'ER, SANITATION AND HEALTH IN BRAZIL
A HEALTH IMPACT SURVEY IN APIAI-MIRIM AND FERREIRA DOS MATOS, SAO PAULO

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Water, sanitation and health in Brazil.
A health impact survey in Apiaí-Mirim and Ferreira dos Matos, São Paulo.

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PREFACE

This study is a part of our study Environmental Engineering at the Agricultural University of Wageningen.
Our time in Brazil would not have been so wonderful without the never ending energy of our supervisor and friend Jose Santos de Oliveira.
CETESB, especially Dr. Rossin and Celia Castello, we thank for the possibility to work in the framework of the projeto saneamento rural.
From the ERSA in Capão Bonito we received a lot of help and cooperation, special thanks to the inspirational Dr. Edna Bugni, Ester and Sandra Regina.
Back in Holland support was given by our supervisor Bert Jansen.
Last but certainly not least we would thank all the people of Apiaí-Mirim and Ferreira dos Matos who showed us the Brazilian hospitality.
"Saudade" to the fantastic Brazilians and the beautiful Brazil will remain.

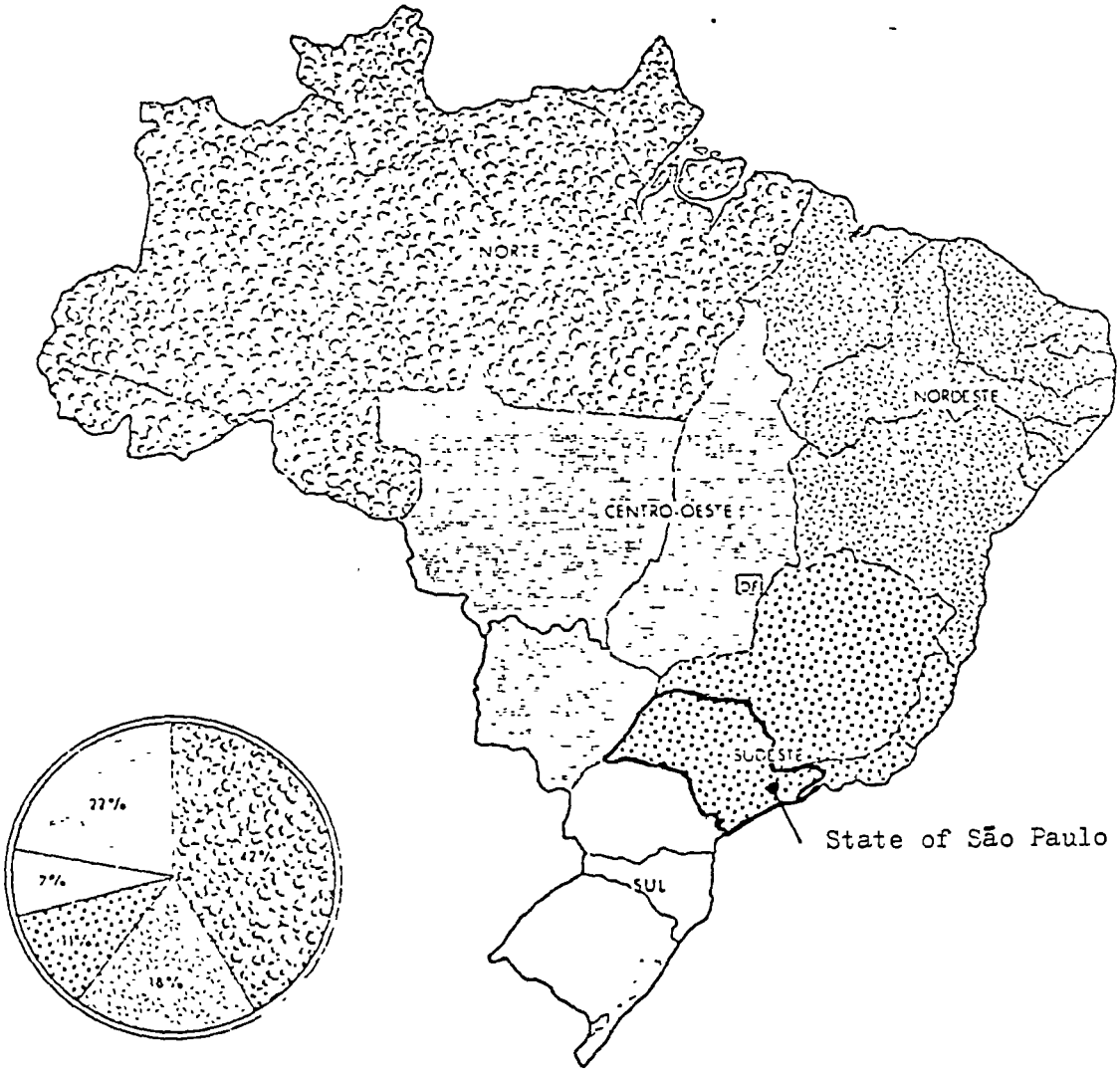
LIST OF ABBREVIATIONS AND TRANSLATIONS

AM	Apiaí-Mirim
C	City
FdM	Ferreira dos Matos
M	Município
S	State
Bacia	Round wash-bassin used for taking bathes, for washing dishes and for washing clothes.
Bairro	District, quarter. Apiaí-Mirim and Ferreira dos Matos are bairro's of Capão Bonito (M).
Burrinho	Way of bombing water with help of the gravitation of the water.
Camarada	Seasonal worker: he works per day and earns per day.
CETESB	Companhia de Tecnologia de Saneamento Ambiental. Control Agency of Environmental Pollution.
Conselho	Umbrella organization in FdM. Here the important decisions of the village are made.
Cruzado	Monetary unit of Brazil. Cz$ 100 = US$ 2,17 ó (August, 1987).
DAEE	Water Resources and Electric Energy Agency.
ERSA	Escritórios Regional de Saúde e Assistência Social. Regional Health Secretariat.
Estado	State. Brazil is divided into states, of which São Paulo is one.
Farinha	Flour made of manioc or maize, served with any hot meal.
Filtro	A little water container which holds 5 litres and contains a filter.
Inspetor de quarteirão	Inspector of a (city) block. His task is roughly the task of a policeman.
Meeiro	Share cropper; he farms the land of the landlord. the costs of inputs as fertilizer, pesticides, seeds etc. are divided as is the yield.
Meio Ambiente	Environment.

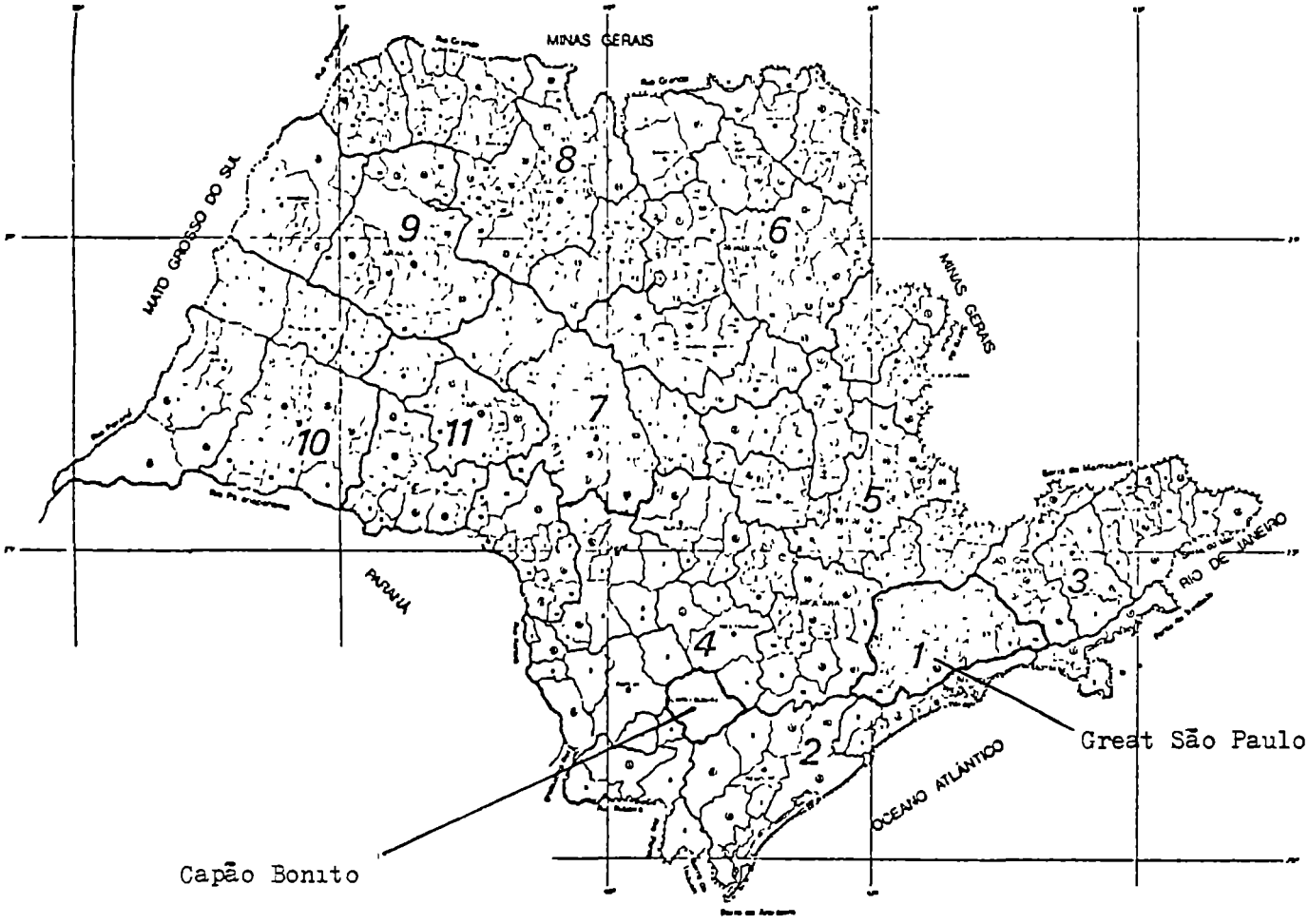
Município	The states of Brazil are divided in Municípios which in turn are divided in municipial districts. Capão Bonito is a Município of the State of São Paulo.
Obras públicas	Public works.
Pau-a-pique	Material used for the construction of houses. It's a frame of bamboo filled up with clay.
Pote	A clay pot with a narrow neck, holding about 7 litres.
Prefeitura	Agency of Municipial Government, under a Prefeito (Mayor).
Projeto Saneamento Rural	Project to supply the rural population with adequate water and sanitation systems.
SABESP	Institute of Public Works and Sanitation.
Saneamento	Sanitation.
Saúde	Health.
Secretaria da Saúde	Secretariat of Health.
Taboa	Material used for the construction of houses. It's board of less than 3 cm thick.
Tropeiros	Drivers of pack animals.
Unidade Básica da Saúde	Basic Health Unit. Here is no physician available. Only easy nursery takes place.
Voluntario	By means of terrestrial gravitation.

Map of Brazil

ÁREA DAS GRANDES REGIÕES



Map of the State of Sao Paulo



SUMMARY AND CONCLUSIONS

Introduction

This report presents the results of a health impact survey, carried out in two villages, Apiaí-Mirim and Ferreira dos Matos, in the State of São Paulo, Brazil. The study is part of the Projeto Saneamento Rural of the Brazilian government, which aims to help the population in rural areas to obtain "Clean water and sanitation adequate for all, by the year 1990", goal of the International Water Decade. This project is still in its infancy; no village has been supplied yet with an improved water supply and sanitation system. The Projeto Saneamento Rural intends to pay attention to the evaluation of installed water supply and sanitation facilities.

Objectives

The objectives of this study are:
- to carry out a health impact survey by means of a quasi-experimental design; two villages with a different level of traditional water supply and sanitation facilities are compared
- to gain experience with and transfer knowledge of health impact evaluation (HIE).

Methodology

The "Minimum Evaluation Procedure (MEP) for Water Supply and Sanitation Projects" (Schultzberg, 1982) and the book "Evaluation for Village Water Supply Plannning" (Cairncross, 1980) served as a guide for this study. Although the MEP is meant to evaluate functioning, use and impact of improved facilities in subsequent stages, this study has focussed on a description of different levels of traditional water supply and sanitation facilities and health. The MEP methodology has also proven to provide a good tool for comparison in this respect.
This study focusses on three subjects: water, sanitation and health.
Information about the water situation was obtained through the Household survey, observations near the main water source in Apiaí-Mirim and bacteriological and physical/chemical examination of the water sources.
Information about the sanitation situation was received through the Household survey and inspection of the latrines.
As health indicators were used: faeces examination, diarrhoeal morbidity survey and anthropometric measurements.
Information about the socio-economic situation was obtained through the Preliminary questionnaire.
The researchers lived together for almost two months with the people of Apiaí-Mirim and Ferreira dos Matos in the period May/September 1987.

Results

The two villages have a different water supply system. In AM the women and children have to draw water from various water sources: spring, well, river and rain water. Most households use water

from the communal spring. In FdM 81% of the households has a piped water supply, constructed by themselves. The water for these supplies comes from various wells and springs.
All water sources in AM would be condemned if WHO standards are applied. In FdM the situation is better; six water sources were without any faecal pollution. There was not noted an increase in pollution between collection and consumption of the water in AM.
The mean collection of water per capita per day is very low in AM, 9,9 litres. During the household survey the women said to use 11,5 litres per capita per day. In FdM an average of 26,8 litres per capita per day was used according to the women.
Chlorinating or boiling of the water is not common in both villages.
The most common drinking water storage in AM is a tin or plastic drum, while the filtro is more used in FdM. In FdM more storage containers are covered.
The people of FdM tend to take more bathes than in AM, probably because of the fact that more people in FdM have a shower.

The majority of the households in AM and FdM owns an excreta disposal system; however in AM are more households without a sanitation facility than in FdM.
In both villages the pit is used as off-site technology for the excreta disposal systems.
The local costume is to squat during defeacation. For this reason the squatting plate is mostly used in both villages. However, especially in FdM, the population has started to use water seals.
In FdM the sanitation facilities are better constructed.
When the children defaecate in the yard the mothers in FdM remove the faeces of the children to the latrine.
In AM adults and children tend to wash their hands more often with soap after defaecating.

Faeces examination showed the prevalence of 10 different worms and protozoa in both villages.
In AM there was a significant higher prevalence of Ascaris lumbricoides, Endolimax nana, Entamoeba coli, Strongyloides stercoralis and Trichuris trichiura has been registrated.
Of the 276 inhabitants of AM who collaborated, 98 (35,5%) were negative and 178 (64,5%) were infected of which 59 (21,4%) had more than one infection. In FdM 475 samples were examined. Of these examinations 260 (54,7%) turned out negative and 214 (45,1%) were positive of which 25 (5,3%) persons had more than one infection.
In AM the diarrhoea incidence is significant higher compared to FdM. In AM 49% of the children had one or more episode of diarrhoea. In FdM only 8,2% of the children had one or more episode of diarrhoea.
Snyder and Merson estimated from 24 published studies the annual morbidity rate for acute diarrhoea for under five year old children in the developing world as 2,2 episodes per child. For AM an annual morbidity rate for acute diarrhoea of 17,8 episodes per child is calculated, in FdM this rate is 3,4 episodes per child.

The results of the anthropometric measurements are difficult to interpret. According to Brazilian graphs for measurement of nutritional status 68,3% of the children in AM and 60,7% of the children in FdM suffer from chronic malnutrition. According to the MEP only 2,4% of the children in AM and 1,6% of the children in FdM suffer from chronic malnutrition. According to the MEP the acute malnutrition, which is associated with diarrhoea and thus with water and sanitation suplies, does not exist in both villages.
It seems clear from the results mentioned above that the health situation related with water and sanitation conditions is worse in AM. However this does not indicate that the health situation in FdM is optimal. Diarrhoea incidence is higher compared with results of other studies (Snyder,1982). Also 45% of the population is infected with worms and protozoa.

Conclusions

Concluding can be stated that the functioning and use of the water supply and sanitation facilities is better in Ferreira dos Matos than in Apiaí-Mirim. Also the health situation is better in Ferreira dos Matos ; significant differences have been found in diarrhoea incidence and worms and protozoa prevalence.
It seems that the differences in health situation can be explained from the differences in water supply and sanitation facilities. However this is not fully justified.
The assumption that the villages have the same characteristics is not correct. There are two important differences. From the Preliminary questionnaire became clear that Ferreira dos Matos is not as poor as Apiaí-Mirim. Secondly there is a difference in organization system, which means a difference in consciousness.
Also some remarks can be made about the MEP methodology.
It is very difficult to link the various investigations because of interfering variables and indistincnesses. Worms and protozoa, diarrhoea and undernutrition are not exclusively caused by habits concerning water and sanitation. For example, the kind of alimentation is also an important factor. Also the effects on the human body and the transmission route of worms and protozoa are not completely clear.
The community as a whole has been used as unit for the investigation. The villages are not homogenious. The possibility to use the facilities and the use of the facilities within the villages are different.
Scientific reasons only do not justify this type of research. Important is to realize that you are working with people and not with subjects. With this kind of information you ask a lot of time and cooperation of people, for example people have to answer a lot of questions and deliver their faeces for examination. One has to be sure that a solution can be offered for example to give medical treatment for worms and protozoa infections.
There seems to be general agreement that positive effects of water supply and sanitation facilities on health exist. That is why it seems usefull to aim further investigations on identifying problems on water, sanitation and health in cooperation with the

people. From here action should be developed.

TABLE OF CONTENTS

1 INTRODUCTION

This report contains the results of a study, which has been carried out in the framework of the Projeto Saneamento Rural of the Brazilian government. This project aims to help the population in rural areas to obtain "Clean water and sanitation adequate for all, by the year 1990", goal of the International Water Decade. The project is still in its infancy; no village has been supplied yet with an improved water and sanitation system (for more information about the project see Appendix 1).

The Projeto Saneamento Rural intends to pay substantial attention to the evaluation of installed water supply and sanitation facilities. Therefore, as an initial step, the present study has aimed at the evaluation of health aspects in two villages, Apiaí-Mirim and Ferreira dos Matos, both relying on traditional but different levels of water supply and sanitation facilities. These villages are planned to receive improved facilities in the framework of the Projeto Saneamento Rural.

The guide to this study was the "Minimum Evaluation Procedure (MEP) for Water Supply and Sanitation Projects" (Schultzberg, 1982) and "Evaluation for Village Water Supply Planning" (Cairncross, 1980).
The work has been done with help of CETESB (control agency of environmental pollution), the ERSA (regional health institute) of Capão Bonito and the people of Apiaí-Mirim and Ferreira dos Matos. The field work has been done in the period May/September 1987.

This report is built up as follows.
Chapter 2 shows the objectives of this research. In chapter 3 a short description of the study area is presented: the location and the main characteristics of the two villages and the health care in Brazil. Chapter 4 gives a brief summary of the MEP and explains the methodology and organization of this study. Statistic data on water, sanitation and health in Brazil can be found in chapter 5. Chapter 6 gives background information about the socio-economic situation and daily life in the two villages. In chapter 7, 8 and 9 the results are presented. Chapter 7 contains the results related to water: sources, use, quantity and quality. In chapter 8 the sanitation systems and their use are outlined. The general health situation and the results of the faeces examination, the diarrhoeal morbidity survey and the anthropometric measurements are described in chapter 9. In the final paragraphs of the chapters 7,8 and 9 some conclusions and a discussion of the used method are presented.

Abbreviations and an explanation of Portuguese words can be found in the list of abbreviations and translations.

2 OBJECTIVES

Although Brazil has a rich experience with drinking water and sanitation programs, reliable investigations on the impact of these programs on health have not yet been conducted. However, one of the important reasons to install water supply and sanitation facilities is to improve health standards.
This study tries to contribute to the research on health impact of water and sanitation programs in Brazil.

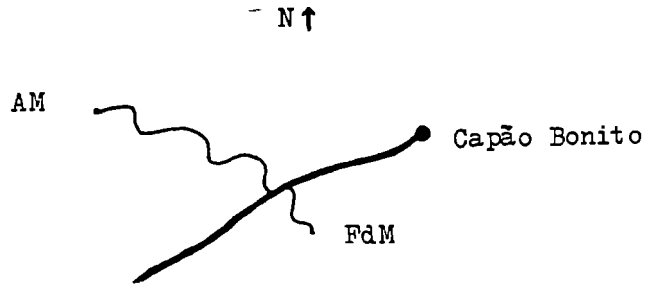
The objectives are:
- to carry out a health impact survey by means of a quasi-experimental design; two villages with a traditional but different level of water supply and sanitation facilities are compared
- to gain experience with and transfer knowledge of health impact evaluation (HIE).

The villages Apiaí-Mirim and Ferreira dos Matos will receive improved water supply and sanitation facilities. The results of this study can be considered as baseline survey in case the impact of improved facilities will be evaluated in the future.

3 DESCRIPTION OF STUDY AREA

3.1 Location

This investigation took place in the State of São Paulo, in the south-east of Brazil. The State of São Paulo is divided in Municipio's, of which Capão Bonito (M) is one. The government seat of this Municipio is located in the city Capão Bonito (C). The city has 30.000 inhabitants. The study villages Apiaí-Mirim (AM) and Ferreira dos Matos (FdM) are bairro's of Capão Bonito (M), respectively 35 km and 15 km to the west from Capão Bonito (C).



3.2 Health Care

Everyone in Brazil can receive health care for free. This does not include dental care. A privat health sector also exists; for quality reasons wealthy people make use of these facilities.
Under control of the Ministry of Health, the Secretarias do Estado da Saùde operate per state. These Secretarias are divided in several ERSA's, who coordinate all the activities of their specific working area in relation with health.

The ERSA operating in the region of Capão Bonito has started a new initiative two years ago. This initiative has two main components:
- the building of a Unidade Bàsica da Saùde (UBS), a Basic Health Unit. The investment costs of this UBS are divided between the population and the ERSA; the running costs are payed by the ERSA.
- the training of two local persons to assist the visitors of the UBS. These health assistants are elected by the villagers. The education is payed and arranged by the ERSA, as are their wages. The health assistents are trained to do basic nursery: first aid, immunization, urine and faeces sample collection, furnishing of chlorine tablets for water chlorination, distribution and administration of medicine for treatment of the most common and simple diseases.

3.3 Apiaí-Mirim

AM is a little village with at the start of the investigation 297 inhabitants and 60 households. The people draw water from various water sources. The most important water source is the communal spring, which is used by the majority of the households. Other water sources are private springs, wells, the river and rain water. The most common sanitation facility is the traditional pit latrine. A UBS is functioning in AM.

3.4 Ferreira dos Matos

FdM has 501 inhabitants and consists of 107 households. The majority of the households has a piped water supply, constructed by themselves. The water comes from various springs and wells, mostly situated in the forest. The water is transported by pumping

or by means of terrestrial gravity. The pit latrine is the most used sanitation facility. However, sometimes instead of a squatting plate a water seal is constructed. A UBS is attending the people.

4 METHODOLOGY AND ORGANIZATION

4.1 The principles of the MEP

The ultimate objectives of allocating resources for water supply and sanitation investments are to improve the health, welfare and economic status of the users of the constructed facilities. None of these objectives can be achieved unless the facilities are, firstly, functioning in the correct way and, secondly, utilized by the community. Therefore the evaluation of water supply or sanitation facilities has to be undertaken in three subsequent stages: first functioning, then utilization and finally impact. This is in fact the basic philosophy underlying the MEP, an evaluation methodology developed by Schultzberg/WHO in 1984. There is little value in evaluating a particular stage unless the objectives of the previous stage have been largely achieved. For each stage the MEP gives indicators, which are listed in table 1 for a water supply and in table 2 for a sanitation facility.

Table 1 Indicators for the evaluation of functioning, utilization and impact of a water supply.

Stage	Indicator
Functioning	Water quality Water quantity Reliability of the water supply Proximity of water sources
Utilization	Proportion of households using the facilities Volume of water used and for what purposes
Impact	Improved health: diarrhoeal diseases, worm infections, skin and eye infections, nutritional status Time savings Improved hygienic behaviour

Table 2 Indicators for the evaluation of functioning, utilization and impact of sanitation facilities.

Stage	Indicator
Functioning	Provision of government inputs Proportion of households that have improved latrines Sanitation hygiene Sanitation reliability
Utilization	Proportion of people using the facilities
Impact	Improved health: diarrhoeal diseases, worm infections, nutritional status Reduced environmental contamination Improved hygienic behaviour

4.2 The approach of this investigation

Although the MEP is meant to evaluate functioning, use and impact of improved facilities, the present study has focussed on different levels of traditional water supply and sanitation facilities and health in the villages AM and FdM; the MEP methodology has also proven to provide a good tool for comparison in this respect.
In the near future AM and FdM are planned to receive improved facilities in the Projeto Saneamento Rural. It is envisioned that the project will evaluate functioning, use and impact of these improved facilities, making use of the MEP. The results of the study obtained in this report can then be considered as a baseline survey.
Three subjects have been investigated:
- water
- sanitation
- health.
Table 3 presents more detailed information.

Table 3 The three subjects of this investigation and their aspects.

WATER	Types of water sources
	Choice of water sources
	Number of users of the water sources
	Reliability of the water sources
	Volume of water used
	Water quality
	Water use
SANITATION	Sanitation facilities
	Proportion of families using the facilities
	Use of facilities by children
	Sanitation hygiene
HEALTH	General health situation
	Prevalence of worms and protozoa
	Diarrhoea incidence of under fives
	Nutritional status of under fives

The household is the starting point of this investigation. The definition of Casley and Luvey (1982) is used:
"A household comprises a person or a group of persons, generally bound by the ties of kinship, who live together under a single roof or within a single compound and who share a community life in that they are answerable to the same head and share a common source of food."

4.3 Choice of the two study villages

First of all it was necessary to contact an ERSA to cooperate with. In the working area of this ERSA the two villages had to be chosen.
AM is a village with extremely poor water supply and sanitation facilities and therefore high ranking on the priority list of the Projeto Saneamento Rural.
FdM has been chosen because this village had better water supply and sanitation facilities than AM and had more or less the same socio-economic characteristics as AM.

4.4 Collection of information

The information has been collected through various methods.
General information through:
- Preliminary questionnaire.
Information about the water situation through:
- Household survey
- Observations near main water source in AM
- Examination of the water quality.
Information about the sanitation situation through:
- Household survey
- Inspection of latrines.
Information about the health situation through:
- Faeces examination
- Diarrhoeal morbidity survey
- Anthropometric measurements
- Conversations with the local health assistants and persons working for the ERSA in Capão Bonito.
The researchers lived for almost two months with the people of

AM and FdM, thereby receiving a good deal of information.

Preliminary questionnaire
The main purposes of this questionnaire were : to introduce the researchers to the population, to explain something about the investigation and to ask permission for the investigation.
Questions were asked about the composition of the household, labour, formation, luxury goods etc. This preliminary questionnaire is contained in Appendix 2.
In AM as well as in FdM all households were visited.

Household survey
The household survey consisted of two parts (see Appendix 3). The first part is about water and the second about sanitation Questions were asked about the aspects detailed in table 3. The researchers visited the houses together; one asking the questions and the other recording the answers.
When possible the women were interviewed. The women can give the best information, because they take care of domestical work: for example they draw the water.
In FdM 60 households were randomly chosen as a representative sample. In AM all 59 households have been visited.

Observation at the water source
The purpose was to get an impression of the water quantity used per person per day. This was only done in AM, because in FdM most households have piped water and there is no communal water source.
Data on water collection were obtained by observing the communal spring in AM for two subsequent days between 6.30 am and 18.30 pm. Registrated were all the households who only use water of the communal spring.
For the ease of recording and analysing the data, a standardized protocol has been used (see Appendix 4). Records were obtained from 54 household-days.
The contents of the bucket or tin used for drawing water were measured before.

Examination of the water quality
The aim of this investigation was to get an impression of the water quality of the various water sources. In order to reach this, several samples were taken which have been analysed at the laboratory of CETESB in São Paulo (C). The methods of analysis of the samples are based on the 16th edition of "Standard methods for the examination of water and waste water"(APHA-AWWA-WPCF). An example of a record with results of the water samples can be found in Appendix 5.
In AM a bacteriological and physical/chemical water examination has been carried out. The bacteriological examination has been carried out twice; the first time on a day with rainfall and the second time four days after rainfall. Samples have been taken from the communal spring, three wells and the river. Because water may be subject to contamination between collection and consumption, samples have also been examined from the buckets and storage vessels in the houses.
Two indicators were used to examine the bacteriological pollution. First the organisms of the group of coliforms were used as indicator. They are universally present in large numbers in the faeces of man and warmblooded animals, but are not exclusively of faecal origin. As second indicator the faecal

coliform organisms, in particular Escherichia Coli, were used. They provide definite evidence of faecal pollution.
The physical/chemical examination has been carried out only four days after rainfall. Samples have been taken from the communal spring, three wells and the river. Measured were the colour, pH, turbidity, bicarbonates, chlorides, iron, nitrates and consumed oxygen. A physical/chemical examination may reveal colours, odours or tastes that might discourage people from using the water, even if it is not harmful.
In FdM the bacteriological examination has been carried out on a sunny day. Samples have been taken from 24 different water sources. A new well and the river were not included. The samples were not all collected directly at the water source. In case of long distance or difficult access the samples were collected from the pipe, the reservoir or the tap in the house.

Inspection of the latrines
The general conditions of the latrines have been inspected. First by questioning (see Appendix 3). Secondly by observing fauling, smell and privacy of the latrines.

Faeces examination
Intestinal agents are health indicators, because changes in water use or improvements in excreta disposal should reduce their transmission, especially of Ascaris, Trichurius and the hookworms. Infection is measured by detecting the eggs of worms in the stools. Stools have been collected from the whole population of both villages. Trays have been distributed house to house and the population was explained to defaecate on a piece of paper and to put a bit of the stools in the tray, using a spatula. The trays were collected the next day at the houses and within 24 hours after defaecating transported to the laboratory of the ERSA in Capão Bonito. There the stools were prepared and examined microscopically. The laboratory has a standardized protocol to examine the following worms and protozoa:

Worms	:	Protozoa
Ascaris lumbricoides	:	Entamoeba coli
Trichocephalus trichurius	:	Entamoeba histolytica
Ancylostomidae	:	Giardia lamblia
Schistosoma mansoni	:	Chilomastix mesnili
Hymenolepis nana	:	Iodamoeba bütschlii
Enterobius vermicularis	:	Endolimax nana
Taenia sp.	:	Trichomonas hominis
Strongyloides stercoralis	:	Embadomonas intestinalis
Trichostrongylidae	:	Balantidium coli
Hymenolepis diminuta	:	Isospora hominis
	:	Isospora belli

Diarrhoeal morbidity survey
Diarrhoeal diseases are a major cause of illness and death among under five year old children in all poor communities throughout the world. Most diarrhoeal diseases are caused by infection of the intestines by viruses, bacteria and/or protozoa. The agents of diarrhoea are transmitted from faeces to mouth in various ways and this transmission should reduce as a result of a successfull water, sanitation and education project. Diarrhoeal disease incidence constitute the most universally appropriate indicator of the health impact of water and sanitation projects

(Schultzberg, 1982).
The diary-assisted recall method has been used to measure the morbidity of diarrhoea. Each household was visited and the purpose of the survey explained. The mother received for each under five year old child a calender of two weeks. The mother was asked to make a daily mark on the calender, recording whether or not the child had diarrhoea that day. General agreement on the definition of diarrhoea exists in the region; therefore a definition of diarrhoea was not given. The households were revisited after three and after seven days. The calender was discussed with the mother to ensure that all diarrhoea events were recorded with an X. After two weeks the calenders were collected. An example of the used calender is contained Appendix 6.

Anthropometric measurements
There is evidence that diarrhoea may be responsible for up to 90% of the growth failure observed in infants and children from six to thirty months of age in developing countries (Schultzberg, 1982). This association between diarrhoea and nutritional status can be used as an indicator of the health impact of improved water supply and sanitation systems. The nutritional status of children can be assessed through anthropometry.
The weight and height of under five year old children was measured. The results were marked on standard graphs (see Appendix 7), that are being used by health institutes in Brazil. The children were measured with clothes because of the cold weather.

Conversations
From people working at the ERSA in Capão Bonito (C), general information was collected about the functioning of the health care in the region of Capão Bonito.
From the local assistents working in the basic health unit a lot of information was obtained about the situation in AM and FdM.

4.5 Statistical methods

In AM all the 59 houses were visited for the household survey. In FdM 60 from the 107 houses were selected at random. In the other investigations the whole population was involved. During the study period the number of households in the villages, especially in AM, was not constant, because of migration.
The results of the various investigations have been statistically verified with help of the X^2-test.

4.6 Organization

The method and kind of investigation were discussed with CETESB and the ERSA. Starting point was that the results should not only be useful for the investigation, but also for practical purposes. For instance, the results of the faeces examinations were used to treat all the infected persons, reexamine the persons who did not had an intestinal agent and give information about the subject. Another example, the anthropometric measurements were used to set up a rural system to provide undernourished children with milk.
The samples taken from the various water sources have been analysed in the laboratory of CETESB in São Paulo (C). Analyses

of the stools have been done in the laboratory of the ERSA in Capão Bonito.
During the field work a lot of help of the population of AM and FdM was received. In AM the purposes of all investigations were explained in the church. A few older children visited together with the researchers the houses to make the first contact easier. Before starting the research in FdM the purposes of the investigations were discussed with the local population in a village meeting. Afterwards information was given in the church and with notes, which the children took from school to their parents.
In AM the field work has been carried out during the months May/June and in FdM during the month September.

5 BRAZILIAN STATISTICS ON WATER, SANITATION AND HEALTH

5.1 Water and sanitation

5.1.1 Brazil

In 1984 the Brazilian population consisted of 128.265.206 persons. Of this population 72,4% lives in urban areas, 27,6% in rural areas (IBGE, 1986).
As can be seen in table 4, 57,0% of the total and 80,4% of the urban population has a piped water supply system. This implies that only in urban areas people are served with a piped water supply system.
Only 24,0% of the total population and 33,8% of the urban population has a sewerage system.

Table 4 Percentages of the Brazilian population with water and sanitation system (ABES, 1986).

	PIPED WATER SUPPLY SYSTEM		SEWERAGE SYSTEM	
	TOT. POP.	URB. POP.	TOT. POP.	URB. POP.
NORTH	40,9	70,4	1,9	3,2
NORTHEAST	37,8	70,4	5,7	10,6
CENTREWEST	53,5	72,9	21,3	29,0
SOUTHEAST	74,3	86,2	45,4	52,7
SOUTH	54,4	81,9	10,5	15,8
BRAZIL	57,0	80,4	24,0	33,8

These data show the great regional difference: in the Southeast (including the State of São Paulo) the situation is the best.

5.1.2 São Paulo (S) and Capão Bonito (M)

In the State of São Paulo 91,9% of the population lives in urban areas (SEADE, 1986). Almost everybody in the urban areas has piped water. In the rural areas 75,5% of the population draws water from a well or spring (SEADE, 1986).
A sewerage system is not widely available in São Paulo (S); 64,3% of the urban population and 7,0% of the rural population has this kind of sanitation system (SEADE, 1986). The most common sanitation system in rural São Paulo is still the traditional pit latrine.
As becomes clear from table 5 the percentage of houses with piped water is much higher in São Paulo (S) than in Capão Bonito (M).

Table 5 Percentages of the houses with different water systems in Capão Bonito (M) and São Paulo (S) (IBGE, 1983, B).

	C.B.	S.P.
PIPED WATER	54,2	82,3
WELL OR SPRING	38,2	15,6
OTHER	7,6	2,0

In São Paulo (S) 55,5% of the houses are served by a sewerage system, though only 27,9% in Capão Bonito (M) are served (see table 6).

Table 6 Percentages of the houses with different sanitation systems in Capão Bonito (M) and in São Paulo (S) (IBGE, 1983, B).

	C.B.	S.P.
SEWERAGE	27,9	55,5
SEPTIC TANK	6,5	16,1
PIT LATRINE	50,8	21,0
NOTHING	14,8	7,4

5.2 Health

5.2.1 Brazil

Only the Secretarias do Estado da Saúde have morbidity data, referring to their respective States, which are not summed up for Brazil as a whole. The Ministry of Health computes and publishes mortality data by State and each of its capital city (Brasil, 1987).
The Ministry of Health admits that approximitaly 25% of the total deaths are not reported to the health agencies. The causes of the reported 75% are presented in table 7.

Table 7 Causes of reported deaths in Brazil.

CAUSES	PERC. OF REPORTED DEATHS:
chronic-degenerative diseases(heart, liver, kidneys etc.)	50 %
infectious diseases	10 %
neoplasm	10 %
external causes (homicides, suicides: accidents etc.)kidneys etc.)	10 %
poorly defined	20 %

The composition of the infectious diseases is as follows.

Intestinal infectious diseases	56%
Other bacterial diseases (included leprosy)	13%
Arthropid-born diseases	11%
Tuberculosis	10%
Other (viral and veneral, late effects etc.)	10%

Because not everybody reports the deaths to a clinic, especially in non health assisted areas, the actual percentages are likely to be higher.
Infant mortality, the annual rate for children aged 0-1 year per 1000 born alive, is about 30 in health assisted areas and climbes to 250 in non health assisted regions. The Brazilian mean of infant mortality in 1980 was 80, in the United States it was 12 (Grant, 1984).

5.2.2 Capão Bonito (M)

The most important causes of death in Capão Bonito (C) are:
- infectious diseases, tuberculosis, leprosy
- respiratory diseases
- birth complications
- accidents
- undefined causes.

Exact morbidity data are unfortunately not available.
In table 8 available mortality data are presented.

Table 8 Age specific mortality date in percentages (São Paulo, 1987 & Brasil, 1987).

AGE	CAPÃO BONITO(M)	SÃO PAULO(S)	NORTH-EAST	BRAZIL
0 - 1	25,0	16,7	24,7	18,3
1 - 4	5,5	2,2		
5 - 19	3,5	3,4		
20 - 49	21,0	20,5		
> 50	45,0	57,0		

6 SOCIO-ECONOMIC BACKGROUND

6.1 History

In the 18th century an important trade route led from Rio Grande do Sul to Rio de Janeiro, the major port in that epoch. During the trip tropeiros, drivers of pack animals, were provided with food by small communities along the route. When this source of income disappeared, the people of these villages changed to subsistence agriculture. Large farms for the production of coffee and sugar-cane have never existed in this region.

6.2 Climate

Capão Bonito (M) is located 700 metres above sealevel. The climate is subtropical. The average annual temperature is 20 degrees Celsius. The summer is hot, but in wintertime the temperature can decline to 5 degrees Celsius. There is no particularly dry or wet season. The annual rainfall, 1300 mm, is more or less equally divided over the year, with a little peak in January, 225 mm (Comissão interestadual da Bacia Parana-Uruguai, 1966).

6.3 Communication and facilities

Up to about 3 days after medium rainfall it is difficult or even impossible to cross the 25 kilometres sandpath, which is the main route to AM. FdM is always attainable, the 5 km sandpath which leads from the asphalt road to the village has been covered with little stones. Transport between Capão Bonito and the villages is arranged by local car-owners.
In FdM a community telephone is present, which is not the case in AM. Neither AM nor FdM is visited by a mailman.
In both villages one shop exists, where one can buy the most necessary provisions.
Bars are very popular, as well in AM as in FdM, and therefore richly on hand.

6.4 Demografic figures

The total population of AM consists of 297 persons, which are divided over 63 households. The average of one household consists of 5 persons. The number of children is almost equal to the number of adults as can be seen in table 9.

Table 9 Demografic figures in AM.

AGE	MALE	FEMALE	TOTAL
0 - 1	2	5	7
1 - 4	16	21	37
5 - 14	47	57	104
> 15	81	68	149
TOTAL	146	151	297

Many young people leave AM after their adolescence, to a place where they think work is available, because they can not see a future for themselves in this little community.
In FdM are living 107 households, totalling 501 persons. Migration to the city hardly exists. The possibility to gain a satisfactory life is limited, but exists. For this reason the number of adults is almost twice the number of children as can be seen in table 10.

Table 10 Demographic figures in FdM.

AGE	MALE	FEMALE	TOTAL
0 - 1	5	5	10
1 - 4	31	20	51
5 - 14	70	54	124
> 15	162	154	316
TOTAL	268	233	501

6.5 Education

At present all seven year old children attend the local school. The school consists of four classes, sufficient to learn to read and write. In FdM the people have the possibility to visit four additional classes for free at night in a nearby village.
The illiteracy among persons older than 15 is 31% in AM and 22% in FdM. In both villages the illiteracy among women is greater than among men, as can be seen in tables 11 and 12.

Table 11 Illiteracy in AM among persons older than 15 years.

	MALE	FEMALE	TOTAL
READ AND WRITE	60	43	103
ILLITERATE	21	25	46
TOTAL	81	68	149

Table 12 Illiteracy in FdM among persons older than 15 years.

	MALE	FEMALE	TOTAL
READ AND WRITE	134	114	248
ILLITERATE	28	40	68
TOTAL	162	154	316

6.6 Economic activities

The main source of living in both villages is agriculture.
For 72% of the households in AM and 59% in FdM agriculture is the most important source of income.
Small farmers are more present in FdM (50%) than in AM (7%). Beside these small farmers two other agricultural labourforms can be distinguished. Camarada is a seasonal worker, who works per day and earns per day. This type of work is done by men, women and children. The wages are very low and only in times of harvest there is sufficient work for all.
The other labourform is meeiro: the worker farms land of his landlord. The costs of input as fertilizer, pesticides, seed etc., as well as the yield are divided between the landlord and the meeiro. If necessary women and children help.
About 15% of the households in AM and FdM earn their cost of living in the tertiary sector: taxidrivers, shop- and barkeepers and local health assistents.
Wage labourers do not exist in AM, because this type of work simply is not available.
As a result of their difficult economic position a lot of small farmers in FdM became wage labourer in the nearby sawfarm or at the experimental station (25%).
The others are old people who live alone and farm a tiny little piece of land, sometimes receive pension (half of the minimal wage) and often their children look after them.
In table 13 the various labourforms are presented in percentages and numbers. Every household is placed in only one catagorie. In case of more than one labourform per household the form which generates most income is choosen.

Table 13 Labourforms in AM and FdM in numbers and percentages of households.

	Apiaí-Mirim		Ferreira dos Matos	
	No.	%	No.	%
Agriculture:	43	72	63	59
- landowner	4	7	53	50
- meeiro	12	20	2	2
- camarada	27	45	8	7
Commerce & Services	9	15	13	12
Wagelabourers	-	-	28	26
Others	8	13	3	3
Total	60	100	107	100

6.7 Standard of living

It was not possible to get an impression of living standard on the basis of monthly income figures, mainly because of the irregular periods of income. Therefore the following indicators were used: cattle, luxury goods, electricity connection.
The overall impression seems to be that the living standard in Fdm is somewhat better than in AM. More households own cattle, a radio, a refrigerator, a television or/and a car and have an electricity connection.

6.8 Organization

The organization of the villages is different, most likely due to the different parochies working in the villages.
AM hardly knows any organization. The officially and unofficially acknowledged leader is Senor Roque: he and his son are inspetor de quarteirão . Their task is roughly the same as a policemen. The inspector, who does not earn anything, is appointed by the Prefeitura. Senor Roque is the contact person between Capão Bonito (C) and the village. When the community has to make a decision a meeting is called. Senor Roque explains the problems and possibilities and a voting takes place.
FdM is a well organized village. The most important commission is the Conselho , of which everyone of the community is a member. Important decisions are made by the Conselho. There are subcommissions of the fathers, the mothers, the young ones, the water, the football etc. These subcommisions talk about the problems and interests of the community. Every month these subcommissions report to the Conselho about their activities and progress.

6.9 Daily life

The division of work is traditional; the man works in the fields. the woman takes care of all the domestical services, raises the children and assists when needed on the field.

Alimentation is every day very similar. Breakfast is a piece of bread with sweet coffee. Lunch and dinner consist of beans and rice with farinha , sometimes accompanied with some porkmeat or a little bit of vegetables. In most families both cooking range, stoked with dead wood and gascooker are used to prepare the meal. Three materials are being used to construct houses: pau-a-pique, taboa and bricks. The cheapest is pau-a-pique, a frame of bamboo filled up with clay. Taboa, board of less than one centimetre thickness, is somewhat more expensive. The construction of houses with bricks is expensive because these bricks have to be transported from the city. The roof of all houses is made of tilings, however this roof does not protect well against rain and hail. The floor is made of tamped earth or bricks.
The most practiced religion is Catholism. The number of Protestants is very small.

7 WATER

7.1 Water sources

7.1.1 Apiaí-Mirim

Four different kinds of water sources are being used in AM: spring, well, river and rain water. The communal spring is the most important water source as can be seen in table 14. Sometimes people use several sources for different purposes.

Table 14 Numbers and percentages of households which use a particular water source.

	Numbers	Percentages
communal spring	24	38%
private spring	6	10%
well	8	13%
several sources	25	39%

In AM six springs are used; one spring is communal, the other five are private. The springs are all unprotected. Most are not more than a hole in the ground. The diametre is about 60 cm and the depth ranges between 40 and 60 cm.
Even in times of little rainfall there is always a sufficient quantity of water.
The surroundings of the springs are very muddy; wastewater of rinsing and cloth washing is thrown away nearby, children play there and cattle and fowl can reach the springs unhindered. Only one private spring is cleaned once a week.
The communal spring is used by the majority of the households (77%), of whom half use it as their only source for general home-use.
Especially as drinking water, the water of the communal spring is highly appreciated. The water is very cold and is considered to be clean. This spring is situated at the end of a slope. Rain water running off the hill can enter the spring.

There are six traditional dug-wells. The depth ranges between 15 and 30 metre and the diametre of the wells is about 1 metre. All the wells have an inner lining of the upper part of 2 metres. The well-lining is extended to 1 metre above the ground. Only one of the wells has an apron of bricks lined with cement , the others lack any kind of apron. All the wells have a wooden cover. However these covers do not protect well against dirt. The water is drawn with pulley, rope and bucket. According to the users the waterlevel in the wells tends to drop in the hot season. During the investigation one well fell dry. Any kind of cleaning of the wells has not been observed. Two households said to chlorinate the water, one once a week. the other once a month. Only a quarter of the households use well water, of whom the half use it as their only source for general home-use.

The river São José is about 5 metres wide and the depth reaches 2

metres in the middle. The city Guapiara (8000 inhabitants, 15 km upstream) discharges its sewage in this river. The river is being used to wash clothes, to bathe and to wash slaughtered animals. When it rains however, the river rises to three or more times its normal width and becomes very turbid. Washing and bathing is then impossible.

Rainwater is hardly used. Only three women said to collect rain water, simply by storing water running of the roof into a basket. Two women used it only to wash clothes, the other also for drinking water.

7.1.2 Ferreira dos Matos

The majority of the households has a piped water supply, constructed by themselves, as can be seen in table 15.

Table 15 Numbers and percentages of 107 households with or without piped water in FdM.

	Numbers	Percentages
Piped water:	87	81%
-tap in the house	47	44%
-tap outside the house	40	37%
No piped water:	20	19%
-neighbour	11	10%
-reservoir or pipe outside yard	4	4%
-direct of spring	5	5%

There are 26 different water sources: 21 springs supplying 97 households with water, 4 wells serving 9 households and a little river providing 1 household.

Four springs are localized near the house. These are not or bad protected. Animals (cows, pigs, goats, chickens) can reach the springs easily. The other 17 are situated in the wood.
Spring captation is made by building little dikes and digging holes or installating a water-reservoir of concrete. These springs are only protected by the natural environment. In some cases a little canal is dug around the dikes to catch the rain water streaming of the hills preventing the water entering the reservoir.

The wells are not deep; the depth is about 3 metres. The diametre ranges between 1 metre and 1½ metre. The well-lining is made of concrete, but none of the wells has an apron. Three wells are supplied with a cover of concrete, the other has a shed of roofing tiles. This shed does not protect the well against dirt.
Three little rivers cross FdM. The depth is at most half a metre and the width 1 metre. Some households wash there clothes in the stream, but no one takes a bath here. Pigs, goats and chicken walk freely around.
Only when it is very dry, there is a shortage of water.

7.2 Water use

7.2.1 Apiaí-Mirim

Water drawing
Drawing of water is a task of women and children, however there are men who assist their wives with drawing water. The water is transported on the head in a plastic bucket or a tin, which ranges from 5 to 20 litres. Most women carry per journey 20 litres. The hygiene practices show a wide difference. At the spring some women rinse their bucket, others do not. Sometimes they place their bucket at some metres of the spring and fill it with a little scoop e.g. a bowl. The area around the spring is often very muddy and slippery. Therefore it is very difficult to kneel and fill the scoop. Often the children playing at the spring help the women filling the bucket.
The distance to walk for drawing water ranges between 30m and 800m.

Choice of water source
Private water sources are in general only used by relatives and friends. Old and pregnant women are often allowed to use the closest water source. There are five households who prefer drinking water from the spring instead of the closest water source. The taste of the water is the alleged reason for prefering this water.

Drinking water
Water is stored in the same vessel used for drawing. Often this vessel is also a drinking water storage. The most common drinking water storage container is a 20 litre tin or plastic drum. A clay pot with a narrow neck, pote , holding about 7 litres and a filtro, a little container which holds 5 litres and contains a filter are also used (for percentages see Appendix 8).
In the majority of the houses (58%) the drinking water storage container is not covered. The women said to clean the container three times a week or more, some just by rinsing, others by scouring with soap.
Water is drawn from the storage container with a cup. This cup is used by everyone to drink and is seldom cleaned. Only in case of a filtro the water is tapped.
Two households chlorinate the drinking water. Three women said to boil the drinking water for someone who is ill.
Half of the households take drinking water with them to the field. The others use whatever kind of source available.

Personal hygiene
As with any population group there is a considerable range of hygienic practices and habits and these can only be considered in the most general terms.
In summer personal washing is far more frequent than it is in winter. In summer a great number of persons take a bath every day; in winter the mean is about two or three times a week. The use of soap is common.
A lot of women told that after working on the field the members of the household often do not take a bath because they are tired. For this reason they tend to wash themselves less. Children generally take more baths than their seniors. It was noticed that little children took a bath almost every evening.
River bathing is a widespread practice. In general women tend to

take more often a bath at home, while men and children use the river. There are no different washing places for both sexes. Men and children use shorts when taking a bath in the river, women use short and shirt or a skirt.
Only two households have a shower. Water for these showers is manually collected.

Cloth washing
Most women wash their clothes in the river. The clothes are given a thorough scrubbing with soap on the rocks and are rinsed in the river water. The river is difficult to reach, because the path is steep. The women have to wash with a bended back. When it is not possible to wash clothes in the river because of rain fall, the women wash the clothes on a little bench nearby the communal spring. All the wastewater is thrown away at the same spot close to the spring.
Some women have a tanque for washing clothes in the yard. It is difficult to use this tanque without a water source nearby; cloth washing requires a great amount of water.

7.2.2 Ferreira dos Matos

Transport of the water
Almost all the water is transported voluntario (by means of terrestrial gravitation), by an electric bomb or a burrinho (way of bombing water with help of the gravitation of the water) by pipes. Sometimes there are problems; the bomb burns through, the burrinho stops functioning or the pipe is clogged by dirt.
Before entering the house, the water is often stored in a reservoir of concrete (200 or 500 litres). One pipe may provide more houses. When a household needs water, the pipe from the house is connected with the pipe from the source.
There are however, 20 households who have to take the water to the houses in buckets or tins. The distance to walk varies from 5 to 300 metres.

Choice of water source
Previously the people of FdM used the water of the three little rivers. Later they searched other sources, because of the bad quality of this water. The criterea for using a water source are the quality (taste, colour, cleanliness), the quantity and the distance. The choice of a certain water source is also influenced by family-relations.
Recently 11 households searched for another source because of the distance and difficult access. To repair or to control something they had to walk a few kilometres.
Nowadays few people think the quality of the water isn't good.

Drinking water
Most households use a filtro to store the drinking water. A pote or a bucket is also common. The others take the drinking water directly from the tap or the pipe in the yard or store the drinking water in the refrigerator (for percentages see Appendix 8). In the majority of the houses (62%) the storage container is covered.
Half of the women said to clean the container every day with water, soap or sponge. The others cleaned it less, using water, soap, sponge, sugar or salt.
Six households chlorinate the drinking water sometimes; four households boil the water before drinking it.

On the fields more than half of the households use water of a spring or little stream on the fields for drinking, the others take water from their houses. This depends also on where the fields are situated. Sometimes there is no water available.

Personal hygiene
In FdM more households than in AM have a shower (42%). The others take a bath in the bacia (wash- bassin) at home. No one uses the river for bathing. Most people take a bath almost every day; the others two or three times in a week. After working at the fields the people always take a bath. Use of soap is common.

Cloth washing
Half of the households have a tanque for cloth washing in the yard. The others wash clothes in the bacia or in the river.

7.3 Water quantity

In AM data on water collection were obtained by observing the communal spring for two days. Records (see Appendix 4) were registered of 54 household-days of water collection.
The total amount of water drawn was 2701 litres, used by 274 persons which gives an average of 9,9 litres per capita per day (excluding water for cloth washing). The analysis of the water quantity is difficult because of the highly skewed nature of this distribution (see also Appendix 9). An explanation of the extreme skewness of the data is that all families draw water for cooking and drinking and some also for bathing, animal watering and garden watering. During the household survey the women said to use 11,5 litres per capita per day.
Because of the piped water it was not possible to observe the quantity of water used per capita in FdM. Therefore this information was collected in the same way as in AM during the household survey. Unfortunately it was sometimes impossible to estimate the quantity, because some water reservoirs were only used for taking a bath or cloth washing and more households used the same reservoir. Therefore the next results are based on estimates of 39 households. Excluding cloth washing an average of 26,8 litres per capita per day was used; the minimum was 6 litres and the maximum 75 litres. Mostly the amount of water was not enough to grow vegetables in the garden.

7.4 Water quality

In order to relate water supply to health, it is necessary to assess the quality of the water consumed. The WHO Bacteriological Quality Guideline values for unpiped water supplies are 10 total coliforms per 100 ml and 0 faecal coliforms per 100 ml (WHO, 1984, p.19). For untreated piped water supplies the Guideline values are 3 total coliforms per 100 ml and 0 faecal coliforms per 100 ml.
According to Feachem et al. (1987, p.116) there is no correlation between the time of the day and the water quality.
In AM the samples have been collected on two different days: one rainy day in the afternoon and four days after rainfall in the morning. The results of the bacteriological water examinations are given in Appendix 10. During rainfall the water sources are heavily polluted, all the wells show more than 1600 faecal coliforms per 100 ml. Without rain the situation is somewhat better, but the pollution is still heavy. One explanation for the better quality of the spring is probably that having higher flows

it is flushed clean. The physical/chemical analyses did not show any problems. The turbidity was a bit raised, probably because of the rain. All other parameters were within the limits for well- and spring water intended for human consumption according to the Brazilian decree 12.486 de 20-10-78 (1987).
The data collected on the water quality between collection and use did not show an increase in pollution, which is in contrast with findings of Feachem et al. (1987, p.120) and Marseille and van Genderen (1985, p.81).
In FdM 24 samples were collected of all water sources, except a new well and the rivers. Where the samples have been taken can be seen in Appendix 8 , showing the results. The water sources are less polluted in FdM than in AM. In FdM are 6 water sources without any faecal pollution.

7.5 Conclusions and discussion

The two villages have a different water supply system. In AM the women and children have to draw water from various water sources: spring, well, river and rain water. Most households use water from the communal spring. In FdM 81% of the households has a piped water supply, constructed by themselves. The water for these supplies comes from various wells and springs.
All water sources in AM would be condemned if WHO standards are applied. In FdM the situation is better; six water sources were without any faecal pollution. There was not noted an increase in pollution between collection and consumption of the water in AM.
The mean collection of water per capita per day is very low in AM, 9,9 litres. During the household survey the women said to use 11,5 litres per capita per day. In FdM an average of 26,8 litres per capita per day was used according to the women.
Chlorinating or boiling of the water is not common in both villages.
The most common drinking water storage in AM is a tin or plastic drum, while the filtro is more used in FdM. In FdM more storage containers are covered.
The people of FdM tend to take more bathes than in AM, probably because of the fact that more people in FdM have a shower.

From the Water questionnaire a good impression was obtained about what kind of water sources are used and for what purposes and the daily amount of water used per capita. However it was not possible to estimate the quantity of water used for different activities. Only the total amount of water could be estimated. By observing the communal spring in AM the water consumption figures obtained during the interviews were confirmed. However to get exact data, more observations are needed.
The water analyses give a reasonable impression of the quality of the water. Unfortunately the number of samples was limited. Especially for measuring the pollution between collection and consumption of the water more samples are needed.

8 SANITATION

8.1 Excreta disposal systems

The majority of households in both AM and FdM owns an excreta disposal system, as is represented in table 16. AM also has a communal pit latrine, which is situated near the UBS.

Table 16 Percentages and numbers of households with and without an excreta disposal system.

	Apiaí-Mirim		Ferreira dos Matos	
	63 HH		107 HH	
	Perc.	No.	Perc.	No.
with e.d.s.	70	44	86	92
without e.d.s.	30	19	14	15

Excreta disposal systems consist of off-site and on-site technology.
The off-site technology used in both villages is the pit. This dug pit measures about 1,2x1,0x3,0 M, which accomodates the wastes of a family of five persons during a 3-4 year period (Pacey, 1978). These pits are usually dug by the men of the family.
All the pits are sited at an adequate distance downstream from any watersource.
During the investigation three latrines in AM stopped functioning because rainwater had entered the pit.

The part of the latrine above the soil is the on-site technology. In the villages the superstructure is made of any kind of material: board, tin, plastics etc.
During the investigation the superstructure of two latrines in AM was blown away.
The local costume is to squat during defaecation. However the population has started to use water seals (see table 17).

Table 17 Percentages and numbers of households with squating plate or water seal.

	Apiaí-Mirim		Ferreira dos Matos	
	63 HH		107 HH	
	%	No.	%	No.
squatting plate	64	40	74	79
water seal	6	4	12	13

The squatting plate is made of timber, earth or, in a few cases, concrete. The shape of the opening is a square. Footrests are not provided. In a few cases a cover of the hole is available.

In general the squatting plate is made by the men of the family. In only a few cases the squatting plate has been constructed by the carpenter.
Only a few households have a water seal, partly because of the high costs. In AM the absence of piped water is also a problem. In AM only two of the four water seals are being used; the water for the water seals is manually collected. Any problems with the functioning of the water seals in AM and FdM has not been reported.
Most of the water seals are installed by a carpenter.

In AM more households than in FdM do not have an excreta disposal system. Of the 19 households in AM without an excreta disposal system, 7 use the latrine of their neighbours, 2 use the communal latrine and 10 households do not use any facility at all. Of the 10 households in FdM who do not have a sanitation facility, 5 use the latrine of the neighbours, the others use the yard or the bushes. The reasons for not having a sanitation facility are written in Appendix 11.
In both villages there are no sanitation facilities on the fields, mainly because of practical reasons. For instance they work on different fields.

8.2 Use of the sanitation facilities

In AM 44 facilities have been inspected, in FdM 33 because the women were less willing to show the facility.
In AM the condition of the squatting plates showed great difference. It was found that about a quarter of the squatting plates were filthy with faeces, rubbish or soiled paper. Although almost half of the women said that there were rats, mosquitos or flies in the latrines provided with a squatting plate, this was not noticed. Almost half of these latrines did not give enough privacy to the occupant. Often the walls and doors consisted of plastic bags and in some cases there were no doors at all.
In FdM the overall condition of the latrines provided with a squatting plate was better, although the women said there were problems with rats, mosquitos or flies and sometimes the latrines were flooded during rain.
In AM the women cleaned the squatting plates by throwing water, sometimes with soap, and sweeping this into the squat hole. Seven squatting plates were never cleaned. One woman didn't find it necessary, the others said it was not possible, because the squatting plate was made of earth.
In FdM in case of timber squatting plates, water and a broom were used, while earthen squatting plates were cleaned by strewing earth. Four women said it was not necessary to clean the squatting plate. Very rarely the husband or sons helped the women cleaning.
Both in AM and in FdM the water seals were clean. The women cleaned them regularly with water, desinfectant or broom. There were no problems with mosquitos, flies or rats.
About half of the mothers in both villages start teaching their children to use the latrine when they reach the age of 2-3 years. Before using the latrine , the children use the napkin or defaecate in the yard. The other children do not use the latrine up till 5, 6, 7 or even 8 years. They defaecate in whatever kind of place: yard, bushes etc. In FdM many mothers remove the faeces of the children to the latrine .
Older people prefer to use the squatting plate, younger ones the

water seal.
At school in AM the latrines are provided with a squatting plate. These latrines are hardly used. When the children need to defaecate they go to their houses. Why they do not use the pit latrines, is not clear.
The latrines at school in FdM are being used, these are provided with water seals.

8.3 Personal hygiene
The majority of the households in AM and FdM use hygienic paper, a journal or a piece of cloth for anal cleaning. More persons in FdM than in AM use this kind of cleansing material as can be seen in table 18.

Table 18 Used sanitational cleansing material in percentages.

	AM	FdM
paper, cloth	63%	93%
leaves, maize cobs	37%	7%

In most cases people had to take the cleansing material to the facility. After use the cleansing material is thrown into the latrine in the bushes or is collected in a dishrack and burnt afterwards.
In AM more people said to wash hands with soap after defaecating as is shown in table 19.

Table 19 Percentages of children and adults washing the hands with soap after defaecating.

	AM		FdM	
	children	adults	children	adults
always	38%	52%	30%	35%
sometimes	34%	36%	40%	38%
never	29%	18%	30%	27%

8.4 Conclusions and discussion
The majority of the households in AM and FdM owns an excreta disposal system; however in AM are more households without a sanitation facility than in FdM.
In both villages the pit is used as off-site technology for the excreta disposal systems.
The local costume is to squat during defeacation. For this reason the squatting plate is mostly used in both villages. However, especially in FdM, the population has started to use water seals.
In FdM the sanitation facilities are better constructed.
When the children defaecate in the yard the mothers in FdM remove the faeces of the children to the latrine.
In AM adults and children tend to wash their hands more often with soap after defaecating.

Before starting with part 2, Sanitation of the household survey the researchers had doubts about the willingness of the people to

answer questions about their hygienic practices and use of the sanitation facility. However, although some women showed a bit of shyness, most answered the questions frankly.
Some doubts exist nevertheless about the honesty of some answers. In most of the houses there was not a wash bowl ready for use. It seems logical, that a lot of people, children especially, find it tiresome to look first for soap and water to wash their hands, although they may like to do it.
Sometimes the women were ashamed to show the sanitation facility.

9 HEALTH

9.1 General health situation

In AM the UBS has been functioning since March 1986, in FdM since April 1987. These Health Units do not only cover village people but also people from neighbouring communities. The total amount of potential visitors in AM is 2000. In February of 1987, 500 persons visited the UBS.
In FdM about 500 persons have visited the UBS between April and September 1987.
The most important reason for visiting the UBS are diarrhoea, helminthiasis, influenza and respiratory problems.
When a person in AM gets ill, he or she usually goes to the UBS to ask for a medicine. The people in AM use a lot of medicines. In FdM the situation is a bit different. Not everybody makes use of the UBS; some people buy their medicine directly at the drugstore or visit the physician in Capão Bonito (C). When somebody is ill, a lot of people try to cure themselves by drinking curative tea. However in serious cases one always looks for professional help.

9.2 Faeces examination

Of the 286 inhabitants of AM, 276 participated in this investigation. Of these 276 persons, 98 (35,5%) were negative and 178 (64,5%) were infected with intestinal agents, 59 (21,4%) had more than one infection.
In FdM 475 faeces samples were examined of the population of 501 persons. Of these examinations 260 (54,7%) turned out negative and 215 (45,3%) were infected with intestinal agents, of which 25 persons (5,3%) had more than one infection. The results are presented in table 20.

Table 20 Number and percentages of the prevalence of infectious agents in AM and FdM.

	AM		FdM	
Infectious agent	No.	%	No.	%
Ancylostomidae	1	0,4	6	1,3
Ascaris lumbricoides	115	41,7	95	20,0
Endolimax nana	17	6,2	7	1,5
Entamoeba coli	57	17,5	25	5,3
Entamoeba histolytica	2	0,7	1	0,2
Giardia lamblia	28	10,1	70	14,7
Hymenolepis nana	3	1,1	0	0
Strongyloides stercoralis	8	2,9	3	0,6
Taenia sp.	3	1,1	4	0,8
Trichuris trichiura	12	4,3	4	0,8
Negative	98	35,5	260	54,7

A short description of the identified infectious agents is contained in Appendix 12.
The worms and protozoa were statistically tested on their prevalence with the X^2-test (α=0,05). The results are presented in table 21.

Table 21 Statistical results of the prevalence of worms and protozoa.

Significantly more prevalant in AM	Significantly more prevalent in FdM	No significant difference
E. coli		E. histolytica
E. nana		G. lamblia
Ascaris		H. nana
S. stercoralis		Taenia sp.
T. trichiura		Ancylostomidae

In Appendix 13 the results of the faeces examination are demonstrated per age group. Helminths and protozoa are most common in the age groups 1-4 and 5-15 years. Children play on the ground, often do not wash their hands after defeacating and for these reasons they have the greatest risk to become infected. In AM the children up to one year hardly suffer from infectious agents because they are still under the charge of their mother. In FdM none of these children were infected.

9.3 Diarrhoeal morbidity survey

Subject for this investigation were under fives.
In AM two children were unfortunately not included, so 41 mothers have marked the calender (see Appendix 6). The investigation has been done in June, the beginning of the cold season. According to the mothers this was not the season of diarrhoea. Of the 41 children, 21 (51%) did not have diarrhoea. The others had one or more days diarrhoea (not necessarily sequential) as can be seen in table 20.
In FdM all of the 61 children younger than five were included in this investigation which has been done in September.
Only five children had one or more days with diarrhoea (table 22); 56 (91,8%) did not suffer from diarrhoea.

Table 22 Recorded cases of diarrhoea in two weeks per under five years old child in AM and FdM.

DAYS WITH DIARRHOEA	0	1	2	3	4	5	6	7	8	9	>10
RECORDED CASES IN AM	21	7	3	3	2	2	1	0	0	2	0
RECORDED CASES IN FDM	56	3	0	0	1	0	0	0	1	0	0

The data of the diarrhoeal morbidity survey of AM and FdM are statistically compared with the X^2-test. In AM the incidence of diarrhoea is significantly higher than in FdM ($p<0,001$).
In 1982 Snyder and Merson estimated the annual morbidity rate for acute diarrhoea in the developing world. From 24 published studies about diarrhoea, the median annual diarrhoeal morbidity rate for children under five years of age was estimated as being 2,2 episodes/child. The authors do not give a definition of an episode. In the framework of this study one or more sequential days of diarrhoea are considered as an episode. In AM were recorded 28 episodes of diarrhoea in two weeks. In FdM this amount was 8. The median annual diarrhoeal rate for under fives in these villages is respectively 17,8 and 3,4 episodes/child, fairly greater than the rate found by Snyder and Merson.

9.4 The nutritional status of young children

Anthropometric measurements have been carried out with 41 children in AM and with 61 children in FdM, all between 2 months and 5 years of age.
There are various ways to present the results of anthropometric measurements. In the past the nutritional status of groups of children has been most frequently assessed by using a classification based on a deficit in weight for age. However weight for age has the disadvantage that it does not make a difference between acute and chronic malnutrition. Height for age and weight for height do not have this disadvantage. Height for age is an indicator of chronic (past) malnutrition. Weight for height is an indicator of acute (present) malnutrition, which can be associated with diarrhoea (Briscoe, 1986). For analyzing the data two methods are used. First the results of the measurements according to the Brazilian "Graphs for the accompaniment of growth and development" (Marquez, 1982) will be presented. These graphs

are contained in Appendix 7. Secondly data obtained with the MEP method will be shown.
The Brazilian anthropometric graphs are based on investigations in a suburb of the Great São Paulo with children of a high economic class. These graphs are statistically defined. The curve P50 is considered the average weight and height at a certain age of Brazilian children. The curve P10 refers to the limit under which a child is considered undernourished. Unfortunately this limit curve is only presented for weight for age and height for age and is not presented for weight for height. The graphs can be used up to five years old children and are different for males and females. Health institutes in Brazil use these graphs to see whether a child is undernourished. An undernourished child receives milk from the government untill its weight is above the limit curve P10.
From the Brazilian graphs the children under the limit curve P10 were counted, for weight for age as well as for height for age. The results are presented in table 23 for AM and in 24 for FdM.
Weight for age results do not show a difference in the two villages: 31,7% of the children in AM and 31,1% of the children in FdM has a weight considered far below the normal weight.
Chronic malnutrition tends to be worse in AM, 68,3% of the children have a height far below the normal height. In FdM this is the case with 60,7% of the children.

Table 23 Anthropometric results of AM in percentages, counted directly from the Brazilian graphs.

		MALE	FEMALE	TOTAL
WEIGHT FOR AGE	Under curve P10	37,5	28,0	31,7
	Above curve P10	62,5	72,0	68,3
HEIGHT FOR AGE	Under curve P10	75,0	64,0	68,3
	Above curve P10	25,0	36,0	31,7

Table 24 Anthropometric results of FdM, counted directly from the Brazilian graphs.

		MALE	FEMALE	TOTAL
WEIGHT FOR AGE	Under curve P10	30,6	32,0	31,1
	Above curve P10	69,4	68,0	68,9
HEIGHT FOR AGE	Under curve P10	52,8	72,0	60,7
	Above curve P10	47,2	28,0	39,3

In the MEP a method is outlined how to calculate whether a child is suffering of chronical (height for age) or acute (weight for

height) malnutrition. " A child whose height is less than 90% of the expected height for age is defined as 'stunted'. If it is less than 85% of the expected height, the stunting is severe.
If the weight of a child is less than 80% of the expected weight, the child is defined as 'wasted'. If it is less than 70% the wasting is severe."(Schultzberg, 1982)
The results according to the MEP method are listed in table 25 for AM and in table 26 for FdM. In both villages only one child had a height less than 85% of the expected height. Seven children had a height less than 90% of the expected height. According to these results only one child in both villages is suffering from chronic malnutrition.
The weight of a child has been compared with the expected weight for height. The expected weight is calculated from the Brazilian graphs by combining the weight for age and the height for age curve. In both villages there were no children with a weight less than 80% of the expected. According to these results are children with acute malnutrition nor in AM neither in FdM.

Table 25 Anthropometric results of AM, according to the MEP (X=percentage of the measured children).

		MALE	FEMALE	TOTAL
HEIGHT FOR AGE	X<85%	-	4,0	2,4
	85%<X<90%	25,0	12,0	17,1
	X>90%	75,0	84,0	80,5
WEIGHT FOR HEIGHT	X<80%	-	-	_
	80%<X<90%	12,5	12,0	12,2
	X>90%	87,5	88,0	87,8

Table 26 Anthropometric results of FdM, according to the MEP (X=percentages of the measured children).

		MALE	FEMALE	TOTAL
HEIGHT FOR AGE	X<85%	2,8	-	1,6
	85%<X<90%	8,3	16,0	11,5
	X>90%	88,9	84,0	86,9
WEIGHT FOR HEIGHT	X<80%	-	-	-
	80%<X<90%	13,9	28,0	19,7
	X>90%	86,1	72,0	80,3

9.5 Conclusions and discussion

Faeces examination showed the prevalence of 10 different worms and protozoa in both villages.
In AM there was a significant higher prevalence of Ascaris lumbricoides, Endolimax nana, Entamoeba coli, Strongyloides stercoralis and Trichuris trichiura has been registrated.
Of the 276 inhabitants of AM who collaborated, 98 (35,5%) were negative and 178 (64,5%) were infected of which 59 (21,4%) had more than one infection. In FdM 475 samples were examined. Of these examinations 260 (54,7%) turned out negative and 214 (45,1%) were positive of which 25 (5,3%) persons had more than one infection.
In AM the diarrhoea incidence is significant higher compared to FdM. In AM 49% of the children had one or more episode of diarrhoea. In FdM only 8,2% of the children had one or more episode of diarrhoea.
Snyder and Merson estimated from 24 published studies the annual morbidity rate for acute diarrhoea for under five year old children in the developing world as 2,2 episodes per child. For AM an annual morbidity rate for acute diarrhoea of 17,8 episodes per child is calculated, in FdM this rate is 3,4 episodes per child.
The results of the anthropometric measurements are difficult to interpret. According to Brazilian graphs for measurement of nutritional status 68,3% of the children in AM and 60,7% of the children in FdM suffer from chronic malnutrition. According to the MEP only 2,4% of the children in AM and 1,6% of the children in FdM suffer from chronic malnutrition. According to the MEP the acute malnutrition, which is associated with diarrhoea and thus with water and sanitation suplies, does not exist in both villages.
It seems clear from the results mentioned above that the health situation related with water and sanitation conditions is worse in AM. However this does not indicate that the health situation in FdM is optimal. Diarrhoea incidence is higher compared with results of other studies (Snyder,1982). Also 45% of the population is infected with worms and protozoa.

The faeces examinations worked out very well in both villages. Although a lot of people where shy in the beginning, almost everyone participated and the response was in both villages more than 95%. A prerequisite to get this kind of response is a house to house distribution and collection of the trays: it makes it much easier for the people to cooperate. Also the house to house distribution reduces the chance of confusion. This investigation has given a good impression of the prevalence of parasitic agents. However, for an accurate assessment of the prevalence of worms and protozoa the investigation has to be repeated several times. Eggs and worms are not secreted each time, when someone defeacates. Consequentely this investigation is an underestimation.
The diary-assisted recall method has succesfully been applied. There are no reasons to believe the calender was not marked correctly. The house visits after 3 and 7 days were very important for 2 reasons. First to solve the problems with marking the calender and second to show to the mothers the importance of marking the calender correctly. Maybe there was no total agreement on the diagnosis of diarrhoea due to the lack of a common definition. The incidence of diarrhoea depends on the season. According to the mothers the incidence is higher in the

hot season. The different periods in which the diary-assisted recall method has been applied, the beginning of the cold season in AM (June) and the end of the cold season in FdM (September), do not seem to have influenced the results.
The number of children in the diary-assisted recall method is small. Therefore the children were not divided in age groups. It would have been difficult to make reliable statistical analyses.
Anthropometric investigation is easy: the measurements require little equipment, can be applied by persons with a minimum of training and the problems related to definition of morbidity and recall are eliminated. However the association between nutritional status and diarrhoea can be influenced by many other factors besides water supply.
The results of anthropometric measurements can be interpreted with help of different methods. There is a big difference between the Brazilian and MEP standards. According to the MEP only 2,4% of the children in AM and 1,6% of the children in FdM suffers from chronic malnutrition. None of the children suffer from acute malnutrition. Only by looking it could be noticed that some children suffered of chronic malnutrition: they were small and skinny and often reacted apathatic. It seems that MEP norms should be adapted.

Appendix 1 The Projeto Saneamento Rural

Introduction
The Projeto Saneamento Rural is a national program, which will be executed per state. The project aims to help the population in rural areas to obtain "Clean water and sanitation adequate for all, by the year 1990", goal of the International Water Decade.

Objectives
The main objective is to improve the health standard of the rural population. The specific objectives are to improve the quality of the consumed water and to isolate human faeces, to impede their contact with water and provide an adequate disposition for them (CETESB, 1987, A). During the implantation there will be a continious control of the quality of the systems. After some years there will be an evaluation of the implanted systems.

Organization
For the State of São Paulo the project is a cooperation of:
- Secretaria de Obras e Saneamento (DAEE, SABESP)
- Secretaria do Meio Ambiente (CETESB)
- Secretaria da Saúde
- Prefeitura Municipal
- Local community.

Apiaí-Mirim
The Projeto Saneamento Rural in the State of São Paulo is still in its infancy. Apiaí-Mirim is the first community that will receive assistance of this project. The first phase is the construction of an improved water supply. A well with a depth of 150 m and a diametre of 150 mm has been drilled by DAEE. An electric pump is going to produce 3,0 m^3 water per hour, 20 hours a day. This water will be directly transported to the houses by means of PVC pipes. The water which is not used immediately will go to a reservoir of 50 m^3, located at the highest point of AM. The water will be chlorinated and fluorized (CETESB, 1987, B).
Every house in the nucleus is going to receive a connection with this piped water, up to the privat ground for free. The connention to the house and the distribution in the house the owner has to construct himself. At first everybody is going to pay the same price for the water Cz$ 32,90 (US$ 0,71) per month, independent of the amount used. After a while a metre will be installated. Up to 10 m^3 per month consumed will cost Cz$ 32,90 (US$ 0,71). Above this amount consumed a progressive pricetable is used. For example 15 m^3 will cost Cz$ 68,25 (US$ 1,48) and 20 m^3 will cost Cz$ 103,60 (US$ 2,25) (SABESP, 1987).
By DAEE the present population was estimated at 360 inhabitants. According to them this number will be doubled in the year 2000 (CETESB, 1987, B). The capacity of the well is sufficient to supply the village with water till the year 1996/1997. These calculations are based on a consumption of 100 litres per capita per day. Then a second well will be perforated, with identical characteristics as the first one.
The people of Apiaí-Mirim are already waiting for a long time for the piped water. The well has been perforated two years ago. The water reservoir is laying for more than a half year unused and is rusty now. During this research SABESP was constructing a little house for chlorination and fluorization.
A month after this research was finished, the water supply was functioning. A person of the community had to be nominated to

control the water supply. Senor Roque, the leader of AM was asked for a capable person to do this job and so his son-in-law got the job, while other people were probably more capable. Once in two days samples are taken to control the quality of the water.

Ferreira dos Matos

Ferreira dos Matos is next on top of the list to receive treated piped water. A place to drill the well is already chosen, but the construction of the pipes is detaining. However the people of FdM keep on struggling to achieve piped water. Every two months the water committee of FdM pays a visit to SABESP and they have send the results of the water samples to the government and SABESP.
In FdM was asked what women thought was better/liked more: a pit latrine or a w.c. This because there were several options within the project to improve the sanitation facilities. The mentioned advantages and disadvantages are written in the next table.

Table 1 Mentioned advantages and disadvantages of the w.c. and the pit latrine.

	advantages	disadvantages
w.c.	better for the health	expensive
	more hygienic	needs more cleaning
	cleaner	needs sewage
	easier to use while raining	difficult to use
	easier to use at night	needs a lot of water
	easier to use at night	needs a lot of water
	easier to clean	more for young people
	easier to use	
pit latrine	cheaper	bad smell
	doesn't need cleaning	
	no defects	
	on a distance of the house	
	easier for children to use	
	used to a pit latrine	

Opinions about piped water

The women in AM and FdM were asked about their opinion of the piped water. Most women were very anxious to receive piped water, because it makes life much easier. However the money to pay for the water is sometimes a problem. At the moment the price is rather low, but what will happen in the future with the prices is uncertain because of the inflation. Another problem is that people have to pay monthly for the water and also for other things, but they don't receive money per month. A few women remarked that "Piped water is not cold and therefore not tasty". Also the taste of chlorine could be a problem.
Unfortunately these conversations were often very difficult. People had not thought about it and it was dificult to ask open questions.

Recommendations

This report is a result of an investigation as part of the Projeto Saneamento Rural of the Brazilian government. This project achieved already a water supply system in AM and conditions to provide a sewage system are available.
During the investigations the researchers were confronted with the

opinion of the inhabitants on water and sanitation supply. With these informations and experiences gained during the investigations recommendations for further projects will be made. This recommendations can not be simply replaced to every project, it will always be necessary to find the best solution for the problems in cooperation with the inhabitants of the villages. the project planners and executers. The different options have to be studied and the, according to all participants, best solution has to be chosen.

As mentioned before AM received piped water. Probably this is a good solution: women do not need to draw water anymore, the quality and quantity can be garanteed. However, there has not been an investigation to the ability of the people to pay for the water. A great disadvantage is the delay in the construction of a sewage system, the amount of wastewater will increase because of the new water supply. The waste water will not be captured and will run over the street. Instead of improving health the health condition could deteriorate.

It is a pity that it was not investigated if the existing facilities could be improved. In the case of AM it would have been a good intermediate solution. Instead of apathically waiting for three years that followed upon the news of a new water supply, the people could have been stimulated to improve their supply with financial help of the Project. For example the oil-drum, of the communal mina could have been replaced by a concrete construction.

The supply of a sanitation system should be carefully prepared. A w.c. does not always means the right choice. In case of AM and FdM an improvement of the existing, traditionel pit-latrines seems a good solution. Squatting plates should be made of reinforced concrete. This is strong enough to carry the necessary loads and is easy to clean. The latrine superstructure must be adapted to local preferences and to the materials available. By anchoring the superstructure at the four corners of the squatting plate by means of iron holders it can not be blown away easily during stormy weather.

An important point of consideration is the labour on the fields. Water and sanitation supplies are in most cases missing. An important part of the day villagers are working on the fields. so they can not use the supplies in the village. To this problem there is no easy solution: conditions. ability and willingness are missing.

Only good water and sanitation facilities do not improve health of the users. The utilization of the installations need to be correct. For this reason education has to be part of every water and sanitation project. Health assistents, teachers and local leaders can fullfil a very important place to increase the hygienic awareness.

Appendix 2

QUESTIONÁRIO PRELIMINAR

LOCALIDADE _____ DATA ___/___/___

ENDEREÇO _____

FAMÍLIA _____ RELIGIÃO _____ CAT. R1 ☐ PROT R2 ☐ OUTRA R3 ☐

CÓD	A. PESSOA DA FAMÍLIA	B NOME	C FAIXA DE IDADE (ANOS)	INSTRUÇÃO D. LÊ E	E. PRIM	F. SEC	G. TEM TERRA?	TRABALHA FORA ? H. ENTRES	I. MEEIRO	J. QUANTAS TARefas?	USA PRODUTOS QUÍMICOS L. ADUBO	M. VENENO
1	PAI											
2	MÃE											
31	FILHOS		0 - 4									
32			5 - 15									
33			> 15									
41	OUTROS		0 - 4									
42			5 - 15									
43			> 15									
5	T O T A I S											

CÓD	ESPECIFICAÇÃO	N SIM	O NÃO
6	GADO		
61	VACA		
62	CABRA		
7	CRIAÇÃO		
71	PORCO		
72	GALINHA		
73	PATO		
74	OUTROS		

CÓD	ESPECIFICAÇÃO	P SIM	Q NÃO
8	INSTALAÇÕES SANITÁRIAS		
81	POÇO PRÓPRIO		
82	FOSSA SECA		
83	WC		
9	ELECTRODOMÉSTICOS		
91	RÁDIO		
92	GELADEIRA		
93	TELEVISÃO		

APLICADO POR: _____

Appendix 3 Household survey

A. ÁGUA

ITEM / MANANCIAL			A. RIO	B. POÇO	C. NASCENTE	D. CHUVA (CISTERNA)	E. OUTRO
1 DE ONDE VEM A ÁGUA QUE USA?	1. TR.	1. BEBER; 2. COZINHAR; 3. TOMAR BANHO; 4 LAVAR ROUPA; 5 LAVAR LOUÇA					
	2. CS						
2. FICA LONGE? A QUE DISTÂNCIA?							
3 BAIXA NA SECA? FALTA ÁGUA?	1 MUITO 2 POUCO	3 NADA					
4. QUEM VAI BUSCAR A ÁGUA? QUANTAS VEZES POR DIA? QUE QUANTIDADE DE CADA VEZ? POSSO VER A LATA (O BALDE)?		1. HOMEM					
		2 MULHER					
		3 CRIANÇA					
		4. TOTAL					
5. É PROTEGIDO (A)?	1. SIM	2. POUCO; 3 NÃO					
6. A ÁGUA TEM	1. MAU CHEIRO?						
	2. GOSTO RUIM?						
	3 COR						
	4 MUITO BARRO?						
7. LÁ ONDE PEGA ÁGUA TEM	1 BICHO (INSETO)?						
	2. LIXO?						
	3. LAMA?						
8. QUE QUANTIDADE DE ÁGUA USA POR DIA PARA	1. BEBER?						
	2. COZINHAR?						
	3. TOMAR BANHO?						
	4. LAVAR AS MÃOS?						
	5. LAVAR ROUPA?						
	6 LAVAR LOUÇA?						
	7. DAR À CRIAÇÃO?						
	8. REGAR O JARDIM?						
	9. DESCARGA W/C?						
	10. TOTAL						
9. QUANTAS VEZES POR SEMANA TOMA BANHO?	1 PAI						
	2. MÃE						
	3. FILHOS						
	4. OUTROS						
10. ONDE É QUE (OS PRATOS)	1. TOMA BANHO?						
	2. LAVA A COMIDA?						
	3. LAVA A LOUÇA?						
	4 LAVA A ROUPA?						
11. EM QUE VASILHA GUARDA A ÁGUA DE BEBER?	1 POTE 2. TITICO						
12. TEM TAMPA?	1 SIM 2 NÃO						
13 QUANTA ÁGUA CABE DENTRO?							
14. ONDE PÕE A TALHA (O POTE, A BILHA)? POSSO VER?							
15 POR QUE ESCOLHEU ESSE LUGAR?							
16 COMO TIRA AGUA DA TALHA	1 CANECO 2 COPO						
17 USA CLORO NO POTE (NO FILTRO)?	1 SIM 2 NÃO						
18 FERVE A ÁGUA ANTES DE BEBER? ANTES?	1. SIM 2 NÃO						
19 DE QUANTO EM QUANTO TEMPO LAVA A TALHA?							
20 GOSTARIA DE TER ÁGUA DENTRO DE CASA (ENCANADA)?							
21. PAGARIA PARA ~~TER ESSE SERVIÇO~~?							

B DEJETOS & LIXO

ITEM	TIPO			A. MATO	B QUINTAL	C. RIO	D. FOSSA SECA	E. WC	F. URINOL
1. ONDE É QUE AS CRIANÇAS FAZEM AS NECESSIDADES?	1. ES 2 CS	1 INTERNO 2 EXTERNO 3 VIZINHO 4 PÚBLICO							
2 COM QUANTOS ANOS AS CRIANÇAS COMEÇAM A USAR? E ANTES?									
3. E OS MAIS VELHOS? E NO TRABALHO?	1. TR 2 CS	1 HOMEM 2 MULHER	1 INTERNO 2 EXTERNO 3 VIZINHO 4 PÚBLICO						
4 ONDE FICA? É LONGE? A QUE DISTÂNCIA?									
5 COM QUE É QUE LIMPA AS CRIANÇAS? E OS OUTROS USAM PRA SE LIMPAR?		O QUE	1 PAPEL 2 FOLHA 3 SACUGO 4 OUTRO						
6 O QUE FAZ COM O PAPEL (A FOLHA) O SACUGO ELE (A) USADO(A)?	1 JOGA NA PRIVADA 3 NA MATO 2 QUEIMA		4 NO RIO 5 NO LIXO 6 ENTERRA						
7 DEPOIS DE FAZER UMA NECESSIDADE LAVA AS MÃOS COM SABÃO? TODO MUNDO FAZ ASSIM?		1 HOMEM 2 MULHER 3 CRIANÇA	1 SEMPRE 2 ÀS VEZES 3 NUNCA						
8 POR QUE NÃO TEM PRIVADA?	1. NÃO 2. NÃO 3. NÃO TEM TEMPO P/FAZER 4 É MUITO CARO 5 OUTROS	É PRECISO SABE O QUE É/COMO FAZ	NÃO CARECE						
9 DESDE QUANDO USA PRIVADA?									
10 QUEM FOI QUE FEZ?			1. MARIDO 2. FAMÍLIA 3 GOVERNO 4. OUTRO						
11 JÁ DEU ALGUM DEFEITO? QUANTAS VEZES?									
12. A PRIVADA	1 TEM 2 TEM 3 DÁ 4 DÁ RATO? MOSQUITO? 5. INUNDA NA CHEIA? 6. AGRADA BEM O OCUPANTE? 7. É DIFÍCIL PRA CRIANÇA USAR	SUJEIRA? MAU CHEIRO? MOSCA?							
13 SE QUANDO EM QUANDO TEMPO FAZ A LIMPEZA?	1 SEMPRE 2 ÀS VEZES 3 NUNCA								
14 POR QUE NÃO FAZ LIMPEZA?									
15 QUEM FAZ A LIMPEZA?	1 MULHER 2 MARIDO 3 CRIANÇA								
16 GOSTA DE TER PRIVADA DENTRO DE CASA?			1 SIM 2 NÃO						
17 LIGA A POR ISSO			1 SIM 2 NÃO						
18 INCOMODA A FEDOR ISSO?			1 SIM 2 NÃO						
19 DÁ MOSCA EM CASA?	1 SIM 2 NÃO		3 MUITA 4 POUCA						
20 DÁ RATO EM CASA?	1 SIM 2 NÃO		3 MUITO 4. POUCO						
21 GOSTARIA QUE LEVASSEM EMBORA O SEU LIXO?			1. SIM 2. NÃO						
22. PAGARIA PARA TER ESSE SERVIÇO?			1. SIM 2. NÃO						
23 LIGAÇÃO À REDE ELÉTRICA?			1 SIM 2. NÃO						
24 POR QUE NÃO?									

Appendix 4 Protocol of water collection

FICHA DE COLETA DE AGUA

LOCALIDADE ____________ MANANCIAL ____________ PERÍODO ____________ DATA / / ____________ TEMPO ____________

CASA Nº	1	2	3	4	5	6	7	8	9	10
HORA										
VISITANTE										
LITROS										
HORA										
VISITANTE										
LITROS										
HORA										
VISITANTE										
LITROS										
HORA										
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VISITANTE										
LITROS										
HORA										
VISITANTE										
LITROS										
HORA										
VISITANTE										
LITROS										
TOTAIS										

C - COLETA

S - BANHO COM SABÃO

BANHO

Appendix 5 Example of water quality results

CETESB

BOLETIM DE ANÁLISES

COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

Nº DA OS 090600

Nº DA AMOSTRA

CLIENTE/PROGRAMA CONVÊNIO DAEE

ENDEREÇO

MUNICÍPIO Apiaí-Mirim - SP

COLETOR/CARGO Engº Luis Gustavo

LOCAL DA COLETA Vide procedência

MANANCIAL/ORIGEM - TRATAMENTO Bruta

CHUVAS NAS ÚLTIMAS 24hs ☒ SIM ☐ NÃO TEMPERATURA AMOSTRA - °C-AR - °C

ASPECTOS - ODOR

DATA E HORA DA COLETA 10.06.87 DATA ENTRADA NO LAB 20.06.87

Amostra Número	PROCEDÊNCIA	Hora	H.M.P. de Coliformes/100 ml		Contagem de Bactérias Heterotróficas
			Totais	Fecais	35°C 48 h
52749	Direto do poço raso da Avó Claudete- casa nº 9	09:45	≥1600	130	1100
52750	Direto do poço raso- Crente- casa nº 4 (coletado c/balde estéril)	09:51	≥1600	34	>6500
52751	Direto do poço raso- Crente- casa nº 4 (coletado c/balde da casa)	10:00	≥1600	500	>6500
52752	Direto do pote d'água (mina)-casa 47- D. Verônica	10:07	1600	<2	1400
52753	Direto do balde- D.Verônica- casa 47 (mina)	10:10	500	9	>6500
52754	Direto da mina (latão)	10:30	1600	21	1200
52755	Direto do balde- Dona Rosali- casa 42 (mina)	10:45	1600	50	1700
52756	Direto do poço raso- D.Ernestina- casa 40	10:50	≥1600	900	>6500
52757	Direto do balde- D. Clementina casa 1 (Poço da Família, casa 4	11:15	≥1600	13	>6500
52758	Direto do pote d'água- Dona Clementina- casa 1 (poço da Família, casa 4)	11:20	≥1600	12	>6500
52759	Rio Apiaí-Mirim (ponte)	12:00	≥1600	≥1600	>6500

OBSERVAÇÕES As amostras de nºs 52749 a 52758 acusam poluição; recomenda-se imediata proteção e desinfecção das unidades. Após tais medidas novos exames deverão ser realizados.

DADOS DE ANÁLISE BASEADOS NA 16ª EDIÇÃO DO "STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER" - APHA - AWWA - WPCF

Original Devidamente Assinado

20/7/87

Encarregado

1ª VIA - INTERESSADO (BRANCA)
2ª VIA - UNIDADE SOLICITANTE (VERDE)
3ª VIA - UNIDADE DE CONTROLE (ROSA)

33-10-1777/0

Appendix 6 Diarrhoeal morbidity calender

REGISTRO DE DIARRÉIA INFANTIL

LOCALIDADE _____ FAMÍLIA _____ PERÍODO ___/___/___ A ___/___/___

ENDEREÇO _____ NOME _____ IDADE _____

DIA		
1º		
2º		
3º		
4º		
5º		
6º		
7º		
8º		
9º		
10º		
11º		
12º		
13º		
14º		
TOTAL		

Appendix 7 Brazilian anthropometric graph

PRONTUÁRIO

Nº

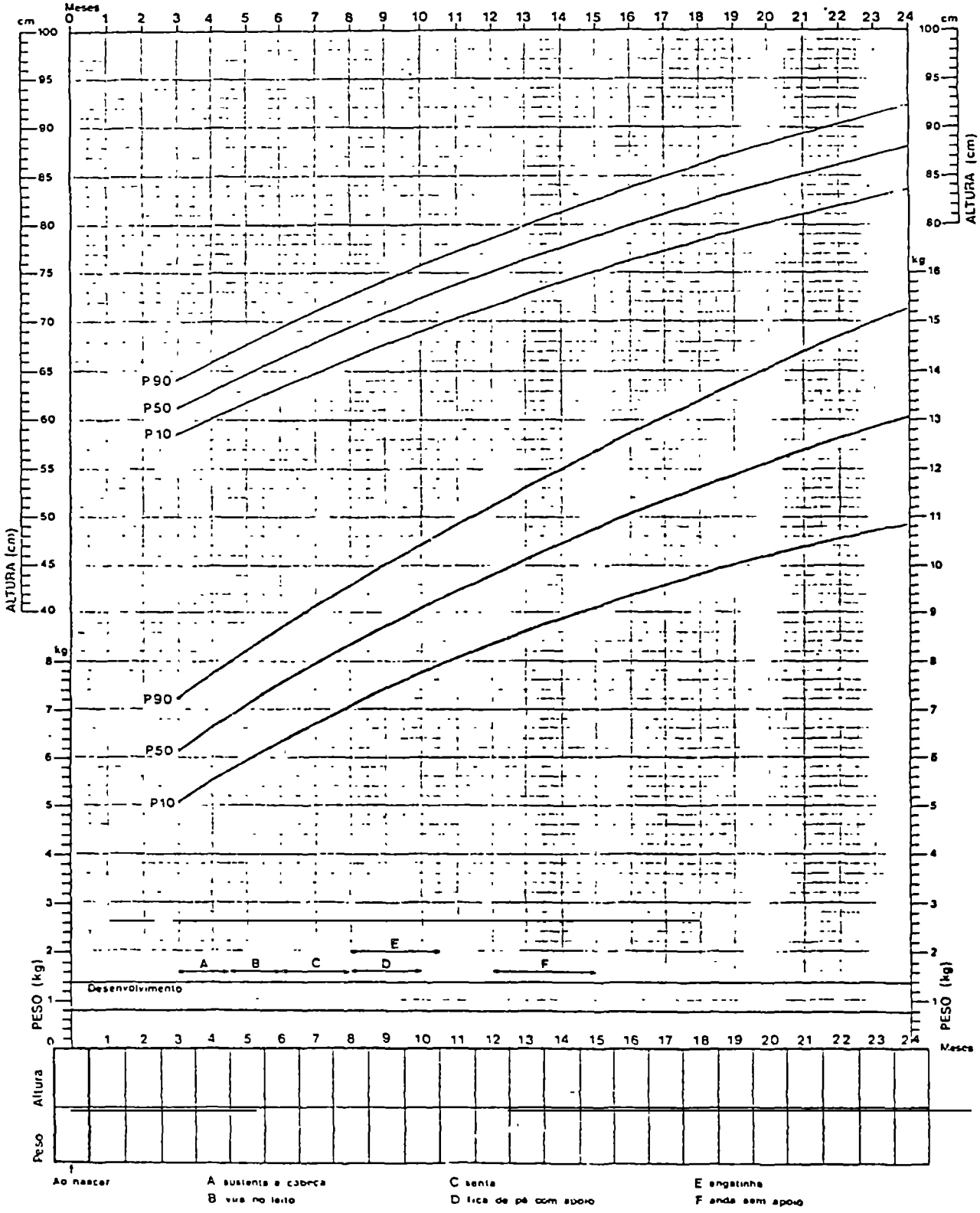
Secretaria de Estado da Saúde

Gráfico para acompanhamento de crescimento e desenvolvimento

Nome

Data do Nascimento / / Dados ao nascer: PESO (g) ALTURA (cm)

A TERMO | | semanas (37 a 42 semanas) PRE-TERMO | | semanas (<37 semanas) PÓS-TERMO | | semanas (>42 semanas)

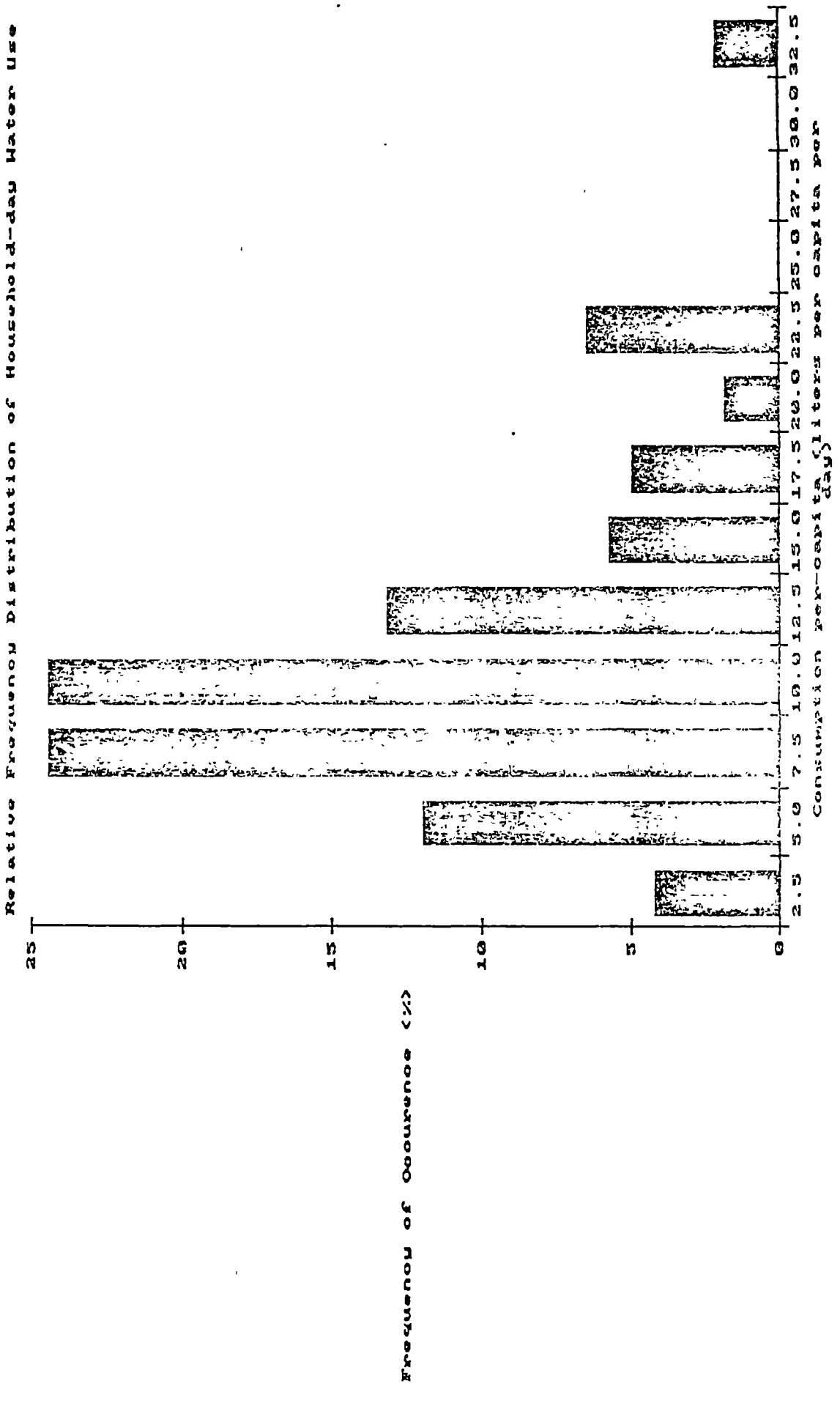


Appendix 8 Drinking water storage

Table 1 Kind of drinking water storage used in AM and FdM in percentages.

	AM	FdM
tinnen or plastic drum	47%	27%
pote	14%	18%
filtro	8%	42%
bucket used to collect the water directly from the tap	31%	0%
	0%	13%

Appendix 9 Analysis water quantity



Appendix 10 Results bacteriological water examination

Figure 1 Results of the bacteriological examination of water sources in AM on a rainy day (total coliforms/100 ml)

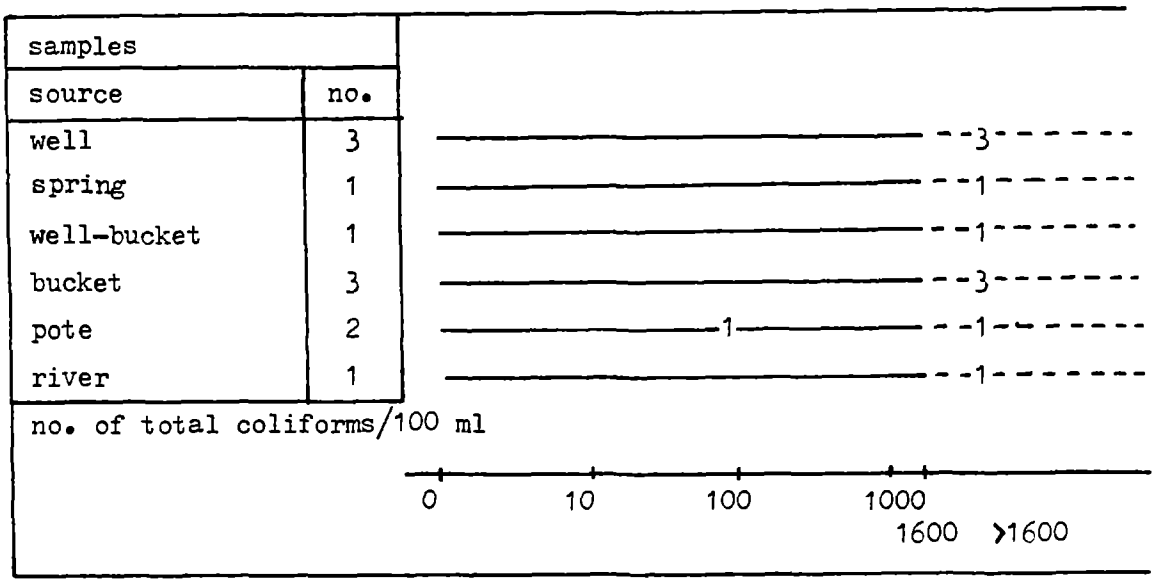


Figure 2 Results of the bacteriological examination of water sources in AM on a rainy day (faecal coliforms/100 ml)

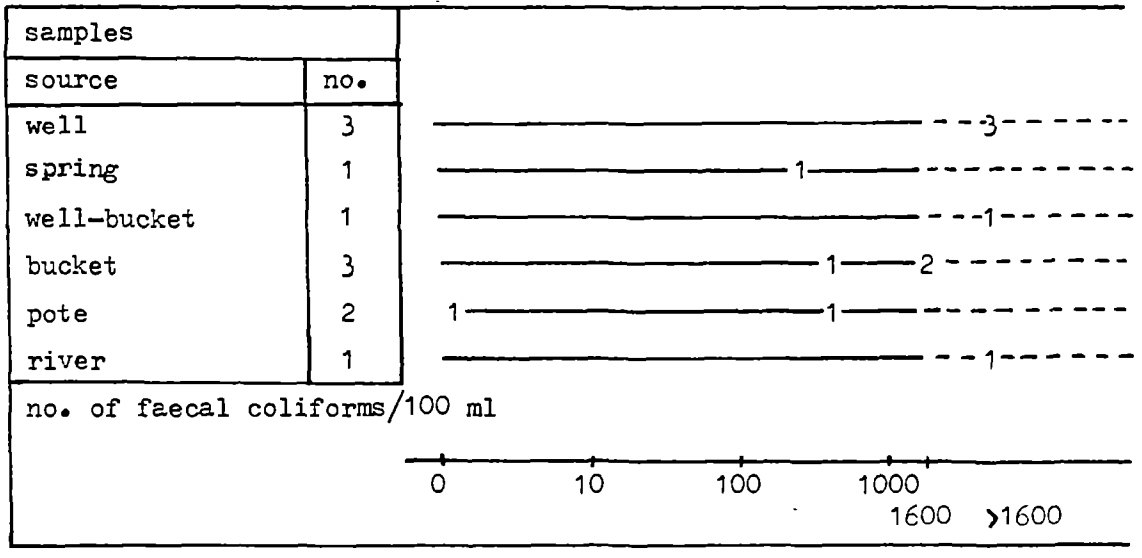


Figure 3 Results of the bacteriological examination of water sources in AM four days after rainfall (total coliforms/100 ml)

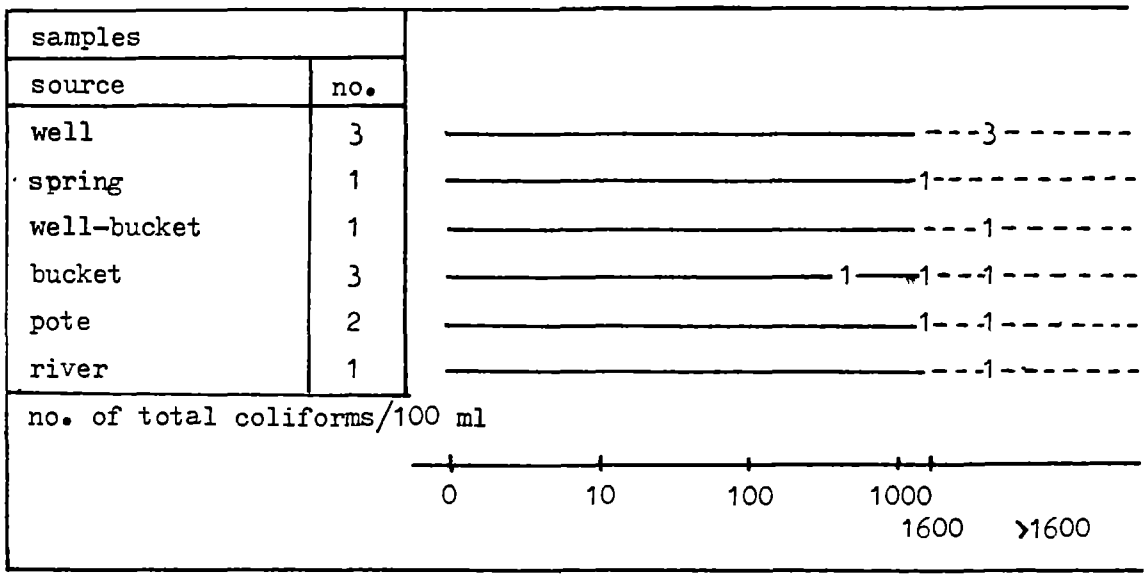


Figure 4 Results of the bacteriological examination of water sources in AM four days after rainfall (faecal coliforms/100 ml)

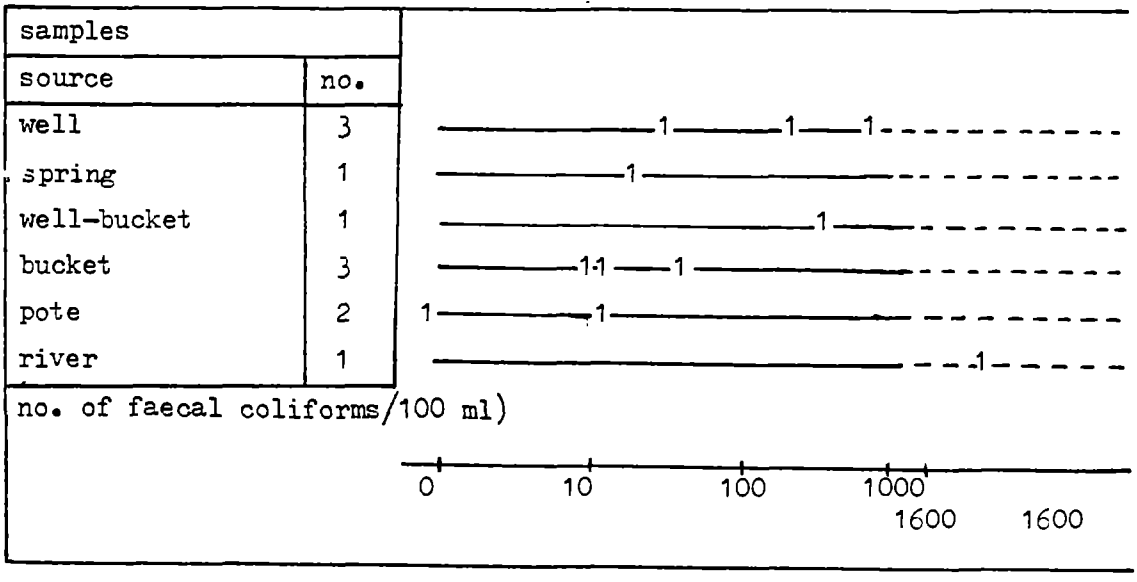


Figure 5 Results of the bacteriological examination of water sources in FdM (total coliforms/100 ml)

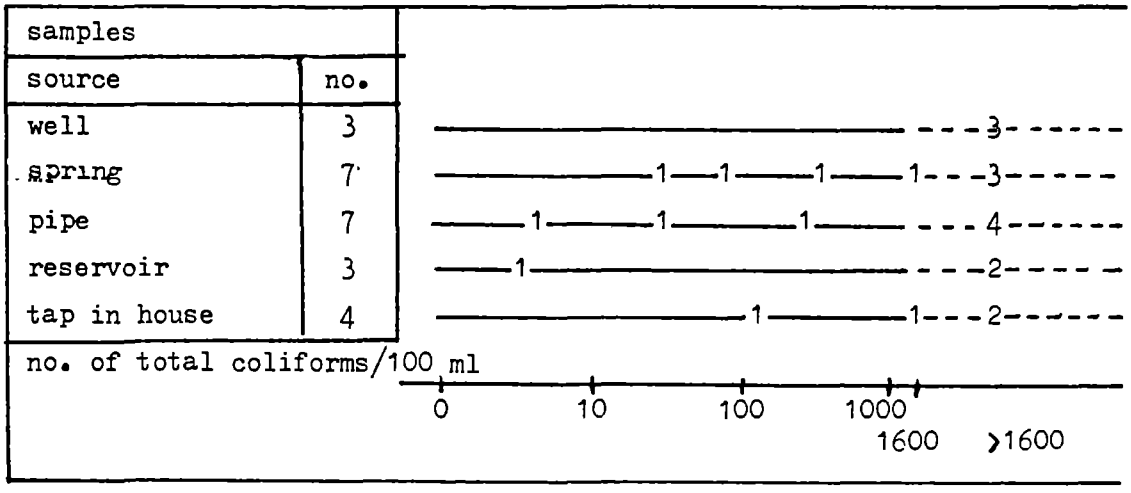
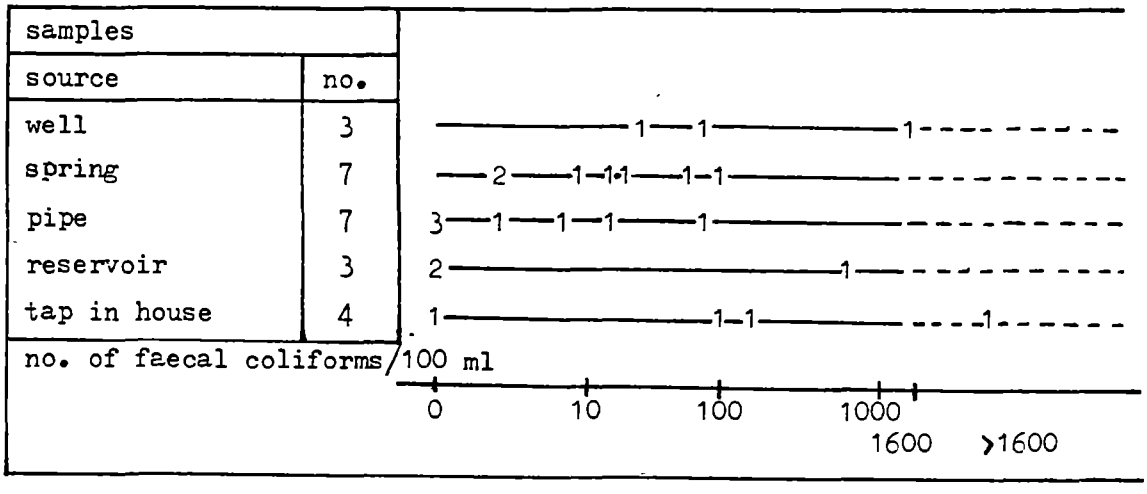


Figure 6 Results of the bacteriological examination of water sources in FdM (faecal coliforms/100 ml)



Appendix 11 Reasons for not having an excreta disposal system

Table 1 The number of times that a particular reason is given for not having a sanitation facility in AM and FdM.

Reason for not having a sanitation facility	AM	FdM
we do not need one	7	1
we do not have time to build one	3	4
we do not know how to construct it	2	0
it is too expensive	2	2
we do not have space to build one	2	3
we are waiting for piped water	2	0
others	1	0

Appendix 12 Description of infectious worms and protozoa

In this Appendix characteristics of the prevalent worms and protozoa in AM and FdM are presented. All the information comes from the book Manson's tropical diseases (1987).

1 Non pathogenic amoeba

Entamoeba coli
This protozo measures in active vegetative stage from 10 to 40 um. It normally lives in the large intstine, does not invade tissues but develops in intestinal contents where it ingests bacteria, yeasts and other material. E. coli is a very common parasite in the tropics and wherever sanitation is primitive it is propable that no individual escapes infection.
This amoeba does not invade tissues: it is therefore a non-pathogenic species and a harmless commensal in the intestinal tract of man.

Endolimax nana
E. nana is a small species, 6-12 um in diameter. It ingests food granules and bacteria commonly inhabiting the intestinal tract of man.
E. nana is certainly non-pathogenic and is not amenable to emetine.

2 Diarrhoea causing protozoa

Entamoeba histolytica
E. histolytica is a protoza which normally lives and multiplies in the contents of the large intestine in man but can under certain conditions invade the tissues and can spread from the bowel to the liver, lungs, brains, skin and other organs. E. histolytica is present in two forms: trophozoites, 10-40 um, and cysts, 9,5-17.5 um. Cysts are the only infective form.
Infections by cysts occurs most frequently by direct person to person transmission or contamination of food. Waterborne transmission is unusual.

Giardia lamblia
G. lamblia lives in the upper part of the small intestine particularly in the duodenum. The trophozoite is a pearshaped flagellate, 12 to 18 um in length. The cyst is formed in the lower bowel and may occur in large numbers in the stools. It is oval measuring 10.5X7.4 um. There is a wide spectrum of disease and spontaneous eradiction of the infection is the rule. About 20% of infections are symptomatic and in most cases cause an acute diarrhoeal illness subsiding after one or two weeks. Weakness, abdominal pain, anorexia and failure to thrive in children are important symptoms. Malabsorption of fat is common.
The source of inifection is children who excrete large numbers of cysts (adults excrete few cysts). The faecal-oral route is the usual method of transmission in edemic tropical areas. Also foodcontamination and waterborne transmission can occure.

3 Tapeworms

Tapeworms are long flat worms which inhabit the intestine of mammals. They have a head on top of a number of segments which absorb nutriment through the cuticle. They are hermaphroditic.

Hymenolepis nana

H. nana, also called the dwarf tapeworm, is 25-45 mm long by 0,5-0,9 mm. Development of larva to adult worm takes 16-17 days. Man is the only definite host and it has no intermediate host. Humans are the natural reservoir and infection is direct from human to human by faecal oral infection.

Light infection cause no significant damage but very heavy infections (over 1000 worms) are not uncommon in children and cause symptons. Clinical features in man are asymptomatic: fever, abdominal symptons and eosinophilia.

Taenia sp.

Beef is hardly eaten in the two villages. So we will only describe the Taenia solium (pork tapeworm).

T. solium has a length of 2-3 metres with 800-1000 segments. Infection with the adult worm is acquired from eating uncooked pork or ham. The eggs are passed out in man's faeces and eaten by a pig, the usual intermediate host.

The adult T. solium causes little pathology in the bowel.

4 Soil transmitted helminths

Soil transmitted helminths are intestinal nematodes of whose development takes place outside the body in the soil.

Soil transmitted nematodes are of great importance in the health of many populations in Third World countries where the frequency of infection is a general indication of the local level of development of hygiene and sanitation. These nematodes are usually found as multiple infections and measure against and treatment of one closely affect the others. They may be divided into three types according to their life-cycle.

Type 1 Direct. Embryonated eggs are passed with hatch and reinfect within 2-3 hours by being carried from the anal margin to the mouth and either do not reach the siol or, if they do, do not require a period of development there. Trichuris trichiura (whipworm) is included in this group.

Type 2 Modified direct. Eggs are passed out in the stool which require a period of development in the soil before being ingested, where they hatch, releasing larvae which penetrate the mucous membrane of the stomach and enter the circulation to reach the lungs, passing up the respiratory tract to enter the oesophagus and reach the intestine where they become adult. Ascaris lumbricoides (roundworm) is a member of this group.

Type 3 Penetration of the skin. In this group eggs are passed out in the stools to the soil where they hatch into larvae which undergo further development before they are ready to penetrate the skin and reach the circulation and lungs which they penetrate to enter the respiratory tract, and move up to enter the oesophagus and reach the small intestine where they become adult. Ancylostoma (hookworm) and Strongyloides stercoralis belong to this group but differ in that Stronyloides larvae are passed in the stool and autoinfection can occur at the anal margin, or independent development take place in the soil where it can exist in the absence of any further cycle through man.

Ascaris lumbricoides

Ascaris lumbricoides is a comparatively large worm (female 20-25 cmX 3-6 mm; male 15-31 cmX 2-4 mm), which inhabits the small intestine.

Infection is acquired from the ingestion of eggs from contaminated soil usually by children when playing around the house situated in suitable soil.
Most Ascaris infections are symptomless but heavy infections in childhood give rise to symptoms. These heavy infections are controlled by immunity, or by diminished exposure, so thath adults show much lighter infections, although reinfection can occur throughout live. Light infections do not cause symptoms though a single adult worm can cause a liver abcess or block the common bile duct. Acute manifestations are roughly proportional to the number of worms when the burden amounts to 100 worms or more.

Trichuris trichuria

Trichuris trichuria is a greyish-white worm, which lives in the caecum and appendix. the male is 30-45 mm long, the female measures 30-35 mm.
Transmission is direct from mature eggs to the mouth via fingers contaminated from infected soil.
In the vast majority of infections which are light, the worms live harmlessly in the caecum and appendix but when the infection is heavy (more than 10.000/g of faeces) they cause haemorrhages, mucopurulent stools and symptoms of dysentery with rectal prolapse.

Ancylostomidae (hookworm)

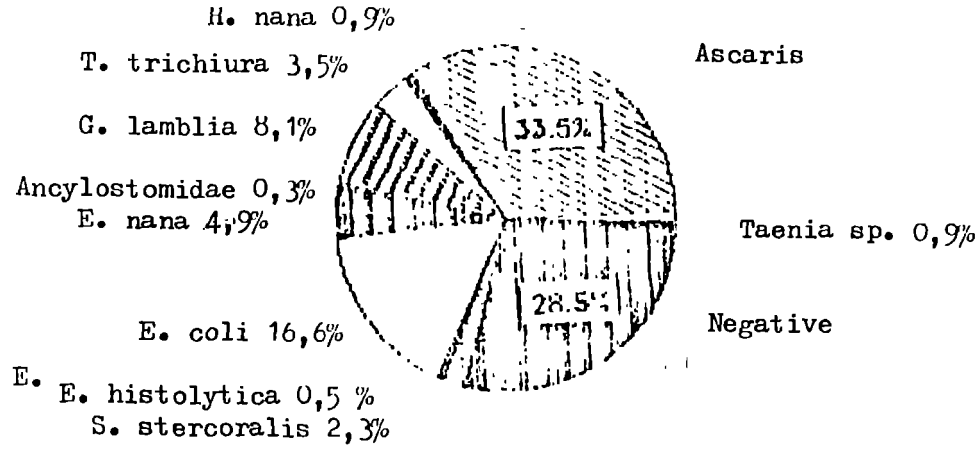
Two species of hookworm, Ancylostoma duodenale and Nector americanus, infect man.
A. duodenale is a small cylindrical white, grey or reddish-brown (from ingested blood) thread-like worm. The female (1-1,3x0,6 cm) is slightly larger as the male (0,8-1,1x0,4-0,5 cm).
N. americanus closely resembles A. duodenale but is shorter and slenderer (0,9-1,1x0,4 cm).
Infection is acquired via the skin (or mouth) from filariform (infective) larvae in the soil contaminated by human faeces.
In many cases the nematodes, which are often present in huge numbers attacked to the small intestine, from which they suck blood and protein and cause disease (hookworm anaemia. hookworm disease).

Strongyloides stercoralis

Strongyloides stercoralis has two life-cycles in which reproduction takes place: an internal sexual cycle involving parasitic worms and an external sexual life involving free living worms. The adult female parasitic worm is 2,5x0,034 mm. The male exists but disappears from the bowel soon after oviposition and eggs can be produced parthenogenetically.
Infection is acquired originally from contaminated soil from free-living filariform infective larvae. Once established further infection may be acquired from the bowel or anal skin from parsitic infective larvae.
The vast majority of infections in endemic areas are symptomless. When for various reasons the number of Strongyloides present in the intestine increases then symptoms develop: diarrhoea. malabsorption of fat and vitamine B12, hypereosinophilia, skin rashes, massive strongyloidiasis.

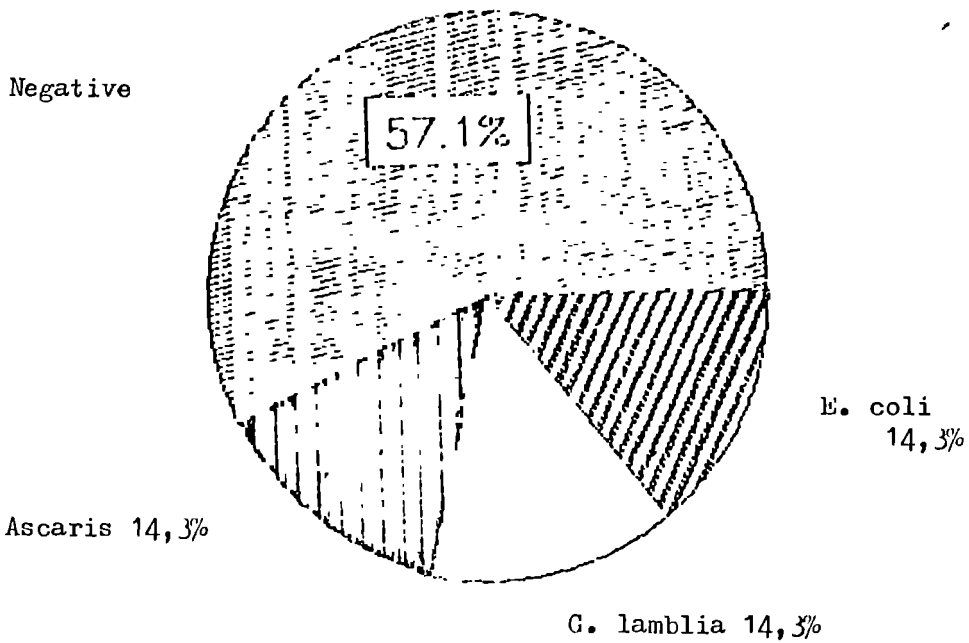
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

AM total population



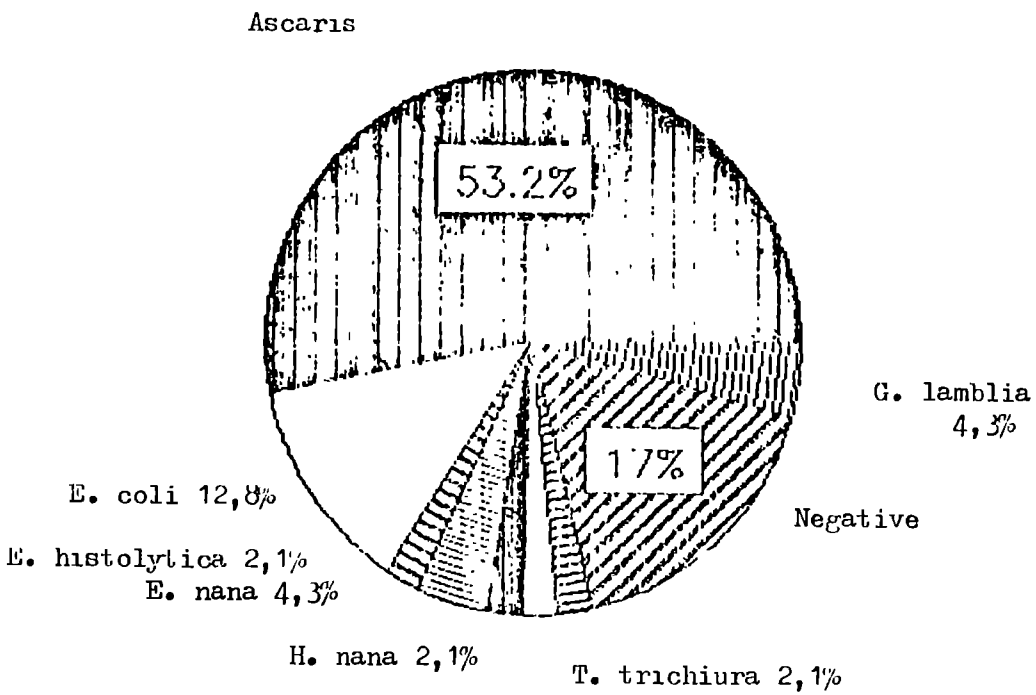
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

AM Age group : 0 – 1



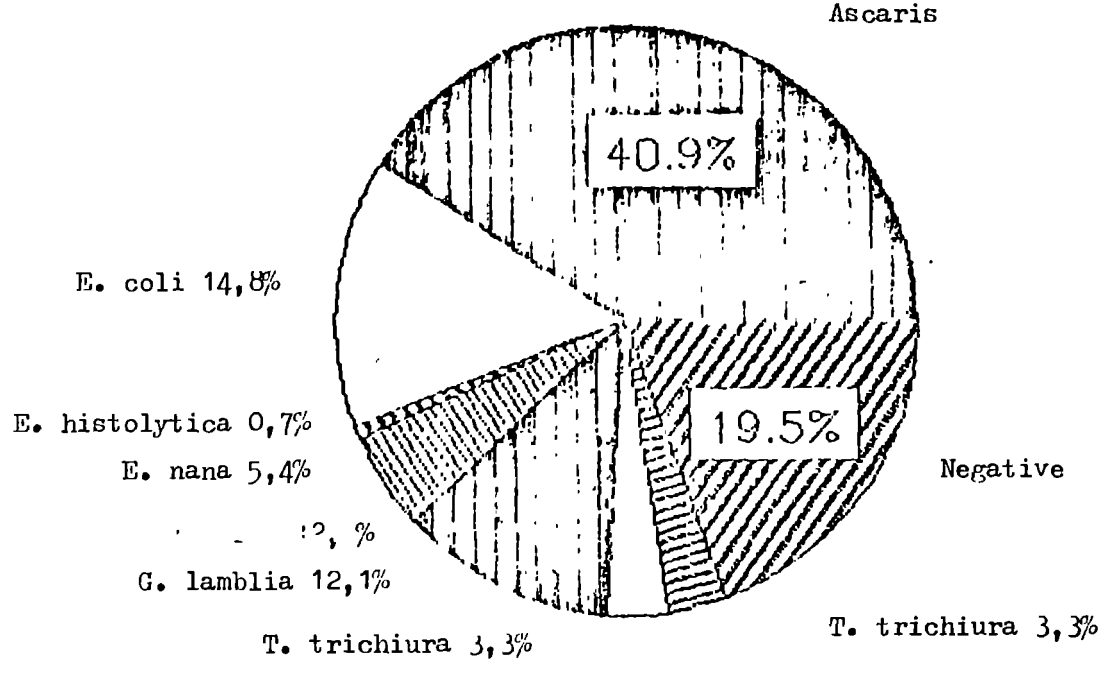
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

AM Age group : 1 – 4



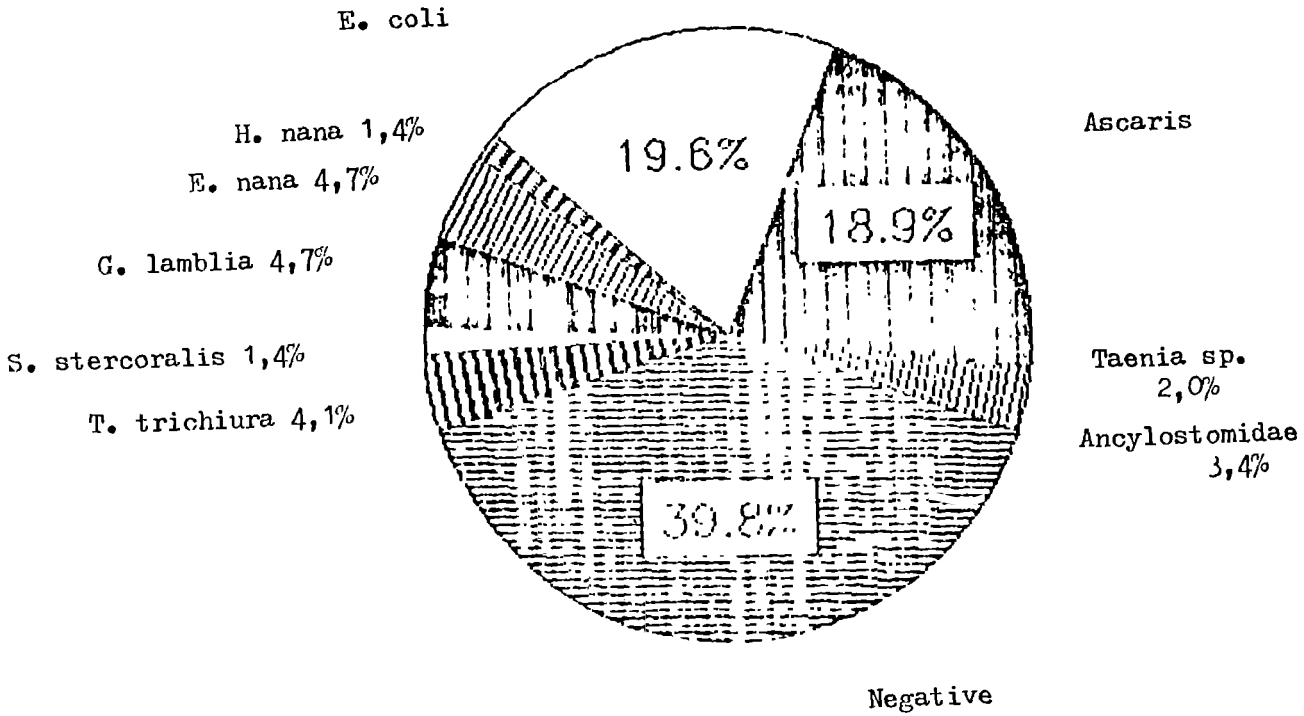
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

AM Age group : 5 - 14



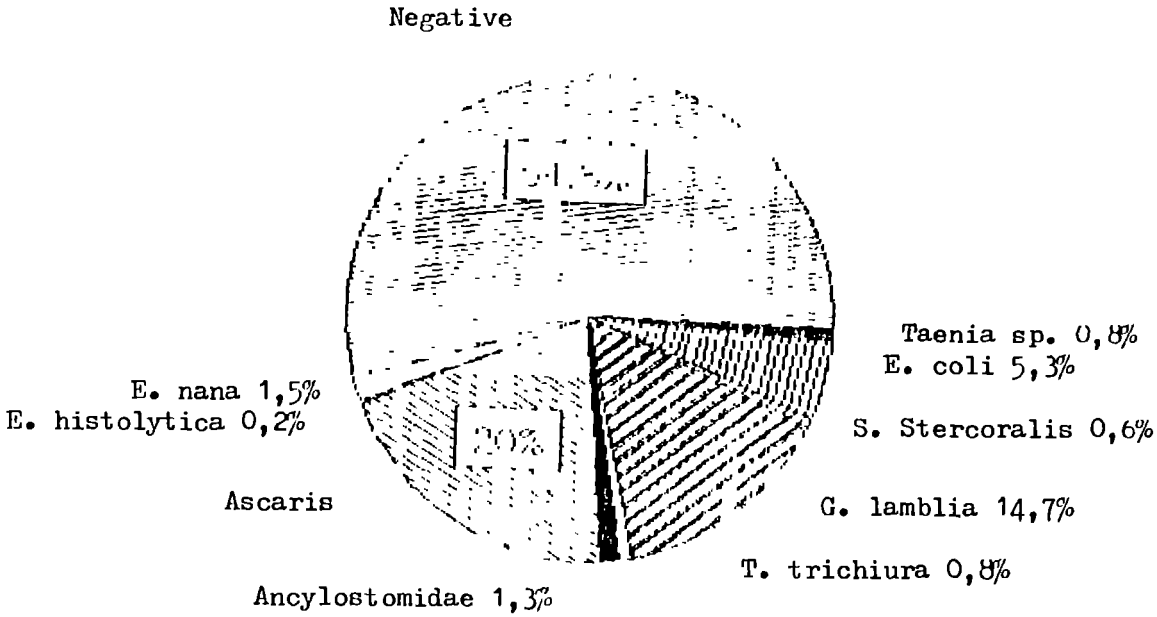
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

AM Age group : >15



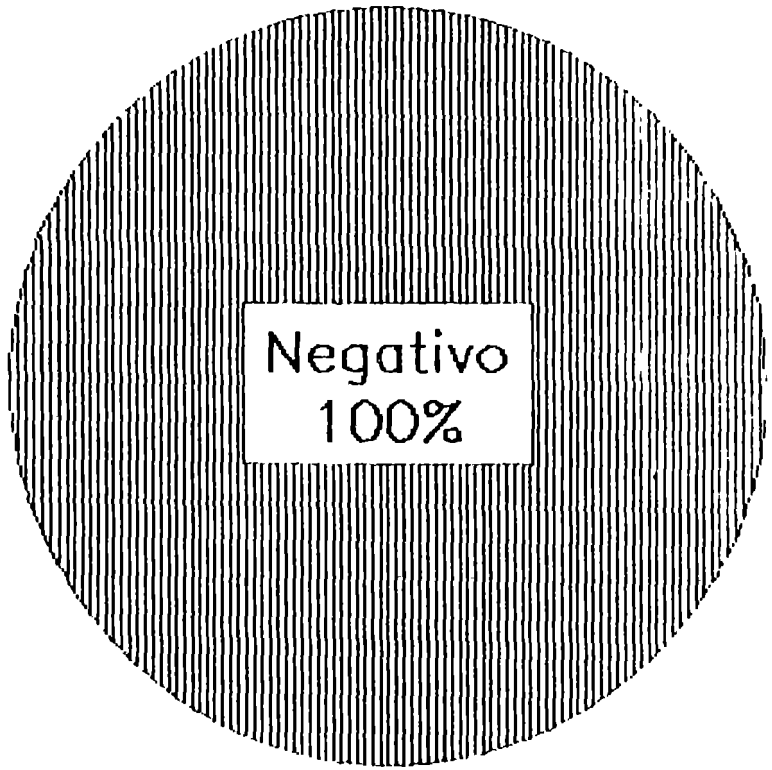
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

FdM total population



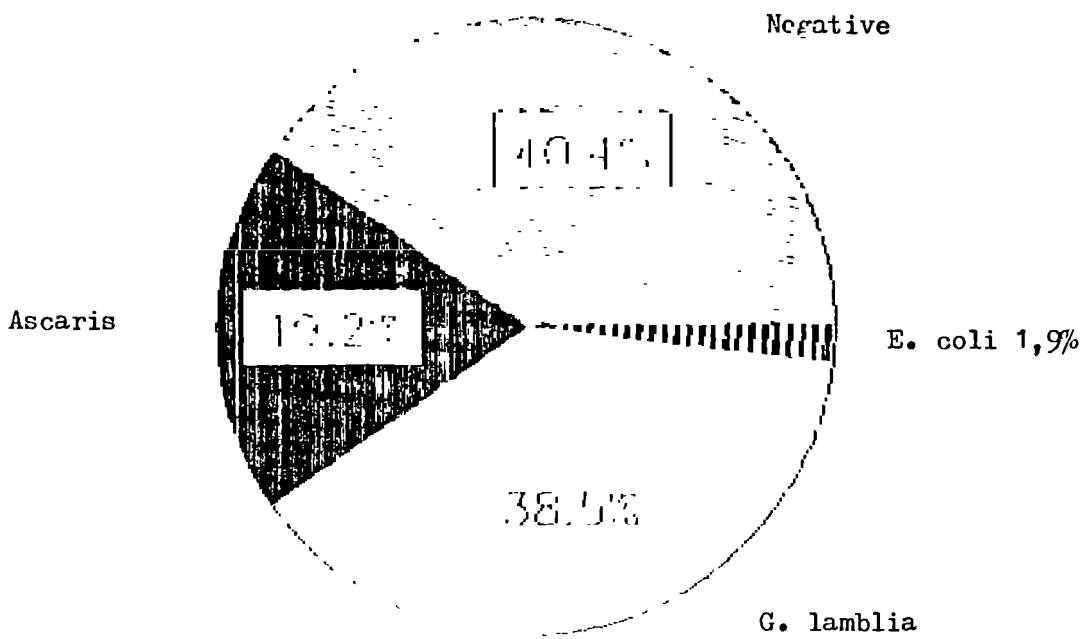
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

FdM Age group : 0 - 1



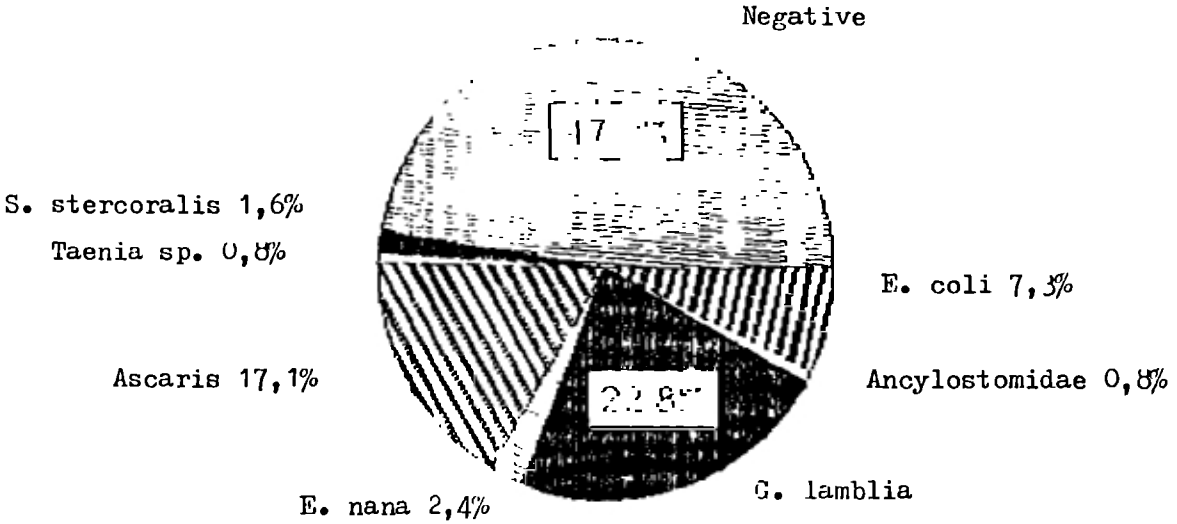
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

FdM Age group : 1 - 4



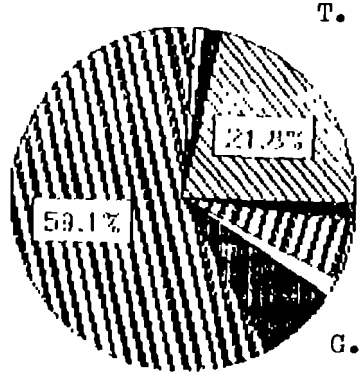
PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

FdM Age group : 5 - 14



PERCENTAGES OF PREVALENCE OF WORMS AND PROTOZOA

FdM Age group : >15



Taenia sp. 1,0%

T. Trichiura 1,4%

Ascaris

Negative

E. nana 1,4%

E. histolytica 0,3%

E. coli 5,5%

Ancylostomidae 1,7%

G. lamblia 7,5%

S. stercoralis 0,3%

Appendix 14 Sample size

	AM	FdM
Preliminary questionnaire		
Number of households	63	107
Number of inhabitants	297	501
Household survey		
Number of households	59	60
Inspection of latrines		
Number of inspected latrines	44	33
Examination of the water quality		
Number of bacteriological samples	22	24
Number of physical/chemical samples	5	0
Faeces examination		
Number of persons	276	475
Diarrhoeal morbidity survey		
Number of children	41	61
Anthropometric measurements		
Number of children	41	61

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