827-NI-13120-1

Foto: Waterstorage in typical outside kitchen in barrio Santuaria, Juigalpa

FOREWORD

The Dutch are world known for their knowledge of water related subjects. At least, this seemed to be the case in Juigalpa, Nicaragua, as was found out during the investigation 'Water-use in Juigalpa' But affirming this was not the aim of the research carried out as a thesis for the study International Land & Water Management at the International Agricultural College 'Larenstein' (IAHL) in Velp, The Netherlands. This final assignment was performed during the period from the 1st of May until the 10th of August 1994 in Juigalpa, Nicaragua.

Because of former practical terms, both abroad, in different developing countries, we became interested in drinking water supply and sanitation in general, and decided to fulfill our thesis in this field of work. The municipality of Juigalpa invited us to do a research on the water-use in the city for the educational campaign 'Fuente de Amor'.
But without the help of several persons we could have never performed it. For opening the door to this research, we would like to thank Loes Witteveen. Many thanks go out to Carla Hoekenga of SIS The Hague for letting us in. And for giving us the key to the outcome of the investigation we thank the co-ordinator of 'Fuente de Amor', professor Juan Sánchez Guevara

But still, without the indispensable help of many others, we would have never have come this far Special thanks go out to:

Lisette Verheijen	
ing Edgard Fletes	- INAA Juigalpa
Wouter van den Wall Bake	- IAHL
All the families involved	
Schools and directors	
Section CII of the school 'Normal'	
Juan Carlos Sánchez G.	
Cristina	
Remco Dapper	

Juigalpa, Chontales
Nicaragua, August 1994

Jochem Bauhuis
Mark van Dijk

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List of Abbreviations and Expressions

C_{s1}	-Nicaraguan currency (Córdoba, 1 US$ = 7,10 C_s August 1994)
c/hh	-Capita per household
DWL	-Dune Water Company, The Hague Duin Waterbedrijf Zuid-Holland
GPM	-Gallons Per Minute
hh	-Household
IAHL	-International Agricultural College Larenstein
IMF	-International Monetary Fund
INAA[2]	-Nicaraguan Institute of Drinking Water Supply Instituto Nicaraguense de Acueductos y Alcantaríllados
INE	-Nicaraguan Institute of Electricity Instituto Nicaraguense de Energia
IWACO	-Consultants for Soil and Water projects
l/c/d	-Litres per capita per day
l/d	-Litres per day
MINSA	-Ministry of Health Ministerio de Salud
SAP	-Structural Adjustment Programme
SIS	-Secretariat City Exchange Programme The Hague - Juigalpa
TELCOR	-Nicaraguan Telecommunication Company
WB	-Worldbank

Barrio	-Spanish word for quarter
Chele	-Nicaraguan expression for a white man (woman)
Format Inquiry = Questionnaire	-Instrument used to collect data during observations of households -List with questions used to obtain information from the households in Juigalpa

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[1] Unless explicitly stated otherwise, prices are given in Córdobas

[2] For more information concerning INAA, see annex 8

SUMMARY

This is the report concerning the investigation 'Water-use in Juigalpa' which was carried out under the instruction of the municipality of Juigalpa.
Juigalpa is the capital of the province Chontales in Nicaragua, Central America.
The city faces the problem of water shortage. Water supply is scheduled once every four days.
To improve this situation, the municipality launched the education campaign "Fuente de Amor", with the aim to inform the inhabitants of the city about their own habits of water-use and, when possible, lower the water consumption of the city through educating the people.

The investigation was implemented in a period of time of 13 weeks within the period from the 19th of April to the 10th of August 1994.
It investigation served as an instrument to get quantitative data about the water-use of the inhabitants, as well as data about the habits of the households concerning the storage of water and their degree of satisfaction concerning the water supply.
These data are needed for the education campaign.
Also recommendations for improvement of the water supply where expected as outcome of the investigation.

Five different manners to collect data were used, so that each time the necessary information was viewed from a different angle
To get a reliable outcome, the thus obtained data are verified with each other

The investigation gave remarkable outcome about the use of water.
Before, it was expected that the users waste much water on gardens, streets, and by throwing old water away when new water comes.
According to the research, only around 5 l/c/d of the total consumption of 76 l/c/d are lost, thus stating that the water problem can not only be blamed on the households

The biggest problem proved to be fact that the potable water system is not continuously supplying water.
As an indication for need of improvement, 69% of the users said to be prepared to pay C_s 10.80/month more when water comes daily.

This report gives recommendations for improving the water system so that a continuous water supply is realized.
Iit is needed to build a storage tank in the mainline of the system, just outside the city
To get a better control of the system the malfunctioning water meters have to be replaced, more households have to be connected to the piped potable system and master meters have to be installed at strategic points in the system . Also the search for locations for new water wells has to be continued to cope with the population growth

CHAPTER 1 GENERAL

§ 1.1 Introduction

The Dutch are in love with water, is sometimes whispered silently. Then performing the research 'Water-use in Juigalpa (Nicaragua) within the framework of the education campaign 'Fuente de Amor' (Source of Love) looks like a perfect match.
The campaign is the last phase of the water project that is carried out within the framework of the sister city-bond between The Hague, The Netherlands and Juigalpa.
The water project started in 1984 and needs to relieve the problem of water shortage in the city.

The investigation served as an instrument to get quantitative data about the water-use of the inhabitants, as well as data about the habits of the households concerning the storage of water and their degree of satisfaction with the water supply.
These data are needed for the education campaign

The research or investigation 'Water-use in Juigalpa', is implemented in the city of Juigalpa, Nicaragua. Juigalpa is situated in the south-eastern part of Nicaragua, 25 kilometres to the east of lake Nicaragua Juigalpa is the capital of the province of Chontales, and inhabits roughly 42,000 people

'Fuente de Amor' is launched to inform the inhabitants about the causes of their water problem and to support to a change of habits in using water.
To make the education campaign successful, it is important to have a good view of the ins and outs of the water-use in the city
This report, 'Water-use in Juigalpa', serves as an instrument in clarifying this image.

§ 1.2 Problem Description

Juigalpa faces the problem of a water shortage. The majority of the inhabitants receive water on a four-day basis in the wet season. During the dry season, people sometimes even have to wait two weeks for water coming out of the tap.
Large scale technical solutions, which could end water shortage, cannot be initiated in the ffforeseeable future.

§ 1.3 Opting for social solutions

The sight is now aimed at a better water division between the Juigalpinos. The education campaign as mentioned above is proposed to bring about a change of habit in using water,
to realize that with the same amount of water more people can be served

§ 1.4 Aim of the research

The aim of the research is to provide a clear view of the water-use of the people, so that this will enable the campaign to undertake adequate measures in educating the people.[1]
The research will consist of two parts:

1) Investigating the water-use in quantitative sense within the different sections of the distribution system More specifically concerning the following aspects:

   A How is the piped potable water used?

   B. What different ways are there to store water on the compounds?

   C. Degree of satisfaction concerning the quality and the quantity of the delivered water

2) Giving recommendations for the improvement of the availability of water, based on the outcome of the investigation.

These recommendations are divided in three different discretion parts:
- a Institutional
- b Financial
- c. Technical

§ 1.5 Responsibility

The research is carried out by Jochem Bauhuis and Mark van Dijk, students of the IAHL, under the daily supervision of the coordinator of 'Fuente de Amor'.
Instructor of the research is the municipality of Juigalpa, who were also the initiator of the campaign.

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[1] The detailed description of the research proposal is given in paragraph 3 2. The original research proposal can be found in annex 5

CHAPTER 2 ORIENTATION

§ 2.1 Topography

The water project, in the context of which the investigation is carried out, is located in the municipality of Juigalpa, the capital of Chontales. Chontales is a province within Region V in Nicaragua.

§ 2.1.1 Nicaragua

Nicaragua, with 130,000 sq km, is the largest country in Central America. It is bordered on the north by Honduras on the south by Costa Rica, on the east by the Caribbean Sea, and on the west by the Pacific Ocean. Its population is 3,999.000 (1992).
The country was formed through heavy volcanic activity. The Pacific coastal region for example is broken by 40 volcanoes. These gave Nicaragua its fertile soil.
Agriculture forms the backbone of the Nicaraguan economy It employs 35 % of the population and a quarter of the national income is obtained through it.
The revolution of 1978-1979 and the war between the Sandinist's and the Contra's which ended in 1990 left the country in an economic chaos. To try to alleviate the economic situation, IMF and the Worldbank designed a Structural Adjustment Program (SAP) which calls for lower government spending, and tries to create a climate in which (foreign) investors are likely to invest. In practice this means that many people are sacked from government institutions, state owned profit making firms are likely to be privatized (Telcor, INE and INAA[2]), thus rendering many people unemployed. And above all, commodity prices (which were subsidized before) are increased. This means that the poor, who already suffered most from the problematic situation, suffer even more once a SAP is implemented, this situation can be witnessed in many other countries [3+4]
Some of these developments find there repercussion in the outcome of this investigation as can be seen later on.
For example it means that INAA faces a change of wind, but the institution needs time to adjust to this new course And maybe even more important, the people can spent less money then they used to, also for water.
More general information about Nicaragua is found in Annex 1

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2 For more information concerning INAA see annex 8

3 Graham Hancock, Lords of Poverty, London 1989.

4 Another thing that can be witnessed, in Juigalpa, being the capital of the national Nicaraguan cattle stock, milk is drunk which is imported from Costa Rica, while at the same time the milk cooperatives only lead a marginal existence Source, Policy, J P. (1993) Juigalpa '93 The Hague, The Netherlands

§ 2.1.2 Juigalpa, Chontales

The name of Juigalpa origins from the Aztec language in which it signified 'Great city'. In February 1879 it officially became a city, although its predecessor existed already since 1659.
The municipality can be encountered at 12°6' northern latitude and 85°22' western longitude. It has an extension of 1,081 km^2 and offers a place to live for 53,484 people[5]. With a density of 40.3 persons/km^2 it is one of the most densely populated parts of region V. Its mean height equals 116 meters above mean sea level, the mean temperature is 27°C and the annual precipitation amounts up to 1,300 mm. The distance to the lake of Nicaragua is 25 km. Juigalpa lies at a distance of 137 km from the country's capital Managua and is reasonably accessible. (See figure 1 ;Juigalpa and its position in Nicaragua See also annex 1 ,2 ,3.)

§ 2.2 History of the water project

In 1984, when the capital of Chontales had only 22,000 people, the city was also suffering from a shortage in water Probably ever since the city existed There were not enough sources to pump water from and the distributing system was too small. Most houses did not have a connection and the water quality was so low that many people became ill by consuming it About 40 % of the water that was produced, was lost through leaks in the pipes. Also because of old equipment many times a pump would stop functioning, thus laming the delivering of 'agua' needed so badly.[6]
INAA, the responsible body for the water, did not at that time have the financial- nor the personal means to improve this situation. This gave reason for SIS (in casu the people of The Hague) to reach out a helping hand.

§ 2.2.1 The Dutch involvement in water in Juigalpa

This year the 10th anniversary of the city-bond The Hague - Juigalpa was celebrated. The drinking water programme was the first big project to be executed within the framework of the sister cities relation It began in 1984 and ended in 1993. Funds came from The Hague and the implementation was done by INAA Juigalpa with technical assistance from the Dune Water Company (DWL The Hague) and IWACO. The initial goals are amply met, maps were made of the piped system, the piped system was enlarged and improved, the production increased and secured and the water quality has improved. But the increase of the population has exceeded the increase in production

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5 The city of Juigalpa however, inhabits 41,407 people These figures will be explained to a greater extent in the annex 4, population

6 TH Delft, (1984) ~~Sin Agua No Hay Vida~~ Una investigation de abastecimiento de agua potable de Juigalpa, Nicaragua October 1984, Delft, The Netherlands

Already for a long time the idea exists to use water from the freshwater lake of Nicaragua. But not only a distance of 25 km has to be overcome, also some remarkable differences in heights.
Apart from the technical and organizational problems related to such a project, the costs (estimated to be 25 million US$) transcend the abilities of the SIS by far.[7]

In the last years the emphasis, that was always put on technical assistance, was more and more put on the educational aspect of giving more water to the people This resulted in the campaign 'Fuente de Amor'.

§ 2.3 Research organization structure

Below a brief description is given of the context in which the research 'Water-use in Juigalpa' was carried out.

Since 'Fuente de Amor' is performed by the municipality of Juigalpa, it was logical that this research fell under their formal responsibility. The day to day coordination was done by the p.r. official (being responsible for the educative campaign) who in practice also functioned as the SIS coordinator in Juigalpa. On a monthly basis progress reports were send to SIS, The Hague and the companion of the IAHL, Velp (in connection with the authors final study assignment).
Inter-relations existed with INAA and the campaign coordinator concerning information about and for the research. The investigation serves for both (principally the municipality of Juigalpa) as an instrument of knowledge, while at the same time information was obtained from them to perform the research.
Finally this research should be used as a tool to make it possible to have more water for the people of Juigalpa.
(The above is shaped in the form of the following organogram)

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7 Poley, J P. (1993) Juigalpa '93, Verslag van een bezoek vanuit Den Haag aan de zusterstad Juigalpa 8 - 21 november 1993 1993, The Hague, The Netherlands.

FIGURE 1. Organogram Research; Water-use in Juigalpa

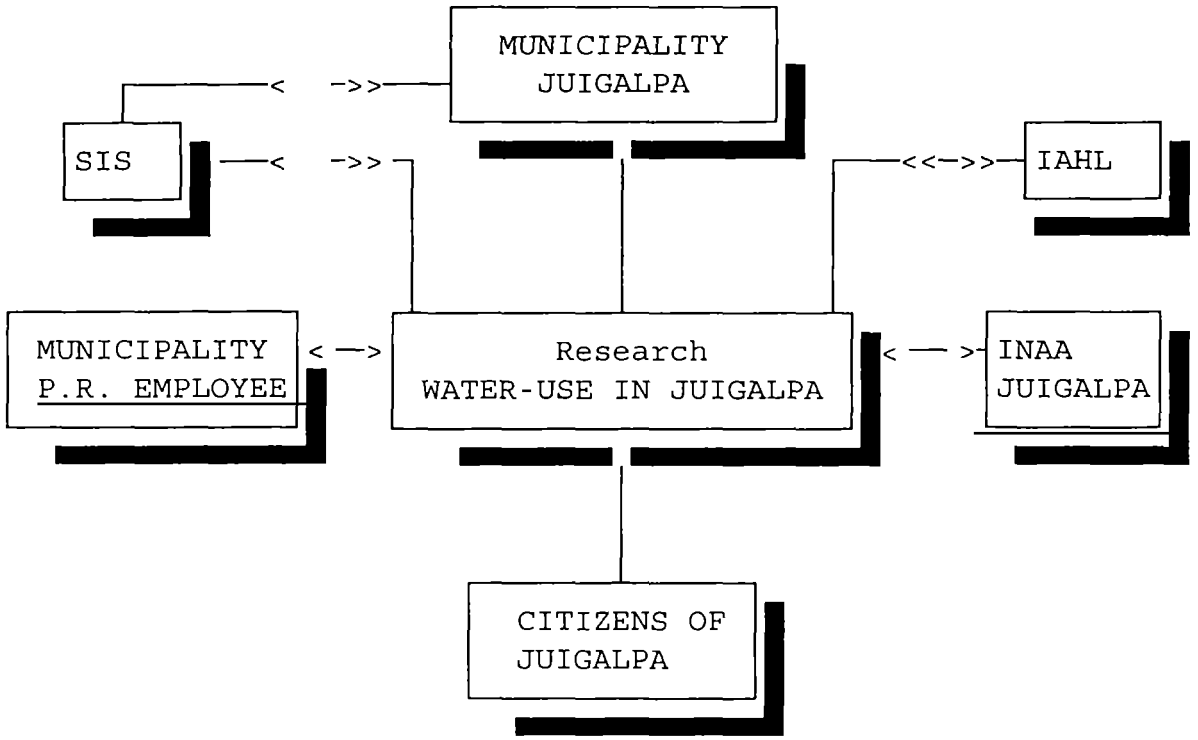

Figure 2: Location of Juigalpa

CHAPTER 3 METHODOLOGY

§ 3.1 Introduction

How the necessary data was obtained, is described below. First of all is shown which information was needed. In § 3.3 the sources were the information came from are analyzed, the next paragraph handles about the collecting methods, which is then followed by § 3 5. In this an insight is given in the different manners that were used to collect data.
Finally the methodology is criticized upon in paragraph 3.11.

§ 3.2 What information was needed?

Since the beginning of the water project most emphasis was laid on increasing the pump capacity, thus delivering more water to the people. More and more however it became clear that water resources are limited and that a further (major) increase in produced water is not very likely. This made the municipality to start an educative campaign to try and create a behavioral change in water-use of its inhabitants. If was expected that a lot of water was 'misused' for example for car washing or watering the garden. These expectations however were founded mostly on mere observations instead of scientifically correct data. This investigation is thus serving as an instrument to collect data with which it is possible to address to the people in a correct way.
The information that needed to be collected during the investigation was the following:

A. How and how much water is used?
- Water-use at home.
  Cooking, drinking, dish washing, cleaning the house, washing cloths, washing hands, bathing, water closet, garden, car washing, animals and other uses
  general "cleaning"· personal hygiene, cloths, house etc
- "Bad" use of drinking water
  car washing, cleaning streets, watering gardens etc.
- What is the relation between the need and the availability of drinking water?
- How much is the actual deficit?

B. What different ways are there to store water on the compounds?
- What different types of containers are used, how much is stored and how is it stored?

C. Degree of Satisfaction
- Are the people satisfied with existing service level?
- Are the people satisfied concerning the water quality?

§ 3.3 Sources of information

§ 3.3.1 Introduction

Analysing the water-use in the city of Juigalpa means that one needs to have a clear view of the 'live cycle' of the water. From its beginning, when the ground water is pumped up from the deep soil (varying from 15-40 m), via its way through the distribution system, till its end, when it is consumed by the people.
Thus the two main sources of obtaining information about water-use in the city are INAA and the Juigalpinos.

§ 3.3.2 INAA versus Juigalpinos

Looking at the institute that delivers the water to the city is an essential part of the investigation. What is their policy, what are their restrictions and which problems do they encounter were some of the questions that needed to be answered to find out why the water distribution system works as it does. The users on the other hand were a bit more difficult to analyze. The good thing about them is that they all have an opinion about potable water. The bad thing however is that these opinions rarely match. People who have only little money to spent, think about- and use water in a different way than those who have a high income. And although people use water day in day out, thinking about it in terms of quality and quantity is not daily business. It is a known fact for example, that it is difficult for people to estimate how much water they use, not only in countries who do not have a long history of system supplied drinking water.

One of the main questions that needed to be answered during the investigation, was how much water an individual person uses per day divided over the different uses (see § 3 2).
The interesting part would be to compare data collected from the people about how much water they thought they would use and 'objective' data collected from INAA combined with our own observations But collecting data from the 'users' also called for attention and care in selecting methods of collecting data.

§ 3.4 Manners of collecting data

§ 3.4.1 Introduction

Especially before and during the first weeks of our assignment, a lot of thoughts were spent on how to get realistic and objective information from the people of Juigalpa. As stated before, obtaining data from INAA and the municipality was thought to be relatively easy. Getting data from the people in the streets, was thought to be another thing.
Care had to be taken not to project western ideas upon the people who would be interviewed or observed. This would, without any doubt, lead to incorrect information

§ 3.4.2 Banning the 'expectation'

Nicaragua, in casu Juigalpa, was flooded with western aid and relief workers, during and after the war. This has in many cases led to a certain extent of 'expectation' with the Nicaraguan people whenever they see a *Chele* or white face. This 'expectation' can then again lead people to giving certain answers, wittingly or unwittingly, which they think are more beneficiary for them, but which do not correspond to the truth

> **This, among other things, made us realize how important it was to have different instruments within the investigation, with which it was possible to obtain the same information, but each time viewed from a different angle. So that it could be combined afterwards to a truth-corresponding image. In this way the collection of realistic, objective data would be guarantied as much as possible.**

§ 3.5 Using instruments to collect data

§ 3.5.1 Introduction

In our research proposal, which was prepared before our leave to Nicaragua, five different aspects are shown which were seen then as objective instruments to use while performing the investigation (see annex 5 ;Research proposal and § 3 5 2).
During the course of the research however some adjustments were made.
The participative investigation was cancelled since the results were not available in time (this part fell under the responsibility of the municipality) Also the 'field observation' and 'interviewing' were adjusted for more practical use in the field. (See chapter 4 § 4 3, and annex 6, Adjustments in Work Plan)

§ 3.5.2 Researching according to plan

According to the following adjusted work plan (see also annex 6, 7) the investigation was performed, using the five instruments:
1. Desk study
2. Field study
3. Field observation & Interviewing
4. Questionnaires
5. Verification & Conclusions

§ 3.6 Desk study

The desk study concentrated on studying the available literature and data on the town water system from a technical point of view. Thus creating a first impression of how the system works, and the relevance of the available data.

§ 3.7 Field study

§ 3.7.1 Introduction

The field study would need to result in a clear idea of all the different aspects of the water system in Juigalpa. With this obtained knowledge, it would be possible to establish objective parameters for the selection of representative areas in which we would interview and observe the water users.

§ 3.7.2 Parameters

From the beginning it was clear that the time we had was insufficient to study all the different parts of Juigalpa. But more than this, it was also not seen necessary.
During the preparation of the investigation it was expected that the major differences in water-use between families in Juigalpa would largely depend upon five different geographical and physical parameters. These are:[8]

Geographical situation;

* Position in the water system; high - low
  Since the system is divided in a high and a low part, see annex 15, differences in water availability could occur.

* Distance to the river; near by - far away
  Would the availability of this alternative water source influence the water-use, and in what way?

Physical situation;

* Frequency in receiving water, daily - once every 4 days

* Type of connection; private tap-point - communal tap-point
  It was expected that answers could be found to the following questions
  - Do families with a private connection use less water than families who obtain water from a communal tap-point?
  - Are private connection more efficient in use?

* Age of system; new piped system - old piped system
  - Does the design of a quarter influence the efficiency?
  - Does the efficiency influence the water use?

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8 A more detailed explanation of the theory behind these different parameters is found in annex 9

Through means of the above mentioned criteria, 9 different *barrios* in town were chosen, 5 in the 'high-pressure' part of town and 4 in the 'low-pressure' part. By looking at the map of Juigalpa and talking to different persons, sub-quarters were selected which all had one or two distinct conditions In these selected sections could then the water-use be observed, and the results could afterwards be compared with the results from a section with the opposite condition. For example the results of water-use in an old part of town with those of a new(er) part.
These comparisons should ultimately result in the ability to state what the influence of each different criteria would be on the water-use.That this is not easy will be explained in annex 9 ;Detailed Description of Chosen Parameters, § 3.

§ 3.7.3 Small Inquiry[9] (see annex 10)

During the field study and -observation small inquiries were used as an instrument to make it easier to introduce ourselves with families in town. To eliminate the effect of 'steering' the answers, we introduced ourselves simply as students who were interested in the Nicaraguan way of live. The questionnaire was developed in such a way that water-related questions were alternated with more general ones This instrument was not used for a long time since it became clear soon that it was fairly easy to talk directly to people about the water situation without such a questionnaire.

§ 3.8 Field Observation and Interviewing

Observation was seen as an important way of obtaining information about the handling of water by the households The observation was combined with the filling in of questioning lists (so-called 'Formats', see § 3.8 1). Through observation and questioning, obscurities could soon be cleared and the value of the answers from the questionnaires could be established. Above all it could be seen and noted down exactly what was practice regarding the handling and storing of the water, and the differences between *barrios* concerning the water-uses
Answers were needed on the three following aspects, already mentioned in paragraph 3 2.

A. How and how much water is used

B. What different ways are there to store water on the compounds?

C. Degree of satisfaction

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[9] View of the used tools for obtaining information

Field study	-> -Small inquiry	annex 10
Field Observation & Interviewing	-> -Formats	annex 11
	-> -Water-use forms	annex 12
Questionnaires	-> -1e Questionnaire	annex 13
	-> -2e Questionnaire	annex 14

§ 3.8.1 Format

Since houses were going to be visited separately, it had to be ensured that the same data (at least the necessary information) was collected. For this purpose a field-observation-interviewing-list = Format was prepared (see annex 11). The collected data were analyzed with the computer programme dBase IV. In this manner all kinds of relations could be established e.g. kind of connection - use in litres/capita/day.

§ 3.8.2 Water-use forms

It is rather difficult for people to estimate the amount of water that they use day in day out. It's even more difficult to estimate how much the used water is divided over the different uses like for example dish washing or drinking. Therefore a water-use form was developed and used. The people were asked to use this form and fill in the amount of water they used, for which use and the time they used it. (See annex 12).

§ 3.9 Questionnaires

§ 3.9.1 Introduction

Twice, questionnaires were handed out, the first time; 120 in the wet season, and the second time; 850 copies during the wet season. The questionnaires would primarily serve as an instrument to obtain so much information regarding the different research questions, that the outcome would give a statistically justified image. This image would then not only represent parts of *barrios*, but would be representative for the whole city, through all layers of its population.
As shown below, a lot of concern involved pre-knowledge. Besides taking care that the questions were understandable enough to be filled in at home, also much attention was paid giving a good explanation during the handing out Examples of both questionnaire are given in respectively annex 13 and 14

§ 3.9.2 First big questionnaire

Since it was expected that the water-use in the dry season would differ from that of the wet season, a questionnaire was prepared and distributed already during the third week of the research Apart from giving data regarding the dry season, it could also function as a test case to see where the questionnaire needed some adjustments.
To ensure that pre-knowledge with the inhabitants of the city would stay at a safe level -since pre-knowledge could in theory lead to people giving other answers, than they would have given if they didn't receive pre-knowledge-, but at the same time significantly enough data would be collected, 120 questionnaires were distributed

§ 3.9.3 Second big questionnaire

Whereas the information collected during the observation in the different parts of the city was supposed to function as a way of controlling other obtained information, the 2nd inquiry served more as an instrument to obtain enough information to be able to give significantly correct statements.
In opposition to the first inquiry, this one served to obtain information about the use of water in Juigalpa in the wet season.
To ensure that enough households were taking part in the investigation 850 copies were distributed.

§ 3.10 Verification/Conclusions

Technical data (1), and information gathered through observation (3) and interviewing (4) are combined and compared. Where necessary, gaps are filled until a clear image existed. Conclusions were drawn out of this image

§ 3.11 A critical view upon the used methodology

As shown above, a lot of attention was paid at the so called 'pre-knowledge'. It was thought that this could negatively affect the outcome of the investigation Now, at the end of the research however, it can be concluded that this 'fear' was unjustified At no occasion anything related to this 'pre-knowledge' was observed.

CHAPTER 4 IMPLEMENTATION

§ 4.1 Introduction

This chapter views the way in which theory was put to practice. For the sake of clearness, the same five points of the work plan mentioned in paragraph 3.5.2 are followed step by step This does not necessarily represent a chronological view. In annex 7; Adjusted Working Schedule, the used implementation schedule is given.

§ 4.2 Desk study

The desk study which originally was supposed to take only the first week, was executed throughout the entire research. This was done because of different reasons. First of all, it proved to be impossible to read the available literature in just this one week, because of others things that were needed to be done and because of lacking sufficient knowledge of Spanish. This also influenced our contact with the director of INAA Juigalpa. But the reason more important, was that during the course of time more and more questions were asked, and these questions were often met with newly available literature Apart from reading a lot, also time was spent in the office of the water institute Here the different books were analyzed and whenever a new question arose, immediately it could be answered by the responsible person

§ 4.3 Field study

§ 4.3.1 Introduction

As said before in paragraph 3 7.2, it was seen neither possible nor necessary to investigate the whole of the city and all the Juigalpinos. But how to ensure, as much as possible, the information obtained from the few selected parts in which would be investigated, could be projected upon the whole of town and its population? By using objective, independent parameters as selection tools for the parts in which the research would take place. How these tools were used, explains the following

§ 4.3.2 Selection

During the first few weeks, most parts of the city were visited to get a good idea of all its ins and outs. Maps with the piped system were copied, to see for example which sections
were connected and which not or what the exact division in (relative) high and low parts of Juigalpa was.

Based on these first impressions different *barrios* were chosen.

- Initially the idea was to select different zones, it would enable us to get a good impression of the losses of the distribution system. This was based upon the assumption that every zone had its own master meter. After it became clear however that these did not exist, the opinion manifested that it was better to select smaller unities. -

Afterwards, these parts were visited in the field to see if they indeed could function as representative parts. This was not solely by passing through, but also by interviewing or questioning the people in the streets or their houses.
Fearing it would be difficult to question the people without a good excuse, a small inquiry was prepared (see annex 10) and used.
After these visits again the parameters were discussed and when necessary adapted
Finally nine different sections of *barrios* where selected to do the research in (these are shown in § 5.3).
This period took three weeks.

§ 4.4 Field observation and interviewing

In these selected quarters, it was now time to visit different households, to observe these, and to have interviews with the persons responsible for the use of water
Once within the chosen part, again three sub-parts were chosen, mostly different roads. Within these different blocks each researcher chose three houses (initially these were four, but this became too much work). This selection was done solely by looking which house looked interesting and whether somebody was home Most of the times the people liked collaborating, but whenever they felt uncomfortable, an other household was selected. It was explained what the purpose of the investigation was, how much time was needed for the observation and what was expected from the people
At first the small inquiry was used as an introduction method, to create a confidential atmosphere This was cancelled the second week, because of lacking time and because it wasn't seen as really necessary.
And during every visit the position of the water-meter was noted down.
The second time this household was visited, besides observing the water-use, the 'format' was used as an instrument to interview the people with (see annex 11 and § 3.8 1) This means that was asked how much water they thought they were using, what kind of storage facilities they had, and to establish to which income-class the household 'belonged'

- During the field observations it had become clear that even within a sub-barrio many differences in water use existed originated upon the wealth of a household So to establish this wealth, it was observed for example, how many luxury goods a family had -

Also during the second time the water-use form was distributed and explained (see annex 12).
During the third visit the water-use form was explained another time, whenever necessary -which was often the case-, or taken in when completed. Missing information was amplified.
Each particular household was visited a fourth time, whenever necessary. To take in the water-use forms and to read the meters another time.

This part of the investigation is not completely implemented.
Only 7 barrios where visited. The barrios La Tonga and Tamanes fail.

§ 4.5 Questionnaires

§ 4.5.1 Introductions

Two questionnaires were held. The first one was meant to obtain data about the water-use in the dry season, thus enabling the investigators to see the difference between the wet and the dry period.
Simultaneously the 1st questionnaire served as a testing model for the 2nd questionnaire composed of the same, but improved questions From the 1st questionnaire, 76% of the forms returned filled in.
It proved to be very important to explain the questions thoroughly, and many questions needed to be improved and/or changed.
This means that the 1st questionnaire can hardly be compared to the 2nd Differences in answers are too big and are not likely to be caused solely by the difference in a dry and wet season alone The total average water-use for example differs 17 l/c/d while the total water production differs only four l/c/d.

Results of the 1st questionnaire are not likely to be very reliable due to wrong questioning The first questionnaire was thus only used for improvement of the questions, so that results of the 2nd version would be more trustworthy. Consequently, only the results of the 2nd questionnaire are given in § 5 5, except some data and information regarding the degree of satisfaction in the first questionnaire

§ 4.5.2 Changes in questions

In the 1st questionnaire questions caused difficulties in filling in the tables, because other words were used in the columns as in the questions itself. (questions 2 3; 2 4; 2.10a).
Other questions where not stated clearly and not understood by the people (questions 2.1; 2 2; 2.8, 2 10c; 2.10d; 2.10e, 3.1; 3.2, 3 5).
In some questions things where added and/or removed (questions 2.4, 2 8; 2 9, 3.1) for exact changes see annex 13 and 14.

§ 4.5.3 Used questions

The questionnaire contains many questions about many different aspects of water-use. The thought was to analyze all those different aspects. During the use, it showed out to be too much work.
Only questions related to the point's water-use, water storage, degrees of satisfaction and financial aspects were controlled (checked questions: 1; 2 1; 2.4; 2.6; 2.9c; 2.9h; 2.9i; 3.2; 3.3; 3.5).
For results see § 5.5 - results of questionnaire.
In the 1st questionnaire not all the above mentioned points were checked, only questions 1.1; 1.2; and 2.10.g where controlled. Others where not filled in correctly because of bad questioning or not considered trustworthy.

§ 4.5.4 Distribution

The distribution of the 1st, and the 2nd questionnaire was done at secondary schools. This was a relatively easy way of distributing, which enabled us to reach many families.
During the distribution of the 1st questionnaire, the absolute necessity of explaining all the questions became clear.
Seventy-six percent of the questionnaires were filled in upon return For the distribution of the 2nd questionnaire version, 10 students of the college for school-masters were trained to distribute and explain the questionnaires at five different schools It was thought that they could explain the questions better than the authors, since they would understand the people and their problems with the filling in better.
Each group had to distribute up to 200 pieces, depending on the number of students of that particular school. A total of 850 questionnaires was handed out.
Due to unexpected exams and vacations of the schools at which was distributed, only 26% (=280 pieces) of the questioning lists were filled in and returned The reason that the questionnaires were distributed during the exams, was that there was no other date available for distribution. Also it was told only one day before the distribution was planned to commence The students of the college for school-masters were briefed already, and expecting to start working independently the next day

§ 4.7 A critical view upon the implementation

Too much information was tried to be collected, especially during the field study. It would have been better if more time was spent on lesser things

CHAPTER 5 RESULTS

§ 5.1 Introduction

The results of the investigation will be given in the same order as described in § 3.5.2 ;Researching according to plan, for the sake of clearness.
After the results, a short evaluation of the reliability of the obtained data is given. This serves as a way of viewing the relative importance and reliability of the data.
At the end of the chapter the results of the different manners of collecting data will be compared with each other, to ensure that the most reliable outcome is achieved.

§ 5.2 Results of the desk study

§ 5.2.1 Introduction

One of the most important results of the desk study are the figures about the population of the city. It is impossible to estimate water-uses without knowing the number of inhabitants of Juigalpa These figures and the method of estimation of the used figures are described in annex 4 and table 2a; population. Also figures of water production and consumption as well as numbers of different connections are given.
All these figures are related to the month of May 1994, so that it is possible to compare them with each other.
For a short description of the functioning of the system one has to look at annex 15 ;Water-supply System

§ 5.2.2 Population

The used number of inhabitants of the city is 41,407.
With a number of 6,788 households, this gives 6 1 people per household
Calculated with growth rate of 3 5%, this gives 50,900 inhabitants in the year 2000 (see annex 4 ;Population).

§ 5.2.3 Water production

(See table 5 , Monthly Production of Water 1994)
The production of water for the month of May 1994 is 159,260 m^3

§ 5.2.4 Water consumption

The Water consumption of the city is calculated with the meter readings of May 94. Out of 3,796 connections the average use was computed and the total consumption of the 4,140 existing connections was estimated. An estimation was made because not all the reading books were available
Outcome. 116,042 m^3 (See annex 16 ;Not Accounted for Water-use - § 16 2.3 3 calculations.)

Table 1. Division of water-users and consumption

Type of connection	# Of consumers charged	Charged amount of water (m^3)	% Of total	Consumption m^3/con./month	%
Private	3922	71,086	68	18,1	1
Commercial	122	8,754	8	71,8	1
Public	55	2,539	2	46,2	1
Government	45	12,112	12	269,2	5
Industries	2	57	0	28,5	1
Multi-families	2	128	0	64,0	1
Hospitals	2	9,163	9	4581,5	90
	4,140	103,839	100	5,079	100

Source Results Desk study

§ 5.2.5 Charged water

According to the bookkeeping of INAA Juigalpa, the charged water-use is 103,839 m^3 (See table 6 ;Production versus Consumption INAA Juigalpa)

§ 5.2.6 System losses

The system losses were calculated through the division of the monthly consumption and -production of water. For the month of May '94 the losses were 27%

§ 5.2.7 Not functioning water meters

According to the computation of the meter readings for the month of May, 10.6% = 439, of the water-meters were not functioning or not readable.
These improper meters are most likely the cause of the difference between the water consumption and the charged water. (See annex 16 ;Not Accounted for Water-use, § 16.2 3 3 calculations)
Because of this, the monthly loss of payment amounts up to 14,640 Córdoba, the equivalent of 2,065 US$

§ 5.2.8 Number of connections

In the month of June 1994, 4,140 connections existed in the water-supply system.
These connections were subdivided as follows:

	# Conn.	Consumption (m^3)
Private connections	3922	84845
Commercial conn.	112	8754
Public conn.	55	2539
Governmental conn.	47	7616
Industrial conn.	2	128
Multi-family conn.	2	57
TOTAL	4140	103,839

§ 5.2.9 Water-use per capita per day

For household consumption, a total of 87,441 m_3 is used
(May '94 - charged water). This is 84% of the total amount of charged water
To establish the consumption per capita per day, 84% of 116,043 m^3 is divided by (41,407 * 30 (= population * time)). This gives a consumption of 76 l/c/d.

§ 5.2.10 Number of people per connection

With a total of 3,979 connections for household use, an average of 10.4 persons use one connection.
17,483 People have to fetch their water at a public tap-point or at another private tap-point.
2,866 Family's have no connection These family's don't all fetch water at the 55 private tap-points or at the 2 multi-family connections. Many buy water at houses who use their private connection as a water vending point Water bought at these points is far more expensive, up to twice the amount one would have to pay for water coming from a multi-family connection.

§ 5.3 Results of the field study

As a result of the field study, 9 different barrios where chosen This barrios where· Madrid, Sta.Ana, Sta Clara, Felipe Acoste, Virgen Maria, Nueva Amanecer, Hector Ugarte, La Tonga and Tamanes.

§ 5.4 Results of Field observation and Interviewing.

§ 5.4.1 Introduction

A total of 60 households participated in the observation and interviewing.
Results will be given in 2 parts First, outcomes of observation will be presented, secondly, the outcome of the 'format' and the interviews.
It has to be noted that the difference between the two 'sources' is vague at some points, because they were carried out simultaneously

§ 5.4.2 Differences between barrios

During the observations it was seen that differences between barrios regarding water-use, were hardly present, let alone significantly It was thought that differences in water-use depended mostly on differences in income of the users.

§ 5.4.3 Results of observations

§ 5.4.3.1 Introduction.

The observed facts are presented according to the 3 points of the needed information
A. How and how much water is used?
B. What different ways are there to store water on the compounds?
C. Degree of satisfaction
(see § 3.2 What information was needed)

Meter readings resulted in an established water-use in l/c/d, distinguished into 5 income classes. This is not solely the result of the observations, but as well a result of the interviews.

§ 5.4.3.2 Water-use per capita per day

Out of the meter readings, an average use of 84 l/c/d was found. This average includes a family with a per day consumption of 345 l/c/d. This is an extreme high consumption and influences the average consumption strongly.
Without this family, a consumption of 71 l/c/d is the average.
The real average consumption is supposed to lie somewhere in between this two figures (78 l/c/d). The relative reliability should not be seen as absolute correct, but the figures give a good indication. This is mainly cause by a low number of available data (60).

* Data per income class
The data given per income class are more reliable because of a smaller deviation between the consumption of the families within these classes.

Table 2. Consumption versus Income Class

INCOME CLASS	CONSUMPTION (l/c/d)	# OF READINGS
1	48	8
2	52	12
3	96 (!)	11
4	70	20
5	345	3

Source: Water-meter readings
Clearly a trend can be seen of an increase of the per capita use related to a the rise of the income.

* Bad use of drinking water
In the contrary of what was thought in the beginning, it was observed that not many people are using water in 'bad' ways, like wetting roads (dust protection) or watering their gardens with a great amount of water
Most water is lost by changing the old stored water when the new water comes, this because of the fact that the water only comes once every four days or even less often.
People with a private connection as well as people who obtain their water at a public tap-point, perform this habit, although it can be seen that families who obtain their water by fetching it by bucket, have less waste water. Often these are the poorer families

* Need versus availability of water
As can be concluded out of the fact that the people are changing water when new water comes, people have sufficient water in stock.
This means that the system supplies enough water to those who have direct access to a water connection
Households who have to buy their water at a water vending point, buy water up to a basic need level because the water is expensive When they would have easier access, they are expected to use more water (in l/c/d)
The water price is of greatest influence on the amount of obtained water.

§ 5.4.3.3 Water storage
Since the water system does not supply water continuously, water needs to be stored at household level. Favourable containersfor storage are buckets with a fitting lit and (oil)drums. Water for cooking and drinking is stored inside the house, mostly in the kitchen, and always well treated This means that water is stored in closed buckets, and that the place of storage is kept clean on a regular basis. People are mostly well aware of the health risks involving the storage of water used for consumption

Water, used for washing clothes, for cleaning the house and for bathing, is stored mostly outside the house. Drums are commonly used for this. A small percentage of the households are using concrete tanks in combination or in instead of drums.
In the contrary to the containers used for drinking water, these containers hardly have a well fitting cover. Often used items for covering drums and tanks are pieces of wood or metal and plastic.

Rainwater
The most simple and cheapest form of obtaining water, is using rainwater. Although many people in Juigalpa use rainwater, it is mostly done on an ad hoc base. Only very few households have a construction which enables them to fetch rainwater on an efficient and permanent base.
Rainwater can be stored for a long time without quality loss. To prevent an increase of breeding places for mosquitos, the tank openings have to be protected with special wire.
Once the health aspect is seriously encountered, rainwater can be a cheap and healthy alternative for water coming from the piped system. Although it would be best if no storage at all would be necessary. But since it is clear that private storage will be necessary for the foreseeable future, it is better to give options of storing water in a save way.

Rivers
Many citizens of Juigalpa have easy access to the rivers surrounding the city Of these, río Mayales is the most important. During the wet- as well as during the dry season, many woman wash their clothes in the river. Not only do they wash cloths, they also use it to bath themselves and there children Although very understandable, since the water is for free, it is at the same time a habit that should be discouraged since the contaminated river water can cause a great deal of health risking diseases.

§ 5.4.3.4 Degree of Satisfaction
People are concerned about the quality of the water they use. Some have doubts about the quality -9% Of the people believe that the piped potable water is causing diseases. This is probably the result of superstition; Source questionnaires, see § 18.4, Street opinion. -, but the majority is satisfied with the water quality.
People do complain about the frequency in which the water runs out of the taps Many households even suffer from the sporadic delivering of potable water during summertime. In the dry season it can occur that water comes only once every two weeks. This naturally results into problems, since it is impossible to store enough water of good quality for such a long period, especially when such a prolonged period is not predicted.

The dissatisfaction is not so high that it brings people to start changing the existing situation. A combination of indifference and lacking funds prevents people taking initiative in for example the construction of elevated storage tanks to have constant water pressure in the house

§ 5.5 Results of Questionnaires

§ 5.5.1 Introduction

Two inquiries (=questionnaire) were held, one in the dry season and one in the wet season. The 1st inquiry, of which 120 were printed, served as a test and to obtain data concerning the dry season. Not many results were derived from this specimen, since many of the questions were not crystal clear, which resulted in doubtful answers.
The 2nd inquiry, of which 850 pieces were distributed gave more useful results. Lack of time forced us to filter out the most important questions. The results of these questions are given below.

Out of the main questions of the inquiry, the results are drawn in 3 different manners of comparison:

1. Averages of the total number of questionnaires
2. Averages per income class
3. Averages per type of connection

Each of the above mentioned points is subdivided into the following aspects.

* general data
* water-storage
* degree of satisfaction
* financial aspects

The results will give a good view of how the people think about their water-use. For figures related to amounts of water, one should bare in mind that these represent the quantities that the people think they use. -It is known that it is difficult for people in general to estimate what their water consumption is - These amounts should therefore be used more as indicative figures instead of absolute numbers. The division of the use of water in percentages of the total average use per capita per day are more likely to correspond to the exact truth.

§ 5.5.2 Results of the first inquiry

* No of people per household	. 7.5 persons
* Average total water-use	49 l/c/d
* No of private connections	55%
* No of public connections	: 45%
* Degree of satisfaction, satisfied	. 58%
not satisfied	: 42%

Reasons for dissatisfaction: -Water does not come every day
-Water is too heavily chlorinated
-Water comes during the night

§ 5.5.3 Averages of the total number of questionnaires

To obtain the averages of the total number of inquiries, roughly 220 of the 280 returned filled in questionnaires were used. These specimens were filled in correctly for the individual questions.

§ 5.5.3.1 General data

* Number of people per household: 7
* Sources of drinking water: -private connection 77%
  -public connection 23%

Remarks:
- For a more detailed division in connections see table 8 annex 19.
- A public connection is not necessarily a public tap-point.

Sources of piped water other than a home connection can be considered a public connection too. All connections which are used by more households are considered public connections. When people for example obtain water at their neighbours private connection, they obtain water at a public tap-point.

* Average total water-use: 66 l/c/d

This figure is the average of the total water-use per person per day of all families in the involved in the questionnaire. It differs from the total of the results given in paragraph 5 5.3.2, because these are given only for the number of households who answered that particular question.

§ 5.5.3.2 Division of water-uses

Table 3.

USES	l/c/d	%
Cooking	3 2	5
Drinking	2.6	4
Dish washing	5	8
Cleaning house	6	8
Washing cloths	27	38
Washing hands	2	3
Bathing	16	23
Water closet	9	11

Table 4. Division of not frequently performed water-uses

USES	L/C/D	%
Gardens	7	37
Car washing	6	27
Animals	4	20
Other uses	3	16

(See also annex 20 table 15 and 16 distribution of water-uses 1 and 2)

§ 5.5.3.4 Water-storage

Table 5.

CONTAINER	PERCENTAGE OF HOUSEHOLDS USING A PARTICULAR TYPE OF CONTAINER
Buckets	73
Sinks	23
Tanks	49
Pots	22
Drums	93
Others	4

Remarks:

- The total exceeds 100% because all families use a combination of different containers.
- As can be seen, bucket and drum are highly favoured for storage
- The percentage of 'sink' is considered to be too low, because the Spanish translation of sink, 'pila' is also used for a big concrete tank.
- Many houses have a sink for washing cloths, dishes and utensils, sometimes they also use it to store water.
- Also the word tank has different meanings in Spanish, it signifies tank as well as a (oil)drum, thus increasing the percentage of (concrete) tanks.

§ 5.5.3.4 Degree of satisfaction

42% of the users are satisfied
58% of the users are not satisfied

People are satisfied because:
- The water is very useful
- The water comes to the house
- The water is of good quality

People are not satisfied because:
- The water does not come daily
- In the summer the water fails to come many times

What do the people wish to see improved?.
- Water on a daily basis
- More services for repairs and installation of new taps
- Higher water quality
- A lower price for the water

§ 5.5.3.5 Financial aspects

* 69% Of the users want to pay more if water is delivered every day
* As an average, these users are willing to pay 10.80 $C_{\$}$/month extra for an improved water system
* The price that people have to pay for a new connection is considered too high by 62 percent of the questioned

These results also say a lot about the degree of satisfaction of the water-users The Juigalpinos want to pay for 'every day water', which shows that this is an important point of failure of the system.

§ 5.5.4 Results related to income classes

§ 5.5.4.1 Introduction

As mentioned, the questionnaires were distributed through the different schools (private as well as public) The pupils of all these schools handed the questionnaires over to the (female) head of the family who filled it in. Since the investigators wanted to obtain an equal view of all the households of the city, it was checked that the inquiries were distributed equally over 'rich' as well as 'poor' schools. For this the visited schools were divided over three classes; rich, middle and poor
The real poor however were not reached through questionnaires since they do not have the money to send there children of to school.
Again, the results given below, should be used more as an indication than as exact reliable data Especially since the division is done rather roughly.

§ 5.5.4.2 General data

Table 6. Number of persons per household

RICH	MIDDLE	POOR
6.9	6 9	7.2

Table 7. Sources of potable water in relation to income classes

	RICH	MIDDLE	POOR
Private connection %	74	87	77
Public connection %	26	13	23
Total water-use l/c/d	67	58	67

§ 5.5.4.3 Division of uses of water per capita per day in %

Table 8. Income classes versus water-uses

	RICH	MIDDLE	POOR
Cooking %	4	5	6
Drinking %	4	3	5
Dish washing %	7	5	10
Cleaning house %	8	9	8
Washing cloths %	39	35	38
Washing hands %	3	1	4
Bathing %	25	18	24
Water closet %	10	24	6

Remarks. - The division of water is not given for the group of Gardens, Carwash, Animals, Others, because too little data were available

§ 5.5.4.4 Water storage

The water-storage differs only little between the three classes, the only aspect in which a difference exists is that rich people have relatively more tanks (55%) than poor people (20%) See also table 17 annex 19.

§ 5.5.4.5 Degree of satisfaction

Table 9. Income classes versus satisfaction

SATISFIED	RICH	MIDDLE	POOR
yes %	33	71	46
no %	67	29	64

Remarks: - It can be noted that middle class people are more content.

§ 5.5.4.6 Financial aspects

Table 10. Willingness to pay more for an improved water-system

	RICH	MIDDLE	POOR
Want to pay more %	75	53	68
How much more C_s/month	9.80	12.0	12.0
% Of hh who do not want a connection for 550 C_s	61	61	64

§ 5.5.5 Results related to the type of connection

§ 5.5.5.1 Introduction

Division in type of connection was made to discover wether there is a difference in water-use between a private and a public tap-point INAA thinks that a public tap-point has a lower per capita consumption than a private connection.

§ 5.5.5.2 General data

Table 11. Number of people per household:

PRIVATE CONNECTION	PUBLIC CONNECTION
7.0	6 9

Table 12. Total drinking water use per capita per day

PRIVATE CONNECTION	PUBLIC CONNECTION
68 l/c/d	72 l/c/d

§ 5.5.5.3 Use of water per capita per day divided over different uses

Table 13.	PRIVATE CONNECTION %	PUBLIC CONNECTION %
Cooking	4	6
Drinking	4	4
Dish washing	9	6
Cleaning house	10	7
Washing cloths	42	40
Washing hands	3	3
Bathing	19	23
Water closet	10	11

Remarks: - For the other uses see table 16-2 annex 19.

§ 5.5.5.4 Water storage

- same as the totals -

Also here the combination of buckets and drums is preferred strongly The hh with a private connection use slightly more buckets than drums.

§ 5.5.5.5 Degree of satisfaction

Table 14.	PRIVATE CONNECTION %	PUBLIC CONNECTION %
Satisfied, Yes	52	27
, No	48	73

§ 5.5.5.6 Financial aspects

Table 15.	PRIVATE CONNECTIONS	PUBLIC CONNECTIONS
Willingness to pay %	90	79
How much more C_s/month	13.95	14 30
% Of hh who do not want a connection for 550 C_s	71	68

§ 5.4.4 Results of interviews and water-use forms

§ 5.4.4.1 General data

Table 16. Number of people per household; related to income classes and total

Income class	1	2	3	4	5
No. of fam. members	8	8	6	5	5

* Total average: 6.7 c/hh

* Percentage of private connections: 45%

* Percentage of broken down water meters. 14%

* Total water-use in l/c/d; Own estimations: 45
Water-use forms: 48

This last figure of 48 litres is probably so much lower than the 78 l/c/d (derived from the meter readings) because of the fact that more than expected the used amounts of water were estimated instead of registered every single time.

§ 5.4.4.2 Water-use/capita/day according to people own estimations

Table 16.

USE	L/C/D	PERCENTAGE
Cooking	2.1	3
Drinking	1 6	2
Dish washing	4	6
Cleaning house	6	9
Washing cloths	38	55
Washing hands	1	1
Bathing	16	23

It showed out to be very difficult for the people to estimate their on water consumption Mostly too low estimations are given for the total water-use. When divided in different uses, a better estimations are given.

Water-use/capita/day based upon the water-use forms

Table 17.	USE L/C/D	PERCENTAGE
Cooking	2 2	3
Drinking	1.7	2
Dish washing	4	6
Cleaning house	6	9
Washing cloths	27	39
Washing hands	2	3
Bathing	12	17
Water closet	15	21

Remarks: - The water-use forms give a more realistic deviation in % of the water consumption for the different water-uses.

§ 5.4.4.3 Water storage

Table 18

	# OF FAMILIES USING A PART TYPE	LITRES/FAMILY AVERAGE	MAJOR USE OF WATER
Bucket	51	55 (3 buckets)	Drinking & Cooking 62%
Sink	-	-	-
Tank	11	1666	-
Pots	6	22	Drinking (and cooking)
Drums	48	426	All except Cooking and Drinking 56% Washing and Bathing 17% Cooking and Drinking 6%

Remarks. - It can be noted that people mostly store their water in buckets and (oil)drums Per family an average of 3 buckets (55 litres) and almost 2 drums (426 litres) is used
The findings show a lot of similarity with paragraph 5.4.3.3, water storage

§ 5.4.4.4 Degree of satisfaction

The results are the same as given in paragraph 5 4.3.4.

§ 5.4.4.5 Financial aspects

Many of the 'poor' families who were interviewed, considered the price for a connection at the water system as being too high.
Striking enough however, this group pays the highest price for potable water. When they fetch their water from a public tap-point, they pay up to C_s 0.50 per bucket of 20 litre water. This sums up to a price of 25 córdoba per m^3, which is more than 20 times as expensive as one single cubic meter obtained directly from INAA through a private connection. See also annex 23 Observation of public tap-points.

§ 5.6 Verification and reliability analysis for the obtained results

§ 5.6.1 Introduction

In this paragraph, the overall results of the research will be given. This is the most important paragraph for everyone who is especially interested in the gathered data.
The results of the different manners of collecting data, will be compared with each other according to the five points used in the previous paragraphs

- General data
- Water-use
- Water storage
- Degree of satisfaction
- Financial aspects

Because the needed information was obtained through different collecting methods, the comparison of these is supposed to give reliable outcome which corresponds mostly to reality.
Each outcome will be analyzed for its reliability, some of the results of the separated findings are at least doubtful, to be able to make statistically justified statements

Results that do not fall under the 5 mentioned points, will not be verified. They can be found in the separated paragraphs with results (§ 5 2 Results of desk study; §5 3 Results of the field study, paragraph 5 4; Results of field observation and interviewing and § 5.5 Results of questionnaires).

§ 5.6.2 Verified general data

* Population
As mentioned in § 5.2.2 and in annex 4 (population) a number of 41,407 inhabitants is used for the city of Juigalpa
This figure is obtained by multiplying the no. of households according to MINSA (6 788) and an amount of 6.1 people per household (see annex 4 populations).
- Reliability An amount of 41,407 inhabitants seems to be appropriate for the city, although, it is not a 'hard figure'
MINSA is trying to register all the inhabitants of the city, but comes up with a figure of 5 1 people per household

This number is too low when compared to the results of questionnaires and interviews (which are quite reliable although the # of reached families is not very big). A average of 6.1 people per household seems more appropriate. Taking into account that only the figure for the amount of households (6,788) seems to be of sufficient reliability, the number of inhabitants of Juigalpa is not sure enough yet. Nevertheless it is used in the calculations, since it is the best available figure.

* population growth
(see annex 4 § 4.6 ;population growth)
The growth percentage of 3 5 % comes from the statistic board of the MINSA.
In the year 2000, Juigalpa will have around 50,900 inhabitants.
-Reliability: It is difficult to say how many inhabitants the city will have in the year 2000, when even the figure for the year 1994 is not sure.
Moreover, population growth depends on many (economical as well as social) factors. It is therefore that only a 6-year prognosis is given.

Table 19. Number of people per household

INTERVIEWS	QUESTIONNAIRES	MINSA	VERIFIED
6 7	7.0	5 1	6.1

A figure of 6.1 p/hh is used to calculate with This is an average of the results of the questionnaires and the figure of the MINSA The outcome of the interviews was not taken into account, because it was not available when the calculations where made
A figure of 6 1 p/hh is still seen as appropriate.

Table 20 Sources of drinking water

	DESK STUDY	INTERVIEWS	QUESTION-NAIRES	VERIFIED
PRIVATE CONN.	93%	45%	77%	61%
PUBLIC CONN	3%	55%	23%	39%

-Reliability. The figures found with the desk study differ from the percentages discovered with interviews and questionnaires, because of a different definition for a private connection. In the interviews and questionnaires, a connection was called public when the water was used for more than one household, even when it officially was a private connection
When people obtained water at their neighbours private connection, the connection was called a public.
The average between interviewing and questionnaires is considered to be the most appropriate figure.
61 % Of the hh have a private connection, used by their family only

Table 21. Average total water use
DESK

DESK	DESK STUDY	METER READINGS	INTER-VIEWS	QUESTI-ONNAIRES	VERIFIED
WATER-USE	76 (l/c/d)	78 (l/c/d)	48 (l/c/d)	66 (l/c/d)	71 (l/c/d)

-The desk study gives the most reliable water-use in l/c/d, although it is computed with a few uncertainties. Not all the meter readings were available at INAA and the percentage of water for household use was calculated out of the 'invoice books' of INAA.

-Meter readings done in the different barrios give nearly the same outcome. But because of the small number of read meters and the influence of one extreme high figure that was included, the outcome is likely to be a bit on the high side But still it gives a very good idea.

-The total water use obtained with the water use forms is considered too low. Many people forgot to fill in the forms at the moment they use water and they gave an estimation of their consumption afterwards. Mostly, people estimate their Water consumption too low, as was found out during the observations and interviewing. The authors as well tried to fill in water-use forms for their own water use. It appeared hard to fill it in correctly and too low uses were easily registered.
Although the resulted total figure is lower than in reality it is given to give an indication of the result of using water-use forms. In the authors opinion Water-use forms can give very useful extra information if they are used in high enough numbers and if a the use is regularly checked in the field. During the research it was found that a percentage of roughly 30 filled in the forms consciously.
The total water-use found to be 48 litres/capita/day.

-The Outcome of the questionnaires gives an average of 66 l/c/d
As stated above, people easily estimate their water uses too low. Because the question for the people was to fill in the water consumption for the whole family and distinguished over different uses, estimations are likely to be rather precisely, especially when divided by the number of family members.
Nevertheless 66 l/c/d still is a (bit) too low figure

Since it is a habit to change the water that is left in the storage when new water comes, the average water use will be lower than 76 l/c/d (which is the average consumption)
An appropriate estimation for the amount of waste water is 5 l/c/d. This figure was the result of observations.
This means that the average water use lies around the 71 l/c/d, which gives an under-estimation of 5 l/c/d for the result of the questionnaires

* It should be noticed that this figures are estimations, made according to what was observed during the research. The significance can not be guarantied in litres, but the figures will lie within a range of 5 l/c/d difference.

Extracted is a figure of 71 l/c/d for the average total water use and 76 l/c/d for the average total water consumption.
This means that an average family wastes 31 litres of water per day.

§ 5.6.3 Use of water in l/c/d, divided in different uses.
Table 22.

	WATER-USE FORMS		QUESTION-NAIRES		INTERVIEWS		VERIFIED	
	L/C/D	%	L/C/D	%	L/C/D	%	L/C/D	%
COOK	2.2	3	3.2	5	2.1	3	2.8	4
DRIN-KING	1.7	2	2.2	4	1.6	2	2.1	3
DISH WASH	4	6	5	8	4	6	5	7
CL. HOUSE	6	9	6	8	6	9	6	9
WASH CLOTHS	27	39	27	38	38	55	28	39
WASH HANDS	2	3	2	3	1	1	2	3
BATH	12	17	16	23	16	23	14	20
TOILET	15	21	9	11	-	-	11	15

Remarks - Striking is that the division in percentage of the total use between the outcomes of the inquiry and the outcomes of the questionnaires is very small while the total water uses in l/c/d differ much!! (48 l/c/d versus. 66 l/c/d)

This means that a division in water-use given in percentages gives the key to a deviation in l/c/d when an average total water-use (in l/c/d) is given!!

The deviation in percentages is not strongly influenced by the height of the total water-use, except when this is extremely low.

Table 23.	USE (In % of total use)
Cooking	4
Drinking	3
Dish washing	7
Cleaning house	9
Washing cloths	39
Washing hands	3
Bathing	20
Water closet	15

Remarks: - Not all the households perform all of the described uses of water. There are, e.g., families who wash their cloths at the river. Although this influences the deviation in percents, ti is still possible to give an indication for the water-use in l/c/d, when the total water-use is known.

§ 5.6.4 Water storage

Table 24	INQUIRY	QUESTIONNAIRES	VERIFIED
Bucket	85 %	73 %	79 %
Sink	-	23 %	23 %
Tank	18 %	49 %	34 %
Pots	10 %	22 %	16 %
Drums	80 %	93 %	87 %
Others	-	4 %	4 %

Remarks: - The total of the percentages exceed the 100 % because many families use more water containers simultaneously.
Bucket and drum are highly favoured.

- Water for cooking and drinking is mostly stored in buckets, mostly inside the house. The place of the storage is kept reasonably clean, although from hygienical view, the storage of water should be discouraged since the water will easily be contaminated.

- Water for cleaning-uses and personal hygiene is usually stored in drums (see § 5 4 3 3 Water storage) and mostly outside the house.
The storage place is often muddy and thus a breeding place for mosquitos.

§ 5.6.5 Degree of satisfaction

Table 25.	QUESTIONNAIRES
Satisfied	42 %
Not satisfied	58 %

Reasons for satisfaction:

1) The water is useful
2) The water comes to the homes
3) The water is of good quality

Reasons for being not satisfied:

1) The water does not come daily
2) In the summer the water fails many times

Wishes of the people for improvement of the water system:

1) Water on a daily or 2- daily base
2) More service for reparations and constructions of new taps for household use.
3) More hygienic water.
4) A lower water price

-Reliability: The data and opinions given by the people are likely to be trustworthy

Note. 58 % of the families are not satisfied about the water supply, this does not mean that these people really dislike the system It gives more an indication of the amount of people who want to improve the water supply system.

§ 5.6.6 Financial aspects

Table 26.

	QUESTIONNAIRES			
	RICH	MIDDLE	POOR	VERIFIED
Want to pay more	75 %	53 %	68 %	69 %
How much more/month	9.80 C_s	12.0	12.0	10.80
No. conn. for C_s 55O	61 %	61 %	64 %	62 %

Remarks: - 69 % of the people wants to pay more when the system supplies water every day This 69 % is prepared to give C_s 10.8 more per month

Remarkably, the 'middle' and the 'poor' class are prepared to pay C_s 2 20 per month more than the 'rich' people. Perhaps this is because they are in a worse position concerning water than the 'rich' and are more in need of improvement.

Out of this "willingness to pay" can also be concluded that the people really long for a continuous water supply.

62 % Of the families consider a price of C_s 550,- too high for a new connection.

CHAPTER 6 CONCLUSIONS

§ 6.1 Introduction

The conclusions will be given in order of importance, and where possible, in a logical relation to each other.

§ 6.2 Conclusions general

1. Juigalpa has a number of 41,407 inhabitants (1994)

2. Total average water consumption = 76 l/c/d

3. Total average water use = 71 l/c/d

4. 'Water losses '(max) = 5 l/c/d
   = 6,211 m^3/month
   This opens opportunities for saving water, for example through educating the people (campaign 'Fuente de Amor') see recommendations

5 On the contrary of what was initially thought, are the losses of water at household level not very high, see point 5. The greatest part of the lost water in Juigalpa is caused by the other (161) users Especially the hospitals and commercial users like the filling stations use the water very inefficiently. A saving in lost water is more efficiently done by checking the use of the big users, instead of checking at household level.

6 27 Percent of the water that is pumped up from the pumping fields does not reach the consumers These system losses are due to leaks in the pipes and connections.

7 The percentage of water meters which are not functioning properly is 14 These broken meters are for a great deal the cause of the so-called 'not accounted for water'

8. A view of the specific losses of water in the piped system is missing. There are water meters installed at the beginning (pump field) and at the end of the system (household meters) Water meters to check the 'behaviour' of the water between these two points do not exist.

9. Average total use for private connection = 68 l/c/d
Average total use for public connection = 72 l/c/d

The water-use of a public connection (in l/c/d) is higher than the water-use (in l/c/d) of a private connection.
This means that the construction of more private connections will give a reduction in water consumption

10. A trend can be seen in a higher per capita use with the rise of the income (see § 5.4.3.2)

§ 6.3 Average water-use, divided over the different uses

11 The division of the used water over the different uses can best be given in percentages of the total use, since this gives the most reliable outcome.

Table 27.

USE	PERCENTAGE OF TOTAL USE
Cooking	4
Drinking	3
Dish washing	7
Cleaning house	9
Washing cloths	39
Washing hands	3
Bathing	20
water closet	15

For the other uses, a separated balance is made. These uses are performed on such a low frequency, that a proportional outcome will give a false idea of reality Moreover, these figures are given separately, because the uses are not personal.

Table 28.

USE	LITRES PER DAY
Gardens	43
Car washing	37
Animals	24
Other uses	18

Not every household has all the water-uses Many families wash their cloths at the river and others only use a small amount for their water closet (latrine) This means that the total average water-use is lower than the sum of the separated uses.

§ 6.4 Water storage

12 Favoured containers for water storage are bucket and (oil)drum
The buckets are mostly used to store water for drinking and cooking, and are almost always covered with an appropriate lit. The majority of the households store the buckets inside, mainly in or close to the kitchen at a clean spot.
The average storage in buckets was found out to be 55 litres (3 buckets).

Pots are as well used to store water for drinking Although pots can be considered safe containers for the storage of potable consumption water, only 10% of the households use them.

Drums are used to store water for 'cleaning uses' and personal hygiene (bathing). Often these are placed outside the house on the compound Less attention is payed to the hygiene aspect of this water. Storage places are sometimes muddy and most drums lack a proper cover. The average storage amount in drums was found to be 426 litres, almost 2 drums

13 Constructions to improve the water situation at household level are seldom seen
- Some hh have permanent gutters for the collection of rainwater, but the majority of the families catches rain water on an ad hoc basis
- Elevated tanks are nearly not seen at household level
- Inside taps are scarce

14 People are not content with the fact that they have to store the water. They are concerned about the quality of the water when stored for some days.

§ 6.5 Degree of satisfaction

15. 58% Of the people is not satisfied with the water supply.

16. The main reason for the users to be not satisfied, is that the water does not come on a daily basis.

17. The water is considered to be of good quality, but some people still think that the water out of the piped system causes diseases, probably due to superstition.

18. Points of improvement for the water supply system and the INAA organization, suggested by the people·
- Delivering of piped potable water on a daily basis
- More and better service provided by INAA for repairs and the installation of new taps and lines, for household use.
- The quality of the water needs to be higher, more hygienic
- The price of the potable water has to be lowered

§ 6.6 Financial aspects

19. The price of 550 córdoba for a new connection is considered too high by 62% of the families

20. 69% Of the people are prepared to pay C_s 10.80 more per month when the system would supply water every day

21. Families who don't have direct access to a water connection pay up to 20 times as much for one cubic meter of potable water (25 córdobas) as do households who have their own connection (1.20 C_s).

CHAPTER 7 RECOMMENDATIONS

§ 7.1 Introduction

As stated in chapter 1, § 1.4 aim of the research (see also annex 5 § 5.3. The research), the recommendation will be divided into 3 distinct parts.

I Institutional recommendations
II Financial recommendations
III Technical recommendations

The institutional as well as the financial recommendations will mostly aim at institutional improvement of the INAA organization, - a 'large-scale' solution for the water problem.

The technical recommendations are as well given at scheme-level as well as for household use.

Most recommendations are aimed at the realization of a continuous water supply of the water system, since the non-existence of such a permanent supply is seen as problem no. 1 by the users

§ 7.2 Institutional recommendations

1 To obtain a reliable figure of the population of the city of Juigalpa, it is strongly recommended that all institutions /offices /organizations who need correct data concerning population and population growth (INAA, Municipality, MINSA, INE, TELCOR) join together and agree upon what figure is used, or which method should be used to investigate this very important aspect.

2. As described in annex 8: INAA Organization structure, a top down organized structure has lots of disadvantages when it comes down to the ability of that organization to adapt to local situations and people.
Although is realized who difficult it will be, it is recommended to change the INAA National-Local structure in such a way that the local offices can work much more independently They should be able to make their own water- tariff, be more able to meet the wishes of their clients, provide a better service by adapting to the local situation etc. It is not the intention to propose a complete change of the structure of INAA, just a greater deal of independence. In this way the advantages of a top-down structure will be combined with the advantages of decentralized organization

3. The aim of the campaign 'Fuente the Amor' should be the education of the people in the city about the cause of water-related problems (e.g. diseases) and to stimulate people to use only the water they really need. The campaign coordinators must be aware that within the view of the authors, the public, or 'small water-users', is not responsible for a high level of water losses due to car washing or watering the garden. It is more likely that these losses are the responsibility of the 'big' users

4. Since it is still not known precisely where and how much water is lost in the system, it is recommended that this is further investigated. Strongly bearing in mind the theory given in annex 17: system losses check. At the same time a better view can be obtained of the possible water losses of 'big' users like the hospitals and other commercial users.

5. To lower the risk of copying mistakes while administering the obtained data from the water meters, only one 'book' should be used to administer the data in instead of the actual two. INAA should be responsible for writing the monthly water bills as well.

§ 7.3 Financial recommendations

6. Since 62% of the people considers C_s 550,- for a new connection as being too expensive, a lower price has to be set. A price lower than C_s 400,- is advised. The price should be set in consultation with all involved parties, with an accent on the users.
With more connections, INAA can sell more water. This will neutralize the lower income because of cheaper meter installations

7. Making a new progressive tariff setting to have a more justified relation between the price of water and the use.
= It should be noticed that a new water tariff can only be implemented when the system really supplies water to the whole city every day! =
An example of a new progressive tariff is given in annex 21 · New water tariff. The price of basic use of water is lowered
while connections with a high use pay relatively more. This will lead to a more conscious use

8. To avoid 'water trade' in the city, it should be strived for to give all families direct access to piped water supply.
Recommended is to lower the price of a connection so that the poor households can afford to buy one.
With constructing more connections the system also becomes more controllable

§ 7.4 Technical recommendations

§ 7.4.1 Introduction

The technical recommendations given are divided in recommendations at system level and recommendations at household level.
The last are suggestions for the people who want to improve their family water situation on a short-term (< 1 year)

§ 7.4.2 Technical recommendations at system level

Since all recommendations are given to improve the reliability of the system, all these recommendations aid at a water supply system which can ensure continuous water flow

9. To alleviate the shortage of water in the low pressure part, a storage tank should be build. During the night time it can store the water which is not used
   Ideal size of the tank is: 8 * 735 m^3 . 24 hours = 249 m^3 (= 62,250 Gallons).

10. For a better use of the two existing storage tanks, -which are now positioned at the tail-end of the line, and therefore hardly filled during the night- they should preferably have a direct connection coming from the main pipe entering the town

11. To meet the increase of use of water, the search for new water sources should continue. The production has to be increased in the coming years from the actual 950 GPM to a level of 1260 GPM

12. 426 Not functioning water meters should be replaced to increase the controllability of the system

13 To increase the controllability and reliability of the system furthermore, at strategic points in the system master meters should be installed as suggested in annex 17: System losses check.

§ 7.4.3 Technical recommendations at household level

§ 7.4.3.1 Introduction

Since the users of the water can only wait for an improvement of the water supply system, thoughts were spent on how to enable the people to improve their household water situation with relatively simple techniques.
There are three sides to this
First of all should the increase of private tanks be discouraged from the health point of view

Secondly, an increase of storage capacity could people bring to perform less effort in improving the piped system and or provided service.
But most important, people should be helped in improving their living standard. In this case it means giving information of modern and save storage facilities.

§ 7.4.3.2 Recommendations

14. Giving information about the advantages of well constructed elevated tanks who give a constant water pressure.

15. Automatic valve-systems can be installed to reduce to amount of lost water. For a design see annex 22. Note: this design works only with a high water pressure, as was found out during tests.

16. For a more hygienic storage of water, concrete tanks should have well fitting cover, preferably made of concrete.

17. Test construction of an ferrocement elevated tank with an automatic valve.
This test can show how the design works out in practise, what the problems are in practice and if this design can also compete with the price of ordinary tanks.

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