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Research report no. 85

Per Lindskog
Jan Lundqvist

Why Poor Children Stay Sick

The Human Ecology of Child Health and
Welfare in Rural Malawi



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Foreword

This report is one of a series of papers, which account for the results of a research project that was carried out in Malawi between 1982 and 1985.

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Per Lindskog and Jan Lundqvist

I do not know
the white man's name for diseases,
I do not know
the names of their medicines,
I cannot measure
the heat of the body
with the white man's glass rod
because my hand trembles
and I cannot read it.

When my child is unwell
I see it from his watery nose,
the hair of his body stands up
and his lips are parched,
I see that he is not bright,
I do not read the name of diseases
from books,
I hear him cry
and his eyes water,
I hear the noise from his stomach
the worms complaining;

He is pale
as if he has been playing in ashes,
you hear his chest crackling,
he has no appetite,
and he is aggressive but tired and weak;
he is troublesome,
he wants this thing and that thing,
then he does not want this thing
and does not want that thing.

p'Bitek: Song of Lawino

1. Decades of Efforts to Improve the Drinking Water Situation

Efforts to supply safe drinking water

Adequate supply of drinking water of appropriate quality within easy reach is vital for all development efforts. For an overwhelming majority of the population in the developing countries, this basic precondition for development and human dignity is far from satisfied. Apart from the tedious and time-consuming work connected with drawing water from sources far away, the situation is characterized by human sufferings in terms of poor health. Although there are numerous diseases which are water-related, diarrhoeal diseases are the most serious, which to a large extent can be reduced by improved household water supply. It is estimated that children under five years of age in Africa, Asia (excluding China) and Latin America suffer from 740 million diarrhoeal illnesses per year and that four and a half million children under five years of age die every year in diarrhoeal diseases alone (Snyder & Merson, 1982).

The water consumption varies enormously in different parts of the world depending upon climate, cultural and social habits etc. Regarding the quantities of water consumed at home, White, Bradley and White (1972) found that it may vary from 3-4 litres *per capita* and day in areas with extremely arid conditions to 600 litres *per capita* and day in some industrialized countries. In general, we know that people in rural areas of tropical developing countries, who do not have water within the compound, mostly consume around 10 to 20 litres *per capita* and day at home. The water consumption will increase dramatically when water is connected within the compound. The effects of such an increase are likely to be dramatic. In addition to the water carried and consumed at home, people in developing countries often use considerable amounts of water at the water source for washing clothes, bathing, cleaning utensils etc.

During the last decades there have been repeated attempts to narrow the gap between the population being served with improved water and those unserved. In 1972 the World Health Assembly set the aim that by 1980 25 % of all people in rural areas of developing countries (excluding China) should have "reasonable access to safe water" (WHO, 1973). 160 million rural people were served with safe water in 1970 (Table 1.1). The areas which had the lowest proportion of rural population served with safe water, were South-East Asia and Africa with 91 % or 662 million and 89 % or 136 million people not served respectively. This figure had increased to 472 million in 1980, which meant that 31.7 % of the rural population in developing countries had reasonable access to safe water, thus well above the target.

Table 1.1 *Rural population served and unserved with water supply in developing countries (excluding China) in 1970, 1980 and 1985 (millions).*

Year	No of people served	No of people unserved	Total	% served
1970	160	1 050	1 210	13.2
1980	472	1 018	1 490	31.7
1985	581	1 029	1 610	36.1

Source: WHO (1986)

Water supply development became an even higher priority for the international community in the 1980's. In November 1980, the United Nations General Assembly declared the 1980's as the International Drinking Water and Sanitation Decade (in the following abbreviated as the IDWS decade). A target was set that by 1990 all (i.e. 100 % !) inhabitants of the world, including all people in rural areas, should have "reasonable access to safe water", i.e. the target expressed in quantitative terms. By safe-guarding access to water, it was anticipated that significant improvements in health and social conditions would follow, i.e. a qualitative improvement in living conditions. This goal is part of the wider United Nations strategy to secure "health for all by the year 2000".

Even though this ambitious task will not be reached except for a few countries (IBRD, 1988), it has certainly increased the pace in the provision of improved methods of water supply. In addition, it has increased the awareness of the seriousness of the situation for a majority of the world population. Despite these commendable efforts, the rate of increase in providing safe water seems to have slowed down.

In 1985 a total of 581 millions or 36.1 % were served according to official figures. At the same time the number of people left unserved was not reduced but roughly at the same level (Table 1.1). The relatively rapid increase in the number of rural people served between 1970 and 1985, both in absolute figures and in percentage, was thus not enough to reduce the number of people who were unserved.

The problems related to the poor water situation are obviously massive, especially in the rural areas, where a majority of the Third World population live. When examining this development, it should also be kept in mind that there are uncertainties in calculating the number of people being served by water. In areas, where there have not been reasonably accurate population estimates or where proper surveying and mapping never have been performed, reliable estimates of the number of inhabitants who have "reasonable access" to "safe water" are impossible to attain. Further, the definition of "reasonable access" as a situation where "the housewife or members of the

household do not have to spend a disproportionate part of the day fetching the family's water needs" leaves open what is a "disproportionate part of the day" and what is "the family's water needs".

Difficultly defined impact of improved water supply

In spite of the numerous evaluation studies and observations, the impact of improved methods of water supply upon health is not univocal (Esrey *et al.* 1985). The expectation of such an impact appears to be based on a failure to comprehend the multitude of problems which beset poor people in Third World countries (Feachem, 1980b). Poverty means lack of resources and also that the capacity among individuals to change their behaviour is limited. It is therefore not surprising that an improved method of water supply in itself will not have a significant health impact. In the absence of such an impact, it is essential to study how the resource situation and the knowledge and motivation of people will affect the water use and handling pattern in order to be able to ensure that the gap between the aims of water programmes and their actual impact is minimized. However, the problem is also one of documentation. Since the impact can be assumed to be fairly small, if at all noticeable, and since changes in health situation may have other causes than improved methods of water supply, it is important to have a proper design of the evaluation studies.

Beyond the decade

As was pointed out above the goal of the IDWS decade will not be attained by the year 1990. However, the work of the decade will continue and the dedication to improve human conditions remains. Currently the strategy to improve the situation is based on a broader perspective. "The greatest uncertainty is in the deteriorating environment, caught in the cycle of overpopulation, deforestation, overgrazing, overcultivation, erosion, desiccation and desertification" (Beyer 1986, 153). In terms of water supply, there are a number of factors that are important for an evaluation of the extent to which the aims of the IDWS decade will be reached. The most important factors are:

- 1) the percentage of the population provided with, and actually utilized, safe water at the onset of the decade, as well as the population increase and redistribution.
- 2) the possibility to accelerate the provision of improved water supply and at the same time maintain a high degree of consumer participation, commitment and involvement in all stages of water projects from the original initiative and planning of the project to its operation and maintenance.

- 3) the knowledge and understanding of the population and their motivation to be involved in development programmes. There may be constraints among the beneficiaries in terms of cultural, economic and time resources, which hamper the practising of the knowledge with regard to water, sanitation and health.
- 4) the challenge to develop and choose technological solutions which are practical (light, easy to operate with regard to ergonomic requirements etc), functional (with regard to the intensive use and seasonal variations) and which are appropriate to local socio-economic conditions. It should be possible to repair the equipment locally, spare parts should be affordable etc.

Improvement of water supply may have many consequences, both positive and negative. The positive consequences expected are shorter distance to a good water supply and less time spent to draw water, as well as improved health and increased agricultural production. The negative consequences may be that there is an increasing pressure on the land around wells, that the river which some people used as their water source before is dried up by the project and that they only get a tap far away, resulting in much farther distances to walk.

Feachem (1977) identified the immediate aims as well as the long term potential benefits, which are anticipated as a result of water supply programmes and arranged them in a number of classes (Table 1.2). The additional inputs required to achieve these aims are included in the table. Governments and development agencies need to know and have a responsibility to find out whether and to what extent the aims put down in development programmes have been attained. It is important to identify the reasons for not attaining the goal. This is especially true for large world-wide programmes like the IDWS. It is therefore essential not only to monitor the performance of water projects but also to evaluate the impact of the projects in terms of health and social conditions.

In order to attain the aims mentioned above it is now widely recognized that it is necessary to achieve both an improvement of the quality of the water used as well as an increase in water quantity consumed by the population (Falkenmark, 1982). This requires that the water supply system functions properly, i.e. that it has a high reliability. It also has to be accessible to the users. In other words, the improved water source should be easier to reach and use than the old water source. If a scheme is not reliable and if alternative traditional sources are easy to reach and use, it is quite natural that the traditional sources are used. People are hardly left with any other choice than to use unprotected water sources at some time or another, even if they are aware of the risks and disadvantages.

With regard to consumed quantities, several evaluation studies of improved water supply systems have shown that the increase in the amount of

Table 1.2 Aims, potential benefits of water supply improvements and complementary inputs necessary for the achievement of the various aims (Feachem, 1977).

Aim or benefit	Complementary inputs or prerequisite conditions
<u>Immediate aims</u>	
Improve water: quality quantity availability reliability	Active community participation and support. Competent design. Adequate facilities for operation and maintenance.
<u>Stage 1 benefits</u>	
Save time	New supply used in preference to old.
Save energy	New supply closer to dwellings than old.
Improved health	Water use pattern changed to take advantage of improved quantity, availability and reliability. Hygiene changed to utilize improved supply. Other environmental health measures taken. Supply must not create health hazards (e.g. mosquito breeding sites).
<u>Stage II benefits</u>	
Labour release	Good advice and extension services must be provided by government personnel concerned with agriculture, animal husbandry, cooperatives, marketing, education, credit etc.
Crop innovation	
Crop improvement	
Animal husbandry innovation	
Animal husbandry improvement	
<u>Stage III benefits</u>	
Higher cash incomes	Water supply development must be just a single component of an integrated rural development programme which has the active support of the local community.
Increased and more reliable subsistence	
Improved health	
Increased leisure	

water use per capita has been rather small unless the water is brought very close to the homestead (McJunkin, 1982). A possible conclusion may be that the water supply system has to be brought within yards of the house in order to achieve a significant increase in water quantity consumed, a goal which is not even considered for the IDWS decade. However, even small absolute

increases in quantity consumed mean a big increase in relative terms. In combination with improved water handling and use, such changes may have an impact.

The importance of proper functioning and utilization

The functioning and utilization of a scheme will determine its service level. In general there is a peak in the demand for water in the morning and in the late afternoon. It is essential that water schemes are designed in such a manner that the demand can be matched with a proper supply, i.e. a high service level. With a rapid increase in the number of people served and in water consumption, there is a risk that the service level will be inadequate. As a result of a rather massive increase of water supply programmes in Indian cities between 1970 and 1975, it was for instance observed that the number of people having access to improved water supply had increased from 66 to 107 million or from 60 % to 80 % of the urban population. The number of people not served had been reduced from 44 to 27 millions. More important was, however, that the service level had been decreased. Before the programme, the service level in cities involved in the programme was about 8-10 hours/day, while after it was between 2-3 hours/day (UNESCO, 1981).

The example illustrates the importance of a design of water schemes, which will allow them to function and to be utilized at an appropriate service level. There is always a possibility that people use more than one source of water or that they use other sources than those which are "safe". Such a risk will increase significantly if the water supply is irregular, far away etc. The risk is particularly evident during the wet season when water which is often of inferior quality is readily available.

Studies of the performance of water schemes and evaluation of their impact are supposed to consider aspects such as those mentioned above. In Cairncross *et al.* (1980), an overview is given of principles of evaluation. An appropriate and very good manual for evaluations is provided by WHO (1983b). This manual identifies three stages, each of which has to be fulfilled before the succeeding stage. The first stage is to assess whether the project is functioning properly, i.e. has a sufficiently high reliability. The second stage is to assess whether the project is utilized by the population for which it is intended. The final stage is whether it has any impact upon the population, both in terms of time and energy spent to draw water and in terms of health and social conditions.

Most evaluation studies deal with the first two stages mentioned above, i.e. functioning and utilization of the improved water supply system. Evaluation of the impact of the project upon the population is very time-consuming and expensive and is therefore done only to a very limited degree. However, despite proper functioning of the improved water system and extensive use of it, this is no guarantee that it will result in improved health.

Functioning and utilization are necessary but not sufficient conditions in order to attain social and health improvements. A high service level is important in order to minimize the need for people to use other sources as well. Many other factors, like sanitation, personal and environmental hygiene, economic conditions, nutrition (food supply and food storage and preparation) as well as social and cultural customs and traditions, all influence the degree to which a project will have an impact. Therefore, an evaluation of the social and health impact requires a more comprehensive approach than evaluation of functioning and utilization.

2. Aim of the Study

The perception among donor agencies concerning the main objectives of improving the methods of water supply has changed significantly over time. Initially, the emphasis was simply to bring "water to the tap". What happened during storage and in connection with consumption was hardly considered. In recent years, however, much more concern is devoted to what is happening "between tap and mouth". It has been shown that the quality of the water stored in the household tends to deteriorate (see *e.g.* Stenström & de Jong, 1983). Patterns of water handling and their relation to water quality and health, has become a crucial aspect. Analyses of water storage and hygienic behaviour are thus of crucial importance.

This study is part of a project evaluating the impact of an improved method of water supply, sanitation and hygiene upon health in a part of the Zomba West piped water project in Malawi. Both medical and social science aspects were studied. The social science aspects of the project were published as a monograph (Lindskog P., 1987), while the medical aspects were published elsewhere (Lindskog U., 1987). This study focuses upon the significance of social and cultural systems in relation to water supply and health. The topic requires analysis of the complex interrelationships between human behaviour, environmental conditions, water and water related diseases.

The aim of the study is to:

analyse the interrelationships between water supply, the physical and human environment in which the improved water supply is provided and the implications for health and social conditions.

The analyses focus on the living conditions of children under five years of age, as they are the most vulnerable age-group. During the first years of their lives, children suffer from a great number of diseases, many of which are related to poor water. The health problems which the children face are to a very large extent related to the situation of their family or the local environment. It is therefore necessary to study circumstances within the family, the clan or other social unit, and in the environment, which are likely to be the main factors affecting the health situation of children.

More specifically, the following circumstances will be considered in the analyses:

- 1) The importance of the cultural background and the opinions, expectations and reactions of the population regarding improvements in water supply systems including handling of water from the tap.

It is now widely acknowledged that projects will not be successfully implemented and used unless the population is motivated to operate and maintain it when it is completed. An assessment of the opinions, expectations and reactions of the population regarding water projects is a crucial component of any evaluation programme.

- 2) The significance of socio-economic conditions for water use patterns and for disease prevention measures and their relationship to health.

It may be a truism that formal and informal education is positively related to health, although the relationship is not simple. For a review of the topic see *e.g.* Franks & Boisseau (1980). However, it may be that economic conditions are more important than education. Knowledge without opportunities to apply it is of little use. As with education, there is no simple relationship between economic conditions and health. Increased cash income does not necessarily lead to better health but may sometimes cause a deterioration. If cash is used to buy *e.g.* consumer goods, beer, women etc., it does not improve health but may instead decrease the possibilities to improve health conditions. The need for cash could also lead to a reduction in food crop production. Therefore, under certain conditions cash income may be detrimental to people in traditional societies. Within the study area there are big differences in socio-economic conditions. Attempts are made to pin-point how these varying conditions relate to the health situation.

- 3) The knowledge of water-related issues among the population for an understanding of their situation and their needs.

People in all societies have a life-long experience of survival in their local environment, often under very harsh conditions. This may or may not coincide with the knowledge which is generally accepted by scientists. Development programmes should take into consideration both the traditional knowledge and the scientific knowledge when the present conditions and the future needs are reviewed. This should form the basis for development programmes.

- 4) The significance of physical and environmental conditions for the water supply situation and its relationship to health.

Topographical conditions, soils and vegetation, as well as temperature, rainfall and humidity, have a great impact on the environment. High rainfall and humidity increase for instance the time of survival of pathogens. The degree of contamination of the environment around the house, in which a child lives, is of crucial importance to the health of the child. The use of the compound for various activities may directly or indirectly affect water quality and there-

by health. The presence of chicken and other animals in combination with various household activities in the compound is for instance an important aspect to be considered. The problems to keep a compound clean are particularly great during the rainy season.

Along with the growing consciousness of a connection between water quality and methods of storage and pollution hazards in general, there is a noticeable concern for the environment in which the improved water supply scheme is located (Beyer, 1986). The relations between the deterioration of the quality of water at the source and contamination of the environment in general are, however, fairly complex. It has been shown that water quality deteriorates at a time of the year when the environment is considered comparatively "clean", that is, during the end of the dry season (Wright, 1986). In addition, the deterioration of water quality coincides with increasing hardship to obtain water. It is therefore essential to discuss how the quality of water and the environment are related and assess their health implications.

5) Personal hygiene habits, water handling and their impact on water quality and health.

The importance of good personal hygiene habits is generally acknowledged but few studies have been carried out to determine the actual behaviour. However, in one of the few studies carried out, Khan (1982) showed the significance of hand-washing for reduced rates of diarrhoeal diseases. Apart from hand-washing after defecation, good personal hygiene is essential in relation to cooking, when feeding children etc. Therefore, personal hygiene issues, e.g. frequency of hand-washing, where and how it is done and whether soap is used, are studied.

The five aspects mentioned above are analysed with respect to their seasonal variations. It is especially pertinent to take into account the seasonal aspects under points 2 and 4 above. As Chambers (1982), Pacey *et al.* (1981), Schofield (1979) and many others have emphasized, many governments and development agencies overlook the seasonal variations based on climatological factors and only consider conditions of rural areas during the dry season ("the tarmac bias").

Project personnel and researchers alike, simply have practical problems to visit rural areas during the rainy season (Chambers *et al.* 1981). In addition there is a more profound bias involved. Falkenmark (1981) argues that there is a "climatic bias" in the entire approach by people coming from countries with a temperate climate. According to this argument, donor agents and researchers are not sufficiently attuned to think about the significance of seasonal variations.

In evaluations of development projects it is thus crucial to consider the impact of climatic seasonality. Furthermore, it seems that a sub-division of

the year into a wet and a dry season is an oversimplification. The intra-seasonal variations should be considered as well.

During the rainy season, and particularly at the beginning of the rainy season, morbidity and mortality rates are high, labour requirements peak, while food supply is at its lowest level, which cause malnutrition. Births often peak, while birth weights decline. In a relatively poor setting, the combination of these factors causes an additional strain on children which is often fatal.

3. Water-Related Diseases and Human Behaviour - Some Theoretical Aspects

A basic assumption

A basic assumption in this study is that there are numerous factors, which together determine the results of the improved method of water supply and of the health education and promotion programme. In broad terms these factors can be grouped into three main categories:

- i) knowledge, perception and motivation
- ii) resource situation of the beneficiaries
- iii) physical and environmental characteristics of the area where the intervention takes place and where the beneficiaries live.

The common assertion that development programmes will result in noticeable improvements for a "target population" seems to be too simple. In areas where projects are executed it is often noted that some of the supposed beneficiaries may fail to take advantage of the project. On the other hand, it is likely that people who do not belong to the "target group" may benefit. Any development project - and research project - may therefore have certain "spill-over" effects. Similarly, it is likely that the impact on individuals change over time due to variation in motivation or in the resource situation.

Relative importance of water quality and quantity for health

Health benefits are one of several aims of water projects. Improvements in household water supply is a necessary but not a sufficient condition for improved health. Improvements in hygiene and sanitary conditions of the population are also required. Both improvements are necessary, particularly for attaining a reduction in diarrhoeal diseases, since there are different routes of transmission of the disease agents (for a classification of water-related diseases, see Chapter 4).

It has been assumed that improvements in hygiene and sanitation may have greater impact upon water-related diseases than improvements in water quality (Falkenmark, 1982). To attain these aims requires a proper understanding of the society in which the project is to be implemented and of the issues which people of that society regard as their main problems. Secondly, it requires that the knowledge gained about the society is taken into

account when planning and implementing the project. Active involvement of the population in all stages of the project from the original initiative to the operation and maintenance is a prerequisite for a health impact.

It is widely recognized that improvements in household water supply must include improvement of water quality at the water-source (which in turn requires good reliability, proper operation and maintenance). It is, however, of equal importance to improve quality of the water in the household which does not immediately follow from the first step. In most households of the Third World, flushing water at the house is not available but water is collected from a water source which is often common for several households. Furthermore, the standard of living in most parts of the Third World is so poor that it is much more difficult to maintain good water quality than it would be in more developed countries. Even if people understand the importance of good hygiene they may not have the means to maintain it as there are many constraints (Chapter 6).

As was mentioned above, improvements in sanitation and hygiene may have greater impact upon diarrhoeal diseases than improvements in water-quality at the source. This may be so because improvements in water-quality at the water-source only influences the disease load in one way, while improvements in sanitation and personal hygiene influence the disease load three different ways. Firstly, better personal hygiene reduces faecal-oral transmission via solid bodies. Secondly, better hygiene reduces faecal-oral transmission via water. Finally, better hygiene reduces faecal-oral transmission via food. Improvements in sanitation, *i.e.* properly constructed pit-latrines which are correctly used, prevent transmission via water, while lack of good personal hygiene may still result in transmission via the other routes.

It is therefore pertinent to analyse water, hygiene and sanitation in relation to human behaviour, knowledge and practice in order to get a proper understanding of the spread of diarrhoeal diseases.

Different types of knowledge and perceptions

Water consumption and water handling is determined by a mixture of needs of the individuals, the social and cultural norms prevailing in that society and the resource situation. From the point of view of individuals or even the entire community, there are a multitude of reasons which determine the existing water use pattern. People may for instance recognize the need for improvements in their water supply system but due to lack of time or economic resources they may not be in a position to change their situation. In addition, numerous other pressing needs constitute additional constraints. "...in communities where people lack a wide range of facilities and opportunities, most of which are acutely needed, it is *e.g.* no wonder that some will give priority to other projects" (Lundqvist, 1984). In other cases, traditions and social contact networks restrict the choice of action. Visits to traditional healers may

for instance take precedence over visits to health clinics. It may be that the child is taken to a health clinic only when it is severely dehydrated. It may then be too late for rehydration therapy to be successful.

It seems plausible to assume that knowledge and awareness about the relationship between water quality and sanitation on the one hand and the health situation on the other would be positively related to a "felt need" among the people for improvements in water supply and water handling. The fact that a majority of the population in Third World countries today use water of poor quality and that no effective precautions are taken to improve the water quality or prevent its deterioration, does on the other hand not mean that they lack knowledge about the health hazards involved. Indeed, the knowledge of the population is often underestimated by "outsiders", both government employees, academic researchers and donor agencies (Chambers, 1983).

The relationship of the knowledge and perception of people, which could be called traditional knowledge, to the knowledge as defined by the government, scientists etc, in the following called scientific knowledge, may vary (Figure 3.1). The poem "Song of Lawino" by Okot p'Bitek (page 11) illustrates the villager's view. Although different words are used, it is nevertheless the same phenomena which is described. Most people in Third World countries do not know, and may not comprehend, the details of disease transmission. However, they have a lifelong harsh experience on which they base their understanding and considerations about how to behave and survive.

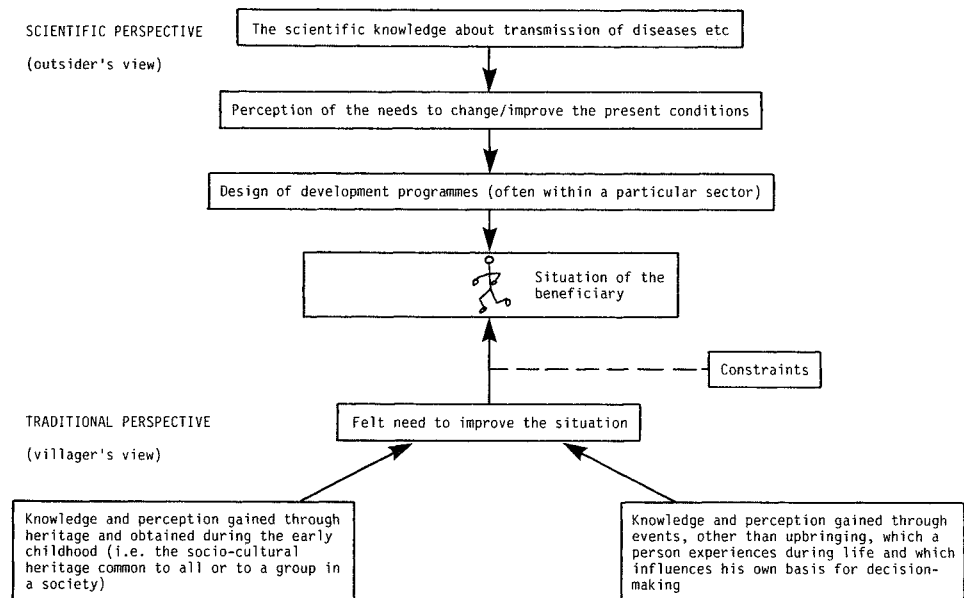


Figure 3.1 An illustration of two different perspectives influencing peoples' living conditions.

This experience constitutes the basis of their knowledge and has two components (Figure 3.1). It is firstly gained through inheritance from the society in which the person lives and secondly, it is determined by events, which the individual herself has gone through or is exposed to. In the former case, other people in the society, *e.g.* parents, relatives and elderly people, transfer their experience and perceptions to the new generations, mostly during childhood. A person has little opportunity to influence the selection of experiences which he/she will be exposed to since birth through upbringing. It is important to bear in mind in the evaluation of development projects, that people within traditional societies to a large extent share a number of experiences and perceptions.

The second type of experience is gradually gained during life through events which the person experiences. A basic experience is, of course, that the individual herself has survived in spite of the problems that outsiders tend to ascribe to the traditional setting. If a woman has survived, reached a grown-up age and has given birth to a new generation as her mother and father did, it is not self-evident to that individual that improvements in water supply and water handling are of such a crucial importance. This is especially so when all other needs, which are necessary for survival, are taken into consideration. However, becoming a mother and experiencing the first serious disease of one's children are presumably dramatic events which force individuals to reflect on their situation in one way or another.

With regard to water supply projects and health education projects, it is essential to design the implementation as well as the operation and maintenance, so that the knowledge and perception of people are considered. It is likely that at any time there are some individuals who are susceptible to new ideas and are prepared to change their habits. In the long run it is necessary that the community at large accepts changes. This is also likely to happen, when the benefits of changed habits become apparent to people. However, before this is obvious to the villagers, it is not likely that they will take the risk of changing habits, which have been put into practice by his forefathers during generations. The margin on which he lives does not allow any experimenting before he is certain of the outcome.

Relationship between knowledge, motivation and practice

People's knowledge and experience about the relationship between water and health is important, but is nevertheless only one aspect which determines their water use pattern and health-related behaviour. What is often forgotten by outsiders is the multitude of worries that beset poor people. On average, a child under five years is ill during 40 days per year. A family with two children under five years and two older ones should on average have a capacity to take care of children who are ill for 80 to 120 days per year. It is

thus an arduous task to nurse children properly apart from all other duties. As long as the child is not seriously ill, it is therefore not surprising if a mother does not practise all the knowledge and experience which she has. When she realizes that the condition of the child may be life-threatening, however, she exerts all the efforts which she is able to mobilize. Still the choice of treatment may not be made according to the scientific knowledge, as her information on the best treatment to the child is based on her own knowledge and experience.

In order to ensure that development programmes have an impact upon the societies in which they are to be implemented, it is therefore a necessary but not a sufficient condition that the need for the programmes are felt by the beneficiaries *i.e.* that they are motivated to practice it. Without a 'felt need in the community, the notion of community participation is a contradiction' (Brandström & Shirima, 1984).

In many countries it is well-known that people dislike muddy water and that it even contributes to lower water consumption. People do not find it "worth while to wash vegetables, meat or even dishes properly as 'you would make them even more dirty'" (Jahn, 1981, 32). Thus, it may be that the knowledge and perception of people concerning water quality is often close to the scientifically determined bacteriological quality of the water. Furthermore, people seem to make efforts to use water of good quality and may reduce their use of water of inferior quality.

It may be argued that the rationale for development projects is that knowledge, motivation and practice of people in Third World countries need to be adjusted and improved. Water supply and health education programmes aim at changes in water handling and water use patterns. The experience from water supply and health education programmes, however, clearly illustrates that it is not enough to convey a message concerning a new habit and to supply the hardware. A number of preconditions are required to make the message of the programme properly implemented. Knowledge about the hazards of using water of inferior quality may not necessarily be enough to change a behaviour. On the other hand it may well be that a message has not been comprehended, but is practiced anyhow. Very few people, if any, optimize their behaviour. There are many economic, social, cultural, political and physical circumstances that effect their behaviour.

There are thus various combinations of relations between knowledge and practice (Figure 3.2). Combinations A) and D) imply a rational behaviour in the sense that practice corresponds to a comprehension of a message, whereas combinations B) and C) are not rational. The latter combinations require further attention, particularly since they imply that the expected outcome of development projects is jeopardized.

It seems that there are two main reasons why human practice does not correspond to knowledge. One has to do with motivation and psychological factors. Well-educated people smoke in spite of the fact that they know about

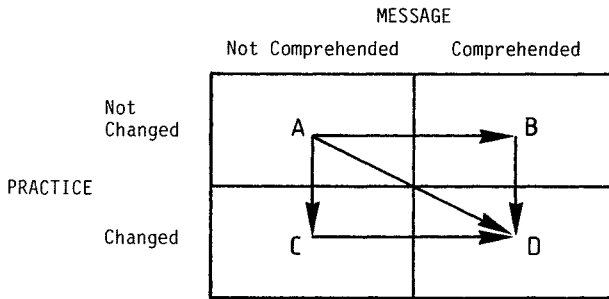


Figure 3.2 Four principal combinations between human comprehension and practice.

the health implications. The other reason is related to various constraints which make practising one's knowledge difficult or impossible. Mothers who have the knowledge about what to do to avoid diarrhoea of children, may not practice it. Similarly, many mothers have been told at under-fives' clinics that they should give oral rehydration solution, but may be reluctant to practise it. The reasons for not doing it or not doing it completely may be that the importance of the treatment is not understood, which in turn may be due to lack of 'felt need' or due to values, which hinder the message to be properly comprehended. Quite often, however, it is due to lack of resources, e.g. shortage of time during the cultivating season, economic constraints to buy sugar and salt or physical constraints like lack of fuel to boil the water (Figure 3.3).

Variability in options to improve practice

Lack of correspondence between practice and knowledge could thus to a large extent be explained in terms of constraints created by the resource situation. It varies, however, over the year. During the dry season, from May to October, people have more time and, generally speaking, a better resource situation, than during the rainy season although the change is gradual. It may therefore be that the knowledge which people have is more often practised during the dry season than during the rainy season.

Similarly it may be assumed that motivation to practise new ideas of for instance water handling and hygiene behaviour varies with individual experience as discussed above. Generally speaking it is likely that community norms and life experience of people determine the practice.

Bertrand and Walms (1983) tested the assumption that "a better description of the relationships between knowledge, attitude and practice (KAP) and socioeconomic and environmental factors will lead to an improved understanding of their relative importance in the transmission of diarrhoea" (*ibid*, 205). They found a correlation between diarrhoea in children less than five with mother's age, mother's birthplace, general maternal knowledge of

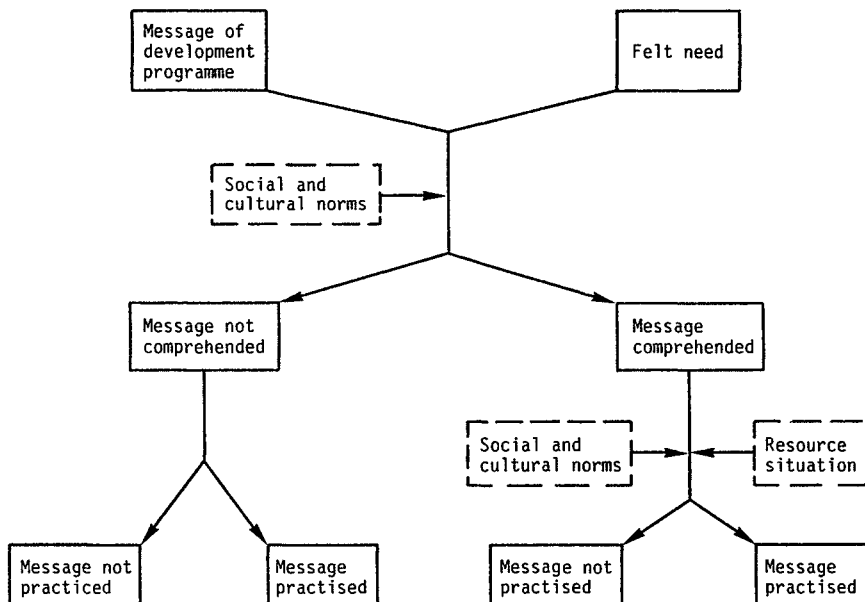


Figure 3.3 Factors affecting practice and non-practice of the message of development programmes.

the causes and treatment of diarrhoea and house appearance (*ibid*, 209). They suggested that "these factors operate through maternal practices, such as preventive measures, cleanliness and hygiene habits, to reduce the transmission of water-washed and water-borne diarrhoeal diseases" (*ibid*, 210).

As analytical and explanatory categories, mother's age and mother's birthplace are, however, fairly vague. Presumably these categories could be translated into more precise terms like levels of education, significant cultural traits and exposure to development programmes. "Birthplace" may conceal important physical characteristics like specific settlement pattern, agricultural orientation etc.

There are consequently a number of circumstances which influence the relationship between knowledge, motivation and practice of the individuals. In broad terms they could be identified and grouped into the following categories.

Circumstances that influence practice

Impact of climatic seasonality

One of the most obvious problems in tropical areas is climatic seasonality. Both inter- and intra-seasonal variations have far reaching consequences. They influence access to water, environmental conditions, food production and transport. As such, seasonality will not only mean a direct threat of dis-

ease prevalence. It is also likely to have considerable indirect consequences in terms of varying opportunities for people to practice their knowledge. In the analyses of morbidity patterns and water handling it is therefore of utmost importance to pay attention to these circumstances.

"Spill-over" effects of development projects

The assumption that a development project will automatically lead to predictable (positive) effects among a specified target group is too simple. With regard to the discussion above it could be assumed that the provision of a water supply system is in itself not sufficient to change behaviour in a profound sense. Instead it is necessary that a wide range of circumstances among the beneficiaries and in their setting are favourable.

On the other hand, it would seem natural that a development project, of whatever kind, may have other effects than those intended, also among people who are not defined as beneficiaries (Figure 3.4).

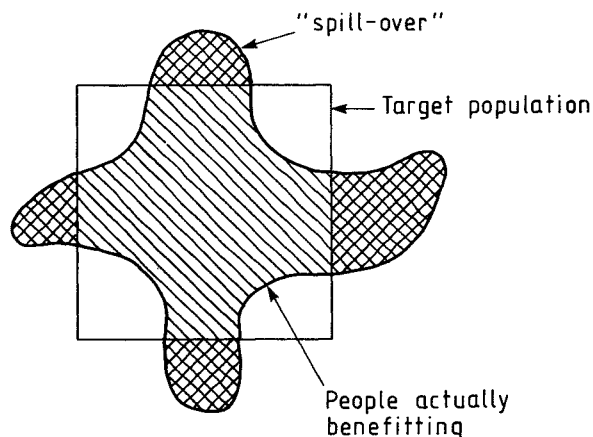


Figure 3.4 An illustration of differences between target population, people actually benefitting and "spill-over" effects.

It may therefore be assumed that a development project - and a research project - will have implications also for people who are not part of the target population. With regard to this study it is, for instance, important to analyse tendencies of general change in the region where intervention of water supply and health education took place.

Characteristics of individuals

As discussed above, it is likely that individuals at some occasions or in connection with certain experiences, alter their pattern of behaviour. Changes

in the family situation may, for instance, lead to new patterns of behaviour. Among the personal characteristics the level of education is probably positively related to a behaviour which corresponds to "scientific knowledge" (Figure 3.1). In addition, it seems relevant to analyse if susceptibility to for instance health education increases in connection with threatening situations (like serious diseases among one's children).

In chapters 6-8 these theoretical assumptions will be tested against our empirical findings.

4. Methodological Aspects

Planned design of the study

The present evaluation study was based and designed upon the experience, which earlier studies provide. A detailed review of problems of evaluation of water supply and health education programmes and of previous studies on the topic is published elsewhere (Lindskog U., *et al.*, 1987a).

This study was designed as a prospective cohort study with comparison groups to be carried out before and after intervention with an improved method of water supply and health education. It was originally planned to be carried out in a part of the Dombole gravity-fed piped water project in southern Ntcheu district, Malawi. However, it was later found that the time schedule of this project would not allow a thorough baseline study before the intervention of the piped water project would be implemented. Another water project was therefore selected. It was found that the time schedule of the Zomba West gravity-fed piped water project was more suitable and would allow a year of baseline study, starting in February 1983, to be completed before the intervention would take place in the beginning of 1984.

The Zomba West piped water project is located in the Rift Valley between the Shire River and the eastern escarpment of the rift (for further details of the area, see Chapter 5). This water project surrounds the area covered by the first piped water project in Malawi (the Chingale piped water project), which was undertaken in 1968-69 (Chapter 6). The Zomba West water project provides improved water to an estimated 50 000 inhabitants.

A gravity-fed piped water system was designed with originally two intakes. It was later supplemented by a third one as the minimum water flow during the end of the dry season proved insufficient (Map on Figure 4.1). It was to provide all 50 000 inhabitants within the Zomba West water project with water from taps, located at a maximum distance of 400 meters from any house. Private connections to individual houses are not allowed, but all households have to carry their water from public taps. Only public institutions, like schools and clinics, are allowed to have their own connections.

This prospective cohort study before and after intervention with improved water supply and health education was designed to be carried out in three separate but relatively closely located areas in the north-eastern part of the Zomba West gravity-fed piped water project (Map on Figure 4.2). The baseline study was planned to be carried out from February 1983 to January 1984 and the study after intervention from February 1984 to January 1985 (Figure 4.3)

Area 1 and Area 2 were designed to get improved water in February 1984, while Area 3 would serve as a control area and would not get any improved

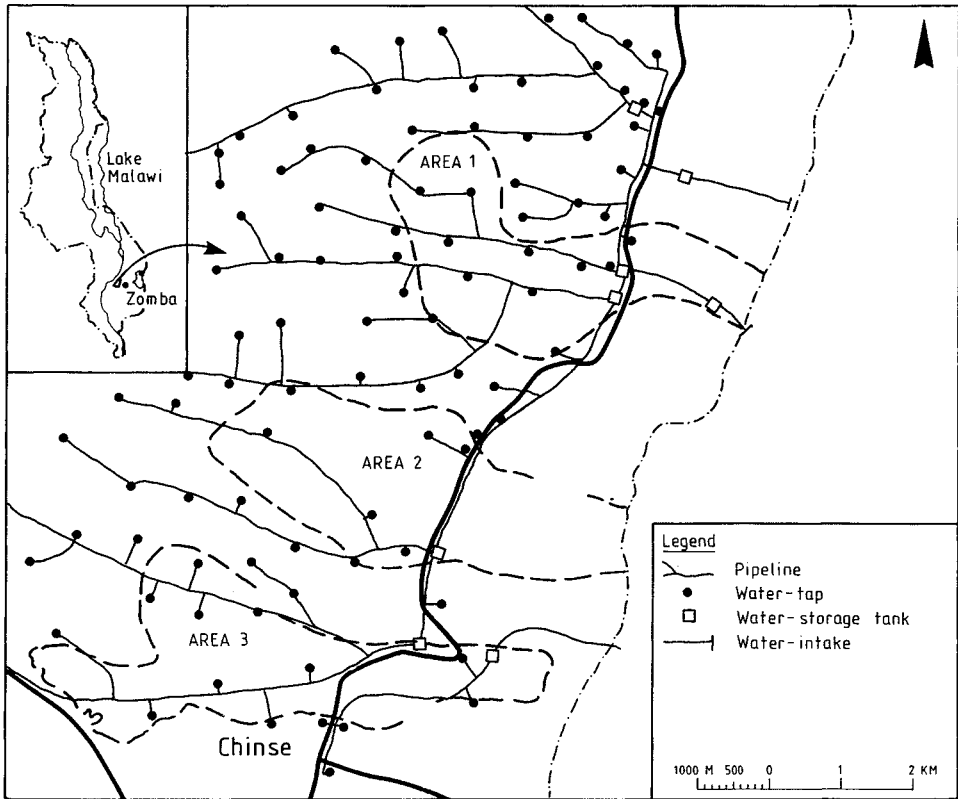


Figure 4.1 Location of water-taps and pipelines in the area.

water until after this evaluation study was over (Figure 4.2). Health education intervention was planned for the villages of Area 1 within the Health Education and Sanitation Promotion (HESP-) programme of the Ministry of Health (chapter 7.3.1), while the villages of the other two areas would benefit from this programme later on.

Data from the Malawi Population Census of 1977 for the study area as well as the 1982 Sample Population Census (not covering the study area but indicating the changes, which had taken place since 1977) were used for the selection of the three areas. Similarly, an examination of maps and airphotos taken in October 1982 provided basic information of the area. In addition, discussions with community leaders were important. The three areas were selected to be as similar as possible with regard to water supply, environmental conditions, social and economic structure, educational level, food production and health services.

In all, eleven villages with a total population of 4 139 inhabitants in January 1983 were selected (Table 4.1). Area 1 and 2 were chosen to be of roughly the same size, while Area 3 was designed to be 50 % larger in order

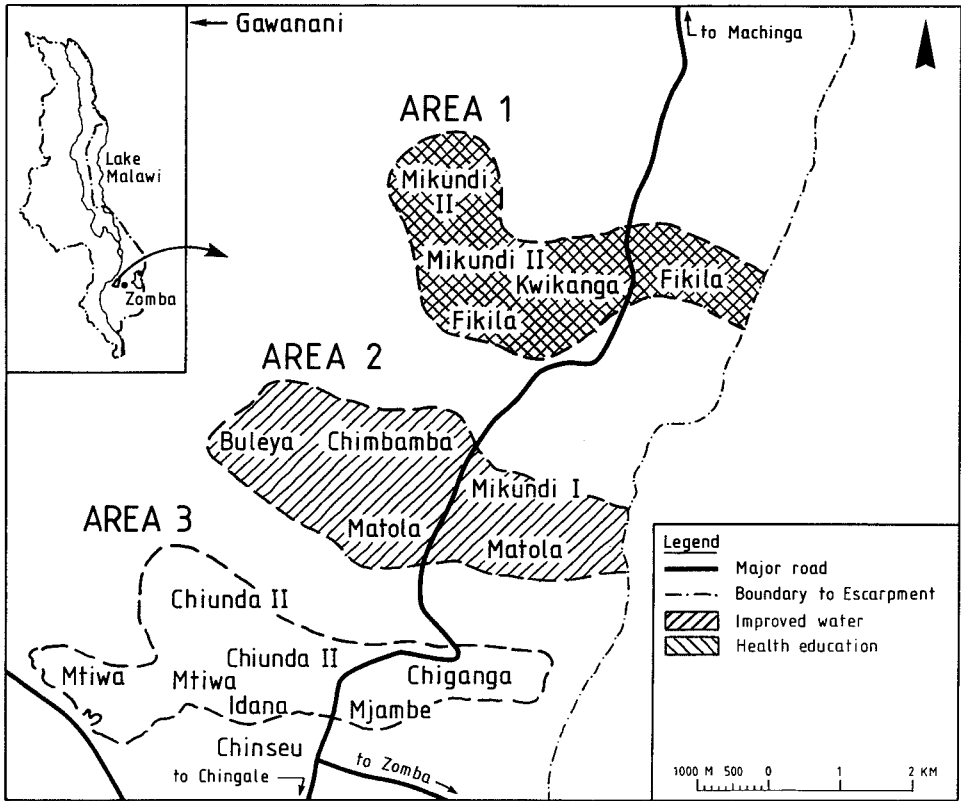


Figure 4.2 Planned design of the intervention with improved water and health education.

to act as a control area against the first two. All three areas were chosen to include roughly the same topographical and climatological features. They stretch from the forest reserve boundary (where the altitude is 700 to 800 m and rainfall is more reliable and streams from the mountain are more frequent), down towards the plains and the Shire river (at an altitude of around

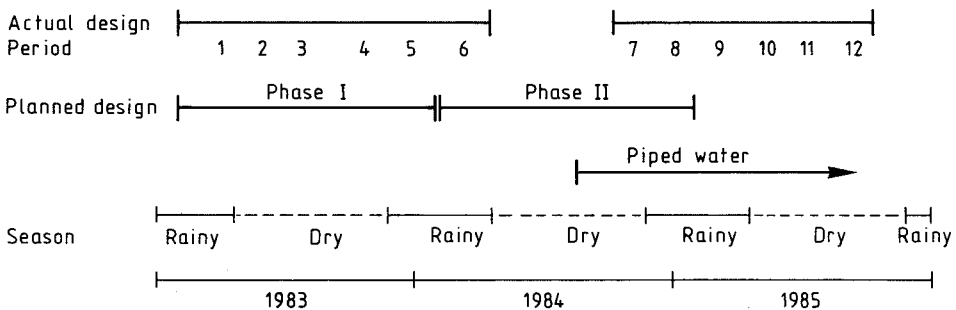


Figure 4.3 Time schedule of the planned and actual design of the study.

Table 4.1 Age- and sex- distribution of the population of Malawi, Zomba district, T.A. Mlumbe and of the study areas.

	No of house- holds	Total no of inhab	No of househ. with under 5's	Age- and sex-distribution (%)										Sex- ratio M/F·100 15-49				
				0-4		5-9		10-14		15-49		50-59			60-			
				M	F	M	F	M	F	M	F	M	F	M	F	M	F	
Malawi	-	5 547 460	-	10	10	7	8	5	5	21	23	2	3	3	3		88.0	
Zomba district	-	352 334	-	9	9	7	7	5	5	21	25	3	3	3	4		84.9	
T.A.Mlumbe 1)		78 401	-	9	9	7	7	6	5	20	24	3	3	3	4		80.7	
Study population																		
Area 1	277	1 096	151	9	10	7	7	6	5	19	22	5	6	2	2		83.1	
Kwikanga	33	147	16	9	6	10	4	6	5	26	19	3	5	3	4		135.7	
Mikundi II	101	382	53	8	11	6	9	5	3	19	24	4	4	3	4		78.7	
Fikila	143	567	82	9	11	7	7	6	6	17	23	6	7	1	0		74.6	
Area 2	345	1 285	172	10	9	8	8	5	5	18	20	5	5	4	3		87.4	
Matola 2)	135	507	70	12	8	8	7	5	4	18	18	4	5	6	5		94.8	
Chimbamba II 3)	52	189	26	8	11	7	8	6	6	19	23	4	3	4	2		82.2	
Mikundi I	158	589	76	9	9	9	9	6	4	17	21	5	6	3	2		83.5	
Area 3	504	1 758	219	8	9	8	9	6	5	17	24	5	4	2	3		68.9	
Mtiwa	142	484	55	7	7	7	6	7	6	20	26	5	4	2	3		78.2	
Idana	31	118	17	10	8	6	7	5	6	17	30	4	3	2	2		58.3	
Chiunda II	126	436	41	7	6	12	13	5	4	13	20	4	6	4	6		65.2	
Chiganga	172	598	86	10	11	5	8	7	5	18	27	5	3	0	1		66.0	
Mjambe	33	122	20	10	13	11	10	6	1	12	17	3	4	3	10		70.0	

Source for table 1a: Malawi Population Census 1977, Final Report, Vol. 1, Zomba; National Statistical Office, 1980

Source for table 1b: Village Census, January 1983

Notes: 1) The target population Zomba West Water Project constitutes 59.5 % of T.A. Mlumbe; 2) + Buleya; 3) + Mtiku B

550 to 600 m and with much drier conditions). The most common ethnic group in all the eleven villages is Yao, while the other groups are Nyanja, Lomwe and occasionally Ngoni.

The percentage of children under five years of age varied between 15 and 22 % in the eleven villages. The biggest variation between the villages according to the census figures was the proportion of population which had attended primary school. It varied from only 19 % in Mjambe to 49 % in Matola. More than 99 % of the population used unprotected water sources. There were no boreholes or protected wells within the selected area. People in the southern-most area had 1.5 km to the nearest tap of the old Chingale piped water project.

Actual design of the study

The initial design of the study described above had to be altered due to a number of reasons. Firstly, the water project was delayed. The first taps were not opened until October 1984, while some people started to use flush water

from August 1984. The evaluation period after intervention with improved water therefore lasted from September 1984 to September 1985 instead of from February 1984 to January 1985 (Figure 4.3). During the first period after intervention in September-October 1984, only 5 % of the households used piped water. By the end of the study around 50 % of the households used piped water.

Secondly, the water project was gradually extended into all three areas, not only Areas 1 and 2 (Figure 4.4). It was intended that Area 1 and 2 were to comprise 150 households with children under five, while Area 3 was intended to be 50 % bigger as described above in chapter 4.1. Characteristics of the villages selected for the study are presented in Table 4.1.

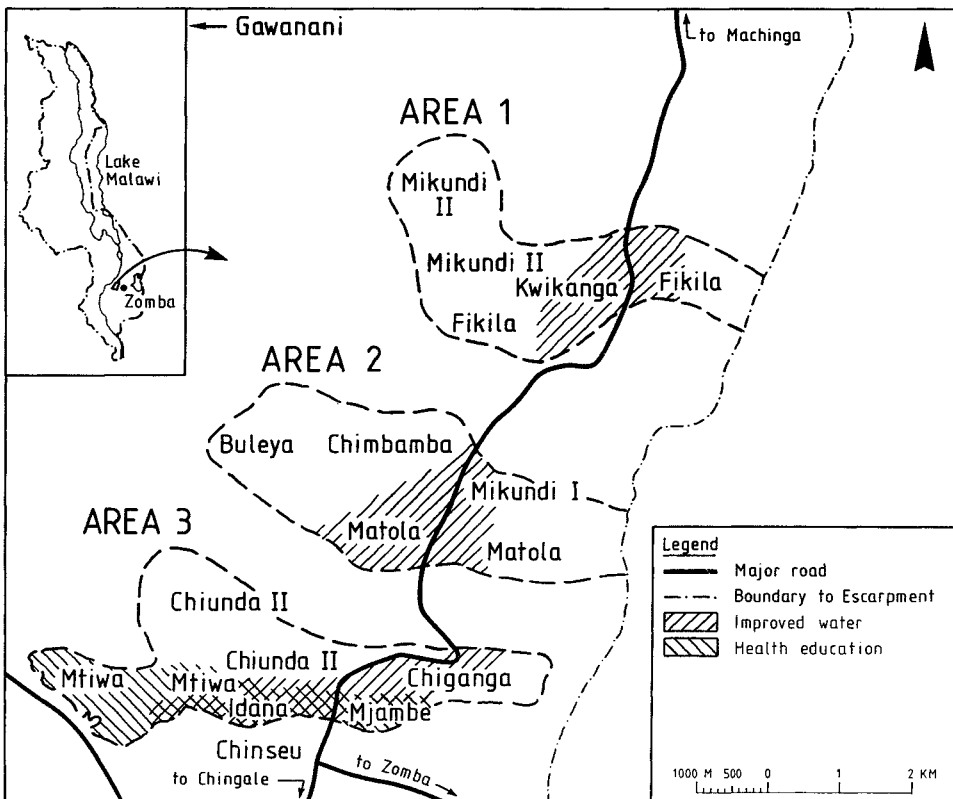


Figure 4.4 Actual design of the intervention with improved water supply and health education.

Finally, the Health Education and Sanitation Promotion programme was never implemented in the villages of Area 1. The health surveillance assistant responsible for the work within the study area found the villages to be

too far away from his residence which was 8-12 km away, especially as he had no bicycle. Instead, three target villages in Area 3 were selected, where health committees were formed. A more detailed description of the planned and actual design are given elsewhere (Lindskog & Lindskog, 1982; Lindskog & Lindskog 1983).

Reliance on quasi-experimental design - A critical comment

Due to unforeseeable events, the quasi-experimental design never materialized. All the three areas got an improved method of water supply at the same time, not only two areas as originally planned. Comparison groups had thus to be looked for within the areas. This was not a great disadvantage since there were considerable differences within the areas in terms of water-related issues as well as health.

It is, however, important to note that the entire population of all three areas participated in the work of the water project, that is, both those in the "target group" as well as those who were not supposed to benefit from the improved method of water supply during this evaluation study. They all worked once a week with digging trenches, laying pipes etc. already before the intervention with improved water supply during the latter part of 1984. Similarly, most of the inhabitants of the areas were in contact with our research project. There was therefore no group of people uninfluenced by the water project. Under such condition it is, of course, likely that changes in health-related behaviour may occur not only among people belonging to the "target group" but also among those who did not belong to that group. Even if the planned design had been possible to implement in our case, it is doubtful whether the comparison group had been unaffected by the water project or by the research project.

It may be unrealistic to design quasi-experimental community studies as there are many factors involved which rarely, if ever, can be kept under control. In order to adjust to changed conditions it might be preferable to adopt a more flexible design.

A cohort design does, however, entail a big advantage since it makes it feasible to follow the same children for a long period of time, in this case from birth until they were two and a half years old. This allows analyses of variations of diseases over time, and of the accumulated effects of positive as well as negative circumstances affecting the situation of the children. It is particularly important to study the seasonal variation of disease load, something which rarely has been done as pointed out by Schofield (1979). This is facilitated by a longitudinal study design with cohorts.

Methods of data collection

Village census

In January, 1983, a village census was done of all households within the study area, a total of 1 126 households. Of these, 542 or 48 % had children under five years of age (Lindskog & Lindskog, 1983). These households constituted the study population. The number of inhabitants of each household and their age and sex were recorded (Table 4.1).

The age- and sex-distribution was fairly even with a male/female sex-ratio of around 85 in Area 1 and 2, while it was 69 in Area 3. The only village which showed a marked difference was Kwikanga with a sex-ratio of 135 (Table 4.1). In Area 2 and 3, around 75 % of the heads of households were farmers, while 91 % were farmers in Area 1. Area 3 had more heads employed as farm labourers, most of them working on the nearby Piemonpe Tobacco Estate, while employment in urban areas and abroad was more common in Area 2.

All 542 households with children under five were to be included in the study. However, three households had to be excluded. The adults in two of these households were mentally disturbed. Already during the village census it was obvious that reliable information could not be obtained in these households. The third household moved out of the area a few weeks after the study started and it was therefore considered inappropriate to include it. Households, which later got children under five, were not added, as this would have caused logistic problems and socio-economic baseline data from January 1983 would have been missing. However, new-born children in the initially included households were added to the study, as well as children moving in to these households from outside the area.

At the beginning of the study, in January 1983, there were 810 children under five in the 539 households. During the study 346 children were born and 22 moved into the households. Not less than 137 children died and 340 were excluded as they passed the age of five. Finally, 129 children moved out of the study area. Records of children who moved from one village to another within the study area were transferred to the new village. These demographic changes resulted in altogether 1 178 children who were covered by the study, while 572 were included at the end in September, 1985.

Seven field assistants were employed and made the interviews and observations. Attempts were made to recruit female field assistants, as the interviews were mainly with women, but there were only two female applicants. As it was regarded essential that all field personal were of the same sex, only males with four years of secondary school but no medical training were recruited. They spoke Yao apart from the national language Chewa.

Household surveys

A household survey of all the 539 households was accomplished both at the beginning of the study (January, 1983) as well as before the study of the intervention effects (September, 1984). Baseline data covering demographic information of all members of the household, social and economic conditions, as well as environmental issues like water collection, storage and use, sanitation and hygiene facilities, were recorded.

Anthropometry

For all children in the study, anthropometric measurements were made twice a year, in March, when food supply is lowest, and in September. It could be expected that the nutritional status of children is best in September, *i.e.* some months after the harvest in May. The results are reported elsewhere (Lindskog U., *et al.*, 1987b).

Fortnightly morbidity and water use interviews

The morbidity of all children, as well as water collection and use, was recorded fortnightly at home (altogether 23 times during the baseline study and 23 times during the year after intervention). The interviewee was the mother of the child(ren) whenever she was present, otherwise the person in whose care the children were left. At the interviews, symptoms of water-borne and water-washed diseases, *i.e.* diarrhoeal diseases, skin- and eye-infections, during the 24-hour period preceding the interview, were recorded. These are the diseases, upon which improvements in household water supply could have an impact. In addition, other symptoms like fever, cough, running nose, ear pain and discharge were recorded in order to establish any change in the general disease pattern. For further details of the methods of the morbidity study as well as the results see Lindskog P., *et al.* (1988).

At the above mentioned fortnightly interviews, it was also recorded which water source was used for various purposes (*i.e.* for drinking, cooking, washing clothes, washing utensils and bathing). The amount of water carried home from each water source was recorded as well as whether the same or different containers were used. The amount of water carried home was estimated by asking the mother how many times she had drawn water during the 24 hours preceding the interview. For each container which she had used, the volume was determined. For cylindrical containers, the height and circumference were measured. For clay-pots, the height as well as the circumference of the rim and at the widest part were measured.

Other surveys of the whole study population

Detailed information concerning conditions of relevance to the aims of the study was collected on a few occasions. Among other things, this was done

regarding the amount of staple food, *i.e.* maize, which the household had in the grain-storage. They are cylindrical and were measured the same way as cylindrical water vessels. Whether the household had had any contact with the HESP-programme and their attitude to the water project were also recorded.

It is easier to test whether improvements in water quality has an impact, than to test the impact of improvements in hygiene and sanitation. However, an attempt to test the latter was also made. Hygiene related behaviour of a person is defined as all behaviour which in some way influences the hygiene of a person. Standard of hygiene is difficult to measure accurately with a large population. The indicators mentioned below were therefore supplemented by detailed observations of some of the households. In this study hygiene-related behaviour is measured as:

- 1) Water consumption *per capita* and per household
- 2) Consumption of soap per household
- 3) Availability and standard of latrine
- 4) Availability and standard of kitchen
- 5) Availability and standard of bath shelter
- 6) System of waste disposal of the household
- 7) Handwashing after defecation

Poor hygiene affects water quality. Therefore, the close relationship between personal hygiene and water quality may make water quality in the household a good proximate indicator of hygiene, which is accurate and relatively easy to measure.

Observations and interviews not covering the entire population

Chambers (1983, 58) emphasized that surveys using questionnaires (for instance methods mainly giving quantitative results) have to be carried out with utmost care and that such methods should be complemented with other more sensitive methods (for instance methods mainly giving qualitative results), like participant observations and indepth interviews, in order to check the validity and reliability of the information.

Throughout the study the seven enumerators were asked to record observations of relevance to the aims of the study. In addition, during five weeks in January-February 1984 and five weeks in January-February 1985 detailed observations were carried out in 35 households from dawn to dusk. The households selected were informed about the aim of this detailed study and were asked whether they were willing to participate. Almost all households originally selected were willing, often anxious, to be included, as they regarded it as an honour. All relevant activities by any of the members of the

household were recorded during five consecutive days, Wednesday through Sunday. A special study of the food intake of children under 18 months was also done.

Cross-sectional *versus* cohort studies

When intervention programmes in developing countries are implemented, virtually all evaluations are of cross-sectional rather than of cohort design. The reason is probably that cross-sectional studies are simpler and cheaper to carry out although they have serious shortcomings. Cohort studies allow morbidity and mortality rates under for instance one and five years to be determined more correctly than in cross-sectional studies. In the former type the same individuals are followed during the whole study. A further advantage with cohort studies is that they allow cohorts with children born during the same parts of the year to be constructed so that seasonal variations may be determined. The disadvantages with cohort studies are that they are more expensive and demanding to carry out.

In the present study four cohorts of children under five years of age were studied from birth up to 18 month of age. This made it possible to determine the influence of birth season upon diarrhoeal diseases, which, as Schofield (1979) pointed out, has not been done as extensively as it deserves.

Classification of water-related diseases

The most important effect of the improved water supply system which is expected is that it will result in better health. Improvement of the water quality of the water source is sometimes believed to automatically improve the quality of the water which is used. Even if this was attained, it does not necessarily give better health, as there are many other aspects than water quality which affect health. First of all, an improvement of the water supply system does not influence all diseases but only those which are water-related, which may be subdivided into infectious and non-infectious water-related diseases. The latter are those diseases which are related to the chemical property of the water. The present study is only concerned with the infectious water-related diseases. An original classification of these was done by Bradley (1971), who identified four groups of water-related diseases, namely water-borne, water-washed and water-based diseases, and finally water-related diseases via insect vectors, and was later restated in Bradley (1977).

Water-borne diseases are transmitted via pathogens which are in the water, which is drunk by a person, who becomes infected. Examples of diseases of this group are cholera, typhoid and other diarrhoeal diseases. However, it should be noted that all diseases of this group may also be transmitted by routes of infection which allow faeces to be ingested, *e.g.* with

contaminated food or due to bad hygiene. Therefore, all diseases of this group may also belong to the second group.

Water-washed diseases are infections which are caused by bad hygiene. Therefore, they may be reduced by an increase in the quantity of water used irrespective of the water-quality. The most important disease in this group is diarrhoeal disease, which accounts for "vast amounts of morbidity in people of all ages" (Bradley, 1977). The other group of water-washed diseases are skin- and eye-infections, which rarely are fatal but cause suffering.

Water-based diseases are those "in which the pathogen spends a part of its life cycle in an intermediate aquatic host or hosts. All these diseases are due to infection by parasitic worms which depend on aquatic intermediate hosts to complete their life cycles. Therefore the degree of sickness depends on the number of adult worms which are infecting the patient" (Feachem *et al.* 1978, 141). *Schistosomiasis* and guinea worm or *dracunculiasis* are the two most important diseases of this group.

In the final group, water-related diseases via insect vectors, diseases are spread by insects which either bite near water or breed in water. Malaria, *filariasis*, *onchocerciasis* and yellow fever are examples of this group, which are transmitted by insects which breed in water, while *trypanosomiasis* is an example of a disease which is transmitted by an insect (riverine tsetse fly) which bites near water.

With this classification, the fecal-oral diseases may be assigned to both the water-borne and the water-washed categories. Therefore, the categories are not mutually exclusive. Feachem (1977) therefore suggested a revision of the categorization, which is used in the present study. The difference between the two classifications is that the group with water-borne diseases is substituted with a group in which all faecal-oral diseases are included (and which may either be water-borne or water-washed). The group with water-washed diseases then consists of those water-washed diseases which can only be water-washed and not water-borne.

5. Physical, Social, Cultural and Economic Conditions of the Study Area

Introduction

By now it is well accepted that the health impact of improvements in water supply and sanitation can not be seen in isolation from the physical, social, cultural and economic conditions prevailing in that society. These conditions may be favourable or unfavourable, and thus acting as constraints to be overcome. In an evaluative study it is therefore important that the conditions in the local setting are appreciated. This chapter discusses, albeit only briefly, some of the aspects of living conditions within the study area which may cast some light on the conditions that might hinder or promote reduction of water-related diseases through improvements in water supply. It is based on the works of Kandawire (1979) and Mitchell (1956) as well as data collected during this study.

The physical environment

Location, topography and drainage

The Chingale area in Zomba district in Malawi is located in the rift valley between the Shire River and the eastern rift valley escarpment (Figure 5.1). The land is gently sloping towards the Shire River (Figure 5.2). The altitude is 750 m at the foot of the escarpment and just under 500 m at the river. The highlands to the east of the escarpment are at an altitude of 950-1 000 m. At the escarpment there is a decrease in altitude of 250 to 300 m within a distance of 1 000 m to 1 500 m. This drop is much bigger at the Zomba and Malosa mountains; the former reaches an altitude of 2 200 m. These topographic conditions not only facilitate easy drainage within the study area but also the provision of gravity-led piped water from the higher and wetter parts of the catchment.

The area is intersected by a number of streams from the Zomba and Malosa mountains (Figure 5.3). Most of them carry a low volume of water and dry up during the dry season. The area is, however, not among the most arid parts of the country. The frequent occurrence of streams together with the area's location below the escarpment contributes to its relative underdevelopment in terms of transportation and its relative inaccessibility from Zomba town, only 25 kilometres away.

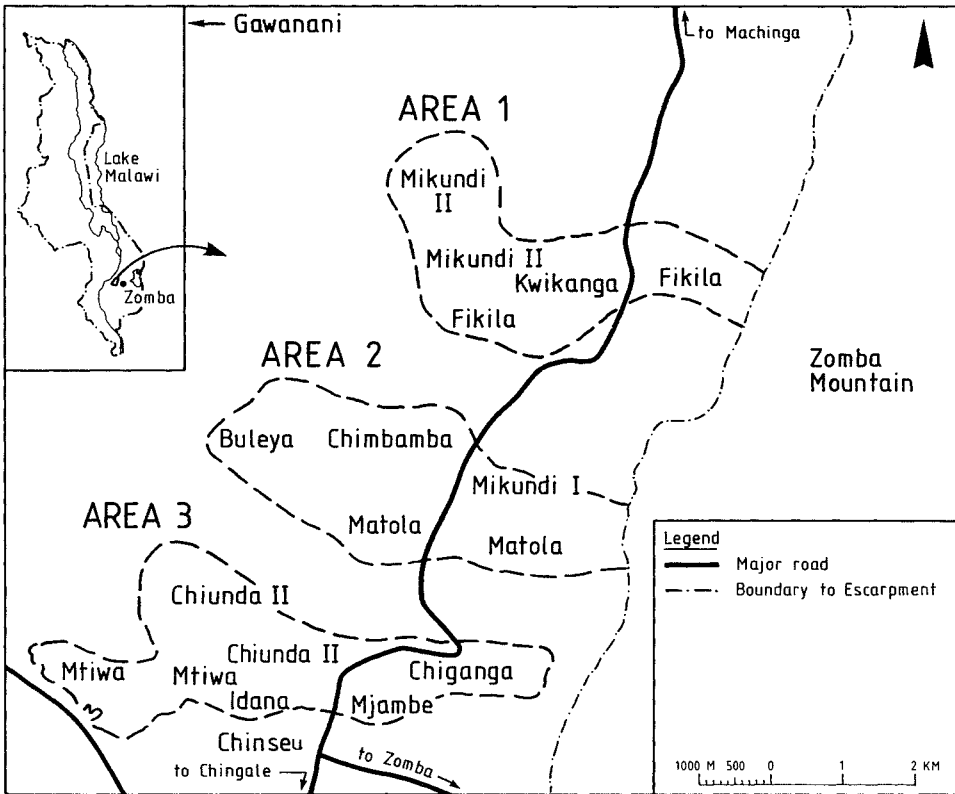


Figure 5.1 Location of the three study areas.

Climate

Chingale is a low-lying area, and like other areas in the rift valley it has one rainy season. Before the onset of the rains, *i.e.* in October, November and December, the temperature is around 30-35 C. Especially during the latter two months when humidity is high the climate is uncomfortable. In May, June and July, the temperature is significantly lower, but never too low to hamper plant growth. Plant growth is essentially related to rainfall.

The Chingale area is in the rain-shadow of the south-easterly trade winds and therefore receives less rain than the highlands to the east. The rainfall varies from around 800 mm at the Shire River to 1 200 mm at the escarpment although the variations from year to year are considerable. As for most parts of Malawi, almost all rain falls during one rainy season from November to April. The rains usually commence in the end of November or in December and become heavy in the end of December or in January.

The seasonality of rainfall has important implications in terms of the prevalence of disease and morbidity. Rains will bring water for domestic use within easy walking distance, but it will also cause the spread of malaria-

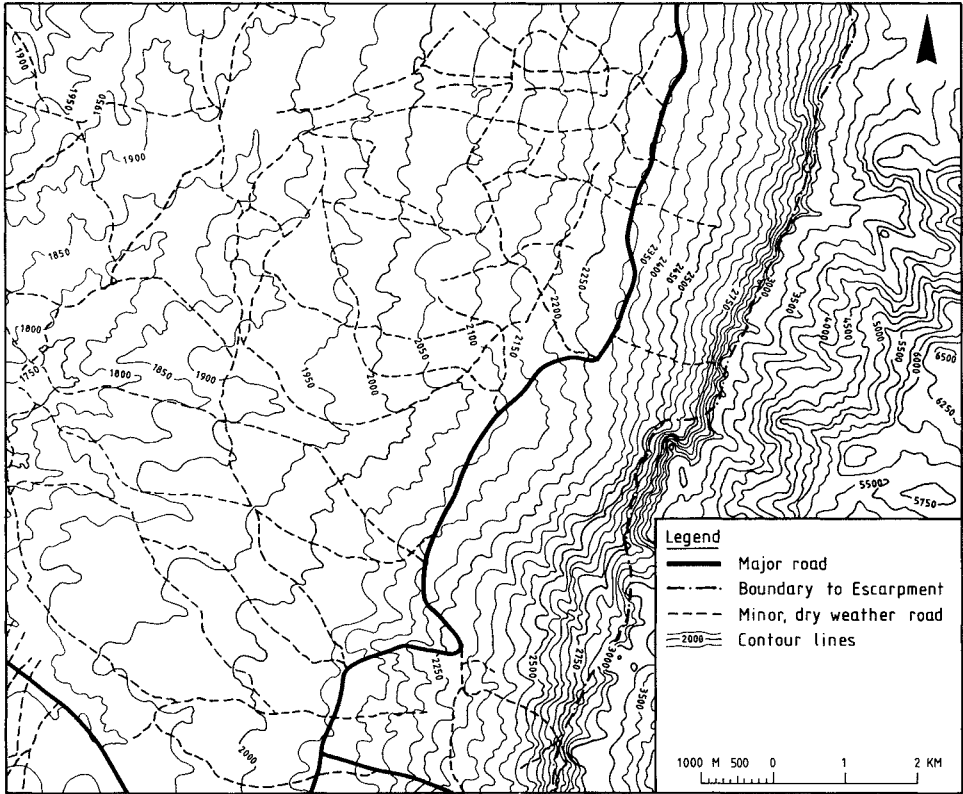


Figure 5.2 Topography and roads of the study area.

carrying mosquitoes and create favourable conditions for the spread of water-borne diseases etc. During the rainy season the transportation possibilities drastically deteriorate. The Chingale area which is difficult to travel to and from even during the dry season becomes even less accessible during the rainy season. The unsurfaced roads that serve the area often become impassible by motor vehicles for several months (Figure 5.4).

Land and soil resources

Soil constitutes perhaps the most important resource in the study area. Soils are important not only for agricultural purposes but also as a source of building material. The soils in the study area are by no means uniform but are generally of the ferruginous type; red in colour, with a sandy clay loam topsoil over a sandy clay subsoil. They are considered good agricultural soils, suitable for the growing of maize, groundnuts and tobacco.

Many households do not have sufficient land to support themselves with the cultivation methods used at present. Some people have in fact found it necessary to move to other areas in order to be able to support themselves.

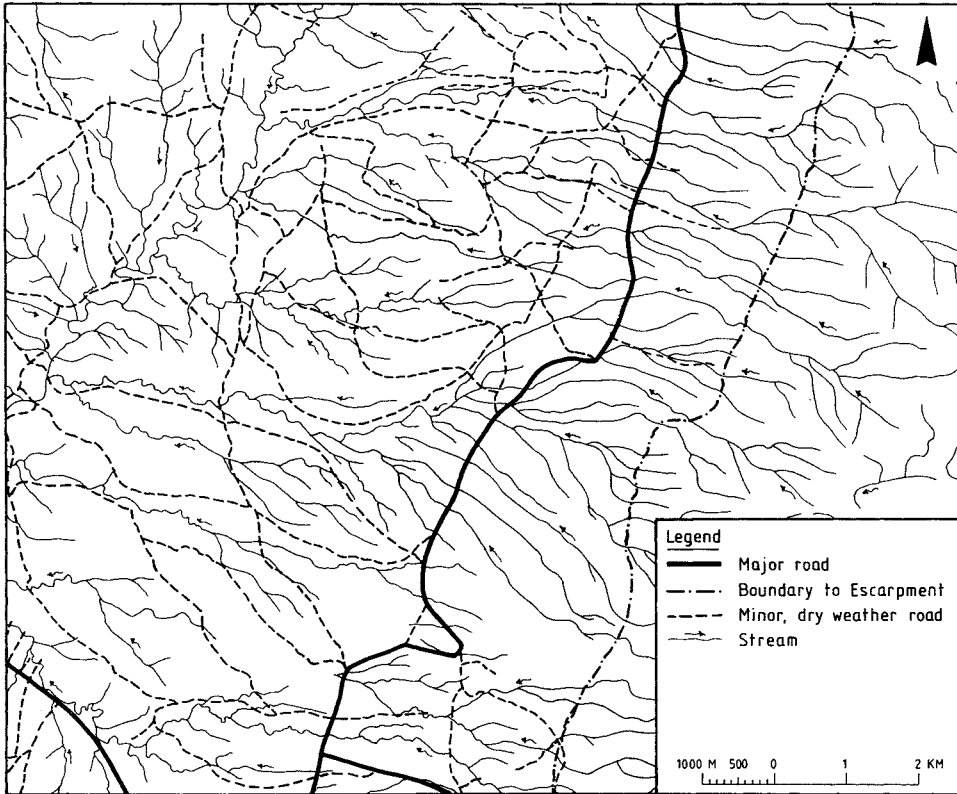


Figure 5.3 Water courses in the study area.

Still, in-migration is higher than out-migration for the Chingale area. The increasing pressure upon the physical resources, especially land for cultivation, which has followed, has caused a number of land disputes. Such disputes are the most common cause of legal actions together with marital disputes. As discussed below, witchcraft is common in connection with such disputes.

Under these circumstances, it is not surprising that food supply is not sufficient to many households during a part of the year before the next harvest in April-May. However, those who have *dimba* gardens (see below) are in a much better position, as these provide a possibility to harvest a crop when food supply is most scarce in December to April.

Availability of firewood - implications for health

The natural vegetation provides another important resources base. Firewood, the main source of energy for domestic use for all the families in the study area, is largely derived from the naturally forested areas. Poles and grass for the construction and thatching of houses are derived from the same

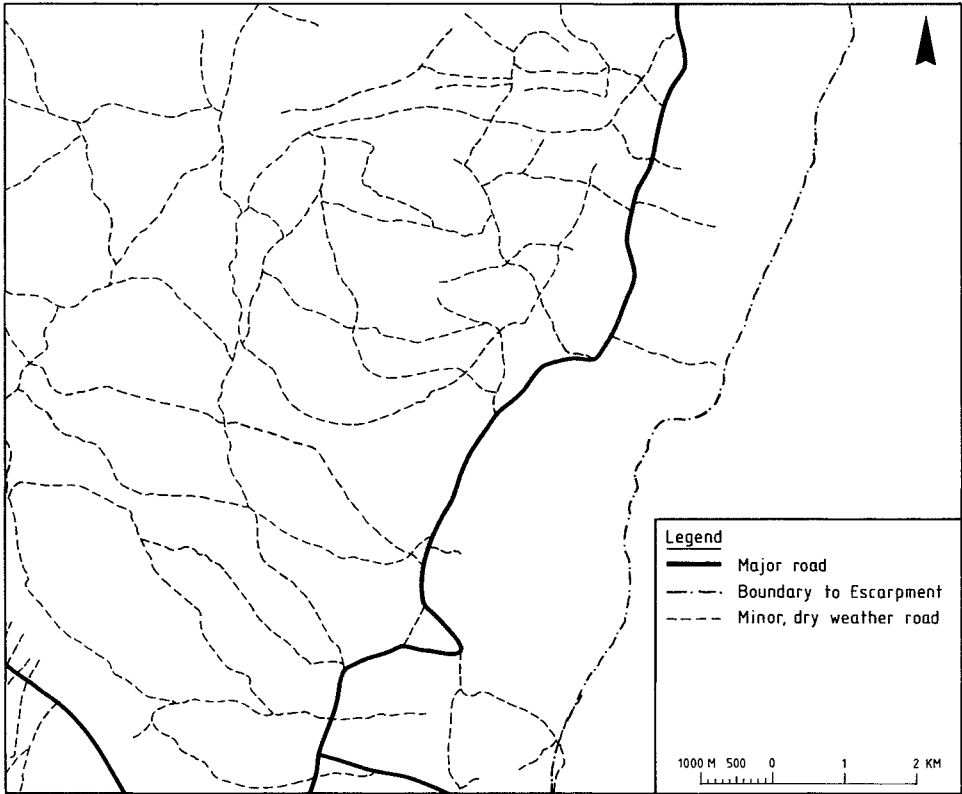


Figure 5.4 Roads of the study area.

source. Regrettably, however, the open canopy woodland type vegetation, which originally characterised the area, has been cleared for cultivation. Many families now have to walk long distances to obtain firewood, often up to 10 kilometers to the edge of the forest reserve at the escarpment.

Firewood is essential for health conditions although the implications of its availability are not as immediate and obvious as they are with water resources. However, its significance is often underestimated. In many countries of the tropics, forests have been cut down in order to safeguard the need for firewood and building material. The loss of trees and other vegetation cover not only increases the distance to such resources, but it also has contributed to environmental hazard and rapid surface runoff etc. It is then not surprising that boiling drinking water, which requires around one kilogramme of firewood to boil one litre of water, is completely unfeasible. Instead, a more realistic method to obtain water of reasonably good quality under poor conditions in tropical countries with sufficient sunshine is so lar disinfection (Acra *et al.*, 1984). It has not been practised in Malawi but could fairly easily be done.

In the study area, firewood is almost exclusively used for cooking food. On rare occasions it is used for boiling water, for instance for a child who has diarrhoea. Hot water is never used for washing or for house cleaning purposes. However, it is common during the cold season to heat water for the bath of the husband!

Apart from the forest reserve of the Zomba mountain, there are hardly any forests within walking distance of the study area. The little that is found on the plains is quickly cut down long before it has grown to full size. Most people, therefore depend upon cutting fire wood illegally in the forest reserve of the mountain, where they go whenever they need it. Forest reserve guardians have little possibility to protect the vast, steeply sloping mountain sides and hills, which cover an area of several hundred square kilometres. Collecting firewood as well as drawing water is the responsibility of the women. Most women in the study area go to collect firewood about once a week. Often older children assist them.

Households further down the plains have a distance of 8 to 10 km to the edge of the forest reserve. The women of these households spend as much as 8-10 hours per week to collect firewood. Especially during the time of the year when the gardens require a lot of work, *i.e.* the cropping season from October to April, time is a scarce resource. The "marginal" time requirement of 8-10 hours per week may be very detrimental to the mother's possibility to give good child care. The provision of sufficient food and especially the looking after young children may then be hard to attain.

Demographic and social characteristics

Population size, growth and density

The Chingale area had a lower population density than most other parts of the Southern Region up to the 1950's but has seen a rapid in-migration during the last decades. The population increase of T.A. Mlumbe (Traditional Authority of Mlumbe - the administrative unit in which the study area is located) was the highest in Zomba district some ten years ago. A comparison of the population censuses of 1966 and 1977, reveals a population increase of 46 % compared to 25 % for the district as a whole. The population density increased from 79 inhabitants per square km in 1966 to 115 in 1977. This is, however, lower than the average for Zomba district, which was 137 inhabitants per square km in 1977. The immigrants have mainly come from the most densely populated areas of the Southern Region, and also to a large extent from Mozambique (19 % of the heads of households in the study group were born there).

Within the study area the total population enumerated in the 1977 national population census was 3 402. According to our village population census, by January 1983 the population had risen to 4 166, an increase by about 22 % in six years, or about 3.3 % per year. The national average increase is 2.6 %.

The relative attractiveness of the area and the dynamics of in-migration may be seen from the changing ethnic composition. The Mang'anja were the original inhabitants of the area up to the middle of the 19th century. At that time Yao people who originate in Macombique and Tanzania moved into the area as well as to many other parts of the Southern Region. They successfully pushed the Mang'anja away from the best land near the escarpment. The Mang'anja then moved further down towards the Shire River. The Lomwe is another ethnic group which arrived later during the 20th century and who generally got poorer land and settled further down. The 1983 village survey revealed that the Yao today is by far the most dominant ethnic group in the study area accounting for 70 percent of all the heads of households, followed by the Chewa, 17 % and the Lomwe 9 % (Table 5.1).

Table 5.1 *Ethnic belonging of the head of household in January 1983 before intervention and in November 1984 after intervention.*

Ethnic group of the head	Before		After	
	N	%	N	%
Yao	552	69	545	71
Lomwe	75	9	102	13
Chewa	136	17	93	12
Ngoni	22	3	24	3
Other	16	2	11	1

Household size and headship

The criterion used in this study to determine which people belong to a household is the one used by the National Statistical Office in its surveys. A household includes persons who are present in the village at least once a month and eat food which is cooked in common. If a husband visits the household at least once a month it is assumed that he can take part in decisions concerning the household and is therefore considered a member of the household. If a man is present he is the head of the household, which was the case in 74 % of the households (Table 5.2). Few of the heads of households hold key positions in the village (Table 5.3). 20 % of the mothers with children under five years of age were heads of the household (Table 5.4). In cases where a woman is the head of the household, she may either be married but with a husband present less than once a month or she may be unmarried, divorced or widowed. There may be one or more adult women in the same household,

Table 5.2 *Sex of the head of household in January 1983 before intervention and in November 1984 after intervention.*

Sex of the head	Before		After	
	N	%	N	%
Male	593	74	607	74
Female	203	26	218	26

Table 5.3 *Position of the head in the village.*

Village headman	11	1	7	1
Local party leader	51	7	54	7
Village development & school committee member	11	1	23	3
Health committee member	0	0	18	2
Other position	25	3	165	20
no position	698	88	551	67

Table 5.4 *Number of households (N) and position of the mother with child(ren) under five years, before and after intervention.*

	Before		After	
	N	%	N	%
The mother is the head	135	17	173	21
wife	543	70	556	68
daughter	81	10	62	8
other	24	3	24	3

e.g. a mother and her daughter who has her own children or two or more sisters.

Around 30 % of the heads of households were under 30 years of age, while 35 % were over 40 years (Table 5.5). Around 70 % of the heads of households were married and non-polygamists, while 14 % were divorced in January 1983 and 19 % in November 1984 (Table 5.6).

Members of a household need not necessarily live in the same house. Most young men, for instance, build and live in their own houses when they are around 15 years of age and yet continue eating food prepared by their mother. It should be noted that the concept of "household" is narrower than that of "extended family". The latter refers to a wider grouping of persons re-

Table 5.5 *Age of the head of household before intervention (January 1983) and after intervention (November 1984).*

Age of the head	Before		After	
	N	%	N	%
15-19	8	1	11	1
20-24	91	11	52	6
25-29	155	19	154	20
30-34	144	18	188	24
35-39	127	16	91	12
40-44	77	10	90	11
45-49	78	10	77	10
50-	119	15	130	16

Table 5.6 *Marital status of the head of household, before and after intervention.*

Marital status of the head	Before		After	
	N	%	N	%
Never married	8	1	19	2
Married, non-polygamist	579	72	544	66
Married, polygamist	77	10	78	10
divorced	114	14	158	19
Widowed	20	3	24	3

lated to an individual, but who may not necessarily eat food which is cooked in common on a regular basis. Parents, brothers, sisters, nieces, nephews, cousins, uncles etc, although living miles apart and not eating regularly food cooked in common, may nonetheless be members of one's extended family upon whom one can call for assistance in times of need.

The 4139 inhabitants of the study area enumerated in 1983 belonged to 1123 households, giving an average household size of 3.7 persons. However, the number of persons per household varied considerably from 2 to 15. Around three out of four households had 3 to 6 members (Table 5.7).

Sex and age distribution

In common with many other rural areas of Malawi there is an excess of females over males in the study areas as reflected in the male/female ratio of 78.4 males to 100 females. However, there are considerable variations between the three areas in the level of sex imbalance. This phenomenon is generally accounted for by male labour migration to employment centres

Table 5.7 *Size of the household, before and after intervention.*

No of members	Before		After	
	N	%	N	%
2	39	5	26	3
3	135	17	101	12
4	177	22	222	27
5	187	24	168	21
6	101	13	110	13
7	64	8	82	10
8	50	6	53	6
9-15	43	5	62	8

either within or outside the country, the importance of the latter declining in recent years. In area 3, 13 % of the husbands were working outside the area and did not return to the wife every month. This is the area, where a relatively large portion of the population is involved in the cash economy, and which is least traditional.

Similar to other parts of the country, the population of the study areas is characterised by its youthfulness. Nearly 45 % of the population is aged below 15 years, with nearly 20 % below 5 years. About two thirds of the households had two or more children aged below five years (Table 5.8). At the upper end, less than 5 % of the population was 60 years and above. These demographic characteristics suggest a high rate of fertility accompanied by a high rate of mortality in the population.

Table 5.8 *Number of children under five years in the household.*

No of children under 5 years	Before		After	
	N	%	N	%
1	261	33	343	42
2	404	50	338	41
3	127	16	126	15
4	6	1	15	2

Education and occupation

No specific information about education was collected for the entire study population, but there is little doubt that a high proportion of the population

is without formal education. According to the 1977 national population census, only 55 % of the population aged above 5 years more either attending school or had primary education. More than 50 % of the heads of households had no primary education at all while about a quarter had primary education only up to Standard 4, which in general is not adequate for permanent literacy (Table 5.9). Data of the village census, which was generally confirmed by people, suggests that the rate of educational attainment in the country as a whole tends to be lowest among the Yao. They are predominantly Moslem and have traditionally been negative to western education because of its historical, association with Christianity.

Table 5.9 *Education of the head of household, before and after intervention.*

Education of the head	Before		After	
	N	%	N	%
None	430	54	437	54
Standard 1-4	207	26	189	24
Standard 5-8	151	19	161	20
Secondary school	11	1	17	2

Nationally, women tend to be behind men in the level of educational attainment. In 1977, 44 percent of the males aged 5 years and above, were reported as having no education, while the corresponding figure for females was 64 percent. This gender differential is reflected within the study area, where 65 % of mothers with children under 5 years were found to have no education (Table 5.10); the corresponding figure for heads of households (man or woman) was 54 %.

Table 5.10 *Education of the mother with children under five years, before and after intervention.*

Education of the mother	Before		After	
	N	%	N	%
None	506	65	539	67
standard 1-4	182	23	164	21
standard 5-8	88	11	95	12
secondary school	2	0	2	0

An overwhelming majority (68 %) of the heads of households enumerated in 1983 reported farming as their main occupation. The remainder were mostly self-employed small businessmen or traders. The majority of these people were nonetheless not entirely divorced from agriculture. In Area 2 and especially in Area 3 it was more common with seasonal farm labour on estates (Table 5.11).

Table 5.11 *Occupation of the head of household, before and after intervention.*

Occupation	Before		After	
	N	%	N	%
Farmer	542	68	583	73
Businessman	47	6	41	5
Teacher	10	1	3	0
Cash employment in the area	24	3	68	9
Tailor	22	3	14	2
Builder/carpenter	54	7	43	5
Other & employment elsewhere	95	12	50	6

Housing, sanitation and hygiene constructions

Physical, cultural and economic factors have contributed to the housing conditions of the area. The houses are generally constructed of wooden poles and bamboos, with the walls being plastered with mud (Table 5.12) and the roofs thatched with grass (Table 5.13). The floors are commonly of bare soil, neither cemented nor tiled (Table 5.14). A few houses have walls with burnt bricks, corrugated iron/ zinc roofing, and cemented floors. They reflect changing circumstances and a sign of affluence by the local village standards. But even in these houses the furniture and amenities are basic and do not include such things as electricity (for refrigerators and cookers) or piped water which are commonly associated with modern housing.

Besides the main house in which the head of household lives, many households have a separate house/hut which serves as a kitchen (Table 5.15). The latter may also be used for older children to sleep in and/or for keeping chickens at night. Chickens are, however, often kept in separate smaller structures. But whether they are kept in a separate structure or in the kitchen (or even in the main house), the chickens are allowed to feed freely during the day and could be found in any part of the homestead.

Sanitation structures are usually part of the homestead although they are by no means universal. About 70 % of the households had a latrine (Table 5.16), while there were 76 % which had a bath-shelter before intervention

Table 5.12 *Type of walls of the main building.*

Type of walls	Before		After	
	N	%	N	%
Mud	157	20	21	2
Burnt bricks	31	4	46	6
Unburnt bricks	523	65	583	73
Mud with poles	79	10	142	18
Other	9	1	7	1

Table 5.13 *Type of roof of the main building.*

Type of roof	Before		After	
	N	%	N	%
Thatched	756	95	759	95
Corrugated iron	43	5	39	5

Table 5.14 *Type of floor of the main building.*

Type of floor	Before		After	
	N	%	N	%
Mud	777	97	767	96
Cemented	22	3	30	4

Table 5.15 *Building for kitchen.*

	Before		After	
	N	%	N	%
No	407	51	445	56
Yes	392	49	350	44

and 69 % after (Table 5.17). Before intervention 32 % said that they used the refuse-pit while only 19 % after intervention. Many people were aware of the fact that refuse-pit is the best method of waste disposal. It seems that people were more conscious about their replies at the beginning of the study, *i.e.* before intervention (Table 5.18)! Most people put their dishes on a dish-rack

Table 5.16 *Availability and condition of the latrine (January 1983).*

	N	%
No latrine	242	31
Yes, good condition	65	8
Yes, average condition	452	58
Yes, bad condition	21	3

Table 5.17 *Availability and condition of bath-shelter (January 1983).*

	N	%
No bath-shelter	186	24
Yes, good condition	86	11
Yes, average condition	491	63
Yes, bad condition	21	3

Table 5.18 *Disposal of rubbish.*

	Before		After	
	N	%	N	%
In the refuse-pit	252	32	150	19
In the bush	244	31	253	32
Anywhere	303	38	388	49

(26 %) or in a basket (52 %) (Table 5.19). Families with goats or sheep would also have a separate structure for these, the animals being let out during the day to feed either free range (especially during the dry season after most

Table 5.19 *Disposal of dishes.*

	Before		After	
	N	%	N	%
On a dish-rack	207	26	202	27
In a basket	415	52	384	52
On the ground	25	3	28	4
In the house	7	1	1	0
Anywhere	143	18	123	17

crops have been harvested) or confined to particular pieces of grazing land where their movement is restricted.

Houses and related structures belonging to members of the same household or even the wider extended family are often clustered together. However, it is not unusual to find some houses isolated from others. In either case it is common to have fruit trees such as mangoes, paw paws and bananas in the vicinity of the houses.

Settlement pattern and water-related diseases

Availability of water for domestic purposes together with efficient drainage and good soils are the main conditions which influence the settlement patterns and the distribution of houses among the Chewa and the Yao (Marwick, 1965). This is probably not unique to Malawi but universal. The relatively good quality of the soils together with the fairly common occurrence of surface water in most parts of Malawi means generally favourable living conditions compared to other parts of Africa.

Both the Chewa and the Yao settle in a semidispersed way, while other people like the Ngoni live in highly clustered villages. The houses usually last five to ten years. Traditionally, a house was demolished when a person died. Nowadays, houses are usually "treated with medicine to cleanse them of the harmful effects of the death and they are used again" (Mitchell, 1956). However, they need to be repaired continually. The daughters of a woman stay near their mother, but may build their house on the outside fringe of already existing houses. When their mother's house collapses she may build her house on the outside fringe near to her daughter's house. "In this way the spatial distribution of the huts gradually comes to reflect the segmentation of the lineage". Thus, "The physical form of the village is reflecting the continuing social differentiation" (Mitchell, 1956).

As is well-known from an epidemiological point of view, the transmission of contagious diseases is facilitated with increasing density of settlement. Therefore, the settlement pattern of the Chewa and the Yao should be more favourable for the prevention of spread of diseases such as diarrhoeal diseases and skin- and eye-infections compared to the settlement pattern of the Ngoni.

When the relationships of the settlement patterns to these diseases were tested, they were not found to be significant. It could be added that the general hygiene condition in the study area is so poor, that the additional risk of contracting a contagious disease from neighbours in a densely populated area is minimal.

Cultural aspects

Although several ethnic groups are represented in the Chingale area in general and the study area in particular, the numerically dominant groups

of Yao, Mang'anja and Lomwe share many common cultural characteristics. Some differences exist but these have tended to fade over time because of intermarriage and close interaction among the different groups.

Land tenure

In common with other parts of Zomba district and indeed most parts of the Southern Region, the people in the study area are matrilineal which means that land belongs to the wife's family, of which the wife's oldest uncle or brother is in charge. The family has obtained the rights to the land from the village headman who has the power to allocate land previously not distributed and also to withdraw land from people who mismanage their land. He may distribute this land to people who are settling in his village. If a family grows it may approach the village headman to get more land.

In principle a man gets access to land through marriage, as his own mother's land is supposed to be shared amongst his sisters. However, it is sometimes possible for a man to acquire some of his family's land if he is living in the same village, e.g. when he is divorced.

Marriage

The Yao, Mang'anja and Lomwe are not only matrilineal but also matrilocal. The girls inherit the land and the husband moves to the wife's village at marriage, although the reverse sometimes occurs with the special consent of the wife's relatives. The latter occurs especially where the man has special responsibilities or property in his home village. When the man moves into the wife's village, he builds a house for his family.

It is often argued that the matrilocal system of marriage does not induce a man to invest in his wife's village. Instead he tends to spend only some of his time and money there, since he often returns to his own village where he may be the head of his sisters' families. This is especially the case if he is the eldest brother. He may also have to return there when he is divorced. He is, therefore, inclined to make more investments there than in his wife's village where his children live. Thus the money which in theory is available to a household may not be equal to that which is actually spent on its members, including the children.

Men who have regularly visited towns often wait to marry until they are at least 25 years, while those who have never or rarely visited towns tend to marry at an earlier age. Marriage between a man and a woman is said to exist if the maternal uncle or brother, *ankhoswe*, of the man and the woman agree at a simple ceremony that the two are allowed to marry. There is no religious part to this ceremony.

Sometimes this ceremony takes place after a couple have stayed together for some months. The ceremony serves the purpose of validating the existing relationship. In the past, it was common practice for a young man to have

a wife chosen for him by his parents or for a girl to accept her parents' choice of husband but this practice is now rare.

If the partners belong to a church, then the traditional ceremony is confirmed at a ceremony in the church. Moslem marriage ceremonies are called *ndowa* and are done either in the presence of a sheik or *mwali mu*. It is equivalent to a Christian ceremony.

If one or both of the partners wish to separate, they meet together with their respective *ankhoswe* to agree that the marriage will be dissolved. If one of the partners is away (e.g. if the husband is abroad for many years), then his *ankhoswe* may act on his behalf and dissolve the marriage. This agreement is called *kusudzula*. A small amount of money, *mpambala*, is paid by the partner who takes the initiative to signify the divorce. This may be 50 tambala to one kwacha, but sometimes as little as one tambala. If one of the partners of a marriage dies, the other cannot remarry unless *kusudzula* has taken place.

On the initiative of one of the parties involved, divorce may have to be sanctioned in a traditional court. This happens when, for instance, a woman and her *ankhoswe* feel that there are no valid grounds for divorce and that the husband should be penalized for terminating the marriage. In general, reference to a traditional court implies that the husband and wife, together with their respective *nkhoswe* have failed to reach a mutual agreement on divorce. For Christian families the church may also become involved in matters relating to divorce, its usual role being that of trying to prevent it from happening. Of the mothers with children under 5 years, 2 % were unmarried, 82 % were married, 15 % were divorced and 1 % widowed (Table 5.20).

Table 5.20 *Marital status of the mother with children under five years.*

Marital status	Before		After	
	N	%	N	%
Never married	14	2	22	3
Married	638	82	610	75
Divorced	113	15	173	21
Widowed	7	1	6	1

Although Islam is the dominant religion in the area and polygamy is accepted practice among Moslems, few men (10 %) are polygamists (Table 5.6). Most men cannot afford polygamy or they feel that their wives will not accept it and may bewitch them.

The total number of children which a woman gives birth to is determined by a number of factors, of which the most important are age at marriage, and the use of traditional birth control measures. Prolonged breast-feeding may

contribute to increased child-spacing. In general, however, there is no conscious attempt to reduce the number of children born. Even in the young generation there is a positive attitude to having many children. The following statement by a 17 year old Moslem girl may illustrate this: "I would like to have as many children as God can give me, even 10 or 15". Table 5.21 shows the total number of births of mothers in the area.

Table 5.21 *Number of children which the mother has given birth to.*

No of children	N	%
1	78	10
2	135	17
3	167	21
4	117	15
5	94	12
6-7	105	13
8-9	55	7
10-11	33	4
12-13	12	1

Religion

Traditional religion is deeply rooted in all people in Malawi, even among Christians and Moslems, although the majority of the people do not regularly practice it. They may not even be aware of its significance to themselves. Still, its importance comes forth in times of crises, *e.g.* lack of rain, famine, illness and death.

There are several shrines (places for traditional worship) in Malawi which are used for prayers especially at times of crisis. There are a number of minor shrines in different parts of Zomba district, but the nearest major shrines are in Chief Liwonde's and Chief Kalembo's areas in Machinga district. Villagers and Village Headmen bring offerings to the shrine. This is sometimes also done by Christians, although the church does not allow it. According to Father George Matinga some people in T.A. Mlumbe also visit shrines, although Christians do it secretly to avoid being ex-communicated by their church.

The dominant religion of the study area is Islam. At the beginning of the study in January 1983, 60 % of the heads of households in the study group (households with children under 5 years in the area) were Moslems (Table 5.22). The remaining 40 % were of different Christian denominations, of which the Church of Central Africa Presbyterian was the biggest with 16 %,

Table 5.22 *Religion of the head of household (January 1983).*

Religion of the head	N	%
Moslem	470	60
Catholic	97	12
Presbyterian	134	17
Other	85	11

followed by the Catholic church with 12 %. There were big variations between the three areas. Other Christian denominations than the Presbyterian and the Catholic church were more common in area 3 than in other two areas. The religion of the mothers with children under five years showed roughly the same distribution as for the heads of households (Table 5.23).

Table 5.23 *Religion of the mother with children under five years (January 1983).*

Religion of the mother	N	%
Moslem	458	60
Catholic	81	10
Presbyterian	136	18
Other	95	12

Within the whole study group there were only four household heads who responded that their religion was traditional. This reflects the condition that virtually all people in Malawi have been in contact with either the Christian or the Moslem religions. They may have gone to school at a mission station or lived near one or may have relatives who belong to one of these religions. Still they may hardly ever have practised this religion. It is often regarded as inferior to practice traditional religion. But as noted earlier, traditional religion is still deeply rooted even among practising Christians and Moslems. There is no clear cut pattern; most people have faith in a bit of each.

Initiation ceremonies

Between the age of 11 and 14 both boys and girls are brought to initiation ceremonies, *chinamwali* for boys and *nyanja* for girls. This is particularly important for Moslem Yao families for whom such ceremonies are not simply a form of education but also an important religious ritual. For Moslem boys the religion demands that the ceremony must involve circumcision.

To decide a suitable time for an initiation ceremony, the village headman performs prayers and at the same time makes offerings of some flowers at a *msolo* tree. If the flowers are upright the next morning then the ceremony can take place. Otherwise it has to be postponed. These days, because of pressure from government, which insists that such ceremonies should not coincide with school days, they are held mainly in August and September but in the past any time during the dry season would be considered acceptable.

The chief then leaves the initiation ceremony in the hands of the *nankungwi*, the equivalent of a teacher. The rest of the ceremony is undertaken either in a temporary grass shelter outside the village or in a house, the latter being particularly common for the initiation of girls. Mothers of children undergoing initiation are expected to provide food and indeed the whole ceremony and its associated celebrations can be, by local standards, expensive in terms of money, food, and effort for the families concerned.

Ceremonies associated with economic activities

Religious and ceremonial practices are important from an economic point of view. Fishing, for instance, traditionally requires special religious ceremonies. Prayers are said and "medicine" applied to the fishing net and the boat. If an accident happens, a diviner (see below under disease) is consulted to determine the cause. If the diviner finds that a certain person who is not on good terms with the fisherman caused the accident, that person may be requested to visit the fisherman to indemnify the damage, *kupemera*.

In the past, people would dance and walk across the fields to get better crops. Sometimes "medicine" was applied to boost the crop by taking a share from a neighbour's garden, *kufumba*. These practices are, however, fast disappearing. Similarly, belief in the need for the application of "medicine" before building a modern house to protect it (i.e. a house with brick walls, roofed with corrugated iron sheets, and cemented floor), or before building or buying a shop, or buying a car, is disappearing. It was believed that without such protection people jealous of your acquisition would harm you through magic or witchcraft.

Diseases and traditional attitudes towards illness

Almost all illnesses and death are believed to be unnatural. It is only in connection with old age that illnesses or death are considered "natural". Even then, unnatural causes are commonly suspected.

If someone is ill, he/she goes to a diviner, who is a person who reveals secret things, e.g. which spirit or witch, is causing the illness. However, the diviner does not usually carry out any witchcraft treatment against a disease as the *sing'anga* (see below) does, unless he is both a diviner and a *sing'anga*.

Diviners are common in most villages. Some have better reputation and are more in demand than others. People may be willing to travel long distances to reach such people. Before people go to hospital, the diviner is often consulted, although increasingly these days the diviner is only consulted if an illness has proved persistent and western medicine has proved ineffective.

If a person needs treatment for a disease, he goes to the *sing'anga*, the traditional doctor/herbalist, who prescribes herbs or other traditional medicine. The *sing'anga* may also provide protection. If a person is troubled by witches (*mfiti*, see below) a special group of *sing'anga* called *seketera* may find out the intention and practice of the *mfiti* and deal with him/her. The *sing'anga* may also provide protection of a house or any other property against the actions of witches.

The reason why a person is bewitched may be that he/she has been prosperous or has a successful family life (e.g. ownership of cattle, grocery store or other business, many children, good reputation expressed as "his name is heard everywhere"). This may lead to other people's jealousy. Witchcraft is mainly used within the family or clan. Supernatural powers are supposed not to function outside these social units.

There are several ways through which a person may be bewitched. It could be through symbolic action. The person who is jealous of some one goes to a *wamasenga*. Together they try to identify the victim by looking into a mirror. Concrete actions may also follow. The *wamasenga* may use a magical hammer to beat the victim, which is called *kumenyedwa* (=to be beaten). Sometimes food, water, beer or other drinks may be poisoned. Another alternative is that the route of the person to be punished is found out and some *mankhwala* (medicine) is dug down into the road on which the victim will travel. The *mankhwala* is supposed to cause a disease or accident as the person passes the place.

Illness in young children can be associated with certain behaviour pattern. For instance, food-deficiency related diseases such as kwashiorkor and marasmus are often accounted for in terms of the extra-marital sexual behaviour of the child's father. When a child shows symptoms of these diseases, the father is suspected of having had extra-marital sexual relationships and if the child dies this could lead to divorce.

However, through health education at under five clinics many mothers are aware of the true causes of this type of diseases. 74 % of the mothers had attended health education at an under five's clinic at least once.

Economic and social aspects

Food production

Subsistence agriculture is the mainstay of the local economy. Paid employment opportunities within the area are very rare. Those employed are either

working at an agricultural estate or at Chagalume Cement Factory, both located nearby, but outside the study area. At the time of the study, cash crops were hardly grown as the main crop in the area. Only two farmers grew cotton as their main crop and one farmer grew tobacco. Most farmers (97 %) reported maize, the area's staple food, as their most important crop, followed by cassava, an other subsistence crop. Groundnuts, peas, beans, sweet potatoes and pumpkins are other subsistence crops but these are generally of secondary importance.

Subsistence crops can be a valuable source of income. Any surplus produce above subsistence requirements can be sold either to local traders or ADMARC, a statutory marketing board with seasonal markets within the area. In fact farmers badly in need of cash, sometimes sell more of their produce than could be considered safe in relation to their food requirements. Some farmers grow beans, groundnuts, cassava, or hybrid maize as secondary crops specifically with the market in mind.

Most of the crops are grown as wet season crops on rain-fed land. Maize is planted at the beginning of the rainy season in November-December and harvested towards the end of the rains in April. Sweet potatoes are planted in December-January and harvested in May-June. Cassava is planted either at the end of or just before the rains and is harvested any time after one year. Beans, groundnuts and pumpkins are often inter-cropped with maize.

Shifting cultivation is now much less common than only one or two decades ago, as the population pressure has made it impossible. Most rain-fed land, especially near the escarpment, tends to be permanently cultivated, often without crop rotation. Further away from the escarpment where the land is less fertile and the rainfall is less reliable, the cultivation is less intensive.

Near rivers there are large pieces of land called *dambos*. Such areas may be cultivated also during the dry season, in many cases all year around, as the water table is high. The land thus cultivated is called a *dimba* garden. Thus two, occasionally three, crops per year may be harvested in a *dimba*. Before the rains in September-October, maize or rice is usually planted in the *dimbas*. Maize is ready for harvest in February-March, while rice is transplanted from nurseries in December-January and is harvested in May-June. The *dimbas* may be prepared for other crops, like beans, turnips, cabbage and other vegetables, in April, which are planted in May. Turnips, cabbage and vegetables are ready for harvest in June-July, while beans require longer time and are ready for harvest in September-October. Maize may also be planted twice per year depending upon water availability. A few people irrigate the *dimba* in order to get even higher yields.

Daily routine work, variation in food availability and nutrition

Most people get up early in the morning, usually at sunrise around 4-5 a.m. Particularly during the hot season before the rains, *i.e.* in October-November, people start to work early. In that season it is hot already around 9 o'clock 10 a.m. and the gardens (fields) require a lot of work to be prepared for planting when the rains come. Usually people do not eat any breakfast immediately as they get up but go straight to work in the gardens or to other activities. Sometimes cassava or sweet potatoes, avocados or fruits of the season are eaten during work.

Young children are breastfed whenever they are hungry, which means that the mother often wakes up several times during the night for breastfeeding. Apart from early work in the garden the mother may undertake other tasks in the morning like sweeping of the surroundings of the house, drawing water and collecting firewood. Markets are held only during morning hours. It is also common to wash clothes, to pound maize or alternatively go to the maize-mill for grinding. It should also be added that under five's clinics are open only in the morning. All this means that there are severe time-constraints and ensuing stress on women during part of the day.

In many cases the woman does the majority of the work in the garden. It is the man's duty to clear new gardens and to build houses, while he only occasionally works in the garden. When the mother goes to work in the garden, she either takes her children with her, especially the very young ones under one or two years of age. If she has someone to look after the children, it is often a girl of only 7 or 8 years of age. The number of hours spent in the garden varies from less than an hour up to 5 or 6 hours.

When the mother returns from the garden, she has to prepare porridge or some other breakfast for the younger children who are not breast-fed. Food is in short supply during the rainy season before the maize harvest. At that period it is mainly cassava, which provides the basic food supply.

Most people eat twice a day when the household has sufficient maize. The first meal is usually at midday and the second at or after dusk. *nsima*, which is maize flour boiled around 40-60 minutes, is the staple food. Some of the people who have a *dimba* garden, grow and eat rice. *nsima* is eaten with some "relish" like beans, peas, pumpkin leaves, turnips or other green vegetables, which are available at a particular season. Dried fish is occasionally bought at markets or from traders in the village. Meat from chicken, doves, goats and other animals is eaten at special occasions.

The cooking is done either in the kitchen, which is a separate house (50 % in the study group) or on the *khonde* (verandah) of the house. There is usually only one fire-place so that the relish and *nsima* have to be cooked one after the other. This means that the woman has to spend around two hours to cook each meal, apart from the time it takes to prepare the food, wash it, soak it,

etc. Plates and cooking utensils are either washed at the river or at home. Sand or ash is often used to clean the pots and utensils, which means that they are quickly worn out. Sometimes there is a dish-rack to put them for drying or otherwise they are left on the *khonde* or on the ground to dry (Table 5.19).

Food availability and nutrition

From a nutritional point of view *dimba* gardens are an important, if not crucial, ingredient of the agricultural production. Together with cassava (and sweet potatoes) they provide the only food supply to many people during the wet season before the harvest at the end of the rains. As this time coincides with the peak in labour demand and the peak in diseases, this period is a time of major strain on the people.

People who have finished their maize supply and do not have any cassava and no *dimba* garden (70 %) have to rely on either gifts from relatives or on buying the food for cash. Occasionally they sell goods like radios, bicycles, etc. or borrow money from relatives with employment or else they have to work in other peoples' gardens (15 %) for which they may be paid in cash or in kind. It is then no surprise that the period from January to April is called the "hungry" season and that many people eat at most once a day at that time of the year.

Conclusion

From the above description it should be obvious that the Chingale area shares many common characteristics with other rural areas of Malawi and indeed of tropical sub-Saharan Africa. Climatic seasonality, low levels of education, strong beliefs in unnatural causes of illness, heavy dependence on subsistence agriculture, low levels of nutrition and relatively poor water and sanitary and hygiene conditions, are some of these characteristics. It is also evident from the above description, that women have a great responsibility to provide food for their families even where a husband is present. Any water supply and sanitation improvement programmes should take these factors into account.

6. Water Supply, Water Handling and Health Implications

Development of rural water supply programmes in Malawi since independence

Malawi became independent in 1964. From the end of the 1960s there was a dramatic increase in the provision of improved rural water supply. The number of new boreholes increased from around 40 per year before independence to an average of 400 per year around 1970 (Wilderspin, 1973, p. 3). There is also a programme to construct shallow wells, which are much cheaper than boreholes and allow more participation of the people who will use the water. For further details about the development of the rural water supply in Malawi, see Lindskog & Lindskog (1982).

In 1968, the first piped gravity water supply project started at Chingale in western Zomba district. The Department of Community Development of the Ministry of Community Development and Social Welfare was involved in an adult education and health/sanitation project in this area, when people pointed out that their main problem was to find safe water nearby. However, some miles away there was clean and safe water from the mountain available. The Government then agreed to supply pipes, if the people did all the trench-digging and other manual work on a self-help basis. The project was therefore wholly initiated, planned, implemented and maintained by the people in the area and consequently became their pride (Glennie, 1979; Glennie, 1983; Bharier, 1978).

The Chingale project was followed by the much larger Chambe project in 1969-1970 designed to serve 30 000 inhabitants in 60 villages. Village leaders from the Chambe area were taken to the Chingale project, where the water supply committee proudly showed the visitors their project. The leaders from the Chambe area returned home and were given time to discuss whether or not a project should be started. At a public meeting the decision to start the project was taken and committees were formed. After an initial enthusiasm by most inhabitants, the progress of this project gradually slowed down due to political unrest initiated by some clandestine political elements who opposed the ruling Malawi Congress Party. Fortunately, the water was by this time flowing through the pipes, and people gained confidence in the project again. It was finally completed in 1969 (Glennie, 1979).

The lessons learnt through the Chambe project was that "there was a credibility gap between what the leaders had seen at Chingale and what they were able to convey to the people", that "the project was too large for a pilot project in a new area", that "field staff should be drawn directly from rural com-

munities", and that "while self-help was suitable for tasks requiring unskilled labour, it was not so suited to skilled work" (*ibid*, 32). The water project which the present study evaluates, the Zomba West piped water project, surrounds the original Chingale piped water project.

Since then the piped gravity water programme has expanded considerably and served 750 000 inhabitants by 1983 (Ministry of Health, 1983, 10) and probably around one million by 1987. The mean water consumption *per capita* and day was 12 litres in 1983, less than half the designed capacity (*ibid*, 11). Previously, the staff of the water project instructed people about water handling and storage, hygiene etc. With the new division of duties between the ministries, these duties fall under the Ministry of Health (see chapter 7).

The community organisation of the piped water projects in Malawi

Nowadays, most piped water projects in Malawi are initiated at the request of local leaders through the District Development Committees. The local people are responsible for marking the pipelines, clearing temporary access roads to storage tank sites, digging the trenches, excavating tank sites, loading and unloading pipes, collecting local material, laying the pipes, filling the trenches and finally planting grass to mark completed pipelines. Major projects involve several villages, which work together often involving more than one traditional authority (the smallest administrative unit) and sometimes more than one district. A high degree of organisation is required at the village level in order to carry out the work successfully. The community organisation is based on existing institutions in the community and on local leadership. Thus at the district level, the District Development Committee plays an important role in the initial stimulation of the project. Very often a proposal for a project will come to the Water Department from local people through the District Development Committee.

The Main Water Project Committee is responsible for the overall management of the project. The programme for the involvement of the different villages is prepared by this committee. It is also responsible for setting up the programme for digging the trenches of the main line. The Main Committee conducts elections for other committees and supervises their work. The villages which are located along the same section of the main pipeline elect a Section Committee, whose task it is to prepare a programme for the work of the villages along that section. Committee members organise and supervise the work of the villagers. In case there are problems related to the work, the committee calls all villagers concerned to a public meeting where the problems are discussed. If the section committee does not manage to solve the issue, it is referred to the Main Project Committee.

For each branch line of the project, Branch Committees are formed, which are responsible for organising all the work along that branch. They are organised in the same way as the Section Committees.

Finally, the lowest level in the organisation of the community is the Village Committee, whose task it is to ensure that all villagers attend the work as scheduled and to encourage and supervise the work.

This organisation has been developed over many years. The explanation for the relatively successful performance of these piped water projects may be attributed to a number of conditions, firstly, the long history of self-help in Malawi, secondly, the way in which this programme originated, not from above, from the authorities, but with a genuine popular demand, and thirdly, a proper approach by the government in the community organisation and the growth of the water programme.

Water sources, water storage and water use in Chingale area

Compared to many other parts of Malawi, the people living in Chingale area have access to relatively ample water resources. The distance from the house to the traditional drinking water supply of most households included in the study varies from only a few metres to a little over 1 km (Table 6.1). Even during the end of the dry season in October - November, there are few people who have more than 1 km to either a perennial river or a well or spring. During the rainy season, water is, of course, more easily available. Much of the surface water during this season is, however, highly contaminated. Various contaminants have accumulated during the dry season especially on the riverine slopes and are washed away at the onset of the rains into the watercourse (Wright, 1986).

The traditional water sources which people use in the area are either unprotected shallow wells (holes dug with a hoe by the villagers to reach the water-table) or unprotected springs or rivers. Springs are more frequent near the escarpment, while wells are more common further away from the escarpment. In the beginning of the survey, a majority of the households (56 %) used wells for their household water supply, while around 30 % used rivers (Table 6.2). Relatively few used springs. As mentioned in chapter 4, the connection of the gravity-fed piped water supply was delayed from the beginning of 1984 until the end of August 1984. Then the piped water supply was gradually extended into all three areas instead of only to area 1 and 2 as originally planned.

In the beginning of the after-intervention year in September-October 1984, only 5 % of the households used piped water, while a peak of 52 % was reached in May-June 1985 (Table 6.3). When an increasing proportion of households used piped water, fewer people used wells. During periods 11 and 12 only half as many used wells as before intervention. The water quality

Table 6.1 *Distance to water source (in metres) (January) 1983.*

Distance to water source (m)	% of households
0 - 99	12
100 - 199	16
200 - 299	17
300 - 399	13
400 - 499	8
500 - 599	7
600 - 699	4
700 - 799	6
800 - 899	3
900 - 999	3
1 000 - 1 300	11

Arithmetic mean = 420 m

Table 6.2 *Main water source used in January 1983.*

Type of water source	No of households	%
Well	302	56
River	162	30
Spring	75	14

Table 6.3 *Seasonal variations in the number and percentage of households using different types of water sources.*

Type of water source	Before intervention		After intervention		Period 9		Period 10		Period 11		Period 12			
	Period 6		Period 7		Period 8		1985 Jan-Feb		Mar-Apr		May-Jun		Jul-Aug	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Well	200	63	271	66	234	60	179	50	149	36	119	29	128	33
River	105	33	85	21	83	21	96	27	81	20	64	16	46	12
Spring	11	4	34	8	40	10	11	3	39	10	12	3	48	12
Piped water	0	0	22	5	33	9	70	20	138	34	210	52	167	43
Entire population	316	100	412	100	390	100	356	100	407	100	405	100	389	100

of the wells is generally bad (Lindskog & Lindskog, 1988). Although we did not get any statistical evidence of a relationship between increasing piped-water usage and water-related diseases (Lindskog *et al.* 1988), it may still be that there is a relationship, although difficult to measure.

Water is mostly carried home in metal-buckets containing 20 to 30 litres, almost exclusively by the women, sometimes by older girls too. A few people use clay-pots to carry the water especially if they cannot afford a metal-bucket. When a woman collects water, she usually rinses the bucket with some water once or a few times. She may use some sand if it is available to rub the bucket. Cleaning with sand means that the inside of the vessels becomes rugged and thus increasingly difficult to keep clean. Hands are also used to rub the inside of the bucket. After emptying the bucket, it is filled with water, either by dipping the bucket into the water source or otherwise water is scooped out of the source with a plate or a cup in case of traditional water sources.

A full bucket is so heavy that many women need assistance of another woman to lift it up and put it on her head. A small ring of leaves may be put on the head under the bucket or clay pot. A branch with a few leaves is sometimes put into the water to avoid that the water splashing over. If the woman has a young child she often carries it with her on her back when collecting water, especially if the child is under one or two years of age. If she has got older children, she may leave the younger ones in care of these older ones.

Water is carried home mainly for cooking, drinking, bath for the husband and occasionally for washing cooking utensils. It is common that utensils are brought to the river for cleaning, especially if there is one near the house. In addition to the domestic needs, water is carried or diverted away from water sources for a number of other reasons. The most common are to brew beer, to make bricks and build houses. Around 5 % of the households irrigate gardens during the dry season. Still fewer have constructed fish-ponds and breed fish, both for their own consumption as well as for sale.

Washing of clothes is almost exclusively done at the river, as it demands a lot of water. Stones at the river are used for rubbing the clothes. People avoid to wash clothes, especially dirty nappies, at springs and wells, as they are aware of the risk of pollution. Instead they wash clothes, including dirty nappies, in the river, as "that is the only way to do it". Women and children mostly bathe in the river. People claim that if they have to use the river for all household water needs, they draw the drinking water furthest upstream, while they bathe and wash clothes further down and wash nappies still further down. Some people also noted that they could not influence contamination which was caused by other people further upstream. The separation of water use along rivers for different purposes was observed several times during the study, although it also happened that water for all purposes was used at the same spot.

Men usually wash themselves at home, mostly once a day during the hot season, if there is a bath shelter. This requires something like 20 - 30 litres each time. Three quarters of the households had a bath shelter in 1983. Women often heat the bathwater for the benefit of their husbands. A majority use soap when bathing. In a detailed study of 70 households, 86 % used soap

when bathing (Table 6.4). The main reason for using soap is to remove dirt and to get clean, while other reasons are to soften the body and to smell nice. Thus, soap is used mainly for hygienic reasons. It is a common opinion among people in the study area that Lifebuoy soap is good for the health as well, while other soaps, like Rexona, Vinolia, and Lux are mainly used to get clean and smell nice. Lifebuoy is the cheapest soap and costs only half of Rexona.

Table 6.4 *Hygiene related habits in 35 households in January-February 1984 and 35 households in January-February 1985.*

	No of answers	% responding yes
1. Does the person who prepares/cooks the meal wash hands before she prepares meals?	1 003	73
2. Defecation habits		
a) in latrine	195	42
b) in the pants, on the lap	66	14
c) at the house-yard	61	13
d) in the garden (fields)	73	16
e) "behind" latrine, kitchen	52	11
f) elsewhere	17	4
3. Washing of hands after defecation	421	13
4. Use of soap when washing hands after defecation	51	12
5. Place for washing utensils		
a) at home	210	45
b) at the river	173	37
c) at the well	41	9
d) at the spring	18	4
e) other place	24	5
6. Use of ash or sand when washing utensils	516	22
7. Place for washing clothes		
a) at the river	110	70
b) at home	20	13
c) elsewhere	27	17
8. Use of soap or washing powder when washing clothes	153	83
9. Place of bathing		
a) at home in bath-shelter	216	38
b) at the river	168	30
c) at home, no bathshelter	134	23
d) elsewhere	54	9
10. Use of soap when bathing	545	86

People prefer to store water in a clay-pot, as it keeps the water cooler than a metal bucket. There is no particular place for the storage of water. It may be stored either in the kitchen or on the *khonde* of the house or inside the house. In a sample of 194 house holds, 116 or 60 % stored their water indoors. A few houses have two pots for storing water, one for drinking and one for cooking water. If water is stored outside on the *khonde*, chickens, doves and goats may easily go and drink directly from the bucket or the clay-pot. People are generally concerned about the risk of animals contaminating their household water but do not really have any means to prevent contamination. About half (53%) of the containers in the 194 households were covered. However, of those containers stored indoors, 68 % were covered, while only 32 % of those stored outdoors were covered. Despite the obvious risk of contamination of water stored outside and uncovered, there was no evidence for a better bacteriological quality of water stored indoors and covered. The significance of the storage place is blurred by the use of one or two containers for collecting and storing water (Lindskog & Lindskog 1988).

Adults usually take water out of the container with a cup or some other utensil. The cup was sometimes found on the ground and was therefore dirty. In general it was kept on a table or a chair. Through the health education and sanitation promotion (HESP-)programme, see chapter 7, people are encouraged to hang the cup on the wall of the house, where children cannot reach it and where it can not be polluted. This is a good idea, but a problem is that young children, instead of asking an adult for the cup, sometimes dip their hands directly into the water container, thereby polluting the water. This is difficult to avoid especially for a mother who is alone with several children. She often needs to leave them alone.

Water quality

Within the study area there are no traditional water sources which are protected. They are all liable to contamination of various kinds. Springs usually supply water of better quality with regard to the presence of faecal coliforms and faecal streptococci compared to wells and rivers (Lindskog & Lindskog, 1988). During the rainy season, the water quality was generally much worse compared to the dry season. The increases in amounts of indicator bacteria were significant for both wells and springs but not for total and fecal coliforms of rivers, which may be due to the dilution effect in the rivers during the rains. In a study of a rural area in Gambia, Barrell and Rowland (1979) found a marked increase in bacterial contamination to be related to the beginnings of the rains. In Sierra Leone, Wright (1986) interpreted a continuing increase in contamination of water sources during the dry season as an increase in the concentration of bacteria due to reduced volumes of water (see further discussions in chapter 8).

Household water quality generally deteriorated after collection and during storage (Figures 6.1 and 6.2). In the diagrams presented there, each sample is logarithmed. Thereafter mean values are determined. Obviously, there are various reasons for this deterioration, some of which have already been discussed in chapter 6. During the middle of the dry season in September 1983, household water originating from wells and springs was much more contaminated during storage than water originating from rivers, when using faecal coliforms as indicator bacteria. However, the water quality of rivers was by far the worst already at the source. The quality of household water originating from the improved piped water system showed even larger increases in contamination during storage, both during the rainy season in December 1984 and the dry season in May 1985. When using faecal streptococci as indicator bacteria, the change in water quality between water source and storage did not differ so much depending upon water source but all deteriorated (Lindskog & Lindskog, 1988).

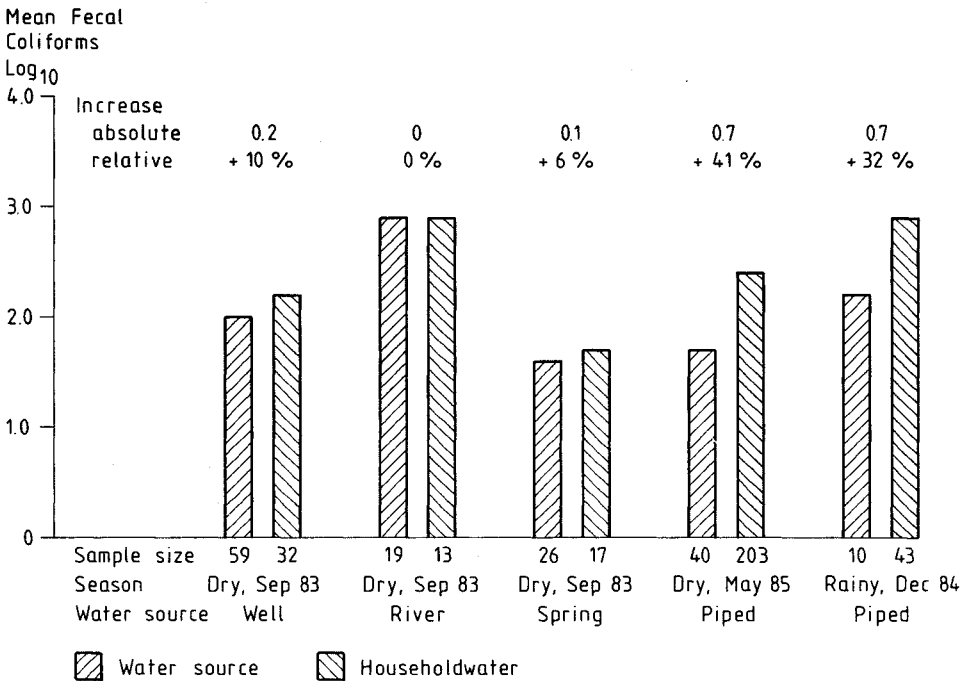


Figure 6.1 Mean Faecal Coliforms Log₁₀ (counts per 100 ml), at water source and during storage in household.

It is a common view among inhabitants in the area that it is better to store water inside and covered. As mentioned above, about 60 % of the households store water indoors and a majority of those cover their pots. However, water

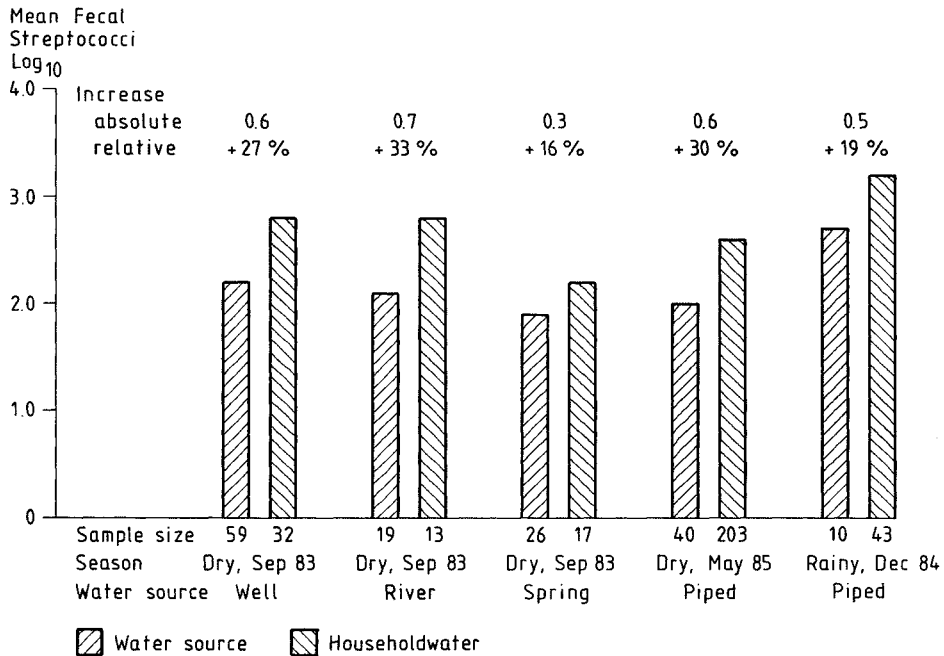


Figure 6.2 Mean Faecal Streptococci Log₁₀ (counts per 100 ml) at water source and during storage in household.

stored inside and covered had in fact the highest coliform count, while those stored outside and uncovered had the lowest count. Still, neither coverage nor storage place was the main discriminatory factor for household water quality but the decisive factor was whether the same or different container was used for drawing and storing water (Lindskog & Lindskog, 1988). The reasons why those using the same container for both drawing and storing water had the best water quality is probably that they emptied and usually cleaned the container at the water source. Those using different containers on the other hand mostly topped up water in the storage container without cleaning it. There was then mostly some water left, which was likely to be contaminated.

The HESP-programme encourages people to store water inside and covered with a cup hanging on the wall. This programme also emphasizes the importance of cleaning all water vessels daily. The results of this study indicate that proper cleaning of water vessels is more important for good water quality than storage of water inside and covered. Although the latter is important to maintain good water quality, it is not sufficient to prevent contamination. In addition, it is probable that water quality will improve during storage, if there is no further contamination (Tomkins *et al*, 1978). The results of the experimental work by Acra *et al*. (1984) suggest that bacterial

contamination of water is likely to be destroyed when exposed to sunlight. This implies that improvement of water quality is quicker in light places, for instance outdoors, than in dark places.

An important measure to improve quality of water during storage, is to introduce water storage vessels similar to those used in parts of West Africa and the Middle East. In those regions it is common to use vessels which have an opening which is so narrow that hands can not be put down into the vessel. Preferably, the water vessel should have a spout or a cock, which is opened when water is to be tapped. Although such vessels may be more difficult to clean, it is probably more important to avoid contamination from dirty hands, cups etc, which are dipped into the vessel.

The quality of water for consumption was thus generally bad, compared both to the standards recommended by WHO (1983a) but also in relation to the more modest standards suggested for developing countries (Feachem, 1980a and Lloyd, 1982). It has been recommended that water under such circumstances should be boiled (*e.g.* WHO, 1980a and 1980b), but it is doubtful whether this recommendation is viable where firewood is scarce (Gilman & Skillicorn, 1985). In any case it is important that storage after boiling is done with extra care due to risks of new contaminations.

Effects of intervention on water consumption

Before intervention with improved piped water, the average water consumption *per capita* and day was 12.8 litres. This amount is roughly the same as that found in other studies, *e.g.* White *et al.* (1972), Ståhl *et al.* (1979) and Feachem *et al.* (1978).

After intervention, the amount of water consumed at home increased to 15.5 litres *per capita* and day, which is a statistically significant increase. It is noteworthy that not only households using piped water showed significant increase in water consumption *per capita* but also those households, which after intervention still used wells (Table 6.5). On the other hand, households using rivers did not show any increase, not even during the rains. It could have been expected that increased quantities of water from rivers would be used during the rains, but especially during the beginning of the rains, the river water is muddy and disliked by people (*cf.* Jahn, 1981). Although there was some increase in water consumption for those using springs towards the end of the study, too few who used springs for the figures on water consumption to be reliable. There were no obvious or measurable seasonal variations in water consumption for the different types of water sources.

There is no obvious explanation for the increased water consumption during the year after intervention for the majority of the households, *i.e.* those using piped water and wells, apart from the demonstration effect of the intervention itself. However, the distance to the improved piped water supply was reduced from 470 m before intervention, to 270 m after intervention

Table 6.5 *Seasonal variations in the water consumption per capita and day and the number of users of different types of water sources.*

Type of water source	Before intervention		After intervention		Period 7		Period 8		Period 9		Period 10		Period 11		Period 12	
	Period 6 1984 Feb-Mar		Period 7 Sep-Oct		Period 8 Nov-Dec		Period 9 1985 Jan-Feb		Period 10 Mar-Apr		Period 11 May-Jun		Period 12 Jul-Aug			
	No	l/c,d	No	l/c,d	No	l/c,d	No	l/c,d	No	l/c,d	No	l/c,d	No	l/c,d	No	l/c,d
Well	200	10.2	271	13.5	234	13.6	179	12.7	149	14.5	119	15.0	128	15.5		
River	105	8.6	85	11.2	83	12.0	96	11.8	81	12.9	64	11.9	46	11.8		
Spring	11	9.3	34	12.0	40	13.0	11	9.4	39	12.9	12	14.0	48	17.2		
Piped	0	-	22	11.6	33	12.9	70	13.2	138	13.0	210	15.7	167	15.5		
Entire population	316	9.7	412	12.8	390	13.2	356	12.4	407	13.5	405	14.9	389	15.3		

when using piped water, which may contribute to the increased consumption (see below).

Water consumption *per capita* was most strongly related to size of household (Figure 6.3). The larger the size of the household, the less water was consumed *per capita*. In most cases there is only one woman who carries water from the water source to the house. Although she is often assisted by her children in this work, the amount which they can carry home is rather limited and does not increase the amount of water consumed *per capita* very much. This means that water consumption per household varies much less than water consumption *per capita*. This in turn may have negative health consequences for large households, if less quantities of water per person are available for hygiene purposes.

Apart from size of household, water consumption *per capita* was significantly related to location of village (Table 6.6), to dwelling space (Table 6.7) and to presence of bath shelter (Table 6.8). The villages in the southern part of the study area, especially those near the escarpment, consumed significantly more water *per capita* than those further to the north and further away from the escarpment. The variations in water consumption *per capita* between the villages were to a large extent explained by the two variables, Distance to Chinseu (the main trading centre just south of the study area) and Distance to Escarpment. There was a significant negative partial correlation coefficient between Water consumption *per capita* and Distance to Chinseu ($R=0.83$, $df=5$, $p=0.020$), when controlling for the variable Distance to Escarpment. There was also a significant negative partial correlation coefficient between Water consumption *per capita* and Distance to Escarpment ($R=0.76$, $df=5$, $p=0.047$), when controlling for Distance to Chinseu.

The variations in water consumption *per capita* between the villages probably mirror the differences in availability of water within the study area. The first parts of the study area to be inhabited were those near Chinseu and near the escarpment, where streams from the mountain are most frequent, which also have the highest water consumption *per capita*. The availability of water as an important factor in determining settlement patterns is well known (Dixey, 1928; Dixey, 1938; Savage, 1940).

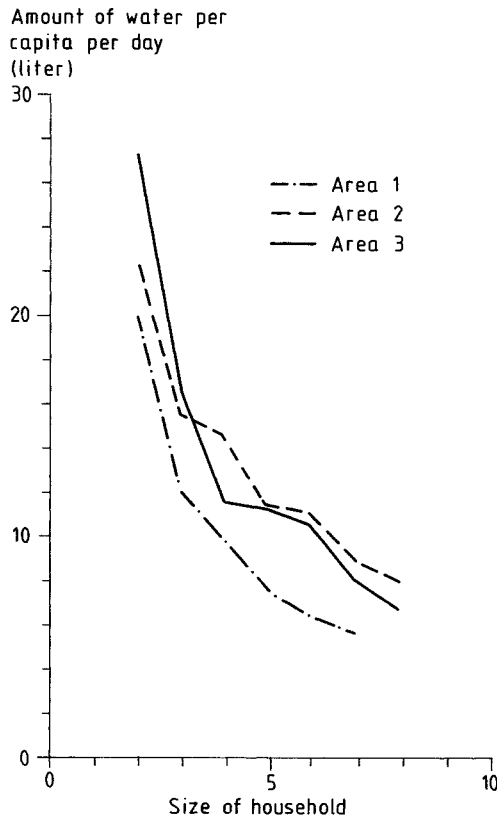


Figure 6.3 Water consumption per capita and day related to size of household (Plotted when $n \geq$ for each class).

The explanation for more water consumed by households having bath-shelter is rather obvious, while it is less evident why households with larger dwelling space consume more water. A possible reason is that better standard of living, which is difficult to quantify, is a confounding factor for both.

There is a noticeable increase in consumption among those households that received improved water through the intervention (Table 6.9). It is to be noted that the relative increase is quite substantial, about 50 %, for those who had their distance to the new water source most substantially reduced. In addition, consumption did increase also among those who had a longer distance to the new source compared to their traditional source. Irrespective of the reduction in distance, it is apparent that households having a relatively short distance to their water source use significantly more water compared to those with a longer distance (Table 6.10). It seems that there are only negligible increases in consumption if distance to the new source is 500 meter or more.

Table 6.6 *Average water consumption per capita and day in the eight villages of the study area after intervention. (Test for heterogeneity: $p < 0.0001$.) The villages are identified in Figure 4.1.*

Village	No of house-holds	Mean water consumption per capita and day (l)	Distance to escarpment (m)	Distance to Chinseu (m)
Kwikanga + Mikundi II	58	9.8	4 090	6 800
Fikila	60	13.6	2 350	7 350
Mikundi I(part)+Matola	67	14.3	3 140	3 850
Mikundi I(part)+Chimbamba	67	13.2	2 530	4 250
Chiunda II	31	17.2	4 180	1 150
Mtiwa	48	14.3	5 130	450
Idana + Mjambe	32	14.2	4 000	300
Chiganga	60	18.4	2 050	1 550
Entire population	423	14.2	3 280	3 640

Table 6.7 *Water consumption per capita in the household in relation to dwelling space.*

Dwelling space per member of the household, m ²	No of house-holds	Water consumption per capita in the household, litres
$\bar{x} \pm \text{SEM}$		
- 3.0	113	13.0 \pm 0.4 *
3.0 - 6.0	158	14.0 \pm 0.3 *
6.0 -	119	15.3 \pm 0.4 *
Test for trend		$p < 0.001$

* Adjusted for number of members of the household, village and presence of bathshelter (SEM = standard error of measurement)

As noted above, there was an increase in consumption also among those households that did not get access to the improved method of water supply. The most likely explanation for the increase in consumption, is an increased awareness of the importance of water for health. This applies thus both to those using improved water sources and those using traditional water sources. The result is an illustration of the "spill-over" effects discussed in chapter 3. A change in awareness was noticed in many respects during the study. The extent to which the increase of consumption was temporary or lasting

Table 6.8 *Water consumption per capita in the household in relation to presence of bath-shelter.*

Presence of bath-shelter	No of households	Water consumption per capita in the household, litres
		$\bar{x} \pm \text{SEM}$
Yes	294	14.5 \pm 0.2 **
No	96	13.0 \pm 0.4 **
Test of difference		p < 0.01

** Adjusted for number of members of the household, village and dwelling space (SEM = standard error of measurement)

Table 6.9 *Water consumption and change of distance to water source, among households with piped water during the second half of the after-intervention year.*

Change of distance to water source (new-trad.), m	No of households	Water consumption per person and day		
		Before intervention	After intervention	Difference
		Traditional source	Piped water	After-before
		$\bar{x} \pm \text{SEM}$	$\bar{x} \pm \text{SEM}$	$\bar{x} \pm \text{SEM}$
-750	28	10.5 \pm 0.8	15.7 \pm 1.4	5.2 \pm 1.0
-750 - -500	28	12.3 \pm 1.0	19.2 \pm 1.9	6.9 \pm 1.5
-500 - -250	23	11.9 \pm 1.1	15.1 \pm 1.6	3.2 \pm 1.3
-250 - 0	70	12.4 \pm 0.7	14.2 \pm 0.7	1.8 \pm 0.7
0 - 250	36	11.2 \pm 0.9	12.4 \pm 0.9	1.2 \pm 0.8
250	27	12.0 \pm 1.1	12.1 \pm 0.9	0.2 \pm 1.0
Test of trend		ns	p < 0.001	p < 0.001

is difficult to assess. It should be kept in mind that there was no possibility for any person to influence the time-schedule of connecting his/her tap to the piped water system. This decision was taken by the Ministry.

Conflicts between households over water

On a number of occasions there were quarrels between inhabitants over the use of water-taps. By far the most common reasons behind these quarrels were accusations that people had not worked for the water- project, or alter-

Table 6.10 *Water consumption and distance to water source, among households with piped water during the second half of the after-intervention year.*

Distance to 'tap' m	No of house- holds	Water consumption per person and day		
		Before intervention Traditional source	After intervention Piped water	Difference After-before
		$\bar{x} \pm \text{SEM}$	$\bar{x} \pm \text{SEM}$	$\bar{x} \pm \text{SEM}$
0 - 200	101	11.9 \pm 0.6	15.3 \pm 0.7	3.4 \pm 0.6
200 - 400	65	12.3 \pm 0.7	15.1 \pm 0.9	2.9 \pm 0.8
400 - 600	26	11.5 \pm 1.1	13.1 \pm 1.4	1.5 \pm 1.2
- 600	20	10.1 \pm 1.4	11.0 \pm 1.7	0.8 \pm 1.5
Test of trend		ns	p < 0.05	ns (p=0.08)

natively that they had not worked sufficient time, as stipulated in the rules of the water-project.

Some households took part in the digging of trenches on the main line in the beginning of the project but not later on when the feeder line and the tap and the soak-away pit were constructed. These people were therefore refused access to the tap by the tap committee.

Some households were not allowed to use any tap. Instead women in these households drew water from the water-storage tank further up the slopes of the mountain. Other women often claimed that these households only had worked on the main line and branch line but not on the feeder lines and with the construction of taps. They claimed that certain households had refused to go to work several times despite repeated reminders.

The chairman of one village development committee argued that "internal disputes in the village is the worst enemy to development". A member of a branch line committee said concerning the preparedness of people in a village to work for the water-project: "to go on with hard work for a long time requires some reward or incentive. If this is not fulfilled, people will stop to work as they lack motivation". In the beginning, people in this village worked hard because they thought that they would get a tap outside their house, but as they realised that the nearest tap would be 500 m away, they lost confidence in the project and motivation to continue to work during the latter part of the project. Thus, proper information and communication is a crucial precondition to overcome this problem.

Attitudes of people to water

People are generally concerned about their water supply and make efforts only to use water of good quality. This applies especially to drinking and boiling water, for which people may pass a nearby water source and go to another further away, which they believe is better. A sample of households were asked about their opinion of the quality of the water source which they used. In most cases their assessment was correct (Table 6.11).

Table 6.11 *The opinion of people regarding the quality of their water-source in relation to the bacteriological quality of the water.*

Households no	Opinion regarding the water quality	Bacteriological water quality (faecal coliforms/100 ml)	
			log
1	very good	100	2.0
2	very good	25	1.4
3	good	460	2.7
4	good	500	2.7
5	good	80	1.9
6	fairly good	1 750	3.2
7	fairly bad	2 000	3.3
8	fairly bad	3 200	3.5
9	fairly bad	1 320	3.1
10	bad	4 000	3.6
11	bad	81 000	4.9
12	very bad	18 000	4.3
13	very bad	200 000	5.3
14	very bad	71 000	4.9
15	very bad	250 000	5.4

Most people appreciated the piped water supply and worked regularly on the water project digging trenches, laying pipes etc. 60 % of the population were satisfied with the piped water supply, while 21 % expressed concern over the delay in the supply of new water. Another 6 % found the distance to the piped water to be too long. 3 % were discontented with congestion at the tap. No one found the piped water not to be good.

Some people claimed that the main advantage with the piped water is the taste. The well water which was used before was regarded as unsavoury as it tasted soil. Many people related water to bilharzia. Shortly before the present study there was a bilharzia campaign in the district and many people

had heard about the risk of bilharzia infection when visiting health clinics. Also, many people think that if they use piped water when bathing, they will not get the itching, which they get when they bathe in the river. People think that the itching comes from leaves, which frequently fall into the water and thus contaminate it. This is a commonly held opinion concerning reasons for contamination of water.

Almost all adult people of the study area took part in the work of the water project on a more or less regular basis from the end of 1983 or the beginning of 1984, depending upon where within the study area they lived. A reason for lack of significantly stronger improvement of child health of those households, which got piped water during the study compared to those which did not get improved water, could be the work with the water project. Through this everybody including people of those households without any piped water during the study changed their hygiene related habits, as the water project and the work made them aware/reminded them of health hazards.

In addition, this study itself may have further contributed to this increased awareness among all people of the study, both those with piped water and those without. This is an illustration of the "spill over" effects discussed in chapter 3.

Health impact of improved water supply

As discussed elsewhere (Lindskog, U., 1987 and Lindskog, P., *et al* 1988), the health impact of improved water supply has been difficult to detect and verify. When total morbidity and diarrhoeal morbidity of the intervention group were measured before and after intervention and compared with the control group, there was no significant health impact. However, it should be noted that there was an increase in the amount of water consumed both among the households belonging to the target group as well as among those belonging to the control group, *i. e.* both among those having access to improved water supply and among those who had to rely on traditional sources of water supply. Equally important, the deterioration of the water quality during storage was apparent among all households. This implies that the quasi-experimental design is of limited value for the analysis and for the interpretation of the results.

If the changes in diarrhoeal morbidity between the baseline year and the second six months of the after-intervention year are measured, there is a conspicuous decline in the prevalence of diarrhoeal diseases among children in households having access to the improved water supply as well as in households who had to rely on traditional sources of water supply (table 6.12). The decline must, however, be interpreted with great care. Measurement problems, temporary effects, etc. are likely to contribute to the figures presented. It is, however, to be noted that all households, both those in the intervention and those in the control group, actively participated in the work for the water

Table 6.12 *Change of total morbidity and diarrhoeal diseases ($\bar{x} \pm SEM$) among children between the baseline year and the second six months of the after-intervention year in relation to piped-water usage in the household.*

	Piped-water usage during 2nd half of after-intervention year*			Test for trend
	0%	1-49%	50-100%	
Number of households	163	47	183	
Total morbidity** (% of visits)				
Baseline year	50.1 \pm 1.4	47.4 \pm 2.6	53.3 \pm 1.3	
2nd half of after-intervention year	43.7 \pm 1.7	41.6 \pm 3.2	40.0 \pm 1.6	
Difference	-6.4 \pm 2.0	-5.9 \pm 3.6	-13.3 \pm 1.8	p = 0.013
Diarrhoea** (% of visits)				
Baseline year	6.4 \pm 0.7	5.5 \pm 1.3	8.2 \pm 0.7	
2nd half of after-intervention year	2.9 \pm 0.7	2.4 \pm 1.4	4.0 \pm 0.7	
Difference	-3.5 \pm 1.0	-3.1 \pm 1.8	-4.2 \pm 0.9	p = 0.58
Skin infections** Difference	-5.9 \pm 0.9	-3.6 \pm 1.7	-4.8 \pm 0.8	p = 0.45
Eye infections** Difference	-4.3 \pm 1.0	-4.2 \pm 1.8	-4.7 \pm 0.9	p = 0.13

* See text for definition

** Adjusted for age, season and village (see Statistical analyses)

project. It is likely that the awareness for health related issues increased among people belonging to both groups. In addition, people from both groups were in contact with our research project.

On many occasions we observed that people had a fairly good apprehension about health related issues, but due to heavy work load or due to resource constraints, they have limited possibilities to accomplish their good intentions. The water project "activated" people's awareness of the importance of proper water handling for health. The water project - as well as the research project - may have increased the motivation of people to modify their behaviour in such a way that health conditions were affected. The increase in the amount of water consumed, also among people belonging to the control group, is an indication of such an impact.

The significant intervention was obviously the participation in the work for the project, not the hardware as such. Exposure to new ideas and contacts between people are crucial for change and development. Unfortunately these aspects are given little attention in most development projects.

7. Health Education, Sanitation and Hygiene Behaviour

“Education does not mean filling a cask, but lighting a fire; but you will also discover that there are pieces of wood which you can not easily set fire to”

Herakleitus, Greek philosopher, around 500 B.C.

Two perceptions of health and disease

Awareness of public health issues in traditional societies has hardly been considered by western scholars. This has been the case especially in Africa, where it has been assumed that such an awareness was only created by the modernization connected with the colonization in the 19th and 20th centuries. Gloria Waite has refuted this assumption in the case of east-central Africa (Waite, 1987). She defined public health as all activities that traditional leaders as well as contemporary authorities in the communities undertake to promote the well-being of the inhabitants in the societies of which they are in charge. In the traditional societies in east-central Africa, the most important of such activities were rainmaking and sorcery. Nowadays, rainmaking has virtually disappeared in the Chingale area, while sorcery is common. These activities are mostly performed by men.

This traditional view contrasts with the modern, scientific perception of disease transmission. It may be particularly difficult to “light the fire” of health education. The need for water of good quality is obvious to people all over the world and one of their main concerns for survival. However, the health hazards of bad hygiene are much more difficult to grasp, as the pathogens causing diseases are invisible. According to Whyte (1976), there are two important differences between modern and traditional concepts of health and disease. “The first is that in traditional views, disease and illness are related to religious, magical and moral concepts instead of just hygiene and aesthetics. The second is that whereas modern concepts of disease are focused on a knowledge of pathogenic organisms as causal or contributory, traditional medicine is unaware or less concerned with a germ theory of disease” (*ibid.*, p. 38). The germ theory corresponds to the “scientific knowledge” commented upon in chapter 3.

These days, the role of traditional village leaders has decreased in relative importance and thereby also the role of traditional knowledge. Political and other formal leaders have to a large extent replaced the old informal leaders in the villages. The Malawi Congress Party, with local party committees, as well as committees for village development, schools, health etc do play a great role today. Positions in these committees are in principle open to both

men and women. However, older men tend to dominate these committees, which restricts the influence of women. The new context of leadership, together with education efforts implies that there are channels through which scientific knowledge can be communicated. (cf. Figure 4.1).

Health services in the Chingale area

The health clinic closest to the study area is located about 1 km outside the area at Chinseu market. It is run by the Anglican church and is staffed by a medical assistant, a nurse and auxiliary staff. It provides elementary treatment. More complicated cases are referred to Zomba general hospital. There is also a maternity clinic and an under fives' clinic which is open once a month. Fees are charged, which, although low to people with a wage, may be deterrent to those without a regular income. About 10 km further to the south, there is a government clinic at Chingale, where treatment is free. Another clinic used by inhabitants in the area is at Gawanani, 8 km north-west of the study area. This clinic is also run by the Anglican church and fees are charged. There are also under fives' clinics at Chingale and Gawanani (Figure 5.1).

The health education at the under fives' clinics aims to teach the mothers proper child care, especially the need for nutritious food, use of safe water, cleanliness of the house and its surroundings as well as good personal hygiene.

A noticeable feature of the health education is the advice to mothers attending health clinics to give oral rehydration solution (ORS), *i.e.* boiled water, sugar and salt when a child has diarrhoea. ORS in pre-packed bags were generally not available in the study area. Instead mothers were advised how they should make the solution with water, salt and sugar on their own.

Given the high incidence of serious diarrhoea diseases, this advice is certainly called for. In situations where the resources are adequate, it may work well. However, in areas like Chingale, where virtually no one has the necessary firewood easily accessible, as well as the economic resources to buy sugar and salt and the time to prepare ORS properly, it may be questioned whether this advice will contribute to a significant improvement of the situation. In any case, it is essential to take the resource constraints into consideration. Further, it should be ensured that ORS is not comprehended as a "miracle medicine", which is seen as a substitute for good environmental and personal hygiene.

In settings such as Chingale, which are similar to many other parts of Africa, improvements in personal and environmental hygiene are of basic importance. If improvements in hygiene are combined with improvements of the water supply, in terms of proper functioning, utilization and storage, significant health benefits are likely to be attained.

Health education and sanitation

The Health Education and Sanitation Promotion (HESP)-programme of Malawi

The Health Education and Sanitation Promotion Programme of Malawi (HESP) started in the beginning of 1984 with training of the staff. During the dry season 1984 the programme began to be implemented. It aims to be a complementary input to the improved water supply programme. A health assistant or a health surveillance assistant is responsible for implementing the programme in the villages. Target villages are selected, in which the HESP-programme starts. Later the programme is extended to other villages. In each target village a health committee is elected. Each committee starts with identifying the main health problems of their village. If the villagers consider a non-water related disease, for instance measles, to be the major health problem, the health assistant devotes time to discuss with the committee how this problem can be solved.

It is intended that he should go on with the water-related issues only when other problems have been satisfactorily solved. This order increases the possibility that the villagers are motivated to practice the message of the HESP-programme. Sanitary and hygiene facilities in the village, like latrines, bath-shelters, garbage-pits and dish-racks, are then inspected and advice given in cases where they are not adequate. Much attention is given to instructions about water-storage and water-handling. The members of the health committee should then teach and instruct the other villagers what they have learnt through the HESP-programme.

The experience from the Zomba West area

In the study area three target villages were selected and health committees in these villages were elected. They met once or twice during the middle of 1984. The members did not participate in the two day course organized for all Village Health committees of target villages in the western part of Zomba district. The people had been promised transport by lorry to the school, where the training was to be held, around 15 km away, and also food. Two days before the course was to start, they were told that the lorry could not come. They were also asked to bring their own food. This made people so disappointed that no one came to the course. This illustrates the difficulty of solving logistic problems in remote rural areas.

Interest of committee members was never comparable to that which the water project attained. It was therefore obvious that the HESP-programme would not result in reduced frequency in any of the morbidity indicators. This was the first time that the HESP-programme was implemented and therefore sufficient experience had not been gained. Also the health surveillance assistant did not seem to have the necessary personal qualities and did

not get much response from the villagers. Other possible reasons are discussed below.

In the case of the study area, and for Malawi in general, with a high proportion of people who have not attended primary school, hygiene education through extension is necessary to get a health impact of water and sanitation projects. There is certainly a need to complement the traditional views of disease with those of the germ theory of disease. It was observed that it is much more difficult to change hygiene-related habits of the population than to switch to a new water source. There was no resistance to using the improved piped water supply, and virtually every household with a tap within a distance of 500 m used it. Some people walked further than to their traditional water source in order to get piped water. People are thus very concerned about the quality of their household water, especially that for drinking purposes.

People have a concern for hygiene issues, but it is related to visible items. Most people in the study area carefully swept the yard surrounding their houses. However, people know virtually nothing about invisible items like protozoa, bacteria and viruses and can therefore not connect pathogens on the fingers after defecation to subsequent illness. They can consequently not relate these germs to health.

It is natural that villagers lack detailed knowledge about health conditions. It is, however, remarkable that the health educator himself did not practise the messages of the HESP-programme. In his house, the cup to take water out of the water container was on several occasions found on the ground. The young children in his family were defecating behind the house. If the health educator is not motivated and really believes and practises what he is supposed to teach, it could not be expected that the inhabitants change their hygienerelated behaviour. It is, by the way, noteworthy that the health educator was male.

A complementary reason for the failure of the HESP-programme in this area is the lack of resources. The health educator did for instance not get a bicycle as promised. To make health education programmes successful requires in the first place motivation together with adequate resources and adequate training programmes of all staff of the programme, especially the health educators working in the field.

On the other hand, the contents of the HESP-programme and its educational design, starting with identifying the needs as the inhabitants themselves see them, is appropriate and deserves further attention.

Formal education and hygiene behaviour

The level of formal education of the population is of crucial importance for their perception and behaviour. Several studies have shown a relationship between formal education and health and diseases (for a review of the topic

see for instance Franks & Boisseau, 1980). In the present study, however, it was not possible to trace any relationship between education of the mother nor of the father on the one hand and total morbidity on the other. Education was only weakly related to diarrhoea (Tables 7.1 and 7.2). It is to be noted that the level of education is low in the study area. It may be necessary with several years of formal education before it gives an impact upon health

Table 7.1 *Diarrhoeal diseases of children under five years of age related to education of the mother (January 1983).*

Educational level of the mother	% and number of children with diarrhoea							
	Area 1		Area 2		Area 3		All areas	
	%	no	%	no	%	no	%	no
No education	4.5	149	8.7	145	8.8	214	7.5	508
Standard 1-4	5.1	63	8.0	46	10.7	79	8.2	188
Standard 5-8	1.3	10	6.7	33	7.1	49	6.3	92
All	4.5	222	8.2	224	9.0	342	7.5	788

Table 7.2 *Diarrhoeal diseases of children under five years of age related to education of the father (January 1983).*

Educational level of the father	% and number of children with diarrhoea							
	Area 1		Area 2		Area 3		All areas	
	%	no	%	no	%	no	%	no
No education	4.5	132	9.6	117	9.4	184	8.0	433
Standard 1-4	4.4	66	6.6	54	7.6	97	6.4	217
Standard 5-8	5.0	27	7.5	51	9.1	72	7.8	150
Form 1-4	0.8	5	0.0	2	13.6	4	5.3	11
All	4.5	225	8.2	224	9.0	357	7.3	811

Furthermore, the hygiene education provided in primary schools does not appear to be sufficiently developed to result in changes of behaviour. School teachers, both in the study area and at a nearby teachers' training college, regarded hand-washing as less important than boiling drinking water. Such an attitude is not only questionable but also unrealistic, given the shortage of firewood and other resource constraints. Considering the current situation, it seems that the most urgent aim to strive for is a spread of a realistic

and proper view of good hygiene behaviour. A revision of the primary school curriculum may be necessary. An increased number of years of education is certainly also of importance, but is under current conditions not a realistic option.

Although many people know of the importance of good hygiene, they may not be able to apply their knowledge due to a number of constraints. Shortage of wood means that women have to walk several miles to get the minimum amount of firewood necessary for the household, which requires much time, which otherwise could be devoted for instance to child care. Time constraints, especially during the rainy season and in families with many children and few adults, is therefore a severe restriction to improved health. More convenient water supply would reduce the time which has to be spent to collect water by a tired mother (Briscoe, 1984).

A certain amount of education creates the candour, which is necessary in order to alter priorities and give the message of development projects such a high priority that it is practised. Two examples of the difference of influences due to varying educational and marital conditions of households are given below. In both cases the children have a high rate of diarrhoea. The first is a case in which the mother has no education, while in the second case the mother has completed eight years in primary school.

Environmental hygiene: defecation and use of latrines

Traditionally, people in Malawi defecate in the bush along the river banks or in other secluded places. In the 1930's there were no sanitary pits according to Steytler but "people defecate at the nearest convenient spot" (Steytler, 1939). Latrine construction programmes in Malawi from the 1950s and onwards have resulted in a fairly large number of pitlatrines in most parts of Malawi. In January 1983 about 3/4 of the households of the study area had a latrine. However, the existence of a latrine does not necessarily mean that it is used. People who do not have a latrine may use either a latrine of a neighbour or a relative or may defecate in the bush, often near rivers or *dambo* areas, where the vegetation is dense and gives privacy. Those who have a latrine do not always use them, *e.g.* when they work in the fields, visit markets or clinics or when they are on journeys. People may also avoid to use their latrine, simply because it may be full or because of the odour if it is not kept clean. The need and benefit to use a latrine as perceived by people in the area may not always be strong enough to motivate construction of a latrine.

Children rarely use the latrine until they are 5 to 7 years old, as they fear falling into the hole. Newborn children are most of the time on their mother's back. From 8 to 10 months of age, they are increasingly on the ground, often with some pants or a cloth on. However, it is common to find children, also a few years old, without any trousers. They then defecate anywhere around the house. If the mother is busy in the gardens, draws water, visits markets

or neighbours, it may take a long time before she notices the faeces of the child and removes it.

Behaviour of people related to defecation is among the most difficult to influence. Thus, Marwick noted that "an occasional pit latrine may be found - more a monument to some enthusiastic district officer than an object of daily use; for to most villagers 'to go to the bush, *kupita kuthengo*' is still both the literal and the polite equivalent of 'to defecate'" (Marwick, 1965, 36).

Personal hygiene: importance for morbidity

The importance of personal hygiene may seem trivial to anyone with basic education. But what is the significance of personal hygiene (washing hands, bathing and washing the body etc) for health improvement in relation to other interventions? The topic has been reviewed by Feachem *et al.* (1983b). It is important not only to emphasize that personal hygiene is of vital importance, but also to discuss which specific hygiene habits contribute most to improved health under specific circumstances.

Interventions with improved personal hygiene has been studied by, among others, Khan (1982). In Dhaka, Khan studied the effect of hand-washing with soap and water before eating and after defecation. The study showed that this relatively simple intervention reduced the secondary case rate of shigella by about 80 % and other diarrhoeal diseases by 35 %. Khan concluded that "an additional quantity of water does not help much. Washing the hands with soap, however, markedly reduces the secondary infection and case rates. It is most effective in vulnerable younger groups possibly because mothers feed them. ... The effects were most significant in all shigella species except shigella dysenteriae type I" (Khan, 1982, 167).

Through participation in the daily life of households in the study area, the hygiene habits were observed. Information concerning hygiene related issues were collected from a limited sample of households in January-February 1984 and in January-February 1985. All members of 35 households were followed from dawn to dusk during five consecutive days.

About three quarters of those who prepared meals washed their hands before starting. As a comparison, it is to be noted that only 13 % washed their hands after defecation. Only a few of those who washed hands after defecation used soap. Washing clothes was mainly done at a river. A majority of them used soap or washing powder. It was also clear that most people used soap when bathing (Table 6.4). Thus, a majority of the population seems to take great care of hygienic issues apart from those related to defecation, which indicate that people do not regard the latter to be important for hygiene.

The issue of personal hygiene like hand-washing in Third World countries with poor facilities is far from simple. Most people in Malawi as well as in other parts of Africa normally use the right hand for all types of activities

in the household and elsewhere, *e.g.* to prepare food, eat and draw water. The left hand is reserved for personal hygiene after defecation and collecting faeces deposited at the compound or its surroundings by children. The left hand is used exclusively for this purpose, while the right hand is used for all other purposes. These practices are demonstrated to young children already when they are two or three years old. These habits may to some extent reduce the risks of faecal-oral transmission of diarrhoeal disease pathogens via hands direct after defecation, although it is difficult to assess their significance relative to other factors affecting fecal-oral routes of transmission.

There are, nevertheless, situations where both hands are necessary. Such situations are:

- washing rice and maize (which is rubbed between the hands)
- washing household utensils
- peeling cassava, sweet potatoes, turnips and other roots
- peeling fruits like oranges, lemons, bananas and sugar canes
- giving medicine to a child (the child is held with one arm, while the medicine is given with the other)

The examples illustrate that washing of hands is important both when preparing food as well as before other activities.

Some illustrations of hygiene behaviour

Case: Family with low education

The following situation in one of the households in the study area may illustrate certain features and problems of hygiene behaviour. In this household, there are two small boys, both having a high prevalence of diarrhoea. The older boy, who was born in September 1982, was the child with the highest prevalence of diarrhoea in the area. He was reported to have diarrhoea during 52 % of the interviews during the period January 1983 to March 1984. The last born child of this household, a boy, was eight months old during the observations. He crawls around on the yard between the house and the kitchen. He is hungry, as it is a long time since he got some food, and therefore tries to find something to eat on the ground. After a while he urinates and starts to play with the urinated soil. His elder brother, who soon is three years old, tries to carry away his younger brother but does not succeed.

The mother of the two boys watches the incident but does not interfere. The infant continues to crawl around to find something to eat but only finds sand, some stones and a dried piece of a sweet potato, all of which he puts into the mouth. Eventually, he is so tired that he has no more energy to crawl around but sits and cries. His older cousin, who is staying nearby, brings him

up from the ground and hands him over to the mother, who then breast feeds him. After a while he falls asleep on the *khonde*.

The father and head of the household is the third husband of the boy's mother. The mother has no formal education. The father has been working at Portland Cement Factory at Changalume since before they married in 1980. In April 1984 he left his wife. The first husband of the boy's mother works as a cook in Zomba, while the second is employed in the mines in South Africa.

When the father of the boy stayed in the house he employed a servant to work in the gardens, to clear the bush, to weed the gardens etc. When he left, the mother continued to employ the servant and intends to keep him all year around. She sells maize soon after harvest, when prices are low, to get cash to pay the servant. Last year's harvest was finished in January. They then had to buy maize up to the harvest in April. After harvest, they sold maize, rice and beans in order to pay debts. It is common that people have to sell their crop after harvest to pay debts, despite the fact that prices are low then. Later when their crop is finished they have to buy the same crop at a much higher price. The main house of this household is one of the few houses which are built with burnt bricks. It is one of the biggest houses in the village.

Many households, like the one described above, are not able to plan their economy and their use of the harvest. In combination with a low educational level as well as low cash income the situation is often quite troublesome. As a consequence the poorest health conditions are often found in these households.

Case: Family with educated mother

A girl born in June 1981 had the second highest incidence of diarrhoea in the area. She had had diarrhoea frequently since she was around one year, and during 46 % of the interviews between January 1983 and March 1984. The mother of the girl had completed standard 8 and was married to a man who worked at Portland Cement Factory. They divorced in 1983.

Similar to the previous case the food supply situation is typical for families in similar positions and reveals an important circumstance behind the morbidity pattern. In 1983, the harvest was only 5 baskets (40-50 litres), partly due to bad rains and partly due to problems caused by the divorce. When that year's harvest was finished, the grandmother of the girl gave them some maize which lasted till December. They then had to buy their staple food. In 1984, the harvest was a bit better but was still finished by November.

The wife was ill in the beginning of 1984 and bought traditional medicine, for which she had to borrow money. The creditors requested the money to be paid back in May, just after harvest when the prices were low. She therefore had to sell 10 baskets of maize for a price which was about half the price

she could have fetched by November - December. Instead she had to buy maize when prices were high and the harvest was finished.

In connection with the high frequency of diarrhoea of her daughter the mother took her to Gawanani clinic. The personnel of the clinic told the mother to give her boiled water, sugar and salt whenever she had diarrhoea. They emphasized that an improvement would not come quickly but that she would have to go on and give this drink for a long time. The father of the child did not believe that the girl would survive and therefore did not invest any money in buying sugar and salt. Therefore, the mother sometimes had to give the girl water without sugar or salt.

The fact that the mother had completed 8 years in primary school may be an important explanation for her understanding of the significance to give oral rehydration solution properly. According to the personnel at the clinic, it is common that mothers start to give their child oral rehydration solution but do not continue to give it, as they do not see any immediate improvement.

Comments

The two examples illuminate the influence which formal education and motivation may have. It is probable that the message of development programmes is more commonly understood and practised among people with more education than among those with less education. The second case illustrates that the family continuously is under such strain that a "normal" amount of disease does not change the daily routine of the household. However, when a mother realizes the seriousness of her child's disease, she mobilizes all her efforts to counteract the disease.

Formal or health education, properly designed with an emphasis on practical applications relevant to the conditions of the area, contribute to a better understanding how to improve living conditions. Education is a necessary but not necessarily sufficient precondition for development (cf. Tables 7.1 and 7.2). Further, the resource constraints, both physical like water and firewood as well as economic constraints, must be overcome (Chapter 3 and 5). Many people may have difficulties finding the means to practise the message of development programmes. Only in connection with critical conditions, for instance a life-threatening illness, is it likely that all efforts are made to improve the situation. This situation is often seen by health workers in Third World countries, when people come too late for any medical treatment to be effective.

In conclusion, it seems that formal education:

- 1) increases the motivation to practise the message of development programmes

- 2) makes people more aware of the need to devote sufficient resources (especially economic) to the basic needs of the family, especially food, water, house and clothes, and of the fact that consumer goods must have a lower priority than the basic needs
- 3) makes people more aware of the needs of children (especially child care and attention) and makes it more likely that children will get a sufficient share of the basic needs mentioned above.

8. Impact of Seasonality

Climatic seasonality - a lacking dimension in research

Seasonal variations in temperature, rainfall and humidity affect water sources, the physical environment as well as the daily life of people. Water quality both at the water source and at home thus varies tremendously with the seasons (Lindskog & Lindskog, 1988). Food supply, and as a consequence nutritional status of the population, as well as labour requirements and time available for child care, including breast feeding, weaning and household duties, are all related to the seasons.

All these seasonal variations do naturally affect the pattern of diseases. The increased disease load during the rainy season is aggravated by deteriorating nutritional status. The food supply during the last trimester may be especially critical. The combined effects of child age and season may make living conditions of children born during certain months of the year more vulnerable to diarrhoeal disease than children born during other months.

A conclusion drawn by Drasar *et al.* (1981) concerning the influence of seasonality upon diarrhoeal diseases is that in periods of peak labour requirements "the severe constraint on mother-child contact time may be the major limiting factor in giving an infant sufficient food. Seasonal work patterns and food shortages may combine in several ways, and with several other environmental and social factors, to produce the seasonal outbreaks of diarrhoea that are so often observed".

The implications of seasonal variations have been dealt with by, among others, Chambers *et al.* (1981), who reviewed the seasonal dimensions of rural poverty. In spite of the significance of seasonality, it is noteworthy that comparatively few studies give adequate attention to it. There is a "tarmac bias" in research, i.e. "out-siders" carry out field work along the main roads and during the dry season, when conditions are relatively good (Chambers, 1983). Among the studies which do deal with the relationship between seasonal variations and morbidity, the following should be mentioned: Gordon *et al.* (1968), Schofield (1979), Throwbridge & Newton (1979), Stintzing *et al.* (1981), Black *et al.* (1982), Guerrant *et al.* (1983), Yap *et al.* (1983), Mutanda *et al.* (1986) and Haddock & Malilay (1986). In areas with two rainy seasons, some studies have shown two peaks for water-related diseases per year (Mutanda *et al.* 1986; Stintzing *et al.* 1981; Yap *et al.* 1983).

The causal relationships between seasonal variations in climate and disease are intricate. It is difficult to calculate the importance of individual circumstances. In another article (Lindskog, P. *et al.* 1988) the variation in morbidity between the dry and the wet seasons has been analysed. In this study attempts are made to present detailed pictures of the intra-seasonal

variations in total morbidity and some individual diseases. Details of the seasonal characteristics are related to variations in disease load.

Seasonal variations of morbidity - a general picture

In the area of study, total morbidity showed a peak during the warm, rainy months, February-March, both in 1983, 1984 and 1985 (Figures 8.1 and 8.2). The diagrams are based on a running mean, which is appropriate given the big fluctuations. The lowest total morbidity was recorded just before the onset of the rains in November-December both in 1983 and 1984. The study started in February 1983 and made a break in February 1984, which means that the situation before 1983 and from March to September 1984 is not recorded. There were, however, no signs of a significantly different situation in 1983 and 1984 compared to 1985, which may reveal a typical pattern. It is noteworthy that the morbidity level was lower in February 1984 than in February 1983. This could be due to differences in amounts of diseases from one year to another. It is also possible that the effect of the study itself is biggest in the very beginning of the study and then gradually diminishes.

Respiratory tract infections showed less seasonal variation, especially during the second year. It had two peaks during the year before intervention, one at the end of the rainy season in March and one in the cool months, June-July. The lowest level was in November-December just before the rains. During the year after intervention, the lowest value was again in November-December but there was only one peak, in March. Eye infections reached a marked epidemic peak in the middle of the rainy season both years but especially during the year after intervention. It had a low prevalence during the rest of the year. Skin infections were more prevalent during the warm, moist months, but the variations were not so pronounced as for eye infections.

When relating the prevalence of diseases to the amount of rainfall, eye-diseases showed the highest correlation, followed by skin-infections and total morbidity, while diarrhoeal disease had the lowest correlation (Table 8.1). The best correlation was generally obtained when rainfall was compared to the disease load during the two-week period immediately after the period when the rainfall was recorded. Diarrhoeal diseases were neither related to precipitation during the same two-week period as the diseases were recorded, nor to the precipitation during the preceding two-week period.

Seasonal variations of diarrhoeal diseases - a deviant pattern

Diarrhoeal diseases morbidity had a rather divergent pattern compared to total morbidity. It had the lowest values in June-July, the cool, dry season, and then gradually increased during the hot, dry season in September to No-

Table 8.1 Correlation coefficients between seasonal variations in diseases and rainfall.

Disease	Rainfall recorded during the same period as the recording of the disease		Rainfall recorded two weeks before the recording of the disease		Rainfall recorded four weeks before the recording of the disease	
	R	p-value	R	p-value	R	p-value
Total						
morbidity	0.23	0.14	0.43	0.01	0.35	0.02
Diarrhoeal disease	0.05	0.74	0.07	0.65	0.14	0.38
Respiratory tract infection	0.05	0.74	0.22	0.16	0.13	0.43
Skin infection	0.27	0.08	0.44	0.01	0.41	0.01
Eye infection	0.55	0.01	0.62	0.01	0.48	0.01

vember. The peak was reached during the first part of the rains in November to January. It decreased during the latter part of the rainy season until the cool, dry season in June-July. Thus, the peak in diarrhoeal morbidity was well before the peak in the rains in February. Similar results have also been recorded elsewhere. In northeastern Brazil, Guerrant *et al.* (1983) recorded the peak in the number of episodes of diarrhoea in January and February, during or slightly before the peak in precipitation. In El Salvador, the highest incidence of diarrhoea was in the beginning of the rainy season in May to July (Throwbridge and Newton, 1979, 138).

The increasing incidence of diarrhoea during the dry season and the peak during the transitional period between the dry and the wet seasons warrants further comments. The explanation to this pattern has probably to be searched for both in the changing environmental conditions, as well as changes in water quality and availability. In addition, there is a variation between the seasons in the amount of time people spend indoors and in different parts of the environment, which may be important in terms of human exposure to contaminations.

Conditions for pathogen survival in the terrestrial environment and in water

Environmental conditions and water quality

It is widely accepted that climatic conditions, like temperature, rainfall and humidity, are important determinants of pathogen survival. Feachem *et al.* (1983a) stress that the most important factors which limit pathogen persistence are time and temperature. Most organisms survive well at temperatures around +5 C, while they rapidly die at high temperatures (+40° C). During the hot and dry period, the abundant solar radiation apart from high temperatures on the ground, creates an unfavourable situation for pathogen survival in large parts of the surroundings.

Temperature of water in ponds, streams etc. is rarely above 20-25° C, which is more favourable for pathogen survival. Furthermore, the amount of water is gradually decreasing during the dry season. Due to evaporation there is a tendency of increasing concentration of contaminated material in water sources, implying a deterioration in water quality. Consequently, the relatively favourable health situation of the environment during the dry season does not correspond with the water quality situation, nor with the water quantity situation.

Variations in water-quality and their implications for diarrhoeal diseases

In Nairobi, Kenya, Mutanda *et al.* (1986) studied the seasonal variations of some of the pathogens, which cause diarrhoeal diseases of children. Significant variations over the year were found for rotavirus, shigella and campylobacter but not for enteropathogenic *E. coli* (EPEC) (*ibid.*). Rotavirus and enterobacterial pathogens were inversely related to each other for the greater part of the year. Rotavirus had two peaks, one in January and February, which are dry and warm months with low relative humidity, and another in July and August, which are cool and dry with high relative humidity. Shigella had one peak in June to September, again the cool, dry season, which follows after the rains in April to June. Campylobacter were found to be most common during September and October, which are characterized by light rainfall. Enteropathogenic *E. coli* showed no significant seasonal variations, although the lowest values were recorded during the cool, dry months of July to September, the same season as both shigella and rotavirus were most common (*ibid.*). Utsunomiya *et al.* (1982) recorded a similar pattern in Mombasa, Kenya. Similarly, Brandt *et al.* (1982) found a similar pattern for shigella with a peak in the dry season after the monsoon in Bangladesh.

These results indicate that the incidences of rotavirus and shigella are not influenced by rainfall. The material was too limited to establish whether or

not EPEC and campylobacter are related to rainfall. Although the area studied by Mutanda *et al.* in Kenya is characterized by two rainy seasons, conditions are relatively similar to those in Malawi. There is neither in Kenya nor in Malawi any evidence of a relationship between the incidence of diarrhoeal disease pathogens and rainfall. It may be that other factors like relative humidity, temperature and ultraviolet radiation as well as socio-economic conditions are more important than rainfall, although it could be that the "dilution effect" and the "washing-down effect" (see below) to a large extent counteract each other. Mutanda *et al.* (1986) found rotavirus to be most strongly and negatively correlated to maximum relative humidity (-0.49).

In our study area, the bacteriological quality of traditional water sources deteriorated considerably between the dry and the rainy season, mainly due to faeces and other types of contaminating material being washed into the water sources during heavy rains (Lindskog & Lindskog, 1988; cf. Barrell & Rowland, 1979; Wright, 1986). Wright found that water quality in Sierra Leone was best during the cool, dry season and then deteriorated during the hot dry season to reach a peak at the onset of the rains. The explanation of this situation apart from an accumulated amount of faeces and other contaminating material being washed into water sources by the rains, is that the faecal material of the water sources gradually gets less diluted, as the dry season progresses and the amount of water decreases. Even small amounts of contaminations may thus result in high concentrations which will be detrimental to water quality.

The "washing-down" effect is likely to be significant, particularly during the transitional period between the dry and the wet season. In the course of the rainy season, the "dilution effect" may gradually become more important than the "washing-down" effect. Apart from the changes in quality of water over the seasons, there is an improvement in the accessibility of water from the dry to the wet season.

Combination of circumstances impeding health

A deterioration in the water quality together with increasing difficulty to draw water is naturally detrimental to health. Heavy labour demand and dwindling food reserves during the transitional period between the dry and the wet seasons are coinciding with the deterioration of the water situation. In the area it is thus common that people have to sell their crop after harvest, when prices are low in order to pay back debts. They may then have to buy food at very high prices towards the end of the year. A possibility to get cash to buy food is to engage in casual labour or in agricultural work during the rainy season.

There are consequently a combination of environmental, social and economic stresses, which coincide during the transitional period and which ne-

gatively affecting the health situation, in particular the incidence of diarrhoea. The diagrams in Figures 8.1 and 8.2 reveal this pattern.

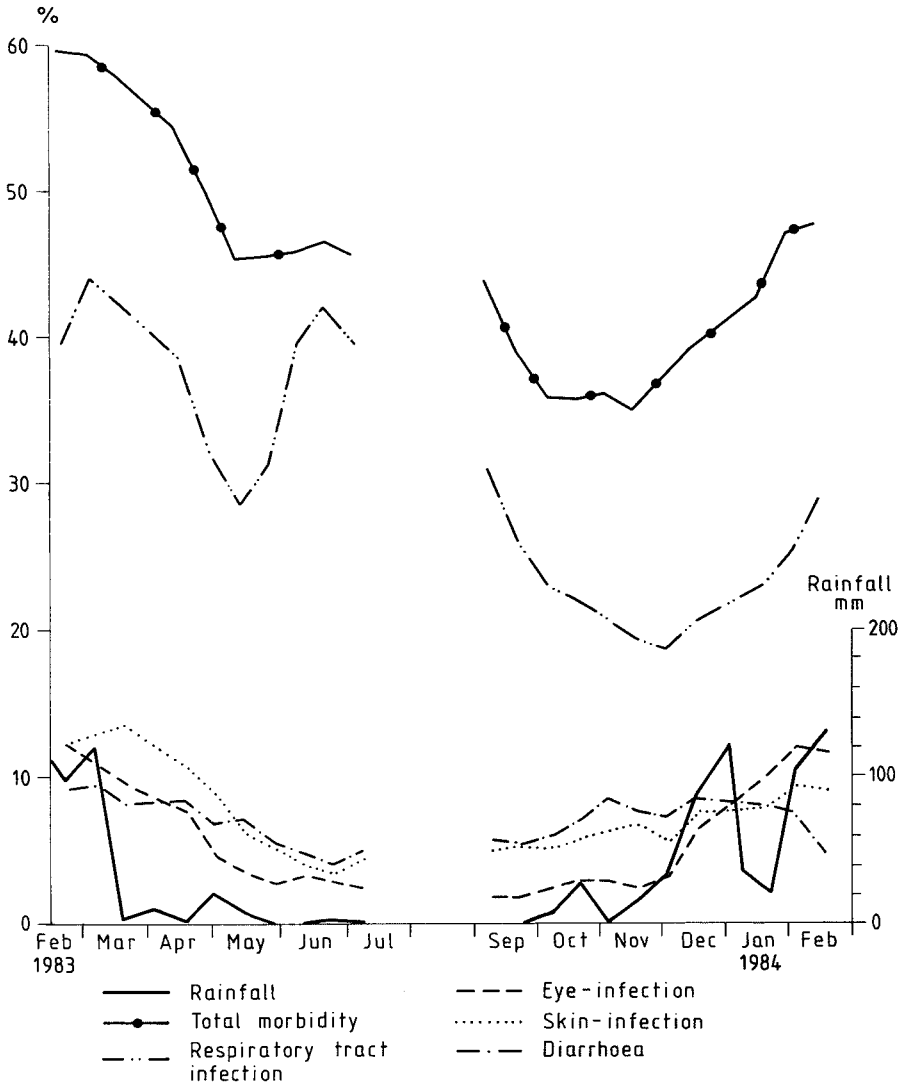


Figure 8.1 Seasonal variations of morbidity before intervention based on a moving average of three consecutive 14-day periods.

But how could the downward trend in incidence of diarrhoea during the latter part of the rainy season be interpreted? It could be related to the "dilution effect" mentioned above. Access to water will also increase during the

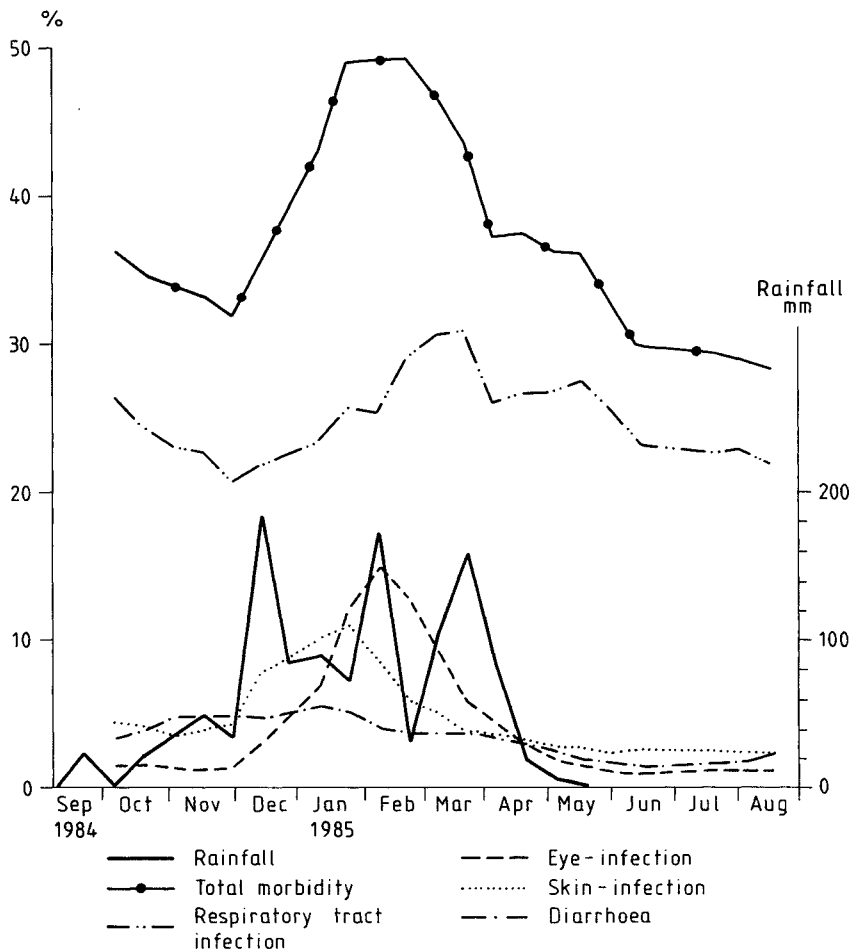


Figure 8.2 Seasonal variations of morbidity after intervention based on a moving average of three consecutive 14-day periods.

wet season. It was, however, not possible to document any increase in consumption during the rainy season.

In order to assess the exposure to contaminations, it is relevant to consider the options for people, and especially children, in terms of the time they spend in various parts of their environment. In general, people spend most of their time outdoors, as the rooms are dark and mostly small. The main activity taking place indoors is sleeping. Water is often stored inside the house but this does not require spending much time indoors. There is therefore not much seasonal variation in the time spent indoors or outdoors.

The main seasonal differences in terms of places where activities are performed, are whether they are carried out in the open or on the *khonde* (ver-

andah). During the rains much more time is spent on the *khonde* than during the cool, dry season. In addition, the *khonde* gives shade and is therefore often preferred during the hot season in October-November.

To what extent the amount of contaminations vary between the different places where children spend their time has not been examined. One might assume that the outdoor environment would contain more contaminations than the *khonde* and thus that outdoor stays would imply a comparatively high exposure to health hazards. Crowding on the *khondes* may, on the other hand, also have negative health implications. The results of this study do not give any basis for further conclusions about the implications of staying in the *khonde* or outdoors.

An important circumstance is the labour requirement. Women have the main responsibility for cultivation. During the end of the dry season and during the rainy season, a considerable part of the mothers' time was spent carrying out work in the fields. The need for labour was highest during the preparation of the ridges before the rains, during the planting at the onset of the rains and to some extent about a month later when the fields had to be weeded. This meant that less time could be given to child care, food preparation etc. The maximum demand for labour coincides with the peak in diarrhoeal diseases. Also, it was often difficult to get time for clinic and hospital visits during this time of the year. Thus, the need for labour in the household is strongly and negatively related to diseases.

All the above mentioned circumstances would harmonize with the intra-seasonal variations found for diarrhoea. At the same time it is essential to remember that food supply is decreasing during the entire rainy season and will not improve until the harvest in March to May.

Delayed effects

The impact of seasonal variations on health are not only concurrent but also delayed. The combined effect of heavy demand for labour inputs, dwindling food reserves and bad environmental conditions put a very high stress particularly on pregnant women and their off-springs, which is very harmful. They are exposed to a number of infections and conditions at birth are extremely bad. It is therefore distressing that births tend to peak during the latter part of the rainy season and at the time of harvest. This has been shown to be the case in a number of countries (Earthscan, n.d.). Moreover, the birth weights of children delivered during the rainy season averaged about 10 % less for rural Gambian children compared to birth weight during the dry season (*ibid*). Similarly, it is worth noting that in Tanzania birth weight is lower in areas with higher rainfall (Bantje, 1987).

The relatively poor start of children born during the rainy season will have long-lasting consequences. In rural Gambia it was found that "82 % of all the deaths of children under three were of children born during the six rainy

months" (Earthscan, n.d). Morbidity and mortality patterns of children should thus be related to the period of birth in addition to morbidity and mortality variations over seasons and among age groups.

Schofield (1979) reviewed a number of studies in which the combined effect of child age and season and their impact on vulnerability to diarrhoeal diseases were analysed. She investigated the long-term effects of birth season on the nutritional status of pre-school children. She identified five factors which, apart from the age of the child, influence nutritional status: birth weight, breast-feeding, supplementary feeding, type of immunity and child care. These five factors interact so that "children born in any season will, at some stage in the first two years of life, be vulnerable to the effects of seasonality factors" (*ibid*, 109). The implications of this for the disease load of a child vary depending upon at which age vulnerability to seasonal factors is most crucial. If vulnerability for diseases during, say, the first years of life is mainly determined by conditions at birth, then those children born at the beginning of the dry season will have the best possibilities to get a low disease load. If 7-12 months is the age when children are most vulnerable, i.e. when passive immunity is lost and breast-feeding becomes inadequate, then children born in the beginning of the rainy season will have the best opportunities to get a low disease load during their first two years of life.

In the present study the age with highest incidence of diarrhoea was for children between 6 and 18 months, especially 9 to 15 months. As mentioned in chapter 8, the peak of diarrhoea was at the transition from the dry to the rainy season and at the beginning of the rainy season, i.e. in November to January. Diarrhoea was lowest during the cool season in July to August. If these two factors are combined, a clear pattern is discerned with maximum amount of diarrhoea during the rains in November to January for children 9-15 months.

For a more detailed analysis of the material of our study, children born during each of four 3 month periods of the year were treated as a cohort and the total load of diarrhoeal diseases up to 18 months of age and up to 24 months were measured (Figure 8.3). Children born between July and December had started their last trimester during the period April to September, when food supply is at a maximum. During this time labour requirements are at a minimum. Further, children born during the period July to December are fortunate to reach the age with maximum amount of diarrhoea, i.e. around one year, during a period with relatively good food supply and low rates of diseases. Children born from January to June both have had their last trimester and will reach the age of one year when environmental conditions are worst.

Children born during the beginning of the rainy season, i.e. mid-November to mid-February, reached the age of 6 to 9 months, i.e. when passive immunity is lost between mid-May and mid-November when most conditions are favourable. Despite this, this cohort had during their first 18 months of

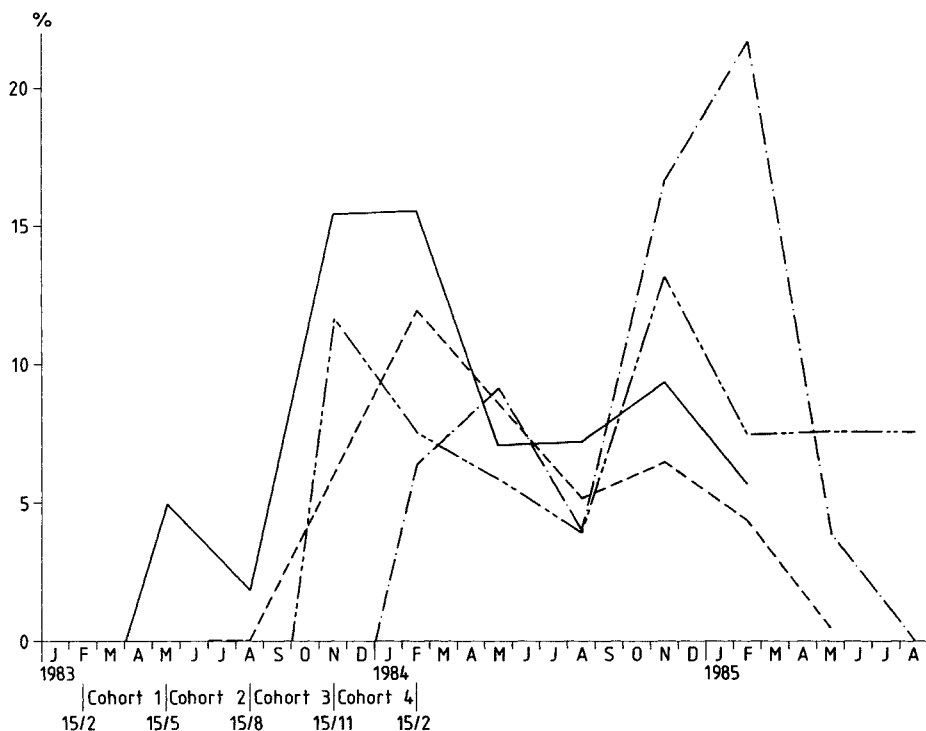


Figure 8.3 Prevalance of diarrhoeal diseases up to age of two years of children born during different seasons.

life the highest accumulated rate of diarrhoea of the whole study (10.3 %). Children born from mid-February to mid-May had the second highest rate (8.7 %) (Figure 8.3). Thus, one of Schofield's hypothesis that the most vulnerable age is when the passive immunity is lost and breast-feeding becomes inadequate, is not supported.

It is worth noting that the cohort with highest frequency of diarrhoea was born during the beginning of the rainy season and the second highest during the end of the rainy season. Children born in the beginning of the dry season, *i.e.* mid-May to mid-August, both had the lowest overall prevalence of diarrhoea up to 18 months (6.4 %) and also the lowest peak (12 %) at the age of 7 months. They had started their last trimester from mid-February to mid-May. Thus the cohort of children which are born when the seasonal conditions are most favourable in mid-May to mid-August has the least amount of diarrhoea. This therefore seems to support the second of Schofield's hypotheses, *i.e.* that vulnerability to a large extent is determined by circumstances at birth and during the last trimester. This is important to keep in mind when implementing health education programmes. Special advice and at-

tention may be necessary for mothers, whose children are born from November to February, when the vulnerability of children is highest.

9. Summary and Conclusions

The purpose of this study was to analyse the relationships between water supply, water handling and health, particularly among children under the age of five years. Evaluation of the impact upon health of an improved method of water supply as well as the impact of a health education and sanitation promotion programme were part of the analyses. In order to assess the health implications of the water supply and education programmes, morbidity patterns were related to the amounts of water carried home and to water quality at the source and after storage. Circumstances which were likely to affect water handling and consumption were analysed.

The implications of climatic seasonality were studied in some detail. The intervention with the improved method of water supply started towards the end of the dry season in 1984, when around 10% of the households used improved water supplies. The intervention gained momentum during the rainy season in 1984-85. At the end of this study, that is, during the dry season in 1985, about half the households could rely on improved sources of water supply.

Changes in amount of water consumed

One of the most significant changes of the intervention was a substantial relative increase in the amount of water consumed *per capita*. The increase in consumption was closely related to a shorter distance to the new taps, as compared to the distance to the traditional source. However, also households which did not get the new taps closer to their homes than the traditional water sources, increased their consumption. Furthermore, water consumption did increase among those households who continued to rely on traditional sources of water supply.

Two explanations for the increase in water consumption seem natural. First, it is likely that the increased awareness of the importance of water for health, which was created through the intervention and probably also through our research project, stimulated water consumption positively. Second, it is obvious that reduction in the distance to the water source is important. It seems, however, that the relative change is more important than the absolute. Households, whose distance to the water source was reduced more than 500 meters, increased their water consumption by about 50% (see table 6.9). Households, who got the tap further away than 400 meters, increased their water consumption with less than 10% (table 6.10).

Changes in water quality

The piped water was of considerably better bacteriological quality than that of the traditional water sources. However, during storage at home, water from both types of sources became heavily contaminated. The deterioration was particularly pronounced during the rainy season. There was thus a considerable contamination between the tap and consumption. Inappropriate methods of storage together with insufficient personal hygiene were identified as major causes behind the deterioration of the quality. Hands and fingers with faecal contamination are dipped into the water vessel when taking water. In addition, there is a risk that animals around the house pollute the water.

Health implications of the intervention

It was not possible to identify any significant impact on health from the improved water supply and health and sanitation promotion programmes. When total and diarrhoeal morbidities were measured before and after intervention and the results between the intervention and the control groups were compared, no significant trends could be verified. However, when comparing only the second half of the after-intervention year, use of piped water was significantly related to lower total morbidity, but not to any of the water-related diseases (Lindskog, P. *et al.*, 1988). Neither was the use of piped water significantly related to child growth (Lindskog, U. *et al.* 1987b). Regarding mortality, there was a tendency to a reduction among children belonging to households relying on improved water supply.

Considering the generally poor environmental and personal hygiene as well as deficiencies in food supply, etc. the lack of a significant impact is not surprising. In addition, there are serious methodological difficulties connected with the kind of evaluation attempted. It is, however, worth noting that there was a conspicuous decline in the prevalence of diarrhoeal diseases after intervention both among children belonging to households having access to improved methods of water supplies as well as among households who had to continue to rely on traditional sources of water supplies (see table 6.12).

The reduction in diarrhoeal morbidity as shown by the figures in table 6.12, could be interpreted in various ways. It is, for instance, possible that there was a certain amount of "over-reporting" of illness at the beginning of our study. As people were very concerned about the health of their children and then suddenly were exposed to a direct attention to the health situation of their children, an over-reporting seems natural. As the project went on, people gradually got used to the presence of our study and might have reported closer to the actual morbidity pattern. Another problem for a proper interpretation of the trends in morbidity is the impact on morbidity from sea-

sonal variation in the climate and all its implications in terms of variations in water quality, food supply, working conditions etc.

It is, however, interesting to note that the reduction in diarrhoeal morbidity is similar among all children in the area. Analytically, it implies that the use of control groups is of limited value. The results are nevertheless logical, since there was an equally high increase in water consumption among all households and since the deterioration in the quality of water during storage was also apparent in all households. The water in taps which was of comparatively high quality, was of about the same quality as water from traditional sources when it was actually consumed.

Impact of climatic seasonality

There were strong inter- and intra-seasonal variations of all diseases. Eye- and skin-infections covaried closely with variations in rainfall. The prevalence of diarrhoeal diseases was lowest at the beginning of the dry season, then gradually increased to reach a peak at the onset of the rains when total morbidity was lowest. It then decreased towards the end of the rainy season. The results indicate that accessibility to water as well as personal hygiene are relatively more important than the quality of the environment and food supply.

Children born during the beginning of the dry season had the lowest rates of diarrhoeal diseases during their first 18 months, while those born at the beginning of the rainy season had the highest rates, or almost the double.

Concluding remarks

The results of the study illustrate that in spite of relevant knowledge among people concerning aspects of water quality and a motivation to contribute to an improvement in the water supply situation, serious problems remain with regard to water storage and hygiene behaviour. To some extent these shortcomings can be explained by various constraints which in many cases prevent people from improving their practice. The invisible character of pollutants is a complicating circumstance in this regard. The educational challenge is to make the invisible pollutants and the route of transmission of faecal-oral diseases understandable to people and to stimulate the motivation to improve hygiene behaviour.

Poverty and lack of resources are endemic in large parts of Third World countries and can not easily be eradicated. Under the prevailing circumstances it is essential to focus the attention on such circumstances which are most critical. Seasonality aspects are crucial and have been dealt with at length. The implications of climatic seasonality should be duly considered when designing water supply projects. Apart from the design of the scheme itself, it is essential to tailor the contents of educational programmes so that season-

nality aspects are paid attention to. In addition, it is crucial that medical and agricultural equipment is available when most needed. Finally, it seems worthwhile to try to identify situations and circumstances when people are particularly motivated and have the opportunity to improve their conditions.

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