IMPROVED WATER SUPPLY AND PREVALENCE OF SCABIES AMONG CHILDREN UNDER FIVE YEARS OF AGE IN THARAKA-NITHI DISTRICT, KENYA

by

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A THESIS SUBMITTED

IN PART FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF PUBLIC HEALTH

IN THE DEPARTMENT OF COMMUNITY HEALTH

UNIVERSITY OF NAIROBI

1995

DECLARATION

I, Elisabeth Charlotte Riedel, hereby declare, that this thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

THIS BOOK IS DEDICATED TO MY HUSBAND, AKE LENNARTSON, WHO SUPPORTED MY IDEA OF BECOMING A STUDENT AGAIN.

ACKNOWLEDGEMENTS

I wish to thank my supervisors, Dr. Joseph Wang'ombe, Dr. Salvator Kanani and Mr. Melvin Woodhouse for their guidance and support. I am deeply indebted to Mr. Nyabola and Mr. Kihoro, both from the Department of Community Health, University of Nairobi, who advised me on epidemiological procedures and statistical matters.

Mr. Nginya, the Project Manager of the Tharaka Water and Sanitation Programme (TWASP) provided all the necessary support needed regarding information and practical matters - like transport and accommodation - my special thanks to him. I would like to thank all the staff of the TWASP for providing all the information I needed to conduct this study.

I am grateful to Mrs. Joan Miseni from Chuka Hospital who helped me identify the research assistants and to carry out the training .

I am most grateful to my research assistants:
Mrs. Martha Njoka, Miss Catherine Karimi, Miss Francisca Kanyoni, Mr. Julius Njagi, Mr.Justus Mutuota, Mr. Alexander Karongo, Mr. Peter Njagi, Mr. Pius Mugwathi and Mr.Thomas Njagi. For four weeks they had to live under sometimes uncomfortable conditions to carry out the interviews and examinations.

Finally, I would like to thank the Swedish International Development Authority (SIDA) for sponsoring this study. I would like to mention especially Mr. Göran Erikson, SIDA Senior Programme Officer Water and Infrastructure. He showed great interest in this study and provided all support necessary.

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ABSTRACT

This study demonstrates the effect that improved water supply systems have on water consumption and water use patterns within households and on the prevalence of scabies among children under five years of age. A comparison of households using improved water sources with households using traditional water sources indicated that access to an improved water source was not associated with an increase in water consumption but with changes in hygiene practices. Children from households with access to improved water sources were bathed more frequently and changed their clothes more often.

The prevalence of scabies among children under five years of age was found to be significantly associated with the type of water source used by the households.

SUMMARY

A cross-sectional survey was carried out in a rural area in Tharaka Division, Tharaka-Nithi District, Eastern Province, Kenya. The overall aim of the study was to determine the health impact of improved water supply systems in this rural area.

Six hundred and twenty-nine households in ten sub-locations were interviewed regarding the type of water source used, water consumption and water utilization and knowledge about water-related diseases. Socio-demographic and socio-economic characteristics of the households were considered. Nine hundred and seventy-five children under five years of age were clinically examined for scabies.

The overall prevalence of scabies among the 975 children was 25.7 %. There was no significant difference in the prevalence rates between the area where the majority of the study population (64.9 %) had access to improved water supply systems and the area where only 33.5 % of the population had access to improved water sources.

However, scabies was significantly associated with the type of water source used by the individual household. It was found that in Tharaka Division, children from households using improved water sources are less likely to contract scabies than children from households using traditional water sources (Odds Ratio = 1 : 3.5).

The prevalence of scabies was also associated with the frequency of bathing, the use of soap for bathing, the amount of water fetched for the household and the nutritional status of the children.

The choice of water source was not influenced by socio-demographic and socio-economic factors such as household size, occupation, education or landed property of the head of household, but was strongly related to the distance to the water source, the time spent on one trip to and from the water source and payment for water.

Although access to improved water supplies was not associated with changes in the daily water consumption within the households, it contributed to improvements in personal hygiene practices. The frequency of bathing and of changing clothes increased significantly among the children when they lived in households where improved water sources were used. Distance and time were the most important factors for these changes.

Health education was another important factor influencing hygiene practices. Not only was the frequency of bathing small children and changing their clothes significantly associated with health education, but also the amount of water used for hygiene purposes increased when health education was provided.

CHAPTER ONE

Introduction

1.1. General

At the Alma Ata Conference in 1978 an adequate supply of water and basic sanitation were identified as essential elements of Primary Health Care, given many health hazards have been recognized as being related to insufficient water supply and poor sanitation.

In developing countries emphasis has therefore been put on the development of water supply systems in order to increase the availability of sufficient and potable water and to provide adequate sanitation for urban and rural populations.

According to Lindskog and Lundqvist [1989, p.10] statistics of the World Health Organization revealed that in 1985, 36.1 % of the rural population in developing countries had access to safe water compared to 13.2 % in 1970.

In Kenya, 21 % of the rural population had access to safe water in 1985 [UNICEF, 1992, p.76]. A significant increase to 42 % is reported for 1991 [WHO Country Office Kenya, 1991, p.26]. Programmes to improve the water supply especially in the rural areas are on-going in various parts of the country.

1.2. Background Information

1.2.1. Water-Related Infections

Various infectious diseases are related to water and can be prevented by improvement of water supplies. Cairncross and Feachem [1983, pp.6-9] classify water-related infections in four categories based on the mode of transmission:

- water-borne diseases

  e.g. diarrhoeas and dysenteries, enteric fevers, poliomyelitis, infectious hepatitis and others caused by protozoa, bacteria or viruses.

  This mode of transmission refers to intake of water contaminated with faecal matter. These diseases can be prevented by improving drinking water quality. Nevertheless, all diseases in this group may also be transmitted by other faecal - oral routes and could therefore also be water-washed.

- water-washed diseases

  e.g. infectious skin and eye diseases caused by ectoparasites, fungi, bacteria or viruses, systemic infections caused by ectoparasites like louse-borne typhus or relapsing fever, faecal-oral transmitted intestinal infections as already mentioned.

  Water-washed infections are related to lack of water and poor hygiene and can be reduced by provision of sufficient amounts of water for hygiene purposes, combined with behavioural changes.

- water-based diseases

  e.g. Schistosomiasis, Guinea worm and several other infections caused by helminths.

  Water-based infections can be prevented by protection of the water source from pollution by human excreta and by control of the aquatic intermediate hosts of the pathogens.

- water-related insect vector borne diseases

  e.g. Malaria, Trypanosomiasis, Filariasis, Yellow Fever and Dengue caused by protozoa and viruses.

  The pathogens causing these diseases are transmitted by insects breeding in, or biting near, water. Improvement of surface water management and destruction of breeding places are strategies employed to tackle this group of diseases.

1.2.2. Rural Water Supplies for Domestic Use

Traditional sources of water for domestic use are rivers, streams, lakes and springs as well as hand-dug shallow wells. These surface and ground water sources often show a high degree of bacteriological or chemical pollution due to human excreta disposal and agricultural or industrial activities.

In general, improvement of water supplies for households implies:

- better water quality
- greater water quantity
- continuity of water flow
- easier accessibility

The techniques used for improving water supplies depend on the water source available.

Ground water can be drawn from:

- dug wells down to 50 m depth
- driven tube wells down to 10 - 15 m
- bored tube wells down to 25 m
- jetted tube wells down to 80 m
- boreholes drilled to over 100 m deep [Cairncross and Feachem, 1986, p.4] or from springs defined as places where a natural outflow of ground water occurs [Hofkes et al., 1981]. The point where spring water reaches the surface is called the 'eye' of the spring.

There are various methods for raising water from the ground. The method to be applied depends on the type of ground water source, the funds available and the probability of maintenance:

- Buckets on a rope
- hand-pumps
- Wind pumps
- Diesel or electric pumps
- Solar pumps

Ground water is usually of good bacteriological quality due to filtration when flowing underground. This water can get polluted if water running on the surface above comes into contact with it. The withdrawal of ground water should therefore take place in a safe distance of at least 30 m [Cairncross and Feachem, 1986, p.17] from habitats of pathogens like latrines, septic tanks or refuse dumps. In addition to suitable location, wells can be protected from contamination by proper lining, headwalls, drainage aprons and covers. Spring protection consists basically of a spring box around the eye of the spring, a silt trap, overflow pipe and outlet pipe.

Springs show a seasonal variation of flow and they are an ideal water source when reliable as they do not require any pumping.

The yield of ground water reservoirs depends on the quantity of water stored and various hydrologic factors such as precipitation on the area contributing to the aquifer, surface stream-flow from this area, evapotranspiration, net ground water inflow to the area, changes in ground water and surface storage [Linsley et al., 1982, p.196].

Rainwater can be harvested from roofs or from the ground and stored in barrels or tanks. The quantity of rainwater collected depends on the amount of rain falling and the size of the run-off area. Roof catchments can provide relatively clean water for household use while water from

other surfaces may be used for livestock or irrigation. Storage facilities can be above or below ground and made from various materials such as wood, cement, bricks, concrete, etc. To avoid deterioration of the water quality they have to be covered. Additionally, water treatment like disinfection, filtration or boiling may be required before the water is used for drinking.
The common reservoir of surface water in rural areas is the dam or the pond. When not properly protected these reservoirs are often heavily polluted and therefore not suitable for drinking or hygiene purposes.

1.2.3. Domestic Water Use and Consumption

Domestic water is mainly used for
(i) drinking,
(ii) cooking,
(iii) cleaning, washing, personal hygiene,
(iv) garden watering and livestock.

The volume of water used by households varies widely and depends on climate, cultural habits, socio-economic factors and the accessibility of a water supply.
Consumers with taps in the house use an estimated 30 to 250 litres per person per day, with yard taps 20 to 80 litres per person per day.
Water consumption from communal stand-pipes and village wells in a walking distance less than 250 m is estimated at

20 to 50 litres and 15 to 25 litres per person per day respectively.
Increase of the walking distance to the water point to more than 1000 m decreases consumption to 5 to 10 litre per person per day [Hofkes et al., 1988, pp.39-40].
Referring to a number of studies carried out in developing countries, White [in Feachem et al., 1986, pp.108-111] identified the following user considerations regarding the choice of water source:

- quality (from the user's view defined rather by taste, temperature, odour and colour)
- walking distance
- queuing time
- cash payments
- technology at the water source
- social relationships involved in getting water.

1.3. Scope of Interest of the Present Study

This study focussed on the impact improved water supply may have on the health of children under five years of age in a rural area in Kenya. The relationship between access to sufficient amount of water and a water-washed disease was the subject of investigation.

The study was a survey on

(i) Demographic and socio-economic characteristics of the households in the study area.

(ii) Water consumption and water use pattern in the households.

(iii) Prevalence rates of scabies among children under five years of age.

CHAPTER TWO

Literature Review

Bradley [in Feachem et al., 1986, p.9] describes the reduction of infective diseases in relation to water supplies. He suggests that water-washed / potentially water-borne diseases like bacillary and amoebic dysenteries can be reduced by 50 % while purely water-washed diseases such as louse-borne fevers and scabies will be reduced by 40 % and 80 % respectively through improvements in water supplies.

Several studies carried out recently point out the importance of both accessibility and availability of sufficient water quantities for the reduction of water-related diseases.

A study to identify aetiological factors of childhood diarrhoea was conducted between May 1987 and July 1988 in an urban settlement in Papua New Guinea. The presence of a stand-pipe in the compound was associated with a reduction in diarrhoea morbidity of 56 % [Bukenya and Nwokolo, 1991, pp.534-539].

A case-control study from a rural area of Nicaragua revealed a statistically significant association between water availability and diarrhoea morbidity. Marked differences in water quality between different types of water supply as well as ownership of latrines were not found to be related with diarrhoea morbidity. But children from houses with its own water supply had 34 % lower incidence rates of diarrhoea than those from households with water supplies in more than 500 m distance [Gorter et al., 1991, pp.527-533].

In Bangladesh the importance of water-borne and water-washed transmission of diarrhoea was determined during 1985 by comparing the degree of contamination of children's hands and drinking water with the diarrhoea morbidity [Henry and Rahim, 1990, pp.121-126]. Mean diarrhoea attack rates as well as mean levels of water contamination were lower in an area with tube wells and latrines than in an area without such facilities. In both areas, diarrhoea incidence was significantly associated with the degree of contamination of hands, while no significant correlation was found between water contamination and diarrhoeal incidence on an individual basis. The conclusion was drawn that water quantity is of greater importance than water quality in the transmission of diarrhoea .

A survey carried out in Mozambique in 1983 revealed that the trachoma prevalence in a village with water supply (stand-pipe) in the centre was much lower (19.1 %) than in an unsupplied village of similar size (38.2 %). It was found that the volume of water used per capita and the frequency of bathing were much higher in the village with water supply in the centre otherwise no differences regarding hygienic aspects were found [Cairncross and Cliff, 1987, pp.51-54].

A different conclusion was reached in South Africa [Verweij et al., 1991, pp. 681-684]. The impact of an improved water supply system on water use and health status was evaluated by comparing villages with tap and borehole water with villages with unprotected springs. Infectious skin disease and diarrhoea were used as indicators. It was found that provision of improved water supply in terms of easier accessibility and better quality was not accompanied by an increase in water use. The prevalence of diarrhoea showed no correlation with the quality of drinking water and infectious skin disease was not correlated with the quality or quantity of water used per person. Health benefits could not be demonstrated.

Few recent studies try to correlate scabies with accessibility to water or other factors.

In Bangladesh young children were followed up from October 1984 to September 1985 to estimate the annual risk of infestation with scabies and to determine risk factors for infestation. Differences in hygiene practices (hand-washing, defacation habits) were recognized as significant for the presence of scabies but no investigations concerning water accessibility were performed [Stanton et al., 1987, pp.219-226].

A study about communicable skin diseases among children in Kenya undertaken in 1989 aimed at determining the prevalence of skin diseases and associations of socio-economic variables. Regarding water sources it was stated that children using unsafe water sources (described as rivers, wells, ponds, dams) were more infested with parasitic skin diseases than children using piped water. Unfortunately the unsafety of the water supplies in this study was not defined. Output, reliability, quality as well as distance to the source of water were not taken into account [Edhonu-Elyetu, 1991, p.66].

An extensive study on skin diseases was carried out in Brazil involving a study population of nearly 10,000 children aged 6-16 years [Bechelli L.M. et al., 1981, pp.78-93]. The main purpose of this study was to determine the prevalence of dermatosis in school children in a tropical area and its possible relation to certain epidemiological factors. In relation to scabies this survey revealed that the socio-economic status plays a significant role in the appearance of scabies. It was also found that in females, the prevalence of scabies increased significantly with age while no substantial differences among age groups in males occurred.

Studies carried out recently on water consumption and factors affecting domestic water use showed contradictory results regarding distance from water sources. They give different impressions about the relationship between accessibility to the water sources and the volume of water used for domestic purposes.

A study conducted in rural Nicaragua between May 1986 and December 1988 revealed that a decrease in the distance to the water source from 1000 to 10 m is associated with an increase in per capita water consumption of 20 %. In this study; a strong correlation between education and water consumption was also found. In households where mothers had a six year formal education 17 % more water per capita was used, whereas in households where fathers were educated the water consumption was 12 % more [Sandiford et al., 1990, pp.383-389].

A correlation between the time spent on water collection journey (related to walking distance to and queuing at the water source) and water consumption was also revealed in the already mentioned study from Mozambique. A comparison of domestic water use in two villages indicated that the reduction of time needed for the water collection journey from 5 hours to 10 minutes was associated with an increase of average water consumption from 4.1 to 11.1 litres per capita per day. Bathing of children in the village with water supply was done regularly, while it was unknown in the village without water supply [Cairncross and Cliff, 1987, pp.51-54].

A rural household survey conducted in September 1989 in Meru District, Kenya, found no association between daily water consumption per capita and distance from water source or estimated time spent to collect water as well as no association to economic determinants such as farm sizes, cash crop incomes or total farm incomes. Water consumption rates were found to be related to agro-ecological zones. In areas with high agricultural potential the daily water consumption rate per person amounted to 21.95 litres while in the areas with low agricultural potential it was reduced to 12.6 litres [Williams and M'Barine, 1991, pp.271-274].

A study performed in Nigeria examined the effect of distance and season on the use of boreholes. In the dry season 90 % of households used borehole water as main source; distance was of no importance until reaching about 2 km. In the wet season, rainwater became the main water source for most of the households and only 31 % used boreholes as main water source. The borehole use decreased significantly with increasing distance [Blum et al., 1987, pp.45-50].

In Malawi a cohort study comparing areas before and after introduction of improved water supply and health education revealed a substantial increase of water consumption per capita related to shorter distance to newly constructed water supplies. A reduction in distance of more than 500 m resulted in a 50 % increase of water consumption. However, households without access to new water supplies also increased their water consumption. This phenomenon was seen as a spill-over effect of the water and health education project creating awareness of the importance of water for health also in the unserved areas [Lindskog and Lundqvist, 1989, pp.72-77].

Blum and Feachem [1983, pp.357-365] reviewed 44 studies on the impact of improved water supplies and sanitation on diarrhoeal diseases focussing not on the findings of these studies but on problems of methodology. All of the examined studies implied one or more of eight problems which were identified as hampering the drawing of definitive conclusions from these studies:

- lack of adequate control
- the one to one comparison
- inadequate control of confounding variables
- unreliable or incomplete health indicator recall
- inexact health indicator definition
- failure to analyse by age
- failure to record facility usage
- neglect of seasonality

Measures to avoid these problems were pointed out in detail. In the final discussion it was suggested that studies on the health impact of environmental interventions should be carried out in opportunistic settings. A limited selection of health and environmental variables should be studied in the context of a very specific hypothesis. Behaviour and usage of new facilities should be focal points of the investigation. Inter-disciplinary collaboration of engineers, epidemiologists and social scientists was highly recommended.

CHAPTER THREE

Research Problem

3.1.. Statement of the Problem

In Tharaka Division, Tharaka-Nithi District in the Eastern Province of Kenya, a water supply and sanitation programme "Tharaka Water Supply and Sanitation Programme (TWASP)" was introduced in 1988 jointly by the Ministry of Water Development and the Swedish International Development Authority (SIDA).

The overall objectives of this programme are:

- to create better conditions for improved hygiene and health,
- to provide a better basis for economic growth and social development among the poorer groups of the population [Kenya-Sweden Rural Water Supply Programme, 1989, p.1-1].

One of the operational targets to meet these objectives is improved water supply which is defined as being

- continuous,
- of better quality,
- of greater quantity,
- more easily accessible,
- available for various household purposes.

[SIDA, 1984, p.2].

In three locations in Tharaka Division, a number of boreholes have been drilled and supplied with hand or solar pumps, springs have been protected and ferro-cement tanks for rainwater harvesting constructed. By end of March 1992, a major part of the population in these locations had access to sufficient and clean water.
While these improvement activities were under way, a number of latrines for institutions as well as households had been constructed and health education with emphasis on personal hygiene and infectious diseases related to water conducted. So far, little is known about the health impact of the TWASP which has provided additional and clean water to a major part of the Tharaka people for about five years.

Skin diseases are among the top ten of the most common diseases in Kenya. In 1978 they contributed 17.3 % of all out-patient diagnoses [Government of Kenya and United Nations Children's Fund, 1989, p.57] and in 1988 skin diseases accounted for 7.3 % of the outpatient visits [Central Bureau of Statistics, 1990, p.201].
From the annual out-patient morbidity statistics for Eastern Province, skin diseases (including ulcers) came third with 8.49 % in 1990 and fourth with 6.12 % in 1991. The rates for former Meru District (which included Tharaka Division) were even higher with 7.36 % in 1990 and 11.82 % in 1991 [H.I.S., unpublished].
Morbidity reports from two health centres in Tharaka Division showed an increase in the incidence of skin

diseases from 11.4% in 1989 and 14.7 % in 1990 to 20.8 % in 1991 [Norconsult A.S., 12/1992, p.2.8].
These statistics also reveal the rank of skin diseases among water-related diseases. They come second after Malaria and far ahead of other water-washed or potentially water-borne diseases like diarrhoeas.

Various infectious skin diseases are associated with poor hygiene and lack of sufficient amount of water. One of these diseases is Scabies, a contagious, pruritic skin disease. Although no data on scabies in particular was available for Tharaka Division, observations made by health personnel suggested that scabies is a major health problem in this area.

Aetiology: Scabies is caused by Sarcoptes scabiei, a tiny mite. Both male and female mite burrow under the horny layer of the skin, but while the male dies after copulation the female advances 2-3 mm daily, mainly at night. She lays 2-3 eggs daily for 4-5 weeks. The eggs hatch in larvae which migrate to hair follicles and become adults after passing nymphal stages pairing off on the surface of the skin [Manson-Bahr and Bell, 1987, p.921].
Epidemiology: Scabies is a world-wide infectious skin disease associated with poor hygiene and lack of sufficient amount of water. It is contracted by direct contact from person to person or indirectly through contaminated clothing or bedding.

Diagnosis: Scabies can be diagnosed by three typical clinical symptoms:

1. The burrow; visible as a slightly twisted line on the skin, a few millimetres long and ending in a papule or vesicle. But burrows may be difficult to find when masked by scratches or secondary pyogenic infections.
2. Nocturnal pruritus.
3. Characteristic distribution of the skin alterations at the webs and sides of the fingers, the wrists and elbows, the waist, lower part of the buttocks and inner thighs. In women eruptions may be seen around the nipples, in men the genitals may be affected. In children, but never in adults, the face may be affected.

The location of the female mite at the end of a burrow on probing with a needle confirms the diagnosis.

A severe type of scabies is Scabies Norvegica characterized by hyperkeratotic plaques and crusted dermatitis. This variant is caused by massive infestation of mites and is mainly found in malnourished, mentally handicapped or chronically ill persons with low resistance [Canizares, 1982, pp.130-132]. It may persist for years. Stüttgen [1992, pp.C844-C851] refers to the correlation of Scabies Norwegica with immunodeficiency diseases such as AIDS.

Accessibility to sufficient amount of water is a basic requirement for the prevention of scabies. However, the standard of personal hygiene depends on the water use

pattern. Socio-demographic, socio-economic and socio-cultural factors as well as the season of the year may influence the water use pattern and may be conducive to the spread of scabies. In addition, health factors such as malnutrition and immunosuppression might contribute to the prevalence of scabies.
It is not known if these variables have a confounding effect on the prevalence of scabies in Tharaka Division.

3.2. Justification of the Study

Water-washed infections can be prevented by improving water quantity, water accessibility and hygiene [Cairncross et al., 1991, p.78].
Taking all the activities towards improvement of water supply in Tharaka Division into account, one may expect that the prevalence of water-washed diseases in those communities with access to sufficient and clean water has decreased. So far the health impact of these interventions is not known. Therefore this study focusses on the question wether or not accessibility to improved water supply has an effect on the health of the people in Tharaka Division.
To demonstrate the health effect of the interventions in Tharaka, scabies as purely water-washed disease was chosen as health indicator.
The importance of skin diseases for individuals as well as societies is without doubt. Although in general not life

threatening, skin diseases cause not only discomfort but may also have a severe impact on the social situation of the afflicted individual. In addition, they put an enormous constraint on scarce health resources.

The study site was chosen as it enclosed a defined area where the population has access to improved water supplies as well as an area with mainly non-improved traditional water sources.

Children under 5 years of age were taken as study population as scabies appears to be particularly common in young children [Stanton et al., 1987; Taplin et al., 1991; Lucas and Gilles, 1990, p.114]. This age group is vulnerable to malnutrition and immunosuppression due to infectious childhood diseases identified as risk factors to develop scabies [Stanton et al., 1987].

3.3. Objectives of the Study

3.3.1. Overall Objective

To determine the health impact of improved water supply systems in Tharaka Division, Tharaka-Nithi District, Eastern Province, Kenya.

3.3.2. Sub-Objectives

(i) To determine the impact of accessibility to improved water sources on the daily domestic water consumption.

(ii) To determine the degree of utilization of the improved water sources for hygienic purposes in Tharaka Division.

(iii) To identify socio-demographic factors influencing utilization of improved water supplies in Tharaka Division.

(iv) To identify socio-economic factors influencing the utilization of improved water supply systems.

(v) To determine the prevalence of scabies among young children in Tharaka Division, Tharaka-Nithi District, Eastern Province.

(vi) To identify health factors potentially contributing to the prevalence of scabies, such as malnutrition and low immune status.

(vii) To recommend strategies for intervention, if required.

3.4. Hypotheses

(i) Accessibility to improved water supply systems increases the volume of water used for domestic purposes in Tharaka Division.

(ii) Accessibility to improved water supply systems changes the domestic water use pattern in Tharaka Division.

(iii) Accessibility to improved water supply systems reduces the prevalence of scabies among children under 5 years of age in Tharaka Division.

CHAPTER FOUR

Study Site

4.1. Geographical Features

Tharaka Division is a lowland area. The altitude ranges from 1220 m a.s.l. in the west to 700 m a.s.l. in the east, with two isolated peaks of 1458 m (Kijegge) and 1091 m (Kikingo).

Tharaka Division is part of Kenya's arid and semi-arid lands, the climate is hot (mean temperature 35° C). The rainfall pattern is bi-modal - long rains occur from mid-March to May, short rains from October to December. The average annual rainfall is 1000 to 1200 mm in the far western part and declining towards the east down to as low as 400 mm p.a.

There are six major perennial rivers in the area, several seasonal and perennial springs as well as some natural rock catchments [Norconsult, 1992, pp.A3-4].

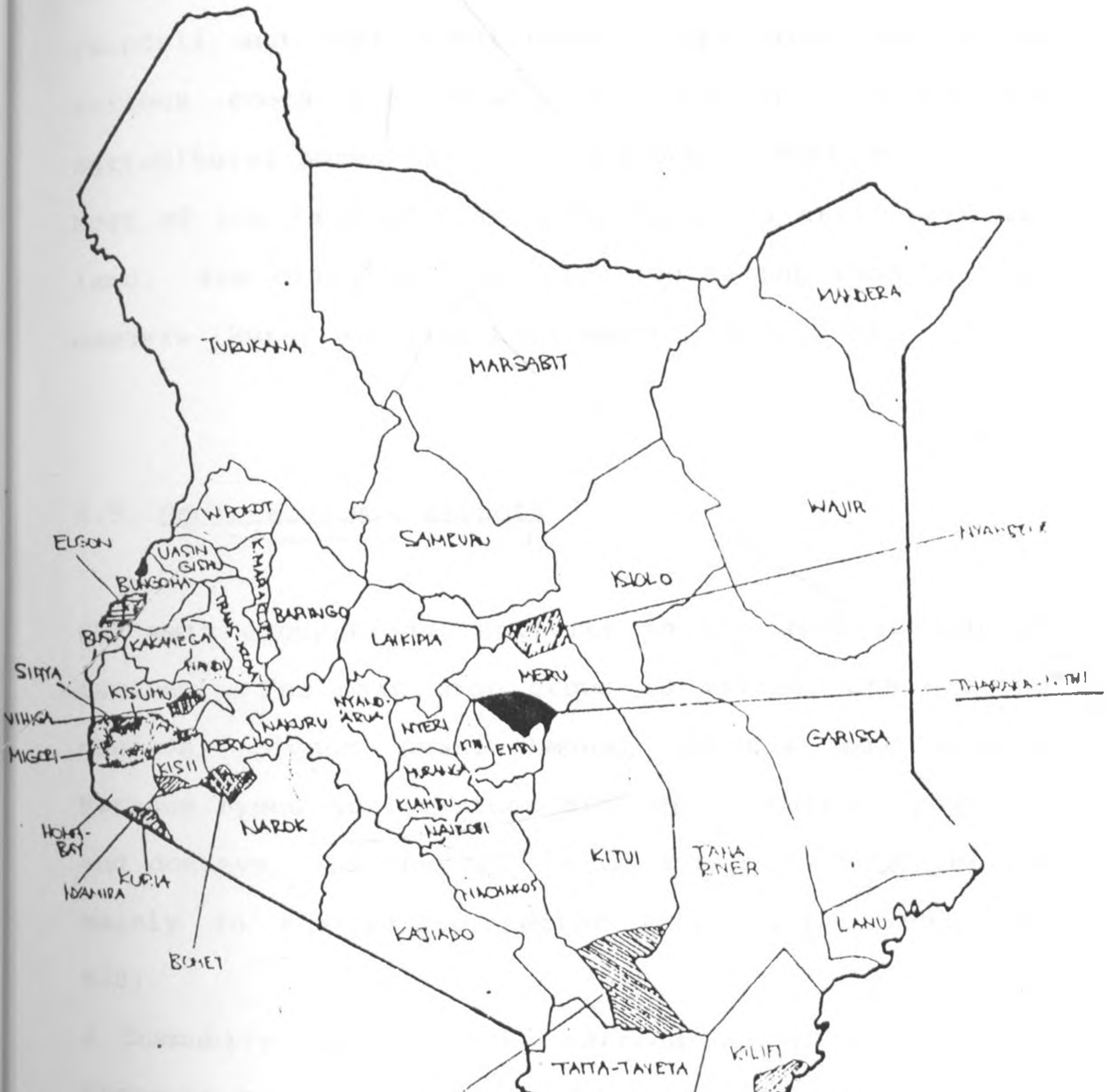


FIGURE 1 : Location of Tharaka-Nithi District

4.4. Cultural Background

The ethnic origin of the Tharakas is somewhat unclear. Lowenthal [1973, p.23] mentions the different opinions of ethnographers seeing the Tharaka as Meru sub-tribe and explorers treating them as separate tribe.

Middleton [1953, p.11] assumes that the Tharakas have come from the east across Tana River and may be of Pokomo origin. The Pokomo were a group of people living in Juba and Shebelle River region in the middle of the sixteenth century. They were displaced by the Oromo and moved south to take residence in the Tana River valley [Maxon, 1989, p.49].

Looking at the two groups linguistically, both Meru and Tharaka belong to the Thagicu sub-group of the East African Bantu Languages [Maxon, 1989, pp.21, 71].

Socially the Tharaka were organized by the age-set and the clan system. The age-set system has lost the significance it had earlier. It was based on initiation. After boys had reached puberty they were separated from their families and lived in a special house (gaaru) where they were educated in moral values, sexual matters and trained in warfare. Initiates from a single circumcision period of one year or more were organized in age units and classes.

A circumcision period was followed by four years where no circumcision was allowed [Bernardi, 1959, pp.11-21].

The clan system is still strong in Tharaka. Clans are ceremonial and political units represented by their elders. Ceremonies are performed and disputes solved by a council

of elders. Clans are segmented into sub-clans (mariko) and families (mucii) [Lowenthal, 1973, pp.31-32]. Non-gazetted land is still owned and distributed by the clans.
The Tharaka people live in extended family homesteads. Several households are arranged in a circle and surrounded by a thorn fence. The very old people, the sons, their wives, the unmarried daughters have their own households in this compound.

4.5. Administration

Tharaka Division has been part of the south-eastern lowlands of Meru District and has been divided in four locations and twelve sub-locations. In 1992 it became part of the newly formed Tharaka-Nithi District.
Administratively Tharaka Division is now divided into:

9 Locations	23 Sub-locations
1. Gatue	Gatunga Kathangachini
2. Maragwa	Kamwathu Kamaguna
3. Gikingo	Irundini Mukothima

4. Kanjoro	Kanjoro Ntorini
5. Chiakariga	Chiakariga Nkareni Kamarundi Kamanyaki
6. Tunyai	Kithino Tunyai Gakurangu
7. Marimanti	Marimanti Kanyuru Gituma
8. Turima	Turima Karocho
9. Nkondi	Nkondi Rukurini Matakiri

The sub-locations are further subdivided in sub-units.

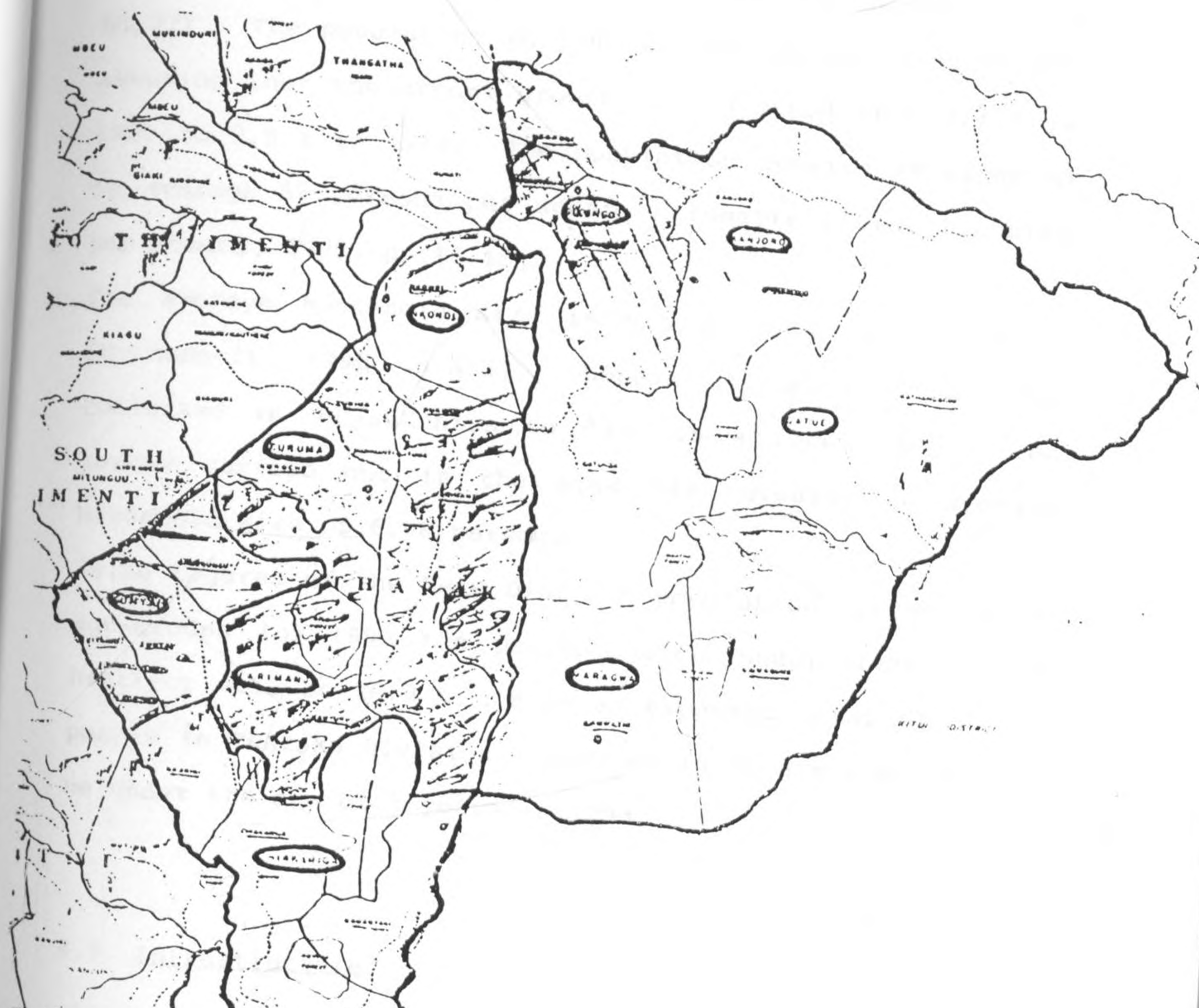


FIGURE 2 : Administrative Boundaries of Tharaka Division

4.6. Demography

In 1979 the total population in Tharaka Division was 50,277. The population in 1993 was estimated to be 86,809 assuming that the annual growth rate dropped from 3.7 % in 1987 to 3.5 % in 1992. The population density is expected to average 58 persons per square kilometre [Rural Planning Department, 1989, pp.16-18].

The average household size is 5.5 persons per household [Norconsult, 1992, p.A15]. However, unpublished figures collected in 74 subunits to date in a recent population survey carried out in the area has revealed an average household size of 6.98 persons.

Using figures of the Meru District population projection by age-groups for 1993 the percentage of under-fives in the District will be 20.3 %. From an expected total of 86,809 people in Tharaka Division 17,622 children are predicted to be under the age of 5 years in 1993.

4.7. Infrastructure

Tharaka Division has a network of about 180 kms of classified roads, 120 primary and 6 secondary schools [Rural Planning Department, 1989, pp.9, 23-29].

Ten health facilities serve the people of Tharaka Division, two health centres and 8 dispensaries.

A community based health care programme is run by the Community Health Department of Chogoria Hospital

(Presbyterian Church of East Africa) located in Chogoria, Nithi Division. Health Committees have been formed, Field Health Educators, Community Health Workers and Traditional Birth Attendants have been trained. Health education on hygiene and sanitation, oral rehydration, growth monitoring, nutrition, family planning as well as treatment of simple ailments and ante/post-natal care are provided to people in parts of Tharaka Division [SIDA Supported Health Programmes in Kenya, 1990, pp.4-6].

350 households should be visited in each area to reach the required number of children under five years of age.

The study population was divided into strata - one stratum where more than 50 % of the population had access to improved water supply and the second stratum where less than 50 % of the people had access to improved water supply. The number of people living in the two areas at present were estimated from the population figures of the censuses 1969 and 1979 for the previous locations using the mathematical procedure of extrapolation. The number of successful boreholes with installed hand-pumps in different areas allowed the calculation of the percentage of people with access to improved water supply (one hand-pump should serve at least 250 people or provide 5,000 litres of water per day to be economical).

The improved area encloses 3 locations - 66.5 % of the estimated population have access to improved water supply. To ensure that the study population was adequately represented in the sample, the population in the non-improved area (consisting of 6 locations) was further stratified, as calculations revealed a significant difference in the coverage with improved water supply (33.5 % and 4.6 % of the populations).

In each area, five sub-locations were randomly selected. A sampling frame of all sub-units in the selected sub-locations was drawn and one sub-unit in each sub-location randomly selected. As the sub-units in some of the sub-locations were relatively small it was decided to expand to the next nearest sub-unit until the required number of households were visited.

Initially 700 households, 70 in each sub-location, were thought to be sufficient to meet the required number of 1000 children under five years of age. However, this number of households proved not to be adequate to reach this sample size. About 850 households had to be visited. All children under five in these households were examined.

Tharaka Division

Improved area | Non-improved area

(3 locations)
8 sub-locations

(6 locations)
15 sub-locations

5 sub-locations | 5 sub-locations

10 sub-locations

20 sub-units

852 households

223 without children < 5

629 households

1000 children < 5 years in the household

FIGURE 3 : Sampling Procedure

5.4. General Preparations

Prior to carrying out the study a research permission from the Office of the President was obtained. Introductions to district authorities (D.C.O., M.O.H., P.H.O.) were made through the Project Manager of the Tharaka Water Supply and Sanitation Programme. Local officials (D.O. and Chiefs) were contacted. To become well acquainted with the study site the area was surveyed extensively.

5.5. Interviewer Selection and Training

With the assistance of an Enrolled Community Health Nurse from Chuka Hospital who acted as research facilitator, ten people from the local community were identified for training as research assistants. Most of them had received some public health training previously and were working as Community Health Workers, Family Health Field Educators or Public Health Technicians.

Unfortunately one of the identified research assistants was not able to attend the training course due to security problems in the sub-location he came from. As it was not possible to find another research assistant at short notice it was decided that one of the remaining nine would cover two sub-locations.

The four day training course provided

- information on study objectives

- instructions on household selection and interview techniques
- lectures on aetiology, diagnosis and treatment of scabies
- guidance in the use of Salter scales and determination of the age of the children.

All lectures were followed by discussions and supported by hand-outs, pictures and practical exercises like role plays (see Appendix II for syllabus).

An assessment test has been conducted at the end of the course to evaluate the knowledge of the interviewers.

5.6. Pretest

The pretest was conducted in one sub-unit of a sub-location not included in the main study. 18 households were visited and interviewed, 16 children under five years of age were examined. This exercise carried out on one day towards the end of the training week revealed not only some short-comings in the questionnaire design but provided also additional practice in interviewing and physical examination for the research assistants under the guidance of the researcher.

Following the pretest some questions of the questionnaire were formulated in a different way in order to be better understood by the local people.

5.7. Administration of the Questionnaire

The questionnaire was administered by the research assistants to one adult person living in the household and willing to answer the questions. The research assistants had to ask the questions in the same order using the same words. Therefore the questions were translated into the local language Kitharaka. The translation was done by the research facilitator together with the research assistants in order to avoid any misunderstandings because there are certain differences in the local dialects within Tharaka Division. To confirm the correct translation the questionnaire was later re-translated into English by a laboratory technician at Kenyatta National Hospital who speaks Kitharaka.

The questionnaire had two parts. Part I referred to the household and the domestic water use pattern, part II referred to the child. This design allowed that only one household sheet had to be filled if several children under five were living in the same household.

The questionnaire consisted of 44 pre-coded questions. They were either dichotomous or had multiple choice format, some of the questions had to be kept open ended (see Appendix I for lay-out of the questionnaire).

5.8. Data Collection

The data collection took place between end of May and end of June 1993. Research assistants were given twelve working days to carry out the interviews. Nevertheless, on Sundays and market days people could not be found at home, hence a four-week period was needed to conduct the field work.
Each research assistant was advised to start at the central point (e.g. school, chief's house) of his sub-unit. By walking from this point in a direction decided upon during the training session by blindly picking papers with the direction written on, he met his first household to visit. From this household he went to the next nearest one without considering direction any longer. Since not only the sub-units but also the homesteads which consist of several households are scattered over a vast area and could often be reached only over narrow and hidden paths guides from the local communities were engaged. Due to these distances the research assistants had also to find accommodation in the particular sub-units.

About one week after the beginning of the field work the researcher met with the research assistants to evaluate the first set of questionnaires and to discuss problems which may have occurred. There was also a plan to visit the research assistants for 'on-the spot' checks. Due to the scattering of sub-units and homesteads this proved to be not in all cases successful despite some long-hour walks through the bush and guidance by local people .

There was no household in the whole area which refused to answer the questions. A few parents did not agree to physical examination and possible treatment of their children giving religious reasons ("God will take care").

It was initially planned to treat all children diagnosed with scabies and their family members. This proved not feasible due to shortage of antiscabietic treatment. Therefore, the research assistants were advised to provide health education stressing the importance of personal hygiene.

5.9. Data Processing and Analysis

The questionnaires were carried to Nairobi where the data were entered into a computer. For data analysis the Statistical Package for Social Sciences (SPSS/PC+) was used. The anthropometric data were entered using the Software for Epidemiology and Disease Surveillance (EPI.INFO Version 5.016) from the Centres of Disease Control in Atlanta and the WHO in Geneva. With this programme the standard deviation scores (WAZ) as well as the percentages of the median for weight-for-age (WAM) were computed and transferred into SPSS for further analysis.

Some of the data had to be grouped:

- educational level of the head of household,
- water source used,
- amount of water fetched for the household and used for the various domestic purposes,
- the age of the children and their caretakers.

The dependent variable in this study was the prevalence of scabies among children under five years of age.
The independent variables were all factors related to accessibility to water supplies such as cost in terms of distance, time, payments. Confounding variables were socio-demographic and socio-economic as well as health factors.
Frequency tables were used to show how the children under study were distributed with respect to the variables.
Cross tabulations allowed the drawing of conclusions on possible associations between the various variables.
The significance of the association was tested with the Chi-Square test.

CHAPTER SIX

Results

This study was concerned with two main subject areas:

1. Water supply and water use within the households;
2. The relationship between water and scabies, the disease under investigation.

However, demographic and socio-economic factors within the households and health education were also considered as these factors may influence the water use pattern. The kind of care provided to a child and health factors such as nutritional and immune status which may contribute to the prevalence of scabies, were also taken into account.

6.1. Descriptive Characteristics of the Households

6.1.1. Distribution of Households

A total of 852 households were visited and of these 223 (or 26.2 %) households were excluded from the study because there were no children under the age of five years. Only 629 households were included in the study.

The households were equally distributed in the two areas, with 317 (50.4 %) households in the area with improved water supply and 312 (49.6 %) households in the area with traditional water supply (see Table 1).

TABLE 1 : Distribution of households by type of area and sub-location.

Area	Households		Sub-location	Households	
	No.	%		No.	%
Improved	317	50.4	Marimanti	57	9.1
			Nkondi	63	10.0
			Rukurini	51	8.1
			Karocho	71	11.3
			Kanyuru	75	11.9
Non-Improved	312	49.6	Kamanyaki	59	9.4
			Gakurungu	70	11.1
			Kamwathu	63	10.0
			Irunduni	67	10.7
			Kanjoro	53	8.4
	629	100.0	TOTAL	629	100.0

.1.2. Demographic Characteristics

The average household size in 611 households was found to be 6.2 persons/household. In 51.4 % of the households with children under five years of age, the family size ranged from 6 to 10 people, while 2 to 5 people lived in 43.2 % of the households. Only 5.4 % of the households had more than 10 people living in each of them.

50.7 % of all households included in the study had only one child under five years of age. 40.4 % of the households had two children under five years of age. Three children were found in 8.1 % of the households. Four children were found in 0.6% and five in 0.2 % of the households.
The average number of rooms per household was found to be two.

6.1.3. Socio-Economic Characteristics

The majority (70.5 %) of the heads of households had attained primary level of education or below. 10.8 % of the heads of households had reached secondary school and 3.0 % had attended college.
15.6 % of the heads of the households had no formal education.

Most of the heads of households were farmers (83.0 %), 9.1 % were skilled and 2.4 % unskilled labourers while 3.2 % were in formal employment.

Only 2.5 % of the heads of households stated that they owned no land. 4.9 % owned less than one acre of land, 32.6 % one to four and 59.9 % more than four acres of land.

6.1.4. Water Collection

52.2 % of all the households interviewed in Tharaka Division use traditional water sources for their daily water supply while the remaining 47.8 % use water sources improved by man (see Table 2).

TABLE 2 : Use of water source in Tharaka Division

Water source	No.of households	Percentage by type of water source	Percentage total
Traditional			
River/Stream	279	85.1	
Pond/Dam	1	0.3	52.2
Spring	48	14.6	
Total	328	100.0	
Improved			
Well	89	29.7	
Hand-pump	155	51.7	
Tap	39	13.0	47.8
Water kiosk	14	4.6	
Roof catchment	2	0.7	
Household pipe	1	0.3	
Total	300	100.0	
TOTAL	628 *		100.0

* One household had no water source defined

In the improved area, 39.7 % of the households had their source of water within a distance of 500 m and only 4.4 % of the households at a distance of more than 2 km. In the non-improved area, only 18.6 % of the households had their water source within a distance of 500 m while 27.0 % of the households used a water source more than 2 km from home (Table 3).

TABLE 3 : Distribution of households by type of area and distance to the water source

Distance	Households in Improved area No.	Households in non-improved area No.	Total No.
< 0.5 km	126 (39.7)	58 (18.6)	184 (29.3)
0.5 - 1 km	122 (38.5)	85 (27.3)	207 (33.0)
1 - 1.5 km	40 (12.6)	42 (13.5)	82 (13.1)
1.5 - 2 km	15 (4.7)	42 (13.5)	57 (9.1)
> 2 km	14 (4.4)	84 (27.0)	98 (15.6)
Total	317 (50.5)	311 (49.5)	628 (100.0)

( ) - are percentages

The time spent on one trip to and back from the water source (including queuing time) was estimated by 24.6 % of the households in the improved area at being less than 15 min. and by 18.3 % of the households at being more than one hour. In the non-improved area only 9.6 % of the respondents said that they need less than 15 min., while 41.8 % estimated the time spent on one trip to and back from the water source at more than one hour (Table 4).

TABLE 4 : Distribution of households by type of area and time spent on one trip to and back from the water source

Time spent	Households in		Total
	Improved area	non-improved area	
	No.	No.	No.
< 15 min	78 (24.6)	30 (9.6)	108 (17.2)
15 - 30 min	76 (24.0)	45 (14.5)	121 (19.3)
30 min -1 hr	105 (33.1)	106 (34.1)	211 (33.6)
> 1 hr	58 (18.3)	130 (41.8)	188 (29.9)
Total	317 (50.5)	311 (49.5)	628 (100.0)

( ) - are percentages

In the improved area 8.2 % of the respondents go to their water source once daily, 41.6 % twice, 40.7 % three times daily and 9.5 % more often. In the non-improved area 16.1 % of the respondents fetch water once daily and 46.3 % twice daily. 26.0 % go to their water source three times daily and 11.6 % more often (Table 5).

TABLE 5 : Distribution of households by type of area and number of trips to the water source daily

Trips made daily	Households in: Improved area No.	Households in: non-improved area No.	Total No.
Once	26 (8.2)	50 (16.1)	76 (12.1)
Twice	132 (41.6)	144 (46.3)	276 (43.9)
Three times	129 (40.7)	81 (26.0)	210 (33.4)
More often	30 (9.5)	36 (11.6)	66 (10.5)
Total	317 (50.5)	311 (49.5)	628 (100.0)

( ) - are percentages

In the improved area most of the people (72.2 %) fetched up to 20 litres of water on one trip to the water source, while only 7.0 % carried more than 40 litres on one trip. In the non-improved area 50.3 % fetched up to 20 litres on one trip, while 17.4 % carried more than 40 litres (Table 6). The mean capacity of the containers used for one trip to the water source was 28 litres .

TABLE 6 : Distribution of households by type of area and amount of water fetched on one trip to the water source

Amount of water fetched (litres)	Households in		Total
	Improved area	non-improved area	
	No.	No.	No.
10 - 20	228 (72.2)	156 (50.3)	384 (61.3)
20 - 40	66 (20.9)	100 (32.3)	166 (26.5)
over 40	22 (7.0)	54 (17.4)	76 (12.1)
Total	316 (50.5)	310 (49.5)	626 (100.0)

( ) - are percentages

In the improved area 44.2 % of the households are charged for the use of their water source while 55.8 % use sources for which they do not pay. In the non-improved area only 9.6 % of the households use sources where they have to pay, while 90.4 % use sources where they are not charged (Table 7).

TABLE 7 : Distribution of households by type of area and payment for the use of the water source

Payment for the use of the water source	Households in Improved area No.	Households in non-improved area No.	Total No.
Yes	140 (44.2)	30 (9.6)	170 (27.1)
No	177 (55.8)	281 (90.4)	458 (72.9)
Total	317 (50.5)	311 (49.5)	628 (100.0)

( ) - are percentages

6.1.5. Water Consumption for Domestic Use

The average amount of water fetched daily for each household member was 11.47 litres. About 1.5 litres were used per person per day for drinking, 2.35 litres per person for cooking and 1.65 litres per person for washing food and dishes (see Table 8).

Regarding personal hygiene, in a number of households (178) adults took their bath at the water source and it was therefore not possible to estimate how much water had been used for this purpose. However, in 433 households where adults took their bath at home, the average amount of water used was 4.37 litres per person (Table 8).

Only in 1.1 % of the households, small children bathed at the water source. In nearly all households children under five years of age were bathed at home. The amount of water used for bathing small children was estimated to be five litres daily or less in 62.4 % of the households. The average amount of water used in the households for bathing small children was 5.15 litres (Table 8).

In 42.1 % of the households, clothes were washed at the water source. 363 households stated that clothes were washed at home. In 43.5 % of these households, 11 to 20 litres of the water fetched were used for washing the clothes. The average amount of water used per person for washing clothes was 3.87 litres (see Table 8).

TABLE 8 : Mean amount of water used in the households per person per day for domestic purposes

Domestic Purpose	Mean amount of water in litres	Standard Deviation	Number of households
Drinking	1.49	0.76	611
Cooking	2.35	1.12	611
Washing food/dishes	1.65	1.07	610
Bathing	4.37	3.27	433
Bathing children< 5	5.15	3.97	620
Washing clothes	3.87	2.96	354

6.1.6. <u>Knowledge on Water-Related Diseases</u>

Sixty-five percent of the interviewed people think that the water from the source they use is safe for drinking. This corresponds with the responses to the question wether or not they boil the water used for drinking. In 65.8 % of the households the water is not boiled.

Three hundred and sixty (57.3 %) people interviewed believe that water can affect their health. In this group, 76.9 % and 67.7 % felt that there is a relationship between water and diarrhoeal diseases and skin diseases, respectively. 20.0 %, 16.0 % and 9.4 % related water to measles, tuberculosis and gonorrhoea, respectively.

Regarding the prevention of water-related diseases, 79.1 % of the respondents mentioned the use of clean drinking water, 47.2 % keeping food clean, 43.5 % hand washing after defacation and 42.7 % before handling food, 40.4 % personal hygiene. 10.2 % of the respondents did not know any measures of prevention of water-related diseases.

Three hundred and seventeen (50.4 %) households mentioned the source of their health information. 59 (18.6 %) respondents mentioned several sources of information.

157 (49.5 %) respondents mentioned the health worker, 84 (26.5 %) the teacher, 10 (3.2 %) mentioned the media and 7 (2.2 %) other sources of information such as churches or relatives as a single source of information.

6.2. The Study Population

6.2.1. Distribution of Study Population

Information was collected on a total of 1000 children in the 629 households. Twenty of these children had already reached the age of 60 months and in 5 of the 1000 cases the age had not been determined. Therefore, the final study population used for analysis amounted to 975 children who were less than 5 years old.

Four hundred and ninety (50.3 %) children under 5 years were from households located in the improved area while

485 (49.7 %) children were in households located within the non-improved area (Table 9).

TABLE 9 : Distribution of children under five years of age by type of area and sub-location.

Area	Children		Sub-location	Children	
	No.	%		No.	%
Improved	490	50.3	Marimanti	101	10.4
			Nkondi	88	9.0
			Rukurini	84	8.6
			Karocho	103	10.6
			Kanyuru	114	11.7
Non-Improved	485	49.7	Kamanyaki	89	9.1
			Gakurungu	99	10.1
			Kamwathu	96	9.8
			Irunduni	97	10.0
			Kanjoro	104	10.7
TOTAL	975	100.0	TOTAL	975	100.0

In the improved area 318 (64.9 %) children lived in households where improved water sources were used, while in the non-improved area, only 162 (33.5 %) children lived in households using improved water sources. The distribution of children by type of area, sub-location and type of water source is presented in Figure 4.

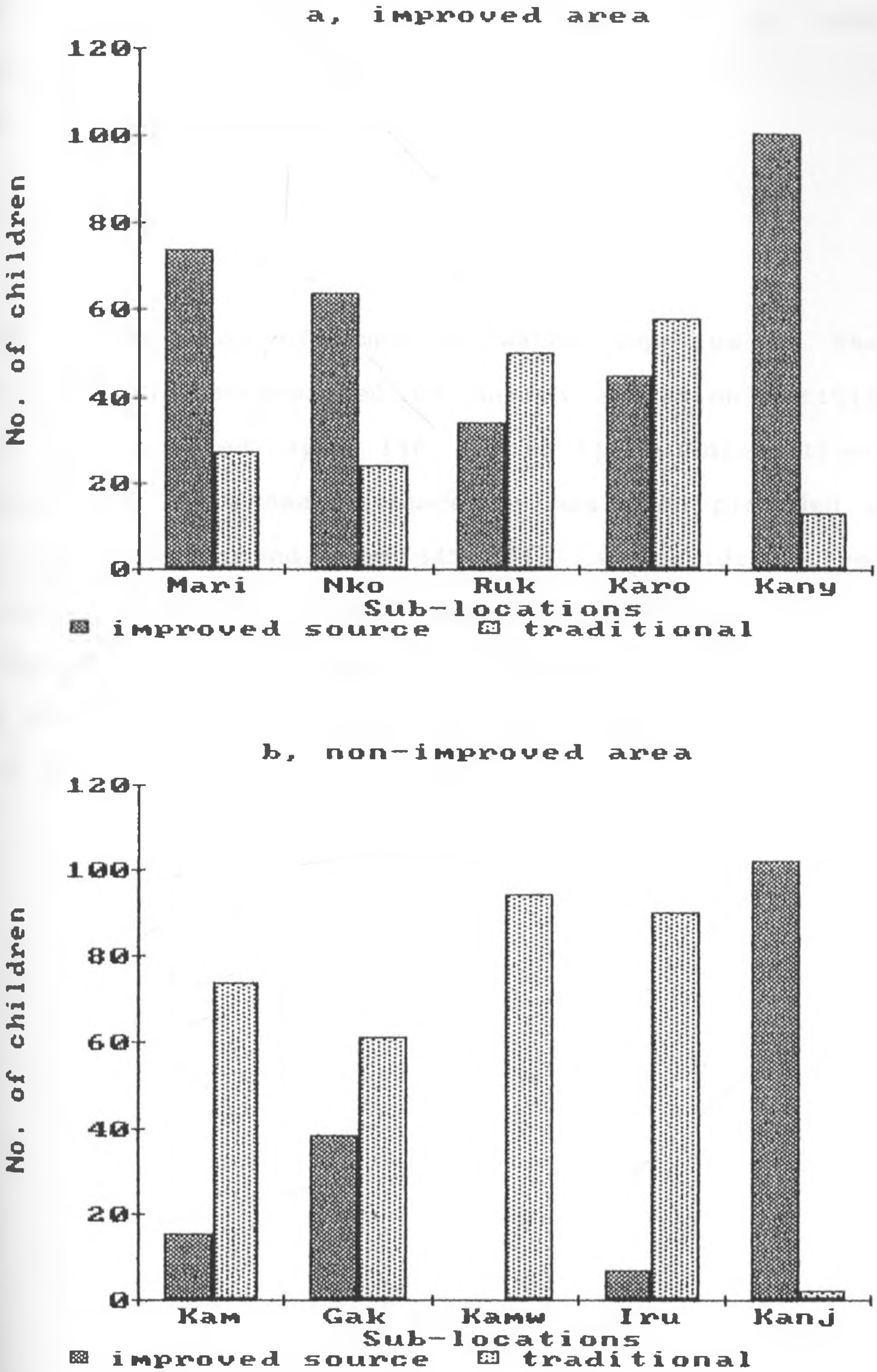


FIGURE 4 : Distribution of children by type of area, sub-location and type of water source they are exposed to.

This confirms the assumption made earlier for sampling purposes where these figures were estimated on the number of existing boreholes.

The introduction of improved water supplies in Tharaka Division was accompanied by health education activities. In the improved area 146 (29.8 %) children lived in households where health education has been provided while in the non-improved area 345 (71.1 %) children lived in households where health education has been provided. Figure 5 illustrates the distribution of children by type of area, sublocation and whether or not health education was provided.

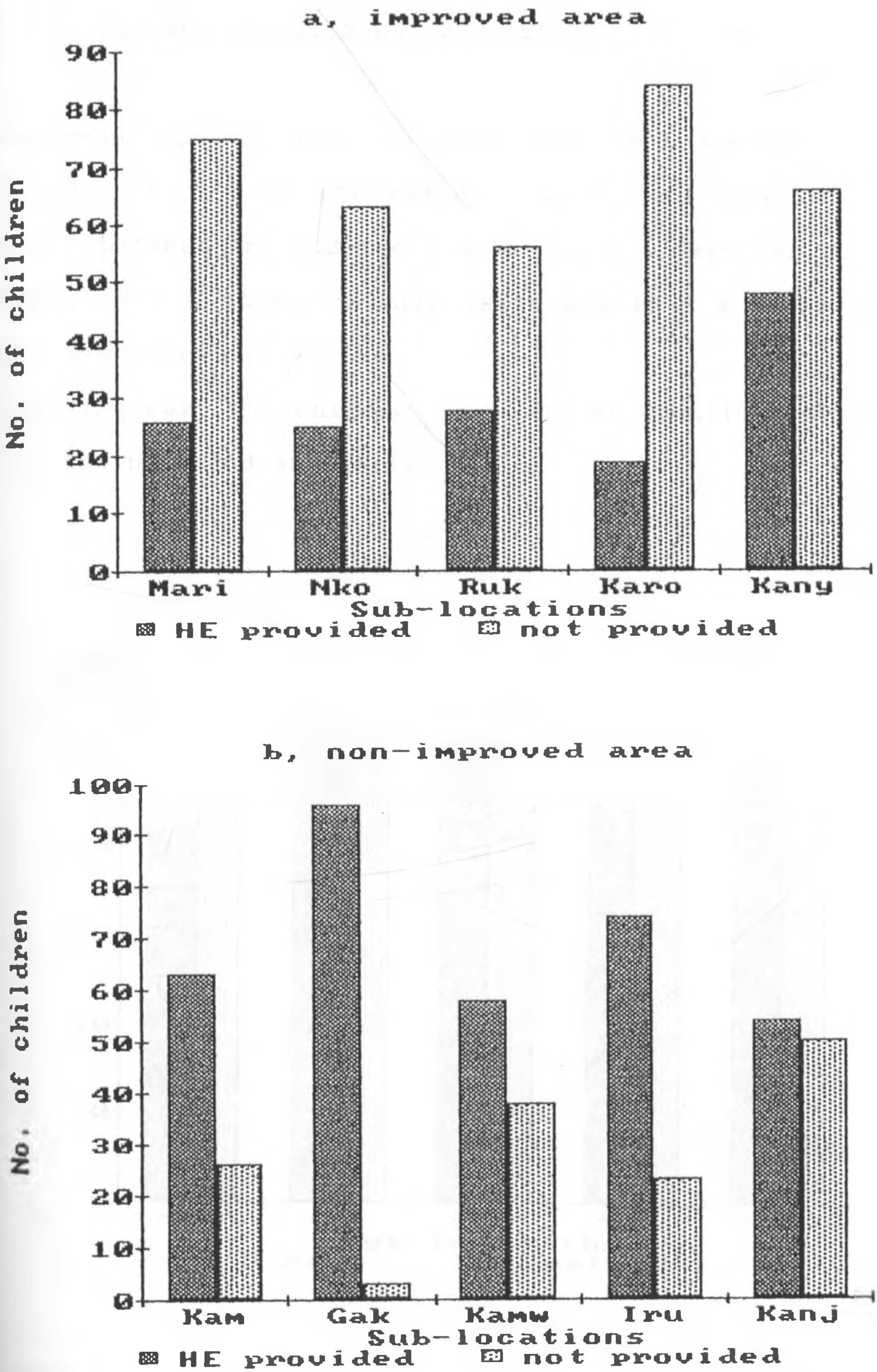


FIGURE 5 : Distribution of children by type of area, sub-location and whether or not health education was provided.

6.2.2. Age and Sex of Study Population

The mean age of the children was 28.9 months (± S.D. 16.57). 17.6 % of the children were less than one year, 22.2 % between one and two years. 22.1 % were two to three years, 18.7 % three to four years and 19.5 % between four and five years old.

Regarding sex, the children were almost equally distributed with 488 boys and 487 girls.

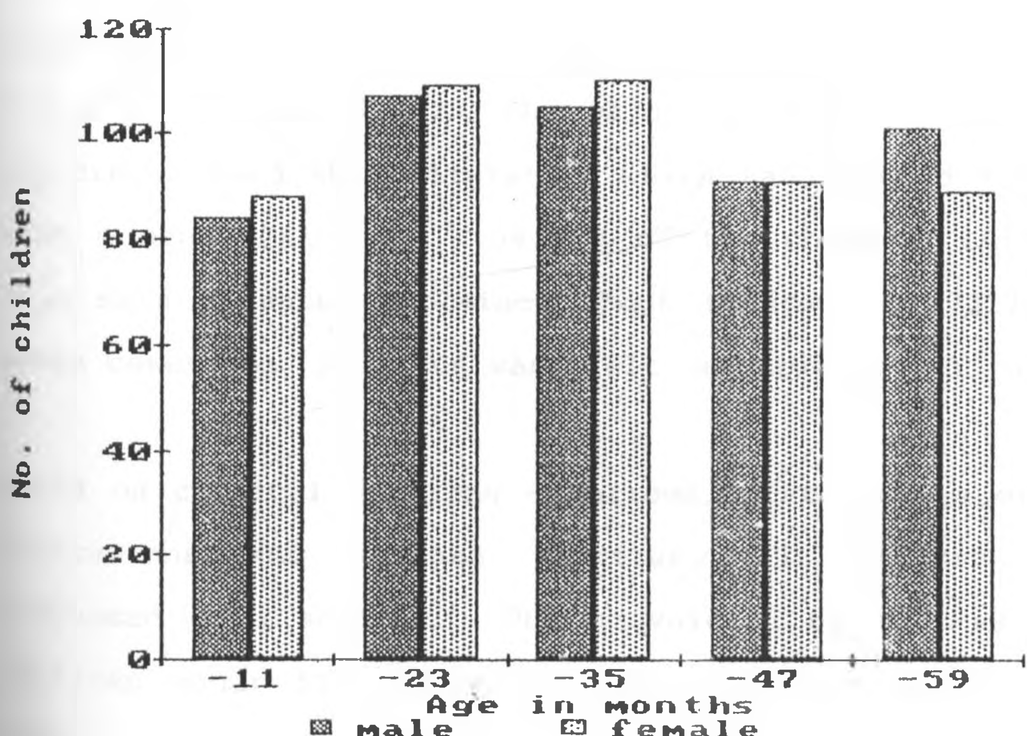


FIGURE 6 : Distribution of children by age and sex

6.2.3. Prevalence of Scabies

A total of three hundred and twenty-two (or 32 %) of all the children examined showed skin alterations such as scratches (30.3 %), papules or vesicles (17.9 %), burrows (14.5 %) and crusts (12.0 %). 5.7 % of the children had skin alterations in their faces, 16.7 % on the webs/side of fingers, 11.9 % on the palms, while wrist, elbows and axilla folds of the children were affected in 15.8 %, 15.0 % and 12.2 % of the cases respectively. 20.5 % of the children had skin alterations at their waists, 20.4 % at their buttocks. Lesions on inner thighs and genitals were found in 11.4 %, on the ankles in 9.5 % and the soles in 8.4 % of the children. The majority, i.e. 322 of these children showed skin alteration which have lasted for more than 4 weeks (48.8 %). 94.4 % of the children suffering from skin disease complained about itching, in 72.7 % of these cases the pruritus was felt especially at night.

Based on clinical symptoms - burrows, distribution of skin alterations and intense pruritus, 251 children were diagnosed with scabies. The prevalence of scabies among children under five years of age in Tharaka Division was therefore 25.7 %. The rates by sub-location are presented in Table 10.

TABLE 10 : Prevalence of scabies in Tharaka Division and the sub-locations

Sub-location	+ ve cases	- ve cases	Children < 5 years	Prevalence Rates (%)
Marimanti	16	85	101	15.8
Nkondi	32	56	88	36.4
Rukurini	23	61	84	27.4
Kanyuru	17	97	114	14.9
Karocho	36	67	103	35.0
IMPROVED AREA TOTAL	124	366	490	25.3
Kamanyaki	28	61	89	31.5
Gakurungu	14	85	99	14.1
Kamwathu	31	65	96	32.3
Irunduni	36	61	97	37.1
Kanjoro	18	86	104	17.3
NON-IMPROVED AREA TOTAL	127	358	485	26.2
TOTAL	251	724	975	25.7

The diagnoses as well as the prevalence rate of scabies have to be seen as putative. Due to the field conditions it was not feasible to confirm the diagnoses by a microscope.

6.2.4. Domestic Care for Children

Many diseases seen in children are preventable and prevention has to begin at home. Ignorance about simple principles of hygiene within the households may contribute to the occurrence of scabies. The person, the age as well as the status of the caretaker may be factors determining the grade of attention paid to a child.
93.4 % of the children were taken care of by their mothers while the father was the caretaker in 1.3 % of the cases. Sisters or brothers took care of 2.7 %, grandparents of 2.2 % and others, like aunts or housemaids of 0.4 % of the children. The mean age of the caretakers was 29.4 years. Only 4 % of the caretakers were under 20 years of age and 9.7 % 40 years and above. The majority of the caretakers were married (89.2 %), 7.1 % were single, 0.9 % widowed, 0.8 % divorced and 1.9 % were separated from their spouses.

58.2 % of the children were bathed once daily while 35.4 % bathed more than once daily. 5.3 % of the children were bathed every second day and only in 1.0 % of the cases, the children were bathed less frequently. Most of the small children (91.2 %) were bathed at home. Only 8.8 % of the children were bathed at the water source. Soap was used for bathing 97.5 % of the children.

The clothes of 42.6 % of the children were washed at home while those of 57.4 % of the children were washed either at the water source where the water was fetched for the household (55.6 %) or at another water source (1.8 %). Soap or washing powder were used for this purpose in 99 % of the cases.

Most of the children (i.e. 64.0 %) were changing clothes daily and 14.4 % every second day. 8.5 % put on clean clothes twice and 10.3 % once a week. Only 2.8 % changed into clean clothes less frequently.

The majority of the children (875) share their beds with other persons. 3.3 % of these children share a bed with only one, other 54.3 % with two persons, while 42.4 % have to share a bed with more than two other members of the family.

6.2.5. <u>Immunization Status and Nutritional Status of Children</u>

Children having reached the age of one year should be fully vaccinated against the six major childhood diseases Tuberculosis, Diphteria, Pertussis, Tetanus, Poliomyelitis and Measles.
In Tharaka Division, 79.3 % of the children aged 12 to 59 months were said to be fully immunized, in 49.8 % of the cases this was confirmed by vaccination cards.

For the purpose of this study it was deemed to be sufficient to use weight-for-age measurements and to ignore the differentiation between acute and chronic malnutrition as the data were not collected for the purpose of a nutritional intervention programme.

Looking at the percentages of the reference values and taking 80 % as cut-off point, 28.1 % of the children were undernourished. Using the statistically more accurate Z-scores the prevalence of low levels of weight-for-age (below -2.0 S.D. from the median) was 24.1 % (n = 966).

6.3. Relationships between Different Variables

Cross-tabulation and the chi-square test of significance were used for analysis of association between two variables at a time. The level of siqnificance used in testing for association was 0.05.

6.3.1. Prevalence of Scabies and Considered Variables

There was no statistically significant association between prevalence of scabies and the variables presented in Table 11.

TABLE 11 : Summary of non-significant associations between prevalence of scabies and listed variables

Variable	x^2	df	p - value
area	0.099	9	0.75350
education head of head of household	4.895	4	0.29822
occupation	1.328	4	0.85669
land owned	6.502	3	0.08956
household size	2.541	2	0.28066
persons/room	3.433	2	0.17973
distance to water source	5.313	4	0.25668
time spent	3.092	3	0.37768
payment	2.017	1	0.15558
health education	0.454	1	0.50047
knowledge about relation of water and skin disease	0.033	1	0.85678
sex	0.040	1	0.84079
age of the children	4.945	4	0.29303
relationship to caretaker	3.094	4	0.54215
age of caretaker	2.512	3	0.47319
marital status of caretaker	5.177	4	0.26964
place of bathing	0.312	1	0.57663
amount of water used for bathing small children	2.633	2	0.26802
place of washing clothes	2.057	2	0.35751
amount of water used for washing clothes	1.553	2	0.45992
use of soap for washing clothes	1.310	1	0.25239

Variable	x^2	df	p - value
frequency of changing into clean clothes	8.309	4	0.08089
bed sharing	0.308	1	0.57872
immunization	1.554	1	0.21254

Although the type of area was not significantly associated with the prevalence of scabies, there was a significant relationship between prevalence of scabies and the sub-locations (x^2 = 44.905, df = 9, p = 0.00000). The highest prevalence was found in Irunduni with 37.1 %, followed by Karocho and Kamwathu where the prevalence was 35.0% and 32.3 %, respectively. The lowest prevalence of scabies was found in Gakurungu with 14.1 % (see Table 10).

Children from households where water was drawn from traditional sources were more infested with scabies than children from households with water from improved sources. The prevalence of scabies among children from households where traditional water sources were used was higher than that among children from households where water from improved sources was used (31.2 % versus 20.2 %). The difference was statistically significant (see Table 12).

TABLE 12 : Relationship between prevalence of scabies and the water source used by the household

		Water source traditional No.	Water source improved No.	Total No.
Scabies	+	154 (31.2)	97 (20.2)	251 (25.8)
	-	339 (68.8)	383 (79.8)	722 (74.2)
Total		493 (50.7)	480 (49.3)	973 (100.0)

( ) - percentages

$x^2 = 15.455$, $df = 1$, $p = 0.00008$, $OR = 1.79$.

The Odds Ratio (OR) reveals that children exposed to water from traditional water sources are actually 1.79 times more likely to get scabies than children exposed to water from improved sources.

The prevalence of scabies among children who bathe once daily or more often was 25.1 % compared to 37.1 % among children who bathe every second day or less. The difference was found to be significant (Table 13).

TABLE 13 : Relationship between prevalence of scabies and frequency of bathing

		Bathing once daily/ more	Bathing every second day/ less	Total
		No.	No.	No.
Scabies	+	228 (25.1)	23 (37.1)	251 (25.8)
	-	684 (75.0)	39 (62.9)	723 (74.2)
Total		912 (93.6)	62 (6.4)	974 (100.0)

( ) - percentages

$x^2 = 4.441$, df = 1, p = 0.03509, OR = 0.57.

The risk of getting scabies is lower for children bathing daily or more often than for those who bathe only every second day or less frequently (0.57 : 1).

Children using soap for bathing were less infested with scabies than children not using soap. Among the children using soap for bathing, 25.2 % of them were diagnosed with scabies while 45.8 % of the children not using soap were found with scabietic lesions (Table 14).

TABLE 14 : Relationship between prevalence of scabies and use of soap for bathing

		Soap Yes No.	Soap No No.	Total No.
Scabies	+	240 (25.2)	11 (45.8)	251 (25.7)
	-	711 (74.8)	13 (54.2)	721 (74.3)
Total		951 (97.5)	24 (2.5)	975 (100.0)

( ) - percentages

$x^2 = 5.195$, df = 1, p = 0.02265, OR = 2.5.

Children not using soap for bathing are 2.5 times more likely to acquire scabies than those who use soap.

The prevalence of scabies among children in households where only a small amount of water was fetched per person for the domestic purposes was the highest (34.9 %) as compared to households where more water was brought from the water source. The prevalence of scabies was decreasing with increasing amount of water fetched from the source. This relationship was significant ($x^2 = 9.570$, df = 4, p = 0.04833).

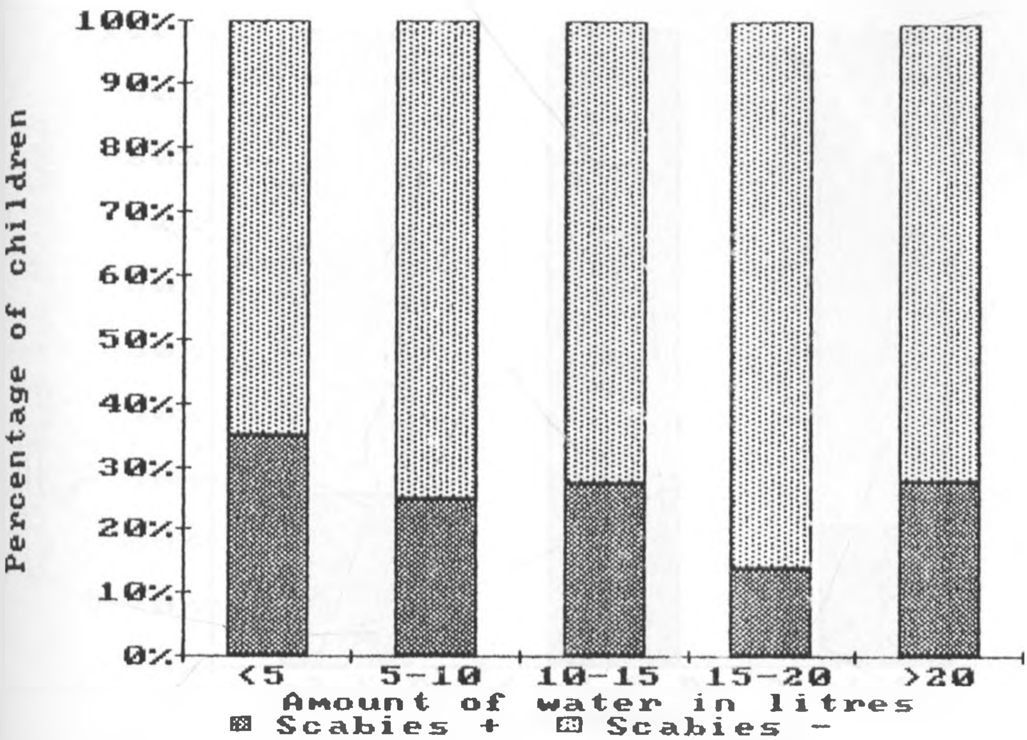


FIGURE 7 : Relationship between prevalence of scabies and the amount of water fetched per person

The prevalence of scabies was also significantly related to the nutritional status of the children ($x^2 = 6.432$, df = 2, $p = 0.04011$). Children with a lower weight-for-age indicator (< -1.0 S.D.) were more infested with scabies than children with a weight-for-age indicator > - 1.0 S.D.

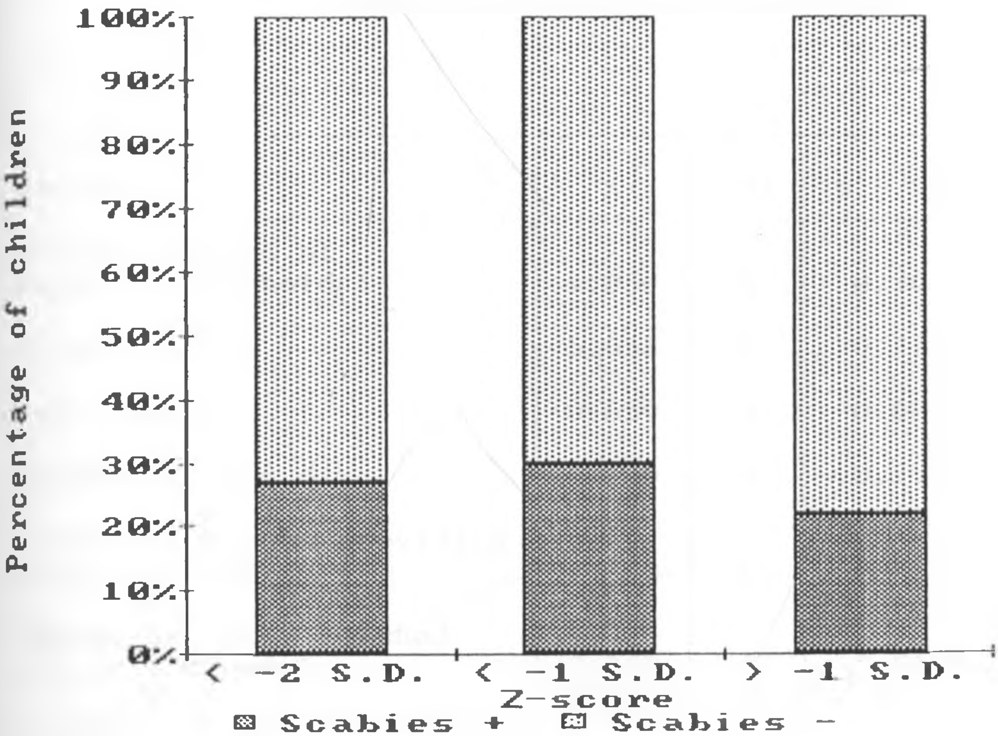


FIGURE 8 : Relationship between prevalence of scabies and nutritional status

6.3.2. <u>Water Source and Different Variables</u>

There was no significant association between the type of water source used by the households and the variables presented in Table 15.

TABLE 15 : Non-significant associations between type of water source and different variables

Variable	x^2	df	p - value
education head of head of household	4.850	4	0.30304
occupation	5.658	4	0.22615
land owned	0.650	3	0.88497
household size	0.520	2	0.77114
status of person providing health education	6.768	1	0.41071
amount of water fetched per person	3.267	4	0.51422
amount of water used for drinking per person	1.058	2	0.58909
amount of water used for cooking	6.081	3	0.10771
amount of water used for bathing per person	0.739	2	0.69111
amount of water used for bathing small children	3.791	2	0.15024
amount of water used for washing the clothes of one person	3.630	2	0.16285

The type of water source used by the households was significantly related to the distance to the water source, the time spent on one trip to the source and the payment for water.

With increasing distance (> 1 km) to the water source the percentage of households using improved sources decreased (x^2 = 56.236, df = 4, p = 0.00000).

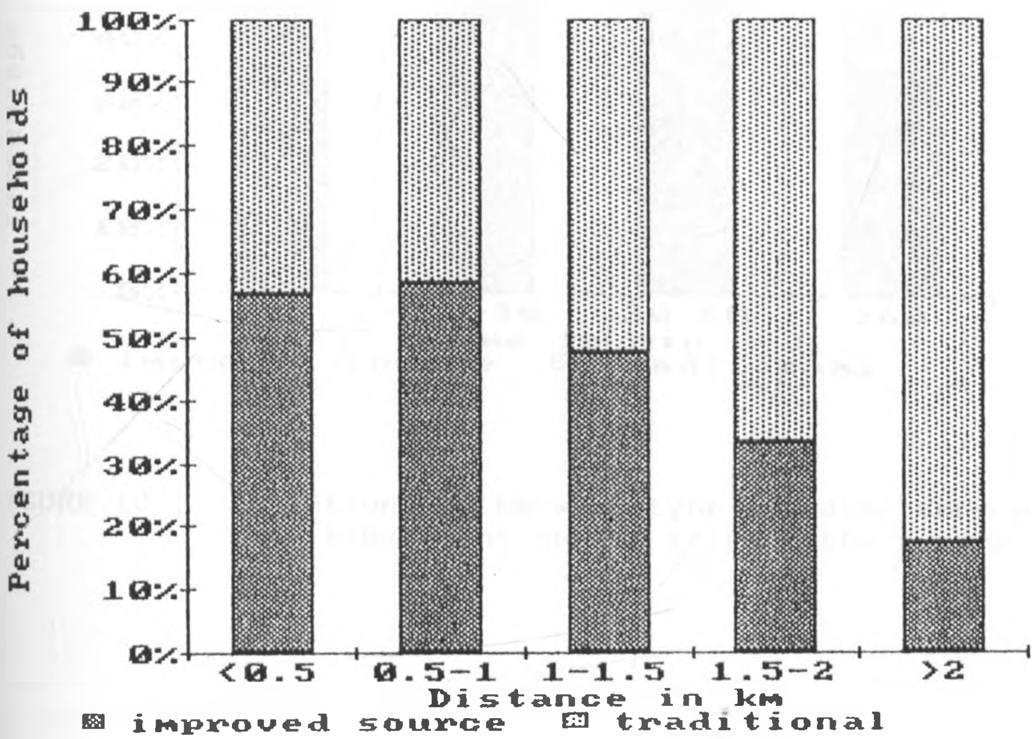


FIGURE 9 : Relationship between type of water source and distance to the water source

When the trip to the water source required a time of more than one hour, the percentage of households using improved water sources decreased (x^2 = 17.271, df = 3, p = 0.00062).

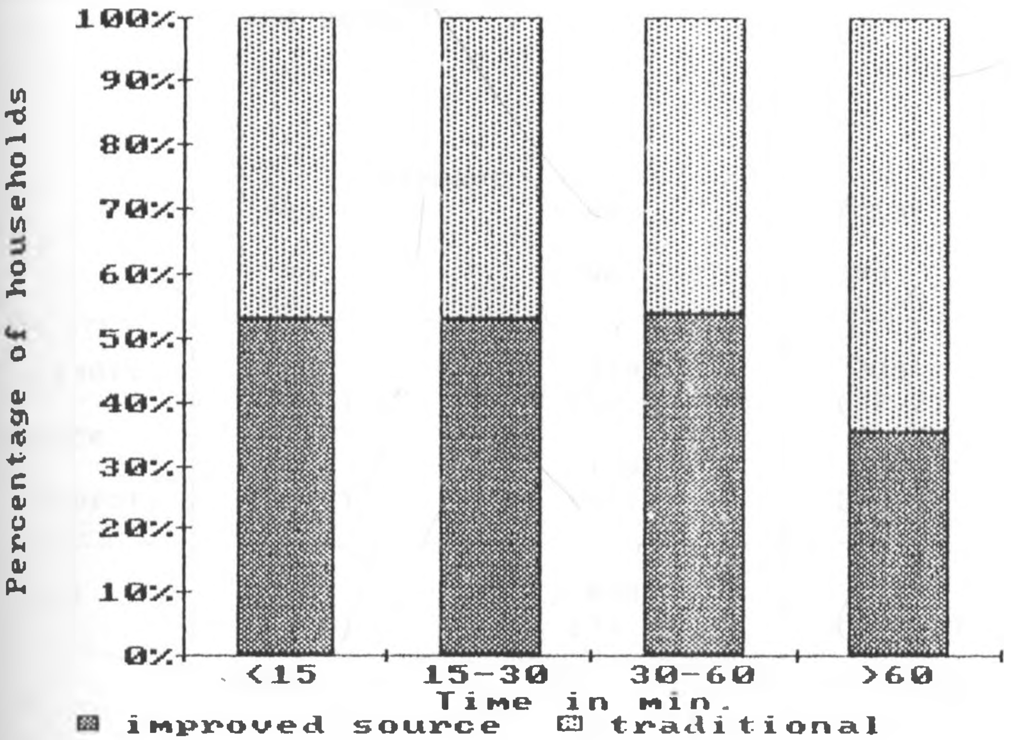


FIGURE 10 : Relationship between type of water source and time spent on one trip to the source

Fifty-four percent of the households using improved water sources paid for water while only 2.7 % of the households using traditional water sources were paying for water. This difference was found to be statistically significant (Table 16).

TABLE 16 : Relationship between type of water source and payment

		Payment Yes No.	Payment No No.	Total No.
Source	tradit.	9 (2.7)	319 (97.3)	328 (52.2)
	improv.	161 (53.7)	139 (46.3)	300 (47.8)
Total		170 (27.1)	458 (72.9)	628 (100.0)

( ) - percentages

$x^2 = 205.809$, df = 1, p = 0.00000.

Distance, time and costs are factors in the accessibility to a water source and may influence the amount of water used daily for the different domestic purposes in the households.

There was no significant association between distance to the water source and the daily water consumption for domestic use (Table 17).

TABLE 17 : Non-significant associations between distance to the water source and amount of water used for the various domestic purposes

Variable	x^2	df	p - value
amount of water fetched per person	15.570	16	0.48332
amount of water used for drinking per person	13.202	8	0.10507
amount of water used for cooking	10.298	12	0.58979
amount of water used for bathing per person	4.752	8	0.78368
amount of water used for bathing small children	13.284	8	0.10243
amount of water used for washing the clothes of one person	6.143	8	0.63117

The time spent on one trip to the water source had no influence on the amount of water used for most of the domestic purposes (Table 18).

TABLE 18 : Non-significant associations between time spent on one trip to the water source and amount of water used for the various domestic purposes

Variable	x^2	df	p - value
amount of water fetched per person	15.570	16	0.48332
amount of water used for cooking	10.298	12	0.58979
amount of water used for bathing per person	4.752	8	0.78368
amount of water used for bathing small children	13.284	8	0.10243
amount of water used for washing the clothes of one person	6.143	8	0.63117

The amount of water used for drinking per person daily however, was significantly associated with the time spent on one trip to the water source (x^2 = 21.699, df = 6, p = 0.00137). With increasing time needed for a trip to the water source and back, the number of households using a higher amount of water used for drinking per person daily increased.

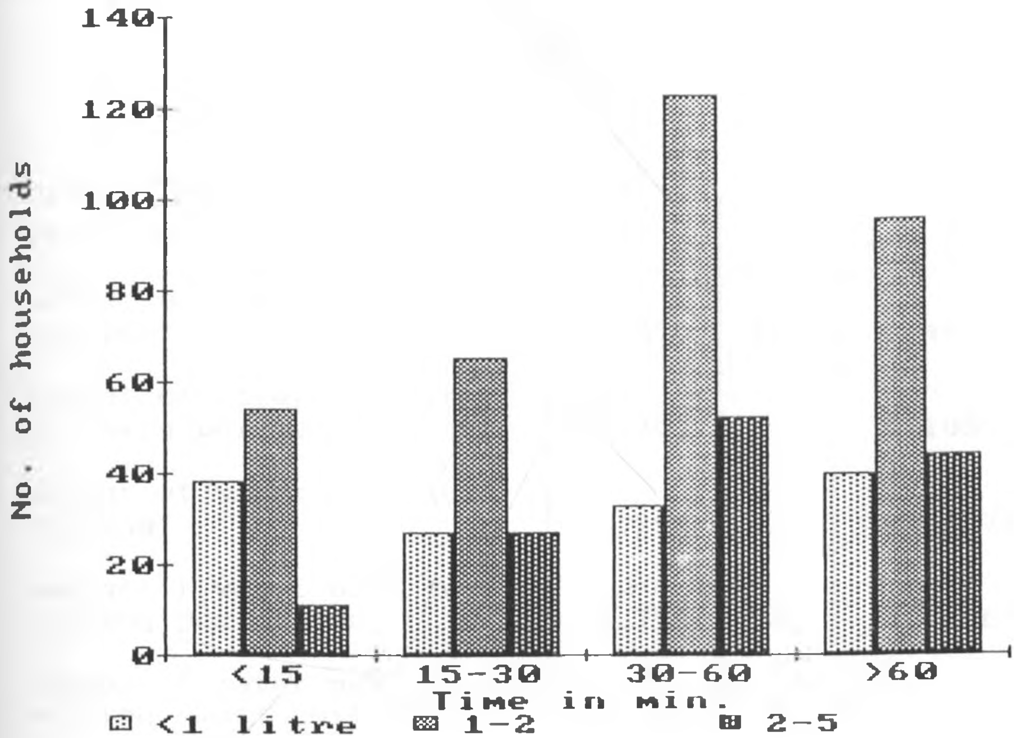


FIGURE 11 : Relationship between time spent on one trip to the water source and the amount of water used for drinking per person daily

Regarding costs, there was no difference in the daily water consumption in households paying for water and households where water was free of charge (Table 19).

TABLE 19 : Non-significant associations between payment for water and the amount of water used for the various domestic purposes

Variable	x^2	df	p - value
amount of water fetched per person	15.570	16	0.48332
amount of water used for drinking per person	13.202	8	0.10507
amount of water used for cooking	10.298	12	0.58979
amount of water used for bathing per person	4.752	8	0.78368
amount of water used for bathing small children	13.284	8	0.10243
amount of water used for washing the clothes of one person	6.143	8	0.63117

With the exception of the amount of water used for drinking, the daily water consumption in the households did not change when water sources were more accessible.

A factor causing changes in the daily water consumption for certain domestic purposes in the households in Tharaka Division was health education.

The amount of water fetched from the water source as well as the amounts used daily for drinking, cooking and bathing small children were not influenced by health education (Table 20).

TABLE 20 : Non-significant associations between health education and daily water consumption in the households

Variable	x^2	df	p - value
amount of water fetched per person	6.037	4	0.19639
amount of water used for drinking per person	3.872	2	0.14429
amount of water used for cooking	4.990	3	0.17255
amount of water used for bathing small children	13.284	8	0.10243

But the amounts of water used for hygiene purposes such as bathing of adults and washing clothes were significantly related to health education.

The amount of water an adult person used for bathing at home was higher in households where health education has been provided (x^2 = 7.850, df = 2, p = 0.01975).

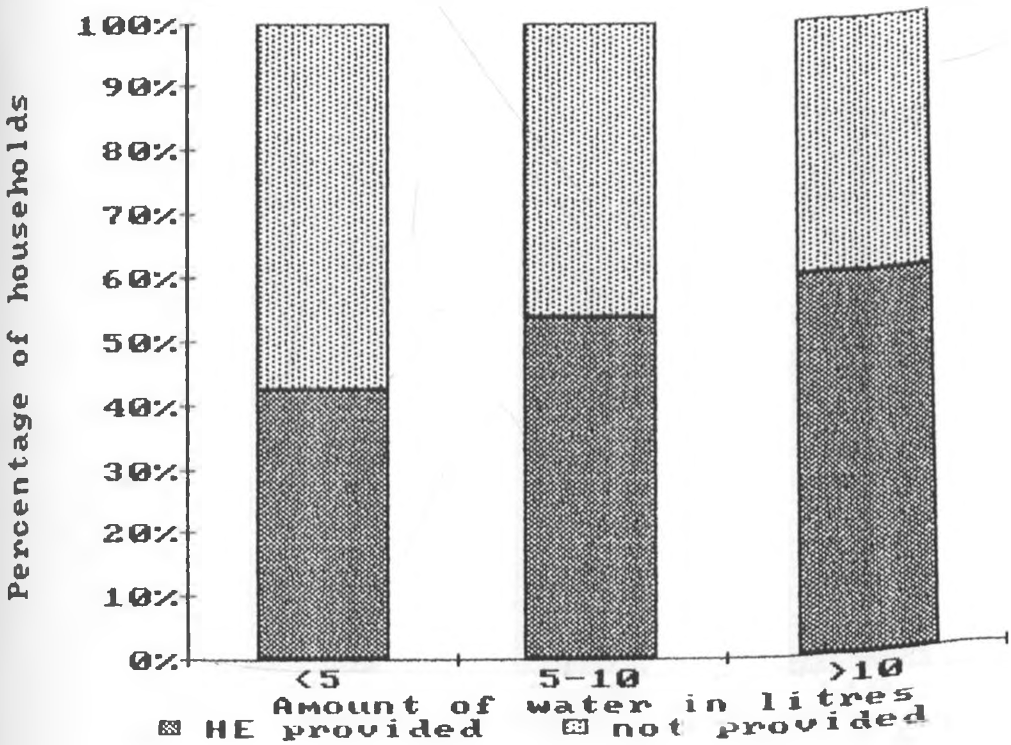


FIGURE 12 : Relationship between health education and the amount of water used daily per person for bathing

The amount of water used for washing clothes at home was higher in households where health education has been provided (x^2 = 22.702, df = 2, p = 0.00001).

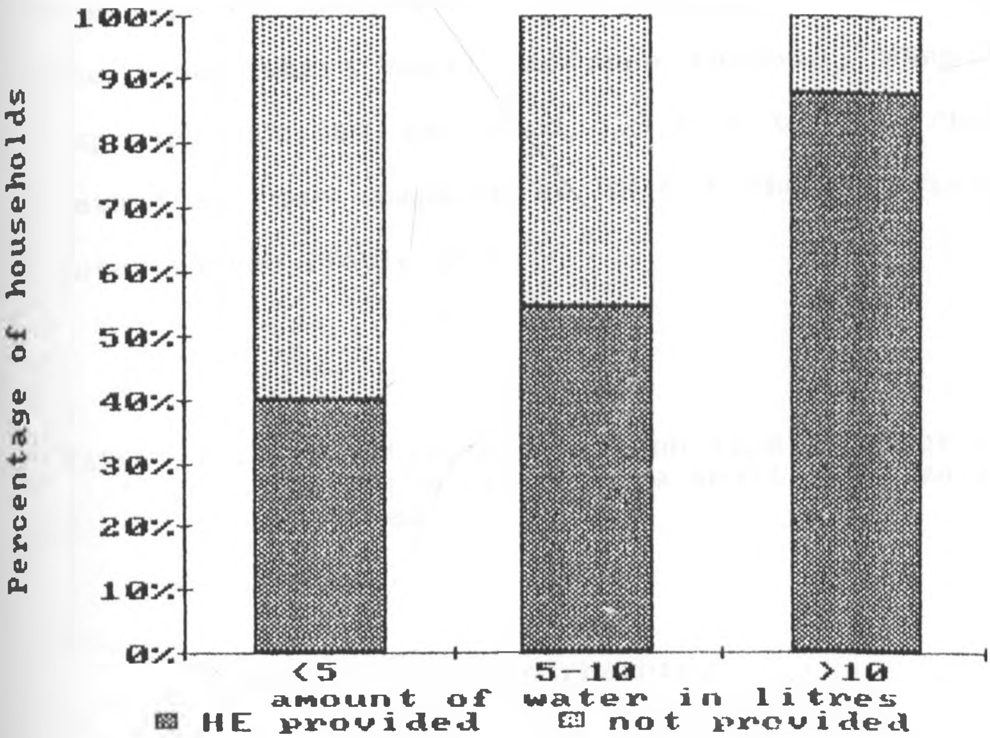


FIGURE 13 : Relationship between health education and the amount of water used daily per person for washing clothes

The type of water source used by the households and the determinants describing accessibility (distance, time, costs) as well as health education were not significantly related to the amount of water used for bathing children under five years of age. Other variables however, related to the personal hygiene of small children were associated with the type of water source, distance, time, payment and health education.

The type of water source was significantly associated with the place where small children bathed. When water from improved sources was used, 50.5 % of the children were bathed at home compared to 38.4 % who were bathed at the water source (Table 21).

TABLE 21 : Relationship between type of water source and the place where small children are bathed

		Place of bathing		
		at home	at source	Total
		No.	No.	No.
Source	tradit.	439 (49.5)	53 (61.6)	492 (50.6)
	improv.	447 (50.5)	33 (38.4)	480 (49.4)
Total		886 (91.2)	86 (8.8)	973 (100.0)

( ) - percentages

$x^2 = 4.576$, df = 1, p = 0.03242.

In addition, the frequency of bathing was significantly related to the type of water source used. Most of the children bathing in water from an improved source bathed daily or more often (50.2 %) while only 37.1 % using an improved source bathed less frequently (Table 22).

TABLE 22 : Relationship between type of water source and the frequency of bathing

		Frequency of bathing		
		daily and more often	less frequently	Total
		No.	No.	No.
Source	tradit.	453 (49.8)	39 (62.9)	492 (50.6)
	improv.	457 (50.2)	23 (37.1)	480 (49.4)
Total		910 (93.6)	62 (6.4)	972 (100.0)

( ) - percentages

$x^2 = 3.999$, df = 1, p = 0.0455.

The type of water source used was also significantly associated with the place people had chosen for washing the clothes of the children. 63.0 % of the children from homes using improved water supplies had their clothes washed at home compared to 39.3 % of children from households using improved sources where the clothes were washed at the water source (Table 23).

TABLE 23 : Relationship between type of water source and place chosen for washing the clothes of the small children.

		Place for washing clothes		Total
		at home	at source	
		No.	No.	No.
Source	tradit.	153 (37.0)	340 (60.7)	493 (50.7)
	improv.	260 (63.0)	220 (39.3)	480 (49.3)
Total		413 (42.4)	560 (57.6)	973 (100.0)

( ) - percentages

$x^2 = 53.272$, df = 1, p = 0.00000.

The frequency children changed into clean clothes was associated with the type of water source used. Children living in households where improved water sources were used changed clothes more frequently (69.2 %) than children from households with traditional water sources (58.9 %) as presented in Table 24.

TABLE 24 : Relationship between type of water source and frequency of changing of clothes

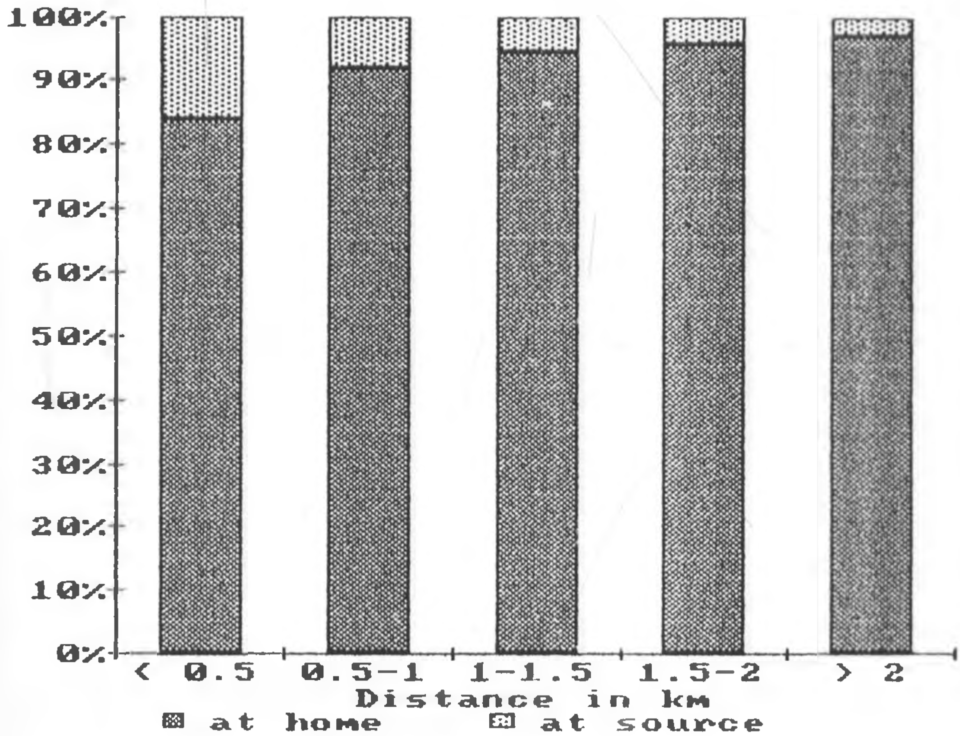
		Frequency of changing clothes daily No.	less frequently No.	Total No.
Source	tradit.	289 (58.9)	202 (41.1)	491 (50.6)
	improv.	332 (69.2)	148 (30.8)	480 (49.4)
Total		621 (64.0)	350 (36.0)	971 (100.0)

( ) - percentages

$x^2 = 11.186$, $df = 1$, $p = 0.00082$.

The choice of the places for bathing small children and washing their clothes as well as the frequency of bathing and changing clothes were also influenced, either by distance, time or costs.

While the distance to the water source played no role regarding the place chosen for washing the clothes of the children, it was significantly associated with the place where children bathed. With increasing distance to the source more children were bathed at home ($x^2 = 28.192$, $df = 4$, $p = 0.00001$).



RE 14 : Relationship between distance to the water source and the place where small children are bathed

increasing distance to the water source the proportion children bathing daily or more often decreased = 18.067, df = 4, p = 0.00120).

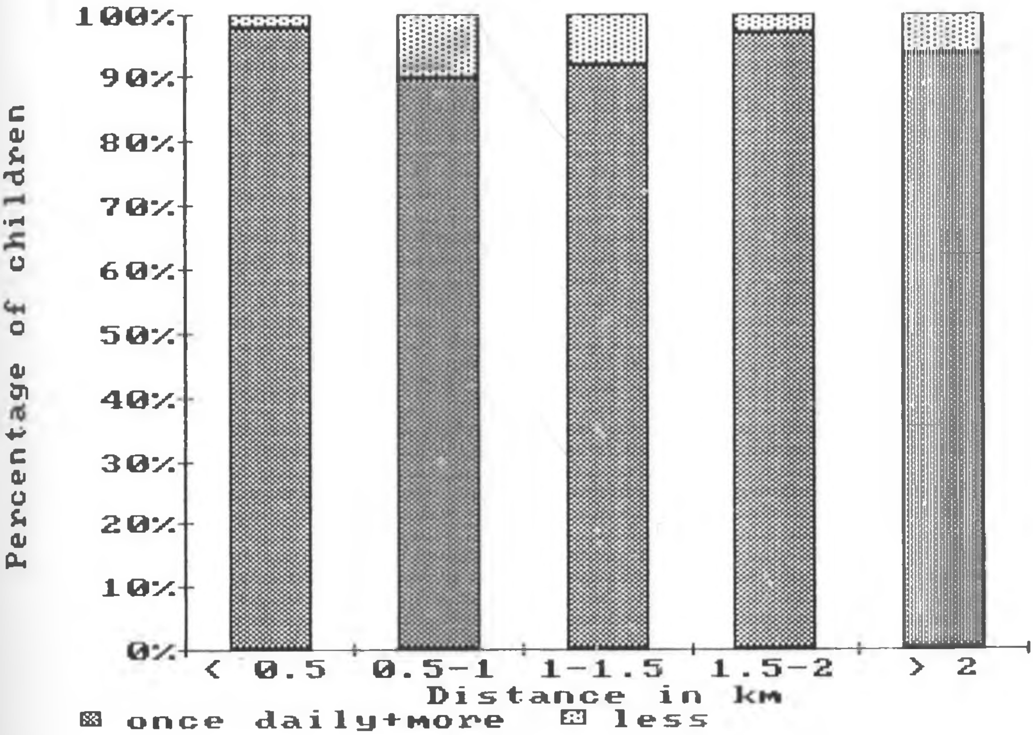


FIGURE 15 : Relationship between distance to the water source and the frequency of bathing

With increasing distance to the water source the proportion of children changing clothes daily increased (x^2 = 23.575, df = 4, p = 0.00010).

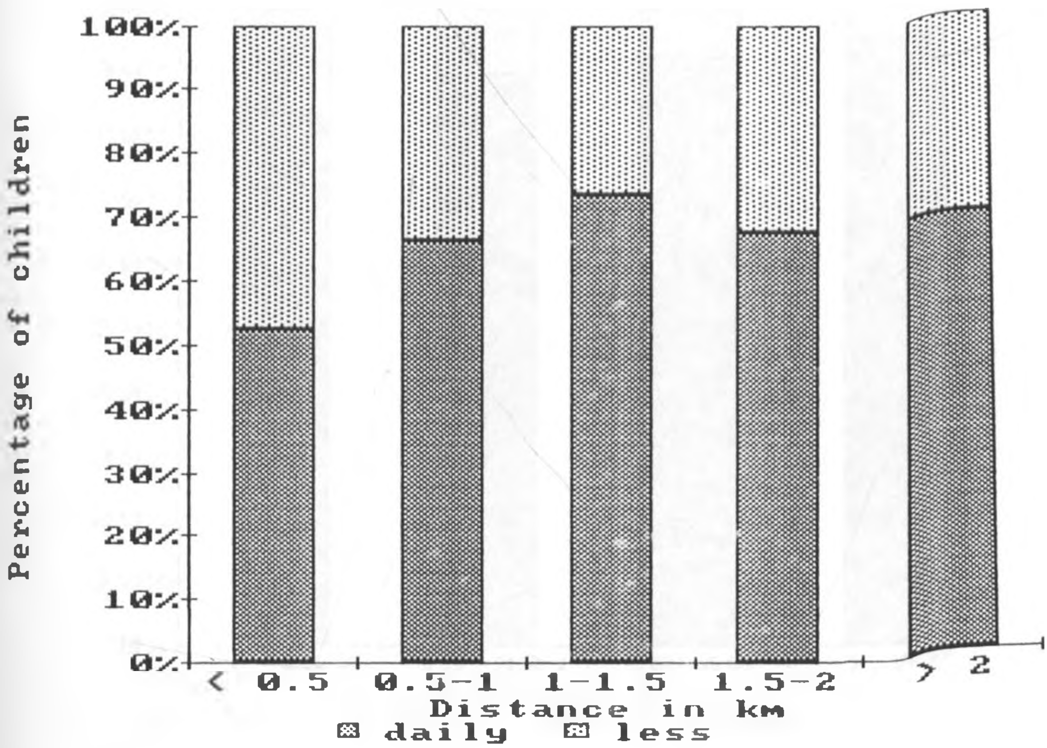


FIGURE 16 : Relationship between distance to the water source and the frequency of changing clothes

Like the distance, time also had no influence on the choice of the place for washing clothes but was related to the place chosen for bathing and the frequency of bathing and changing clothes.

With increasing time spent on one trip to the water source more children are bathed at home (x^2 = 16.546, df = 3, p = 0.00088).

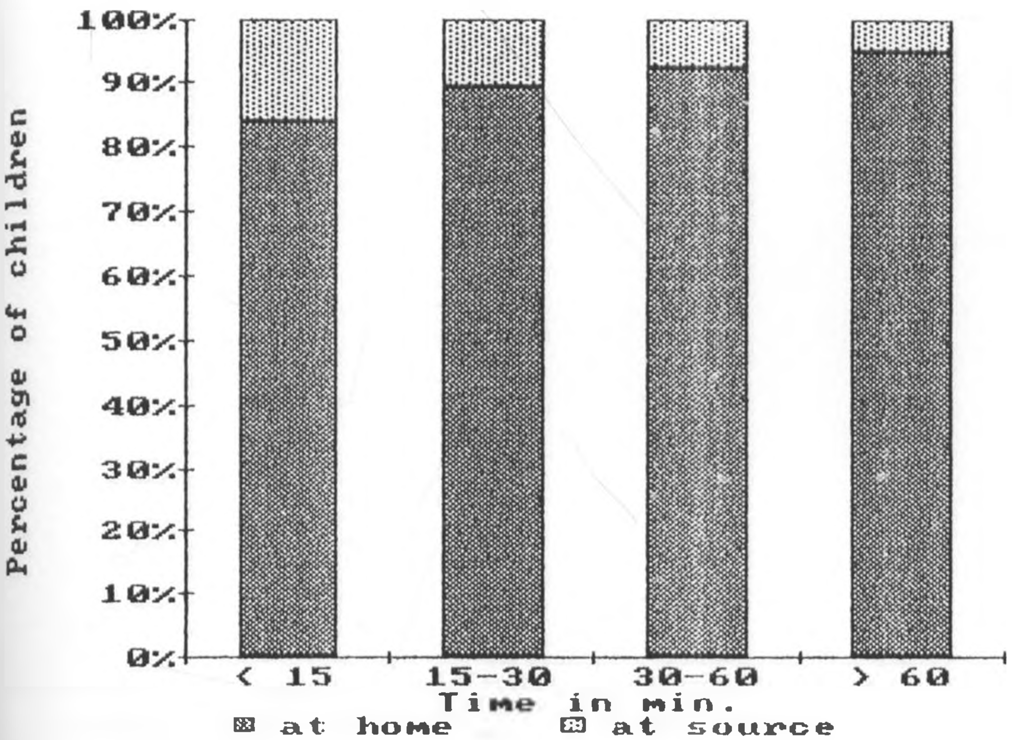


FIGURE 17 : Relationship between time spent on one trip to the water source and the place where small children are bathed

With increasing time spent on one trip to the water source the proportion of children bathing daily or more often decreased ($x^2 = 23.272$, df = 3, p = 0.00004).

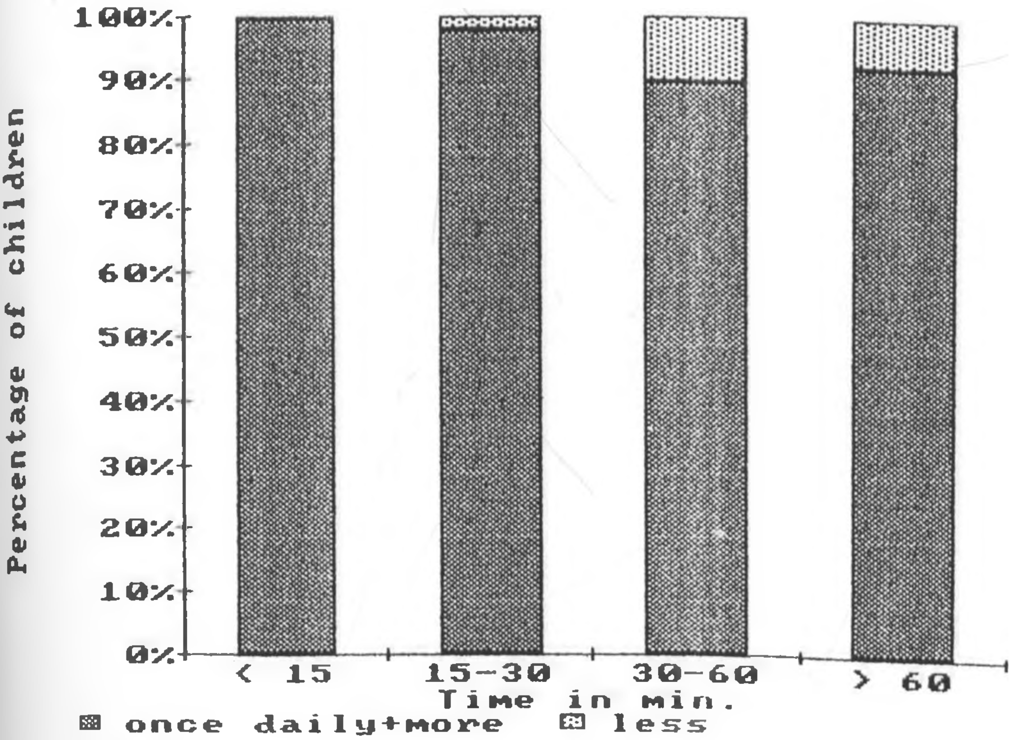


FIGURE 18 : Relationship between time spent on one trip to the water source and the frequency of bathing

The proportion of children changing into clean clothes daily or more often increased with increasing time spent on one trip to the water source (x^2 = 22.418 , df = 3, p = 0.00005).

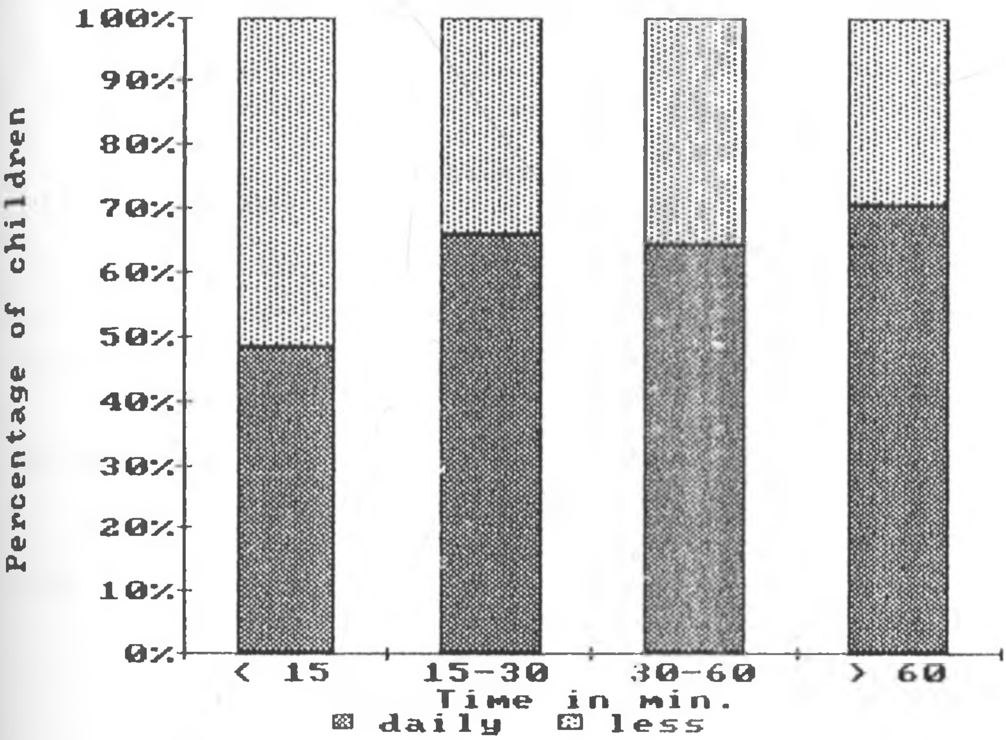


FIGURE 19 : Relationship between time spent on one trip to the water source and the frequency of changing clothes

Payment for water did not influence the frequency of bathing but was related to the places chosen for bathing and washing the clothes, as well as the frequency of changing clothes.

In households paying for water, the proportion of children bathed at home was higher (94.6 %) than in households where water was free of charge (Table 25).

TABLE 25 : Relationship between payment and the place where small children were bathed

	Payment		
	Yes	No	Total
	No.	No.	No.
at home	244 (94.6)	642 (89.9)	886 (91.2)
at source	14 (5.4)	72 (10.1)	86 (8.8)
Total	258 (26.5)	714 (73.5)	972 (100.0)

( ) - percentages

$x^2 = 5.098$, df = 1, p = 0.02396.

In households paying for water, the clothes of 66.7 % of children were washed at home compared to households not paying for water where the clothes of 33.7 % of the children were washed at home (Table 26).

TABLE 26 : Relationship between payment and the place where the clothes of the children are washed

	Payment Yes	No	Total
	No.	No.	No.
at home	172 (66.7)	241 (33.7)	413 (42.4)
at source	86 (33.3)	474 (66.3)	560 (57.6)
Total	258 (26.5)	714 (73.5)	972 (100.0)

( ) - percentages

$x^2 = 84.311$, df = 1, p = 0.00000.

The proportion of children changing clothes daily or more often was 70.9 % in households paying for water compared to 61.4 % in those households which did not pay for water (Table 27).

TABLE 27 : Relationship between payment and the frequency of changing clothes

	Payment		
	Yes	No	Total
	No.	No.	No.
daily	183 (70.9)	438 (61.4)	621 (64.0)
frequency of changing clothes			
less	75 (29.1)	275 (38.6)	350 (36.0)
Total	258 (26.5)	714 (73.5)	972 (100.0)

( ) - percentages

$x^2 = 7.416$, df = 1, p = 0.00646.

As revealed earlier (Fig. 12 and 13), health education was important for the daily water consumption for hygienic purposes.

The choice of the places for bathing small children and for washing their clothes as well as the frequencies of bathing and changing clothes were also significantly related to health education.

Where health education has been provided more children bathed at home (Table 28).

TABLE 28 : Relationship between health education and the place where small children are bathed

	Health Education Yes No.	No No.	Total No.
at home	460 (93.9)	428 (88.4)	888 (91.2)
at source	30 (6.1)	56 (11.6)	86 (8.8)
Total	490 (50.3)	484 (49.7)	974 (100.0)

( ) - percentages

$x^2 = 8.977$, df = 1, $p = 0.00273$.

Less children had their clothes washed at home when health education had been provided to the households in which they are living (Table 29).

TABLE 29 : Relationship between health education and the place where the clothes of the children are washed

	Health Education Yes No.	No No.	Total No.
at home	177 (36.0)	238 (49.2)	415 (42.6)
at source	314 (64.0)	246 (50.8)	560 (57.4)
Total	491 (50.4)	484 (49.6)	975 (100.0)

( ) - percentages

$x^2 = 17.174$, df = 1, p = 0.00003.

The proportion of children bathing daily was 96.7 % in households where health education has been provided, compared to 90.5 % in households not exposed to health education (Table 30).

TABLE 30 : Relationship between health education and the frequency of bathing

		Health Education Yes No.	No No.	Total No.
Frequency of bathing	once daily/ more	474 (96.7)	438 (90.5)	912 (93.6)
	less frequently	16 (3.3)	46 (9.5)	62 (6.4)
Total		490 (50.3)	484 (49.7)	974 (100.0)

( ) - percentages

$x^2 = 15.901$, $df = 1$, $p = 0.00007$.

The proportion of children changing daily into clean clothes was higher in households exposed to health education than in households where no health education has been provided (Table 31).

TABLE 31 : Relationship between health education and the frequency of changing clothes

	Health Education Yes No.	No No.	Total No.
daily	332 (67.8)	291 (60.2)	623 (64.0)
frequency of changing clothes			
less	158 (32.2)	192 (39.8)	350 (36.0)
Total	490 (26.5)	483 (73.5)	973 (100.0)

( ) - percentages

$x^2 = 5.951$, df = 1, $p = 0.01471$.

Regarding changes in water consumption in the households and habits of personal hygiene of small children, health education is obviously a very important factor.

The introduction of improved water supplies in Tharaka Division was accompanied by health education activities. Households using improved water sources have however been less exposed to health education activities than households using traditional water sources (Table 32).

LE 32 : Relationship between the type of water source and health education

	Health education		
	Yes	No	Total
	No.	No.	No.
:radit.	216 (65.9)	112 (34.1)	328 (52.2)
ter ırce			
improv.	101 (33.7)	199 (66.3)	300 (47.8)
lumn tal	317 (50.5)	311 (49.5)	628 (100.0)

( ) - percentages

$x^2 = 64.938$, df = 1, p = 0.00000, OR = 3.80.

ɔuseholds using traditional water sources are nearly four imes more likely to receive health education than ouseholds using improved water sources.

Further investigations revealed that in the improved area, only 29.3 % of the households have been exposed to health education compared to 71.8 % of the households in the non-improved area (Table 33).

ABLE 33 : Relationship between health education and type of area

		Area		
		improved	non-improved	Total
		No.	No.	No.
Health education	Yes	93 (29.7)	224 (70.3)	317 (50.4)
	No	224 (71.7)	88 (28.9)	312 (49.6)
Total		317 (50.4)	312 (49.6)	629 (100.0)

( ) - percentages

x^2 = 113.385, df = 1, p = 0.00000,

OR = 6.13.

The Odds Ratio shows, that households in the non-improved area are six times more likely to receive health education than households in the improved area.

6.4. Further Analysis

6.4.1. Logistic Regression Analysis

In order to be able to predict if the association between prevalence of scabies and the type of water source used by the households holds after controlling for other possible confounding variables, the logistic regression analysis was performed.

The function

$$\frac{\text{Prob(event)}}{\text{Prob(no event)}} = e^{B_0 + B_1 X_1 + B_2 X_2 \ldots\ldots\ldots + B_p X_p}$$

describes the odds of an event occurring (or the ratio of the probability that an event occurs to the probability that it will not occur). The function can be rewritten in terms of the log of the odds (logit):

$$\log \left[\frac{\text{Prob(event)}}{\text{Prob(no event)}} \right] = B_0 + B_1 X_1 + B_2 X_2 \ldots\ldots + B_p X_p$$

[Norusis M.J./SPSS Inc., 1990, p.B-43].

This statistical technique allows comparison of observed values of the response variable (e.g. prevalence of scabies) with predicted values obtained from models with and without the variable in question (e.g. type of water source used).

Table 34 presents results from logistic regression analysis.

Table 34 : Relationship of prevalence of scabies with different variables after controlling for possibly confounding variables

Variable	Beta	Wald Statistic	df	p	OR
water source	0.5111	10.9822	1	0.0009	1.67
frequency bathing	-0.0298	0.0572	1	0.8111	0.97
soap for bathing	-0.7738	3.3244	1	0.0683	0.46
amount of water fetched per person	0.0551	0.5402	1	0.4623	1.06
W/A Z-score	0.1261	1.6882	1	0.1938	1.13

The model revealed that there was a significant relationship between prevalence of scabies and the type of water source used.

In Tharaka Division, children under five years of age living in households where traditional water sources are used are 1.67 times more likely to get scabies than children from households using water from improved water sources.

Children bathing more frequently have a slightly lower risk of getting scabies (0.97 : 1). The same applies for children using soap for bathing (0.46 : 1).

Children living in households where a low amount of water per person is fetched from the water source daily, as well as children with a low nutritional status are at a slightly higher risk of getting scabies (1.06 : 1 and 1.13 : 1, respectively). However, these relationships were not statistically significant (see Table 34).

The validity of the regression model used was confirmed by the classification table and the goodness-of-fit statistic. The classification table for the prevalence of scabies shows that 74.25 % of the children were correctly classified by the model (The total number of cases included in the analysis was 936).

		Predicted		
		scabies +	scabies -	% correct
Observed	scabies +	2	236	0.84 %
	scabies -	5	693	99.28 %
			Overall	74.25 %

The goodness-of-fit statistic revealed that the model does not differ significantly from the 'perfect' model as the significance level observed was > 0.05 :

	x^2	df	p
-2 Log Likelihood	1042.013	930	0.0060
Model x^2	19.376	5	0.0016
Improvement	19.376	5	0.0016
Goodness of Fit	934.461	930	0.4527

6.4.2. Testing for Interactions

So far, the possibility that a variable may not only be confounding but also interacting was not taken into account.

Crosstabulations have shown that there are significant associations between

i, type of water source used and frequency of bathing: children using an improved water source bathed more frequently (x^2 = 8.898, df = 3, p = 0.03068).

ii, type of water source used and the use of soap: children using an improved water source were more likely to use soap than children using a traditional source (x^2 = 3.98235, df = 1, p = 0.04598).

iii, amount of water fetched daily per person and frequency of bathing : when a higher amount of water was fetched daily per person children were bathed more frequently (x^2 = 22.80388, df = 12, p = 0.02944).

These associations were included as possible interaction terms in the logistic regression model and forward stepwise variable selection was used to enter or remove possibly confounding or interacting variables in the model. The results are shown in Table 35.

Table 35 : Variables having an effect on the prevalence of scabies after controlling for variables possibly confounding or interacting

Variable	Beta	Wald Statistic	df	p	OR
type of water source	1.2630	13.7523	1	0.0002	3.54
interaction type of water source/ use of soap	-0.7105	5.4951	1	0.0191	0.49

The model reveals that after controlling for possibly confounding variables as well as possible interactions the type of water source has a significant effect on the prevalence of scabies. Children from households using traditional water sources are 3.5 times more likely to be infested with scabies than children from households using improved water sources. However, there is evidence of interaction due to the use of soap. As the interaction term type of water source by use of soap added to the model was statistically significant, the use of soap must be regarded as an effect modifier. For children using a traditional water source but soap for bathing the risk of getting scabies is reduced by 50 %.

CHAPTER SEVEN

Discussion

The purpose of this study was to determine the health impact improved water supply systems have in Tharaka Division in Tharaka-Nithi District, a rural area in Kenya. It has been assumed that accessibility to improved water supply systems

- increases the volume of water used for domestic purposes
- changes the domestic water use pattern
- reduces the prevalence of water-washed diseases among children under five years of age.

This study tried to verify these assumptions.

7.1. Interpretation of the Results

7.1.1. Distribution of Study Population

The study population was equally distributed regarding age, sex and area (Figure 6, Table 9). The percentage of children in each of the five age groups was around 20 %. 17.6 % of all children were younger than one year of age, 22.2 % were in the age group between one and two years, 22.0 % of the children between two and three, 18.7 % of the children between three and four and 19.5 % between four and five years old. Half of the children were boys (50.1 %), half girls (49.9 %).

The stratification of the area into improved and non-improved area for sampling purposes proved to be correct when considering the overall coverage with improved water supply systems. In the improved area 64.9 % of the children were exposed to water from improved sources compared to only 33.5 % of the children in the non-improved area . This corresponds with the estimation made earlier for sampling purposes, where the areas were defined as improved and non-improved only according to the number of successful boreholes provided by the Tharaka Water and Sanitation Programme (TWASP), not taking into account other improved water sources.

Regarding specific sub-locations, the distribution of children by type of water source looked quite different (Fig. 4). In the five sub-locations within the improved area, the percentage of children exposed to improved water supplies ranged from 40.5 to 88.6 %. In four sub-locations in the non-improved area these figures ranged from 0 % to 38.4 %. In one sub-location in this area i.e., Kanjoro, 98.1 % of the children were exposed to water from wells which are man-made and therefore improved in the sense of water quantity and accessibility (in the sense of water quality they may not fulfil the criteria of improvement).

source. The amount of water used for drinking increased with increasing time spent on one trip (Fig. 11).

An important factor influencing water consumption within the households was health education. The amount of water fetched from the water source and the amounts of water used for drinking or cooking were not influenced by health education activities (Table 20). In contrast, however, the amounts of water used in the households for hygiene purposes were significantly associated with health education. In households where health education has been provided more water was used for bathing and washing clothes (Fig. 12,13).

Easier access to water supply systems in terms of shorter distance to the water source and reduced time spent on water collection or access to water free of charge did not change the daily water consumption within the households. The water use pattern, however, changed slightly.

Health education seems to be the causal factor for changes in water consumption and water use pattern. Health education activities are part of the Tharaka Water and Sanitation Programme (TWASP). However, this study revealed that households with access to improved water sources have received less health education compared to households using traditional water sources (Table 32).

Further investigations revealed that there have been less health education activities in the

the non-improved area (Table 33). It is obvious, although in contradiction with the TWSAP, that the introduction of improved water supplies in Tharaka Division was not accompanied by health education activities.

7.1.3. Utilization of Improved Water Supplies for Hygiene Purposes

Practices connected with the personal hygiene of small children were significantly related to the type of water source used.
When water from improved water sources was used by the households, more children were bathed at home than at the water source (Table 21). The clothes of the children were also washed more often at home (Table 23). Children also bathed more frequently and changed their clothes more often when their household had access to an improved water source (Tables 22, 24).

Considering the indicators for accessibility, the distance to the water source, the time needed for one trip to the source as well as payment for water, all had an impact on hygiene practices.
When a water source was far from home and the trip took a longer time more children were bathed at home (Fig. 14, 17). The reason may be that small children are not able to walk long distances and carrying them is exhausting. When the water source was near to the homes in terms of distance

In Marimanti, where the prevalence of scabies was low (15.8 %) most (73.3 %) of the children were from households where improved water sources were used.

In Nkondi, the prevalence was high with 36.4 %, although 72.7 % of the households used improved water sources.

In Rukurini, the prevalence of scabies was 27.4 %. Less than half of the people (40.5 %) in this sub-location used improved water supplies.

The same applied to Karocho where a slightly higher percentage (43.7 %) of children lived in households with improved water sources and the prevalence rate was high (35.0 %).

In Kanyuru 88.6 % of the children came from households with improved water supplies and the prevalence of scabies was accordingly low with 14.9 %.

In the non-improved area, in Kamanyaki, only 16.9 % of the children were exposed to water from improved sources and the prevalence rate of scabies was 31.5 %.

In Gakurungu where only 38.4 % of the children had access to improved water sources the prevalence rate was surprisingly low (14.1 %).

The prevalence rate in Kamwathu reflected with 32.3 % the fact that no child at all (0 %) lived in a household where improved sources were used.

In Irunduni only 7.2 % of the children had access to improved water sources. The prevalence rate was extremely high with 37.1 %.

Although Kanjoro is located in the area which was defined as non-improved for the purpose of this study as no

successful borehole has been provided by the TWSAP there, quite a number of hand-dug wells are used for the domestic consumption. Only 1.9 % of the children came from households relying on traditional sources. The prevalence of scabies in this sub-location was only 17.3 %.
If the areas would therefore be re-defined according to the type of water source actually used by the majority (> 50 %) of the households, Kanjoro would belong to the improved area while Rukurini and Karocho with only 40.5 % and 43.7 % of the households using improved water sources would be assigned to the non-improved area. In this case the areas would differ in the prevalence of scabies by 9.2 %.

In most of the sub-locations the prevalence rates of scabies can be explained by the accessibility to improved water sources. When improved water sources were used, the prevalence rates of scabies were low. However, for Nkondi and Gakurungu this conclusion is not applicable.
A possible explanation for the prevalence rates of scabies in Nkondi and Gakurungu may be the difference in the coverage of the sub-locations with health education activities. Although health education was not confounding after controlling for all other factors, it should be remembered that the provision of health education in the sub-locations in the improved area has been very poor and was much more extensive in the non-improved area (Fig. 5). Especially in Nkondi and Karocho, where the highest prevalence rates in the improved area occurred, the

locations with 28.4 % and 18.4 % respectively. When investigating further, Nkondi is the sub-location with the lowest coverage of health education given by a health worker. This may be one explanation for the high prevalence rate of scabies in this sub-location. However, the possibility that scabies was over-diagnosed in this sub-location cannot be ruled out. As already mentioned earlier the diagnoses have to be seen as putative .

As this study revealed, there was no significant difference in the prevalence rates of scabies between the area where the majority of the study population (64.9 %) had access to improved water supply systems and the area where only 33.5 % of the population had access to improved water supplies. However, when looking at the individual child, it was found that a child with access to an improved water source ran a much lower risk to contract scabies than a child from a household using a traditional water source (Table 12). Children from households which fetched more water for daily consumption and well-nourished children were less likely to get scabies (Fig. 7, 8). Regarding hygiene practices, only the frequency of bathing and the use of soap were significantly associated with the prevalence of scabies . Children bathing more frequently and using soap were less likely to get scabies (Tables 13, 14). All these factors, however, were statistically of no importance in the final analysis (Table 34). After controlling for these possibly confounding factors, only the type of water source used proved to be significantly related to the prevalence of scabies.

Therefore, the hypothesis that access to improved water supply systems reduces the prevalence of water-washed diseases in Tharaka Division was confirmed.

However, it is difficult to understand that solely the type of water source and none of the characteristics of accessibility such as distance, time and payment or factors related to hygiene were significantly associated with the prevalence of scabies when possible confounding variables were controlled for.

One possible reason for this phenomenon could be the fact that type of water source and use of soap are interacting (Table 35). Children using a traditional water source but soap for bathing have a lower risk to get scabies than children using an improved water source and no soap for their bath. The use of soap in this context, however, raises further questions. Are children with access to an improved water source using a higher amount of soap for bathing? How is the soap applied, with a brush or a rough piece of cloth to open possible burrows - a method being part of the treatment of scabies? Answers to these questions are beyond the scope of this study.

Scabies is known as a water-washed disease related to poor hygiene and lack of sufficient amount of water. In the final analysis of this study, however, neither hygiene practices nor the amount of water proved to be related to scabies. In this context questions about water quality as a possibly important factor for the prevalence of scabies may arise. Although this consideration contradicts all expert knowledge, it cannot be rejected with absolute certainty here. This study did not investigate the water quality of the various types of water sources but was only concerned with water quantity.

7.2. Limitations of the Research Method

While traditional water sources may dry out during the dry season, improved water sources are in general more reliable and do not depend on the season. In the dry season, more households may therefore use improved water sources. The season may also influence the prevalence rates of scabies, especially in the non-improved area where more water may be available during the rainy season.
However, seasonal variations in the accessibility to water which may lead to changes in the prevalence rates of scabies could not be considered in this study. Originally, it was planned to collect data twice - in the dry as well as the rainy season. Administrative procedures such as acquiring various permissions delayed the fieldwork by nearly three months. The beginning of the field work fell therefore into a period of the year where the rainy season passed into dry season. The extreme points could not be met to undertake synchronized observation in both periods.

It has to be clearly mentioned that the prevalence rates for scabies have to be viewed as estimates. The study site was stretched over a vast area and covered a terrain which in some places, was very difficult to access. The community health workers could therefore not be supervised every day. Moreover, the study was community based and the confirmation of the diagnosis of scabies with microscopes was not feasible. The diagnosis had to be made on clinical features only, such as the presence of burrows, severe pruritus especially at night and the characteristic distribution of the scabietic eruptions. Scabies, however, is seen as the only skin disease which may be diagnosed by its localization only [Beek C.H., Mellanby K., 1953, pp. 880 - 881].

The verification of the questionnaire information on the utilization of water sources and the water consumption in the households by observational data was not feasible as this would have required a higher input of costs in terms of manpower, time and financial means. The information on behaviour, such as quantity of water used for the various domestic purposes and frequencies of bathing or changing clothes are therefore based on statements given by the interviewed people and not confirmed by interviewer observation.

This study did not take into account cultural factors which may have confounded the outcome. Beliefs about water as well as traditions regarding the utilization of the different type of water sources could not be considered as this would have been beyond the scope of the study in terms of the already mentioned high inputs.

CHAPTER EIGHT

Conclusion and Recommendations

The estimated prevalence of scabies among children under five years of age in Tharaka Division was significantly related to the type of water source used in the households. Accessibility to improved water supplies reduces the risk of contracting scabies.

Accessibility to improved water supply systems does not influence the daily water consumption but causes changes in the water use pattern within the households in Tharaka Division.

8.1. Implication for the Current Work in Tharaka Division

(i) The Tharaka Water and Sanitation Programme has achieved its objective to create better conditions for improved hygiene and health and has as a result created a better basis for economic growth and social development. However, it was striking to see that health education activities within the area with the improved water supply were much less than in the non-improved area. Although health education has been stated as an important component of the programme respective activities have obviously been neglected. This study clearly confirmed the importance of health education for the water use pattern within the individual households as well as for the use of improved water sources for hygiene purposes by the households. Health education must be enforced to intensify the utilization of the improved water supplies provided to the population in Tharaka Division. This will increase the health impact of the project.

(ii) This study identified areas with only a few or no improved water supply systems at all. If the project is expanded, sub-locations like Irunduni or Kamwathu, where the inaccessibility of improved water supplies is reflected in a high prevalence of scabies, should be favoured.

8.2. Implications for Future Research

(i) Further research would be needed to answer questions about the differences in utilization of improved water sources during the wet and dry seasons and the reflection upon the prevalence of water - washed diseases.

(ii) Regarding the prevalence of scabies in Tharaka Division it would be of interest to compare the rates with data of a health facility based study to be able to confirm the prevalence rates within the communities revealed by the present study.

(iii) There is also need for qualitative research in Tharaka Division. With a qualitative research, method perceptions about cultural factors influencing the utilization of improved water supplies could be gained.

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APPENDIX 1: The Questionnaire

SURVEY ON SCABIES AMONG CHILDREN UNDER FIVE YEARS OF AGE IN THARAKA DIVISION, THARAKA-NITHI DISTRICT, KENYA.

Questionnaire No.: .....

Date:............

Interviewer: ....

ASK EVERY QUESTION.

ASK THE QUESTIONS IN THE ORDER IN WHICH THEY APPEAR.

ASK THE QUESTIONS EXACTLY AS THEY ARE WRITTEN.

DO NOT SUGGEST ANSWERS.

TICK ( ) OR FILL IN ..... THE APPROPRIATE ANSWER.

---

1. Sub-location name
   SUBLOCATION YAKU YITAGWA TEA ? ....

   Subunit name
   SUBUNIT YAKU YITAGWA TEA ? ....

   Name of head of household
   MWENE MUCII UYU NUU ? ....

2. Status of person interviewed (insist on adult)
   MUNTU UYU UGUCHOKIA BIURIA NUU WE?
   (ETHIRWE ARI MUNTU UMUNENE)

   1 Head of household ( ) 2 Wife ( )

   3 Son/Daughter ( )

   4 Other, specify ....

3. How many children in the household are less than five years old ?
   IRWANA RUGANA RURIMUCII UYU RURI RUNGU RWA MIANKO ITANO ? ....

IF THERE ARE NO CHILDREN UNDER 5 YEARS OF AGE IN THE HOUSEHOLD DO NOT CONTINUE WITH INTERVIEW.

IF THE CHILDREN ARE JUST NOT PRESENT AT THE MOMENT MAKE A NOTE IN YOUR NOTEBOOK AND COME BACK LATER.

P A R T I : DATA ON HOUSEHOLD

4. What is the highest school class completed by the HH?
MWENE MUCII UYU ATHOMETE MWAKA KUU? (TICK THE NUMBER)

1, 2, 3, 4, 5, 6, 7, 8 for Standard one to eight

9, 10, 11, 12 for Form one to four

13 College

14 No formal education at all

5. What is the occupation of HH ?
MWENE MUCII UYU ARUTAGA NGUGI MBI ?

1 Farmer ( ) 2 Skilled labourer ( )

3 Unskilled labourer ( )

4 In formal employment ( )

5 Others, specify....................

6. How much land owns the HH ?
MWENE MUCII UYU ENA KTHAKA KIGANAATA ?

1 none ( ) 2 less than one acre ( )

3 one to four acres ( )

4 four acres and more ( )

7. How many people are living in the household ?
ANTU BARA BAKARAGA MUCII UYU IBAGANA ? ....

8. How many rooms has the house ?
NYOMBA YINARUMU IGANA ? ....

9. Where did you fetch the water used in the household yesterday ?
RUJI RURA URATUMIIRE MUCII WAKU IGORO URATAITE KUU?

1 River/Stream ( ) 2 Pond/Dam ( )

3 Waterhole ( ) 4 Spring ( )

5 Well ( ) 6 Rock Catchment ( )

7 Handpump ( ) 8 Tap ( )

9 Water kiosk ( ) 10 Roof Catchment ( )

11 Household pipe ( )

12 Others, specify ....

10. Is the water from this source safe for drinking ?
RUJI RURU BUTAGA IRUTHERU RWAKUNYUA ?

1 Yes ( )   2 No ( )

11. Do you boil the water from this source before drinking ?
IBUCAMUKAGIA RUJI RURU MBERE YA KUNYUA ?

1 Yes ( )   2 No ( )

12. How far do you have to walk to the water source used ?
BUTHIAGA BANTU AGANA TA AGU BUTAGA RUJI ?

1 less 500 m ( )   2 from 500 m to 1 km ( )

3 from 1 to 1,5 km ( )   4 from 1,5 to 2 km ( )

5 more than 2 km ( )

13. How much time do you need for fetching water from this source (time spent on journey and waiting) ?
ITA MATHAA MAGANA BUTHIRAGIA GUKINYA NA GUCHOKA ?

1 less than 15 min ( )   2 from 15 to 30 min ( )

3 from 30 min to 1 hour ( )   4 more than 1 hour ( )

14. Do you have to pay for the water from this source ?
IBURIAGA RUJI RURU?

1 Yes ( )   2 No ( )

15. How many times do you go to the water source to collect water ?
IMAITA MAGANA UTAAGA RUJI ?

1 once daily ( )

2 twice daily ( )

3 three times daily ( )

4 more often, specify ....

16. What is the estimated size of container(s) used for <u>one</u> trip ?
UTAAGA RUJI NA GINTU KIGANA ATIA ?

(TO BE CHECKED BY INTERVIEWER)   litres ....

17. How many litres of the container(s) are used daily for:
IRITA IGANA BUTUMAGIRA WANTUKU:

(TO BE ESTIMATED BY INTERVIEWER) litres

1 drinking ......

2 cooking ......

3 washing food/ dishes ......

4 bathing ......

5 bathing small children (under 5) ......

6 washing clothes ......

18. Do you think water can affect your health ?
NUKUTHUGANIA MWIRI WAKU NWA UTHUKUE IRUJI RURU ?

1 Yes ( ) 2 No ( )

19. If yes, which ones of the listed diseases are related to water:
KETHIRWA IBU, IMIRIMO IRIKU KIRI INO IREA IRETAGWA IRUJI:

1 Measles
KITHUKU ( )

2 Diarrhoea
KWARWA ( )

3 Tuberculosis
T.B. ( )

4 Gonorrhoea
GICHONONO ( )

5 skin diseases
MURIMO WA NGOCHI ( )

20. How would you prevent diseases related to water ?
NA ATA GUMBA KURIGIRIA MIRIMO INO IRETAGWA IRUJI ?

1 do not know ( )

2 using clean drinking water ( )

3 keeping food clean ( )

4 washing hands after defaecation ( )

5 washing hands before handling food ( )

6 keeping body/ clothes clean ( )

7 Others, specify ....

21. Who told you about that ?
NUU WAKWIRIRE UGU?

1 Health worker ( )   2 Teacher ( )

3 Media, e.g. Radio,Newspaper ( )

4 Others, specify: ....

P A R T II : DATA ON CHILD
to

Questionnaire No.: ....

Child No. ....

Name of child...

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22. Sex:
MUNTU MURUME KANA IMUKA ?

1 Male ( ) 2 female ( )

23. How old is the child ?
MWANA ENA MIAKA NA MIERI IGANA?

years .... months .....

24. Who is taking care of the child ?
NUU UMENYAGIRA MWANA UYU ?

1 mother ( ) 2 father ( )

3 sister/brother ( ) 4 grandparent ( )

5 other, specify ....

5. Age of the caretaker (at last birthday)
UYU UMENYAGIRIRA MWANA UYU ENA MIANKA IGANA

years.......

5. Marital status of the caretaker
MUMENYERERI WA MWANA IMUNTU MUBI ?

1 single ( ) 2 married ( ) 3 widowed ( )

4 divorced ( ) 5 separated ( )

. How regular is the child bathed ?
MWANA ATHAMBAGUA MAITA MAGANA ?

1 once daily ( ) 2 more than once daily ( )

3 every second day ( ) 4 less frequent ( )

. Where is the child bathed ?
MWANA ATHAMBAGIRUA KUU?

1 at home ( )

2 at water source where you fetched water yesterday ( )

3 at another water source, specify ....

29. Is anything used for bathing the child ?
KURI KIO UTUMAGIRA KU THAMBIA MWANA ?

1 Yes ( ) 2 No ( )

If yes,specify ....

30. Where were the child's clothes washed this week ?
NGUO CIA MWANA IRATHAMBITUE KUU KIUMIA GIKI ?

1 at home ( )

2 at the source you fetched water yesterday ( )

3 at another water source, specify ....

31. Is anything used for washing the clothes ?
GWIKIO GITUMAGIRWA KUTHAMBIA NGUO ?

1 Yes ( ) 2 No ( )

If yes,specify ....

32. How often is the child changing to clean clothes ?
MWANA ACENCAGIA NGUO MAITA MAGANA ?

1 daily ( ) 2 every second day ( )

3 twice a week ( ) 4 once a week ( )

5 less frequent ( )

33. Does the child share the bed with another person ?
KANA GAKU IKAMAMAGA NA MUNTU UNGI ?

1 Yes ( ) 2 No ( )

34. If yes, with how many people ?
WEGWA KURIGWE, BAMAMAGA BAGANA ?

1 One ( ) 2 Two ( ) 3 More than two ( )

35. Which vaccination has the child got ?
INJANCHO IRIKU MWANA AYANCHITUE ?

1 None ( )

	by memory	by card
BCG:	2 ( )	3 ( )
DPT 1	4 ( )	5 ( )
DPT 2	6 ( )	7 ( )
DPT 3	8 ( )	9 ( )

	by memory	by card
Polio Birth d.	10 ( )	11 ( )
Polio 1	12 ( )	13 ( )
Polio 2	14 ( )	15 ( )
Polio 3	16 ( )	17 ( )
Measles	18 ( )	19 ( )

PHYSICAL EXAMINATION:

36. Weight
RATIRI kg ..... grammes ......

37. Skin alterations ?
MUTUNDWA ?

1 Yes ( ) 2 No ( )

38. If yes:
KETHWA IBU: (YOU MAY TICK MORE THAN ONE)

1 burrows ( ) 2 papule/vesicle ( )

3 scratches ( ) 4 crusts ( )

39. Distribution of skin alterations:
IKU NAKU MUTUNDWA JURI ?
(YOU MAY TICK MORE THAN ONE)

1 face ( ) 2 webs/side of fingers ( )

3 palms ( ) 4 wrists ( ) 5 elbows ( )

6 axilla folds ( ) 7 waist ( ) 8 buttocks ( )

9 inner thighs/genitals ( ) 10 ankles ( )

11 soles ( ) 12 none of these places ( )

40. Are these skin alterations itching ?
NTUNDWA IGU IRI NA MWITHUA ?

1 Yes ( ) 2 No ( )

41. If yes, when do they itch most ?
KETHWA IBU, NIRI IGIJAGA MWITHUA MUNO ?

1 at daytime ( ) 2 at night ( )

42. Since how long has the child the skin alterations / itching ?
NIKUMA IGITA RINGANA AKARITE AKITHWAGA ?

1 less than one week ( )

2 one to four weeks ( )

3 more than four weeks ( )

FOR INTERVIEWER:

43. Identified as scabies? 1 Yes ( ) 2 No ( )

3 Not sure ( )

44. Treatment given 1 Yes ( ) 2 No ( )

APPENDIX II: Syllabus for Training of Interviewers

SYLLABUS FOR INTERWIEWER TRAINING

Tuesday, 11.5.1993

9.00	Introduction Purpose of the study
10.30	Tea break
11.00	Selection of households
13.00	Lunch
14.00 – 17.00	The questionnaire - basic structure - review and translation of questions

Wedneysday, 12.5.1993

9.00	Interviewer instructions
10.30	Tea break
11.00	Practical session - interviewing a collegue - assessment of length of interview
13.00	Lunch
14.00 – 17.00	Physical examination of children - scabies - nutritional assessment

Thursday, 13.5.1993

9.00	Written test
10.30	Tea break with Discussion of the test questions
11.30 – 17.00	Field exercise Pre-test of questionnaire

Friday, 14.5.1993

9.00 – 12.00	Final discussions Closure