poor laison between TRDB and political and governmental leaders at all levels

Experiences	Regions				
	Dodoma and Singida	Shinyanga	Singida	Mtwara and Lindi	Mwanza
Scheme type:	- Pumped, diesel engines	- Shallow wells	- Shallow wells	- Shallow wells	- Shallow wells
Village responsibility:	- Select scheme attendants - Pay scheme attendants - Collect fuel at district headquarter	- Select scheme attendants - Pay scheme attendants - Preventive maintenance - Simple repairs - Clean well surroundings - Contribute 50 shs/year/ village	- Nominated villagers report faults	- Select scheme attendants - Pay scheme attendants - Simple repairs	- Contribute 25 % of well costs
Government responsibility:	- All maintenance - Pay fuel	- Check village maintenance - Larger repairs - Provide spares - Keep records on all pumps - Provide tool box and cap for scheme attendants	- All maintenance	- Maintenance back-up	- Remaining costs
Comment:	- All cheme attendants back on government payroll 1981 - Fuel transported to villages by MAJI	- Scheme attendants stopped work after few months - No village contributed 50 shs.	- No reporting after few months	- Not yet fully implemented	- Not known

Table 6.15 Tanzanian experiences with village contributions to operation and maintenance of water schemes 27)

. Inadequate administration of the programme including poor preassessment of candidate borrowers.

These findings have important implications for the practical arrangements for villagers' participation in rural water supply projects as will be described in chapter 6.6.

Operation and maintenance of Rural Water Supplies

White[25] has reviewed the Tanzanian experiences on village contributions to operation and maintenance of rural water supply projects. They are not encouraging. Table 6.15 gives a brief summary of experiences from seven regions. Based on these, White concludes:

"Seeing that community participation in (or indeed entire responsibility for) maintenance is viewed in some quarters as essential to the continued functioning of rural water supplies, and threfore as a necessary condition before more supplies should be constructed, it is distressing to note that the attempts which have so far been made in this direction have clearly failed. However, this failure appears to have been attributable to the fact that insufficient attention and resources were devoted to the attempts to make them succeed".[26]

6.5.4 Village contributions to operation and maintenance costs

Depending on the technology mix, rural water supply schemes typically cost between 150 - 500 shs/person to construct. As a rule of thumb the yearly operation and maintenance costs amount to 1.5 - 5 % of the capital cost per person. The order of magnitude of operation and maintenance expenses of different scheme types are given in table 6.16.

Technology	Capital cost (Shs/person)[a]	Operation and maintenance cost per year			
		% of capital costs	Shs/person	Shs/household[b]	Shs/village[c]
Surface gravity	300	2.5	7.5	41	14350
Surface pumped	500	5	25	138	48300
Borehole	700	5	35	192	67200
Shallow well	200	1.5	3	17	5950

a) based on projected scheme population 20 years from time of construction

b) assuming 5.5 persons per household

c) assuming 350 households per village

Table 6.16 Order of magnitude of operation and maintenance expenses. Selected scheme types 28).

These costs relate to a pre-participation situation. Village participation may decrease total operation and maintenance costs in three ways: Scheme attendants employed by MAJI are paid for a full job. Village employed attendants will probably only be paid (in cash or kind) for the actual amount of work performed. (See proposal in section 6.6). On most existing schemes the attendants appear to be grossly underemployed. Secondly a stock of spares and tools will be established at each scheme site, so that scheme attendants may do minor repairs and some preventive maintenance.

This reduces the need for MAJI-transport which presently is a substantive budget item. It should also be possible to realize relative reductions in the MAJI staff in the maintenance and administrative section when maintenance is decentralized to the village level. The magnitude of these potential savings are impossible to calculate at present. All that can be safely said is that the figures in table 6.16 overestimate costs in the post-participatory situation.

Contributions of the magnitude shown in table 6.16 constitute approximately from 1 % to 8 % of the <u>average</u> disposable household income. On the other hand communal income from an <u>average</u> village could cover the operation and maintenance expenses for shallow wells or a gravity scheme - but not pumping schemes - <u>if</u> these expenses were the only ones that a village incurred.

The conclusion is that not <u>all</u> villages are capable of paying the <u>entire</u> operation and maintenance cost <u>regardless</u> of scheme technology. The recommendation is that the village and the government should <u>share</u> the operation and maintenance costs. This involves, of course, an element of subsidy to each particular village.

How big a share of these costs should a village contribute ? In the end this question can only be settled through consultations among the political decision-makers and villagers. It cannot be answered by technical consultants. But since specific, politically approved guidelines do not exist some options are presented below. They may form the basis for further discussions.

<u>Subsidies for operation</u>

There are basically two types of operating expenses. All scheme types need scheme attendants and they should be paid in cash or kind. In addition substantial operating costs are incurred on those schemes that require fuel for pumping. The operating subsidies paid by government may therefore cover

a) all operating costs, or
b) fuel costs, only.

In the second case b) the village is left with the cost of scheme attendants (s). Normally only one scheme attendant is needed per village. The yearly salary of a fully paid attendant is presently Shs. 5660, but in most villages the job is not full-time, and the expenses incurred should therefore be less than that. Villages could also opt to pay attendant(s) in kind.

Two subsidy models for maintenance

In a physical structure subsidy model certain physical parts of the scheme are maintained entirely by the village. For this part the village arranges for all repairs and preventive maintenance. This work may be carried out by the scheme attendant or a local fundi. The village may also request MAJI to do it. In all cases the village pays the full cost involved. Spare parts for the village part of the structure should be made available by MAJI but costs should be covered by the village. On the MAJI part of the scheme all work is carried out by MAJI and the costs are covered over the recurrent budget.

The village part of the physical structure should be easily identifiable. The scheme layout should make this possible. A clear-cut division could for example be that the village is responsible for the whole distribution system from the gate valve in front of the distribution tank to the domestic point. MAJI would then be responsible for the main line, and the intake (or the pump and engine in case of a pump scheme).

The advantage of this model is that the village and MAJI funds for maintenance come from two completely separate sources. No administrative confusion on this point exists. On group schemes the maintenance performance of neighbouring villages do not affect each other. A village will suffer the consequences of its own neglect. The disadvantage is that the villages have no responsibility for (and maybe no interest in) the maintenance of the MAJI-part. If MAJI fails to maintain it properly the village suffers. Essentially the MAJI part will be maintained under the same system as is in effect today - and which does not function properly.

In the financial subsidy model the village has the full responsibility in all physical parts of the scheme. Maintenance work may be carried out by the scheme attendant, a local fundi or MAJI, but on village initiative. In all cases the village receives subsidies to cover part of the costs.

A village could receive the subsidies in the form of a fixed sum; as a flat rate of all actual expenses; or as a variable rate of all actual expenses. The size of the subsidy could vary according to scheme type.

The advantage of this model is that the village has the responsibility for the whole scheme. It thus has an interest in maintaining all parts of the physical structure. The disadvantage is that villages on a group scheme must share the responsibility for maintaining the common parts of the scheme (intake, pump, main line). This requires mutual village trust and cooperation. The model will also result in administrative problems. The fixed sum option necessitates that the government entrusts the village with maintenance funds before actual expenses are incurred. Under the two rate options subsidies are given after expenses are incurred. This puts demands on village cash flow or savings and on village trust in MAJI's ability and willingness to pick up its share of the bill.

The two models can be combined. Parts of the physical structure could be maintained and paid entirely by the village, while a financial subsidy arrangement could be worked out for the remaining part of the scheme. This arrangement would of course combine the advantages and disadvantages of the two models.

Subsidies according to capability

It is not realistic to assume that the same level of subsidy can be used for all villages. Some villages are poor and are not capable of contributing the same amount of money as better-off villages. Varying levels of subsidies according to capabalility should therefore be considered. Both subsidy models lend themselves easily to this approach.

A two level subsidy arrangement would be the easiest (but not easy) to administer. It requires that high level and low level subsidy villages be identified. The identification should be made on an areal basis so that all villages in a given area automatically qualify for a high level of subsidies. The areal delineation should be based on objective criteria. Agricultural and livestock raring potential under prevailing market conditions could be used as qualifying criteria. The demarcation of high level subsidy areas should be approved at the national level to keep the issue as much out of local politics as possible.

The participatory approach to village contributions

It is absolutely necessary for the successful implementation of any subsidy model that it be clearly explained to the villagers in each particular case, and that it is left to villagers to decide whether they accept or reject the conditions under which a scheme is offered to them. The arrangements proposed in section 6.6 allows for this to happen.

Villagers should also be left free to decide how they are going to collect the necessary funds to cover their share of operation and maintenance expenses. There are problems in collecting funds whether household incomes or communal revenues are the source, and only villagers are in a position to decide how it should be done in their particular case.

Some optimism about the possibilities of introducing the policy of village contributions can be found in the fact that the villagers do at present contribute to many public activities (primary schools, shops, grinding mills, etc.). The success of the new policy does, however, depend very much on agricultural policies. Without satisfactory agricultural production the economic basis for the policy does not exist. Unfortunately, current agricultural policies are not conducive to the generation of rural incomes[29]. If this situation continues or gets worse, a policy of village cash contribution to recurrent costs of water schemes, will be in jeopardy (and so would any other policy for the rural water sector). But this is a potential systemic problem which cannot be solved within the rural water sector itself.

6.6 Practical arrangements for village participation

In this section the proposals for village participation in the rural water sector are presented. They are based on the analyses of the present conditions in this sector (see 6.1, 6.2, 6.3, and 6.4) and on an analysis of villagers' willingness and capability to contribute to the operation and maintenance of schemes (6.5).

The proposals necessitate a number of changes in the organizational set-up at village and government level; in the way that the policy of operation and maintenance of schemes is implemented; and in procedures for selecting, planning, constructing and operating schemes.

The main ideas in these proposals have been presented previously and have been extensively discussed with regional and district authorities.[30] However, only some of the procedures have been carried out in practice (see section 6.7), so adjustments and changes in them will be made as further experiences with village participation are gained in the second phase of the socio-economic study (see chapter 1.6).

6.6.1 The organizational set-up

Changes at both government and village level are needed in the organizational set-up.

Government level

The MAJI organization at the regional and district level must be changed so that it can meet the requirements of efficiency, good planning and accountability which a participatory approach demands. In the MAJI organization three changes should be made:

Decision-making power within the MAJI organization at the regional and district level should be decentralized so that dicisions can be taken faster and so that the persons making them can be held responsible. At present basically only one person within the organization (the regional/district water engineer)can make decisions. Moreover, responsibility for certain functions(i.e. maintenance) is located in several parts of the organization. This obfuscates accountability.

Integrated planning of all MAJI activities should be an ongoing process involving the regional/district water engineer and all heads of divisions at the regional and district level respectively. Especially the integration of survey, design, construction, materials procurement and maintenance is essential. No such planning is done at present. Whatever planning is done is made without much consultation between the divisional heads. One hand does not know what the other is doing, and consequently not much is done.

Finally, MAJI should plan according to a two year implementation cycle (or longer), of which the first year is spent on planning next year's projects. This will allow time for better preparation of scheme construction including proper planning of materials and manpower requirements. Equally important, it will leave time for negotiating with the villagers about the potentiality of a forthcoming project. With the present one year implementation cycle not much project preparation (except design) is made prior to the approval of the financial one year plan for the region or district. Villagers are therefore normally caught unaware of plans involving them. The go-stop-go mode of construction is also in large part caused by the extremely short period available for the project preparation. The drawn out construction period is completely destroying for village participation as well.

The details of this streamlining of MAJI, which does not require major changes in the formal organizational set-up, can be found in the report from the engineering consultants, and will therefore not be discussed further here.

Secondly, a two-way communication between villagers and the government bureaucracy must be established before, during and after a scheme is constructed. Therefore it is proposed that an "Extension Unit" be formed to assist villagers during selection, planning, implementation and operation of a scheme (or an up-grading of traditional sources); to assist in health education efforts; to serve as the link between villagers and the local bureaucracy concerned with the rural water

sector (MAJI, Ardhi, (sanitation), Afya (health) and the Regional/District Offices (finance)). In short it should aid villagers in developing village viewpoints and representing them vis-a-vis this bureaucracy. The precise functions of the "Extension Unit" are spelled out below.

The Unit should be staffed by people experienced in (or having training in) community work, and who have some technical knowledge of water supply schemes. An estimate of the manpower requirements for the Unit is given in section 6.6.4.

A number of different possibilities for attaching the Unit to the existing government bureaucracy exists[31]. The best solution seems to be to place it in the newly established Community Development Division within the Ujamaa and Cooperative Department in the Prime Minister's Office. First, because this department already has a strong political backing that will enable the Unit to withstand pressure from technical personnel unfamiliar with participation and to argue the case of villagers against such pressures. The administration of this department also extends down to the divisional and sometimes to the village level. A third advantage of this attachment is that the Ujamaa and Co-operative Department has considerable experience in community development work - including mobilization of women's projects.

The Unit should be established at the regional and district level only. Given the immense task of improving the water situation in all villages by 1991 the "Extension Unit" staff should concentrate on the activities specified below. They should not get involved in the many other tasks that the Community Development division is supposed to do[32].

Village level

Every villager cannot participate in every decision - though there will be some in which everybody can. There exists a hierarchy of decision-making that cannot be avoided. It is therefore proposed that villagers should form a Village Water Committee to which they delegate a number of responsibilities as described below.

The Village Water Committee should be established as a sub-committee under the already existing Committee for Education, Culture and Social Welfare - for three reasons. This committee is in charge of social welfare of which water is an important part. It is also in charge of educational efforts and responsibility for health education therefore falls under its auspices. Finally, all activities related to health are supposedly the responsibility of this committee.

The Construction Committee is the other option for attaching the Village Water Committee to the existing village government structure. But since the tasks of the Village Water Committee go far beyond construction work itself this solution is not good, although it would be appropriate to have one member from the Construction Committee on the Village Water Committee. A third option is not to attach the Village Water Committee to any of the existing committees, but this solution creates a number of problems between the Water Committee and the village government, and is therefore not recommended.

Members of the Village Water Committee should be partly appointed and partly elected, as shown in table 6.17 below.

Appointed	Elected
Village chairman Chairman of education, culture and Social Welfare Committee Member of Construction Committee	Three female villagers

Table 6.17 Suggested membership of Village Water Committee.

Appointments and elections should be carried out after each local election. The elected members of the Village Water Committee should be elected by the village assembly. Its chairman should be elected among its members. The village secretary, health personnel stationed in the village, and others with special skills may be invited to participate in the work of the committee.

The heavy representation of women in the committee is proposed because water collection is a traditional female responsibility,and dominance of women in the Water Committee will hopefully "modernize women's role in rural water supply, preserving the importance of their contribution, but reducing hardship."[33] It is expected that women organized in Umoja wa Wanawake wa Tanzania (UWT) will play a major role in the Water Committee except where no UWT-branch exists - or where it is dormant.

On group schemes a Project Committee should also be formed at village level. It should consist of the chairman and one female member from each Village Water Committee within the group scheme. The Project Committee is a forum where representatives from the different villages, the local bureaucracy and the party may meet to discuss issues related to the group scheme as a whole. Especially during construction this committee can provide a much needed channel of communication

between the villagers and MAJI. But also during operation the Project Committee will be a suitable forum for discussing operation and maintenance problems with the local bureaucracy.

6.6.2 Procedures for village participation[34)]

The majority of new schemes in the three regions will be gravity schemes. The procedures presented below are therefore developed for this scheme technology in particular. Adjustment will have to be made for other types of technology (shallow wells, pump schemes, etc.).

Selection

Village participation in the selection procedure is very important. It shall ascertain that a village prior to construction accepts the technical lay-out of a scheme and some financial responsibility for its operation and maintenance. The main steps in the selection procedure are outlined in the algorithm in figure 6.2.

Three inputs are needed from the national level decision-making machinery (the Ministry of Water; the Treasury; the Parliament; and the donor in case of donor sponsored projects). A set of priority criteria must exist by which candidate villages are selected (see chapter 12 for a proposal). The number of schemes to be selected per year depends on the approved financial budgets for the region for each particular year. These allocations should be known at least one year ahead of the year of implementation (see discussion of the two-year implementation cycle above). Budget allocations should not be tied to individual projects. Only the regional and district level authorities should deal with projects at the scheme leve. Finally objective guidelines for operation and maintenance subsidies should be worked out by the national level decision-makers. (See chapter 6.5).

At the regional and district level specific project related decisions should be made by the existing decision-making machinery (see section 6.3.2). The first one regards the selection of candidate villages (see figure 6.2). All requests for a new scheme or for the extension or rehabilitation of an existing scheme must be screened using the priority list of the approved water master plan. If the number of high priority village requests does not mach the quota for year x implementation, then schemes should be added from the priority list. Schemes requested by villages should always have priority over other schemes - everything else equal (see chapter 12.8). A village whose request is refused should be informed by letter about the reason for the refusal and the appeal possibilities

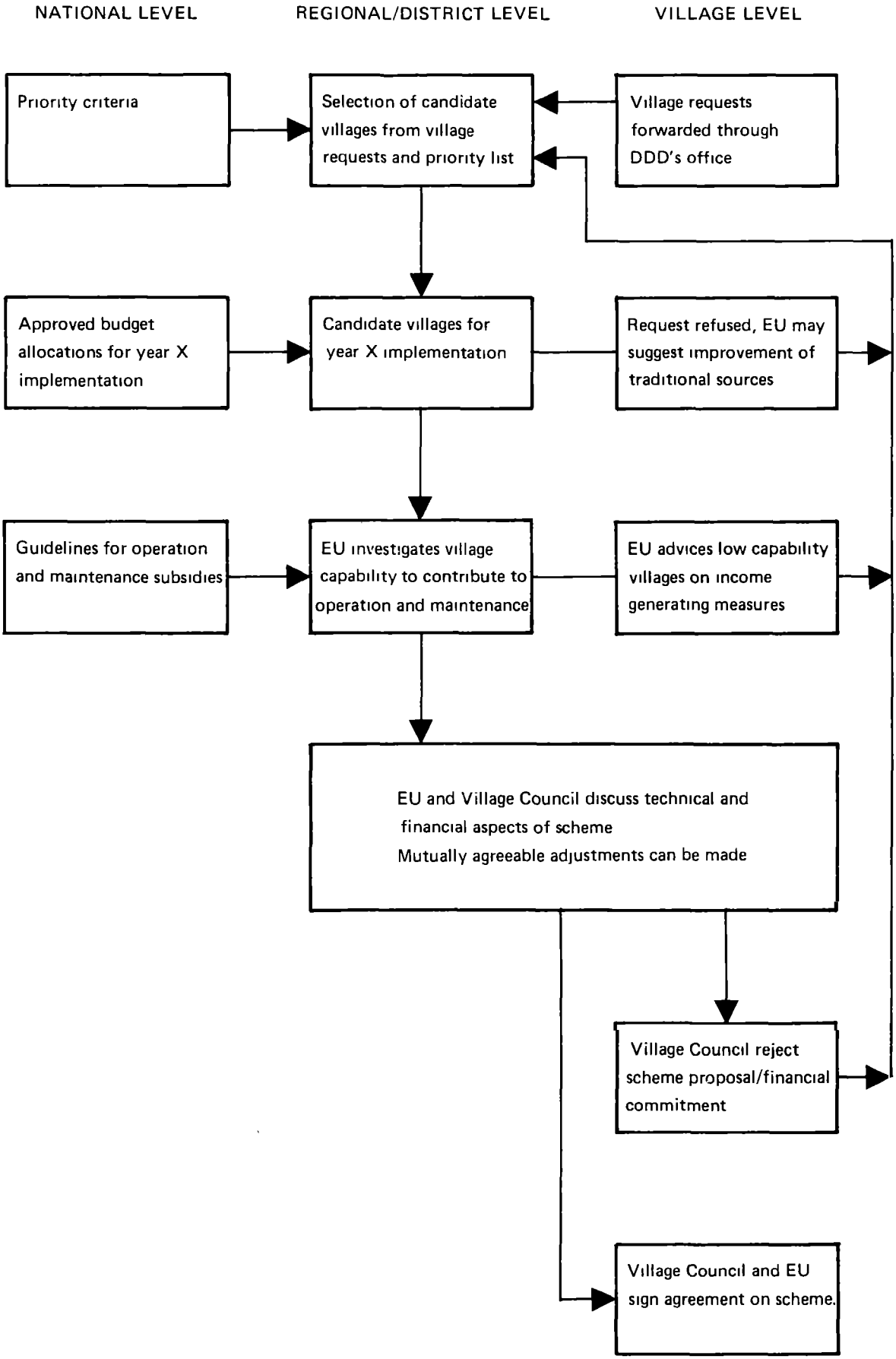


Figure 6.2 Procedure for selection of villages for participatory implementation of water schemes

(see chapter 12.7). If it is unlikely that such a village will qualify for a scheme in the immediate future, then it should also be contacted by the "Extension Unit" which should suggest ways in which the traditional sources in the village could be improved.

Next step in the selection procedure is that the "Extension Unit" for each candidate village assesses its capability to contribute to operation and maintenance. To make this assessment an approved guideline for government (or donor) subsidies must exist. Candidate villages with a doubtful present capability should be contacted by the Extension Unit. Together with the village council it should work out a programme to improve the economic capability of the village. Such villages would not loose their priority. The proposed scheme will merely be postponed until such time where the village is financially capable of receiving it.

At the village level in economically capable villages, village councils and the regional/district authorities can now start direct negotiations. MAJI and the "Extension Unit" brief the village council on the scheme proposal, i.e. water source; location of intake; tanks; main lines; and on the parts of the village which for economical or technical reasons cannot be served by the proposed scheme. Based on these discussions MAJI makes preliminary designs which are then discussed in the same forum and modified if needed. Also the financial obligations of the receiving village should be clearly explained. Village requests for additional facilities (domestic points, washing slabs, livestock watering facilities, etc.) should only be included in the scheme provided the village (or the benificiaries) pay the additional cost (see chapter 9 on livestock watering). The size of the village contribution to operation and maintenance should not be subject to discussion although the practical arrangements for collecting and accounting for it could be made to fit individual villages (see section 6.5).

Those villages that accept the proposed (modified) scheme and the financial obligations should sign an agreement with the District Development Director's Office to that effect (the district being responsible for maintaining its part of the scheme as discussed below). Such schemes will then be included in the year x implementation programme. Schemes in villages where the councils do not accept the scheme or the financial responsibilities are postponed as shown in figure 6.2.

It is envisaged that the selection procedure as described above will take 6-12 months for each individual scheme to allow time for scheme modifications and discussions.

Planning

Most of the main features of the scheme have already been decided upon during the selection procedure. Without preliminary designs the village councils would not have sufficient information to accept or reject a proposal.

However, one important planning decision for each scheme remains to be made, namely the precise location of domestic points. A village Water Committee should be formed at this point, and it should carry out this task as its first one in co-operation with the "Extension Unit" and MAJI. The preliminary designs must be so flexible that the Village Water Committee is not unduly restricted in its choice of locations. The mutually acceptable locations will then be included in MAJI's final scheme design. It is wise to have these locations approved by both the village council and the village assembly. But with location decision made, the village council in principle transfers responsibilities related to the water scheme to the Village Water Committee, although council approval of key decisions should always be sought.

Candidates for scheme attendants should also be appointed by the Village Water Committee at this point in time. Any compensation that these candidates may receive should be entirely up to the Village Water Committee and Village Council to decide. The "Extension Unit" should, however, argue against payment in cash and for female attendants (these two issues are strongly related). The candidates should be as much involved in the Village Water Committee deliberations as possible so that they can become familiar with the reasoning and principles behind the proposals.

Also in villages which agree to improve their traditional sources should a Village Water Committee be formed. Together with the "Extension Unit" it should plan the type of improvements to be done and the way they should be carried out.

Implementation

Trench digging should not begin before all materials needed to complete the main line and the distribution system including the domestic points have arrived at site.

The village chairman, who is also a member of the Village Water Committee, is normally in charge of self-help activities. He (she) may delegate responsibility to the village secretary, the village manager, the ten-cell leaders - or to the scheme attendant or the Village Water Committee members. Whoever is in charge should receive a short instruction in trench digging, back filling and pipe laying prior to the start of the actual work. The villagers who have received this

instruction should demonstrate the tasks for the other villagers. MAJI and the "Extension Unit" should assist in organizing these activities. If villagers do not know how a pipe is properly laid, they cannot be expected to do work of a satisfactory quality. Neither can they be expected to object to sloppy workmanship on the part of MAJI field staff.

Digging, pipe laying and backfilling should be done in close succession and section by section within each village. No new section should be started before the previous one has been approved by MAJI and the Village Water Committee. Villagers should never be asked to go back to a section on which they worked weeks before.

If the proposal above is followed, much work presently done by unskilled village labour paid by MAJI will now be made by self-help labour. Both within MAJI and among villagers this new approach might be greeted with something less than enthusiasm. It is therefore absolutely necessary that self-help labour can be clearly distinguished from unskilled paid labour. Self-help efforts would collapse if some villagers are asked, e.g., to backfill for free while others are getting paid for exactly the same job. There is an urgent need for MAJI to show much more constraint in hiring unskilled labour. This responsibility should not be the exclusive privilege of the foremen.

At the end of the construction phase the Village Water Committee should inspect the scheme together with the "Extension Unit" and MAJI. Unfinished or poorly executed work should be identified and deadlines for rectifications made. A village should only take on the responsibility for operation and maintenance if it is satisfied that the scheme is properly constructed. A written agreement by which MAJI hands over the scheme to the village should always be made.

In those villages where the "Extension Unit" proposes improvements of traditional sources it is not envisaged that MAJI is involved. The proposed improvements should be carried out by the villagers themselves and they should cover any costs involved.

Operation

Among the candidates for scheme attendants the best suitable should now be appointed by the village Water Committee to do the daily inspection work, cleaning of intake, and minor repairs. Another important task is to make arrangements for the hygienic upkeep of domestic point surroundings as soon as the water starts to flow. The "Extension Unit", the Village Water Committee, and scheme attendants should be involved in the first demonstrations. It might be necessary for the

Village Water Committee to organize that one individual user of each domestic point is made responsible for the daily upkeep of the area around the domestic point.

It is also now that the "Extension Unit" should undertake to start health education in the village in conjunction with the Village Water Committee (with the very short construction period envisaged per scheme (see section 6.6.4) there will not be time to start health education before). Informal discussions should be held so that disease causing behaviour can be identified and ways of changing them can be worked out. Health education related to water and sanitation should probably be provided through informal channels (see chapter 11.6). Hopefully this type of education is sufficient to motivate villagers to keep tap surroundings clean. If not then the "Extension Unit" in cooperation with the Village Water Committee should discuss the matter. The Village Water Committee might have to disconnect domestic points that cause a health risk.

Health education should also be carried out in villages that are improving their traditional water sources. This education should be arranged in the same way as in villages receiving a scheme.

Maintenance of schemes is a responsibility to be shared between the village and MAJI at the district level. It is important that all parties involved know exactly where village responsibilities stop and where MAJI responsibilities start. Two different subsidy models were discussed in 6.5.4.

To ensure that a scheme is not hit by immediate breakdowns, MAJI should supply each village with tools and a stock of basic spare parts. The cost should be covered by the village and no village should be connected to the scheme unless it has paid it. Depending on which subsidy model is chosen the cost of later needs of spares and tools for maintenance of the distribution system should also be met by the village but supplied by MAJI.

A village that does not carry out proper maintenance should suffer the consequences of a deteriorating service level. However, the district MAJI organization, which regularly inspects all schemes, should report such cases to the "Extension Unit". This Unit should negotiate with the Village Water Committee so that the problem can be identified and solved. In the end it will be up to the village itself to rectify the situation.

Evaluation

At three points in the project cycle, conflicts between the regional/district authorities and the village may arise.

First, at the selection stage where villages may disagree with the priority received; the scheme proposal made (even after modifications); and with the financial obligations (including subsidies).

Secondly conflicts may arise when MAJI want to hand over projects at the end of the construction phase. A village may refuse to take over the scheme because it is not finished - or finished badly.

And finally conflicts may occur if MAJI does not fulfill its maintenance obligations for the part of the scheme for which it is responsible.

On the district executed projects it is suggested that the regional offices of MAJI and the Community Development Divisions will supervise the performance of their district equivalents. But if that is not sufficient to satisfy village grievances - or if schemes are executed by the regional authorities - appeal possibilities should be established. For all three types of conflicts it is proposed that the district or regional party executive committee should act as an appeal board and a watchdog over the functional offices involved. It should be the task of the "Extension Unit" to inform the villages about these appeal possibilities right from the start of the project cycle.

Given the persistent problems of operating and maintaining rural water supplies it should also be considered to arrange a yearly meeting between representatives from each village Water Committee (or Project Committee) and representatives from the government bureaucracy (MAJI district and the "Extension Unit"). A party representative should also be present at these meetings which should be held yearly at the divisional level.

6.6.3 Implementing the proposed procedures for village participation

Already completed Water Master Plans have generally had very little impact on the activities in the rural water sector. The local government bureaucracy and the party has neither been involved in the planning process nor have they been informed about the content of the plans. The planning exercise has been carried out by foreign consultants in a communication vacuum. The preparation of the present Water Master Plan is no exception.[35] It is absolutely essential that the salient features of the present plan (including procedures for village participation) be explained and discussed with the district and regional authorities. It is therefore proposed that a small team of people with an intimate knowledge of each region and the Water Master Plan arrange some working sessions with relevant district and regional decision-making bodies. As a minimum such sessions should be held with each District Management Team and District Development Committee, and with their regional equivalents.

6.6.4 Manpower training

Two categories of government staff needs special training so that the intentions behind the proposed participatory procedures can be carried out. This training should contribute to giving the trainees a symphatetic attitude towards the participatory approach and it should enable them to use a minimum of community development techniques.

MAJI foremen and skilled workers (fundis) belong to the "forgotten staff" within the organization. They rarely receive training other than the one which qualified them for the job - and the training they got had a purely technical content. There is an urgent need for on-the-job training of this staff in management of and cooperation with self-help village labourers at the point of work. Since such skills are at present lacking within the whole MAJI organization the "Extension Unit" must take on this task - at least in the earlier stages of the implementation programme.

Lack of staff for the "Extension Unit" will be a major constraint for a successful implementation of the participatory procedures. At present the Community Development Division has a staff of around 50 at the regional and district level (Iringa region).[36] This staff is not engaged in the rural water sector for the time being. The extent to which some of it can be switched to the "Extension Unit" activities is not known at this stage where the Water Master Plan proposals have not yet been approved. Neither is the availability of personnel from other departments (education and especially adult education) known. Preliminary estimates indicate, however, that there is a need for at least 25 people per region to run the "Extension Units" at the regional and district levels alone - excluding supporting staff.[37] Taking Mbeya region as an example this number is arrived at as follows: Out of the 590 villages in the region, approximately 25 per cent have a scheme. Of the remaining 450 villages, approximately 150 will be served by large group schemes constructed by the regional teams. The remaining villages will partly be served by single village schemes (approximately 200) and partly by small group schemes (150), constructed by the district teams. In 1988 and 1989 eighteen construction teams will be constructing 54 schemes per year - that is 3 schemes per team or four months per scheme. Assuming that one "Extension Unit" Officer is needed per team, a staff at least of 18 must be available at the district level. Proportionally less staff (4) is required in the field at the regional level because of savings in time, transport and meetings (due to the project Committees) on the larger group schemes. However, at the regional level, supervision of the district "Extension Units" is required and some additional administration must be

anticipated. For these purposes two people are needed, bringing the total "Extension Unit" staff to at least 25. It is envisaged that this staff is also able to carry out activities in the villages that improve their traditional sources.

As the rate of construction slows down towards 1991 the tasks of the "Extension Unit" will shift to assisting villages in operating and maintenance activities.

The Community Development Division recrutes staff from three existing schools with a yearly student output of approximately 150. If only the three regions in question accounted for additional demand for new graduates, the present school capacity may be sufficient. But it is unfortunate that no water-specific participation cources are taught at present. The whole manpower aspect of the "Extension Unit" therefore needs immediate attention, should it become a part of the implementation programme. Any reduction in the expected paces of provision of water supply would of course reduce this man power need correspondingly.

6.7 Experiences with participation on DANIDA funded projects

A few of the proposals put forward in section 6.6 above have been tried out on DANIDA funded projects in the three regions. On certain points the approach adopted in the field differs from those proposals which have been formulated in their final form after the field experiments started. Given the experimental character of introducing participation in the rural water sector, continuous changes and adaptions are to be expected in the participation model put forward above as more experiences are gained.

Almost all projects funded by DANIDA so far have been gravity schemes. Village Water Committees have been established on all these projects in the three regions, and the socio-economic researchers have been involved in the procedures in some of the schemes. In Iringa region the Image scheme (5 villages) located in the medium dry intermediate zone has been followed. In Mbeya region especially the Mapogoro project (2 villages) in the dry northern zone has been investigated, but also the Ulenje and Nyalwela schemes - single village projects in the wet highlands - have been visited. Due to the late arrival of the resident researcher for Ruvuma the two projects in this region have not been followed in detail and will therefore be excluded from most discussions below.

Conditions under which the experiments were carried out were not ideal as will become clear by reading on. Nevertheless, valuable experiences have been gained from the small number of projects in which a limited degree of participation was abruptly introduced. More work on this important issue will be done during the second phase of the socio-economic study (see chapter 1).

6.7.1. The selection of villages

To the villagers who received the DANIDA funded schemes, the news came as a (pleasant ?) surprise. They were not involved in the selection procedure. DANIDA selected the villages from lists of high priority schemes prepared by authorities in the three regions separately. On what basis these lists were prepared is hard to trace (see section 6.3). Some scheme surveys - and even designs - were done up to seven years back. During the intervening period little or no communication about water schemes took place between the selected villages and the government authorities. It is therefore not surprising if the present village leaderships in these villages do not see any clear link between a previous request (if they made one) and the construction of schemes. Essentially no one at village level were aware of what was to come, until just before the construction started.[38)]

This does not necessarily mean that there is no "felt need" for water schemes in the selected villages. Some of the villages are located in agro-ecological zones where the water situation is generally bad. On the other hand it is unlikely that all the selected schemes would have received top priority had the Water Master Plan criteria been available as the basis for selection (see chapter 12).

The projects were not made conditional on village acceptance. Neither were villagers faced with demands of financial contributions before, under or after construction. No strings were thus attached. That villagers would contribute labour during construction was taken for granted.

6.7.2 The formation of village water committees

No "Extension Unit" was formally established to run the experiments. The formation of village water committees was therefore initiated by the socio-economic group on the Image Scheme, Iringa region and on the Mapogoro scheme, Mbeya region. On all other DANIDA funded schemes MAJI staff was the initiator.

Normally five villagers were selected for the village water committees at village assembly meetings. At least two members are women. The village chairman and secretary may or may not be members of the committee, but they would normally always be present during meetings - and frequently very active. On the Ruvuma projects the village water committees have been established under the already existing Construction and Transport Committees. In the other two existing regions the Village Water Committees were not attached to any existing village government committee.

6.7.3 The tasks of village water committees

The committees were established simultaneously with the commencement of construction work. No prior discussions with villagers or village government concerning scheme technology, water source selection, location of intake, main lines and tanks took place. Decisions on these issues were made by MAJI alone.

On the projects followed by the socio-economic researchers from Iringa and Mbeya the common set of tasks of the Village Water Committees were as follows:

a) To follow all aspects of the construction work in order that they may inform other villagers.

b) To locate domestic points in cooperation with MAJI and the socio-economic group.

c) To select one or two villagers, to be trained during construction work by MAJI as scheme attendants.

d) To be responsible for upkeep of domestic point surroundings when water started to flow.

On the Image scheme, Iringa region the committees were, in addition, told that they were:

e) To locate and suggest design for laundry facilities and to locate cattle troughs.

Special duties of the Village Water Committee for Mapogoro, Mbeya Region, were:

f) To employ labourers together with the MAJI foreman.

g) To employ a villager to look after the store.

h) To organize trench-digging.

These responsibilities were defined for the Village Water Committees by the project team. They were not discussed with them.

6.7.4 Experiences with the Village Water Committees

No systematic evaluation of the work of the Village Water Committees have been done. What follows below is therefore mostly based on a limited number of informal discussions with villagers, committee members, MAJI staff, and the research assistants from the socio-economic group who spent considerable time working with the committees.

Selection of committees

Generally few major problems were encountered at this stage. The idea of a committee was even met with some enthusiasm - at least in some villages in the Image group scheme: Soon after the establishment of the first committee, other villages in the scheme had started their own committees without prior briefing by the socio-economic group or the MAJI Site Engineer, who has otherwise been instrumental in the whole participation experiment on this scheme.

In one such village the Chairman had selected the committee himself. No women were appointed. On request the Chairman put in one woman - still selected by himself. This woman rarely stays in the village. After repeated insistance from the Site Engineer a Village Council meeting was finally held at which a committee with two women was formed.

Apparently the real problem was not the Chairman's dislike of the idea of female members. Rather he did not want to call a council meeting at which he knew that questions on embezzlement of village funds would be raised. He was right. Village Water Committees will envitably be involved in local politics.

Although some female committee members were quite vocal and influential during the formal discussions, there is no doubt that the formalities of committees and meetings restrict many of them. It is not known how big their behind-the-scene influence has been.

Committees as disseminators of information

Some meetings would be called by MAJI or the socio-economic group. On the Image scheme such meetings were quite frequent - about 5 - 7 meetings per village from March to December 1981. They were always requested by the socio-economic group or MAJI. On the Mapogoro scheme, 4 meetings were called, one of them by the Village Water Committee itself when trench-digging was to be organized, the rest by the socio-economic group.

In no instances did the committees ask for meetings with the socio-economic group or MAJI to seek information or to discuss problems. Neither did the committees call general meetings with villagers to ask for advice or approval of decisions or to inform them on the progress of the projects.

Village Water Committees have thus not been very active in seeking or disseminating information about the project. The general lack of communication caused some conflicts between villagers, between committees and villagers, and between villages and the project personnel (MAJI staff and the socio-economic group).

Committees as planners

Each committee was given a short briefing on the location of domestic points, while walking around in the village. Basic economic considerations (increasing cost with length of pipe); simple hydraulics (there is a limit to how much uphill water can run); and village planning (likely areas of future village expansions) were discussed.

On the Image scheme the number of domestic points available for each village was given as a planning guideline. It was not subject to discussion. However, the spontaneously established committees (see above) - not yet having been in contact with project personnel - were unaware of such guidelines. In these cases up to 35 domestic points were located by the committee in a village. It took some talking to cut the number down to around eight, for which the project had been planned. Later all villages were offered additional domestic points provided that the village government (not individuals) paid the actual cost of the additional domestic points (Shs 3,000/ = plus pipes). No requests for additions were received then.

On the Mapogoro scheme - and the schemes in Ulenje and Nyalwela - a-priori limits to the number of domestic points were not given. In the two latter villages a number of extra domestic points were added on committee requests.

The locations of domestic points chosen by the committees generally match the settlement pattern very well. On the Image scheme the chosen locations have resulted in a considerably higher service level than would have resulted if the locations chosen by MAJI had been followed. As shown on figures 6.3 and 6.4 the MAJI locations match the present settlement pattern very badly. Also on the three above mentioned Mbeya schemes did the committees cause some changes in MAJI locations - with a similar increase in service level as a result.

Extended distribution systems have been the result whenever a committee has been involved in the planning of the locations of domestic points. This costs money. It can therefore be argued that participation will make projects "more expensive". In a way this is true. Absolute project costs will rise. But the relevant evaluation criteria is cost per beneficiary which may very well decrease as a result of village participation in planning as it did on the Image scheme. Prior to participation no domestic points were located to the south-east of river Mlowa in Kilala Kidewa and Uhomenyi villages (see figures 6.3 and 6.4). People living here would have continued to draw water from this occasionally polluted river had domestic points been built according to the original MAJI plans. For very few drawers of water pass a traditional source to get to a domestic point (see

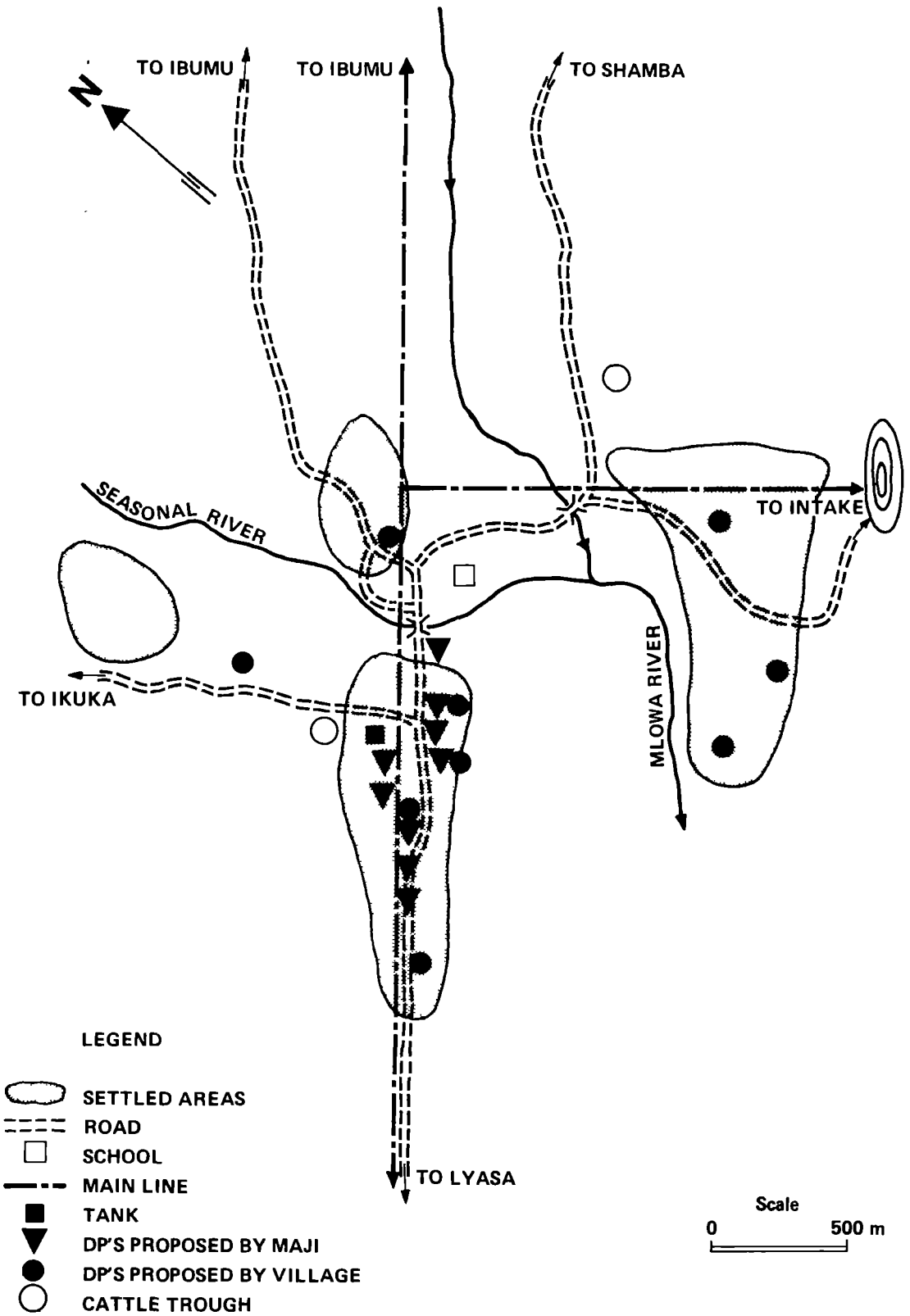


Figure 6.3 Locations of domestic points (DP's) in Kilala/Kidewa.

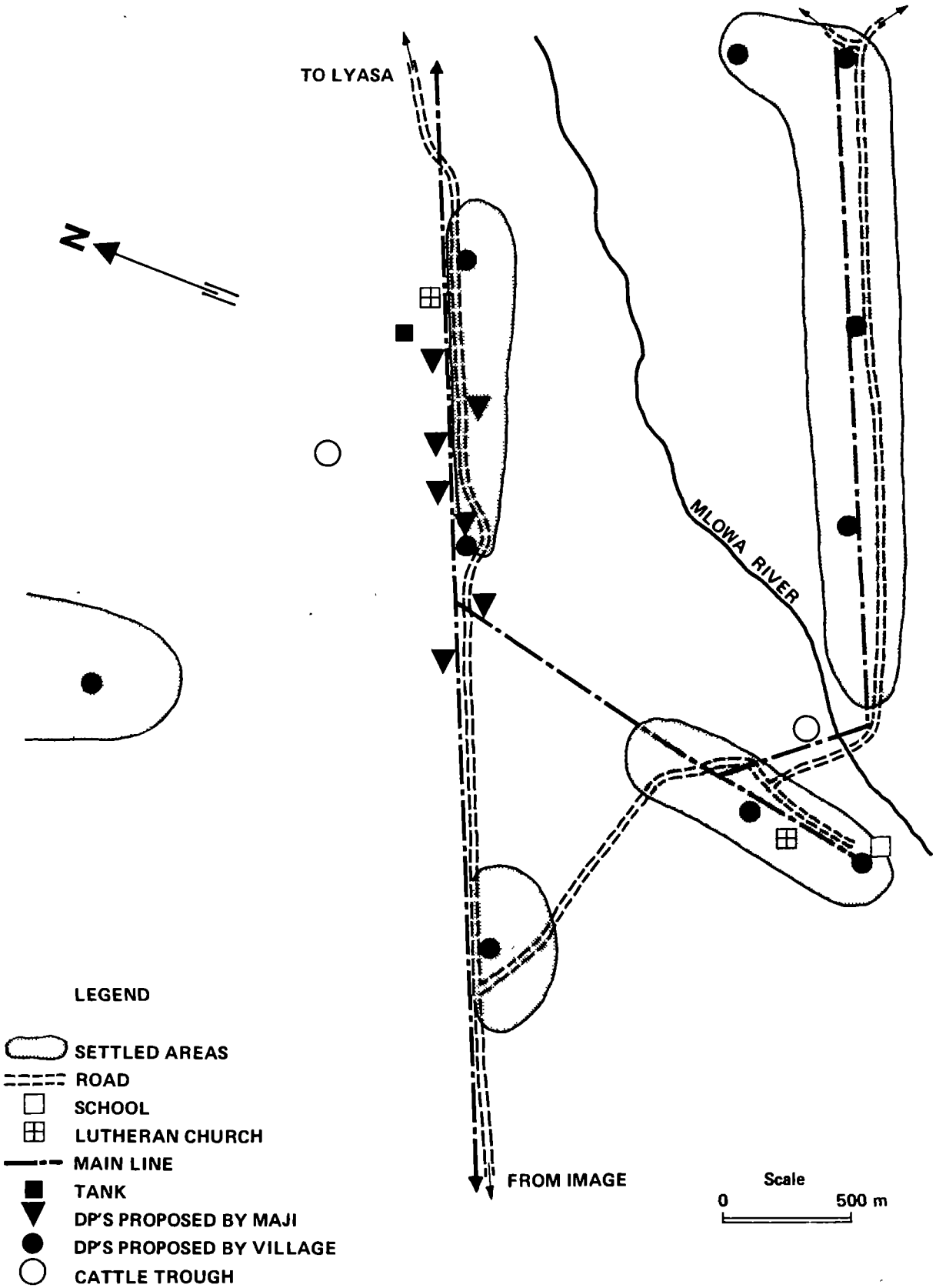


Figure 6.4 Locations of domestic points (DP's) in Uhominyi.

chapter 8.7). Due to the committees' plans these people now have easier access to domestic points. The number of beneficiaries has therefore increased. A simple cost-effectiveness calculation (table 6.18) shows that average cost per capita prior to participation is significantly higher than the marginal cost per additional beneficiary due to participation.

Consequences of participation	Villages	
	Kilala/Kidewa	Uhomenyi
Estimated increase in number of beneficiaries due to participation a)	650	850
Estimated increase in costs due to participation (shs.) b)	80000	64000
Estimated cost per extra beneficiary (shs.)	123	75
Average cost per capita prior to participation (shs.) c)	647	647

a) Underestimate; based on families living not further than 1 km south-east of the river.

b) Based on information from the DANIDA Steering Unit. Total scheme cost increase distributed between villages in proportion to population.

c) Underestimate; based on the total present population (average for whole scheme), not the smaller number of people who would actually be served by the DPs as located by MAJI.

Table 6.18 Example of the cost-effectiveness of village participation in the planning of the location of domestic points, Image project, Iringa Region.

Not everyone in the villages was satisfied with the locations chosen by the committees. Certain chairmen and secretaries were complaining that the committees were incompetent. The real reason for this dissatisfaction appears to be that none of the chairmen or secretaries in the schemes followed, managed to get a domestic point located in front of their house. In many other projects it is usual to find domestic points close by village leaders' houses (see section 6.4). It appears that the locations of domestic points chosen by the Committees result in a more equitable distribution of them.

One MAJI foreman tried to charge people for locating a domestic point near their homes. Enough people in that village knew, that the committee - not the foreman - was responsible for such locations. The Ward Secretary was informed. He wrote a letter to the Regional Water Engineer, who removed the foreman from the site. Corrupt practices among project personnel may decrease as a result of participation.

Committees as hirer of labour

Candidates for future jobs as scheme attendants were selected by the committees in all schemes followed by the socio-economic researchers. Certain chairmen and secretaries who had their own candidates were dissatisfied with the ones chosen by the committees.

On the Mapogoro scheme temporary unskilled workers and a villager to look after the store with construction material were supposed to be selected by the committee. This conflicted with the privilege of the MAJI foreman who normally controls the hiring of such people - even when a site engineer is in charge. In fact the foreman prevented the committee from selecting any of the types of workers mentioned above.

The hiring of unskilled labour for a construction job is a valuable asset for the one who controls it. If committees limit the possibilities for patronage by foremen, village chairmen or others, conflicts are bound to arise, but these conflicts need not be harmful.

Committees as organizers of self-help labour

The committee in Mapogoro called one meeting to organize trench-digging. In all other schemes followed, it was the chairman (assisted by the secretary) who was the overall in-charge of trench-digging.
No politicians were involved in mobilizing people for this work.

Except on the Mapogoro scheme the quality of trench-digging was not satisfactory. Trenches were mostly not straight, too narrow and not deep enough. But then nobody showed villagers how trenches should be dug. Only at a late stage in the trench-digging,villagers were asked to go back and do the trenches properly. This proved to be impossible. Consequently unskilled labour from the villages were paid to do the job. To MAJI personnel involved in patronage this was not an unfavourable situation.

Backfilling was also done by paid labour. Again it proved impossible to get villagers to go back to the trenches when pipes were laid - which often took place one to two months after trench-digging. When asked to backfill, villagers in one village argued that as far as they were concerned "this was the job of the village water committee - why else was it selected".

No villagers working on self-help basis were involved in pipe-laying.

Little cooperation between MAJI staff and villagers during trench-digging took place. Some villagers complained about the "bossy" attitude of some MAJI staff. The widely held opinion in MAJI that villagers cause delays and only do work of an inferior quality, is therefore to a certain extent self-fulfilling.

Committees as designers

Committees in the Image scheme were asked to suggest designs for laundry facilities. A woman in one of the committees described a design. It was drawn up by the Site Engineer, approved by the committee, and subsequently constructed. The extent to which this facility is used has not yet been studied.

Also provision of livestock watering facilities was changed after discussion with committees. The original plan was to provide troughs for cattle and goats/sheep separately on the Image scheme. Due to the way in which herds are kept, the committee preferred a common trough for all types of livestock. Their recommendations were followed.

Committees as upkeepers of hygiene

No attempts at any form of health education were made. But the MAJI Site Engineer and the socio-economic researcher and his assistants have on several occasions reminded committees on the Image scheme of the unhygienic conditions around many domestic points. So far no committee has taken any initiative to improve the situation. Although the awareness about the potential health risks of still water is fairly good (see chapter 5) it seems very difficult for the committees to organize a common effort to improve public water facilities.

6.7.5 Summary of experiences gained so far with the participatory approach to water project implementation

In one important aspect the introduction of participation was an indisputable success: Village Water Committees proved to be fully capable of planning the locations of domestic points on gravity schemes. Even if all other issues on which participation could be introduced eventually may fail, schemes in which villagers have planned the layout of the distribution system provide a higher service level than if original MAJI plans had been followed.

Some village water committees also proposed good and appropriate designs for laundry facilities and caused major changes in the way that livestock watering facilities were eventually provided.

Village Water Committees were generally less successful as disseminators of information about the projects to other villagers; as hirers of labour; as organizers of self-help labour; and as upkeepers of hygiene around domestic points. It can, however, not be concluded that Village Water Committees are inherently incapable of performing these tasks.

One important reason for the lack of village involvement on these issues is that the committees at no time were involved in planning how they should participate. The time available for more thorough discussion between the project personnel and the villagers was simply too short.

Another reason is that whatever dialogue and discussion did take place, was limited to communication between planning personnel and the committees. Many MAJI foremen and other field staff, village governments and most other villagers were not involved in the participation process.

Even if all parties mentioned above were to be involved at an earlier stage village participation is not the solution to all problems and conflicts which arise when a village gets a water supply scheme. Conflicts will enevitably arise when certain powers are taken away from MAJI personnel and village chairmen and given to Village Water Committees. This power entails control over resources, and those from which it is taken are unlikely to keep quiet.

Finally it should be noted that the participatory exercises were fairly easy to carry out because construction work progressed smoothly without the usual interruptions. An efficiently organized supply of material organized by DANIDA and MAJI's own efforts accounted for that. It goes to stress that careful planning of construction work is essential for successful village participation.

6.8 Conclusion

The discussion on participation presented in this chapter suggests that there are advantages to be gained by involving village communities in the developing operation and maintenance of water schemes. White[31] in his report on participation in Tanzania has identified at least ten advantages which can be gained by including participation in water supply programmes. Experiences with participation in Tanzania has, however, revealed that these benefits are more of a theoretical nature than real unless more concerted efforts are taken in the application of the participatory strategy. There is still a great need of conducting a careful study of how to involve local communities more effectively in the development and operation of water schemes.

This chapter has attempted to do that and several suggestions of how to involve communities have been made.

The question of villagers' willingness and capability to contribute to operation and maintenance of water schemes has been examined and we came out with the conclusion that not all villages are capable of paying the entire operation and maintenance costs. It was therefore recommended that in such cases where a village

is not able to meet all the costs of operation and maintenance, the government and villages concerned should share the operation and maintenance costs. However, the share of costs a village has to pay has to be agreed upon by villagers and government through mutual consultations. The village can for example get subsidies for operation. The operating subsidies paid by the government can be made to cover all operating costs or full costs. In other cases government can meet other costs while the villages meet the costs of the scheme attendant.

An organizational set-up for village participation has been proposed, including the establishment of Village Water Committees and an "Extension Unit" outside MAJI, to support these committees.

The experiences gained so far on DANIDA funded projects were outlined, but more definite answers to many questions as well as final implementation guidelines will be presented only after another year of experimentation - in volume 13 (see chapter 1.6).

Notes:

1) The United Republic of Tanzania (1981). Long Term Perspective Plan, 1981 - 2000, Government Printers; Dar es Salaam, par. 96.

2) Tschannerl, G. and Mujwahuzi, M. (1975). Impact of Rural Water Supply: Eight Self-Help Schemes in Arusha, Masai and Lushoto District. BRALUP Research Paper, No. 37.

3) Section 6.3.1 and 6.3.2 are based on information from Iringa region, but the main features of the organizations in the three regions are similar. The information was collected through informal interviews with most heads of divisions; some heads of sub-sections; and other MAJI employees. Also perusal of MAJI files have yielded useful information.

4) For national projects warrant of funds valid for five years may be issued.

5) See Grozier, M., (1967). The Bureaucratic Phenomenon. (The University of Chicago Press: Chicago); P. 51.

6) The District Management Team; the District Development and Planning Committee; the District Development Council; the District Party Executive Committee; the Regional Management Team; the Regional Development Committee; and the Regional Party Executive Committee.

7) These high percentages indicate that improved water supply is high on villagers priority list (see also chapter 4.3).

8) The Agricultural Development Project - funded by the EEC and presently the biggest project in Iringa Region - had to give up the idea of concentrating its activities in selected villages. Instead the project activities were to be shared between as many villages as possible in order to spread the benefits of the project.

9) See chapter 4.5; and BRALUP, (1981). Socio-Economic Aspects of Water Master Plan for Kigoma Region. (BRALUP: University of Dar es Salaam); P. 15.

10) Any scheme estimated to cost more than Shillings 2.5 million may be deemed to be a national project. However, there is no clear definition of this concept.

11) Exception: The Iringa District Water Engineer has recently started a refresher course for pump attendants.

12) The differences between the two regions and the distribution of answers within each region depend on the types of villages selected. And as stated in the Appendix this selection is not random. The row and column differences do therefore not give an unbiased picture of the situation.

13) Saunders, R.J. and J.J. Warford, (1976)
Village Water Supply: Economics and Policy in the Developing World.
(Baltimore: The John Hopkins University Press), chapter 7.

14) Personal Communication. A report is forthcoming. Its title is not yet known.

15) Daily News (1981) "Party Stresses socialistic output" October 2, 1981.

16) Similar calculations for other communally grown crops have not been made due to non-availability of reliable data.

17) Bo, P. and T. Rasmussen, (1981) "Preliminary Report on a village questionnaire survey in Iringa Region, Tanzania". CDR Project Papers A.81.2, Centre for Development Research, Copenhagen.

18) Ibid. table 3.15; crop levy is computed on the basis of amount of crop sold. Actual levies received by villages may be lower due to delayed payment from the crop authorities.

19) Ibid. p. 47.

20) Ibid. p. 49.

21) Bo, P. and T. Rasmussen. (1981) 'Repayment of NAFCREP Seasonal Input Loans - Some observations and some suggestions to improve the loan recovery'. CDR Project Papers D.81.11. Centre for Development Research, Copenhagen, page 3.

22) Ibid. p. 9.

23) Ibid. p. 22.

24) Ibid.

25) White, Alastair T. 'Project for the development of a community participation component in the Tanzanian Rural Water Supply Programme; Draft interim Report'. International Reference Centre for Community Water Supply and Sanitation. The Netherlands. IRC/CEP/Ta.81.03.1981.

26) Ibid. p. 31-32.

27) Ibid. p. 32-35 and 45.

28) Preliminary information from Miles Burton, CCKK.

29) See for example
Dumont, R. and M.F. Mottin, (1980). Self-Reliant Rural Development in Tanzania 13 Years after Arusha Declaration on Socialist Lines. Unpublished report: National Institute of Agronomy, Paris.

Hyden, G. (1980). Beyond Ujamaa in Tanzania: Underdevelopment and an Uncaptured Peasantry. (London, Heinemann).

30) See DANIDA Steering Unit, (1981). Iringa Seminar on Rural Water Supply and Water Master Plan Resolutions and papers presented at the Iringa Seminar on 1st and 2nd September 1981.

31) At least five possibilities have been suggested by White, A., and Kerkhoven, Project for the Development of a Community Participation Component in the Tanzanian Rural Water Supply Programme. International Reference Centre for Community Water Supply and Sanitation. Netherlands.

32) These tasks are desribed in an undated note from the Prime Minister's Office: Wajibu na Kazi za Watumishi wa Idara ya Maendeleo ya Jamii Mikoani.

33) Jorgensen, K. (1980) "Women and Water in Africa" CDR-paper page 4.

34) Many of the ideas in this section have emerged during discussions with MAJI, the Water Master Plan consultants, and the DANIDA steering Unit.

35) Two-day seminars on the present Water Master Plans have, however, been held with regional and district authorities in Iringa and Mbeya regions.

36) Personal communication with Mr. Mayonera, Community Development Division, Iringa Region, December 1981.

37) This indicates the level for Iringa and Mbeya Regions. The need in Ruvuma Region is smaller due to the smaller number of villages there.

38) Based on talks with village chairmen and perusal of files in the District Development Director's and District Water Engineer's Offices.

7. CHOICE OF TECHNOLOGY IN VILLAGE WATER SUPPLY

7.1 Technology and participation

Water supply systems differ in their potential for development on a self-help basis. Whether a certain water supply system can be developed by local people on a self-help basis depends on the nature of the water resource and the technology used in the development of the resource. Therefore in an attempt to identify water supply systems which offer favourable conditions for participation by rural people, we have first to examine various sources and the type of technology which would be suitable for their development. Obviously, if the aim of participation is to involve rural communities in the development of improved water supplies, the technology to be used should be within the people's means and it should commensurate with their abilities. Favourable technologies should therefore possess the following qualities:

- They should be low in cost.
- Rural communities should, with some kind of training, be able to operate and maintain the water supply system. That is, the technology used in the water supply system should not demand a high level of technical skill.
- The system should make as much use as possible of locally available materials, and should avoid heavy reliance on imported materials, such as energy fuels.
- Local labour should be used whenever possible.

If the technology used in a particular water supply system possesses the above qualities, it can be assumed that the water supply system has high potential to be developed with community participation. For easy identification of the water supply systems that can accomodate participation, it is necessary to examine technology in conjunction with the sources of water. This can be done by a systematic examination of the major components of water supply systems, namely: the water sources, the technique of water quality improvement and protection, and the facilities for storage and distribution.

7.2 Extraction and development technology

All points in the hydrological cycle have at one time or the other been used as a source of water. However, the needed technology for extracting water varies with the stage in the cycle at which water is withdrawn. We can identify four major points in the cycle at which water has generally been withdrawn by man. These are: Oceans and the atmosphere, rainwater, surface water, and groundwater. For each of the four sources there are numerous ways of extracting water. In

the following pages the technologies which have been used in withdrawing water from the various sources shall be examined. Since the concern here is identification of technologies that may be suitable for rural water supply development our discussion will be limited to three sources: Rainfall, surface water and ground water.

7.2.1 Rainwater

Rainwater harvesting is one of the most important water supply systems, especially for areas where other sources of fresh water are not available or are too costly to develop. It is a water supply system which has been in use for at least the past four thousand years.[1)] Ancient desert dwellers are known to have collected rainwater by directing water running down the hillslopes into fields or cisterns. Rainwater harvesting is not a suitable water supply system for more modern municipalities. Exceptions are areas where other alternative sources are lacking such as on oceanic islands and isolated peninsulas, Bermuda and Gibraltar being examples respectively. Rainwater harvesting has, however, proved to be particularly suited to supplying water to areas with dispersed population, schools, small villages, livestock and even wildlife.

Rainwater collection systems consist of two parts: the catchment phase and the storage phase. Rainwater can be collected before it reaches the ground, usually by use of roofs, or immediately on reaching the ground but before it escapes into the ground or runs off into rivers, lakes or seas. Water collected in this way can be stored in tanks, cisterns, wells, ponds or reservoirs. In the following pages we shall examine briefly the various methods which have been used in harvesting and storing rainwater. Let us start with the roof catchment system.

Roof catchment

Any roof, provided it is made of rigid and impervious materials which offer a smooth surface can be used to collect rainwater. The most commonly used roofing materials appropriate for rainwater collection are concrete, galvanized and corrugated iron sheet, tin roofs and baked clay tiles. These roofing materials are usually constructed with troughs which lead rainwater to storage units by means of gutters fixed at the lower edges of the roofs. When necessary precautions are taken in collecting rainwater from the roofs, its quality compares favourably with water obtained from other natural sources.

For areas that have no other source of water, and even for areas which experience very light rain, the importance of a roof catchment system can hardly be overstated when it can be shown that each square metre of roof is capable of collecting

approximately 25 litres of water from a 25 mm rainfall. Thus, with a roof of about 24 square metres, 12000 litres of water could be collected easily in a year from a 500 mm annual rainfall. The other advantage of roof catchments is that water can be collected even from very light showers which may be too small to cause runoff from soil catchments.

However, roof collection is not without its own kind of problems. Although the supply costs nothing and the operation and maintenance charges may be very low, the initial capital investments in installing the roof with its gutters and a storage tank may be beyond the financial means of the majority of the rural people.

For a roof catchment water supply system the heaviest expenditure is often for storage facilities, especially in areas which experience long periods without substantial rain. In such places big storage units capable of holding enough water to last through the rainless period are required. The costs of such storage units may at times be beyond the financial abilities of the rural people.

Various types of storage units have been used in different parts of the world. Circular, corrugated, galvanized iron tanks seem to be the most popular. Because they are available in a variety of sizes, they are ideal for household installation. Wooden tanks made of cedar, cypress, white pine, or oregon fir are known to have been used extensively in the past in many parts of the United States for storing water. They lasted between 15 to 20 years. However, construction of wooden tanks at low cost is now probably possible only in areas with abundant forests. It is no longer a cheaper alternative with the present world shortage of wood, and, of course, it has never been a low cost alternative in areas where wood has to be imported. Furthermore, wooden tanks would disintegrate quickly in the tropics where temperature and humidity are always very high. Rectangular metal tanks constructed of flat plates of steel have been used to store rainwater. Because of the high costs involved, this storage method is unsuitable for rural areas in underdeveloped countries.

Brick tanks, constructed of either reinforced or plain brickwork set above the ground surface or in excavation, have been used for rainwater storage. They are usually built in a circular pattern to minimize materials. Another variant of brick tanks are concrete or stone tanks. The main advantage with these tanks is that they are usually constructed with locally available materials. The technology required for their construction is simple as to allow local people to participate in their construction. The overall costs of such storage units are low compared with other types of storage units.[2)]

Ground catchments

Water supply systems based on roof catchments are suitable for single households or for small institutions. When it comes to supplying rainwater to larger communities such as villages, other approaches to collecting rainwater as soon as it reaches the ground are used. The basic principle behind the various methods is to collect water before it percolates into the ground or runs off into rivers or lakes. This is done by controlling the catchment area so as to increase runoff into storage units. The three main methods by which the catchment area is controlled are (a) improving the soil surface by compacting and smoothing, (b) treating the soil with chemicals so as to reduce permeability, and (c) lining the catchment area with waterproofing materials.

Improving the soil surface is the simplest and cheapest method of rainwater harvesting. In many cases what is required is to remove obstructions of runoff by clearing away bushes and rocks, and smoothing and compacting the soil. All these can be accomplished by using labour, without the need for machines.

The system has been tried in many parts of the world. The main problem with this simple rainwater collection method is that it tends to induce erosion. The quality of water obtained is often not suitable for domestic use although it is a suitable source of water for livestock.

Another method which has been tried in an attempt to increase runoff from rain catchment areas has been to treat the soil with chemicals so as to reduce permeability. Sodium salts have been found to be good soil sealants. Sodium carbonate in particular has proven to be very efficient. It causes clay in the soil to break down into small particles which then swell, sealing the soil pores and cracks. However, efficient use of sodium salts is limited to soils which have a minimum of 15 percent clay and are at least 30 cm deep and where the soils have a capacity to exchange calcium (which causes clay to bunch up) for sodium ions.[3] The major drawbacks in using sodium salt are the poor quality of water obtained because of the salts it contains and the costs involved obtaining the salts.

On the other hand, paraffin wax offers promise of building even better impermeable catchments. Granulated wax, when spread on the ground, melts in the sun and flows into soil pores producing an impervious surface that readily sheds water. It can as well be melted and sprayed on the ground. In some places where this method was tested, wax-treated plots yielded 90 percent of rainfall as runoff. This far exceeds the 30 percent runoff which was obtained from untreated plots. Furthermore, runoff from wax-treated plots had low salt content (less than 30 mg per litre) and almost no organic matter.[4] Once more, the major drawback are costs involved in obtaining paraffin wax.

7.2.2 Surface water sources

Many people in the world, and most people in Tanzania, still get their water from surface sources such as ponds and tanks which are either natural or man-made, rivers and streams, lakes and man-made reservoirs, and irrigation canals. The various methods used in extracting water from surface sources depend on many different factors such as the nature of the water source, topography of the area, the need which has to be satisfied, the available technology, quality and quantity of water required, location of the source in relation to where water is needed, and, of course, the cost of extracting water.

Water can be withdrawn directly from any surface source without human effort being made to improve the source. Many such cases are found in rural areas of developing countries. Some surface sources have water during the rainy season and they dry out during the remainder of the year. In other surface sources quantity (and sometimes quality) fluctuates with the seasons. In such situations where quality and quantity are subject to fluctuations there is always a need of improving the source so as to increase the reliability of supply. The other type of situation that leads people to improve the source is to bring water to where it is needed.

In areas where the supply of water is unreliable or the quantity of available water fluctuates with the seasons, one way of ensuring constant supply is to construct ponds and tanks to collect surface runoff. These are usually constructed on broad gently undulating alluvial plains. They can be built in the vicinity of shallow, temporary streams and in depressions which are found in the plains. Their embankments are mainly made of dirt excavated from the reservoir site.

Water from such sources is usually not good for human consumption, but it is best suited for livestock needs. In the 1920s the British colonial government in Tanzania encouraged the construction of such ponds and tanks to harvest surface runoff. Many of these can still be found in parts of Lake Victoria area. They are used mainly for stock watering.[5)]

Small dams are often built on perennial streams for the purpose of raising water levels during the period when the flow is low in order to ensure the availability of water at all times. Different categories of such dams can be identified according to the materials used in construction. Nine types have been identified: brush and boulder dams, earthen dams, loose rock dams, timber dams, wire net dams, masonry dams, concrete dams, reinforced concrete dams, and wire and steel dams.

However, a combination of construction materials can, and sometimes is, used on one single dam as in the case of ferro-concrete dams. The type of dam used is usually determined by such factors as the character of the foundations, topography of site, size and importance of the structure, degree of imperviousness required, costs involved, and, of course, the hydrology of the area. However, certain types of dams are more expensive to build than others. For many rural areas earthern dams are most frequently used and are often capable of solving the local water supply problems. Consequently our interest in dams for rural water supply systems should be restricted to this type of dam.

An earthen embankment is often the cheapest form of a dam and it requires only simple skills to build. The advantage with this type of dam is that it can be built on a variety of foundations provided the dam is based on an impervious stratum. Materials needed in construction are loam, sand, gravel and clay which are always available locally. Usually, an earthen dam is built of materials excavated from its upstream side. The essential features to be observed in the construction of dams of this nature are weight and imperviousness. These requirements can easily be attained by mixing together coarse and fine materials. Compacting of the dam can be done by trampling to and fro of man and animals.

Water can be withdrawn from such reservoirs in many different ways. Using a bucket and a rope is one common way of drawing water. It is a simple and straightforward method. Small hand air pumps are sometimes used to bring the system into action.[6)]

Thus, depending on the quantity of water needed and the nature of the water source, various methods have been used to extract water from surface water sources.

The main problem with surface water sources is quality. Owing to their being open, they are subject to contamination; and it is often difficult to keep them free from pollution. Occasionally, it is possible to find streams which are pure and clean, but these are usually restricted to small uninhabited mountainous watersheds. Generally, surface water is regarded as unsafe for domestic use, and for rural areas that cannot afford the cost of making surface water safe to drink, it is usually advisable to use groundwater for domestic needs wherever possible and to use surface water only as a last resort.[7)] Groundwater sources are preferred because they are less likely to be contaminated.

7.2.3 Groundwater sources

When groundwater is available at shallow depth it is usually the most ideal source of water for villages and small communities because the quality of water, except

where there are salinity problems, is always high; provided necessary steps are taken to protect the source from surface contamination, and the supply can easily be developed. Although deep groundwater is usually high in quality, its development for rural areas is often hindered by the greater costs and high technology involved in its exploitation, since, sometimes, it is necessary to penetrate hard rocks before water is reached. Furthermore, groundwater is reliable, provided it is not overdrawn. Deep groundwater is more reliable than shallow groundwater because it is not normally affected by seasonal changes in precipitation as is the case with shallow groundwater sources.

Taking all the various sources of water for domestic use into consideration, deep groundwater (at least bacteriologically) offers the best quality water. Water from deep ground sources can be used without treatment. The bacteriological quality is usually due to a long process of filtering by the soil and lack of oxygen and nutrients at great depths, factors which inhibit multiplication of pathogenic bacteria. The chemical quality of water from deep ground sources varies greatly with the type of minerals which water comes into contact with in its long passage to deep aquifers. Sometimes the concentration of chemicals in the water may be so high so it is hazardous to health.

In general, a groundwater supply system is usually suitable for consumers in rural areas because it can be constructed in small units and can easily be distributed among the consumers. The methods and difficulties of withdrawing water from the ground depend, among other factors, upon the depth at which water lies and the nature of the rock that has to be penetrated.

In many cases, however, the most common way of extracting groundwater is by wells. These can be shallow or deep depending on the depth of the water bearing aquifer. There are various types of wells and methods of constructing them depending mainly on the nature of the rock through wich the well has to be sunk. Where groundwater is near to the surface and in soft formations, wells may be dug by hand using hand tools. In addition to hand-dug wells, hand drilled and tubewells are also sunk in shallow aquifers by boring, jetting, or driving. Boreholes, on the other hand, are restricted to deeper aquifers. The two main methods of sinking deep wells are rotary (or hydraulic rotary) and percussion (or cable-tool percussion) drilling.

7.3 Tanzania's experience with shallow wells

Among the strategies chosen in supplying water to rural communities, development of shallow wells has been given emphasis. Development of shallow wells has been

undertaken on a large scale in Shinyanga and Morogoro Regions and the government intends to spread shallow well projects to other regions of Tanzania.

The Shinyanga Shallow Wells Project started with hand-dug wells which were lined with non-reinforced concrete rings of about 1.25 metres internal diameter, but as time went by and more experience gained, the project shifted to hand-drilled wells. A shift to hand-drilled wells has only been undertaken where aquifer recharge has been found to be sufficient. Where aquifer recharge has been found to be low, a large diameter well, which in this case is a hand-dug well, has always been preferred and used. With the abundance of human labour which is often found in rural areas of Tanzania at certain times of the year, development of hand-dug wells seems to be a feasible and the next cheapest alternative method of supplying water to rural communities. The experience gained from Shinyanga and Morogoro shallow wells projects shows that the cost ratio for the construction of wells is roughly as follows: hand-drilled wells: hand-dug wells: percussion rig wells = 1 : $1\frac{1}{2}$: 2.

However, shallow wells cannot be developed in every place in Tanzania. In areas where this is not possible other more expensive alternatives of supplying water to rural areas have been undertaken. Deep boreholes are known to have been sunk, pumped and piped water schemes have been built where necessary.

Thus the choice of technology to be used in the development of rural water supply is bound to be determined by many factors and not cost alone.

7.4 Technological alternatives for Iringa, Mbeya and Ruvuma Regions

In most areas of the three regions the Water Master Plan consultants plan surface water gravity schemes, which are suitable in the sense that they use relatively clean surface water from higher, uninhabited areas, and provide it through a system that is fairly easy and cheap to maintain and can locate the domestic water points where the people live.

Other areas will be supplied through shallow wells, which also have advantages in terms of potentiality for village participation, but where a major drawback is that their location has primarily to take water availability into account - not where the water is needed.

There are areas, however, which can only economically be supplied through systems with major maintenance and operation problems (e.g. borehole/diesel pump schemes), or where any "modern" scheme will be too costly, or which have a very low priority because traditional sources have a reasonable quality, capacity and accessi-

bility (see chapter 12).

In such areas support should be available from the proposed "Extension Unit" and MAJI for villages that want to improve traditional sources, primarily through their own efforts. The support would mainly be in the form of expert advice, but could also include minor financial inputs, to establish rainwater catchments or improvement of the quality and quantity of surface water sources.

It should be considered to include experts specifically responsible for this aspect in the "Extension Unit", since it will largely entail mobilization of the people on a sound technical basis, rather than major construction works as undertaken by MAJI.

Notes:

1) National Academy of Sciences, More Water for Arid Lands Promising Technologies and Research Opportunities, Washington, D.C. 1974, p. 18.

2) Dixey, F., A Practical Handbook of Water Supply. London 1931.

3) National Academy of Science, op.cit. pp. 12 - 15.

4) Ibid.

5) Ministry of Water Development and Power, The Role of the Water Development and Irrigation Division in Tanzania, Unpublished report, no date.

6) For the description of the various methods of drawing water from surface sources see: Maystre, Y., 36 - 39.
Maystre, Y., Idelovitch, E., and Burton, I., Technology Assessment and Research Priorities for Water Supply and Sanitation in Developing Countries Ottawa: International Development Research Centre, 1973, pp. 36 - 39.

7) U.S. Department of Agriculture, Water Supply Sources for the Farmstead and Rural Home. Farmers' Bulletin No. 2237, p. 1.

8. WATER USE FOR DOMESTIC CONSUMPTION

8.1 Introduction

8.1.1 Present water use pattern and water scheme design criteria

The aim of the present chapter is to provide quidelines for water scheme design criteria based on analyses of present water use pattern.

Sections 8.2, 8.3, and 8.4 deal with present and projected quantities of water collected per capita by households, and quantities used at the source, leading to a proposed scheme capacity design figure.

The next section (8.5) discusses the extra demand put on scheme capacity in locations where house connections are permitted or preferable.

Then follows analyses of the distribution of water collections over the day, with subsequent calculations of peak factors, and a proposed peak factor design figure (8.6).

Finally 8.7 discusses the impact of distance on the households' water consumption and selection of source, in relation to the 400 m maximum design distance maintained in Tanzanian water supply policy; while 8.8 takes a look at who collects water and what are the specific uses of water in domestic consumption.

8.1.2 Other studies of water consumption in Tanzania

For comparison with the results below we quote Brokonsult's "Rural Water Quality Programme in Tanzania"[1] on other studies of water use in Tanzania:

"Various studies of water use in Tanzania are summarized in (table 8.1)[2]. The average quantity of water taken from the source is 12 liters/person/day. An additional set of investigations carried out during the Tri-Region Water Master Plan gave a range of consumption of the range 8-17 liters/person/day. Volumes of water used are difficult to measure since only part of the water is gathered and taken to the home in vessels so that the volume can be estimated. Laundry and bathing are often performed at the source so that water used cannot really be measured.

The conclusion is that water extracted for use in rural areas is in the range 10-15 liters/person/day. This corresponds to 2-3 debe (tins) per household per day".

The Tanga Region Water Master Plan arrived at an average of 12.2 l/c/d carried home from piped schemes and 11.9 l/c/d from unpiped supplies, with district variations between 10.0 -16.7 for the former and 10.3-15.8 l/c/d for the latter[3].

Water supply type			Average l/ person/day	Minimum	Maximum
Standpipe	(a)	Moshi	13.3	4.2	35.0
Standpipe	(a)	Dodoma	20.8	13.7	36.5
Pit	(a)	Kipanga	12.7	5.0	48.5
Very distant	(b)	Pare District	4.3	3.6	5.2
Stream	(b)	Kilimanjaro Dist.	8.9	8.4	10.8
N.R.[x]	(b)	Morogoro District	13.2	N.R.	N.R.
N.R.	(b)	Nzega	12.6	3.5	20.0
Standpipe	(c)	Mbezi	11.4	4.0	33.0
N.R.	(d)	Shinyanga Region	12.7	8.0	17.0
Average			12.2	7.1	24.4
range				3.5-13.7	5.2-48.5

x N.R. - Not recorded

(a) White, Bradley, White "Drawers of Water" University of Chicago Press 1972

(b) Warner, Presented at conference on Rural Water Supply in E.Africa 1971

(c) Coast Region Water Master Plan

(d) Shinyanga Water Master Plan

From Brokonsult, op.cit.

Table 8.1 Water use studies in Tanzania - summary

Preliminary findings from the Kigoma-Rukwa socio-economic Water Master Plan study carried out by BRALUP indicates a water use of appriximately 13 litres per person per day, while another BRALUP study in Northern Njombe gives average daily per capita water consumption figures for 5 different villages ranging from 8.1 to 11.2 litres with a mean of 9.5 litres.[4)]

It will be seen that these figures, drawn from very different parts of the country, are remarkably similar, and corresponds well with the findings for Iringa, Mbeya, and Ruvuma as presented below, especially taking the measurement difficulties as well as the wide ranges of individual household and village results into account.

8.1.3 The data

Most water used by a household is carried to the house. The figures for the amount of water collected and time of the day are mainly based on the household survey interviews conducted in the following manner:

The respondent (wife) was asked about the types and numbers of containers collected at different times yesterday by herself, her co-wives, children and

husband. The volumes of the different containers used were then measured by the interviewers. The advantage of this method is that it gives relatively reliable water use figures for one point in time (yesterday). The disadvantage is that differences between dry and wet season water use figures (if any) are not known.

Some water is also used at or around the place from which water is drawn. Figures for this consumption are based on observation of activities at or around water taps in Kiponzelo (zone 3 Iringa) and Ikama and Katela (zone 5 Mbeya). The activities of approximately 310 persons collecting water at a total of 4 domestic water points in these three villages were observed. Distances to the sources used at the time of interview, the existence of sources nearer to the house, which are not used, and the different purposes for which water is used can also be derived from the household survey.

8.2 Present domestic water consumption in rural areas in Iringa, Mbeya, and Ruvuma Regions

8.2.1 Present mean water collection per capita, water carried to house

The figures for each of the zones are given in table 8.2 below. The uniformity of mean collection figures across zones is striking. It justifies the use of one common set of water use figures for the three regions. The only zone with a significantly deviating mean figure, wet western highlands in Ruvuma, has a traditional, channeled water supply, which provides water just outside almost everybody's house (see Chapter 2).

Within zones there is however some difference in mean water collection per capita across villages. In the village with the highest mean collection (Rujewa, Mbeya Region), 13 % of the respondents had taps inside the house or just outside it. Most of the other villages with high mean water collection figures also have water schemes, although no respondents had house connections, and taps. For villages with the lowest mean water collection per capita there appear to be a lowest limit at around 4.5 litres per capita. But the variability is large and may indicate the influence of different socio-economic and physical factors across zones. This question is analysed in detail below for Iringa and Mbeya Regions.

Region/zone		Water collection		
		Zonal mean litres/cap.	Village with highest water collection litres/cap.	Village with lowest water collection litres/cap.
IRINGA				
High rainlands		9.6	12.4	4.4
Upper plateau		10.7	14.8	9.2
Medium dry zone		10.4	14.4	7.4
Dry Northern fringe		9.0	13.2	4.8
MBEYA				
Wet highlands		9.7	12.0	6.3
Lake shore		9.7	12.0	7.0
Dry plain		10.7	23.4	6.4
Dry Northern zone		11.6	13.8	10.3
RUVUMA				
Dry eastern zone		8.5	9.3	7.4
Wet Western highlands	x	15.0	15.8	14.3
Intermediate zone	x	10.6	11.5	9.0

x) As computer runs were not yet available figures for these zones are based on manual calculations of per capita consumption of water brought to the house which may differ slightly from water collected, due to storing from day to day.

Table 8.2 Mean water collection (litres per capita) by sample households the day before the interview, Iringa, Mbeya, Ruvuma.

8.2.2 Factors influencing water collection per capita; water carried to house

Spearman's rank correlation coefficient, cross tabulations and Kruskis-Wallis one-way analysis of variance have been used to test the influence of different factors on water collected and carried to the house. All these types of tests are non-parametric. No assumptions of normality have thus been made. All analyses are made at the zonal level for Iringa and Mbeya Regions.

Both socio-economic and physical factors have been included in the analyses. The factors have been analysed one by one. For each of the 8 zones the implicit assumption is therefore that the influence of the different factors (say, education and income) on water use is independent of each other. This is obviously a simplifying assumption.

For each factor and each test type, only the main conclusions are presented in table 8.3. The computer print-outs give the full documentation (subsequently for Ruvuma Region as well).

Independent variable	Type of test	Cases included	No. of zones significant at 10% level	No. of zones with positive/negative correlation +	-	Conclusion
1. Cash income per capita	Spearman correlation	all	4	8	0	Higher income families generally use more water than low income families
2. -do-	-do-	tap users only	6	8	0	Same as above, but for users of tap water
3. School education, household head x)	Cross tabulations	all	1	7	1	School education has a positive influence on water consumption
4. Family size	Spearman	-do-	8	0	8	Large families use less water per capita than small families
5. Percentage of children below 15 years of age	-do-	-do-	8	0	8	Families with many children use less water than families with few children
6. Percentage of females in family	-do-	-do-	4	8	0	Generally, families with a great number of females use most water
7. Walking distance to source	-do-	-do-	4	2	4	Generally, families with long walking distance use less water than families who live near water
8. Type of source xx)	Cross tabulations	-do-	2	6	2	Generally, users of tap water use more water than users of traditional source
9. -do-	Kruskis-Wallis	all users with less than 400m to source	3	6	2	Generally, users of tap water use more water than users of traditional source
10. -do-	-do-	all users with more than 400m to source	2	5	3	-do-

x) Highly correlated with educational level of wives xx) Tap vs. traditional source.

Table 8.3 Factors influencing water collection per capita by sample households; water carried to the house

Of the 7 factors analysed, 4 factors generally have a positive influence on water use per capita while the other 3 factors have the opposite effect on water use. These results are used in the projection of future water use per capita (see 8.3 below).

8.2.3 Present mean water use for personal hygiene and laundry per capita by simple households; water carried to the house

The data below on the use of water for bathing, washing and laundry only include those families that actually carried water to their houses for these purposes yesterday. Thus, families who do not carry water home for these purposes or who did not do so the day before the day of interview are excluded in the consumption figures given in table 8.4 below.

Region/Zone	Washing/bathing at house			Laundry at house		
	Using hh. one day mean l/cap	Using hh. one day % of all hh.	All hh. mean days/week x)	Using hh. one day mean l/cap.	Using hh. one day % of all hh.	All hh. mean days/week x)
IRINGA						
High rainlands	4.3	63	4.4	5.7	14	1.0
Upper plateau	3.6	51	3.6	4.5	10	0.7
Medium dry zone	3.6	80	5.6	8.7	21	1.5
Dry Northern fringe	3.1	55	3.8	12.6	5	0.4
MBEYA						
Wet highlands	2.8	80	5.6	3.7	4	0.3
Lake shore	3.1	86	6.0	17.8	9	0.6
Dry plain	3.1	64	4.5	7.7	16	1.1
Dry Northern zone	4.1	98	6.9	6.3	17	1.2

x) Assuming that the activity is equally distributed on week days; then if x % undertakes it in one day, the mean number of days per week in which it is undertaken by all households is x % of 7 week days.

Table 8.4 Use of water at house for washing/bathing and laundry; by sample households (hh) that did use water for these activities the day before the interview, and by all hh. in a week.

Water used for personal hygiene at the house does not vary much across regions, and the average amount is limited (3-4 litres per capita yesterday). More water is used for laundry (4-18 litres per capita), and the variation across regions is greater. The reason for this variation is partly that the laundry figures are based on relatively few cases (7 to 36).

The table shows that more than half of all families washed or bathed at the house yesterday. Only one-fifth or less did laundry at the house yesterday. The frequency of washing and bathing at the house appears to be 2 to 7 days a week depending on zone. Laundry frequencies vary between 0.3 to 7 days a week, for the households interviewed.

8.2.4 Water used at source

The fairly wide variation shown above in the frequencies of washing/bathing and laundry at the house can in part be explained by the distance to the water source: As shown in table 8.5, the further away a source is, the more likely it is that the family will do the washing, bathing and laundry at the source of water.

Distance metres	Personal Hygiene		Laundry	
	Iringa % of all hh	Mbeya % of all hh	Iringa % of all hh	Mbeya % of all hh
less than 400	10	31	22	44
400 - 999	25	57	46	70
1000 and more	36	67	49	70

Table 8.5 Percentage of sample households using water at source for personal hygiene and laundry

All households carry water to the house for consumption there. Some households also use water at the place of collection.

Three factors influence to what extent water is used at the place of collection. Table 8.5 shows clearly that distance to water source is an important factor. Table 8.6 below indicates that also type of water use is important. Thus approximately one third or more of all households interviewed do some washing/bathing and laundry at the source. Table 8.6 also shows that users of tap water do much less washing/bathing and laundry at the collection point than other users. This clearly shows the influence of the distance factor (taps are often closer to the house than traditional water sources). But the difference in activity level at traditional sources and taps probably also indicates that

traditional sources generally offer better physical possibilities and greater privacy for washing/bathing and laundry than areas around taps do.

Activity	All water sources		Users of tap water	
	at home only	at source	at home only	at source
Drinking	100	0	100	0
Cooking	100	0	100	0
Washing/bathing	67	33	95	5
Laundry	55	45	75	25

x) Estimates extrapolated from all interviews in Iringa and Mbeya regions. Drinking does not include an occasional sip of water taken at source by water collectors.

Table 8.6 Percentage of households[x] using water at source by water use and type of water source

Only estimates of water used at tap are interesting for projection purposes. The results of observations of water consumed for personal hygiene and laundry plus running water at domestic points show that 2.9 litres per capita per day is used at the tap.[3] (See table 8.7 below).

The information on washing/bathing and laundry are based on observations of individuals collecting water in a container before using it at or near the tap. In table 8.7 is also included information about the amount of water used directly from the tap. Sometimes this water was spilled on the ground without being used, while at other times it was used for drinking, washing of hands, face, legs, utensils, crops and water containers.

Use type	Village	
	Kiponzelo (Iringa)	Ikama and Katela (Mbeya)
Personal hygiene	0.0	0.2[x]
Laundry	0.0	0.7[xx]
Running tap	3.5	1.4
Mean total		2.9

x) Based on an average consumption figure of 8.6 litre per person who was observed washing and bathing at the tap (compare table 8.4 column 1)

xx) Based on an average consumption figure of 33.8 litre per person who was observed doing laundry at the tap (compare table 8.4 column 4)

Table 8.7 Water consumed per capita per day at tap (litres)

8.3 Future water collection/consumption per capita

The qualitative basis for forecasting the collection/consumption figure in 20 years time is as follows:

a) some increase in cash incomes and general educational levels can be expected and this is likely to contribute to an increase in water use per capita (see table 8.3, row 1-3)

b) a likely stable or moderately decreasing fertility level will cause a stable or decreasing family size and this will also lead to an increase in per capita water use (see table 8.3, row 4 and 5)

c) users of traditional water sources will - when they are supplied with tapped water - tend to increase their water consumption: partly because of a decrease in walking distance, and partly because of the likely improved service level of water schemes (see table 8.3, row 7-10)

d) if health education becomes an integrated part of a water supply programme, some effect on water consumption may be expected.

The quantitative basis for arriving at the 20-year collection/ consumption figure is the present water collection figures for villages which already have a water supply; which have above average income and educational levels; and in which some non-agricultural activities (mainly administrative) are located. Generally, this type of village has the highest consumption figures within each zone. These figures are shown in column 2, table 8.2. The weighted household average across the 8 villages in Iringa and Mbeya Regions is 14.5 litres per capita. It is assumed that this figure reflects the qualitative considerations a) to c) above. To this figure shold be added the observed average consumption, 2.9 litres per capita per day of water consumed at the tap (see table 8.7). The sum total of these two figures is 17.4 litre per capita per day. Allowing for some increase in collection/ consumption in the future due to health education, etc. (see point d) above), a figure on 20 l/capita/day for collection/consumption in 20 years' time therefore seems reasonable.

8.4 Proposed water scheme capacity

Based on the projected 20 l/capita/day consumption and assuming a 5 l/capita day loss in the system itself (figures provided by the Water Master Plan consultants) we arrive at proposed scheme design figure of 25 l/capita/day.

This is a reduction of 20 % in consumption capacity from the design figure of 30 l/capita/day, assuming that this also includes 5 l/capita/day scheme loss, and a 16.5 % reduction in overall scheme design capacity.

Such a change seems justified, since it would result in reduced scheme costs, and still allow for substantial increases in water consumption over present levels, as shown in table 8.8 below.

	Estimated mean consumption per capita per day				
	present at house litres	at tap litres	total present litres	proposed capacity litres	Increase allowed %
Villages with highest collection figures	14.5	2.9	17.4	20	15
Villages with lowest collection figures	6.7	2.9	9.6	20	108
Mean, 8 zones	10.2	2.9	13.1	20	53

Table 8.8 Proposed scheme capacity compared with present water use.

It is not expected that a possible provision of washing and bathing facilities will increase total consumption significantly, as they will continue to demand that water is carried from the tap to the facility. (Otherwise the costs will be exceedingly high). The main benefit from such facilities would thus be improved convenience. Experiments with washing slabs are under way in one of the water schemes being implemented presently as part of the Water Master Plan project.

Only under one condition can per capita water consumption be expected to rise far above the 20 l/cap/day figure, that is if the habit of having house connections becomes widespread. The consequent water demand is discussed below (8.5), but it is necessary to note here, that to remain within reasonable construction costs, village water supplies do not allow for house connections, even if the direct cost of the connection itself is paid by the consumer. Since a normal village water supply does not have the capacity for any larger proportion of house connections nobody should therefore be allowed to have such connections except institutions such as dispensaries.

8.5 Water collection/consumption figures in large villages with township characteristics and house connections

8.5.1 Rujewa village

In section 8.2.1 above it was mentioned that a number of households in Rujewa village in the dry zone in Mbeya Region had house connections.

This village serves as a sub-district headquarter for part of Mbeya district. It is a service and commercial centre for most of the Usangu plains, including the nearby Mbarali state farm. The village has daily bus connections to Mbeya town. The bus service as well as a transport company are run and owned by a Baluchi. Economically, the Baluchis form a dominating group on the Usangu plains as they formerly did politically. The village also has a large health center, several shops, guest and tea houses (hotellis).

8.5.2 Water use in Rujewa village

The table below shows data on total water collection and on consumption for personal hygiene for households with 10 metres or less to a domestic point. These were compared with households which were situated more than 10 metres away from a domestic point.

Distance	Total collection L/c/day	Personal hygiene L/c/day	N
Households within 10 metres from DP	62.8	11.2	4
Households more than 10 metres from DP	16.9	4.1	24
All households	23.4	5.1	28

Table 8.9 Mean water collection/consumption in Rujewa village, Mbeya, by distance to domestic point (DP)

The figures in the first column may be compared with table 8.2, while the second column should be compared with the first column in table 8.4 above.

The table above shows that households with easy access to water, here defined as less than 10 metres to the tap, on average collect 3.7 times as much water as the mean for the other households with a longer distance to the domestic point. Furthermore, it was found that they consume 2.7 times as much water on personal hygiene per capita as do households with more than 10 metres to the DP.

The situation for these other households can, on the other hand, be seen to approach the conditions in other rural villages. Even they are at the higher end, though, probably due to higher income and educational levels, shorter distance etc. as discussed above (8.2.2.).

The data in the top row in the table are based on only 4 cases. Three of these had house connections and the fourth household had a water tap five metres outside the front door. Because of this small size of the sample of households with private connections we shall not make any definite conclusions on quantities that people with house connections can be expected to use.

8.5.3 Other studies

The Rujewa mean of 60-65 l/c/d may, however, be compared with a few other studies from East Africa, the results of which are presented in table 8.10 below.

Locality	Features of place	Mean water consumption l/c/d
Karuri, Central Province, Kenya[a]	small town	32
Igunga, Busoga, Uganda[a]	"	85
Kamuli, " " [a]	"	86
Moshi, Tanzania[a]	urban	130
Dodoma, Tanzania[a]	urban	73
Dar es Salaam[a]	urban, medium high to high density	160
Urban areas, Tanga Region[b] Tanzania	?	79

a) From G.F. White, D.J. Bradley and A.V. White; Drawers of Water. Chicago 1972. p. 118.

b) Tanga Region Water Master Plan.

Table 8.10 Mean water consumption figures from other studies of urban areas in East Africa.

8.5.4 Tentative conclusion

Our results, together with findings of other studies, suggest that house connections lead to a 6-fold increase in water consumption per capita per day, i.e. from 10-15 litres to 60-90 litres, with a further increase in more urbanized areas with several taps per house, bath, flush toilet, etc.

The village inventory survey for the Water Master Plan study showed that as many as 20 % of all villages with a water supply in Mbeya and 10 % in Iringa have 5 or more house connections, 12 villages having more than 20.

On the basis of the tentative consumption figures it seems necessary therefore to reiterate what was said above: That unless a scheme is specifically designed for house connections (e.g. because of the urban character of the locality) such installations should be ruled out completely for reasons of capacity and equality.

8.6 The peak factor in distribution of water collection over the day

8.6.1 Water collection over the day

Water collection is not evenly spread over the 24 hours of the day. It is limited to the day-light hours, and within this period concentrated in periods when water collectors (mainly women, see 8.8.1 below) are not occupied with other work, especially work away from the house, e.g. shamba work.

Special water demanding chores, such as beer brewing, may also cause a concentration of water collection.

The design capacity of a water scheme must take this into account by applying a peak factor, i.e. a factor that indicates how much higher demand actually is in the peak period, than it would be in the same time period if it was evenly spread over the whole day (24 hours).

8.6.2 The data

The peak factors presented in this section are based on calculations made from data collected during the household surveys in Iringa and Mbeya Regions. From Ruvuma only data from one zone were available at the time of writing. These have been included in the tables, but not in the calculations.

The wives in each household were asked about the time of water collections yesterday. The responses were coded in time intervals of 2.5 hours each.

The drawing of one container of water was registered as one collection. One person was thus able to make more than one collection during each trip depending on the number of containers carried. The table below shows all households divided according to the type of source and distance to that source at the time of water collection.

Source type/ distance	Region		
	Iringa	Mbeya	Ruvuma
Traditional source	432	433	145
Tap source	158	175	1
hh less than 400 m to source	156	417	60
hh more than 400 m to source	428	171	86

Table 8.11 Households (hh) by source type and distance to source.

8.6.3 Distribution of water collection over the day by source type

Table 8.12 below presents a rather uniform picture of water collections during the day.

Two peaks occur during the day. The first one before 9 a.m. and the second one generally occurs between 2.01 p.m. and 4.30 p.m. The weighted averages of water collections for eight zones in Iringa and Mbeya appear in the far right column and show no major difference between collection from taps and traditional sources.

8.6.4 Distribution of water collection over the day by source distance

It appears from table 8.13 that the main peak of collections is still before 9 a.m., when the collections are controlled for distance to source. A second peak is also found, but when the distance to the source is less than 400 metres the difference between the peaks and the other collection frequencies is less pronounced than when a household has to walk more than 400 metre. Consequently, when a household is situated within 400 metres from the source there is a tendency to collect more evenly throughout the whole day.

Somo la II

MAJI MASAFI NI MUHIMU KWA AFYA YAKO

Swali: Kwa nini unafikiri maji ya kisima kilichofunikwa ni masafi ? (Kisima cha kisasa).

Jibu : Maji ya kisima hutoka chini ya ardhi, ambako hayawezi kuchafuliwa kwa urahisi kwa watu huyaogea au kuyafulia nguo. Kama kuna kinyesi mahali, mvua inaponyesha haitaweza kuipeleka kinyesi hicho kwenye kisima kwa sababu kisima kinafunikwa, (angalia picha).

Swali: -Je kila mtu katika kijiji chako huchota maji yake ya kunywa kutoka kwenye kisima cha kisasa.
-Je unaweza kufikiri ni wakati gani watu hawachoti maji kutoka kwenye visima vya kisasa.

Jibu : -Kisima hicho ni mbali zaidi kuliko mto au visima vya kienyeji
-Mara kwa mara kuna kuwa na watu wengi wanaongojea kuchota hapo.
-Maji ya visima vya kisasa hayana ladha nzuri kama maji ya mito au visima vya kienyeji.
-Watoto wanaocheza au kuogelea katika mto au vidimbwi hunywa maji hayo machafu.

Majadiliano: Je tunawezaje kuhakikisha kwamba kila kaya inatumia maji safi kwa kunywa na kupikia, ili waepukane na maradhi yanayoambikizwa kwa njia ya maji machafu au kwa kuhatarisha afya ya wengine kwa kuugua wao wenyewe kuugua maradhi hayo ?

Swali: -Panga mkutano na watu wanaoishi karibu na kisima cha kienyeji kujadili umuhimu wa kutumia maji masafi.
-Angalia kama kila eneo kijijini kuna uwezekano wa kupata maji masafi.
-Kama sivyo, kwajulisha Idara ya Maji au Maendeleo ya Jamii.
-Wakati jawabu linapotafutwa jaribu kupanga sehemu yeyote ambayo haina maji watumie visima vilivyoko karibu yao.
-Jadili na mabalozi wa sehemu hizo namna watu wanavyoweza kuchota maji kwa zamu zamu ili watu wasijazane hapo kwa mara moja.

Source type/ time intervals	Zones: Iringa — High rainland (1) %	Iringa — Upper plateau (2) %	Iringa — Medium dry zone (3) %	Iringa — Dry N. fringe (4) %	Mbeya — Wet high land (5) %	Mbeya — Lake shore (6) %	Mbeya — Dry plain (7) %	Mbeya — Dry North. zone (8) %	Ruvuma — Dry East. zone (11) %	Total — Iringa & Mbeya (weighted)
All sources										
before 9^{00} a.m.	37	32	31	45	37	27	37	35	-	34
9^{01}am-11^{30}a.m.	13	14	17	16	16	21	15	9	-	16
11^{31}am-2^{00} p.m.	10	14	16	10	13	12	13	15	-	13
2^{01}pm-4^{30} p.m.	25	18	20	17	21	24	15	22	-	20
After 4^{31} p.m.	15	22	17	12	13	15	20	18	-	17
	100	100	101	100	100	99	100	99		100
Traditional sources										
before 9^{00} a.m.	37	32	31	42	36	30	4o	44	42	35
9^{01}am-11^{30}a.m.	13	15	18	18	16	21	12	14	9	16
11^{31}am-2^{00} p.m.	6	13	15	7	13	12	12	9	11	12
2^{01} - 4^{30} p.m.	25	18	19	21	21	22	15	20	21	20
After 4^{31} p.m.	19	23	18	13	13	16	21	13	17	17
	100	101	101	100	99	101	100	100	100	100
Tap source										
before 9^{00} a.m.	36	32	29	47	42	17	33	26	-	33
9^{01}am-11^{30} a.m.	13	14	15	15	16	22	19	5	-	16
11^{31}am-2^{00} p.m.	17	18	18	13	11	14	15	22	-	15
2^{01}am-4^{30} p.m.	25	21	22	14	18	28	17	25	-	20
After 4^{31} p.m.	9	16	15	11	13	20	18	23	-	16
	99	101	99	100	100	101	101	101		100

Table 8.12 Distribution of water collections over one day, by source types and zones.

Distance to source time intervals	Zones: Iringa High rainland (1) %	Iringa Upper plateau (2) %	Iringa Medium dry zone (3) %	Iringa Dry N. fringe (4) %	Mbeya Wet high land (5) %	Mbeya Lake shore (6) %	Mbeya Dry plain (7) %	Mbeya Dry North. zone (8) %	Ruvuma Dry East. zone (11) %	Total Iringa & Mbeya (weighted) %
All sources more than 400 m										
Before 9^{00} a.m.	37	35	30	46	36	27	39	42	42	36
9^{01}am-11^{20}a.m.	14	15	17	18	18	20	18	9	9	17
11^{31}am-2^{00}p.m.	7	11	17	7	12	13	12	18	10	12
2^{01} pm-4^{30}p.m.	25	19	19	18	22	19	14	20	22	19
After 4^{31}p.m.	17	20	17	12	13	21	17	21	18	16
	100	100	100	101	101	101	100	100	101	100
All sources less than 400 m										
Before 9^{00} a.m.	38	21	33	42	39	26	36	33	42	33
9^{01} -11^{30} a.m.	11	14	18	12	15	21	15	9	10	17
11^{31} -2^{00} p.m.	16	19	10	18	13	12	14	15	14	14
2^{01} -4^{30} p.m.	25	19	23	15	20	25	16	23	20	20
After 4^{31} p.m.	11	26	17	12	14	16	20	2o	15	17
	101	100	101	99	101	100	101	100	101	101

Table 8.13 Distribution of water collections over one day by distance to source and zones.

8.6.5 Estimated peak factors

On the basis of tables 8.12 and 8.13 we can now calculate the peak factor for the $2\frac{1}{2}$ hour interval used here.[4] Results are shown in table 8.14 below.

Source type/distance	Peak factor for $2\frac{1}{2}$ h. interval
All sources	3.3
Traditional sources	3.3
Tap sources	3.2
All sources less than 400 metres	3.1
All sources more than 400 metres	3.4

Table 8.14 Peak factors for $2\frac{1}{2}$ hour collection intervals by source type and distance, Iringa and Mbeya.

The table shows that when households have the convenience of short distance and tap water the peak factor decreases.

Though domestic points generally are situated within 400 metres from the users, some households walk further than 400 metres to get to a tap source. This probably explains the difference between the two peak factors for tap sources and all sources less than 400 metres and indicates that distance may be more important in reducing the peak factor than type of source.

8.6.6 Impact of chosen time interval on peak factor

Since the peak collection interval, on which the calculations were based, in all cases was the period before 9 a.m., it often includes a few collections before 6^{30} a.m. when the $2\frac{1}{2}$ hour interval should actually start. Consequently the above peak factors are slightly exaggerated.

The $2\frac{1}{2}$ hour interval was chosen as most useful for design purposes. If a shorter period was chosen it would certainly give a higher peak factor, indicating a peak period within the peak period. Taking cost considerations into account it seems reasonable, however, to demand a certain levelling within a somewhat wider peak period (e.g. $2\frac{1}{2}$ hour). An increase of present consumption to the projected 20 l/cap/day will probably in itself have an impact in that direction.

In order to check the difference between a $2\frac{1}{2}$ hour and a 1 hour peak factor, and also to get some comparable figures from Ruvuma (in the absence of computer results), spot checks were made in the 2 missing zones there. 4 traditional sources in 2 villages in the intermediate zone (10) and a traditional and 2 tap sources in two villages in the wet western highlands (9) were selected. Each source was observed during one day, and the number of litres collected recorded for one hour intervals.

Table 8.15 below gives the resulting peak factors, including those for the dry eastern zone (11), based on the figures in tables 8.12 and 8.13.

Taking into account that the samples here are relatively small compared to those on which table 8.14 is based, there is a fair correspondence between Ruvuma and Iringa - Mbeya.

The one hour interval peak factors are only 10 - 30 % higher than those for $2\frac{1}{2}$ hour intervals.

	Peak factor for $2\frac{1}{2}$ hour intervals	Peak factor for 1 hour interval
All sources, wet western highlands and intermediate zone	3.1	3.5
Traditional sources, same zones	3.4	3.9
Tap sources, intermediate zone	2.8	3.6
Traditional sources, dry eastern zone	4.0	-
Sources more than 400 m, same zone	4.0	-
Sources less than 400 m, same zone	4.0	-

Table 8.15 Peak water collection factors for $2\frac{1}{2}$ and 1 hour intervals by source type and zones in Ruvuma.

8.6.7 Recommended peak factor for scheme design in Iringa, Mbeya and Ruvuma Regions

On the basis of the above considerations a peak factor 3 is proposed for scheme design in the three regions.

8.7 Impact of distance on the household's water consumption and selection of source (the 400 m max. design distance)

In Tanzanian water supply policy the target of providing all households with "easy access" to water is operationalized to mean that there should be an improved source within 400 metres distance from every household.

The purpose of course is that primarily for health reasons people should use the improved source (which in most cases will be a domestic point) and preferably use some more water for hygiene etc.

The present study has therefore tried to look at the impact of distance from water sources on the quantity of water collected and on the households' selection of water sources used.

8.7.1 Water consumption

It has already been shown above (table 8.3) that there is a tendency for water collection/consumption to be inversely correlated with distance to the water source.

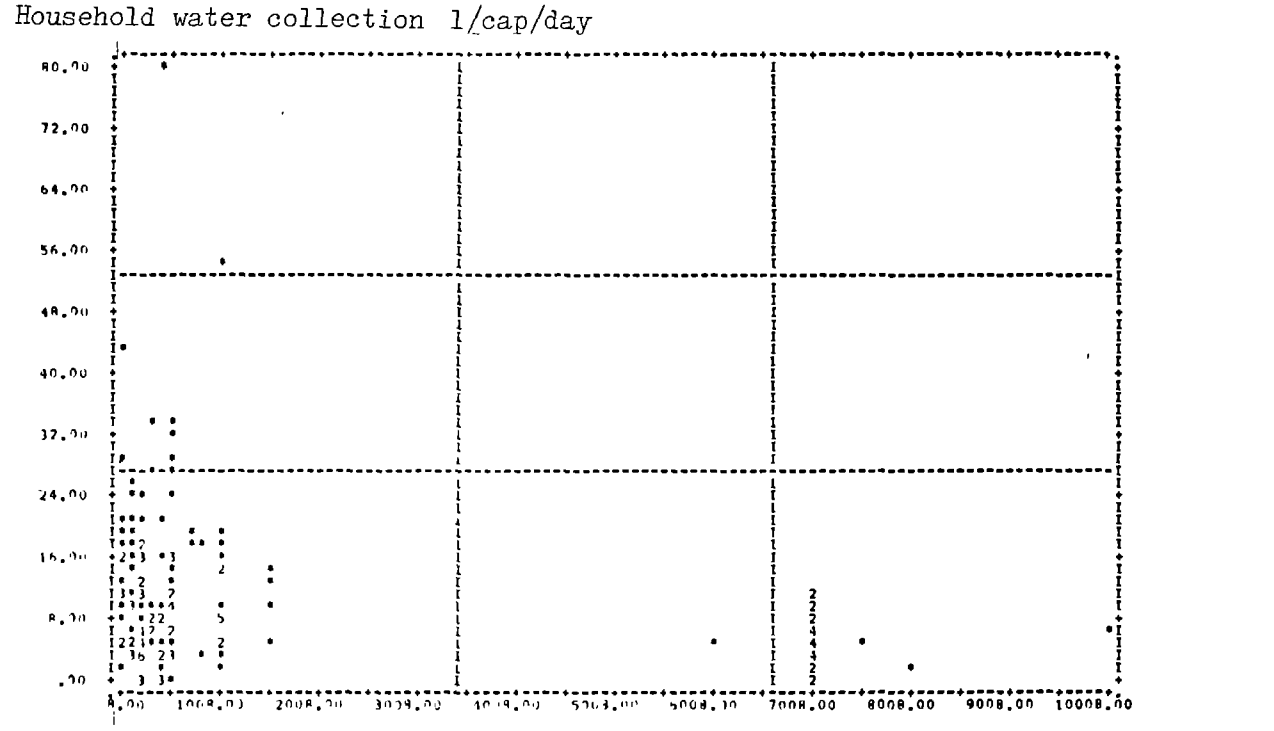
It would also be of interest, however, to know whether this correlation is more or less continuous or whether it has any clear dis-continuities, i.e. whether there is a lower "threshold" in terms of distance to source, below which people tend to use considerably more water than those with a larger distance, and similarly if there is an upper "threshold", above which water use tend to be, relatively speaking, very small.

To this end the scattergrams below, fig. 8.1-8.4 were produced, showing distance to source and mean collection in litres/capita/day for all tap and non tap using sample households in Iringa and Mbeya Regions.

It is easy to see, at a glance, that the scattergrams present no clear picture of any such "threshold" distances among the sample households. The same result is arrived at from table 8.16 showing mean consumption in litres/capita/day by households in different distance categories.

From this we tentatively conclude, that from the perspective of increased total consumption per capita, no definite distance criterion can be established, apart from the earlier established tendency for consumption to increase with decreasing distance, and to reach very high levels with house connections available.

The present 400 m criterion may therefore be as good as any other, but it should not, on the other hand be regarded as anything but an arbitrary figure, which could be longer if finances are strained, but should preferably become shorter, when finances permit it.



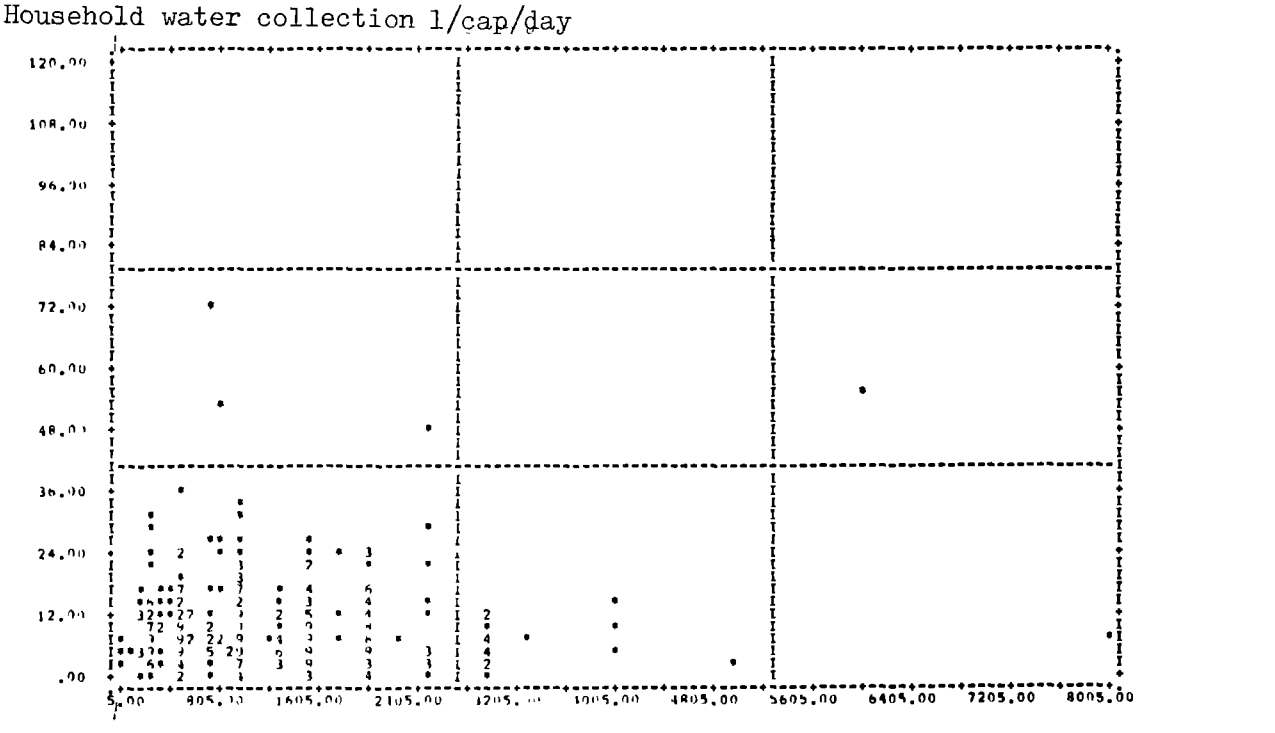


Figure 8.1 Scattergrams of tap using (top)and non-tap using (bottom) sample households by water collection and distance ~~to source~~; Iringa Region.

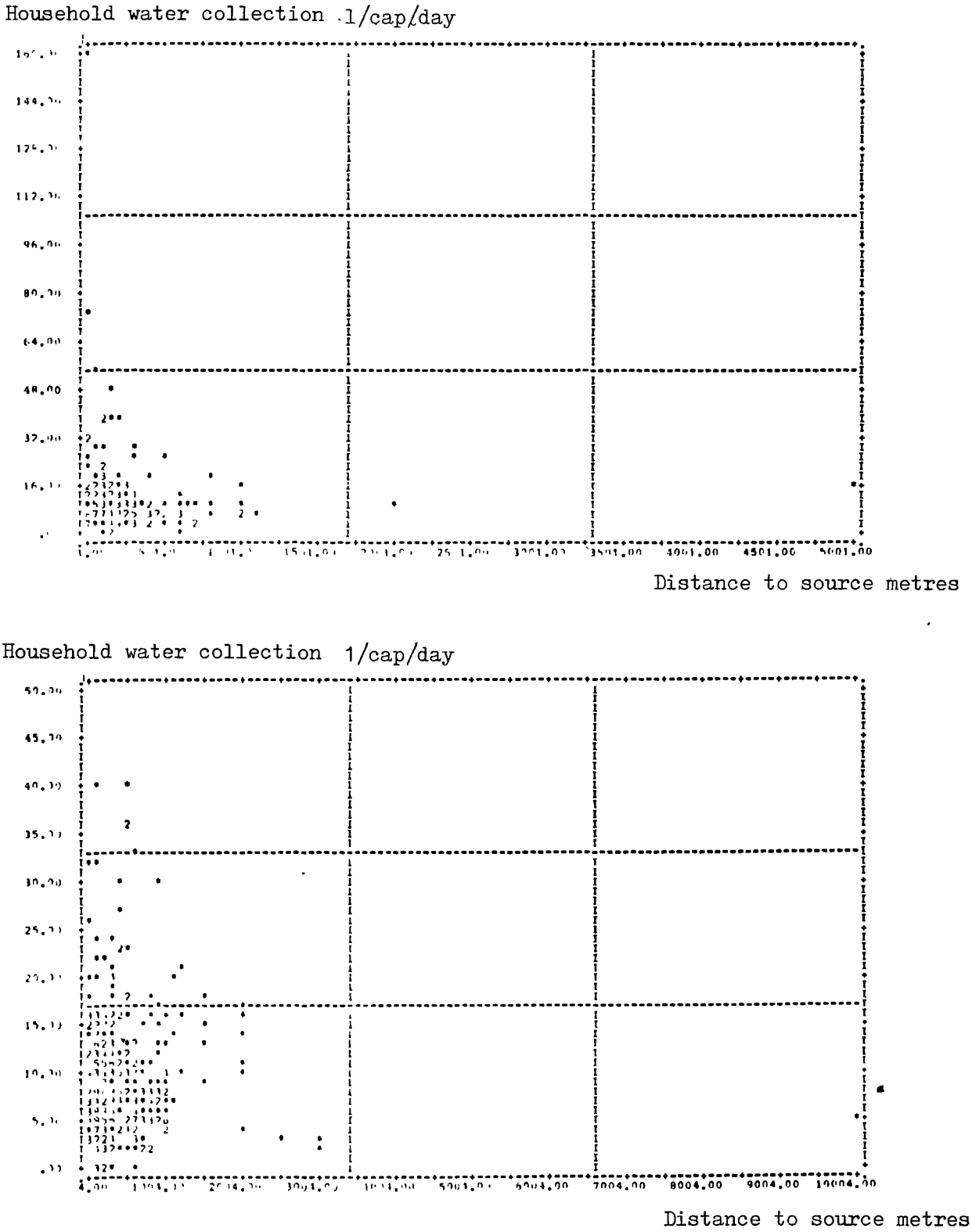
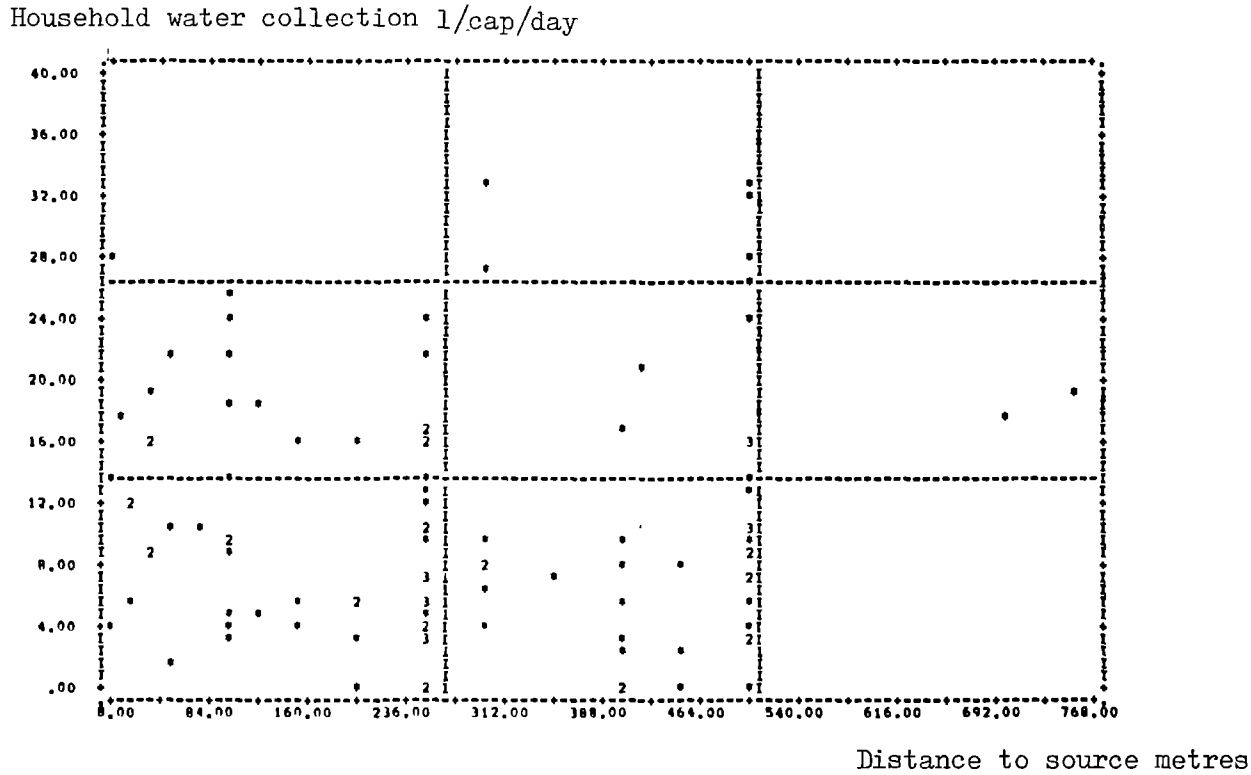


Figure 8.2 Scattergrams of tap using (top) and non-tap using sample households by water collection and distance to source; Mbeya Region.



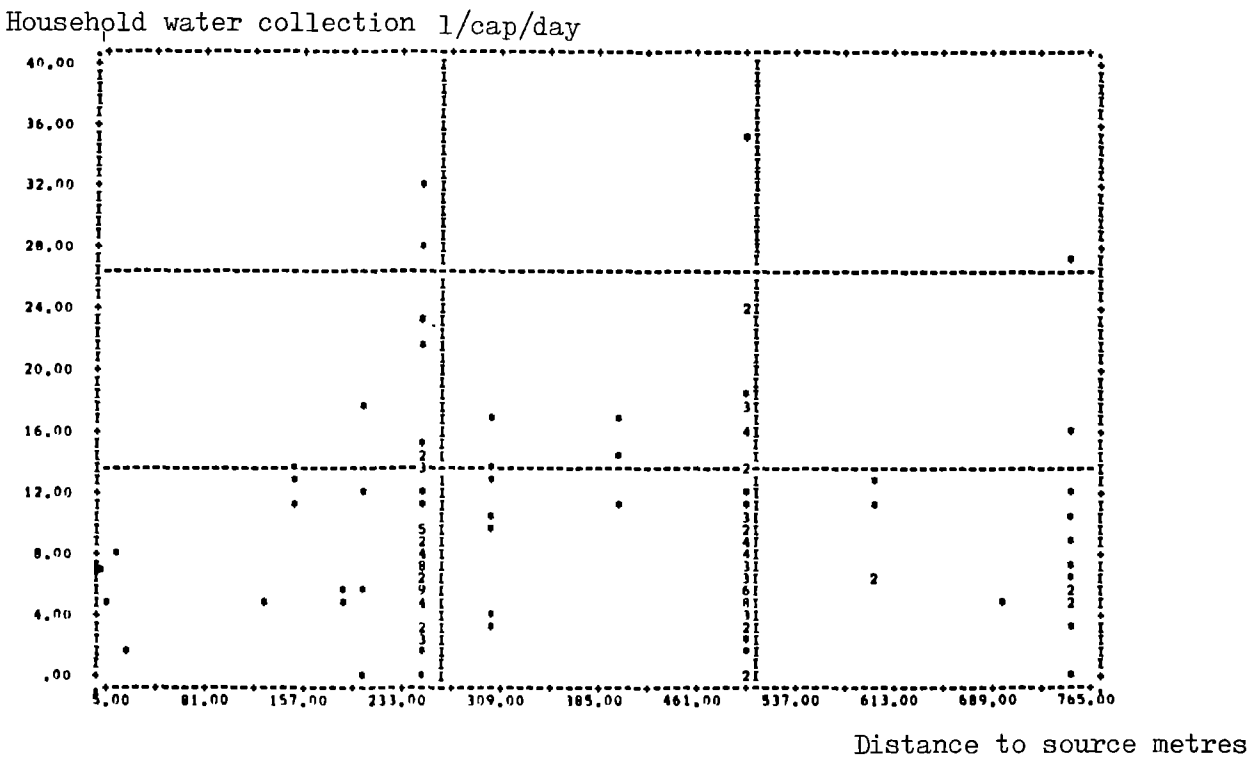
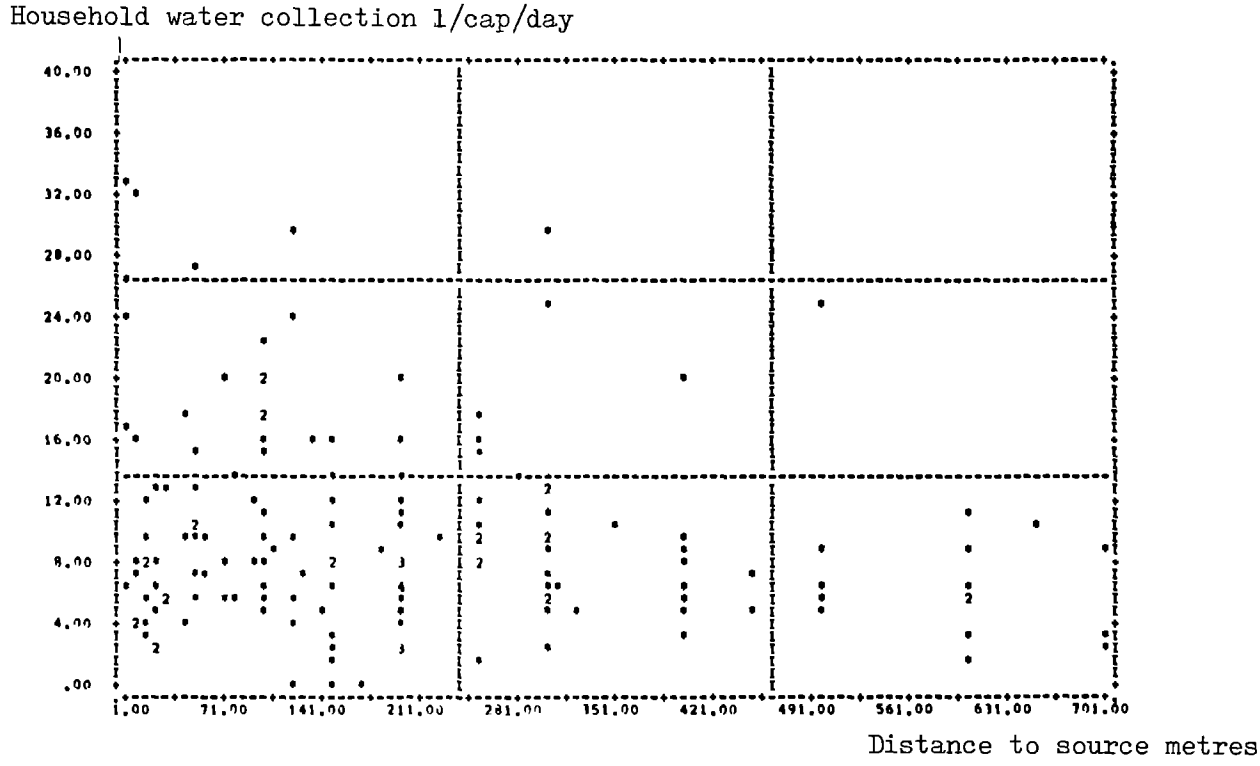


Figure 8.3 Scattergrams of tap using (top) and non-tap using sample households by water collection and distance to source; with upper limits: 40 l/cap/day and 800 metres; Iringa Region.



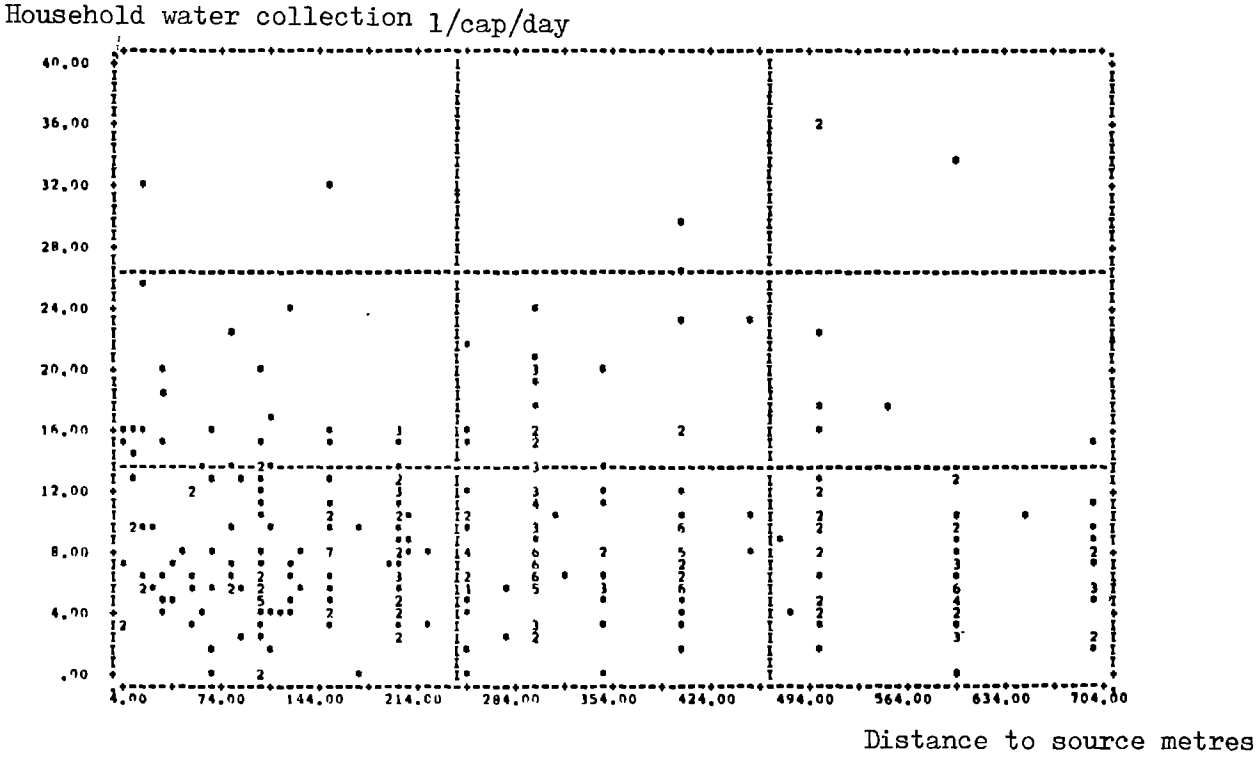


Figure 8.4 Scattergrams of tap using (top) and non-tap using sample households by water collection and distance to source; with upper limits: 40 l/cap/day and 800 metres; Mbeya Region.

	Non tap users						Tap users					
	Iringa		Mbeya		Total		Iringa		Mbeya		Total	
Distance to source	l/cap	% of resp.	l/cap	% of resp.	l/cap	% of resp.	l/cap	% of resp.	l/cap	% of resp.	l/cap	% of resp.
0-50 m	4.9	1	10.7	7	10.2	4	14.9	10	17.3	23	16.6	17
50-100 m	-	-	8.9	10	8.9	5	12.7	8	14.4	14	13.8	11
100-200 m	8.8	2	8.7	16	8.7	9	8.0	6	10.8	26	10.3	17
200-400 m	9.3	15	9.3	30	9.3	22	9.3	27	10.1	21	9.7	24
400-800 m	10.8	19	9.1	21	9.9	20	14.9	20	8.0	12	12.2	16
800-1500 m	8.9	42	10.1	10	9.1	26	12.1	13	8.3	3	11.3	8
1500-3000 m	9.6	19	9.0	2	9.5	11	-	-	10.0	1	10.0	0
3000 + m	17.0	4	11.3	5	13.7	4	5.1	17	15.0	1	5.5	8
Total	9.7	102	9.4	101	9.6	101	10.8	101	12.3	101	11.6	101
N		436		431		867		158		175		333

Table 8.16 Proportion of sample households and their mean daily household water collection per capita by source type and distance to source, Iringa and Mbeya.

8.7.2 Impact of distance on source selection

When improved water supply is provided one purpose of course is that all villagers should use the new supposedly cleaner and more healthy water supply, at least for drinking water.

Table 8.17 below shows that in many villages with a water scheme, this is not the case today. In Mbeya Region 29 % of the people in such villages use an unimproved source for drinking, while in Iringa the figures are 34 %. Of the remaining 71 % and 65 % respectively, who do use the water from taps, only 5 % and 14 % have an alternative unimproved, but unused, source nearer by than the tap.

Households by used and unused sources	Mbeya		Iringa	
	villages with water scheme	villages without water scheme	villages with water scheme	villages without water scheme
Households using tap which is nearest source, %	66	-	51	-
Households using traditional source which is nearest source, %	28	93	31	87
Households using tap, but with nearer unused trad. source x), %	5	1	14	7
Households using traditional source but with nearer unused trad. source x), %	1	6	3	6
	100	100	99	100

x) Includes all households that either the whole year or seasonally have a source nearer than the one they use, but not those that temporarily do not use a tap because it is not working.

Table 8.17 Households using and not using nearest water source, for drinking by source type and by villages with and without water schemes, Iringa and Mbeya Regions.

Nobody who has a tap as their nearest source does not use it, unless it is not working.

Similar figures for people who bypass one source to draw water from one further away appear from villages without a water scheme, in some extreme cases (in Iringa) with people chosing to go all the way to a neighbouring village to obtain piped water.

Thus 82-94 % of the respondents choose to use the nearest source for their drinking water requirements. The remainder, who do seek a source further away almost invariably give bad water quality (dirty, smelly, salty) as the reason for doing so.

The conlcusion therefore is that people have sufficient understanding of the disadvantages of drinking very low quality water to be willing to walk quite long extra distances (see also 5.4) to get better water. But also that in most cases the quality difference is not perceived as great enough to warrant the extra journey.

This means that in order to ensure the most widespread use of or improved water-supply it must be designed so that very few people have a traditional source nearer to the house than the tap/well.

When this is not possible, that is, in villages where most people have an unimproved source less than 400 m from their house, which is not of extremely low quality, provision of a water scheme should not be considered before economics permit the 400 m criterion to be considerably reduced, or when some low cost solution such as individual rainwater tanks partly or wholly paid by the consumer is possible (see chapter 7 on rainwater solutions). promotion by EU? thru HE?

8.8 Collectors of water and different uses of water

8.8.1 Women collect water !

In most of the literature and in the remainder of this volume the fact that women collect water is taken for granted. To document this fact and to show its overwhelming extent we bring the following table 8.18, showing water collection by sex and age groups.

	% hh. where water is collected by				Mean water collection per hh.by				
	Women %	Men %	Girls %	Boys %	Women l	Men l	Girls l	Boys l	All l
Iringa	91	0.8	29	10	37	0	9	2	48
Mbeya	94	0.5	17	2	45	0	8	1	54
Ruvuma (dry eastern zone only)	n.a.	n.a.	n.a.	n.a.	38	0	11	2	51

Table 8.18 Water collection by sex and age groups (above and below 15 years).

No further comment seems necessary ! Except perhaps to mention that the village average for the time used by the women in one household to collect water ranges from about 1 hour to something in the range of 6 hours per day, and that those cases where men do collect water (which can be counted on two hands) all comprise families where the wife (wives) were ill or otherwise disabled on the day covered by the interview (households with no adult women were left out of the sample).

8.8.2 Uses of water

Table 8.19 below gives an indication of the main uses of water brought to the house in one day. As the picture is more or less the same everywhere Iringa Region is used as an example.

The table also shows that there is little difference in the water consumption pattern between tap user and non-tap users, and between people who live more or less than 400 metres from their source, except that people closer to the source tend to carry more water home for bathing/washing and laundry and the same goes for tap users compared with non-tap user as regards laundry, as we have already discussed above.

The variation in consumption for beer brewing is probably mainly due to the sampling, as very few households each uses a lot of water for this purpose in a single day.

Consumption purpose	Type of source		Distance to source	
	Tap users % of consumption	Non tap users % of consumption	Less than 400 m % of consumption	More than 400 m % of consumption
Drinking	15	14	13	14
Cooking	18	20	18	20
Cleaning	14	18	15	18
Bathing/washing	20	20	24	18
Laundry	16	6	18	5
Brewing	4	7	1	8
Other	2	1	0	1
Storing	11	15	10	15
Total	100	101	99	99

Table 8.19 Proportions of water brought to the house in one day used for different purposes , by type of source and distance to source. Iringa Region.

8.9 Summary of recommendations

a) A design figure of 25 litres/capita/day is recommended as scheme capacity for projected population, consisting of a projected consumption of 20 litres/capita/day and 5 litres/capita/day scheme loss.

b) The above design figure does not allow for the much higher consumption resulting from house connections, which should therefore normally be ruled out.

c) The data indicate that the design figure for schemes with many house connections, e.g. in townships, might have to be in the range of 70-80 litres/capita/day or more, including allowance for scheme loss.

d) For scheme design a peak factor 3 is proposed.

e) Shorter distance to water source is preferable, but no definite figure is suggested by the data. The 400 m criterion may therefore be maintained, but is no magic figure as far as water consumers are concerned.

f) People tend to use the nearest source, so scheme design should locate domestic points closer than the traditional sources to most of the people in a village.

g) A village should not be considered for water supply if most of its population live less than 400 m from a traditional source, which is not otherwise difficult to reach or of extremely bad quality. If and when finances allow the 400 m criterion to be reduced this recommendation must be modified correspondingly.

Notes

1) Brokonsult. Rural Water Quality Programme in Tanzania. Final Report, Main text, Chapter 2, p. 23.

2) Table 2.1 in Brokonsult op.cit. p. 23.

3) Tanga Water Master Plan, 1976. Vol. III pp. 23-24.

4) Stahl M. et.al. "A socio-economic Study of Water-related Problems in northern Njombe. Research paper No. 54, BRALUP 1978, p. 41.

5) Warner found that water used at tap constituted 21.1 % - against the present survey's 20.0 % of the amount of water carried home. Warner's results built on an extensive data base: 1314 observations at 11 taps in 7 villages.

Warner, D. (1973): Evaluation of the development impact of rural water supply projects in East African villages. Report EEP - 50, Programme Engineering - Economic Planning - Stanford University, p. 127.

6) Formula used:

$$P_i = \frac{C_i}{\frac{C_{24}}{24} \times i}$$

P_i = peak factor for the chosen time interval

i = time interval used to group collections, and for which peak factor is calculated (here $2\frac{1}{2}$ h.)

C_{24} = total collections in 24 hours, i.e. litres or no. of collections or 100 % of all collections

C_i = highest collections in any of the intervals used.

9. WATER USE FOR LIVESTOCK AND SMALL-SCALE IRRIGATION

9.1 Livestock

It is surprising that no investigations of the need for livestock watering appear to have been conducted in the already completed Water Master Plans. In these plans, water for livestock use has simply been allocated based on the number of livestock thought to be present in an area, using MAJI design criteria for water consumption per livestock unit. The economic investments implied by this approach are significant as will be shown below. The question is whether they are justified.

An attempt at an answer is given in this chapter which brings together information collected during the village inventory, the household survey, and spot checks on the use of existing cattle watering troughs carried out by the socio-economic group.

9.1.1 The livestock population

An objective evaluation of the need for and the cost of livestock watering requires that the livestock population size and its distribution is known with some degree of accuracy. Such information is not available. Livestock population figures from different sources are widely different.[1)]

Regional estimates

The latest livestock population figures available to us are shown in table 9.1.

		Regions		
Livestock	(heads)	Iringa	Mbeya	Ruvuma
Cattle		487,000	850,000	49,000
Sheep		132,000	69,000	15,000
Goats		210,000	101,000	64,000

Table 9.1 Livestock population by regions according to 1977/78 livestock census.

These figures may not even be of an approximate correct order of magnitude as shown in table 9.2, which indicates wide variations between different sources.

	Agricultural census 1971/'72 Heads	Regional estimates 1974 Heads	RIDEP estimates 1974 Heads	Livestock census 1977/78 Heads
Cattle	239,000	858,000	261,000	487,000
Sheep/goats	194,000	544,000	212,000	342,000

Table 9.2 Different estimates of livestock population, Iringa Region, 1971-1978[2)]

The implied annual growth rate from 1971 to 1978 is 12.6 % for cattle and 9.9 % for sheep/goats. Such growth rates are significantly higher than those previously recorded for Tanzania as a whole and higher than those assumed by the RIDEP Team[3)]. The only firm conclusion of this analysis is that the size of the livestock population is not known with a sufficient degree of accuracy for planning purposes.

Village level estimates

Not surprisingly, estimates of livestock populations at village level are even less reliable. Such figures have been collected during the village inventory and are based on information from the village authorities. For those villages in which the socio-economic study has made household surveys an alternative estimate can be calculated. The discrepancy between the two sets of data in the case of Iringa Region is very substantial. It is shown in table 9.3, exemplified by comparing estimates of cattle figures.

	Zones			
Cattle ownership	The high rainlands (a)	The upper plateau (b)	The medium dry intermediate zone (c)	The dry northern fringe (d)
Household survey:				
Cattle ownership % of families	27	29	30	43
No. of cattle per cattle owning family	7	29	13	42
No. of households (data from village inventory)	1020	2357	2870	1331
Est. No. of cattle	1928	13671	11193	24038
Village inventory:				
No. of cattle	1247	5002	6725	9365
Difference %	155	273	166	257

The following villages are included:

a) Kinyika, Matamba, Mbela
b) Itundu, Kiyombo, Lugarawa, Mawala, Milo, Shaurimoyo
c) Kiponzelo, Kitayawa, Ndiwili, Nyambula, Tanangozi, Wenda
d) Igula, Iguluba, Kihorogotha, Mkulula, Usolanga

Table 9.3 Different estimates of village level cattle population, Iringa Region.

Since the household survey data are based on random samples of approximately 30 households in each village, the resulting estimate is more accurate[4] than the cattle population figures from the village inventory (the basis for which is unknown). The conclusion is therefore that the village inventory data may underestimate the livestock population by a factor 1.5 to 2.5 or more[5]. They can therefore not be used for planning purposes.

9.1.2 The use of cattle troughs

Spot checks of the use of cattle troughs were done in three villages in Iringa District: Igingilanyi, Ilambilole and Vitono. These villages are located north of Iringa town in the Medium Dry Intermediate zone.

Livestock is numerous in these villages. The possibilities for watering cattle at traditional sources are limited, but do exist. These are located from 3 to 10 km away from the villages investigated. Thus there is an apparent need for livestock watering in the three villages, which was one reason for selecting them. The other reason was that water was flowing to the cattle troughs - at least for part of the day.

Igingilanyi has one cattle trough. Ilambilole has two. One is, however, located 7 km from the village, and is almost exclusively used by Masai cattle herders. There are three troughs in Vitono, but only one was partly operating during the period of observation. Thus, for all practical purposes only one trough in each village was used by the villagers during the investigation period.

Methodology

The number of livestock drinking from the trough and the time of arrival of each herd was observed at one trough in each village from dawn to dusk. In addition each herdsman was asked about the name of the livestock owner; frequency of the use of the trough; and about alternative cattle watering places.

The specific purpose of the spot checks was to find the present use of troughs expressed as the percentage of total livestock in the village watering at the trough; and the peak hour factor for cattle watering. (No attempt at measuring the amount of water consumed by the livestock was made).

Unfortunately, three problems prevent precise estimates of these two factors: the exact number of livestock in each village is not known; livestock from other villages may use the observed troughs; and the troughs may not be in continuous operation during the period of observation due to water shortage. Thus the data presented indicate an order of magnitude only.

The present use of troughs

Only the Ilambilole trough was operating every day. Two full days of operation were observed. The percentages of livestock in Ilambilole using the cattle troughs are calculated in table 9.4 using different estimates for the livestock population size.

	Cattle	Goats	Sheep
Observed use			
- Average per day	1,058	316	10
Livestock population			
- Village inventory	3,415	2,031	126
- SEC-estimate (vil. inv. x 2)	6,830	4,062	252
Percentage use			
- High estimate %	31	16	8
- Low estimate %	16	8	4

Table 9.4 Use of cattle trough at Ilambilole (excl. livestock from other villages)

The use of the trough is rather low - especially for goats and sheep - no matter which livestock population estimate is used.

The troughs at Igingilanyi and Vitono villages ran dry almost every afternoon. Here water for human consumption was clearly given the highest priority by the scheme attendants who regulate the water flow in the ailing Ismani Scheme from which the villages are supplied. However, their level of usage seem to be of the same order of magnitude as that of the Ilambilole water trough.

The peak hour factor for livestock watering

The large majority of herds (85 %) is only taken to the watering trough once a day. Based on observation of two whole days of livestock watering at Ilambilole the peak hour factor for cattle watering is approximately 3.3[6)]. It falls in the early morning hours and thus coincides with the peak human water consumption (see chapter 8).

9.1.3 The cost of livestock watering

In principle all main elements of a piped water supply scheme (intake, tanks, trunk mains) must be enlarged if piped water is to be supplied to cattle troughs. The additional cost involved depends on the ratio between the livestock and human water demand for which the scheme is designed.

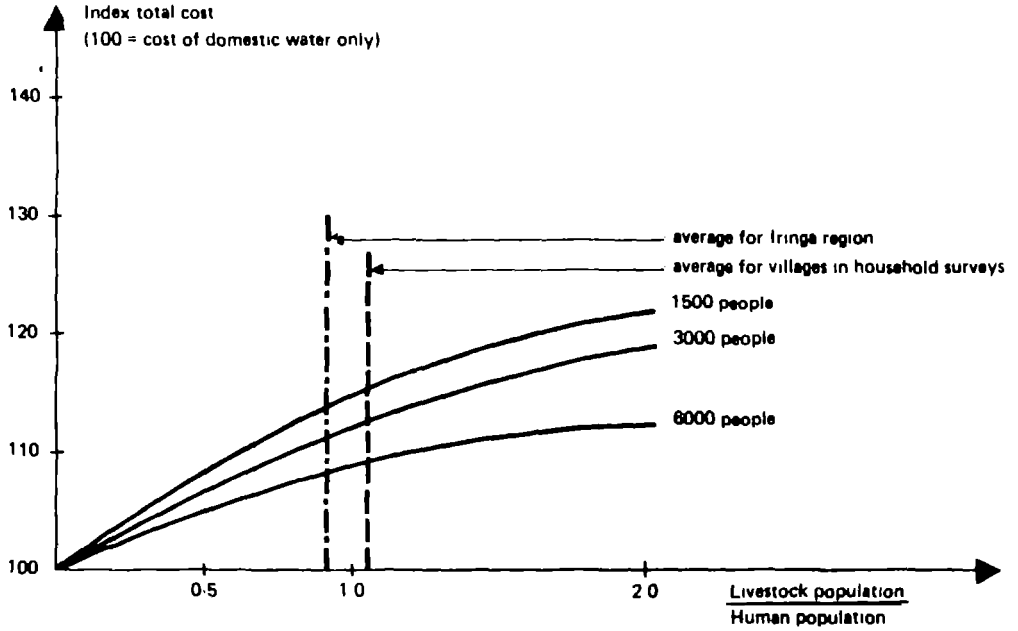


Figure 9.1 Cost implications of providing watering facilities with gravity scheme - by livestock population to human population ratio and scheme size (persons served).

Figure 9.1 gives an approximate picture of the cost implication of livestock watering from a gravity scheme.

The figure shows cost increases between 5 - 26 % of total cost, depending on the absolute size of the village and the relative size of the livestock population. The cost increases are most significant in smaller schemes. The figure also indicates the approximate ratio between livestock and human populations in Iringa Region. (Not adjusted for livestock population underestimates).

Similar or larger increases will result if diesel pump schemes were considered, while livestock watering is not possible on any large scale if shallow or medium wells with hand pumps are considered.

9.1.4 The need for livestock watering

The distribution of livestock varies significantly between agro-ecological zones. The determining factors are mainly the distribution of forage, water and disease incidence. (See table 9.5).

Livestock may not only (or not even) represent a commercial asset for the owner, but may also in various combinations serve as a means of wealth, prestige, or as a prerequisite for marriage, parenthood or subsistence[8]. Cattle tend to be major items of property, whereas sheep and goats tend to have more of a commercial or subsistence value.

By far the largest number of livestock in the three regions consist of indigenous cattle, goats and sheep[9]. Their productivity is generally poor. Excessive preweaning mortality, low reproduction rates; inadequate nutrition and poor standards of husbandry and health account for this[10].

Livestock ownership is rather unequally distributed among households. And there are large differences within the livestock owner group with respect to herd size (table 9.3)[11].

The potentially negative effects of watering livestock at traditional sources are the higher risk of livestock diseases (especially liver fluke) due to contamination. Livestock contamination of water sources used by humans may also be a problem. The magnitude of this problem varies from zone to zone. Salmonella, Streptococci, Brucella and Tuberculosis may in this way be transmitted from livestock to humans[12].

Regions/ zones	Owning cattle % a)	Mean No. per cattle owner	Complaining about insufficient grazing land % b)	Complaining about insufficient watering for livestock % b)
Iringa				
High rainland	27	7	58	68
Upper plateau	29	29	34	19
Medium dry intermediate zone	30	13	32	28
Dry Northern fringe	43	42	44	56
Mbeya				
Wet highlands	55	5	34	36
Lake shore	48	5	59	49
Dry plain	29	136	23	48
Dry Northern zone	(1)	11	-	-
Ruvuma				
Wet Western highland	51	3	50	29
Intermediate zone	4	7	31	36
Dry Eastern zone	2	3	22	55

a) of all sample households

b) of those households owning any livestock, incl. owners of goats and sheep.

Table 9.5 Cattle owners and livestock problems by zones.

On the other hand provision of water facilities may have several potentially positive effects. They may prevent conflicts in water use between humans and livestock. They may reduce livestock walking distances to water, where such sources are far away. And they may reduce livestock diseases by keeping herds away from traditional sources. Yet larger distances to grazing grounds?

It is therefore not surprising that livestock authorities are in favour of watering facilities.[13] The same goes for many livestock holders who complain of lack of water sources around their villages (see table 9.5).

The arguments against a blanket policy for providing watering facilities are, however, strong. Walking distances will only be reduced where water sources along tracks to or in the grazing areas are insufficient or non-existent. Livestock diseases may only be reduced under the same conditions. Costs are high as shown in section 9.1.3. In a one-sector rural water supply programme human and livestock water demand compete for the same limited resources. However, any technical improvements of the traditional livestock productivity "which requires even moderate investment is, at best, likely to prove marginally economic".[14] The land bearing capacity may be exceeded if provision of watering facilities results in an increase in livestock population and/or its concentration in areas around the facilities. Lack of sufficient forage already appears to be a problem in many areas (see table 9.5). Finally proper location of facilities is often difficult. To prevent overgrazing, soil erosion, pollution of water sources, and land use conflicts the best solution will often be to locate several facilities away from the villages in the grazing areas on the higher ground. But this is often technically impossible and/or very expensive.

A final consideration is this. The ownership of livestock is very unequally distributed among villagers (see table 9.5). The free provision of watering facilities is therefore a subsidy to that part of the villagers which may least need it. It will tend to increase rural inequalities. Only if livestock owners are prepared to pay the due cost of watering facilities should they be provided.

9.1.5 Concluding observations

Improvements aimed at indigenous livestock has generally been confined to attempts at introducing technical measures (water, dips, genetic upgrading, etc.) rather than on economic considerations. Given the high cost of watering facilities, their doubtful economic benefits, and the sheer technical difficulties in locating the facilities where they are needed, cattle troughs should

only be considered where livestock watering directly or indirectly conflicts with human use of water and/or agricultural land use.

Provision of watering facilities may be justified in dry areas where concentrated development of dairy cattle takes place. In such cases the developer should pay the cost of the facilities.[15]

The information collected for the Water Master Plans does not make it possible to identify villages where such conflicts exist. This information should therefore be collected during the detailed preparation of each individual scheme. If watering facilities are considered for a scheme the following procedure should be used:-

a) The watering facilities should be requested by the village, and the Village Water Committee involved in the planning.

b) Collect exact livestock population figures, e.g. through sample survey. (Neither official statistics nor information from village authorities can be relied upon - see section 9.1.1).

c) Investigate whether watering facilities might cause overgrazing (see section 9.1.4).

d) Investigate whether low-cost alternatives to troughs are possible.

e) If troughs is the only possibility then assure that there is a proper balance between the design demand for water and the number of troughs provided (see section 9.1.3).

f) Only where livestock watering at traditional sources directly or indirectly conflicts with human use of water and/or agricultural land use should cattle troughs be provided free of charge. Otherwise, cattle owners shold pay the cost of the facilities in proportion to the size of their herd.

9.2 Present small-scale irrigation in Iringa, Mbeya and Ruvuma Regions

9.2.1 Introduction

In the three regions which are the target for the WMP we do not generally find a shortage of land. For this reason irrigation has earlier played a relatively small role in regional plans. Whenever irrigation was mentioned it usually related to large-scale state farms, such as the Mbarali State Farm (rice) at the Usangu Plains, Mbeya.

During the socio-economic study of the Water Master Plan preparation it was realized that much small-scale irrigation takes place. Where arable land is in short supply and where the annual rainfall is too low to secure sufficient food crops irrigation becomes a question of survival. But small-scale irrigation is also provided for cash crops, for instance rice on the Usangu Plains. Most small-scale irrigation projects were started spontaneously by the concerned farmers themselves. Some of the projects received government support for the construction of intakes at the rivers, but a majority of them appears to have been financed and constructed on a self-help basis. Below follows a report on some of these schemes supplemented with information from regional authorities.

9.2.2 The data

In the household surveys conducted in Iringa, Mbeya and Ruvuma each family was asked whether they used water for their shambas or vegetable gardens (bustanis). If the answer was affirmative they were asked about the type of crop being watered. Information on the source and method of irrigation was also obtained and finally they were asked about any problems they may have had with irrigation and whether they would like to irrigate more land.

9.2.3 Irrigation by households

Table 9.6 below shows that by far the majority of respondents do not irrigate. Approximately one fifth of all respondents use water for cultivation of different crops.

The crops irrigated are maize, vegetables and rice in that order of importance. It thus shows that irrigation is mostly used for watering food crops. In many places people will supplement the grains in their

Regions/ zones	Households irrigating %	Main irrigated crop	main source of irrigation	Main method of irrigation
Iringa				
High rainland	41	maize	river	water carried
Upper plateau	21	vegetables	river	ditches
Medium dry intermediate zone	35	maize	river	water carried
Dry Northern fringe	3	vegetables	river	ditches
Mbeya				
Wet highland	0	-	-	-
Lake shore	4	maize	river	ditches
Dry plain	35	rice	river	ditches
Dry Northern zone	5	vegetables	river	ditches
Ruvuma				
Wet Western highland	22	vegetables	river	water carried
Intermediate zone	54	vegetables	river	water carried
Dry Eastern zone	21	vegetables	river	water carried

Table 9.6 Small-scale irrigation in Iringa, Mbeya and Ruvuma; by zones.

storage by growing maize and beans by irrigation in the dry season. In this way they are able to harvest these crops before the start of the rainy season. And thus offset problems caused by possible food shortage if they had to rely on the main harvest alone. In the dry zone in Mbeya the main agricultural produce is rice which in that area is only cultivable when using irrigation.

In all zones the main sources of irrigation are rivers. In some places these are easy to utilize for irrigation purposes. It suffices to make a diversion on the river, the so-called run-of-the river type of irrigation. In some villages one will find a diversion made of concrete while other villages make a diversion of soil or clay reinforced by wooden boards. The latter type is likely to be flushed away each year during the heavy rains. The second most used method of extracting water for irrigation is by carrying it. This is done in areas where the topography prevents direct use of a river or where the nearest water source is a lake or a spring. The burden of irrigating land in this way certainly emphasizes the need for expert advice on irrigation in many places.

The biggest problems with irrigation appears from the table below. A large part of the irrigation users complained that the source dries up. This problem could probably be solved if the agricultural authorities, being responsible for irrigation provided funds for digging ditches or laying pipes from more remote but high yielding sources. The villagers should then make the distribution canals themselves.

Problems mentioned	Iringa % of irrigating households	Mbeya % of irrigating households	Ruvuma % of irrigating households
No problems	37	25	18
Water dries up	31	52	16
Too hard work	20	5	53
Other	12	18	13

Table 9.7 Problems with irrigation mentioned by sample households

Asked if they would like to increase irrigation,a majority answered affirmatively. The reasons given in the table below suggest that people in many places do not have enough food crops from one harvest to last

them until next harvest. Irrigation is thus for a majority a matter of survival and only secondly a means of supplementing the income.

Needs mentioned	Iringa % of irrigating households	Mbeya % of irrigating households	Ruvuma % of irrigating households
No wish to expand irrigation	15	29	18
Expand for food crops	56	46	44
Expand for cash crops	20	16	37
Other	9	19	1

Table 9.8 Increased irrigation needs mentioned by sample households

9.2.4 Regional Plans for small-scale irrigation

Iringa Region

An ongoing agricultural development project in Iringa Region deals with irrigation problems. The study identifies Iringa District and Mufundi District as potential drought areas. Big schemes are found here due to the presence of large rivers. In the other districts irrigation is only used as a standby in dry season and on a very small scale. About 130 small-scale irrigation schemes exist presently. Due to problems of design and location of intakes many existing schemes are not operating optimally. Accordingly, the agricultural development project suggests rehabilitation of these badly operating schemes and development of new small-scale schemes. The latter, primarily for production of vegetables and fruits as an addition to the general diet during the dry season. But of course they could also be used for staple crop production.

Mbeya Region

In Mbeya the regional government has allocated funds for the repair of nearly one hundred "schemes" on the Usangu Plain which irrigate 15,000 ha. of rice. Most of these were made on a self-help basis, but since the middle of the 60's none of them have been maintained.

It is estimated that about 55,000 ha. on the Usangu Plain would be suitable for cultivation of rice if water was provided through micro irrigation schemes.

In the lake shore zone the problem of irrigation is different than in the other zones. Here the climate is suitable for rice cultivation throughout the year if sufficient water is provided. Proposals for flood control in connection with irrigation have been made. But no funds have so far been allocated to carry out the proposals.

Areas for small-scale irrigation, particularly of rice, will be surveyed in Mbosi and Ileje.

Ruvuma Region

In the third five year plan (1976/81) it was proposed to construct five intakes and dig ditches which should irrigate an area of 860 acres in Songea, Tunduru and Mbinga Districts. Irrigated land rice, maize and vegetables were to be cultivated. Due to financial constraints these irrigation proposals have not yet been carried out. Consequently, the plan is repeated in the fourth five year plan.

If funds were available Tunduru District would offer the biggest benefits for investment in small-scale irrigation schemes. This district has a climate which would allow cultivation throughout the year, given sufficient water.

9.2.5 Recommendations

Based on the presentation above we propose the following recommendations which all assume that peasant production and thus small-scale irrigation has a much higher social value than large-scale state farm production using complicated irrigation methods:

- The present use in many places of excess water from domestic points for irrigation should be regulated by the water committees. This may prevent excess water from cumulating around the domestic points with deteriorating health impacts for the users. If the design capacity does not allow such use the committee should prohibit it and make sure that it does not take place.
- Simple small-scale demonstration schemes should be constructed in selected villages. This would teach the peasants how to extract water from rivers/streams when simple diversions for topographical reasons are impossible.

- When a small-scale irrigation project is a joint government/village undertaking, it should be firmly established from the very start, who will be responsible for maintenance. In villages which receive a water supply scheme it should be considered whether the existing village water committee also should be responsible for irrigation or whether this responsibility should be given to a sub-committee under the production committee.

- In order to secure a reliable flow of water for irrigation the government should in some places be willing to provide river offtakes. The villages should be responsible for the construction of the distribution canals/ditches leading water to private as well as communal shambas.

- Provision for potential development of small-scale irrigation should be made for peasant production on areas adjacent to state farms, using irrigation. In most cases the methods of irrigation on these farms are too complicated for duplication by the average peasant farmer. This situation may be aleviated by making built-in provision for irrigation of neighbouring areas.

9.2.6 Closing remarks

Peasants in all the zones - except for one - did some small-scale irrigation. 75 % of these wanted to increase irrigation for the sake of food crop production. Plans for rehabilitation of existing small-scale schemes and for building new ones exist in all three regions. In the section on recommendations the desirability of village involvement on government financed irrigation schemes was emphasized.

Notes:

1) Iringa Region, Tanzania - Integrated Rural Development Proposals for the Third Five Year Plan, 1976-1981.

2) UNDP, FAO op.cit. table 4.11.2; and table 9.1 above.

3) Nationwide growth rates were: 1921 - 1954 2.3 % p.a.; 1954 - 1965: 5.0 % p.a. Iringa RIDEP used growth rates on 3.0 % p.a. for projections of the populations of all livestock classes. Also in the Mbeya RIDEP serious doubt about livestock figures are raised, see Hiemstra, Y.G., A.S. Lamosai, and K.W. Machau, (1981). "Livestock Reconnaisance Survey of Mbeya Region". A report prepared for FAO projects GCP/URT/055 (Mbeya RIDEP project) and URT/73/008 (Assistance to livestock Development Project)

4) The 95 % confidence limit on cattle ownership is - in each zone - approximately +/- 4%. The simple error on the mean number of cattle is not known, but cannot possibly account for the large differences in population figures indicated in table 1.3.

5) The families included in the household survey were drawn from the list of the permanently settled village populations. Thus, livestock owned by nomadic pastoralists is not accounted for in the survey. The estimates from the household survey are therefore underestimates of the true livestock population.

6) If all livestock classes are considered with equal weight, the peak hour factor is approx. 3.0.

7) See also Hiemstra, op.cit.

8) According to the household survey results the contribution to gross family cash income from sale of livestock is below 15 % in all zones except the dry northern fringe in Iringa Region.

9) The number of grade cattle is limited: 7500 (Iringa), 27600 (Mbeya), and less than 1000 (Ruvuma).

10) UNDP, FAO, op.cit. p. 4.64 and Hiemstra, op.cit. chapter 3.3.

11) Jespersen C.B. et al. (1971) Southern Highlands Socio-Economic Survey: Final Report. Uyole Agricultural Centre, Mbeya.

12) Personal communication with J.E. Jelnes, Danish Bilharziasis Laboratory, March 9th, 1981.

13) The Regional Livestock Development Officer, Iringa, suggests that water facilities be provided where livestock has to walk more than 5 km. The same is suggested in a report on livestock for the northern part of Tanzania. UNDP, SF, (1972). Livestock Development Project No. 279, Tanzania. Ranching Association's Water Supply. Final Report. Dar es Salaam, April, 1972, pg. 40. The RIDEP plan for Iringa Region does not suggest watering facilities whereas they are given high priorities in the RIDEP for Dodoma Region.

14) UNDP, FAO op.cit. p. 4.67.

15) The special problems of dairy cattle are described in Mchau, K.W. (1980) Dairy Cattle at Village Level in Ruungwe District Research Report No. 30; Uyole Agricultural Centre, Mbeya.

10. POLLUTION BETWEEN WATER COLLECTION AND USE

10.1 Introduction

Based on a study of 35 households in the two villages of Utengule and Mporo on the Usangu Plains in Mbeya Region it was examined to what extent pollution of water for household use takes place between collection and use. Utengule is supplied by a gravity scheme, while Mporo villagers draw from a nearby river. The study was conducted at the end of July/beginning of August - in the middle of the dry season.

10.2 Method applied

For this purpose tests were conducted for faecal coliforms (excherichia coli):

a) at the water source
b) in user's container at the source
c) in user's container immediately after it had arrived at the home, and
d) in the storage vessel for drinking water approximately five hours after collection.

For all households it was observed whether the container used was cleaned or rinsed with water before filling it. The field assistants who collected the E.coli samples also noted the distance from collection point to the user's home to see whether the distance travelled would influence the number of E. coli in the container.

When a sample of water was taken from the storage vessel for drinking water the cup, which in most cases rests on top of the lid covering the vessel, was used to sample the water. This procedure gives a better estimate of the degree of contamination of water drunk by the consumer.

Any E.coli increase found - applying the mentioned method - will in general be an indication of faecal pollution of human origin.

10.2.1 Sampling

A coli-count sampler manufactured by Millipore was used. When the samples had been incubated for a period of 20 hours at 44.5 degrees centigrades they were read. Each colony of blue or dark blue-green colour represents 100 E.coli per 100 ml. The method used is attached with at least three major types of measurement errors:

a) big colonies are read as equivalent with barely seen ones on the membrane
b) the clarity of the colours of the colonies varies and is thus subject to incorrect readings and

c) consecutive samplings from the same water gives different readings each time.

To test the reliability of the coli-count sampler, nine samples were taken from the same water within a period of 10 minutes. This water was kept free from interference from other water. These nine samples showed different readings, ranging from 15000 - 120000 E.coli/100 ml.[1)] Each randomly taken sample in the mentioned test had 95 % chance to fall between 45286 - 91603 E.coli/100 ml. It thus appears that the accuracy of the sampling instrument used is too low to use the readings with any significant confidence. Any reading should be read as n E.coli $\pm$ 80 %. The actual E.coli content of a source from which a sample is taken which shows 300 may thus be anywhere between 60 and 540 E.coli/100 ml. While the sampler may be of use to test whether a source is polluted at all, the found measurement error makes it unsuitable - strictly speaking - for our purpose.

However, since our data did show some consistency we shall present them below anyway - keeping the considerations above in mind.

10.3 The data

The data presented in table 10.1 gives the individual readings for each sample taken, together with the mean for clusters of households collecting water at the same time. The data for the mentioned clusters are arranged in rows (a,b,c, etc.). Coli-counts for the individual households are presented in the same order in each of the three relevant columns. Thus one is able to follow the occurrence of faecal pollution from collection to use for each household.

The table shows that there is less indication of faecal pathogens in the piped water than in the traditional source. If we start by looking at the means of the E.coli content in users' containers at the source and the means of those samples taken immediately after arriving at the home for those households that collect water from a piped water supply we observe an increase of faecal indicators. This increase is significant ($p \leq 0.02$, t test of paired observations, row d. This is the test used throughout this chapter). When examining the E.coli content in the storage vessel five hours later an additional average increase was observed (row d), but this was not significant.

The differences for the three clusters a,b, and c between the means for the samples taken from users' containers on arrival at home and from storage vessels are not significant (rows a, b, and c).

Source type	Source E.coli/100 ml	Users' container at source E.coli/100 ml	Mean E.coli/100 ml	Users' container arriving in home E.coli/100 ml	Mean E.coli/100 ml	Storage vessel five hours later E.coli/100 ml	Mean E.coli/100ml
Utengule							
a. Piped, untreated	0	100/0+/0/ 300+/0+	80	300/200/200/ 300/100	220	200/100/500 100/500	280
b. -do-	100	200+/200/200+ 0/100	140	400/1200/300 100/200	440	100/200/600 100/100	220
c. -do-	100	200+/0+/100+/ 100/100+	100	600/300/100 200/200	280	200/200/200 600/1400	520
d. -do- (summary)	66		106		313		340
Mporo							
e. River++	600	700/400	550	500/200	350	100/200	150
f. -do-	400	600/200/600	456	1600/900/400	966	800/100/100	333
g. -do-	400	700/300/100 100/200	280	900/700/300/ 300/100	460	100/0/400 300/300	220
h. -do-	600	100/300/500/ 400/400	340	200/400/500 600/500	440	200/0/1200/ 200/400	400
i. -do-	200	600/0/300/ 100/200	240	100/100/200/ 400/0	160	0/300/100/ 500/500	280
j. -do- (summary)	440		340		418		290

+) Rinsed container

++) All drawers from river rinsed their containers

Table 10.1 Occurance of indication of faecal pollution in water samples taken in Utengule and Mporo villages in Mbeya Region.

Turning to the data collected from users of water drawn from the river we notice a mean increase in faecal indicators on arrival at the home compared with E.coli found in the containers at the source (row j). This increase was not significant (0.18). The reduction in E.coli generally observed in storage vessel compared with that found in containers on arrival in the home is significant (0.1). However, taking the clusters separately we found a significant difference only in row f (0.06).

Summing up the findings and for a time ignoring the mentioned measurement errors we found that the increase in E.coli content in samples taken from containers at source and at arrival at home was significant for pipe users, while the increase of E.coli between containers in home and storage vessels was insignificant for the same households.

For the river users the increase in E.coli-content between measurements from containers at source compared with those from container at home was insignificant. While the reduction in E.coli between "container at home" and storage vessel was significant.

10.4 Discussion of findings

Bearing in mind the uncertainties involved in reading the faecal indicators on the membrane of the E.coli sampler, and the limitation of the sizes of the samples it is most doubtful what conclusions can be deduced from the data presented above.

The differences in E.coli content found between the various samples may in some cases be explained by the fact that the water from which samples were taken in the container strictly speaking is not the same as that which was sampled from the source. The quality of the water can change from one minute to another. Other changes may be due to dirt already present in the container before filling it with water, while it seems likely that most changes simply are caused by measurement errors. These three factors combined make it difficult to conclude anything from our data with any certainty.

However, the data collected are sufficient for suggestive findings, though they may appear bold and insubstantial. The suggestions thus put forward serve as proposals for future research hypotheses to be tried under different circumstances than the ones applied here.

All households that fetched water at the river cleaned their buckets before filling them. If this explains why a general improvement of the water quality occurs between collection and consumption from storage vessel, we should expect to find a similar trend among those pipe-users who also cleaned their containers. But when we examined those samples in rows a,b, and c marked with an asterisk (+) for those

who cleaned the container, we found a mean E.coli increase between the three sampling points - container at source, at house and at storage vessel.

The readings for these three points were 122 E.coli/100 ml, 277 E.coli/100 ml and 377 E.coli/100 ml, respectively. We can thus rule out - based on our data - any independent effect from rinsing the container.

The difference in mean E.coli found between samples taken from container at source and at home cannot possibly be explained by the distance travelled and the time used to fetch water. Though the users of the non-pipe source on average travelled 420 metres (one way) the relative small and non-significant increase of E.coli found between source and arrival at home compared with the significant increase of E.coli found among pipe-users who on an average travelled 50 metres between the same two points is unlikely to be explained by distance.

Normally about 90 % of E.coli die off in 48 hours if water is kept in darkness. Thus it is unlikely that the time used to fetch water has had any influence on the E.coli content. But time may be involved in explaining the reduction in E. coli found in the storage containers in the homes of river-users. However, if time was the only factor involved we would have expected the same effect in the storage containers in the homes of pipe-users. To know what causes this difference it would have been necessary to observe to which extent storage containers were used during the five hours between the two samplings and whether the storage containers were covered or not. It would also have been necessary to know whether the river users observe higher hygienic standards than the tap-users.

In the absence of such information we suggest that one reason may be due to a lower hygienic standard among tap-users. 60 % of them cleaned their containers before filling them. And since they believe they get "maji safi" from the piped water scheme, it may be that they see no need to clean their storage container regularly.

On the other hand, the fact that everybody drawing from the river was seen cleaning their containers before drawing water suggests that they may also adhere to hygienic rules at their houses, such as cleaning storage vessels. However, it should be emphasized again that the reasons suggested for the found differences are purely speculative, though plausible.

The people drawing from the river can see how dirty the water is, whereas those taking water from the tap by the water authorities are led to believe that they get clean water. So why should they waste their time, cleaning the containers and storage vessels ?

It is well known that adult education classes are well attended in Mporo, where they get water from a river. Furthermore, there is a tendency for teachers in villages without a water scheme to emphasize for the children the health hazards of polluted water. These things become easily neglected in villages with a water scheme.

Bearing in mind that our data do not allow firm conclusions, we think that differences found may be explained by a higher awareness among the villagers of the health risks of water drawn from the river and a false sense of safety about the water collected from a water scheme among the villagers in Utengule.

10.5 Summary

The findings which are only suggestive, were as follows:

a) all households could at times draw water from a source which did not meet the bacteriological standards for Tanzanian water (i.e. that villagers should have access to water without E.coli)
b) long distances to collection point did not influence the water quality significantly
c) cleaning of the containers was not proved to prevent a deterioration of the quality of the water
d) generally, samples taken indicated medium pollution, that is between 100 to 1000 E.coli/100 ml [2)]
e) approximately 6 % of the households had E.coli exceeding 1000 E.coli per 100 ml in their storage containers
f) villagers with "maji safi" tend to ignore health precautions followed by villagers drawing from traditional sources, indicated by a lower percentage of the former who clean their containers before filling them
g) the water in storage containers in the village drawing from a river was of a better quality than the water sampled directly from the source (river)
h) the water in the storage containers in the village with a piped water supply was of a worse quality than that in the pipes.

10.6 Other studies

Other studies done on pollution between collection and consumption have used the membrane filtration method, which is highly reliable. Feachem in a study in Lesotho on pollution between collection (from a good quality hand pump) and use found an increase of pollution after collection.[3)] This study was based on

a more limited sample than the present one. Information elsewhere in the same study suggests that people's hygienic behaviour and sanitary environment are of a worse quality than the one observed in Mbeya Region. Thus, only 13 % of the people in the area studied in Lesotho had a pit latrine against nearly 100 % in Mbeya Region.

Brokonsult's study on "Rural Water Quality Programme in Tanzania" refers to the Tri-region WMP results.[4] Using the membrane filtration method they discovered in most cases only an extra 50 E.coli per 100 ml. However, this study only took samples at the water source (piped schemes) and from consumers' container. The report does not mention where in the chain samples were taken from the container. Assuming it was done at the collection place, the findings support those in our study. The increase of E.coli/100 ml between source and container at source for households collecting from piped scheme in our study was also only 50 E.coli/100 ml.

If our considerations on hygienic behaviour and attitudes towards piped water in Utengule are correct then the environment in which Feachem conducted his study appears to be similar to that in Utengule. Granting the validity of Feachem's study and ours of 15 households in Utengule the data collected are mutually supportive: The E.coli content increased steadily after collection.

A study from Ismani in Iringa Region[5] found heavy increase of pollution in samples taken from storage containers of users of a tap source, compared with the E.coli-count found in samples taken from the taps. The reason for this increase of E.coli in storage containers was attributed to the fact that nobody covered their storage container and that the water would be stored from one to six days in high temperatures. This study also noted that "it is a general belief in the area that all tap water is purified before it reaches the people". This observation thus corresponds well with our own tentative findings.

10.7 Further research

The study reported on here will be repeated in the same or similar villages applying another method of sampling. Particular emphasis should then be paid to any difference in hygienic awareness and in handling of water in villages of the two types mentioned in the present study. The findings will be reported in the Iringa, Mbeya, Ruvuma Water Master Plan vol. 13, which will appear when the socio-economic study is finalized in early 1983.

Notes:

1) Testing the E.coli-count-sampler

Samples taken from the same water showed the following readings:

64000

72000

100000

53000

81000

21000

90000

120000

15000

Mean = 68 444

sd. = 34 738

Standard error 11 579

2) Feachem R., Michael McGarry and Doncas Mara (eds.): Water, Wastes and Health in Hot Climates. John Wiley and Sons, Chichester, 1978. The following criteria for treatment of polluted water are suggested; less than 10 E.coli/100 ml, supply untreated; 10-100 E.coli/100 ml treat if possible, if not supply untreated; 100-1000 E.coli/100 ml treat if possible, if not supply untreated or abandon depending on various other factors; more than 1000 E.coli/100 ml treat if possible, if not abandon or supply untreated depending on various other factors.

3) Feachem R.: Water, Health and Development, an inter-disciplinary evaluation. Tri-med Books. Ltd. London, 1978. p. 120.

4) United Republic of Tanzania: Rural Water Quality Programme in Tanzania. Final Report, Main Text and Annexes 1-10 2 volumes. Prepared by Brokonsult, Taby 1979 (Sweden).

5) Economic Research Bureau and Bralup: Total coli-counts: A Method to determine biological contamination of rural water supplies. The Ismani example, by J. Kreysler, Max Planck Nutrition Research Unit, Bumbuli, p. 4.

11. WATER SANITATION AND HEALTH

11.1 Introduction

"It is clear that while improved drinking water is probably a necessary condition for the improvement of people's health, it is not a sufficient condition".[1)]

"Sanitation improvements are necessary but in themselves not sufficient for the control of excreted infections. Without them, excreted infections can never be controlled."[2)]

Permanent improvements in health are unlikely unless a safe and convenient water supply is accompanied by other sanitary measures and health education. That is the concensus in nearly all evaluation studies of water supply schemes in developing countries.

The interrelations between water, sanitation and diseases are, however extremely complicated as section 11.2 below indicates. The socio-economic group will do more work on these subjects in phase 2 of the study (see chapter 1.6). This is justified, given the significant water related health problems found in many parts of the three regions (see 11.3).

At this stage of the socio-economic study only a general survey of sanitary conditions in the three regions has been made together with a more detailed survey of these conditions in the Wang'ing'ombe area, Iringa Region. The latter was conducted at the request of UNICEF and the World Bank Technology Advisory Group. The results of the two surveys are presented in section 11.4. At Wang'ing'ombe a simple survey of villagers' knowledge about diseases was also conducted, and section 11.5 contains the results. Conclusions are given in section 11.6.

11.2 The multiple causes of infectious diseases[3)]

Contaminated water; insufficient water for personal hygiene; and the inappropriate disposal of waste water can all be causes of diseases. Thus not only poor water quality but also too little and too much water presents health problems.[4)]

Excreta are related to diseases in two ways. First, pathogens of many infections diseases escape from the body in the excreta and may eventually reach others. And secondly, excreta disposal may encourage the breeding of insects. These insects (flies, mosquitoes, cockroaches), which are a nuisance in themselves,

may mechanically transmit excreted pathogens; or they may transmit pathogens which circulate in the blood (Mosquitoes).

White, Bradley and White tell the story of a housewife in a village who gets up in the morning and soon begins to fetch water.[5] The myriad of ways in which she and her family may catch a disease on that day are truly amazing - and slightly exaggerated: people do survive. But in most rural areas where infectious diseases are a problem any number of the following situations may exist - even in a village with an improved water supply.[6]

- Villagers from neighbouring settlements without an improved supply pay visits.
- Much of the population still prefer to bath or wash clothes in water holes or streams or even take water from such sources. (See chapter 8.2.4).
- Cattle and insects are carriers of a variety of diseases on cattle. (See chapter 9.2).
- Fruits, vegetables and food is improperly prepared.
- Communal beer drinking is widespread (see zonal descriptions, chapter 2 and chapter 8.8.2).
- Local customs and/or work in distant fields may cause non-usage of pit latrines. (See below).
- Water from the domestic point is stored in containers that are sometimes open to flies and are frequently dipped into, thereby exposing the water to a variety of parasites, bacteria, and viruses. (see chapter 10).

Given the multiple sources of infective diseases (the above list is far from complete) it is no wonder that it is extremely difficult to determine precisely how much improvement in health in a given community can be attributed to improvements in water supply or sanitation.[7]

One thing is clear, though: Improvements in either water supply or sanitation or personal hygiene do not affect all types of infectious diseases equally much. The potential impact depends very mucy on the transmission characteristica of each particular disease.

Table 11.1 shows the four types of mechanisms by which infectious diseases can be transmitted.[8] The examples of diseases listed in the table are all found in (parts of) the three regions. Each group of diseases requires specific preventive strategies. The theoretical potential for control of each group is also shown in the table. The stated impacts are, of course, only very rough indications.

Actual improvements would obviously depend on a host of interrelated factors among them the pre-improvement conditions. But to assume that any of the three control measures would have the same potential impact on all four types of diseases would be a greater error. The important point is that as the disease pattern varies between different types of communities so should the measures taken to control them.

		Potential impact on diseases by improvements in:		
Transmission mechanism a)	Examples of diseases	Water supply alone 9)	Sanitation alone 10)	Personal hygiene alone 11)
Faecal-oral (Water-borne or water-washed)	Amoebiasis	Moderate	Negligible	Great
	Ascariasis	Slight	Great	Moderate
	Cholera, typhoid	Great	slight to moderate	Moderate
	Diarrhoeal diseases	Moderate	-do-	Moderate
Water-washed	Scabies	Great	Negligible	Great
	Skin ulcers	Moderate	Negligible	Great
Water-based	Bilharzia	Moderate	Moderate	Negligible
Water-related insect vector	Malaria	Negligible	Moderate	Negligible

Table 11.1 Control of infectious diseases by improvements in water supply, sanitation and personal hygiene.

11.3 Infectious diseases in Iringa, Mbeya, and Ruvuma Regions

The diseases listed in table 11.1 are prevalent in the three regions under study. The potential impact of control measures is therefore considerable. Table 11.2 shows the frequencies of selected infectious diseases.

Generally the incidence of any of the listed diseases is the highest in Iringa Region, except for Bilharzia which is more prevalent in Ruvuma. Around 31 %, 22 %, and 22 % of the hospital out-patients in Iringa, Mbeya, and Ruvuma Regions respectively suffered from the infectious diseases included in table 11.2. No doubt these figures underestimated the true prevalences of such diseases in the three populations.[12)]

% of all out-patient attendances at all hospitals 1974 - 1976			
Infectious diseases	IRINGA	MBEYA	RUVUMA
Faecal-oral diseases excluding Ascariasis	16	12	9
Ascariasis	1	2	0.2
Skin and louseborne	8	3	8
Scabies	3	2	1
Eye diseases	3	4	2
Bilharzia, all types	0.4	0.4	2

Table 11.2 Selected infectious diseases. Frequencies for Iringa, Mbeya and Ruvuma Regions. 13)

In particular areas within each region the infectious diseases pattern may look quite different from that of the region as a whole. This is illustrated in chapter 2 where some statistics from various dispensaries, rural health centers and hospitals are given.

The interesting points is whether a systematic relationship exists between specific infectious diseases and areal characteristics (agro-ecological conditions, culture, etc.). Brokonsult[14] has looked into this problem using rainfall as the main explanatory variable. The analyses are not entirely convincing[15] but they do seem to indicate that Ascariasis is significantly more prevalent in highland rainy areas than in drylowlands. This probably reflects the climatic effect on the viability of the ova more than hygienic differences. The faecal - oral diseases, on the other hand, seem to be the least affected by variation in rainfall. They are prevalent everywhere. The reason is probably the complex relationship between rainfall, water quality and hygiene. Skin and louseborne diseases do show some variation with climatic conditions - but they are not easily explained. The eye diseases show no clearly defined pattern at all. Bilharzia is relatively rare in the highlands with swift streams and in the dry low lands where water is scarce. High incidences are usually found in lowlands with slow flowing streams; and where rice is grown. Malaria - endemic in the warm lowland area if surface water is plenty - is less frequent at cooler high altitudes.

The relationships between diseases, agro-ecological conditions and cultural patterns remain, however, complex and partly unknown. For the time being the planning of complementary inputs to rural water supplies must rely on more readily available information. A part of such necessary information is presented in chapter 11.4 (on the present sanitary conditions) and in chapter 11.5 (on present knowledge about diseases).

11.4 Present sanitary conditions

The bulk of the data presented below were collected during a special survey on sanitary conditions in the Wang'ing'ombe area located in the medium dry intermediate zone (Njombe district, Iringa Region. Four villages were covered: Wang'ing'ombe; Ilembula; Mayale; Igwachanya). These data are supplemented with information from the general household surveys conducted in 11 agro-ecological zones elsewhere in the three regions. The same methodology was used in both surveys as shown in the appendix.

The data for the Wang'ing'ombe sample are, of course, not representative for conditions in all three regions. On the other hand the area is not un-typical of conditions in rural communities as can be seen by comparing selected socio-economic background variables from the three regions with those from the Wang'ing'ombe sample[16] (table 11.3).

Socio-economic characteristics of sample households	Wang'ing'ombe area:	Iringa Region	Mbeya Region	Ruvuma Region
Female head of household, %	34	36	8	2
Household head 25 - 45 years old, %	61	58	43	60
Household head 5-7 years schooling, %	13	6	11	16
Household head attending adult education, %	74	77	39	61
Average gross cash household income, Shs.	3,105	1,860	2,510	4,096
Main house with corrugated roof, %	31	35	17	31

Table 11.3 Selected socio-economic variables; Wang'ing'ombe and Iringa, Mbeya and Ruvuma Regions.

11.4.1 Ownership of pit latrines and baths

Approximately 9 out of 10 households in the Wang'ing'ombe sample were observed to own a latrine with slight variations between villages as shown in table 11.4.

In the Iringa, Mbeya and Ruvuma villages where household surveys were conducted the observed average rate of ownership was slightly higher, but not significantly so, as table 11.4 also showns. The third source of information on ownership of pit latrines is the village inventory survey carried out by the technical consultants in all villages in the three regions. Based on approx. four-fifths of the 1500 villages this survey indicates that the percentage of villages in which 81 % or more of the households own a latrine according to the village authorities are:

- 93.8 % in Iringa Region
- 88.1 % in Mbeya Region
- 81.4 % in Ruvuma Region

It is no exaggeration to state that the three regions are almost completely saturated with latrines, although pockets of villages where latrines are less prevalent do exist - especially in the drier areas.

Almost half of all households in the Wang'ing'ombe villages owned a separate bath (bafu). This room is built into one of the houses on the compound (not the main house), normally has a floor of broken bricks or stones, and is used for washing, bathing, and sometimes laundry.

Regions/Villages	Latrine % of hh.	Bath % of hh.
Ilembula	95	46
Wang'ing'ombe	93	47
Igwachanya	85	38
Mayale	93	45
All 4 villages	91	44
Iringa Region	95	n.a.
Mbeya Region	94	n.a.
Ruvuma Region	92	n.a.

Table 11.4 Observed ownership of pit latrine and bath by sample households.

Four background variables were used in an attempt to identify the characteristics of the households without a latrine in the Wang'ing'ombe villages. As expected (see table 11.5) households with low formal education, low wealth, and female heads (having below average incomes) are the most likely <u>not</u> to own a latrine. Surprisingly, the age of the head of households does not seem to be a significant factor.

Variable	Direction of relationship with owning latrine	Significant[a)]	Probability[b)]
School education	Positive	(Yes)	15 %
Female head of household	Negative	Yes	5 %
Age of head of household	None	No	95 %
Wealth[c)]	Positive	Yes	0.5 %

a) Based on Chi-square tests

b) Probability that relationship is random

c) Roof material of main house used as proxy variable

Table 11.5 Characteristics of households owning a latrine in Wang'ombe area.

11.4.2 Construction and cost of pit latrines

In average latrines are rebuilt every 3 years in the Wang'ing'ombe villages. This is slightly below the average lifetime in Iringa (3.8 years), Mbeya (3.4 years) and Ruvuma (4.8 years) Regions. Only 7 % of the latrines in the Wang'ing'ombe villages last for more than 7 years according to the respondents. There are two main reasons for building a new latrine as shown in table 11.6

Reasons	Wanging'ombe % of hh.	Iringa % of hh.	Mbeya % of hh.	Ruvuma % of hh.
Squatting plate collapsed	60	24	36	35
Latrine fills up	36	71	62	59
Other	4	5	2	6

Table 11.6 Main reasons for building new latrine as given by sample households in Wang'ing'ombe area and Iringa, Mbeya and Ruvuma Regions.

Observations on the main physical features of latrines are listed in table 11.7. The lack of a door, a roof and walls is by and large as frequent in the Wang'ing'ombe villages as in the regions as a whole. These deficiencies affect the privacy of latrines as discussed later. Lining of latrines is very rare.

Observed features	Wang'ing'ombe % of hh.	Iringa % of hh.	Mbeya % of hh.	Ruvuma % of hh.
No door	64	76	54	63
No wall	1	4	4	3
No roof	23	53	18	39
No lining	99	n.a.	n.a.	n.a.

Table 11.7 Observed main physical features of latrines belonging to sample households in Wang'ing'ombe area and Iringa, Mbeya and Ruvuma Regions

The most frequently used materials for latrines in the Wang'ing'ombe villages are:

- cloth/gunny bags for the door (23%)[17)]
- straw for walls (72%)
- straw for roofing (70%)
- soil on poles for the squatting plate (99%)

Digging of a new latrine most often stops when an adult standing at the bottom of the hole cannot reach the edge. Thus the average depth is around 3 metres - with half below and half above that depth. The reasons indicated by the male respondents for not digging deeper were: "hole collapses" (37%); "stone/rocks" (26%); "ground water" (17%). Asked why pits are not dug deeper only 20 % of the respondents give reasons that were not related to the physical conditions of the ground, such as "no need to dig deeper". Otherwise answers such as "rocks"; "loose soil" etc. were typical.

Nine out of ten latrines in the Wang'ing'ombe sample are located less than 20 m from the entrance to the main house. Almost 1 in 10 latrines is built within one of the houses on the compound - normally next to the bath if there is one. Close to,all latrines are situated behind the main house. No particular orientation of the latrine in relation to the main house seems to be preferred, but the opening to the latrine normally faces the main house.

Most households (70%) in the Wang'ing'ombe sample built their own pit latrines without any cash outlays. This fraction seems to be fairly typical overall for the three regions as well. Those 3 out of 10 households in the Wang'ing'ombe sample which did spend cash on the construction, normally paid for a fundi and some materials. Very few spent money on materials only (2%) or on a fundi only (5%). Roughly 150 shillings was spent on a latrine by those 30 % of households that made cash outlays. The majority spend less than 100 shillings as shown in table 11.8.

	Cash outlays (Shs)				
	None % of hh.	1-100 % of hh.	101-200 % of hh.	201-400 % of hh.	400+ % of hh.
Wang'ing'ombe	70	17	6	7	1
Iringa	67	n.a.	n.a.	n.a.	n.a.
Mbeya	71	n.a.	n.a.	n.a.	n.a.
Ruvuma	77	n.a.	n.a.	n.a.	n.a.

Table 11.8 Households with cash outlay for latrine in Wang'ing'ombe area, Iringa, Mbeya and Ruvuma Regions.

There is, of course, a close relationship between wealth and cash outlays for a latrine ($P < 0.5\%$). Surprisingly enough, households with female heads are more likely to have incurred cash outlays than households with male heads ($P < 0.5\%$)[18]. The explanation is probably, that the building of latrines is the responsibility of males, in the absence of whom a fundi is hired (or no latrine built).

11.4.3 Use of pit latrines

Claimed usage of latrines range from 85 % to 100 % for children and from 90 % to 100 % for adults in surveys carried out in 11 different zones in Iringa, Mbeya and Ruvuma Regions[19]. These percentages are difficult to verify, but they are substantiated by impressions from field work in the different areas of the three regions where household surveys were conducted. Observations in the Wang'ing'ombe area indicate a similar level of usage when people are at the house or around in the village[20]. No clear signs of common non-usage (faeces, bad smell in the surroundings) were observed here. The path leading to the latrine was "well trodden" in 92 % of all cases (lowest in Igwachanya (83%) and Mayale (87%); highest in Ilembula (100%) and Wang'ing'ombe (96%). These percentages indicate the order of magnitude only. The age of the latrine, soil conditions and judgement all influence the results of this observation.

Babies and children

Babies are probably the most frequent none-users at the house. Approximately half (48%) of the mothers in Wang'ing'ombe with children below two years of age told that their babies normally defecate in the latrine. The rest use the bush (21%); a piece of cloth (9%); mother's leg (16%); or a hole (3%). Asked why these babies did not use the latrine, the mothers' answers were "babies are not able to" (37%); "fear that child fall through hole" (26%); "fear dirtiness" (6%); and other (37%). Children may also sometimes not use the household latrine. They will, however, often use the latrine at the school.

The defecation habits of babies and children should be made a topic for discussion in a health education programme. The fear of falling through the hole may indicate the need for modifying the pit latrine construction.

Adults

When adults are present in the village they will in almost all cases use their own or a neighbour's/friend's latrine. But for people working in the field the bush is most frequently used for defecation (78%)[21]. Some 7% of the women claimed to dig a hole to cover the excreta, while only a few (2%) used old latrines at deserted houses from the pre-villagization while working in the fields. Finally, 12% of the women asked claimed that they return home or to a neighbour's latrine when need arises.

As shown in section 11.4.1, only 1 out of 10 households does not own a latrine. These households most often indicated that they use a neighbour's latrine, although a few (2%) mentioned the use of fields.

Use at night

Evidence of the level of usage at night is only circumstantial. It does appear as if fear of darkness and snakes may prevent some people from going to the latrine at night. (Kerosene and batteries are rarely available these days). At least these two factors were most often mentioned by those respondents who were asked to explain why they wanted to build their next latrine closer to the main house than their present one.

Attitudes affecting usage

In order to get an idea of beliefs, taboos and other factors which might influence the use of latrines, the wife (wives) were asked the following question. "In your opinion, what are the reasons why some people in this village sometimes do not use their own pit latrine ?" The question assumes that non-users exist, but it does not make any (potentially embarrasing) assumptions about the respondent herself. The respondents gave the following reasons: "fear that plate collapses" (19%); "fear darkness" (4%); "no latrine" (5%); "latrine too far away" (5%) "elders do not defecate" (1%); and other (5%). However the percentage of "don't know" is very large (64%).

The first of the above reasons points to structural problems with latrines in the Wang'ing'ombe area, a subject which is further discussed below. "Fear of darkness" is influenced by the location of the latrine (see section 11.4.2).

Contrary to what other investigators claim about this area the belief that "old aged persons or adults never defecate" does not seem very common, although a short formal interview is not the best way to get at beliefs and taboos. However, informal talks with people in the project area confirmed that this particular belief is not held by many today. The existence of another claimed taboo - namely that fathers do not go to latrines used by menstruating daughters - was also refused during these talks. Such fathers would conceivably use the bush. We did not see any signs of this. Neither did we observe latrines with two doors, and we found only one household out of 230 with 2 latrines. In some other areas of Iringa Region one in ten households has two latrines. The average for this region is 4.1 %. In Mbeya this average is 3.8 %, and in Ruvuma 10.9.

We conclude that latrines are regularly used by almost all adults in the Wang'ing'ombe villages - except when they are working in the fields. We have not found evidence of taboos or beliefs which are so prevalent and so strongly held that they could lead to widespread non-use of latrines.

11.4.4 Users' satisfaction with sanitary conditions

In spite of the high level of usage of latrines in the Wang'ing'ombe villages many users are not satisfied with their present sanitary situation. Table 11.9 shows that 4 out of 5 households in these villages had at least one complaint. The prevalence of these complaints corresponds well with the observations made by the interviewers, which are also shown in this table.

	Wang'ing'ombe area		Complaints % of hh.[a]		
	Complaints % of hh. a)	Observations % of hh. b)	Iringa Region	Mbeya Region	Ruvuma Region
None	19	37	33	n.a.	22
Flies	69	48	45	34	46
Mosquitoes		27			
Dirtyness (squatting plate)	6	15	(14)[c]	(16)[c]	(14)[c]
Bad smell	3	6	14	8	20
Other	4	-	7	9	12

a) Only one complaint recorded per household

b) Each discomfort recorded separately - may add to more than 100 %

c) By interviewers observation.

Table 11.9 Discomforts of latrines; complaints by latrine owning households and observations by interviewers.

Although the percentage of complaints about flies and mosquitoes in the Wang'ing'ombe villages is above the regional averages, there are several zones within these regions where this particular complaint is at the same level as in the Wang'ing'ombe area. Complaints about bad smell were slightly fewer in the Wang'ing'ombe villages than in the three regions.

Although complaints about insects are quite frequent in the Wang'ing'ombe area, they are not among the reasons mentioned for non-use. Only some mothers with less than 2 year old children cited "dirtyness" as a reason for not using latrines (See section 11.4.3 above). However, neither "dirtyness" nor "bad smell" are prevalent features of latrines in the project area, as the table 11.9 shows.

Households most likely to complain about flies/mosquitoes and bad smell are those that do not have a lid for their latrines ($P < 5\%$)[23]. A lid does, therefore, seem to help. It is thus surprising that only one-third of the latrines had one[24].

A water container was found in approx. 12 % of all latrines in the Wang'ing'ombe area. Hand washing after defecation is therefore not very common in the project area. One might hypothesize that water buckets would be most prevalent in households with the easiest access to water. Generally this does not seem to be the case. An analysis of respondents with below and above 400 m walking distance to water revealed a weak relationship of this sort only ($P < 27\%$)[25]. Thus, the provision of a water supply - even with conveniently located DP's - may not in itself induce people to keep water for washing and cleaning in the latrine. Sweepers were found in 38 % of the latrines observed, while ash (used for throwing in the pit to reduce smell) was found in 21 % of the latrines in the Wang'ing'ombe area. Close to half (46%) of all latrines observed here had no lid, water container, sweeper or ash inside.

The Wang'ing'ombe respondents' complaints about latrines (see table 11.9) only concern conditions within the latrine. No one complained about the structural conditions of latrines. It is surprising that no direct complaints about squatting plates were heard, although its collapse was the most frequently cited reason for non-use and for rebuilding as previously discussed. This may indicate that people in the Wang'ing'ombe area do not place great importance on the condition of door, roof and walls. The figures in table 11.7 above reinforce this impression. Almost two-thirds of the latrines do not provide the user with complete privacy because the door opening is not properly covered. Furthermore, almost one-fourth of all latrines do not protect the user from rain. However, further analyses of the Wang'in'ombe data show that relatively wealthy (and well educated) households

are the most likely to own latrines with doors that provide privacy ($P < 5\%$)[26]. The same tendency - albeit weaker - exists with respect to the conditions of walls (cracked or not). This indicates that poverty - not lack of interest - may be the main reason for the structural conditions of latrines.

11.5 Present knowledge about health in the Wang'ing'ombe area

According to the medical authorities in Iringa Region, water related diseases are common in the Wang'ing'ombe area[27]. This corresponds well to information obtained from villagers themselves (see table 11.10).

Diseases	Mentioned as one of the two most frequent diseases % of villages
Diarrhoea/stomach pain	74
Malaria	61
Bilharzia	37
Bronchitis	11
Dysentry; Hepatitis; Goitre; Skintrouble; Eye trouble; Chest pains (in one village each)	16

Table 11.10 Most prevalent diseases in 38 villages in Wang'ing'ombe area[28]

Epidemic outbreaks are not uncommon in the area according to the villagers. Since 1978 there have been outbreaks of

- cholera in 8 out of 38 villages (21%) and of typhoid in 7 out of 38 villages (18%).

With this brief account of health conditions let us turn to results of the survey of villagers' knowledge about diseases. The results are almost exclusively derived from the formal interviews (see Appendix). This methodology has one glaring shortcoming: There might be little or no relationship between what people know and how they actually behave. This should be kept in mind when evaluating the survey results below.

11.5.1 Knowledge about faeces-related diseases

The role of faeces in transmitting diseases is generally fairly well understood by people (women) in the project area. Approximately three out of every four female respondents did regard human faeces as a (potential) disease transmitter. Only ½% disagreed and 24% did not know. Cross tabulating these answers with age, education of household heads and wealth did not reveal any consistent pattern. However, households with female heads were more likely to state that faeces is not capable of bringing diseases than were households with a male head.

Also transmission routes are generally well known by those who regard faeces as a potential danger to health. Table 11.11 shows the routes mentioned (only one recorded for each respondent).

Transmission route	% of respondents
Insects/flies	58
Contact with faeces	26
Dirty water	6
Air/dust/smell	5
Not using latrine	2
Other	3
	100

Table 11.11 Transmission routes of faeces-related diseases mentioned by female respondents in Wang'ing'ombe area.

Whether the order of importance of the different transmission routes shown in the table reflect their actual importance is not known. Contaminated food and bad personal hygiene are conspicuously absent.

Those women who thought that faeces could cause diseases were also asked to mention them. Up to four diseases per respondent were coded. In average each respondent mentioned 2.8 diseases. Diarrhoea, stomac trouble and vomitting were most frequently mentioned, followed by hookworms. Not so frequently mentioned was bilharzia. This group of "correct" answers make up 72 % of all the diseases mentioned. Among the "incorrect" answers were fever, malaria, swollen feet, syphilis and gonorrhoea. Cholera was not mentioned.

The same segment of women were asked if anything could be done by the family to prevent faeces-related diseases. Only 6 % of these women did not think so. The remaining 94 % mentioned the prevention methods indicated in table 11.12 (one method each).

Prevention method	% of respondents
Proper use of pit latrine	34
Boil water	17
Clean surroundings and house	11
Use of foot-wear	11
Use of medicine/dispensary/hospital	10
Clean cooking utensils/clothes	7
Other plus don't know	4
No method	6

Table 11.12 Prevention methods of faeces-related diseases mentioned by female respondents in Wang'ing'ombe

Households with a female head were significantly more likely than households with male heads to answer that faeces-related diseases cannot be prevented ($P < 5\%$)[29].

11.5.2 Knowledge about diarrhoea

Diarrhoea is a faecal-oral disease which is water-borne and/or water-washed (see table 11.1). In 1977 approximately 11 % of all diseases treated at 6 dispensaries in the Wang'ing'ombe area belonged to this category[30]. The actual percentage that suffers from this disease is probably much higher.

Table 11.13 shows the causes of diarrhoea according to the opinions of the respondents. Around three-fourth of the answers are "correct"; that is, diarrhoea may be caused by any of the four first mentioned causes listed in the table. Poor personal hygiene is conspicuously absent from the list

Causes of diarrhoea	% of respondents
Dirty/unboiled water	42
Dirty food	15
Insects/flies	14
Dirty latrine	3
God	3
Other	7
Don't know	20

Table 11.13 Causes of diarrhoea mentioned by respondents in Wang'ing'ombe area.

A number of preventive measures against diarrhoea were suggested by the respondents. They are shown in table 11.14.

Preventive measures	% of respondents
Boil water/use clean water	56
Clean utensils/food	22
Clean latrine	14
Use local medicine	3
Use dispensary/hospital	3
Other	14
Don't know	9

Table 11.14 Preventive measures against diarrhoea mentioned by respondents in Wang'ing'ombe area.

Boiling of water is probably not prevalent in the Wang'ing'ombe area (no questions or observations were made). In Iringa, Mbeya and Ruvuma Regions 39 %, 66 % and 37 %[31] of the respondents respectively claimed that they boil drinking water. The high frequency of this answer in Mbeya Region is most likely a result of numerous campaigns against cholera there. The schisma between knowledge and behaviour is aggrevated by the scarcity of firewood in general and in the Wang'ing'ombe area in particular - a scarcity that has been made worse by the villagization programme in which scattered households were moved together causing everybody to walk longer distances to collect firewood. We thus have a strong suspicion that even those who claim to boil their water don't do it very often !

11.5.3 Knowledge about hookworms

Worm infections (hookworm, ascariasis, thread worm, tape worm, etc.) are also prevalent in the Wang'ing'ombe area. Approximately 1,000 cases were reported to six dispensaries in 1977[32]. Hookworms are transmitted through faecally contaminated ground. Proper use of latrines and personal hygiene are the main control measures.

Table 11.15 shows the different reasons for getting hookworms according to the respondents.

Transmission route	% of respondents
Contact with faeces/not wearing shoes	36
Bad water/food	9
Improper use of latrines	7
Flies/insects	7
Poor personal hygiene	½
Other	10
Don't know	31

Table 11.15 Causes of hookworms mentioned by respondents in Wang'ing'ombe area.

Contact with faeces/not wearing shoes was given as a reason by half of the respondents that gave a reason at all[33]. However, the don't know category is large. Again personal hygiene ranks low on the list. Among those giving "wrong" reasons, households with female heads were again very prevalent ($P < 0.5\%$)[34].

Measures to prevent hookworms were relatively well known by the respondents as table 11.16 shows, although many "don't know".

Preventive measures	% of respondents
Avoid contact with faeces/wear shoes	35
proper use of latrines	21
Good food/water	9
Local medicine	4
Avoid salty food	2
Other	12
Don't know	18

Table 11.16 Preventive measures against hookworms mentioned by respondents in Wang'ing'ombe area.

11.5.4 Knowledge about scabies

Scabies is a water washed disease. It affected 1 % of the patients reporting to six dispensaries in the Wang'ing'ombe area in 1977[35]. Good personal hygiene is the major control measure.

Table 11.17 shows that most people are aware of the reasons for getting scabies. The don't know category is, however, substantial.

Transmission route	% of respondents
Bad personal hygiene	66
Insects/flies	9
Dirty surroundings	2
God	1
Other	1
Don't know	21

Table 11.17 Causes of scabies mentioned by respondents in Wang'ing'ombe area.

Reflecting the respondents'indications of scabies transmission routes, good personal hygiene stands out as the most frequently mentioned precaution against this disease (See table 11.18).

Preventive measure	% of respondents
Good personal hygiene	68
Clean surroundings	7
Control insects	3
Use dispensary/hospital	3
Local medicine	1
God	1
Other	3
Don't know	11

Table 11.18 Preventive measures against scabies mentioned by respondents in Wang'ing'ombe area.

11.5.5 Sources of information on diseases

As could be expected, respondents mentioned a number of different ways in which they gain knowledge about diseases. Table 11.19 indicates the range of them.

Channel	% of respondents
None	27
Informal channels	24
Family members/neighbours	9
Old people	9
Children learn in school	5
Others/own experiences	1
Formal channels	40
Dispensary	30
School teachers	3
Adult education	5
Books	1
Radio	1
Don't know/other	9

Table 11.19 Channels of information on health mentioned by respondents in Wang'ing'ombe area

Although the importance of the informal channels of information is substantial, it is probably underrated: the respondents are likely to be biased towards indicating formal channels to interviewevers whom they regard as representative for the authorities.

The informal and the formal channels of information are used by different segments of the respondents. Cross-tabulations show that informal channels are predominantly used by:

- households where head has no formal school education
- households with female heads

Formal channels on the other hand, are mostly used by:

- relatively wealthy households
- households where the head has some formal education.

There are no significant differences in frequencies of "correct" answers with respect to knowledge about diarrhoea, hookworms and scabies between households using formal and informal channels of information.

11.6 The need for sanitation and health education programmes

There are three major technical options in a rural sanitation programme :

a) upgrading existing latrines
b) building finite-life, but longer lasting latrines
c) building permanent latrines.

Two options exist in the approach to health education, namely:

a) education through formal channels

b) education through informal channels.

11.6.1 Technical aspects of a sanitation programme

To some people there is an obvious need for rural sanitation programmes in Tanzania. Thus one advisor recently wrote:-

> "There are in general no improved waste disposal facilities in rural Tanzania. Most people practise promiscuous defecation near the village or in the fields, while few families have constructed simple pit latrines. There have been a number of local programmes to encourage more wide-spread use of pit latrines, dating back well before independence, but these have lapsed and there is little evidence of improvement visible today".[36] Has he been to the rural areas? This is more like India. EA has very high coverage of pit latrines!

To villagers in the three regions the expressed "felt need" for sanitary improvements is very low indeed: Sanitation was not mentioned as a family or village problem by anyone of the approximately 2,000 male and female respondents who were interviewed (chapter 4). The absense here of a "felt need" does not necessarily reflect a lack of interest in sanitation. Quite the contrary, it may reflect a significant "felt need" that by far the majority of households interviewed in Iringa, Mbeya and Ruvuma regions (95 %, 94 % and 92 % respectively) were observed to own a latrine. Areas with low frequencies of latrines do exist, but these are exceptions.

Contrary to the claim quoted above the almost complete saturation of the villages with latrines is one of the (largely unreported) successes in Tanzanian rural development. This success has probably been caused by intensive educational campaigns; by forcing households to build latrines (through fines or jail) where persuation failed and by the very fact that villagization made the need for proper waste disposal much more obvious. Nowhere in the villages surveyed in the three regions were there clear observable signs of significant non-usage of latrines. Small children may, however, frequently defecate outside the pit, just as adults do when they work in the fields away from the villages. A pan-territorial sanitation programme based on the explicit or implicit assumption that only few people have latrines and fewer use them would therefore be an offence to most villagers in the three regions. And it would be irrelevant in most places.

Upgrading existing latrines

Many villagers do express dissatisfaction with two aspects of their present latrines:-

- they smell
- they attract flies and mosquitoes.

A lid on the hole is the cheapest solution to these two problems, but lids are not very widely used. A ventilation pipe supposedly reduces the two nuisances too. There do not appear to be any technical reason why such pipes could not be fitted onto the existing traditional type of latrine.

Building finite-life, but longer lasting latrines

Two other problems with the present pits - but not expressedly regarded as such by the villaers - are that:

- squatting plates collapse
- pits fill up quickly.

To solve these problems stronger (reinforced) squatting plates; better foundations for the plates; and deeper pits are needed. Often lining of the pit is required as well. Before embarking on such a programme, one question should be asked: Is the use of latrines influenced by the risk that the squatting plate collapses or by the fact that latrines in average must be rebuilt every 3 - 4 years ? If the answer is no as the surveys described in this chapter indicate that it might be for most households, then the decision depends on the trade-off between the increased convenience of a longer life of an improved latrine on the one hand against the costs to each individual household (and possibly an outside agent) of the improvement on the other hand. No major effort of persuasion (or force) should therefore be initiated.

Building permanent latrines

Most families build finite-life latrines without incurring any cash expenditure. A family, a community or an outside agent must be willing to pay (or contribute) if permanent latrines are to be promoted.

Permanent latrines for rural areas are normally of the compost type. The decomposed excreta can be used as fertilizer. But this required that the decomposed matter is removed after some time. People do regard human excreta as a potential transmitter of diseases as shown above. And in many places there are very strong feelings against contact with it - it may well be even in a decomposed form.

Further studies

During phase 2 of the socio-economic study field experiments with the two first technical options mentioned above will be tried out. The ongoing experiments with permanent latrines run by UNICEF, the Technology Advisory Group and the Tanzanian authorities[37] will also be followed. Villagers' reactions to the three options will influence the final recommendations.

11.6.2 Health education

A health education programme based on the explicit or implicit assumption that only few people know anything relevant about diseases would in most areas be just as insulting to villagers as a sanitation programme based on planners' belief in promisuous defecation. Thus, in the Wang'ing'ombe area most respondents are fairly well informed about the causes and preventions of diseases. The socio-economic conditions here are typical of many rural areas, so there are reasons to believe that elsewhere in the three regions the impact of health education in schools; during adult education classes; and at medical facilities have had a similar effect on people's knowledge about health. However, the high prevalence of infectious diseases in the three regions and in the Wang'ing'ombe area indicates that this knowledge has not necessarily changed people's behaviour accordingly. A health education programme should therefore attempt to change those aspects of behaviour that contribute to the prevalence of infectious diseases.

Education through formal channels

There are two main problems with this approach. One is that formal health education tends to reach only those people who already have received some other form of formal education. The other one is that this approach may not be very effective in changing people's behaviour.

Education through informal channels

The illiterate, those without formal schooling, and female heads of household tend to get their knowledge about diseases through family members, friends, old people, etc. Unfortunately not much is known about dissemination of information through these channels or about how efficient they are in contributing to changes in behaviour. The usefulness of the results presented in chapter 11.5 are limited in as so far as it has not been attempted to identify the reasons why there might only be little relation between knowledge of diseases and hygienic habits. To achieve this, participatory observations and discussions - not formal interviews - should be used.

Further studies

There is a lack of well documented experiences from Tanzania with health education through informal channels. During phase 2 of the socio-economic study field experiments with this approach in cooperation with the proposed Extension Unit and Village Water Committees will be carried out (see chapter 6.6). This work will be coordinated with other ongoing efforts at promoting health education through formal channels and through the Village Health Workers' Programme which will be the backbone of Tanzania's ambitious goal of "health to all" by year 2001.

Notes:

1) Saunders, R.J., and Warford, J.J., (1976): Village Water Supply. Economics and Policy in the Developing World. (The John Hopkins University Press: Baltimore). Page 35.

2) Energy, Water and Telecommunications Department, (1978). Appropriate Sanitation Alternatives: A Field Manual. Draft - October 1978. Energy, Water and Telecommunication Department, World Bank. Page 20.

3) The chemical properties of water may also influence health. Water quality tests show that this is a minor problem in the three regions under study. Therefore only infectious diseases will be dealt with here.

4) Water consumption per capita is low (5 - 25 l) in the various parts of the three regions. Disposal of waste water is threfore not likely to be a big problem here.

5) White, G.F., Bradley, D.J., and White, A.U., (1972). Drawers of Water. Domestic Water Use in East Africa. (The University of Chicago Press: Chicago); Page 152.

6) Adopted from Saunders and Warford, (1976). Op.cit., page 35.

7) Ibid. Chapter 2 and White et.al, (1972) op.cit. Chapter 6 provide excellent reviews of such health evaluation studies.

8) This classification is thoroughly discussed by Bradley, D.J., (1977) "Health Aspects of Water Supplies in Tropical Countries" in Feachem, R.G., McGarry, M., and Mara, D., (eds), Water, Wastes and Health in Hot Climates (John Wiley & Sons: Chichester).

9) Feachem, R.G., (1977). "Water Supplies for Low-Income Communities: Resource Allocation, Planning and Design for a Crisis situation." in Feachem et al., (1977). op.cit.

10) White et.al., (1972) op.cit.

11) Energy, Water and Telecommunications Department, (1980). "Appropriate Sanitation Alternatives: A Technical and Economic Appraisal. Summary report" P.U. Report No. RES 20, January 1980. Energy, Water and Telecommunications Department; World Bank, Page 19.

12) Brokonsult, (1979). Rural Water Quality Programme for Tanzania. Final Report. Ministry of Water Development, Energy and Minerals.

13) Ibid. Page 96.

14) Ibid. Chapter 5.2.

15) Private communication of between the socio-economic group and Peter Hawkins; Ross Institute of Tropical Diseases (who did the analyses for Brokonsult).

16) The high average gross cash household incomes in the Wang'ing'ombe sample is due to the inclusion of two large villages: Wang'ing'ombe (a divisional headquarter) and Ilembula (location of a large mission hospital).

17) Percentage of latrines which have a door.

18) Chi-square test; Wang'ing'ombe sample.

19) Percentage of respondents claiming that children and adults respectively always use the pit latrine during day time.

20) The results in the rest of section 11.4.3 are derived from the Wang'ing'ombe sample.

21) Only women were asked this question.

22) Mtavangu G.K. and I.V. Mbaga, (1981). "Promotion and Health Educational Components of the Wang'ing'ombe Rural Sanitation Project" in A.M. Wright, ed., Low cost Sanitation in Tanzania. A report of a ninth Mission to United Republic of Tanzania, February 14th to March 1st, 1981. United National Development Programme, Technology Advisory group; Global Project GLO/)_/ 006; TAG/Ta/11; Annex II, Page 46.

23) Chi-square test; Wang'ing'ombe sample.

24) 46 % of the Wang'ing'ombe respondents (against the observed 33 %) claimed that they had a lid in their latrine. This indicates that respondents try to give the answer that they assume the interviewer would like to hear. It also shows that there sometimes is little relation between what people know and how they behave. Promotion of lids is a standard issue in health education through dispensaries, health centres and hospitals and have taken place for many years. Yet, in spite of this, adoption of lids is limited.

25) Chi-square test; Wang'ing'ombe sample.

26) Chi-square test; Wang'ing'ombe sample.

27) Mduma, G., (1981). "The prevalence of Water Transmitted Diseases in Wang'ing'ombe Rural Sanitation Project Area"; in Wright 1981. op.cit.

28) Village inventory by CCKK; 38 villages - covered by the Wang'ing'ombe North Water Supply Project - included; based on interviews with village chairman/secretaries who were asked to mentioned the two most frequent diseases.

29) Chi-square test.

30) Stahl, M., Sachak, N., and Mkusa, G., (1978). A Socio-Economic study of Water-Related Problems in Northern Njombe. Research Paper No. 54. Bureau of Resource Assessment and Land Use Planning. University of Dar es Salaam; Page 58.

31) In Ruvuma including any type of treatment undertaken by households, but mainly boiling.

32) Stahl, et.al. op.cit. Table 8.2.

33) Use of footwear among members of the households interviewed very much depending on family status. The percentages of family members wearing shoes or sandals were: head of household (56%); First wife (40%); second wife (27%); children (17%). This information is based on observation of family members present during interviews.

34) Chi-square test.

35) Stahl et.al. (1978). Op.cit. Page 60.

36) Feachem, R.G., (1978). Low cost Sanitation in Tanzania. A report of an Exploratory Mission on behalf of the World Bank and UNDP; United Nations Development Programme; Global Project GLO/78/006.; TAG/Ta/01; Page 7/1. This Mission took place between November 19 and December 1, 1978.

37) See Wright (1981). op.cit. for project description.

12. PRIORITY CRITERIA FOR WATER SUPPLY IMPLEMENTATION

12.1 Main principles for establishing priorities

Easy access to sufficient and clean water for domestic use is a social good in itself. It is correctly treated as such in Tanzanian policies for socio-economic development in general and for the rural water sector in particular. And similarly it ranks high among village and family problems as perceived by villagers in Iringa, Mbeya and Ruvuma Regions.

Of course additional benefits may be derived from improvement of water supply. Time savings in water collection and better health conditions may result in increased production in the villages. Or experiences with common action in relation to water could lead to generally improved community organization. However, these are indirect and uncertain benefits, which are often more dependent on the general circumstances and on development efforts in other sectors.

Provision of domestic water supply for the entire rural population is therefore an immediate objective in itself of Tanzanian rural development policies. The service level aimed at at this stage (distance, quantity, quality) has been established in general politically, and is discussed in detail elsewhere in this Water Master Plan.

10 years is the period within which we are planning to achieve this aim. Even if, realistically, it takes somewhat longer, it will still be within a relatively limited period of time. Planning, therefore, does not involve a choice of areas to be provided with water and others that will not be supplied. It is only a matter of timing. Where do we start and which areas must wait until a later part of the plan period ?

With this perspective firmly established, it is still important to have guidelines for the sequence in which all areas and villages will get improved water supply. That is guidelines, that are acceptable to those directly concerned, i.e. the people in the villages, government staff, and political leaders, as being consistent and just in relation to the principal objective of giving everybody easy access to sufficient and clean water for domestic use.

The basic principles used here for establishing such guidelines for the Iringa, Mbeya and Ruvuma Water Master Plans are as follows:-

(a) The selected priority criteria must reflect Tanzanian policies for socio-economic development in general and for the rural water sector in particular.

(b) The proposed criteria must reflect the villagers' own preferences. If they do not, villagers cannot be expected to participate in improving their own water situation.

(c) Priority criteria cannot be selected independently of existing or anticipated resource and technical constraints, without either resulting in unrealistic demands on funds, equipment and personnel or in underutilization of existing capacities.

(d) The criteria must be operationalized in accordance with available and easily revisable data, which are understandable for villagers and government field personnel. And they should be applied through a procedure which is also easily comprehended by everybody involved, and allows for revisions.

(e) Finally, it should be clear, that the resulting priority list of areas and villages for provision of water supply or improvement of existing water schemes, constitutes only the sequence according to which this will be offered to the villagers. Whether or not this leads to actual implementation of a certain project then depends on the villagers' willingness to accept the corresponding obligations (see Chapter 6).

12.2 Priority criteria proposed in other Water Master Plans

The same principles as mentioned above have not always been followed in other Water Master Plans available to us. The proposed priority criteria therefore vary from region to region. Some of the proposed sub-criteria do not even seem relevant for selecting drinking water supplies.

One or more of the following three main types of criteria can be found in other Water Master Plans; namely those relating to "need","development potential" and "costs". Table 12.1 shows the relative importance of these three criteria types in selected Water Master Plans.

The procedures through which the criteria are applied also vary a lot, and are not always equally comprehensible nor easily revisable. The main methods used are:-

a) Differentiation between priority groups of villages (e.g. 1st - 4th priority) through a step by step procedure, each step applying one criteria overruling the following;

b) Priority ranking of all villages through simultaneous application of all criteria, but with different weights to each of them.

c) Some combination of a) and b).

Water Master Plan	Importance given to		
	A. "need"	B. "development potential"	C. "costs"
Shinyanga	Next most important	Most important but not in implementation	Not considered
Morogoro	Most important	Not considered	Not considered
Rukwa - Kigoma	Overruling B and C	Important	Important
Coast/Dar es Salaam	Least important	Overruling A	Overruling A and B
Mara, Mwanza, W.lake	Overruling B and C	Not considered	Important

Table 12.1 Importance given to "need"; "development potential"; and "costs" in other Water Master Plans.

12.3 Proposed priority criteria for Iringa, Mbeya, Ruvuma Water Master Plan

12.3.1 Need

After discussion with other parties involved in the Water Master Plan exercise it is proposed that need factors will be the most important priority criteria in the Iringa, Mbeya and Ruvuma Water Master Plans.

This choice seems not only in accordance with Tanzanian political principles of equality and provision for basic needs, but also with the general views of the people in the regions. It furthermore incorporates development aspects (see below) as well as peoples expected willingness to participate and contribute to construction, operation, and maintenance of a water supply (see chapter 6). The need criteria as used here will include three factors, any one of which indicates a high degree of need for provision or improvement of water supply.

Severe health risk connected with present water source(s)

Areas or villages with indications of a high health risk related to water are regarded as having great need and should be given high priority for provision/improvement of water supply.

Low capacity of present water source(s)

Areas or villages where the presently used water source(s) frequently dries out in dry seasons, or where the amount of water that can be collected per capita goes down to less than the present mean consumption figure in the three regions (see chapter 8) are regarded as having great need and should be given priority for provision/improvement of water supply.

Low accessibility of present water source(s)

Areas or villages where the presently used water source(s) are far away from most of the villagers or where a steep gradient has to be climbed between the source and the village are regarded as having great need and should be given high priority for provision/improvement of water supply.

12.3.2 Development potential

"Development potential" has been very carefully considered as a possible priority criterion. The conclusion is, that we do not propose an independent "development potential" criterion for rural domestic water supply.

Urban areas, the needs of existing or planned industries, and plans for irrigation on a wider scale, must be considered separately, and are thus not included in the present discussion.

There is no evidence that provision of rural domestic water supply in itself is a spur or incentive for accelerated development. It is obvious, on the other hand, that anywhere where there is a great need, as defined above, this may be a barrier to further development, by tapping peoples strength, demanding much of their time, and discouraging possible immigration of people from overpopulated areas. As such, "development potential" is already included in the need criteria above.

Using a separate "development potential" criterion conventionally often favours already more developed areas, whereas there seems actually no reason to believe that provision of water supply in such areas would have greater derived effects in terms e.g. of production, unless they already qualified for high priority through the need criteria.

"Development potential" could also be seen as a way to cater for areas where plans are afoot for especially accelerated development in other sectors, e.g. agriculture, and where it might be conceived that water should be integrated in such plans. However, unless water is or becomes a need accord-

ing to the above criteria, it is not clear why such areas should be further favoured ahead of more needy areas. We may expect that through population increase a NEED will eventually develop, which is the time to move the area into the high priority category. But with limited resources it would seem unjustified presently to place greater significance on a projected (but unsecure) future need, than on the plight of health risks, scarcity of water, and long distances already existing in many villages in less fortunate areas.

Finally it should be noted, though perhaps less important than the above considerations, that "development potential" is not a well or easily defined concept, not to mention the difficulties it would raise to try to operationalize it into easily applicable criteria, which should also be comprehensible and acceptable to government field personnel and the people in the region.

12.3.3 Cost criteria

To serve most people at least costs has also been used as an important general priority criterion for provision of water supply.

Such a criterion does in most instances, however, in our view go directly contrary to the need criteria outlined above, and thus to some of the basic principles of Tanzanian policies. A general cost criterion will almost inevitably, irrespective of needs, favour the more densely populated areas, which in these parts of the world are generally better endowed with water (as well, for that matter, as with all other social amenities), to the disadvantage of the drier, less populated parts of the regions, where water has to be carried over longer distances. The latter are also the areas where the development aspect is inherent in the need criteria, since a high NEED in respect to water may well become a barrier to the realization of their potential for attracting the surplus population from the densely populated areas.

We do, therefore, advise strongly against the inclusion of costs as a general criterion for selection of high priority villages for provision/improvement of water supply.

There may, however, once the high priority villages have been selected on the basis of need, be some of them, where scheme costs are so exceedingly high that implementation would preemt resources available to serve other

high priority villages with water. It is proposed therefore that an exceedingly high cost factor per capita of projected population is used to designate schemes, which are otherwise included in the high priority list based on need, for postponement until cheaper technical solutions have been found or other priority villages have already been served.

This would also include villages where the lack of roads and other infrastructure would indirectly increase the costs of providing water to unacceptable levels. Once this barrier is removed they would automatically move back into high priority for implementation.

12.3.4 Operation and maintenance criteria

Already a number of water schemes are not functioning due to operation and maintenance problems, which are especially attached to certain technical solutions, primarily mechanically powered pumped schemes.

With vastly accelerated implementation of water schemes, it is stipulated that the villages themselves must take over from Maji more of the operation and maintenance responsibilities; which may further increase the problems connected with complicated techniques and supply of fuel.

This has already been taken into account in the proposed scheme types, where such technical solutions have been avoided as far as possible.

There are, however, places where no other alternative has yet been found.

In order to prevent a waste of resources for schemes which can be expected to be out of order for extended periods anyway due to operation and maintenance problems, it is proposed that implementation in high priority villages in this category is postponed, similarly to the proposal above for high cost schemes. These villages should only be moved back into the priority list for implementation when other technical solutions have been found, or when a satisfactory operation and maintenance system has been proved to exist.

In high priority villages, where scheme implementation has been postponed due to either the cost factor or operation and maintenance problems, extra efforts should meanwhile be vested in any possible improvements of the traditional sources, preventive health measures including sanitation and health education, and a search for alternative methods of supplying water.

12.3.5 Summary of proposed priority criteria

NEED

In summary (illustrated in figure 12.1) it has been proposed above, that need be the only criteria used for selection of villages with high priority for provision/improvement of water supply.

NEED factors

NEED should be seen as including three factors:-

- High health risks connected with present water sources(s)
- Low capacity of present water source(s)
- Low accessibility of present source(s),

each one of which is in itself sufficient to indicate a high need.

Costs and operation and maintenance problems

Villages with a high need, but also exceedingly high implementation costs per capita of projected population, or forseeable operation and maintenance problems, will maintain a high priority, but actual implementation must await alternative technical solutions or finalization of implementation of other high priority schemes.

12.4 The operationalized priority criteria

In order that the priority criteria can be used in a selection procedure, as well as in later revisions, they must be operationalized in a way that is unambiguous, easily comprehensible for villages and government field staff, and fitting with the information collected in the Water Master Plan village inventory.

12.4.1 High health risks connected with present water source(s)

With water related diseases prevalent almost everywhere, and the weak diagnostic capacities at local levels, the actual disease situation is not a very reliable measurement of different health risks in different areas and villages. Instead we propose that each one of the following factors is by itself taken as an indicator of a high health risk.

Recent epidemic outbreaks

There has in recent years been several, and in certain places recurrent, outbreaks of especially cholera, causing a large number of deaths, in the three regions. Being a major threat to health we therefore propose that any outbreak of cholera or typhoid epidemics within the last three years is regarded as an indicator of high health risk.

The Water Master Plan village inventory questions 7.2 and 7.3 (variables v 702 and 703 in the computer file) contain information on outbreaks of cholera and typhoid in 1978 - 1980.

NEED	Priority	Implementation problems	Implementation schedule
HIGH NEED:			
Severe health risk with present water source(s)	HIGH PRIORITY	Average or less costs and o + m problems	Candidate villages for early implementation x)
Low capacity of present water source(s)		Exceedingly high costs or o + m problems	Implementation postponed until problems are solved
Low accessibility of present water source(s)			
LESS NEED:			
Average or less health risk	LOWER PRIORITY (possibility of appeal by village in case of faulty information etc.)		
Average or higher capacity			
Average or easier accessibility			

x) These are the villages that should move on to the procedure for selection of villages for participatory implementation, see figure 6.2, chapter 6.

Figure 12.1 Summary of proposed priority criteria for providing villages with new or improved water scheme.

Large concentrated population

Large concentrated populations have a higher health risk in two senses. First the concentration of people gives larger hygienic and sanitary problems, and secondly any health problem related to contamination of water and hygiene etc. is a threat to a large absolute number of people.

On account of assumed health risks,villages with 500 or more households in the main populated area should therefore qualify for high priority for provision/improvement of water supply, unless they already have one, which functions at least 10 months per year and is used by at least 70 % of population in main area.

The appropriate information is found in village inventory questions 2.4, 4.3 and 4.17 (variables v204, v4031 and v417).

Health risk with existing water source(s)

Certain combinations of settlement pattern, source type, and water quality prevailing in general in an area, entail greater health risks than others. The detailed compilation of this indicator of high need will be incorporated by the Water Master Plan consultants from their village inventory, village sketches and water quality tests.

12.4.2 Low capacity of present water source(s)

Minimum capacity below 15 litres per capita per day

If the water that can be collected from the source(s) presently used by a village has a minimum of less than the 15 litres/capita/day, that is approximately the present estimated mean consumption figure, the village has a high need and priority.

Information from village inventory questions 4.25 and 5.19 (variables v425, v5191 - 4).

Water source(s) dry up

In some areas the minimum capacity may have been estimated for an average year, or may not have been estimated at all, due to practical problems.

It is proposed therefore to use the risk that the source(s) used dry up as another indicator of low capacity. In this respect any village where both

the water scheme (if any) and/or the two most used traditional sources run the risk of drying up once or more in 5 years - should qualify as a high need and priority village.

Information from village inventory questions 4.5, 4.6, and 6.11 (v406, v5111 and v5112).

12.4.3 Low accessibility of present water source(s)

These criteria distinguish between:

(a) villages with a water scheme which functions at least 8 months per year and is used by at least half of the villagers (41 - 100 %) and

(b) all other villages, i.e. villages with no water scheme, villages where an existing scheme is out of use 5 or more months per year, and villages where less than half the population (0 - 40 %) use the scheme.

Long distance to water source(s)

(a) villages with existing water scheme, which functions at least 8 months and is used by at least half of the villagers have low accessibility to water source if 2/3 or more (61 - 100 %) of the people in the main area live more than 400 m from a domestic point. Such villages are proposed as high need and priority villages for improvement of water scheme.

Information from village inventory questions 4.3, 4.15 and 4.18 (v 4031, v 415, v 418)

(b) villages with no water scheme, villages where an existing scheme is out of use 5 or more months per year, and villages where less than half the population (0 - 40%) use the scheme. Such villages should be regarded as having low accessibility if half the people or more (41-100 %) live more than 1 km from their water source.

Information from village inventory questions 4.3, 4.15, 5.15, and 5.16 (v 4031, v 415, v 515, v 516).

Steep gradient source to village

(a) This criterion is not used for villages with existing water scheme which functions at least 8 months per year and is used by at least half the villagers.

(b) Villages with no water scheme, villages where an existing scheme is out of use 5 or more months per year, and villages where less than half the population (0 - 40%) use the scheme, have low accessibility and high priority if the altitude difference between village and one of the most used traditional sources is more than 100 m. (v5171 - 74).

12.5 Operationalization of costs and technical operation and maintenance problems as criteria for postponed implementation in high priority villages

Costs and operation and maintenance problems were not suggested above as priority criteria as such, but as factors which could designate high priority villages for postponed implementation until such problems are solved.

12.5.1 High costs

It is therefore suggested that implementation of schemes should be postponed if their per capita scheme costs for projected population (year 2006) are more than twice as high as the mean per capita scheme costs of all high priority villages.

In this calculation necessary costs of overcoming infrastructural barriers to implementation, e.g. lack of access roads, should ideally be included, but with the present information available this is not possible.
This factor will be calculated by the Water Master Plan consultants.

12.5.2 Operation and maintenance problems

Due to foreseeable operation and maintenance problems no schemes based on non-manually powered pumps (e.g. diesel pumps, solar energy pumps, windmill pumps) should be implemented at present, except on an experimental basis.

Information from village inventory question 10.3 (V10032).

12.6 Procedure for applying the priority criteria

12.6.1 Main features

The procedure proposed below for applying the priority criteria has been made as functional as possible, in the sense that it should at the same time

- provide the necessary guidelines for short to medium-term implementation planning;
- be comprehensible for planners, implementers and the people in the regions;

- make revisions relatively uncomplicated;
- clearly demonstrate the political choices involved.

In order to achieve this we suggest a procedure that:

(a) leads to a bisectional categorization of high priority and lower priority villages, but not a complete ranking of all villages against each other, and

(b) makes any one of the separate priority criteria mentioned above a necessary and sufficient condition for inclusion of a certain village in the high priority category.

12.6.2 High priority and lower priority villages

The proposed procedure distinguishes only between a smaller category (about ... of the villages in the three regions taken together) of high priority villages and a larger category with lower priority. The high priority category thus includes those villages which should be covered by short and medium-term implementation planning, i.e. the first 3 - 4 years of implementing the Water Master Plan.

It thus avoids the appearance of refinement, which a full priority ranking has, but which can usually not be justified by the unescapable weakness of the available data base. Furthermore it does not appear to give a promise of a definite implementation sequence, which for practical reasons may not be kept. On the contrary it has a flexibility which allows for practical considerations such as the possible benefits of concentrating implementation in one area at the time etc.

Finally it makes it easy for villagers to know and understand whether they belong to the high priority group that will be offered a water supply within the next 3 - 4 years or not, why this is so, and the appeal possibilities they have (see below).

12.6.3 Separately qualifying priority criteria

The proposed priority criteria are defined so that each single one of them in itself can indicate a high degree of need, independently of the "score" of a certain village on all the others.

This means that such an indication of high need on any one of the proposed criteria automatically should qualify the village concerned for high priority for provision/improvement of water supply.

Such a system has the immediate advantage over the potential alternative, a system which would rank villages according to a weighted sum of scores on all the different criteria, that it is much easier to understand and operate, even for the villagers themselves.

Of course both systems involve some arbitrary, or perhaps rather political, decisions on the delineation for each criteria of which values indicate a higher, and which a lower need. But at least the procedure proposed here avoids the much more obscure attachment of different comparable weights to uncomparable need factors. An exercise which gives an impression of technical exactness, which it does not have at all.

We further escape the problem that several criteria are often highly correlated, so that a high score on one is simply a function of a high score on another.

The procedure proposed thus points clearly to where the general political decisions lie, i.e. deciding how much NEED on each criteria should be sufficient to qualify for high priority, leaving the subsequent application of these decisions as a relatively easy operation, which can in clear terms be explained to the villages.

12.6.4 Revisions of the priority list

The proposed procedure also allows easy revisions without total reshuffling of the priority list. This can take on two forms.

One can occur when new information or new developments leads to indication of high need on one of the criteria for a village which was before given lower priority. Without affecting the remaining list, such a village can then be moved to the high priority category.

The other should occur when implementation is beginning to empty the high priority category. Then lower qualifying values should be decided upon for each priority criterion, and a new batch of villages would get high priority.

12.6.5 Schematic presentation of the procedure for applying the priority criteria

The attached fig. 12.2 gives a schematic presentation of the logic procedure each village has to run through in a form which can be applied both manually

to the village inventory forms (possible revised with new information) as well as on the computerized village inventory.

12.7 Village participation

Village participation is discussed elsewhere in this volume (chapter 6), so here it suffices to note where it affects and is affected by the procedure establishing priorities for provision of water supply.

In chapter 6 it was suggested that no steps to start implementation of a water scheme should be taken before a village had formally requested this, and that actual construction work should only start when the village(s) involved had accepted the accompanying obligations on its (their) side, i.e. contributions to construction and some responsibility for operation and maintenance.

Once the priority selection of villages to be offered water supply (improvement) during the first 3-4 years of the water master plan has taken place, all these villages should therefore be informed accordingly, including information on the needed request for water supply from the village, and on its subsequently needed acceptance of the obligations attached.

Villages which have not been included in the priority list will still be able to request provision of water supply. Upon receipt of such a request, the village concerned must be clearly informed why it is not considered among the highest priority villages, and also be given a chance to contest this decision, either on the plea that the original information was deficient (nobody, not even the Water Master Plan team, is infallable) or that circumstances have changed, so that updating the information will make the village qualify for high priority.

In this way there will be a built-in dynamic in the information base for priority selection, with the advantage that it depends primarily on those directly interested, i.e. the villages, and not on some more or less insecure and distant overall revision of the whole village inventory exercise, instituted from above when and if resources so permit. Similarly it provides an easy and regular entrance for newly established villages into the system.

The principal and indispensable condition for this system to function smoothly is, however, that the villages, as well as government and party field personnel, are fully informed about the rights and duties of villages in relation to provision/improvement of water supply.

It is proposed therefore, that as part of the very first phase of the Water Master Plan implementation, a leaflet in Kiswahili is distributed in the regions, explaining the priority selection procedures, including appeal possibilities, as well as the subsequent rights and duties of the villages in relation to implementation and operation and maintenance.

12.8 Implementation sequence among high priority villages

The priority selection procedure proposed here does not provide a definite sequence for implementation among the high priority villages.

Being deliberately flexible in this respect, it has the advantage that it allows technical and practical considerations to enter into the implementation planning for high priority villages.

It was mentioned earlier (12.3.3, 12.3.4. and 12.5) that exceedingly high costs or operation and maintenance problems related to proposed scheme type should designate otherwise high priority villages for postponed implementation.

Furthermore it may be generally preferable to concentrate implementation to one or a few parts of the region at a time, starting of course in those parts that have a high concentration of high priority villages. Where group schemes are proposed, this is an obvious necessity, which may even include provision of water to a few lower priority villages in addition to several villages with high priority. Such cases should however, at least in the beginning, be kept to a minimum, since it would endanger the credibility of the whole system if too many low priority villages are provided with water supply before some of those with high priority.

12.9 Relevance of the priority selection system for inter-regional comparisons

By classifying all villages in each region into high priority or lower priority categories according to the same objective criteria, the system proposed makes it possible to draw direct comparisons between the NEED levels of different regions, by comparing the proportions of high priority village. This could be done immediately for the three regions, Iringa, Mbeya, Ruvuma, included in the present Water Master Plan study, but could in principle be extended to other regions as well. It is of course a political decision whether the relative NEED levels of different regions should have an impact on the distribution between regions of resources allocated for water development. But if such a decision is made, we suggest that the priority

system proposed here could, if necessary with some adjustments, be an appropriate tool for the application of a NEED based differentiated allocation of resources to regions.

12.10 Summary

12.10.1 NEED as principal priority criteria

A priority system based on NEED as the principal criteria for selection of villages with high priority for provision/improvement of water supply has been suggested.

12.10.2 Operationalized NEED criteria

NEED has been dissolved into a number of operational single factor criteria related to

- high health risks connected with present water source(s)
- low capacity of present water source(s)
- low accessibility of present water source(s).

12.10.3 Exceedingly high costs or operation and maintenance problems

Exceedingly high costs or foreseeable operation and maintenance problems related to a proposed scheme will not influence the priority ranking as such, but will designate the involved villages for postponed implementation until the said problems have been solved.

12.10.4 High priority and low priority categorization only

The proposed procedure for application of the priority criteria simply leads to a categorization of villages into those with high priority and those with low priority, respectively, for provision/improvement of water supply. The high priority villages should be included in implementation planning for the first 3 - 4 years of the Water Master Plan.

12.10.5 Separately qualifying criteria

The operationalized criteria have been defined so that any single one of them separately should be a necessary and sufficient condition to indicate high NEED and thus for inclusion of a village among the high priority categories.

12.10.6 Revisions of priority list

The system proposed allows for revisions of the priority list in two ways:

(a) the information for individual villages may be revised, leading to possible recategorization of the village(s) concerned;

(b) the values of the priority criteria leading to high priority may be generally lowered, resulting in removal of a number of villages from the low to the high priority category.

12.10.7 Village participation

- high priority should not lead to immediate implementation, unless the participatory conditions are met by the village(s) concerned (see chapter 6)
- a procedure should be introduced, and sufficient information disseminated accordingly, whereby the village as the directly interested party, can and will be the initiator of priority revisions as mentioned above under (12.10.6 (a)).

12.10.8 Implementation sequence for high priority villages

The precise sequence of implementation among high priority villages to be carried out over the first 3 - 4 years of Water Master Plan implementation should be based on technical and practical considerations such as e.g. the above mentioned postponement for villages with exceedingly high costs or expected operation and maintenance costs, or an advantageous concentration of implementation to one or a few part(s) of the region at a time.

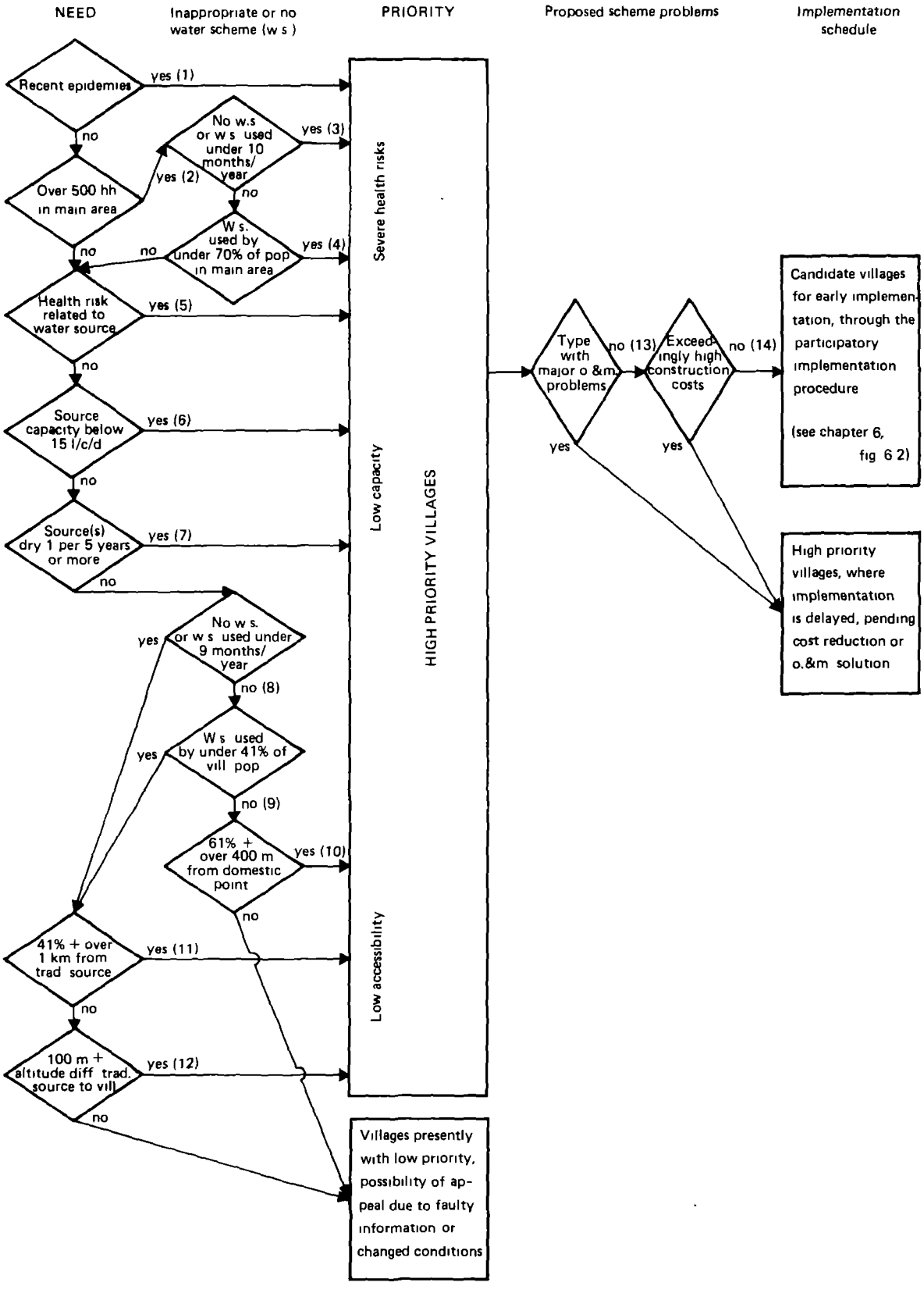


Figure 12 2 Algorithmic system for applying priority criteria for provision or improvement of waterscheme to villages

Village inventory information for algorithmic system; variables and values to be used

(1) V703 $\leq$ 2

(2) V204 $\geq$ 500

(3) V4031 $>$ 2

(4) V417 $<$ 9

(5) To be compiled by CCKK

(6) $\frac{\text{V425} + \text{V5191/3} + \text{V5192/4} \times 86400}{\text{V2015}} < 15.$

Use whichever is lower of V5191 or V5193 and of V5192 or V5193. Exclude V425 = 99 and 5191/3 and 2/4 = 9999.9 from calculation. If V2015 = 9998 use V 2011.

(7) $0 <$ V406 < 6 or V406 = 9; and $0 <$ V5111 < 6 or V5111 = 9; and $0 <$ V5112 < 6 or V5112 = 9.

(8) V4031 $<$ 4

(9) V415 $>$ 1

(10) V418 $>$ 2

(11) V515 + V516 $>$ 1

(12) V5171 = 2 and V5172 $\geq$ 2 and V5173 $\geq$ 100 and V5174 $\geq$ 100

(13) V10032 $\neq$ 02,04,05,06

(14) $\frac{\text{Cost per capita of projected pop. for proposed scheme}}{\text{Mean cost per crop of projected pop. for all high priority villages}} \leq 2$

APPENDIX: METHODOLOGY

1. Introduction

Four primary sources of information have been used in this report:

- Village inventory
- Household surveys
- In-depth studies
- Wang'ing'ombe survey.

2. The village inventory

The village inventory was carried out by the Water Master Plan consultants. A questionnaire that was formulated in cooperation with the socio-economic group was used for the data collection[1)].

The consultants have not - at the time of finalizing most of this volume (January 1981) completed the computer processing of the village inventory data file. Only the results of a few preliminary computer runs are therefore included in the analyses. Some more of the relevant data are, however, presented in the data sheets in chapter 2.

3. The household surveys and in-depth studies

These two sources of information have been extensively discussed previously with respect to aims, selection procedures, organization of interviews etc.[2)] Only a few basic information will therefore be given here.

The household surveys and in-dept studies were conducted from September 1980 to February 1981 in Iringa and Mbeya Regions. In Ruvuma Region the activities were carried out from May 1981 to October 1981.

Appendix tables 1, 2 and 3 list the villages included in the surveys and in-dept studies in the three regions. Selection of the 55 villages was <u>not</u> random[3)]. The proportion of villages in the sample having a water scheme is higher than among all villages in the regions. Furthermore, only villages with a scheme in operating conditions were selected - although this was not possible in one zone in Ruvuma Region (see Appendix table 3).

All information collected through the household surveys have been coded and stored on computer tapes. Information on the organization of data files is available on request.

The SPSS (statistical package for the social sciences) programme has been used throughout for the statistical analyses. Print-outs of the programmes used are available on request. Only non-parametrical tests have been used for the analyses of the household data (chi-square; Fisher's exact probability test; the Kruskal-Wallis one-way analysis of variance; and Pearson's rank correlation coefficient). Thus no assumptions of normality have been made.

4. The Wang'ing'ombe survey

A description of this survey - including the questionnaire - can be found elsewhere[4]. In principle the methodology used was similar to the one used in the household surveys.

The survey was carried out in four villages (see chapter 11) in March and April 1980 and included 230 households.

All data analyses were done by hand. Only the chi-square test was used.

Agro-ecological zone	Village	Registration number	Total population persons	Year	Water scheme	Most used source	In-depth studies
High rainlands	Matamba	077	1154	1980	Gravity	Tap	+
	Kinyika	197	1538	1980	No	Stream	
	Mbela	330	1660	1980	No	Dug hole	
Upper plateau	Lugarawa	108	5705	1979	Gravity	Stream	
	Mlangali (Itundu)	083	2709	1978	Gravity	Ditch	
	Kiyombo	105	2156	1978	No	Stream	
	Mawala	092	1454	1980	No	Spring	
	Milo	084	1276	1980	No	Spring	
	Shaurimoyo	484	812	1979	No	Stream	+
The medium dry zone	Kiponzelo	162	2390	1980	Pumped	Tap	+
	Nyambula	255	2823	1980	Gravity	Tap	
	Kitayawa	256	2052	1979	No	Dug hole	
	Ndiwili	254	2051	1979	No	Dug hole	
	Tanangozi	251	5863	1980	No	Stream	
	Wenda	516	1566	1978	No	Stream	
The dry northern fringe	Igula	037	1277	1979	Gravity	Tap	+
	Kihorogotha	010	1425	1980	Gravity	Tap	
	Iguluba	490	837	1978	No	Stream/tap x)	
	Mkulula	231	1266	1979	No	Dug hole	
	Nyakawangala	515	780	1978	No	Stream/dug hole x)	
	Usolanga	230	1372	1978	No	Stream/dug hole x)	

x) Wet season/dry season

Appendix table 1. Surveyed villages in Iringa Region.

Agro-ecological zone	Village	Registration number	Total population persons	year	Water scheme	Most used source	In-depth studies
Wet highlands	Ikama	252	1974	1980	Gravity	Tap	+
	Katela	364	1056	1980	Gravity	Tap-spring	
	Ijoka	239	2787	1978	No	Dug hole	
	Ilamba	361	1332	1980	No	Dug hole	
	Kasyabone	367	1232	1980	No	Stream	
	Kitali	251	1677	1980	No	Stream	
Lake shore	Kateela	193	1437	1980	Gravity	Tap	
	Lema	183	1574	1978	Pumped	Tap	
	Kasala	198	1498	1978	No	Spring	
	Kikusya	182	1292	1978	No	Stream	
	Matema	203	2423	1980	No	Stream	
	Ngamanga	226	1279	1978	No	Stream	+
Dry plain	Rujewa	075	1145 ?	1980	Pumped	Tap	
	Utengule	535	2266	1980	Gravity	Stream/tap[x)]	
	Isunula	149	1782	1978	No	Stream	
	Luhanga	536	965	1978	No	Stream	
	Mapogoro	077	3376	1978	No	Stream	+
	Mporo	115	1170	1980	No	Stream	+
Dry northern zone	Mwambani	011	2180	1980	Gravity	Spring	+
	New Mbangala	516	800	1980	Pumped	Tap	
	Saza	-	657	1980	No	Well (lined)	

x) Wet season/dry season

Appendix table 2. Surveyed villages in Mbeya Region.

Agro-ecological zone	Village	Registration number	Total population[x] persons year	Water scheme	Most used source	In-dept studies
Wet western highland	Utiri	237		Gravity	Tap	
	Litembo	193		No	Dug hole	
	Mpapa	209		No	Dug hole	
Intermediate zone	Namabengo	074		Gravity	Tap	
	Ngwinde	100		No	Dug hole	
	Njalamatata	097		No	Dug hole	+
Dry eastern zone	Kidodoma	037		Pumped[xx]	Dug hole	+
	Legezamwendo	255		No	Spring	
	Mkwajuni	311		No	Dug hole	
	Namasakata	020		Pumped[xx]	Stream	
	Mkasale	310		No	Dug hole	

x) Not available at time of writing.

xx) Unoperational at time of survey, because of lack of fuel.

Appendix table 3. Surveyed villages in Ruvuma Region.

Notes

1) The questionnaire is printed in socio-economic study (Q.R.1). Quarterly Report No. 1, August 1980. BRALUP/CDR Socio-Economic Water Master Plan study; Iringa, Mbeya, Ruvuma.

2) See socio-economic study, Q.R.1. op.cit. for description of methodology. The questionnaire itself and the codebook is presented in socio-economic study, Q.R. 2. Quarterly Report No. 2, November 1980. BRALUP/CDR socio-economic Water Master Plan study; Iringa, Mbeya, Ruvuma.

3) Socio-economic study, Q.R.1. op.cit.

4) Wright, A.M. "A report of a ninth mission to United Republic of Tanzania", February 14 to March 1, 1981; United Nations Development Programme; global project GLO/78/006. The Development of Low Cost Sanitation in Tanzania. TAG/Ta/11.