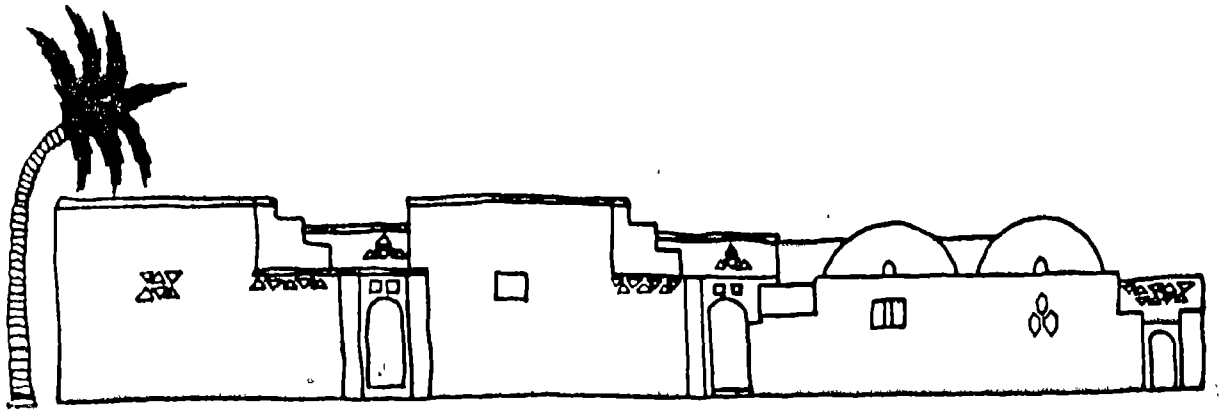
United Nations Children's Fund
(UNICEF)

ASSESSMENT OF THE IMPACT OF A COMBINED WATER AND SANITATION PROGRAMME IN UPPER EGYPT

PROXIMATE IMPACT ANALYSIS

Environmental Sanitation Survey



IWACO
Consultants for Water and Environment

SPAAC
Social Planning, Analysis & Administration Consultants

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List of abbreviations and terms

Ezba	-	Satellite villages, consisting of some 40- 100 households
IWACO B.V.	-	Consultants for Water and Environment, Rotterdam, The Netherlands
SPAAC	-	Social Planning, Analysis and Administration Consultants, Cairo, Egypt
UNICEF	-	United Nations Children's Fund
Zir	-	Locally used (earthenware) container for storage of water

1 INTRODUCTION

1.1 BACKGROUND

General

Diarrhoeal illness is a major cause of both morbidity and mortality among young children in Egypt. Preventive actions to reduce the incidence of diarrhoea in young children have been carried out by UNICEF in conjunction with the National Diarrhoeal Disease Control Project, implemented by the Egyptian government. This programme included among others the provision of water supply and sanitation and the promotion of personal and domestic hygiene, as these interventions are believed to help reduce the occurrence of childhood diarrhoea. However, so far the impact of such a combined water and sanitation hardware programme in conjunction with hygiene education has yet to be satisfactorily documented.
UNICEF has, for nearly ten years, conducted a programme for provision of safe water and family latrines to remote populations of Upper Egypt. During the next two years UNICEF plans to intensify this effort and will integrate an intensive programme of water hygiene education with the provision of India Mark II handpumps and family pit latrines to additional remote areas of Upper Egypt not yet served by the UNICEF programme. This programme provides an ideal setting in which to evaluate the impact of a combined programme on water and sanitation (including hygiene) practices and on childhood diarrhoeal rates.

Hence, within the 1990-1994 Plan of Action for the Village Water Supply and Sanitation Programme of Upper Egypt, a large scale combined intervention/research programme was planned aimed at evaluating the impact of UNICEF water supply and sanitation programmes in Upper Egypt.

UNICEF has contracted SPAAC, an Egyptian consultant in the field of social planning, data collection, etc., to implement its assessment of a combined water and sanitation programme in Upper Egypt. SPAAC is responsible for the data collection -and processing aspects of the project, while UNICEF is charge of implementing the hardware and educational aspects of the intervention. SPAAC has sub-contracted IWACO B.V., Rotterdam, of the Netherlands, for the environmental sanitation aspects of the study.

Research project in Assyut

The main objective of this action-research programme as mentioned in the previous section is :

"To assess to what extent childhood diarrhoea is reduced by the delivery of hardware facilities which improve water quality, water availability and excreta disposal, and also including an intensive educational package directed toward improving behaviours concerning water use and personal and domestic hygiene"

The study was designed as a randomized, controlled experiment which will assess the several impacts of an intervention consisting of water-hygiene education and the provision of handpumps and latrines. In this experiment, which is being conducted in the Assyut governorate, in Upper Egypt, 20 satellite villages were individually randomized to receive the intervention (10 villages) or to receive no intervention (10 villages). At the end of the surveillance, all control villages will be offered the same intervention received by the experimental villages. Thus, this study includes features of a controlled trial within a phased programme in which all participating villages will ultimately have the opportunity to benefit from the intervention.

Baseline data were acquired during the period immediately before the initiation of the intervention in the intervention community, and during the same period for the control community. During this period (called the "baseline period"), the census of the villages was updated, and detailed socio-demographic information collected. A single on-site visit was conducted to ascertain behaviours relevant to water use, environmental cleanliness, and personal hygiene, and also to characterize each village with respect to traditional water pumps, bacteriological and chemical quality of water produced by these pumps, and facilities for defecation. Knowledge and beliefs regarding water use and sanitation were surveyed in selected community members. Moreover, children under three years (the target group for the health impact analysis) were assessed for certain characteristics relevant to the risk of diarrhoea (breastfeeding, immunization status, and nutritional status), and will be visited weekly to ascertain histories about diarrhoeal illnesses.

Immediately following the baseline period in each matched pair of villages, the intervention began in the intervention village.
An attempt was made to provide each household with a latrine and to provide one handpump for every 8-10 households in the village. For the hardware construction a period of 4 weeks was generally realized by UNICEF. The educational programme, which focused on communication of messages related to hand washing, proper storage of drinking water, disposal of faeces, cleanliness of the compound, proper care of baby bottles, as well as use and maintenance of the hardware facilities, continued after the hardware was installed.

Surveillance for outcomes started after the implementation of the intervention, both in the intervention community and in the control community matched to the intervention community. This period of surveillance was extend for about 1 year after completion of hardware installation for each intervention community (a datemark called "zero time" for each type of community). Outcome surveillances were performed 3, 6 and 11 months after the intervention.
Teams made on-site observations of target behaviours related to water use and hygiene, as well as environmental cleanliness and tube well water quality and use for both intervention and control villages. Knowledge and beliefs regarding water use and sanitation were assessed among selected intervention and control community members employing a similar time schedule. Diarrhoea in all children under the age of 3 years was monitored in all villages via weekly surveillance, and diarrhoea risk factors

(breastfeeding status, immunization status, nutritional status) are periodically assessed. In addition to these procedures, which were implemented during the baseline period as well, several special surveillance procedures were employed. All communities were monitored continuously for the occurrence of vital events. Moreover, the use and maintenance of the newly installed facilities were ascertained for the intervention communities. Finally, diffusion of educational messages between intervention and control communities was assessed.

The above-mentioned general set-up of the impact study is abstracted from the detailed research design "A research design for assessment of the impact of a combined water-sanitation programme in Upper Egypt". This research design was written for UNICEF by a team of Consultants sponsored by UNICEF, the Water and Sanitation for Health (WASH) Project, and the National Control of Diarrhoea Diseases Project.

For further details of the study reference is made to the above-mentioned document.

Environmental Sanitation Survey

The major part of the scope of work is the described in the research design under the headings of "On-site Environmental Observations" (page 38,39 for the baseline period and pages 66-71 for the outcome surveillances). Under these headings the following components are described :

- assessment of hand pumps and latrines;
- assessment of environmental conditions in the house;
- assessment of water quality.

The above mentioned components of "Hand pumps and latrines" and "Environmental conditions in the House" are described in separate sections of the research design. However, the Consultant proposed another division of the aspects to be covered in the fieldwork. Since it was assumed that the traditional hand pumps were sometimes used as communal facilities, these hand pumps were therefore not part of a specific household. This would especially be the case for the new hand pumps (after intervention) which were to be implemented as communal/shared facilities. The latrines, however, were expected to be part of a specific household. Communal latrines were not common in the project area.
Considering the above, it was proposed to and approved by the Project's Principal in charge, to include all observations which are related to one specific household in only one observation list/form. The observations concerning all pumps (traditional and new) were therefor executed separately and use was made of separate observation forms.
Assessment of water quality was carried out on water samples taken from hand pumps and zirs of selected observation households.
In addition, the Environmental Sanitation Team was assigned with the task of observing the "water use at the pump" of selected observation households.
These above-mentioned observations were executed both during the baseline study as well as during the outcome surveillances.

Furthermore the Environmental Sanitation Team was assigned to take samples of all the newly constructed hand pumps of UNICEF. The samples were taken after completion of the well construction.
With respect to the water quality assessment, some additional testing was carried out. For more details on these activities reference is made to the Technical Annex on Water Quality Investigations.

The team responsible for the activities as mentioned above consisted of 5 people. The following jobs were covered by the team :

1. Team Supervisor
2. Data collector 1
3. Data collector 2
4. Data collector 3
5. Laboratory analyst (although given a supervisor status, she is considered part of the team)

Besides, 4 additional data collectors were recruited for the observations of water use at the pump.

For more details on the design and methods of data collection, data quality control and data entry, reference is made to the Data Management Report for the Environmental Sanitation Survey.

1.2 THIS REPORT

The main purpose of the Research Project is to produce good quality data on a great number of variables concerning child-morbidity, socio-demography, water- sanitation behaviours, knowledge and beliefs about water use and sanitation, environmental contamination and water quality, before and after a community intervention entailing hardware (India Mark II hand-pumps and pit latrines) and software (Health education). The fundamental question here is, does such an intervention reduce diarrhoeal morbidity in children aged under 3 years.

IWACO provides consultancy services and support to the Environmental Sanitation Team, in their effort to establish a clean data base for the Environmental Sanitation Survey. In addition, as agreed upon with the Principal in charge, IWACO provides a report on the management of data obtained (see Data Management Report, August 1991). Furthermore, some preliminary simple data analyses should be conducted and reported, based on the research design. In this, under the heading "Analyses" (page 73-76), the following is described:

4.10.2 Analyses of the Impact of the Intervention

Analyses of the impact will begin with the assessment of baseline comparability of the intervention and control communities. These will be followed by simple analyses of the impact of the intervention upon relevant....., environmental parameters.

2 BASELINE COMPARISONS FOR ALL VILLAGES

2.1 INTRODUCTION

This chapter provides information about the comparability between all experimental and all control villages at base-line, with respect to the following environmental sanitation variables :

- environmental conditions in house;
- use and condition of latrines;
- use and condition of hand-pumps;
- water quality of handpumps and zirs;
- quantities of handpump water used.

For the analysis of the equality at base-line the following methods of analysis were used:

- Using the SPSS package for statistical processing of data, a Chi-squared test for intervention vs. control comparison was performed. Significance was tested using a 95 % confidence interval (i.e. if $p < 0.05$ a statistically significant difference is proven).
- If the outcome of a variable is a symbol, such as 1, 2, 3, which represents a prescribed value (e.g. 1 = yes, 2 = no), the Chi-squared test for significance was used.
- If the outcome of a variable could be any value between a given range (e.g. pH value of water can assume any value between 0-14, the number of times people collect water can assume any value above 0), the Chi-squared test is not appropriate. In these cases the range, the median, the mean (the arithmetic average) and the standard deviation are given.
- Note: results are analyzed on the basis of responses (i.e. missing values are excluded)

For purposes of presentation the following method is used:

- If the Chi-squared test was applied, outcomes for each variable are presented for both intervention and control villages adjacently, using frequency tabulations. If a statistically significant difference was found, a mark is given (#).
- If no Chi-squared test was applied, the range, median, mean and standard deviation are presented for the outcomes of each variable, for both intervention and control village respectively.

For a number of key-variables a large amount of indicators was observed (e.g. to determine the environmental cleanliness in the house, or the state of maintenance of pumps). However, by comparing all of these individual indicators no overall, comprehensive conclusions can be drawn. For this purpose an index was calculated. This method entailed giving a negative rating each time an indicator was thought to have a bad impact (the rating system for each type of index is explained in Annex 2.1).

The indexes are evaluated on a scale of 0 - 1. The scale is divided into five portions, representing the following values :

- 0 - 0.20 good
- 0.21 - 0.40 fairly good
- 0.41 - 0.60 average
- 0.61 - 0.80 fairly bad
- 0.81 - 1.00 bad

2.2 SUMMARY OF FINDINGS AND CONCLUSIONS

With respect to the environmental conditions in the house/compound both control and intervention villages present an overall image of less hygienic conditions (high prevalence of water ponding, garbage, animals and animal faeces in the living/working areas). However, it should be noted that the intervention villages haver significantly higher numbers of animals living in the house/compound. This situation poses a higher public health risk.

Concerning the presence and conditions of latrines, both the intervention and control communities show a substantially high prevalence of latrines (around 60 %). The sanitary conditions of these latrines are fairly good for both types of villages, although the intervention households score somewhat less good.
Another interesting observation concerns the use of the latrine for bathing (40 - 50 % of the households) and discharge of waste water (10 -15 % of the households). With respect to these practices, the selected type of latrine (dry-composting pit latrine) that was implemented by UNICEF is thought to be less appropriate since these latrines should be kept as dry as possible.

With regard to the availability and state of maintenance of the handpumps, it can be concluded that in the intervention villages there are significantly more pumps available. The pump density for intervention villages was 0.53 per household, whereas in the control areas there were 0.42 pumps available per household. Almost all pumps are working (90 - 95 %), although in the control villages a significantly higher portion of the pumps did not give water.
Both the intervention and control communities score average on the maintenance index and show fairly poor sanitary conditions at the pump-site. Both of these situations cause an increased health hazard, due to possible contamination of the well.

Regarding the use of handpump water it is concluded that the sentinel households in the intervention villages collect slightly more water than those in the control villages. The total volume collected is relatively low (less than 20 litres/capita/day) for both types of households compared with WHO guidelines.
In the majority of cases the containers for collecting water are washed, but not closed. With respect to other water use, hygienic practices and persons collecting the water a similar pattern was found in both intervention and control households.

2.3 ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS

In order to assess the environmental conditions in the house/compound, several key variables were identified that are indicative for the environmental cleanliness and are thought to influence the risk of diarrhoea contamination:

1. Cleanliness of working/living areas.
2. Presence of a provision for animals.
3. Presence of a provision for garbage disposal.
4. Presence, use and condition of a special provision for discharge of used water.
5. Presence of a pump.
6. Presence, use and condition of a special container for water storage.
7. Presence and condition of a special provision for hand washing.
8. Presence and condition of a latrine.

Below, the findings and conclusions are presented for each of the above mentioned key variables, for both control and intervention villages.

1. Cleanliness of working/living areas :

For all working/living areas (place for cooking, washing kitchen utensils, washing clothes, eating, bathing and sleeping) it is assessed (observed) whether a special and separated place is provided inside the house/compound and whether animals, animal faeces or garbage are visible at these places. For some activities (washing kitchen utensils and clothes and bathing) their place can be precised (whether it is at the pump or latrine).

In order to draw an overall conclusion about the cleanliness of living/working areas in the house/compound, a sanitary index for in house environmental conditions was calculated. For more details on the method of calculation reference is made to Annex 2.1.
The sanitary index (see Table 2.2) indicates that both control and intervention villages score in the same range (average conditions). However, the intervention villages score somewhat higher (i.e. sanitary conditions are worse) than the control villages.

On examination of the individual observations (see Table 2.1) it can be concluded that especially for the area for cooking, the environmental conditions in the experimental villages are significantly worse.
This is of particular interest for the impact analyses of the intervention, since the health education component paid special attention to the prevention of food contamination (i.e. clean cooking area).

Another interesting observation concerns the use of the latrine for bathing (40 - 50 % of the households). With respect to this practice, the selected type of latrine (dry-composting pit latrine) that was implemented by UNICEF is thought to be less appropriate since these latrines should be kept as dry as possible.

TABLE 2.1 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR IN ALL HOUSEHOLDS DURING BASELINE - Cleanliness living areas -

Q*	INTERV. NR.	%	CONTROL NR.	%	S #
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	
11 SPEC.PLACE FOR COOKING IN HS/CP	540	96.3	481	98.6	#
	540	100.0	481	100.0	
12 Place separated by fencing	139	25.7	152	31.6	#
13 Animals visible at this place	308	57.0	241	50.1	#
14 Animal faeces visible at this place	320	59.3	240	49.9	#
15 Garbage visible at this place	470	87.0	382	79.4	#
16 SPEC.PLACE WASHING UTENSILS IN HS/CP	471	84.0	419	85.9	
	471	100.0	419	100.0	
17 Place separated by fencing	26	5.5	31	7.4	
18 This place at the pump	111	23.6	62	14.8	#
19 Animals visible at this place	286	60.7	253	60.4	
20 Animal faeces visible at this place	313	66.5	253	60.4	
21 Garbage visible at this place	427	90.7	362	86.4	
22 SPEC.PLACE WASHING CLOTHES IN HS/CP	534	95.2	470	96.3	
	534	100.0	470	100.0	
23 Place separated by fencing	26	4.9	32	6.8	
24 This place at the pump	18	3.4	37	7.9	#
25 Animals visible at this place	323	60.5	276	58.7	
26 Animal faeces visible at this place	338	63.3	283	60.2	
27 Garbage visible at this place	468	87.6	376	80.0	#
28 SPEC.PLACE FOR EATING IN HS/CP	544	97.0	483	99.0	
	544	100.0	483	100.0	
29 Place separated by fencing	89	16.4	70	14.5	
30 Animals visible at this place	254	46.7	215	44.5	
31 Animal faeces visible at this place	257	47.2	229	47.4	
32 Garbage visible at this place	415	76.3	322	66.7	#
33 SPEC.PLACE FOR BATHING IN HS/CP	549	97.9	486	99.6	#
	549	100.0	486	100.0	
34 Place separated by fencing	463	84.3	403	82.9	
35 Place inside the latrine	217	39.5	229	47.1	#
36 Animals visible at this place	140	25.5	133	27.4	
37 Animal faeces visible at this place	185	33.7	183	37.7	
38 Garbage visible at this place	324	59.0	266	54.7	
39 SPEC.PLACE FOR SLEEPING IN HS/CP	553	98.6	487	99.8	
	553	100.0	487	100.0	
40 Place separated by fencing	476	86.1	403	82.8	
41 Animals visible at this place	116	21.0	112	23.0	
42 Animal faeces visible at this place	154	27.8	136	27.9	
43 Garbage visible at this place	320	57.9	245	50.3	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

TABLE 2.2 SANITARY INDEX SCORE FOR ALL HOUSEHOLDS DURING BASELINE - Environmental conditions in living/working areas -

	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.55	0.52

2. Presence of a provision for animals :

If a special provision for animals exists it is observed whether this provision is separate from the house, inside or outside the compound, whether it is fenced and whether the animals have access to the house.

As can be derived from Table 2.3, in the intervention villages significantly more special places for animals can be found inside both house and compound. These places are significantly more often fenced in the control villages. This results (as shown in Table 2.3, q. 48) in more animals having access to the house for the intervention villages. In general the table indicates that both in intervention and control villages, most of the households have animals living inside the house/compound (80 - 90 %). This obviously poses health risks in both type of communities.

TABLE 2.3 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Provision for animals-

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
44 SPEC. PLACE FOR ANIMALS IN COMPOUND	540	96.3	446	91.4	#
	540	100.0	446	100.0	
45 This place is separated by fencing	402	74.4	367	82.3	#
46 SPEC. PLACE FOR ANIMALS IN HOUSE	499	88.9	403	82.6	#
	499	100.0	403	100.0	
47 This place is separated by fencing	375	75.2	349	86.6	#
48 ANIMALS HAVE ACCESS TO THE HOUSE	489	87.2	391	80.1	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

3. Presence of a provision for garbage disposal :

It is observed whether a special container for garbage exists inside the house/compound and/or whether garbage is dumped and/or treated (by burning/burying) on a special place inside the house/compound.

Only a small percentage of the households in both control and intervention communities have a special container for garbage collection (25 %). In the intervention villages a significantly higher proportion of households dump their garbage on a special place inside the house/compound. In both communities about 50 % of the garbage is burned (according to the Environmental Sanitation Team, garbage was never buried). Burning is generally done in the oven.

TABLE 2.4 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Provision for garbage -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
49 CONTAINER FOR GARBAGE COLLECTION	131	23.4	140	28.7	
50 GARBAGE DUMPED AT SPEC. PLACE IN H/C	243	43.3	177	36.3	#
51 GARBAGE BURNED/BURIED	290	51.7	229	46.9	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

4. Presence, use and condition of a special provision for discharge of used water :

It is observed whether a special provision for the discharge of used water is present and if so, if water ponding or mud puddling is visible at this place. In case this place is the latrine this will be noted. Besides, it is observed whether water ponding/mud puddling is visible inside the house/compound (in general).

It was found that approximately 30 % of the households in both control and intervention communities have a special provision for waste water discharge (see Table 2.5). At a large part (about 50 - 60 %) of these areas water ponding was observed. It should be noted that a substantial fraction of the households in both types of communities use the latrine for waste water discharge (in the control villages this fraction is significantly higher). With respect to this practice, the selected type of latrine (dry-composting pit latrine) to be implemented by UNICEF is considered less appropriate and should therefore receive proper attention in the education phase of the project.

TABLE 2.5 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Provision for waste water -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
52 SPECIAL WASTE WATER DISCHARGE AREA	174	31.0	144	29.5	
	174	100.0	144	100.0	
53 This place is the latrine	56	32.2	66	45.8	#
54 Water ponding at place for discharge	95	54.6	86	59.7	
55 WATER PONDING IN HOUSE/COMPOUND	425	75.8	350	71.7	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

5. Presence of a pump :

For each household it is noted whether there is a pump inside the house/compound. Furthermore the type (new/traditional) of pump and the distance to the pump are observed.

As shown in Table 2.6, the majority of the population uses handpumps. In the intervention villages around 50 percent of the pumps is located inside the house or compound, whereas in the control villages around 35 percent is situated inside (a significant difference).
More detailed information about the operation and maintenance of handpumps is provided in Chapter 2.4. Data on water use at the pump can be found in Chapter 2.5.

TABLE 2.6 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Handpumps -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
56 NR. OF HOUSEHOLDS USING HANDPUMPS	518	92.3	465	95.3	
	518	100.0	465	100.0	
57 Pump is new (after intervention)	0	0.0	0	0.0	
58 Pump inside house/compound	254	49.0	169	36.3	#
59 Distance to the pump					
* 0 - 25 M	308	59.5	268	57.6	
* 25 - 50 M	154	29.7	123	26.5	
* 50 - 100 M	48	9.3	58	12.5	
* > 100 M	8	1.5	16	3.4	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

6. Presence, use and condition of a special container for water storage :

It is observed if water is stored inside a special container/zir, whether this container/zir is covered, whether there is a long-handled dipper or cup for taking water from the zir, and where the dipper/cup is stored. The cleanliness of the area is assessed by observing whether animals, animal faeces, garbage or water ponding/mud puddling are visible at the container/zir.

The majority of households in both intervention and control villages have a zir for storing water. However, as can be derived from Table 2.7 in the control villages significantly more zirs/containers were observed. This difference may be due to the fact that in the control villages less pumps are found inside the house/compound (see previous section and Table 2.6).

In the control villages a significantly larger proportion of the zirs is covered. Table 2.7 further indicates that the use of a long-handled dipper for getting water from the zir is not common in both types of communities. This means most people use cups, thus increasing the chance of contamination of the water by hands.

In order to draw an overall conclusion about the cleanliness of the areas around the zir, a sanitary index for environmental conditions at the zir was calculated (see Table 2.8). For more details on the method of calculation reference is made to Annex 2.1. As can be derived from Table 2.8, the intervention villages score fairly poor, whereas the control villages score average. On examination of the individual observations in Table 2.7, it can be seen that in intervention villages conditions around the zir are significant (worse with respect to presence of animal faeces, garbage and water ponding).

TABLE 2.7 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE COMPARISON - Water storage -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
60 WATER STORED IN ZIR/CONTAINER	456	81.3	442	90.6	#
	456	100.0	442	100.0	
61 Zir/container is covered	349	76.5	371	83.9	#
62 Long handled dipper visible	5	1.1	6	1.4	
63 Cup visible	297	65.1	289	65.4	
64 Cup/dipper on the floor	28	6.1	38	8.6	
65 Cup/dipper inside container zir	2	0.4	2	0.5	
66 Cup/dipper on top of zir/container	176	38.6	206	46.6	#
67 Animals have access to cup/dipper(*)	51	17.1	64	21.1	
68 Animals visible near container/zir	222	48.7	198	44.8	
69 Faeces visible near container/zir	268	58.8	223	50.5	#
70 Garbage visible near container/zir	365	80.0	310	70.1	#
71 Mud/water ponding near zir	363	79.6	297	67.2	#

(*) : the percentages for question 67 are calculated in relation to the total number of times a cup was visible.
Note: Chi-squared test for intervention vs. control comparison, # p < 0.05.

TABLE 2.8 SANITARY INDEX SCORE FOR ALL HOUSEHOLDS DURING BASELINE - Conditions around the zir -

	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.66	0.58

7. Presence and condition of a special provision for hand washing:

It is observed whether a separate storage/basin for hand washing is present and whether the water inside it is fresh (in case there is water inside).

As shown in Table 2.9, in both intervention and control communities only a small portion of the households have a special storage/basin for hand washing. In the control villages significantly more storage/basins for hand washing are present. In less than half of the cases a storage/basin with water was present, the water is fresh.

TABLE 2.9 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Provision for hand washing -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
72 SPEC. STORAGE/BASIN FOR HAND WASHING	139	24.8	169	34.6	#
	139	100.0	169	100.0	
73 Water in the basin	44	31.7	70	41.4	
	44	100.0	70	100.0	
74 The water in the basin is fresh	19	43.2	29	41.4	

Note: Chi-squared test for intervention vs. control comparison, # p < 0.05.

8. Presence and conditions of a latrine :

If a latrine is present, it is observed whether it is inside the walls of the house, whether it has a wall and doors, if daylight can enter, whether there is a cement/concrete slab, including whether this slab is free of faeces or dirt, whether the hole in the slab is covered, whether water is available in the latrine, whether water ponding/mud puddling is visible and whether it is necessary to walk through faeces or dirt to reach the latrine.

As shown in Table 2.10, around 60 % of the households in both intervention and control villages have a latrine. It should be noted that this is substantially higher than anticipated. Mostly latrines are located within the walls of the house.

In order to draw an overall conclusion about the sanitary conditions of the latrine, a sanitary index for environmental conditions at the latrine was calculated (see Table 2.11). For more details on the method of calculation reference is made to Annex 2.1. As shown in Table 2.11, the sanitary conditions of the latrines of both control and intervention communities are fairly good, although the intervention households score slightly less good.

TABLE 2.10 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS DURING BASELINE - Latrines -

Q*	INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S #
75 LATRINE INSIDE HOUSE/COMPOUND	362	64.5	302	61.9	
	362	100.0	302	100.0	
76 Latrine inside walls of the house	348	96.1	296	98.0	
77 Latrine has walls and door	207	57.2	189	62.6	
78 Daylight can enter the latrine	240	66.3	239	79.1	
79 Pit is covered with slab	330	91.2	272	90.1	
80 Faeces visible on slab	43	11.9	67	22.2	#
81 Hole closed by cover	72	19.9	84	27.8	#
82 Water available in latrine	84	23.2	95	31.5	#
83 Mud/water ponding in latrine	211	58.3	178	58.9	
84 Walk through faeces/dirt to latrine	110	30.4	76	25.2	
85 Collecting pit inside walls of house	334	92.3	280	92.7	
86 Depth of the pit					
* 1 - 2 M	6	1.7	1	0.3	
* 2 - 3 M	19	5.2	13	4.3	
* 3 - 4 M	43	11.9	42	13.9	
* 4 - 5 M	64	17.7	88	29.1	
* > 5 M	124	34.3	78	25.8	
* NOT KNOWN	106	29.3	80	26.5	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$.

TABLE 2.11 SANITARY INDEX SCORE FOR ALL LATRINES DURING BASELINE - Sanitary conditions in the latrine -

	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.37	0.34

2.4 HANDPUMP SURVEY

In order to assess all traditional handpumps before and after the intervention, and the new pumps after the intervention, a special observation list was designed. Besides questions about the state of maintenance and functioning of the pump, several conditions were identified that are indicative for the environmental cleanliness around the pump and are thought to influence the risk of contamination of the well and/or pump and thereby the water that is fetched from this pump. The following key-variables were identified for the assessment of handpumps :

1. Presence, location and type of pump.
2. Operation and maintenance.
3. Environmental conditions at the pump-site.

Below, the findings and conclusions are presented of each of the above-mentioned key-variables for both intervention and control villages.

1. Presence, location and type of pump :

All pumps in the communities are observed. It is observed whether the pump is located inside a house/compound or not. After the intervention, it is assessed whether the pump is a traditional pump or a new UNICEF pump.

As shown Table 2.12, the pump density in the intervention villages is considerably higher than in the control villages. Most pumps are located inside the house/compound (80 -85 %).

TABLE 2.12 RESULTS HANDPUMP SURVEY FOR ALL PUMPS DURING BASELINE
- Presence, location and type of pump -

Q*	INTERV. NR.	%	CONTROL NR.	%	S #
TOTAL HOUSEHOLDS SURVEYED	561		488		
TOTAL PUMPS SURVEYED	300	100.0	207	100.0	
Pump density (pumps/household)	0.53		0.42		
11 PUMP INSIDE HOUSE/COMPOUND	257	85.7	162	78.3	
12 NEW PUMP (AFTER INTERVENTION)	0	0.0	0	0.0	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

2. Operation and maintenance of pump :

It is observed whether the pump gives water and whether any damages are visible.

As shown in Table 2.13, almost all pumps that were observed are working (90 - 95 %), although in the control villages a significantly higher portion of the pumps did not give water.

In order to draw an overall conclusion about the maintenance conditions of the pumps, a maintenance index for was calculated for all pumps (see Table 2.14). For more details on the method of calculation reference is made to Annex 2.1.
As shown in Table 2.14, both the pumps in intervention and control communities score average on the maintenance index, although the pumps in the intervention villages are in a slightly better condition.
On closer examination of the individual observations concerning maintenance (Table 2.13), it can be concluded that in the control villages significantly more often the pump is loose at base. This situation presents an increased risk of contamination of the well. Also, the majority (60 -70 %) of the pumps have loose handles. This condition can cause damages to the well tubes and therefore increases the risk of well-contamination.

Another very important observation concerns the extremely low prevalence of concrete/cement floors around the pump, in both intervention and control areas. This condition poses another increased risk of contamination of the well.

TABLE 2.13 RESULTS HANDPUMP SURVEY FOR ALL PUMPS DURING BASELINE
- Operation and maintenance of pump -

Q*	INTERV. NR.	%	CONTROL NR.	%	S #
TOTAL PUMPS SURVEYED	300	100.0	207	100.0	
13 PUMP GIVES WATER	290	96.7	188	90.8	#
	290	100.0	188	100.0	
14 Pump leaks while pumping	24	8.3	16	8.5	
15 SPOUT BROKEN	3	1.0	0	0.0	
16 PUMP LOOSE AT BASE	86	28.7	86	41.5	#
17 PUMP HANDLE LOOSE	204	68.0	125	60.4	
18 CEMENT/CONCRETE FLOOR PRESENT	22	7.3	7	3.4	
	22	100.0	7	100.0	
19 Cracks in concrete floor	5	22.7	3	42.9	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 2.14 MAINTENANCE INDEX SCORE FOR ALL PUMPS DURING BASELINE
- Maintenance conditions of the pump -

	INTERV.	CONTROL
MAINTENANCE INDEX SCORE (0-1)	0.41	0.44

3. Environmental conditions at the pump-site :

It is observed whether there is proper and functioning drainage, and whether animals, animal faeces, garbage and water ponding/mud puddling are visible. It is also noted whether a latrine is present within a range of 10 m. of the pump.

In order to draw an overall conclusion about the sanitary conditions at the pump-site, a sanitary index was calculated (see Table 2.16). For more details on the calculation

method reference is made to Annex 2.1.
As shown in Table 2.16, the environmental conditions at the pump-site are fairly poor for both intervention and control villages, although the availability of drainage is significantly higher in the intervention areas.
These poor sanitary conditions around the pump (especially the water ponding), cause an increased health hazard, since the pumps abstract shallow groundwater.

In the control communities a significantly higher proportion of latrines is found near the pump.

TABLE 2.15 RESULTS HANDPUMP SURVEY FOR ALL PUMPS DURING BASELINE
- Environmental conditions at pump-site -

Q*	INTERV. NR.	%	CONTROL NR.	%	S #
TOTAL PUMPS SURVEYED	300	100.0	207	100.0	
20 PROVISION FOR DRAINAGE AVAILABLE	147	49.0	72	34.8	#
	147	100.0	72	100.0	
21 Provision for drainage functions	98	66.7	44	61.1	
22 WATER PONDING AROUND PUMP	242	80.7	160	77.3	
23 GARBAGE AROUND PUMP	246	82.0	154	74.4	
24 ANIMALS AROUND PUMP	111	37.0	68	32.9	
25 ANIMAL FAECES AROUND PUMP	130	43.3	84	40.6	
26 LATRINE NEAR PUMP	102	34.0	102	49.3	#

Note: Chi-squared test for intervention vs. control comparison, # p < 0.05

TABLE 2.16 SANITARY INDEX SCORE FOR ALL PUMPS DURING BASELINE
- Environmental conditions at the pump-site -

	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.63	0.64

2.5 WATER USE AT THE PUMP OBSERVATIONS

In order to assess the water use at the pump,several key-variables were identified:

1. General data on pump used.
2. Quantity of water collected.
3. Other water use activities at the pump:
   - hand washing;
   - child bathing;
   - washing cooking utensils;
   - washing clothes;
   - washing food/vegetables;
   - other activities.
4. Status of person collecting and hygienic practices.

Below, the findings and conclusions are presented of each of the above-mentioned key-variables for both intervention and control villages.

1. General data on pump used :

It is observed whether a new or traditional pump was used, whether the pump was inside the house or compound, how much the distance from the house to the pump measured and whether or not more than one pump was used.

As shown in Table 2.17 not all of the observed (sentinel) households use a handpump. In this case no observations were made.
No significant differences can be found between the sentinel households in intervention and control villages.

TABLE 2.17 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - General data on pump used -

Q* OBSERVATION	INTERVENTION NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	100		100		S #
11 NR OF NEW PUMP USED	0	0.0	0	0.0	
12 NR OF OBSERVATION FORMS COMPLETED	92	100.0	93	100.0	
Nr of households not using pumps	8		7		
13 OBSERVED PUMP INSIDE HOUSE/COMPOUND	36	39.1	37	39.8	
14 PUMP DISTANCE FROM HOUSE					
* 0 - 25 M	71	77.2	67	72.8	
* 25 - 50 M	15	16.3	14	15.2	
* 50 - 100 M	2	2.2	10	10.9	
* > 100 M	4	4.3	2	2.2	
15 HOUSEHOLDS USING 2nd TRADITIONAL PUMP	4		8		
18 HOUSEHOLDS USING 3rd TRADITIONAL PUMP	0		0		

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

2. Quantity of water collected :

For each collection the volume was estimated, using a table with a standard array of containers and their respective volumes.

As shown in Table 2.18, the average number of collections per observation period is slightly higher in the intervention villages (for the sentinel households). The total volume collected is also higher in the intervention villages.
Using average household sizes for the sentinel household (derived from census data: 9.9 for the intervention villages, 10.3 for the control villages), the average use per capita per day is estimated.
The average use per capita appears slightly higher in the intervention villages. However, for both control and intervention communities these volumes are considered low, compared to WHO guidelines.

Typical domestic water usage

Type of water supply	Typical Consumption (l/cap/day)	Range (l/cap/day)
Communal water point		
- at distance > 1000 m	7	5 - 10
- at distance 500 - 1000 m	12	10 - 15
Village well		
- walking distance < 250 m	20	15 - 25
Communal standpipe		
- walking distance <250 m	30	20 - 50
Yard connection		
(tap placed in house-yard)	40	20 - 80

As can be derived from this table, the per capita water use (in the order of 15-17 l/cap/day) is relatively low as compared to typical water usage at communal standpipes (20-50 l/cap/day).

TABLE 2.18 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - Water collections at pump, totals -

Q* OBSERVATION	INTERVENTION NR.	%	CONTROL NR.	%
TOTAL HOUSEHOLDS SURVEYED	100		100	
TOTAL NR OF OBSERVATIONS	92		93	
Nr. Of times no collection/activities during observation period	3		1	
21 TOT NR OF COLLECTIONS PER OBSERV.PERIOD				
Range	0 - 44		0 - 36	
Median	13		11	
Mean	13.9		11.7	
St.Dev.	7.6		6.8	
22 TOT. VOLUME COLLECTED PER OBSERV.PERIOD				
Range	0 - 580 (lt)		0 - 577 (lt)	
Median	161		147	
Mean	175		158	
St.Dev.	104		100	
VOLUME PER CAPITA PER DAY (*)	17.6 (lt)		15.3 (lt)	

(*) Calculated using average household size, based on census data.

3. Other water use :

It was observed how many times hand washing, child bathing, washing of cooking utensils, washing clothes, and washing food/vegetables occurred at the pump.

As shown in Table 2.19 the intervention and control communities show a similar pattern with respect to other water use at the pump. Apart from hand washing and washing kitchen utensils, other water use activities are not common.

TABLE 2.19 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - Other water use, totals -

Q* OBSERVATION	INTERVENTION NR.	%	CONTROL NR.	%
TOTAL HOUSEHOLDS SURVEYED	100		100	
TOTAL NR OF OBSERVATIONS	92		93	
25 NR OF TIMES HAND WASHING				
Range	0 - 13		0 - 20	
Median	2		1	
Mean	2.8		2.8	
St.Dev.	2.8		4.0	
26 NR OF TIMES CHILD BATHING				
Range	0 - 5		0 - 10	
Median	0		0	
Mean	0.2		0.5	
St.Dev.	0.9		1.6	
27 NR OF TIMES WASHING KITCHEN UTENSILS.				
Range	0 - 30		0 - 18	
Median	2		2	
Mean	3.5		3.1	
St.Dev.	4.8		3.7	
28 NR OF TIMES WASHING CLOTHES				
Range	0 - 6		0 - 8	
Median	0		0	
Mean	0.5		0.8	
St.Dev.	1.1		1.8	
29 NR OF TIMES WASHING FOOD/VEGETABLES				
Range	0 - 3		0 - 5	
Median	0		0	
Mean	0.4		0.6	
St.Dev.	0.9		1.3	
30 NR OF TIMES OTHER ACTIVITIES				
Range	0 - 18		0 - 10	
Median	0		0	
Mean	1.8		1.3	
St.Dev.	3.1		2.4	

4. Status of person collecting water and hygienic practices :

For all people collecting water, their the sex and age group (child; older child; adult) is observed and whether or not this person washes or rinses the container before filling it. It is also noted whether the container is closed with some sort of device after filling it with water. It is believed that these two factors are important in determining the (bacteriological) quality during collection and transport of water from the pump.

As shown in Table 2.20, virtually always women (about 95 %) and generally persons older than 20 years of age, collect the water. This pattern is similar in both control and intervention villages.
Both in intervention and control communities, generally open containers are used which are difficult to close. This is also reflected by the frequency of times that the container is actually closed. The majority of containers is washed/rinsed before collecting the water. It should be noted here that when several collections are done in a row, the container is washed only at the first collection.

It can be concluded that with respect to the variables as shown in the Table below, intervention and control villages are fairly similar.

TABLE 2.20 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - Who collects water, how and how much -

Q*	OBSERVATION	INTERVENTION NR.	%	CONTROL NR.	%
	TOTAL HOUSEHOLDS SURVEYED	100		100	
	TOTAL NR OF COLLECTIONS OBSERVED	1281	100.0	1091	100.0
WHO	Person collecting is female	1203	93.9	1025	94.0
WHO	AGE GROUP DISTRIBUTION				
	* < 10 YEARS	100	7.8	94	8.6
	* 10 - 20 YEARS	353	27.6	274	25.1
	* > 20 YEARS	828	64.6	723	66.3
HOW	CONTAINER TYPES USED				
	* TYPE 1 SMALL BUCKET	83	6.9	86	7.9
	* TYPE 2 BIG BUCKET	93	7.7	183	16.8
	* TYPE 3 BIG TASHT	14	1.2	9	0.8
	* TYPE 4 SMALL TASHT	3	0.2	5	0.5
	* TYPE 5 BASTELLAH BIG	60	5.0	71	6.5
	* TYPE 6 BASTELLAH SMALL	342	28.4	178	16.3
	* TYPE 7 BASIN SMALL	165	13.7	143	13.1
	* TYPE 8 BASIN BIG	229	19.0	196	18.0
	* TYPE 9 BIG JERRYCAN	49	4.1	30	2.7
	* TYPE 10 SMALL JERRYCAN	32	2.7	28	2.6
	* TYPE 11 QULAH	16	1.3	16	1.5
	* OTHER TYPES	195	16.2	146	13.4
	CONTAINER WASHING	735	57.4	670	61.4
	CONTAINER CLOSED	19	1.5	17	1.6
HOW MUCH	VOLUME PER COLLECTION (Litres)				
	Range	1 - 60		1 - 60	
	Median	10		10	
	Mean	12.6		13.5	
	St.Dev.	8.7		8.3	

2.6 WATER QUALITY ASSESSMENT

In order to assess the water quality of pumps and zirs, used by the sentinel households, the following variables were observed/analyzed:

1. General sampling information.
2. Bacteriological water quality for pumps and zirs.
3. Chemical water quality of pumps.

Below, the findings and conclusions are presented for each of the above-mentioned variable.

1. General sampling information :

Table 2.21 shows total numbers of samples taken and analyzed. It is found that in the intervention villages less zirs are used and thus not sampled.

TABLE 2.21 RESULTS WATER QUALITY ANALYSIS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - General sampling information -

	INTERV. NR.	%	CONTROL NR.	%
TOTAL HOUSEHOLDS SURVEYED	100		100	
- Total nr of forms entered	104		100	
- Nr of forms for pumps only	4		0	
- Nr of households not using a zir	11		6	
- Total nr of zirs analyzed	89		94	
- Nr of households not using pumps	8		7	
- Total nr of pumps analyzed	96		93	
- Nr unicef pumps analyzed	0		0	
- Nr of sterilized pumps analyzed	0		0	

2. Bacteriological water quality of pumps and zirs :

Both pumps and zirs were analyzed on the concentration of faecal coliforms. In order to analyze the samples on faecal coliforms, the multiple tube test was executed, according to Standard Methods. Positive tubes (showing gas formation) show presence of faecal coliforms. Based on statistical considerations, with the number of positive tubes an estimation can be made of the most probable number of faecal coliforms in the water sample. This is expressed as the MPN-index/100 ml. Standard tables are available of this index (see Table 2.22). Since the number of positive tubes directly determines the MPN-index of the sample, this number of positive tubes is used as the result of the analysis.

Table 2.22 Relationship nr. of positive tubes and MPN-index

Nr. of positive tubes	MPN-index per 100 ml.
0	< 2.2
1	2.2
2	5.1
3	9.2
4	16.0
5	> 16.0

In Table 2.23 the results of the bacteriological analysis are shown.

These results show that approximately 70 - 75% of the water samples obtained from the traditional pumps show contamination with faecal coliforms. This is not surprising. Considering the poor hygienic conditions at the pump sites (see Chapter 2.4), and the fact that water is abstracted from shallow (ground)water layers, the pumped water was likely to be contaminated.
A slight difference is noticed between intervention and control villages.

The bacteriological analyses on the zirs show that virtually all (95 - 100 %) samples from the zir are contaminated with faecal coliforms. So even the water collected from bacteriologically safe pumps gets contaminated during transportation and/or domestic use. As concluded in the previous chapters the conditions around the zir are not very hygienic and containers for collecting water are usually not closed after filling. Again a slight difference is observed between control and intervention, in this case in favour of the latter.

TABLE 2.23 RESULTS WATER QUALITY ANALYSIS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - Bacteriological water quality zir and pump -

	INTERV. NR.	%	CONTROL NR.	%
TOTAL NUMBER OF ZIRS ANALYZED	89	100.0	94	100.0
- RESULTS BACTERIOLOGICAL ANALYSIS ZIRS				
* nr. of positive tubes = 0	4	4.5	0	0.0
* nr. of positive tubes = 1	0	0.0	1	1.1
* nr. of positive tubes = 2	0	0.0	0	0.0
* nr. of positive tubes = 3	0	0.0	2	2.1
* nr. of positive tubes = 4	1	1.1	2	2.1
* nr. of positive tubes = 5	84	94.4	89	94.7
- TOTAL % OF ZIR SAMPLES CONTAMINATED		95.5		100.0
TOTAL NUMBER OF PUMPS ANALYZED	96	100.0	93	100.0
- RESULTS BACTERIOLOGICAL ANALYSIS PUMPS				
* nr. of positive tubes = 0	25	26.0	28	30.1
* nr. of positive tubes = 1	11	11.5	4	4.3
* nr. of positive tubes = 2	4	4.2	9	9.7
* nr. of positive tubes = 3	13	13.5	3	3.2
* nr. of positive tubes = 4	2	2.1	4	4.3
* nr. of positive tubes = 5	41	42.7	45	48.4
- TOTAL % OF PUMP SAMPLES CONTAMINATED		74.0		69.9

3. Chemical water quality of the pumps :

The following chemical analyses were carried out : pH, chloride, total iron, manganese and total hardness.
The chemical quality is of importance, as it relates to taste, effect on the appearance of tea, or on scaling of boiling pots.

As shown in Table 2.24, no major differences were found for intervention and control communities with respect to the chemical quality of the pump water, except for manganese being significantly higher in the control areas.

In Table 2.25, both the WHO and the Egyptian Standards for the chemical quality of water are presented.

TABLE 2.24 RESULTS WATER QUALITY ANALYSIS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE - Chemical water quality pumps -

Q*	INTERVENTION NR.	CONTROL NR.
TOTAL SAMPLES TAKEN	96	93
TOTAL SAMPLES ANALYZED (a)	95 (*)	93
16 CHLORIDE		
Range	15 - 320	15 - 190
Median	60	50
Mean	76	59
Std. Dev.	55	37
17 IRON		
Range	0 - 4.5	0 -3.0
Median	0.3	0.4
Mean	0.5	0.6
Std. Dev.	0.6	0.5
18 HARDNESS		
Range	100-923	100-923
Median	304	380
Mean	310	405
Std. Dev.	155	143
19 pH		
Range	7.0-7.9	7.2-7.9
Median	7.6	7.7
Mean	7.6	7.7
Std. Dev.	0.2	0.2
20 MANGANESE		
Range	0 - 2	0 - 6
Median	0.4	0.9
Mean	0.5	1.0
Std. Dev.	0.5	0.8

a : Except for manganese; 71 and 69 samples were analyzed respectively.
(*) : One sample could not be analyzed due to high turbidity.

TABLE 2.25 WHO AND EGYPTIAN WATER QUALITY STANDARDS

Parameter	Unit	Standards W.H.O	Egyptian
Faecal coliforms	MPN/100ml.	0	0
Chloride	mg/l	250	600
Hardness	mg/$CaCO_3$/l	500	500
Iron	mg/l	0.3	1.0
Manganese	mg/l	0.1	0.5
pH	(-)	6.5 - 8.5	

As can be derived from the table above, the chemical properties of the groundwater regularly exceed W.H.O and Egyptian standards. This is particularly the case with manganese, which at concentrations above 0.1 mg/l has staining properties (gives a black colour). However, the water quality results are quite common for these parts of Egypt.

3 PROXIMATE IMPACT ANALYSIS OF THE INTERVENTION FOR ALL VILLAGES UP TO SIX MONTHS

3.1 INTRODUCTION

This chapter presents the intermediate outcomes for all villages up to six months, with respect to the following environmental sanitation variables :

- environmental conditions in house;
- use and condition of latrines;
- use and condition of hand-pumps;
- water quality of handpumps and zirs;
- quantities of handpump water used.

A simple, proximate analysis is performed of the impact of the intervention upon the intermediate outcomes. This is expected to provide an understanding into the process of change during the months after the intervention, in both control and intervention villages. The analysis is conducted by comparing the outcomes during the three surveillance periods (baseline, 3 and 6 months) for intervention vs. control villages, at each time interval.
To this end, the same method of analysis is used as for analysis of comparability at baseline:

- Using the SPSS package for statistical processing of data, a Chi-squared test for intervention vs. control comparison was performed. Significance was tested using a 95 % confidence interval (i.e. if $p < 0.05$ a statistically significant difference is proven).
- If the outcome of a variable is a symbol, such as 1, 2, 3, which represents a prescribed value (e.g. 1= yes, 2= no), the Chi-squared test for significance was used.
- If the outcome of a variable could be any value between a given range (e.g. pH value of water can assume any value between 0-14, the number of times people collect water can assume any value above 0), the Chi-squared test is not appropriate. In these cases the range, the median, the mean (the arithmetic average) and the standard deviation are given.
- Note: results are analyzed on the basis of responses (i.e. missing values are excluded)

For purposes of presentation the following methods were used:

- If the Chi-squared test was applied, outcomes during the three periods (for each variable) are presented for both intervention and control villages adjacently, using frequency tabulations.
  If a statistically significant difference was found, a mark is given (#).
- If no Chi-squared test was applied, the range, median, mean and standard deviation are presented for the outcomes during the three periods (of each variable), for both intervention and control village respectively.

For a number of key-variables a large amount of indicators was observed (e.g. to determine the environmental cleanliness in the house, or the state of maintenance of pumps). However, by comparing all of these individual indicators no overall, comprehensive conclusions can be drawn. For this purpose an index was calculated. This method entailed giving a negative rating each time an indicator was thought to have a bad impact (the rating system for each type of index is explained in Annex 2.1). The indexes are evaluated on a scale of 0 - 1. The scale is divided into five portions, representing the following values :

- 0 - 0.20 good
- 0.21 - 0.40 fairly good
- 0.41 - 0.60 average
- 0.61 - 0.80 fairly bad
- 0.81 - 1.00 bad

In order to illustrate the changes through time, graphs are presented for some key-observations and indexes.

This Chapter follows the same pattern for discussing the findings as in Chapter 2. However, tables and graphs are presented in separate annexes (annex 3 and 4) at the end of this report.

3.2 SUMMARY OF FINDINGS AND CONCLUSIONS

With respect to the overall environmental conditions in house/compound a striking improvement is found at the 3 months survey for both intervention and control communities as compared with the baseline situation. At 6 months a considerable deterioration occurs for both types of villages, although the conditions remain slightly improved as compared with baseline. In general it is concluded that the improvement through time in the intervention villages has been somewhat better.
However, as demonstrated above both the intervention and control villages show a strikingly similar pattern through time. This phenomenon can most probably be explained as a seasonal pattern. Therefore, the improvements can not be conclusively attributed to the impact of the intervention.

The outcomes of a number of variables show improvement through time as a result of the research itself (socalled 'research -and interview effects'). A striking example is the dramatic increase in the prevalence of garbage containers in both control and intervention villages.

Some improvements can clearly be attributed to the intervention. This especially concerns the increase in the number of latrines and handpumps in the intervention villages (hardware component).
Also volumes of handpump water fetched have increased significantly in the intervention communities.

For a number of conditions and practices which were anticipated to change for the better as a result of the health education, no significant improvements are found. E.g., risk of hand contamination of zirs remained similar.

The new UNICEF pumps are used as first pump by around 60 % of the households. Also, 20 % of the households claim to use it as a second pump. This implies that 40% of the households still use their old pump.
With respect to the bacteriological water quality of the new UNICEF pumps it is concluded that the initial water quality was poor (around 70 % of the pumps showed contamination). Only at the 6 month survey the water quality showed significant improvement, although around 50 % of the new pumps still demonstrate faecal contamination.

Regarding the bacteriological water quality of the zirs, it is concluded that virtually all zirs (95 - 100 %) remain contaminated through time. So, despite health education and the somewhat improved water quality of the pumps, people remain exposed to bacteriologically unsafe water.

In general it is concluded that, using the intermediate outcomes up to six months only, it is too early to draw any definite conclusions on the impact of the intervention. This is largely caused by the occurrence of a seasonal pattern.

Therefore, it is concluded that an impact analysis only makes sense when it is based on a comparison between baseline versus 11- months outcomes, thereby excluding seasonal effects.

3.3 ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS

In order to assess the environmental conditions in the house/compound, several key variables were identified that are indicative for the environmental cleanliness and are thought to influence the risk of diarrhoea contamination:

1. Cleanliness of working/living areas.
2. Presence of a provision for animals.
3. Presence of a provision for garbage disposal.
4. Presence, use and condition of a special provision for discharge of used water.
5. Presence of a pump.
6. Presence, use and condition of a special container for water storage.
7. Presence and condition of a special provision for hand washing.
8. Presence and condition of a latrine.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. Cleanliness of living/working areas :

The sanitary index (see Table 3.2 and Figure 1) indicates that at baseline the environmental conditions in house are somewhat better in the control communities. Both intervention and control villages show an improvement of environmental conditions at the 3 months survey. At 6 months the conditions deteriorate again in both type of villages, but show some improvement compared to baseline. However, conditions remain average through time (i.e. a score of 0.41 - 0.60). On closer examination, it can be concluded that the change through time in the intervention village is somewhat more positive (i.e. the conditions in the intervention villages appear to become more similar to the control).
This conclusion may point at a positive impact of the intervention on the overall environmental cleanliness of living/working areas. However, considering the fact that both types of villages still show less hygienic conditions in absolute terms and the fact that the change is relatively small, no outspoken conclusions should be drawn yet.

Further examination of the individual observations (see Table 3.1 and Figures) shows that most individual variables (e.g. animal faeces at place for cooking and washing kitchen utensils) follow the same pattern as demonstrated by the overall sanitary index (see Figures 1, 3 and 4). However, some significant improvements of the conditions can be found too. Some observations (see Figure 5 and 6 on faeces at place for eating and sleeping) ameliorate in intervention villages when compared to their baseline score and results in the control villages.
These observations are interesting with respect to a possible connection with the intervention. An important key-message here was the prevention of faecal contamination of food and children's play areas. However, all other areas in the house show a less positive pattern, similar to the overall sanitary index patters in both control and intervention villages. Therefore, and considering the fact that the observations for the 11 month survey are not taken into account, no positive correlation between the above-mentioned improvements and the intervention can be concluded yet.

As mentioned earlier, a very slight improvement is visible in the intervention villages as compared with the control areas. However, levels of cleanliness remain approximately the same.
The results for both intervention and control communities show a striking and similar pattern through time: A sharp dip (improvement) at the 3 month survey, and an increase (deterioration) again at the six month survey. This phenomena can probably be explained as a seasonal pattern. The 3 month survey and, although to a lesser extent, the six month survey were conducted during winter, whereas the baseline was performed in summer. During winter time, people are used to changing their lifestyle, e.g., animals are more often in field (in summer it is to hot for animals to be out); also people spent more time inside their houses (although cooking, which is done early in the morning and late in the afternoon, is done outside in the sun).

Another interesting observation (see Table 3.1, q. 35) concerns the use of the latrine for bathing (40 - 50 % of the households). With respect to this practice, the selected

type of latrine (dry-composting pit latrine) that was implemented by UNICEF is thought to be less appropriate since these latrines should be kept as dry as possible. The practice remains after the intervention and even slightly increases.

2. Provision for animals :

As can be derived from Table 3.3, in the intervention villages significantly more special places for animals can be found inside both house and compound. These places are significantly more often fenced in the control villages. This results (as shown in Table 3.3, q. 48) in more animals having access to the house for the intervention villages. In general the table indicates that both in intervention and control villages, most of the households have animals living inside the house/compound (80 - 90 %). This slightly increases at the 3 and 6 - months survey for both types of villages.
Considering the similar pattern in both types of villages, and the relatively small (insignificant) change, no impact of the intervention can be concluded here.

3 Provision for garbage :

As shown in Table 3.4, at baseline, only a small percentage of the households in both control and intervention communities possessed a special container for garbage collection (25 %). However, during the 3 and 6 months survey a dramatic increase in the number of garbage containers is observed for both intervention and control areas (see also Figure 7). This phenomenon is a clearly an effect of the research as it is found in both villages. According to the Supervisor of the Environmental Team, on some occasions, people spontaneously and proudly showed their garbage container, even before the data collectors started their observations. The slightly sharper increase in the intervention villages is thought to be due to the interaction effect between research and intervention.

At baseline, in the intervention villages a significantly higher proportion of households dump their garbage on a special place inside the house/compound. In both communities about 50 % of the garbage is burned (according to the Environmental Sanitation Team, garbage was never buried). Burning is generally done in the oven.
Again a sharp increase in the proportion of the above-mentioned variables (q. 50, 51) can be noticed in control and intervention villages. Especially considering the fact that the variables in question can not be observed at a glance (the data collector should ask about their occurrence), the before-mentioned research effect is a likely explanation here also.

4. Provision for waste water :

As shown in Table 3.5, at baseline it was found that approximately 30 % of the households in both control and intervention communities have a special provision for waste water discharge. At a large part (about 50 - 60 %) of these areas water ponding was observed.

In the intervention villages, at the 3 and 6 month survey a significant decrease as compared with baseline and control areas is found regarding the number of special places for waste water discharge . No sensible conclusions can be drawn as to the cause of this change, since health education did not pay attention to this practice.

Water ponding increases sharply in both types of communities and is most probably due to seasonal influences (in winter, water evaporates less quickly and rainfall is higher).

The absolute number of households using the latrine for waste water discharge does not increase in the intervention communities as contrasted with the control villages. The difference may be due to the effect of health education. One of the messages concerns the proper use of the (UNICEF) latrine (avoid disposing waste water in the latrine).

5. Presence of a pump :

As shown in Table 3.6, at baseline the majority of the population uses handpumps. In the intervention villages around 50 percent of the pumps is located inside the house or compound, whereas in the control villages around 35 percent is situated inside (a significant difference). Due to the intervention the number of pumps located inside the house /compound decreases in the intervention villages (UNICEF pumps are communal), although the majority of the pumps remain within 50 metres distance from the house.
The use of handpumps increases in the intervention villages (due to intervention). However, only 60 % of the households point at the new UNICEF pumps as being their first pump. Besides, about 20 % of the people use the UNICEF pump as second pump. Apparently many people either prefer their old pump or have no easy access to the new pump.
More detailed information about the operation and maintenance of handpumps is provided in Chapter 3.4. Data on water use at the pump can be found in Chapter 3.5.

6. Presence, use and condition of a special container for water storage :

The majority of households in both intervention and control villages have a zir for storing water. However, as can be derived from Table 3.7, significantly more zirs/containers were observed in the control villages. This difference may be due to the fact that in the control villages less pumps are found inside the house/compound (see previous section and Table 3.6).
The use of zirs decreases dramatically at the 3 months survey and slightly increases again at 6 months in both communities. This is due to the typical seasonal pattern, which has been mentioned in earlier sections also. The zir is especially practical in summer, to keep the water cool.

At baseline, in the control villages a significantly larger proportion of the zirs is covered. At the 3 and 6 month survey an increase of this practice is found in the

intervention villages, in addition to which the difference between control and intervention decreases in significance. Since covering the zir was one of the health messages, a cautious conclusion can be drawn that this increase may be related to the intervention.

Table 3.7 further indicates that the use of a long-handled dipper for getting water from the zir is not common in both types of communities. This means most people use cups, thus increasing the chance of contamination of the water by hands. At 3 and 6 months this situation remains, although use of a clean dipper was one of the health messages.

As can be derived from Table 3.8 and Figure 8 (sanitary index for environmental conditions around the zir), at baseline the intervention villages score fairly poor, whereas the control villages score average. Both intervention and control villages show an improvement of environmental conditions at the 3 months survey. At 6 months the conditions deteriorate again in both type of villages, but show some improvement compared to baseline. However, conditions remain average through time (i.e. a score of 0.41 - 0.60). On closer examination, it can be concluded that the change through time in the intervention village is somewhat more positive (i.e. the conditions in the intervention villages appear to become more similar to the control).
This conclusion may indicate a positive impact of the intervention on the overall environmental cleanliness of living/working areas. However, considering the fact that both types of villages still show less hygienic conditions around the zir in absolute terms and the fact that the change is relatively small, no outspoken conclusions should be drawn yet.

7. Presence and condition of a special provision for hand washing:

As shown in Table 3.9, at baseline in both intervention and control communities only a small portion of the households have a special storage/basin for hand washing. In the control villages significantly more storage/basins for hand washing are present. At the 3 and 6 month survey an increase in the number of provisions is found in the intervention villages while the number is stabile in the control areas, as a result of which the difference between control and intervention decreases in significance.
However, in case the storage/basin contained water, the occurrence of fresh water decreased in the intervention villages, whereas in the control villages an increase was found. This process eventually resulted in a significant difference in favour of the control areas at the 6 months survey.
Considering one of the health messages focused on the need for hand washing with soap and running water, no sensible conclusions can be drawn from the above-mentioned situation.

8. Presence and conditions of a latrine :

As shown in Table 3.10, at baseline around 60 % of the households in both intervention and control villages have a latrine. At the 3 and 6 months survey a sharp increase in the number of latrines in the intervention villages can be found, whereas in the control

villages only a small increase is noticed. As a result the difference between control and intervention is significantly enlarged. This change is clearly an effect of the intervention.

The new UNICEF latrines consist of a slab and pit lining only. The construction of walls and doors is considered the responsibility of the household. Many people have constructed the latrine outside the walls of the house, without constructing any walls and doors yet. Hence, significant differences between control and intervention appear at 3 and 6 months with respect to questions 76,77 and 78.

As shown in Table 3.11 and Figure 10, the sanitary conditions of the latrines in both control and intervention communities are fairly good, although the intervention households score slightly less good.
Both intervention and control villages show a slight improvement of sanitary conditions at the 3 months survey. At 6 months the conditions deteriorate somewhat in both types of villages, but show a small improvement as compared with baseline. However, conditions remain fairly good through time (i.e. a score of 0.21 - 0.40). On closer examination, it can be concluded that the change through time in the intervention villages is somewhat more positive (i.e. the conditions in the intervention villages appear to become more similar to the control).
The latter may be due to intervention, but no hard evidence is available yet.

An important observation was reported by the Environmental Sanitation Team, which cannot be derived from the questionnaire on environmental observations in house. It concerns the use of the new UNICEF latrines. A fair number of these latrines are not used for their intended purpose yet. People either did not complete the construction or, e.g. use it as a place for storage. With respect to this situation, it should be noted that part of the latrines were purchased by people who already possessed a latrine and continued using the latter. The observations on the latrine were carried out for the latrine that was actually used.

3.4 HANDPUMP SURVEY

In order to assess all traditional handpumps before and after the intervention, and the new pumps after the intervention, a special observation list was designed. Besides questions about the state of maintenance and functioning of the pump, several conditions were identified that are indicative for the environmental cleanliness around the pump and are thought to influence the risk of contamination of the well and/or pump and thereby the water that is fetched from this pump. The following key-variables were identified for the assessment of handpumps :

1. Presence, location and type of pump.
2. Operation and maintenance.
3. Environmental conditions at the pump-site.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. Presence, location and type of pump :

As shown in Table 3.12, at baseline the pump density in the intervention villages is considerably higher than in the control villages. Most pumps are located inside the house/compound (80 - 85 %).
Due to the intervention, the pump-density in the intervention villages increases significantly. Considering the fact that the new UNICEF pumps are communal, the proportion of pumps located in the house/compound decreases in the intervention and areas. However, the same is found in the control villages, although somewhat less. Therefore, the changes can be partly ascribed to seasonal influences, as fencing of compounds may differ in winter or summer.

On closer examination of the data on new pumps only (see Table 3.17), it is concluded that 50 % of the UNICEF pumps are located inside a house or compound. This practice is in contrast with the supposed communal character of the new pumps. Sometimes UNICEF placed a pump inside a compound because of pressure from the community or its leaders. Also, after installation, some people extended their compound with additional fencing in order to appropriate the new pump.

When comparing the total number of pumps surveyed (see Table 3.12) at baseline and 3 and 6 months, and considering 96 new UNICEF pumps were installed, it must be concluded that a large number of traditional pumps was removed (in the intervention villages). After receiving new UNICEF pumps, some people dismantled and sold their old pumps. In other cases people just abandoned the old pump and left it without maintaining it any more.

2. Operation and maintenance of pump :

As shown in Table 3.13, at baseline almost all pumps that were observed are working (90 - 95 %), although in the control villages a significantly higher portion of the pumps did not give water. After the intervention the number of pumps giving water decreases in both control and intervention villages, although substantially more in the latter. This is due the fact that in the intervention villages old pumps were dismantled or damaged on purpose, after installation of the new pumps.

The number of leaking pumps is fairly similar at each time interval, when comparing control vs. intervention villages. The decrease for both may be due to the effect of research, which leads to increased maintenance efforts.

As shown in Table 3.14, and Figure 12, at baseline both the pumps in intervention and control communities score average on the maintenance index, although the pumps in the intervention villages are in a slightly better condition.

After the intervention, the state of maintenance improves considerably in the intervention villages (scoring fairly good), whereas in the control villages no real change is visible. The improvement in the intervention villages is not only due to the new UNICEF pumps, but also to the upgrading of old pumps. Sometimes, people are motivated to do this out of jealousy (neighbours have a nice looking new pump). Also, the new pumps have become a new status symbol, thus inspiring people to make their old pump look just as nice.

On closer examination of the individual observations concerning maintenance (Table 3.17) for the new pumps only, it can be concluded that a number of pumps were still loose at base, or showed cracks at the 6 months survey. This situation presents an increased risk of contamination of the well.

3. Environmental conditions at the pump-site :

As shown in Table 3.15 and 3.16, the environmental conditions at the pump-site are fairly poor for both intervention and control villages, although the availability of drainage is significantly higher in the intervention areas. The number of provisions for drainage in the intervention villages improves even more after the intervention (due to the new pumps). However, although at the 3 months survey an increasing number of drainage facilities functions in both types of villages, a large dip is visible at 6 months again. This may be due to the fact that the drainage facilities of the traditional pumps are usually of a temporary nature. Therefore, their condition may vary greatly through time.

On closer examination of the new UNICEF pumps (see Table 3.18), it should be noted that not all pumps are provided with proper drainage. Besides, drainage facilities do not always function. This is also illustrated by the high prevalence of water ponding around the new pumps. From field inspection it appeared that the drainage facilities as provided by UNICEF were not adequate and often poorly constructed. In most cases UNICEF left the completion of the drainage to the community. Only a short concrete drainage canal (about 1 metre) was provided. In a number of cases, the canal was not appropriately constructed (e.g. drainage directed to the wall of a house, or to a higher area). This situation results in poor sanitary conditions around the pump.

With respect to the overall environmental conditions around the pumps (see Table 3.16), it can be concluded that the conditions remain fairly poor up till 3 months. At the 6 months survey an improvement is visible for the intervention villages, thereby barely scoring average.

With respect to the changing number of pumps near the latrines (Table 3.15, q. 26), it should be noted that this may be due to differences in interpretation of the data collector.

3.5 WATER USE AT THE PUMP OBSERVATIONS

In order to assess the water use at the pump,several key-variables were identified:

1. General data on pump used.
2. Quantity of water collected.
3. Other water use activities at the pump:
   - hand washing;
   - child bathing;
   - washing cooking utensils;
   - washing clothes;
   - washing food/vegetables;
   - other activities.
4. Status of person collecting and hygienic practices.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. General data on pump used :

As shown in Table 3.19 not all of the observed (sentinel) households use a handpump. In this case no observations were made. After intervention, all sentinel households in the intervention communities were using handpumps. Often, more than one hand pump was used. Approximately 60 % of the hand pumps used are new pumps (this is consistent with the observations in the environmental conditions in house survey).

2. Quantity of water collected :

Using average household sizes for the sentinel household (derived from census data: 9.9 for the intervention villages, 10.3 for the control villages), the average use per capita per day is estimated.
As shown in Table 3.20, at baseline the average use per capita appears slightly higher in the intervention villages. After the intervention the average use increases for the sentinel households in the intervention communities and slightly decreases for the control households. The slight decrease is most likely caused by seasonal influences (less water is used in winter). Normally one would expect a similar pattern in the intervention villages, however, as noted earlier larger amounts of water were fetched. This situation can most likely be attributed to the novelty of the UNICEF pumps and possibly to the message of the health education team : "use as much water as needed..."

It should be noted that, for both control and intervention communities, these volumes are considered relatively low, when compared with WHO guidelines (see Chapter 2.5 for table of WHO guidelines).

3. Other water use :

As shown in Table 3.21 the intervention and control communities demonstrate a similar pattern with respect to 'other water use' at the pump through time. Due to the influence of winter less 'other water use' activities take place at the pump during the 3 months observations.
Apart from washing kitchen utensils,'other water use' activities are not common.

Although one of the health messages was aimed at stimulating people to wash their hands with running water, no effect of this was seen at the pump-sites.

4. Status of person collecting water and hygienic practices :

As shown in Table 3.22, virtually always women (about 95 %) and generally persons older than 20 years of age, collect the water. This pattern is similar in both control and intervention villages.

Both in intervention and control communities, generally open containers are used which are difficult to close. This is also reflected by the number of times the container is actually closed. At the 3 and 6 month survey a clear shift is noticed towards the use of bigger containers, in both control and intervention areas. This is reflected in the very limited number of times the container was closed. A possible explanation may be, that due to winter time people prefer to stay at home and collect larger volumes of water per collection. This is also reflected in the declining number of collections, in the control villages. However, in the intervention villages, although people also fetch more water per collection, the absolute number of collection increases sharply. This is clearly caused by the introduction of the new UNICEF pumps, possibly in combination with the health education.

The number of times that containers are washed/rinsed before collecting the water decreases sharply through in both intervention and control villages. From the viewpoint of health, this is a negative development. It should be noted here that when several collections are done in a row, the container is washed only at the first collection.

3.6 WATER QUALITY ASSESSMENT

In order to assess the water quality of pumps and zirs, used by the sentinel households, the following variables were observed/analyzed:

1. General sampling information.
2. Bacteriological water quality for pumps and zirs.
3. Chemical water quality of pumps.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. General sampling information :

Table 3.23 shows total numbers of samples taken and analyzed. At the 3 and 6 months survey, both in intervention and control areas less zirs were used and thus not sampled. This is due to seasonal influences, as during winter there is less need to store the water at a cool place.

2. Bacteriological water quality of pumps and zirs :

In Table 3.24 and Figure 16 and 17 the results of the bacteriological analysis of pumps used by the sentinel households are shown.
These results show that at baseline approximately 70 - 75% of the water samples obtained from the traditional pumps show contamination with faecal coliforms. This is not surprising. Considering the poor hygienic conditions at the pump sites (see Chapter 3.4), and the fact that water is abstracted from shallow (ground)water layers, the pumped water was likely to be contaminated.

At the 3 months survey hardly any change was found in both types of villages. Clearly no effect of the newly installed hardware was visible yet. Only at the 6 months survey did the pumps used by the sentinel households in the intervention villages show improvement. This is contrary to expectations, since approximately 60 % of these households were using new UNICEF pumps.

Table 3.25 and Figure 18 show the results of the bacteriological analysis of all new UNICEF pumps. As can be derived the pumps did not produce bacteriologically safe water from the start. At the 6 months survey still 50 % of the pumps show faecal contamination, although it can be noticed that the percentage of heavily contaminated samples (5 positive tubes) sharply decreases.

More details on water quality in general and bacteriological contamination of the new pumps in particular, can be found in the Annex on water quality.

The bacteriological analyses on the zirs show that virtually all (95 - 100 %) samples from the zir are contaminated with faecal coliforms in both intervention and control villages. This situations remains throughout the 3 and 6 months surveys. So even the water collected from bacteriologically safe pumps gets contaminated during transportation and/or domestic use. As concluded in the previous chapters the conditions around the zir are not very hygienic and containers for collecting water are usually not closed after filling.
Apparently the health messages concerning the need to cover the zir and avoidance of hand contamination of the zir water have no effect.

3. Chemical water quality of the pumps :

The following chemical analyses were carried out : pH, chloride, total iron, manganese and total hardness.

The chemical quality is of importance, as it relates to taste, effect on the appearance of tea, or on scaling of boiling pots.

In Chapter 2.6 the chemical water quality was discussed for the old pumps. In Table 3.26 the results for the new UNICEF pumps are presented.

No major differences were found between the new and the old pumps in the intervention villages with respect to the chemical quality of the pump water. The new pumps produce a slightly higher concentration of iron, hardness and manganese. These differences however, should not lead to a change in taste and scaling properties of the water.

4. PROXIMATE IMPACT ANALYSIS OF THE INTERVENTION FOR THE FIRST SET UP TO ELEVEN MONTHS

4.1 INTRODUCTION

This chapter presents the intermediate outcomes for villages of the first set up to eleven months, with respect to the following environmental sanitation variables :

- environmental conditions in house;
- use and condition of latrines;
- use and condition of hand-pumps;
- water quality of handpumps and zirs;
- quantities of handpump water used.

A simple, proximate analysis is performed of the impact of the intervention upon the intermediate outcomes. This is expected to provide an understanding into the process of change during the months after the intervention, in both control and intervention villages. The analysis is conducted by comparing the outcomes during the four surveillance periods (baseline, 3, 6 and 11 months) for intervention vs. control villages, at each time interval. In the last section of this chapter also a comparison is made for the intervention villages between baseline and 11 months survey.

The following method of analysis is used as for the comparability analysis:

- Using the SPSS package for statistical processing of data, a Chi-squared test for intervention vs. control comparison was performed. Significance was tested using a 95 % confidence interval (i.e. if $p < 0.05$ a statistically significant difference is proven).
- If the outcome of a variable is a symbol, such as 1, 2, 3, which represents a prescribed value (e.g. 1 = yes, 2 = no), the Chi-squared test for significance was used.
- If the outcome of a variable could be any value between a given range (e.g. pH value of water can assume any value between 0-14, the number of times people collect water can assume any value above 0), the Chi-squared test is not appropriate. In these cases the range, the median, the mean (the arithmetic average) and the standard deviation are given.
- Note: results are analyzed on the basis of responses (i.e. missing values are excluded)

For purposes of presentation the following methods were used:

- If the Chi-squared test was applied, outcomes during the three periods (for each variable) are presented for both intervention and control villages adjacently, using frequency tabulations.
  If a statistically significant difference was found, a mark is given (#).

- If no Chi-squared test was applied, the range, median, mean and standard deviation are presented for the outcomes during the three periods (of each variable), for both intervention and control village respectively.

For a number of key-variables a large amount of indicators was observed (e.g. to determine the environmental cleanliness in the house, or the state of maintenance of pumps). However, by comparing all of these individual indicators no overall, comprehensive conclusions can be drawn. For this purpose an index was calculated. This method entailed giving a negative rating each time an indicator was thought to have a bad impact (the rating system for each type of index is explained in Annex 2.1). The indexes are evaluated on a scale of 0 - 1. The scale is divided into five portions, representing the following values :

- 0 - 0.20 good
- 0.21 - 0.40 fairly good
- 0.41 - 0.60 average
- 0.61 - 0.80 fairly bad
- 0.81 - 1.00 bad

After the finding and conclusions of section 4.2, the baseline comparisons and the intermediate outcomes are reviewed in the sections 4.3 and 4.4. The tables belonging to these sections are included in annex 5. The baseline comparison is extensively discussed, while the subsequent intermediate outcomes are briefly summarized.

Hence section 4.5 contains a extensive comparison between the baseline vs. 11 months survey, particularly for the intervention villages. Seasonal fluctuations are expected to have a minimum impact on the analyses, since both surveys have been conducted during the month of August.

4.2 BASELINE COMPARISONS

4.2.1 Summary of findings and conclusions

With respect to the environmental conditions in the house/compound both control and intervention villages present an overall image of less hygienic conditions (high prevalence of water ponding, garbage, animals and animal faeces in the living/working areas). However, it should be noted that the intervention villages haver significantly higher numbers of animals living in the house/compound particularly in cooking areas. This situation poses a higher public health risk. In the intervention villages a significant higher proportion of the households dump their garbage in a special place inside the house/compound.

The intervention villages have significantly less latrines than the control villages; however, this is substantially higher than previously anticipated. Another interesting observation concerns the use of the latrine for bathing and discharge of waste water. With respect to these practices, the selected type of latrine (dry-composting pit latrine) that was implemented by UNICEF is thought to be less appropriate since these latrines should be kept as dry as possible.

With regard to the availability and state of maintenance of the handpumps, it can be concluded that in the intervention villages there are significantly more pumps available.

Almost all pumps are working (90 - 95 %), although in the control villages a significantly higher portion of the pumps did not give water.

Both the intervention and control communities score average on the maintenance index and show fairly poor sanitary conditions at the pump-site. Both of these situations cause an increased health hazard, due to possible contamination of the well.

Regarding the use of handpump water it is concluded that the sentinel households in the intervention villages collect slightly more water than those in the control villages. The total volume collected is relatively low (less than 20 litres/capita/day) for both types of households compared with WHO guidelines.

In the majority of cases the containers for collecting water are washed, but not closed. With respect to other water use, hygienic practices and persons collecting the water, a similar pattern was found in both intervention and control households.

The majority of households in both intervention and control villages have a zir for storing water. In the control villages significantly more zirs/containers are covered. It is also concluded that the use of a long-handled dipper for getting water from the zir is not common in both types of communities. This means most people use cups, thus increasing the chance of hand contamination of the water. With respect to the overall sanitary condition around the zir, the intervention villages score fairly poor, whereas the control villages score average.

Taking into account the poor conditions around the zir and the use of cups for fetching water from the zir, it is not surprising that virtually all zirs (95 - 100 %) were severely bacteriologically contaminated in both intervention and control households.
The bacteriological quality of the water from the traditional handpumps is also poor. Approximately 70 - 75% of the samples in both types of communities show serious bacteriological contamination.
No major differences are found for intervention and control households with respect to the chemical quality of the pump water, except for manganese being significantly higher in the control areas and regularly exceeds the quality standards.

4.2.2 Environmental conditions in house observations

In order to assess the environmental conditions in the house/compound, several key variables were identified that are indicative for the environmental cleanliness and are thought to influence the risk of diarrhoea contamination:

1. Cleanliness of working/living areas.
2. Presence of a provision for animals.
3. Presence of a provision for garbage disposal.
4. Presence, use and condition of a special provision for discharge of used water.
5. Presence of a pump.
6. Presence, use and condition of a special container for water storage.
7. Presence and condition of a special provision for hand washing.
8. Presence and condition of a latrine.

Below, the findings are presented for each of the above mentioned key variables, for the comparison between the control and intervention villages. All tables are included in annex 5.

1. Cleanliness of working/living areas :

For all working/living areas (place for cooking, washing kitchen utensils, washing clothes, eating, bathing and sleeping) it is assessed (observed) whether a special and separated place is provided inside the house/compound and whether animals, animal faeces or garbage are visible at these places. For some activities (washing kitchen utensils and clothes and bathing) their place can be precised (whether it is at the pump or latrine).

In order to draw an overall conclusion about the cleanliness of living/working areas in the house/compound, a sanitary index for in house environmental conditions was calculated. For more details on the method of calculation reference is made to Annex 2.

The sanitary index (see Table 4.2) indicates that both control and intervention villages score in the same range (average conditions). However, the intervention villages score somewhat higher (i.e. sanitary conditions are worse) than the control villages.

On examination of the individual observations (see Table 4.1) it can be concluded that especially for the area for cooking, the environmental conditions in the experimental villages are significantly worse.

This is of particular interest for the impact analyses of the intervention, since the health education component paid special attention to the prevention of food contamination (i.e. clean cooking area).

Another interesting observation concerns the use of the latrine for bathing (40 - 50 % of the households). With respect to this practice, the selected type of latrine (dry-composting pit latrine) that was implemented by UNICEF is thought to be less appropriate since these latrines should be kept as dry as possible.

2. Presence of a provision for animals :

If a special provision for animals exists it is observed whether this provision is separate from the house, inside or outside the compound, whether it is fenced and whether the animals have access to the house.

As can be derived from Table 4.3, in the intervention villages more special places for animals can be found inside both house and compound. These places are significantly more often fenced in the control villages. This results in more animals having access to the house for the intervention villages. In general the table indicates that both in intervention and control villages, most of the households have animals living inside the house/compound (85 %). This obviously poses health risks in both type of communities.

3. Presence of a provision for garbage disposal :

It is observed whether a special container for garbage exists inside the house/compound and/or whether garbage is dumped and/or treated (by burning/burying) on a special place inside the house/compound.

Only a small percentage of the households in control and particularly intervention communities have a special container for garbage collection. In the intervention villages a significantly higher proportion of households dump their garbage on a special place inside the house/compound. This also counts for the burning of garbage which is generally done in an oven (according to the Environmental Sanitation Team, garbage was never buried).

4. Presence, use and condition of a special provision for discharge of used water :

It is observed whether a special provision for the discharge of used water is present and if so, if water ponding or mud puddling is visible at this place. In case this place is the latrine this will be noted. Besides, it is observed whether water ponding/mud

puddling is visible inside the house/compound (in general).

It was found (see Table 4.5) that the households in intervention communities have a significant lower number of places for waste water discharge (only 15 %). It should be noted that a substantial fraction of the households in both types of communities use the latrine for waste water discharge (in the control villages this fraction is significantly higher).

With respect to this practice, the selected type of latrine (dry-composting pit latrine) to be implemented by UNICEF is considered less appropriate and should therefore receive proper attention in the education phase of the project.

Water ponding occurred in a considerable number of households (40-45 %).

5. Presence of a pump :

For each household it is noted whether there is a pump inside the house/compound. Furthermore the type (new/traditional) of pump and the distance to the pump are observed.

As shown in Table 4.6, the majority of the population uses handpumps. In the intervention villages around 55 percent of the pumps is located inside the house or compound, whereas in the control villages around 30 percent is situated inside (a significant difference).

More detailed information about the operation and maintenance of handpumps is provided in Chapter 4.2.3. Data on water use at the pump can be found in Chapter 4.2.4.

6. Presence, use and condition of a special container for water storage :

It is observed if water is stored inside a special container/zir, whether this container/zir is covered, whether there is a long-handled dipper or cup for taking water from the zir, and where the dipper/cup is stored. The cleanliness of the area is assessed by observing whether animals, animal faeces, garbage or water ponding/mud puddling are visible at the container/zir.

The majority of households (90 %) in both intervention and control villages have a zir for storing water. In the control villages a significantly larger proportion of the zirs is covered. Table 4.7 further indicates that the use of a long-handled dipper for getting water from the zir is not common in both types of communities. This means most people use cups, thus increasing the chance of contamination of the water by hands.

In order to draw an overall conclusion about the cleanliness of the areas around the zir, a sanitary index for environmental conditions at the zir was calculated (see Table

4.8). For more details on the method of calculation reference is made to Annex 2. As can be derived from Table 4.8, the intervention villages score fairly poor, whereas the control villages score average. On examination of the individual observations in Table 4.7, it can be seen that in intervention villages conditions around the zir are worse with respect to presence of animal faeces, garbage and water ponding (the latter significantly).

7. Presence and condition of a special provision for hand washing:

It is observed whether a separate storage/basin for hand washing is present and whether the water inside it is fresh (in case there is water inside).

As shown in Table 4.9, in both intervention and control communities only a small portion of the households have a special storage/basin for hand washing. In the control villages significantly more storage/basins for hand washing are present. In 80 % of the cases a storage/basin with water was present, the water is fresh.

8. Presence and conditions of a latrine :

If a latrine is present, it is observed whether it is inside the walls of the house, whether it has a wall and doors, if daylight can enter, whether there is a cement/concrete slab, including whether this slab is free of faeces or dirt, whether the hole in the slab is covered, whether water is available in the latrine, whether water ponding/mud puddling is visible and whether it is necessary to walk through faeces or dirt to reach the latrine.

As shown in Table 4.10, the households in intervention have significantly less latrines than the control villages (around 50 and 67 %). It should be noted that this is however substantially higher than anticipated. Mostly latrines are located within the walls of the house.

In order to draw an overall conclusion about the sanitary conditions of the latrine, a sanitary index for environmental conditions at the latrine was calculated (see Table 4.11). For more details on the method of calculation reference is made to Annex 2. As shown in Table 4.11, the sanitary conditions of the latrines of both control and intervention communities are fairly good.

4.2.3 Handpump survey

In order to assess all traditional handpumps before and after the intervention, and the new pumps after the intervention, a special observation list was designed. Besides questions about the state of maintenance and functioning of the pump, several conditions were identified that are indicative for the environmental cleanliness around the pump and are thought to influence the risk of contamination of the well and/or pump and thereby the water that is fetched from this pump. The following key-variables were identified for the assessment of handpumps :

1. Presence, location and type of pump.
2. Operation and maintenance.
3. Environmental conditions at the pump-site.

Below, the findings and conclusions are presented of each of the above-mentioned key-variables for both intervention and control villages.

1. Presence, location and type of pump :

All pumps in the communities are observed. It is observed whether the pump is located inside a house/compound or not. After the intervention, it is assessed whether the pump is a traditional pump or a new UNICEF pump.

As shown Table 4.12, the pump density in the intervention villages is considerably higher than in the control villages. Particularly the pumps in the intervention villages are significantly more located inside the house/compound (91 %).

2. Operation and maintenance of pump :

It is observed whether the pump gives water and whether any damages are visible.

As shown in Table 4.13, almost all pumps that were observed are working (nearly 100 %).

In order to draw an overall conclusion about the maintenance conditions of the pumps, a maintenance index for was calculated for all pumps (see Table 4.14). For more details on the method of calculation reference is made to Annex 2.
As shown in Table 4.14, both the pumps in intervention and control communities score average on the maintenance index, although the pumps in the intervention villages are in a slightly better condition.

On closer examination of the individual observations concerning maintenance (Table 4.13), it can be concluded that in the control villages significantly more often the pump is loose at base. This situation presents an increased risk of contamination of the well.

Another very important observation concerns the extremely low prevalence of concrete/cement floors around the pump, in both intervention and control areas. This condition poses another increased risk of contamination of the well.

3. Environmental conditions at the pump-site :

It is observed whether there is proper and functioning drainage, and whether animals, animal faeces, garbage and water ponding/mud puddling are visible. It is also noted whether a latrine is present within a range of 10 m. of the pump.

In order to draw an overall conclusion about the sanitary conditions at the pump-site, a sanitary index was calculated (see Table 4.16). For more details on the calculation method reference is made to Annex 2.

As shown in Table 4.16, the environmental conditions at the pump-site are fairly poor for both intervention and control villages, although the availability of drainage is significantly higher in the intervention areas.

The poor sanitary conditions for intervention villages are particularly indicated by the high scores for animals and animal faeces (significantly higher) around the pumps. These conditions cause an increased health hazard, since the pumps abstract shallow groundwater.

In the control communities a significantly higher proportion of latrines is found near the pump.

4.2.4 Water use at the pump observations

In order to assess the water use at the pump,several key-variables were identified:

1. General data on pump used.
2. Quantity of water collected.
3. Other water use activities at the pump:
   - hand washing;
   - child bathing;
   - washing cooking utensils;
   - washing clothes;
   - washing food/vegetables;
   - other activities.
4. Status of person collecting and hygienic practices.

Below, the findings and conclusions are presented of each of the above-mentioned key-variables for both intervention and control villages.

1. General data on pump used :

It is observed whether a new or traditional pump was used, whether the pump was inside the house or compound, how much the distance from the house to the pump measured and whether or not more than one pump was used.

As shown in Table 4.19 all of the observed (sentinel) households use a handpump. The walking distance to the pumps is considerably less for the intervention villages.

2. Quantity of water collected :

For each collection the volume was estimated, using a table with a standard array of containers and their respective volumes.

As shown in Table 4.20, the average number of collections per observation period is slightly higher in the intervention villages (for the sentinel households). The total volume collected is also higher in the intervention villages.

Using average household sizes for the sentinel household (derived from census data: 9.9 for the intervention villages, 10.3 for the control villages), the average use per capita per day is estimated.
The average use per capita appears slightly higher in the intervention villages. However, for both control and intervention communities these volumes are considered low, compared to WHO guidelines.

Table 4.2.1: WHO guidelines for water consumptions

Type of water supply	Typical Consumption (l/cap/day)	Range (l/cap/day)
Communal water point		
- at distance > 1000 m	7	5 - 10
- at distance 500 - 100 m	12	10 - 15
Village well		
- walking distance < 250 m	20	15 - 25
Communal standpipe		
- walking distance <250 m	30	20 - 50
Yard connection		
(tap placed in house-yard)	40	20 - 80

As can be derived from this table, the per capita water use (in the order of 15-17 l/cap/day) is relatively low as compared to typical water usage at communal standpipes (20-50 l/cap/day).

3. Other water use :

It was observed how many times hand washing, child bathing, washing of cooking utensils, washing clothes, and washing food/vegetables occurred at the pump.

Table 4.21 that the water from the handpumps in the control communities is more used for other purposes. This counts for hand washing, child bathing and washing clothes. The water is regularly used for washing kitchen utensils in both types of communities.

4. Status of person collecting water and hygienic practices :

For all people collecting water, their the sex and age group (child; older child; adult) is observed and whether or not this person washes or rinses the container before filling it. It is also noted whether the container is closed with some sort of device after filling it with water. It is believed that these two factors are important in determining the (bacteriological) quality during collection and transport of water from the pump.

As shown in Table 4.22, virtually always women (about 95 %) and generally persons older than 20 years of age, collect the water. This pattern is similar in both control and intervention villages.
Both in intervention and control communities, generally open containers are used which are difficult to close. This is also reflected by the frequency of times that the container is actually closed. The majority of containers is washed/rinsed before collecting the water. It should be noted here that when several collections are done in a row, the container is washed only at the first collection.

It can be concluded that with respect to the variables as shown Table 4.22, intervention and control villages are fairly similar.

4.2.5 Water quality assessment

In order to assess the water quality of pumps and zirs, used by the sentinel households, the following variables were observed/analyzed:

1. General sampling information.
2. Bacteriological water quality for pumps and zirs.
3. Chemical water quality of pumps.

Below, the findings and conclusions are presented for each of the above-mentioned variable.

1. General sampling information :

Table 4.23 shows that samples from both zirs and handpumps have been taken from all households.

2. Bacteriological water quality of pumps and zirs :

Both pumps and zirs were analyzed on the concentration of faecal coliforms. In order to analyze the samples on faecal coliforms, the multiple tube test was executed, according to Standard Methods. Positive tubes (showing gas formation) show presence of faecal coliforms. Based on statistical considerations, with the number of positive tubes an estimation can be made of the most probable number of faecal coliforms in the water sample. This is expressed as the MPN-index/100 ml. Standard tables are

available of this index (see Table below). Since the number of positive tubes directly determines the MPN-index of the sample, this number of positive tubes is used as the result of the analysis.

Table 4.2.2: Relationship nr. of positive tubes and MPN-index

Nr. of positive tubes	MPN-index per 100 ml.
0	< 2.2
1	2.2
2	5.1
3	9.2
4	16.0
5	> 16.0

In Table 4.24 the results of all the bacteriological analysis are shown.

These results show that approximately 70 - 75% of the water samples obtained from the traditional pumps show contamination with faecal coliforms. This is not surprising. Considering the poor hygienic conditions at the pump sites (see Chapter 4.2.3), and the fact that water is abstracted from shallow (ground)water layers, the pumped water was likely to be contaminated.

A slight difference is noticed between intervention and control villages.

The bacteriological analyses on the zirs show that virtually all (95 - 100 %) samples from the zir are contaminated with faecal coliforms. So even the water collected from bacteriologically safe pumps gets contaminated during transportation and/or domestic use. As concluded in the previous chapters the conditions around the zir are not very hygienic and containers for collecting water are usually not closed after filling. Again a slight difference is observed between control and intervention, in this case in favour of the latter.

3. Chemical water quality of the pumps :

The following chemical analyses were carried out : pH, chloride, total iron, manganese and total hardness. The chemical quality is of importance, as it relates to taste, effect on the appearance of tea, or on scaling of boiling pots.

The main difference between intervention and control communities, as shown in Table 4.26, concerns the chloride content. The chloride content in the intervention villages

is considerably higher but, however, the water can still be considered as very fresh.

The manganese content is clearly higher in the control villages. As can be derived from the table below, the chemical properties of the groundwater regularly exceed W.H.O and Egyptian standards. This is particularly the case with manganese, which at concentrations above 0.1 mg/l has staining properties (gives a black colour). However, the water quality results are quite common for these parts of Egypt.

Table 4.2.3: WHO and Egyptian water quality standards

Parameter	Unit	Standards W.H.O	Egyptian
Faecal coliforms	MPN/100ml.	0	0
Chloride	mg/l	250	600
Hardness	mg/$CaCO_3$/l	500	500
Iron	mg/l	0.3	1.0
Manganese	mg/l	0.1	0.5
pH	(-)	6.5 - 8.5	

In general it is concluded that, using the intermediate outcomes up to six months only, it is too early to draw any definite conclusions on the impact of the intervention. This is largely caused by the occurrence of a seasonal pattern.

Therefore, it is concluded that an impact analysis only makes sense when it is based on a comparison between baseline versus 11- months outcomes, thereby excluding seasonal effects as much as possible

4.3.2 Environmental conditions in house observations

In order to assess the environmental conditions in the house/compound, several key variables were identified that are indicative for the environmental cleanliness and are thought to influence the risk of diarrhoea contamination:

1. Cleanliness of working/living areas.
2. Presence of a provision for animals.
3. Presence of a provision for garbage disposal.
4. Presence, use and condition of a special provision for discharge of used water.
5. Presence of a pump.
6. Presence, use and condition of a special container for water storage.
7. Presence and condition of a special provision for hand washing.
8. Presence and condition of a latrine.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. Cleanliness of living/working areas :

The sanitary index (see Table 4.2) indicates that at baseline the environmental conditions in house are somewhat better in the control communities. Both intervention and control villages show an improvement of environmental conditions at the 3 months survey. At 6 months the conditions deteriorate slightly in both type of villages, but show improvement compared to baseline in particularly the intervention villages (score from 0.53 to 0.46).
This conclusion may point at a positive impact of the intervention on the overall environmental cleanliness of living/working areas. However, considering the fact that both types of villages still show less hygienic conditions in absolute terms and the fact that the change is relatively small, no outspoken conclusions should be drawn yet.

Further examination of the individual observations (see Table 4.1) shows that most individual variables (e.g. animal faeces at place for cooking and washing kitchen utensils) follow the same pattern as demonstrated by the overall sanitary index. However, some significant improvements of the conditions can be found too. Some observations (on faeces at place for eating, bathing and sleeping) ameliorate

in intervention villages when compared to their baseline score and results in the control villages.

These observations are interesting with respect to a possible connection with the intervention. An important key-message here was the prevention of faecal contamination of food and children's play areas. However, all other areas in the house show a less positive pattern, similar to the overall sanitary index patters in both control and intervention villages. Therefore, and considering the fact that the observations for the 11 month survey are not taken into account, no positive correlation between the above-mentioned improvements and the intervention can be concluded yet.

The results for both intervention and control communities show a striking and similar pattern through time: A sharp dip (improvement) at the 3 month survey, and an increase (deterioration) again at the six month survey. This phenomena can probably be explained as a seasonal pattern. The 3 month survey and, although to a lesser extent, the six month survey were conducted during winter, whereas the baseline was performed in summer. During winter time, people are used to changing their lifestyle, e.g., animals are more often in field (in summer it is to hot for animals to be out); also people spent more time inside their houses (although cooking, which is done early in the morning and late in the afternoon, is done outside in the sun).

Another interesting observation (see Table 4.1, q. 35) concerns the increasing use of the latrine for bathing (from 32 to 37 % of the households of the intervention villages). With respect to the selected type of latrine (dry-composting pit latrine) reference is made to the remarks section 4.2.2.

2. Provision for animals :

As can be derived from Table 4.3, in the intervention villages significantly less special places for animals can be found inside the house. These places are significantly more often fenced in the intervention villages. These two trends are more pronounced at the 3 and 6 months surveys. In general the table indicates that both in intervention and control villages, most of the households have animals living inside the house/compound (80 - 90 %). The indicated trends may be an effected by the intervention.

3 Provision for garbage :

Compared to baseline, during the 3 and 6 months survey a dramatic increase in the number of garbage containers is observed for particularly the intervention communities (see Table 4.4). This can also be observed for the control areas, which phenomenon is a clearly an effect of the research. According to the Supervisor of the Environmental Team, on some occasions, people spontaneously and proudly showed their garbage container, even before the data collectors started their observations. The slightly sharper increase in the intervention villages is thought to be due to the interaction effect between research and intervention.

A sharp increase in the proportion of two other variables (garbage at a special place, garbage burned) can be noticed in both control and intervention villages. Especially considering the fact that these variables in question can not be observed at a glance (the data collector should ask about their occurrence), the before-mentioned research effect is a likely explanation here also.

4. Provision for waste water :

The number of special places for waste water discharge remain the same for both the intervention and control villages (about 15 and 35 %). It can be noted that the health education did not pay attention to this practice.

Water ponding increases sharply in both types of communities (see Table 4.5) and is most probably due to seasonal influences (in winter, water evaporates less quickly and rainfall is higher).

The absolute number of households using the latrine for waste water discharge does not decrease in the intervention communities as contrasted to the control villages. The difference. An opposite effect is here observed considering one of the messages of the Health Education Team (avoid disposing waste water in the (UNICEF) latrine).

5. Presence of a pump :

As shown in Table 4.6, at baseline the majority of the population uses handpumps. In the intervention villages around 56 percent of the pumps is located inside the house or compound, whereas in the control villages around 30 percent is situated inside (a significant difference). Due to the intervention the number of pumps located inside the house /compound decreases in the intervention villages (UNICEF pumps are communal), although the majority of the pumps remain within 50 metres distance from the house.

Around 60 % of the households point at the new UNICEF pumps as being their first pump. Besides, more than 40% of the people use the UNICEF pump as second pump at the 6 months survey. Apparently still part of the population either prefer their old pump or have no easy access to the new pump.

More detailed information about the operation and maintenance of handpumps is provided in Chapter 4.3.3. Data on water use at the pump can be found in Chapter 4.3.4.

6. Presence, use and condition of a special container for water storage :

The majority of households in both intervention and control villages have a zir for storing water. For all surveys no significante differences could be observed between these villages (Table 4.7). The use of zirs decreases dramatically at the 3 and 6 months surveys in both communities. This is due to the typical seasonal pattern, which has been mentioned in earlier sections too. The zir is especially

whereas in the control villages only a small increase is noticed (from 67 to 73 %). The trends here are an effect of the intervention.

The new UNICEF latrines consist of a slab and pit lining only. The construction of walls and doors is considered the responsibility of the household. Many people have constructed the latrine outside the walls of the house, without constructing any walls and doors yet. Hence, significant differences between control and intervention appear at 3 and 6 months with respect to questions 76,77 and 78.

As shown in Table 4.11 the sanitary conditions of the latrines in both control and intervention communities are fairly good, although the intervention households score slightly less good.
Both intervention and control villages show a slight improvement of sanitary conditions at the 3 months survey. At 6 months the conditions deteriorate somewhat in both types of villages, but show a small improvement as compared with baseline for only the intervention villages. No hard evidence is available for an relation with the intervention.

An important observation was reported by the Environmental Sanitation Team, which cannot be derived from the questionnaire on environmental observations in house. It concerns the use of the new UNICEF latrines. A fair number of these latrines are not used for their intended purpose yet. People either did not complete the construction or, e.g. use it as a place for storage. With respect to this situation, it should be noted that part of the latrines were purchased by people who already possessed a latrine and continued using the latter. The observations on the latrine were carried out for the latrine that was actually used.

4.3.3 Handpump survey

In order to assess all traditional handpumps before and after the intervention, and the new pumps after the intervention, a special observation list was designed. Besides questions about the state of maintenance and functioning of the pump, several conditions were identified that are indicative for the environmental cleanliness around the pump and are thought to influence the risk of contamination of the well and/or pump and thereby the water that is fetched from this pump. The following key-variables were identified for the assessment of handpumps :

1. Presence, location and type of pump.
2. Operation and maintenance.
3. Environmental conditions at the pump-site.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. Presence, location and type of pump :

As shown in Table 4.12, at all surveys the pump density in the intervention villages is significantly higher than in the control villages. Most pumps are located inside the house/compound (70 - 80 %); this figure has decreased for the intervention villages.
Due to the intervention, the pump-density in the intervention villages increases significantly. Considering the fact that the new UNICEF pumps are communal, the proportion of pumps located in the house/compound decreases in the intervention areas. However, the same trend is found in the control villages, although less pronounced.

On closer examination of the data on new pumps only (see Table 4.17), it is concluded that 43 % of the UNICEF pumps are located inside a house or compound. This practice is in contrast with the supposed communal character of the new pumps. Sometimes UNICEF placed a pump inside a compound because of pressure from the community or its leaders. Also, after installation, some people extended their compound with additional fencing in order to appropriate the new pump.

When comparing the total number of pumps surveyed (see Table 3.12) at baseline and 3 and 6 months, and considering 21 new UNICEF pumps were installed, it must be concluded that part of the traditional pumps was removed (in the intervention villages). After receiving new UNICEF pumps, some people dismantled and sold their old pumps. In other cases people just abandoned the old pump and left it without maintaining it any more.

2. Operation and maintenance of pump :

As shown in Table 4.13, the number of pumps giving water decreases in both control and intervention villages after the intervention. The difference in number of pumps giving water remained the same in favour of the control villages.

The number of leaking pumps has increased after 3 months and has strongly decreased after 6 months for both control and intervention villages. The decrease for both may be due to the effect of research, which leads to increased maintenance efforts.

As shown in Table 4.14, at baseline both the pumps in intervention and control communities score average (around 40 %) on the maintenance index, although the pumps in the intervention villages are in a slightly better condition. After the intervention, the state of maintenance improves considerably in the intervention villages (scoring fairly good), whereas in the control villages a slight deterioration is visible. The improvement in the intervention villages is not only due to the new UNICEF pumps, but also to the upgrading of old pumps. Sometimes, people are motivated to do this out of jealousy (neighbours have a nice looking new pump). Also, the new pumps have become a new status symbol, thus inspiring people to make their old pump look just as nice.

On closer examination of the individual observations concerning maintenance (Table 4.17) for the new pumps only, it can be concluded that two pump showed cracks at the 6 months survey. This situation presents an increased risk of contamination of the well.

3. Environmental conditions at the pump-site :

As shown in Table 4.15 and 4.16, the environmental conditions at the pump-site are fairly poor for both intervention and control villages, although the availability of drainage is significantly higher in the intervention areas. The number of provisions for drainage in the intervention villages improves even more after the intervention (due to the new pumps). However, although at the 3 months survey an increasing number of drainage facilities functions in both types of villages, a large dip is visible at 6 months again. This may be due to the fact that the drainage facilities of the traditional pumps are usually of a temporary nature. Therefore, their condition may vary greatly through time.

On closer examination of the new UNICEF pumps (see Table 4.18), it should be noted that all pumps are provided with proper drainage. Besides, drainage facilities do not always function. This is also illustrated by the high prevalence of water ponding around the new pumps. From field inspection it appeared that the drainage facilities as provided by the intervention were not adequate and often poorly constructed. In most cases UNICEF left the completion of the drainage to the community. Only a short concrete drainage canal (about 1 metre) was provided. In a number of cases, the canal was not appropriately constructed (e.g. drainage directed to the wall of a house, or to a higher area). This situation results in poor sanitary conditions around the pump.

With respect to the overall environmental conditions around the pumps (see Table 4.16), it can be concluded that the conditions for the intervention villages improve in comparison to the control villages. However, the environmental conditions remain fairly poor up to the 6 months survey.

With respect to the changing number of pumps near the latrines (Table 4.16, q. 26), it should be noted that this may be due to differences in interpretation of the data collector.

4.3.4 Water use at the pump observations

In order to assess the water use at the pump,several key-variables were identified:

1. General data on pump used.
2. Quantity of water collected.
3. Other water use activities at the pump:
   - hand washing;
   - child bathing;
   - washing cooking utensils;

- washing clothes;
- washing food/vegetables;
- other activities.

4. Status of person collecting and hygienic practices.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. General data on pump used :

As shown in Table 4.19 all of the observed (sentinel) households use a handpump. Somethimes, more than one hand pump was used. Approximately 50 to 60 % of the hand pumps used are new pumps (this is consistent with the observations in the environmental conditions in house survey).

2. Quantity of water collected :

Using average household sizes for the sentinel household (derived from census data: 9.9 for the intervention villages, 10.3 for the control villages), the average use per capita per day is estimated.
As shown in Table 4.20, the average use of water for the sentinel households in both communities slightly increases at 3 months and sharply decreases (particularly the intervention villages) at 6 months. Seasonal influences (less water is used in winter but also on colder days) may cause these fluctuations. Conclusions concerning the messages of the Health Education Team like "use as much water as needed..." can not be drawnfrom these data.

It should be noted that, for both control and intervention communities, these volumes are considered relatively low, when compared with WHO guidelines (see Chapter 4.3.3) for table of WHO guidelines).

3. Other water use :

As shown in Table 4.21 the intervention and control communities demonstrate a similar pattern with respect to 'other water use' at the pump through time. Due to the influence of winter less 'other water use' activities take place at the pump during the 3 months observations.
Apart from hand washing and washing kitchen utensils,'other water use' activities are not common.

Although one of the health messages was aimed at stimulating people to wash their hands with running water, no effect of this was seen at the pump-sites.

4. Status of person collecting water and hygienic practices :

As shown in Table 4.22, virtually always women (about 95 %) and generally persons

older than 20 years of age, collect the water. However, there is a considerable difference in the percentage of persons older than 20 year collecting water between intervention and control communities (around 55 and 80 % respectively).

Both in intervention and control communities, generally open containers are used which are difficult to close. This is also reflected by the number of times the container is actually closed. At the 3 and 6 month survey a clear shift is noticed towards the use of bigger containers, in both control and intervention areas. This is reflected in the very limited number of times the container was closed. A possible explanation may be, that due to winter time people prefer to stay at home and collect larger volumes of water per collection. This is also reflected in the declining number of collections, in the control villages. However, in the intervention villages, although people also fetch more water per collection, the absolute number of collection increases sharply at 3 months survey. This seems to be caused by the introduction of the new UNICEF pumps, possibly in combination with the health education.

The number of times that containers are washed/rinsed before collecting the water decreases sharply through in both intervention and control villages. From the viewpoint of health, this is a negative development. It should be noted here that when several collections are done in a row, the container is washed only at the first collection.

4.3.5 Water quality assessment

In order to assess the water quality of pumps and zirs, used by the sentinel households, the following variables were observed/analyzed:

1. General sampling information.
2. Bacteriological water quality for pumps and zirs.
3. Chemical water quality of pumps.

Below, the findings and conclusions are presented for each of the above-mentioned key variables at each successive time interval, thereby comparing changes in intervention and control villages through time.

1. General sampling information :

Table 4.23 shows total numbers of samples taken and analyzed. At the 3 and 6 months survey, both in intervention and control areas less zirs were used and thus not sampled. This is due to seasonal influences, as during winter there is less need to store the water at a cool place.

2. Bacteriological water quality of pumps and zirs :

In Table 4.24 the results of the bacteriological analysis of pumps used by the sentinel households are shown.

These results show that at baseline approximately 70 - 75% of the water samples obtained from the traditional pumps show contamination with faecal coliforms.

At the 6 months survey, the pumps used by the sentinel households in both the intervention and control villages show similar improvement (56 % contaminated). This is contrary to expectations, since approximately 55 % of these households were using new UNICEF pumps.

Table 4.25 shows the results of the bacteriological analysis of all new UNICEF pumps. As can be derived the pumps did not produce bacteriologically safe water from the start. At the 6 months survey still 19 % of the pumps show faecal contamination, although it can be noticed that only one new pump was still heavily contaminated (5 positive tubes). More details on water quality in general and bacteriological contamination of the new pumps in particular, can be found in the Annex 1 on water quality investigations.

The bacteriological analyses on the zirs show that virtually all (95 - 100 %) samples from the zir are contaminated with faecal coliforms in both intervention and control villages. This situations remains throughout the 3 and 6 months surveys. So even the water collected from bacteriologically safe pumps gets contaminated during transportation and/or domestic use. As concluded in the previous chapters the conditions around the zir are not very hygienic and containers for collecting water are usually not closed after filling.
Apparently the health messages concerning the need to cover the zir and avoidance of hand contamination of the zir water have no effect.

3. Chemical water quality of the pumps :

The following chemical analyses were carried out : pH, chloride, total iron, manganese and total hardness.
The chemical quality is of importance, as it relates to taste, effect on the appearance of tea, or on scaling of boiling pots.

In Chapter 4.2.5 the chemical water quality was discussed for the traditional pumps. In Table 4.26 also the results for the new UNICEF pumps are presented.

The new handpumps produce higher concentrations of iron, hardness and chloride compared to the traditional handpumps. The average concentrations for iron and manganese exceed the quality standards and may slightly change the physical property of the water.

4.4 COMPARISON OF BASELINE VERSUS 11 MONTHS

4.4.1 Summary of findings and conclusions

Similar improvements are observed in the environmental conditions in house/compound for both intervention and control villages (e.g. animals and faeces in cooking areas). However, animals have even more access to the house and water ponding increasingly occurs at the 11 months survey in both types of villages. This situation poses a higher public health risk.
The number of garbage containers increased dramatically particularly in the intervention villages. This increase can be related to a message of the health education. The observed increase in control villages is probably due to the interviews and research effects.

The intervention resulted in a sharp increase in the number of latrines, although both types of villages allready showed a high prevalence of latrines. The sanitary conditions of the latrines in both intervention and control villages remained fairly good.

The pump density in both types of villages slightly increased, for the control villages however on a significant lower level. Improvement of handpump maintenance is only observed in the intervention villages due to the new UNICEF handpumps and also some upgrading of traditional handpumps. The environmental conditions around the pumps in the intervention villages clearly improved in comparison to the control villages. However, drainage facilities of traditional as well as UNICEF handpumps do not always function properly.
The bacteriological analyses of the water from handpumps used by the sentinal households show a slight drop in the contamination with faecal coliforms. This drop is more pronounced in the control villages, despite the presence of new handpumps in the intervention villages. One explanation is that half of the handpumps used by the sentinal households of the intervention communities are new UNICEF handpumps. Moreover, 40 % of all new handpumps show faecal contamination to some degree at the 11 months survey. However, the bacteriological quality of water from UNICEF handpumps is considerably better compared to traditional handpumps.

The average use of water in the intervention villages remain on a same level, while a significant drop in the water use of control villages is observed. The total volumes collected are relatively low for both types of households compared to WHO guidelines. Containers for collecting water are usually not closed. Washing of containing significantly decreased at the 11 months survey in both intervention and control villages, which is a negative development from a health point of view.

The zirs for storing water in house are less used during the 11 month survey in both types of communities. Compared to control villages, zirs are significantly more closed in the intervention villages, which trend may be due to the health education. The sanitary conditions around zirs have slightly improved for both types of villages, but remain below average. However, all samples taken from zirs

appear to be heavily contaminated with faecal coliforms. Even water taken from bacteriologically safe handpumps gets contaminated during transportation and/or domestic use.

4.4.2 Environmental conditions in house observations

In order to assess the environmental conditions in the house/compound, several key variables were identified that are indicative for the environmental cleanliness and are thought to influence the risk of diarrhoea contamination:

1. Cleanliness of working/living areas.
2. Presence of a provision for animals.
3. Presence of a provision for garbage disposal.
4. Presence, use and condition of a special provision for discharge of used water.
5. Presence of a pump.
6. Presence, use and condition of a special container for water storage.
7. Presence and condition of a special provision for hand washing.
8. Presence and condition of a latrine.

Below, the findings and conclusions are presented for each of the above-mentioned key variables comparing changes in intervention and control villages between the baseline and 11 months surveys.

1. Cleanliness of living/working areas :

The sanitary index (see Table 4.4.2) shows similar improvement compared to baseline for both the intervention and control villages. The control communities score somewhat more positive through time. Therefore no outspoken conclusions can be drawn on the relation between the improvements and the intervention.

Further examination of the individual observations (see Table 4.4.1) shows that most individual variables (e.g. animal faeces at place for cooking and washing kitchen utensils) follow the same trend as the overall sanitary index. Some important and significant improvements of the conditions cconcern animal (faeces) at place for cooking, eating, bathing and sleeping. concluded yet.

Another interesting observation (see Table 4.4.1, q. 35) concerns the increasing use of the latrine for bathing. With respect to the selected type of latrine (dry-composting pit latrine) reference is made to the remarks section 4.3.1.

2. Provision for animals :

As can be derived from Table 4.4.3, no positive changes can be observed concerning the provision for animals, either inside or outside the house. In general the table indicates that both in intervention and control villages, most of the households have animals living inside the house/compound (80 - 90 %). Animals even have more access to the house at 11 months after intervention.

TABLE 4.4.1 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Cleanliness in living areas -

Q* OBSERVATION	BASELINE					11 - MONTHS				
	INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
11 PLACE FOR COOKING IN HOUSE/COMPOUND	130	95.6	118	100.0		136	99.3	117	100.0	
	130	100.0	118	100.0		136	100.0	117	100.0	
12 PLACE SEPARATED BY FENCING	41	31.5	43	36.4		38	27.9	45	38.5	
13 ANIMALS VISIBLE AT THIS PLACE	64	49.2	63	53.4		46	33.8	36	30.8	
14 ANIMAL FEACES VISIBLE AT THIS PLACE	75	57.7	45	38.1	#	54	39.7	33	28.2	
15 GARBAGE VISIBLE AT THIS PLACE	111	85.4	77	65.3	#	108	79.4	75	64.1	#
16 PLACE FOR WASHING UTENSILS IN HOUSE	97	71.3	101	85.6	#	115	83.9	100	85.5	
	97	100.0	101	100.0		115	100.0	100	100.0	
17 PLACE SEPARATED BY FENCING	3	3.1	7	6.9		8	7.0	4	4.0	
18 THIS PLACE AT THE PUMP	51	52.6	24	23.8	#	53	46.1	23	23.0	#
19 ANIMALS VISIBLE AT THIS PLACE	52	53.6	67	66.3		58	50.4	49	49.0	
20 ANIMAL FEACES VISIBLE AT THIS PLACE	58	59.8	63	62.4		54	47.0	47	47.0	
21 GARBAGE VISIBLE AT THIS PLACE	90	92.8	79	78.2	#	102	88.7	75	75.0	#
22 PLACE FOR WASHING CLOTHES IN HOUSE	129	94.9	113	95.8		135	98.5	112	95.7	
	129	100.0	113	100.0		135	100.0	112	100.0	
23 PLACE SEPARATED BY FENCING	6	4.7	8	7.1		6	4.4	6	5.4	
24 THIS PLACE AT THE PUMP	5	3.9	17	15.0	#	12	8.9	14	12.5	
25 ANIMALS VISIBLE AT THIS PLACE	73	56.6	72	63.7		61	45.2	50	44.6	
26 ANIMAL FEACES VISIBLE AT THIS PLACE	78	60.5	58	51.3		64	47.4	55	49.1	
27 GARBAGE VISIBLE AT THIS PLACE	109	84.5	74	65.5	#	108	80.0	87	77.7	
28 PLACE FOR EATING INSIDE HOUSE	134	98.5	118	100.0		136	99.3	117	100.0	
	134	100.0	118	100.0		136	100.0	117	100.0	
29 PLACE SEPARATED BY FENCING	16	11.9	13	11.0		20	14.7	17	14.5	
30 ANIMALS VISIBLE AT THIS PLACE	68	50.7	67	56.8		42	30.9	36	30.8	
31 ANIMAL FEACES VISIBLE AT THIS PLACE	69	51.5	49	41.5		43	31.6	45	38.5	
32 GARBAGE VISIBLE AT THIS PLACE	100	74.6	69	58.5	#	95	69.9	76	65.0	
33 PLACE FOR BATHING INSIDE HOUSE	134	98.5	116	98.3		137	100.0	117	100.0	
	134	100.0	116	100.0		137	100.0	117	100.0	
34 PLACE SEPARATED BY FENCING	92	68.7	84	72.4		131	95.6	111	94.9	
35 PLACE INSIDE THE LATRINE	32	23.9	59	50.9	#	43	31.4	72	61.5	#
36 ANIMALS VISIBLE AT THIS PLACE	41	30.6	28	24.1		22	16.1	17	14.5	
37 ANIMAL FEACES VISIBLE AT THIS PLACE	48	35.8	39	33.6		35	25.5	23	19.7	
38 GARBAGE VISIBLE AT THIS PLACE	74	55.2	56	48.3		69	50.4	56	47.9	
39 PLACE FOR SLEEPING INSIDE HOUSE	136	100.0	117	99.2		136	99.3	117	100.0	
	136	100.0	117	100.0		136	100.0	117	100.0	
40 PLACE SEPARATED BY FENCING	127	93.4	94	80.3	#	122	89.7	88	75.2	#
41 ANIMALS VISIBLE AT THIS PLACE	31	22.8	36	30.8		14	10.3	14	12.0	
42 ANIMAL FEACES VISIBLE AT THIS PLACE	37	27.2	33	28.2		17	12.5	17	14.5	
43 GARBAGE VISIBLE AT THIS PLACE	66	48.5	53	45.3		61	44.9	51	43.6	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.50$

TABLE 4.4.2. SANITARY INDEX SCORE FOR ALL HOUSEHOULDS AT BASELINE AND 11 MONTHS - Environmental conditions in living/working areas -

	BASELINE SURVEY		11 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.53	0.49	0.44	0.41

TABLE 4.4.3. RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Provision for animals -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%		11 - MONTHS INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
44 PLACE FOR ANIMALS INSIDE COMPOUND	131	96.3	106	89.8		134	97.8	115	98.3	
	131	100.0	106	100.0		134	100.0	115	100.0	
45 PLACE SEPARATED BY FENCING	115	87.8	99	93.4		119	88.8	98	85.2	
46 PLACE FOR ANIMALS INSIDE HOUSE	111	81.6	98	83.1		110	80.3	107	91.5	#
	111	100.0	98	100.0		110	100.0	107	100.0	
47 PLACE SEPARATED BY FENCING	98	88.3	92	93.9		98	89.1	91	85.0	
48 DO ANIMALS HAVE ACCESS TO THE HOUSE	114	83.8	102	86.4		122	89.1	100	85.5	

Note: Chi-squared test for intervention vs. control comparison # $p < 0.05$

3 Provision for garbage :

Compared to baseline, during the 11 months survey a dramatic increase in the number of garbage containers is observed for particularly the intervention communities (see Table 4.4.4). This can also be observed for the control areas, which phenomenon is clearly an effect of the research. The sharper increase in the intervention villages is thought to be due to the interaction effect between research and intervention.

A sharp, increase in the proportion of two other variables (garbage at a special place, garbage burned) can be noticed in both control and intervention villages. A relation with the intervention is not clear, since this increase is more or less similar for both types of villages.

TABLE 4.4.4 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Provision for garbage -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%		11 - MONTHS INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
49 CONTAINER FOR GARBAGE COLLECTION	6	4.4	40	33.9	#	76	55.5	81	69.2	#
50 GARBAGE DUMPED AT SPECIAL PLACE	43	31.6	14	11.9	#	68	49.6	42	35.9	#
51 GARBAGE BURNED/BURRIED	34	25.0	13	11.0	#	88	64.2	72	61.5	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

4. Provision for waste water :

The number of special places for waste water discharge remain the same for both the intervention and control villages (about 16 and 35 %). It can be noted that the health education did not pay attention to this practice.

Water ponding increases sharply in both types of communities (see Table 4.4.5), despite the level of water use did not increase. Maybe weather influences (during 3 and 6 months surveys seasonal influence) play a role in the occurrence of water ponding.

TABLE 4.4.5 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Provision for waste water -

		BASELINE					11 - MONTHS				
Q*	OBSERVATION	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
52	PLACE FOR WASTE WATER DISCHARGE	21	15.4	38	32.2	#	23	16.8	46	39.3	#
		21	100.0	38	100.0		23	100.0	46	100.0	
53	IS THIS PLACE THE LATRINE	10	47.6	29	76.3	#	10	43.5	34	73.9	#
54	WATER PONDING AT PLACE FOR DISCHARGE	8	38.1	17	44.7		17	73.9	29	63.0	
55	WATER PONDING IN HOUSE/COMPOUND	57	41.9	52	44.1		133	97.1	107	91.5	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

5. Presence of a pump :

As shown in Table 4.4.6, all of the households use handpumps. Due to the intervention the number of pumps located inside the house/compound decreases significantly in the intervention villages (UNICEF pumps are communal), but the majority of the pumps remain within 50 metres distance from the house.

Around 60 % of the households point at the new UNICEF pumps as being their first pump. Besides, about 40 % of the households use the UNICEF pump as second pump at the 11 months survey. Apparently still part of the population either prefer their old pump or have no easy access to the new pump.

6. Presence, use and condition of a special container for water storage :

The majority of households in both intervention and control villages have a zir for storing water. Table 4.4.7 shows a similar decrease of zir use at the 11 months survey in both communities, which is possibly due to colder weather.

Compared to the control villages, a more pronounced and significant increase is observed at 11 months for the zir covering in the intervention villages. Since covering the zir was one of the health messages, this increase may be related to the intervention.

Table 4.7 further indicates that the use of a long-handled dipper for getting water from the zir is not common in both types of communities. This means most people use cups, thus increasing the chance of contamination of the water by hands, although use of a clean dipper was one of the health messages.

TABLE 4.4.6 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Handpumps -

Q* OBSERVATION	BASELINE					11 - MONTHS				
	INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
56 NR. OF HOUSEHOLDS USING HANDPUMPS	136	100.0	118	100.0		137	100.0	117	100.0	
	136	100.0	118	100.0		137	100.0	117	100.0	
57 PUMP NEW (AFTER INTERVENTION)	0	0.0	0	0.0		82	59.9	1	0.9	#
58 PUMP INSIDE HOUSE/COMPOUND	76	55.9	36	30.5	#	55	40.1	47	40.2	#
59 DISTANCE TO THE PUMP										
* 0 - 25 M	82	60.3	70	59.3		86	62.8	79	67.5	
* 25 - 50 M	47	34.6	41	34.7		42	30.7	25	21.4	
* 50 - 100 M	7	5.1	78	66.1		9	6.6	12	10.3	
* > 100 M		0.0	0	0.0		0	0.0	1	0.9	
87 HOUSEHOLDS USING SECOND PUMP $	0	0.0	0	0.0		58	42.3	14	12.0	#
						58	100.0	14	100.0	
88 PUMP NEW (AFTER INTERVENTION) $	0	0.0	0	0.0		25	43.1	0	0.0	#
89 PUMP INSIDE HOUSE/COMPOUND $	0	0.0	0	0.0		23	39.7	0	0.0	#
90 DISTANCE TO THE PUMP $										#
* 0 - 25 M	0	0.0	0	0.0		30	51.7	1	7.1	
* 25 - 50 M	0	0.0	0	0.0		17	29.3	6	42.9	
* 50 - 100 M	0	0.0	0	0.0		11	19.0	7	50.0	
* > 100 M	0	0.0	0	0.0		0	0.0	0	0.0	
91 HOUSEHOLDS USING THIRD PUMP $	0	0.0	0	0.0		0	0.0	0	0.0	
						0	0.0	0	0.0	
92 PUMP NEW (AFTER INTERVENTION) $	0	0.0	0	0.0		0	0.0	0	0.0	
93 PUMP INSIDE HOUSE/COMPOUND $	0	0.0	0	0.0		0	0.0	0	0.0	
94 DISTANCE TO THE PUMP $										
* 0 - 25 M	0	0.0	0	0.0		0	0.0	0	0.0	
* 25 - 50 M	0	0.0	0	0.0		0	0.0	0	0.0	
* 50 - 100 M	0	0.0	0	0.0		0	0.0	0	0.0	
* > 100 M	0	0.0	0	0.0		0	0.0	0	0.0	

($): Observations started at the end of baseline survey
Note: Chi-squared test for intervention vs. control comparison, # p < 0.05

Both intervention and control villages show a very slight improvement of environmental conditions at the 11 months survey for the sanitary index for environmental conditions around the zir. However, conditions remain average through time. On closer examination, both positive and negative changes occur but these are similar for both type of villages. For this reason, no outspoken conclusions can be drawn.

7. Presence and condition of a special provision for hand washing:

As shown in Table 4.4.9, only a small portion of the households have a special storage/basin for hand washing. In the control villages significantly more storage/basins for hand washing are present at baseline, while the number of provisions equals at the 11 months survey.

However, in case the storage/basin contained water, the occurrence of fresh water decreased considerably in the intervention villages.

One of the health messages focused on the need for hand washing with soap and running water. The above-mentioned situation indicates the occurance of positive and negative effects probably both related to the intervention.

TABLE 4.4.7 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Water storage -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%		11 - MONTHS INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
60 WATER STORED IN ZIR/CONTAINER	122	89.7	106	89.8		112	81.8	95	81.2	
	122	100.0	106	100.0		112	100.0	95	100.0	
61 ZIR/CONTAINER COVERED	91	74.6	93	87.7	#	100	89.3	89	93.7	
62 LONG HANDLED DIPPER VISIBLE	1	0.8	2	1.9		1	0.9	0	0.0	
63 CUP VISIBLE	51	41.8	54	50.9		56	50.0	62	65.3	#
64 CUP/DIPPER ON THE FLOOR	12	9.8	22	20.8	#	7	6.3	8	8.4	
65 CUP/DIPPER INSIDE CONTAINER ZIR	0	0.0	1	0.9		0	0.0	0	0.0	
66 CUP/DIPPER ON TOP OF ZIR/CONTAINER	19	15.6	39	36.8	#	37	33.0	39	41.4	
67 ANIMALS HAVE ACCESS TO CUP/DIPPER	10	8.2	24	22.6	#	7	12.5	5	8.1	
68 ANIMALS VISIBLE NEAR CONTAINER/ZIR	66	54.1	68	64.2		37	33.0	30	31.6	
69 FAECES VISIBLE NEAR CONTAINER/ZIR	67	54.9	55	51.9		34	30.4	36	37.9	
70 GARBAGE VISIBLE NEAR CONTAINER/ZIR	80	65.6	68	64.2		75	67.0	58	61.1	
71 MUD/WATER PONDING NEAR ZIR	88	72.1	48	45.3	#	108	96.4	82	86.3	#

(*) : The percentages for question 67 are calculated in relation to the total number of times a cup was visible.
Note: Chi-squared test for intervention vs. control comparison. # $p < 0.05$

TABLE 4.8 SANITARY INDEX SCORE FOR ALL ZIRS AT BASELINE, 3 AND 6 MONTHS - Environmental conditions around the zir -

	BASELINE SURVEY		3 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.61	0.56	0.57	0.54

TABLE 4.4.9 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Provision for handwashing -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%		11 - MONTHS INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
72 STORAGE/BASIN FOR HANDWASHING	17	12.5	36	30.5	#	34	24.8	28	23.9	
	17	100.0	36	100.0		34	100.0	28	100.0	
73 WATER IN BASIN FOR HANDWASHING	5	29.4	5	13.9		6	17.6	9	32.1	
	5	100.0	5	100.0		6	100.0	9	100.0	
74 WATER IN BASIN IS FRESH	4	80.0	4	80.0		4	66.7	7	77.8	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

8. Presence and conditions of a latrine :

As shown in Table 4.4.10, a sharp increase in the number of latrines in the intervention villages can be found, whereas in the control villages only a small increase is noticed. The trends here are an effect of the intervention.

The new (shallow) UNICEF latrines consist of a slab and pit lining only. The construction of walls and doors is considered the responsibility of the household. Many people have constructed the latrine outside the walls of the house, without constructing any walls and doors yet. Hence, significant differences between control and intervention appear at 3 and 6 months with respect to questions 76,77 and 78.

As shown in Table 4.4.11 the sanitary conditions of the latrines in both control and intervention communities are fairly good. The overall scores for type of villages are almost the same. No relation with the intervention can be assessed.

An important observation was reported by the Environmental Sanitation Team, which cannot be derived from the questionnaire on environmental observations in house. It concerns the use of the new UNICEF latrines. A fair number of these latrines are not used for their intended purpose yet. People either did not complete the construction or, e.g. use it as a place for storage. With respect to this situation, it should be noted that part of the latrines were purchased by people who already possessed a latrine and continued using the latter. The observations on the latrines were carried out for the latrine that was actually used.

TABLE 4.4.10 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Latrine -

		BASELINE					11 - MONTHS				
		INTERV.		CONTROL			INTERV.		CONTROL		
Q*	OBSERVATION	NR.	%	NR.	%		NR.	%	NR.	%	
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
75	LATRINE INSIDE HOUSE/COMPOUND	68	50.0	79	66.9	#	119	86.9	90	76.9	#
		68	100.0	79	100.0		119	100.0	90	100.0	
76	LATRINE INSIDE WALLS OF THE HOUSE	66	97.1	79	100.0		105	88.2	89	98.9	#
77	LATRINE HAS WALLS AND DOOR	48	70.6	57	72.2		58	48.7	63	70.0	#
78	DAYLIGHT CAN ENTER THE LATRINE	49	72.1	61	77.2		103	86.6	69	76.7	
79	PIT IS COVERED WITH SLAB	60	88.2	68	86.1		119	100.0	88	97.8	
80	FAECES VISIBLE ON SLAB	8	11.8	16	20.3		32	26.9	7	7.8	#
81	HOLE CLOSED BY COVER	16	23.5	17	21.5		41	34.5	27	30.0	
82	WATER AVAILABLE IN LATRINE	24	35.3	22	27.8		20	16.8	28	31.1	#
83	MUD/WATER PONDING IN LATRINE	36	52.9	39	49.4		70	58.5	53	58.9	
84	WALK THROUGH FAECES/DIRT TO LATRINE	13	19.1	21	26.6		32	26.9	13	14.4	#
85	COLLECTING PIT INSIDE WALLS OF HOUSE	55	80.9	77	97.5	#	93	78.2	88	97.8	#
86	DEPTH OF THE PIT										#
	* 1 - 2 M	0	0.0	0	0.0		27	22.7	0	0.0	
	* 2 - 3 M	4	5.9	3	3.8		21	17.6	8	8.9	
	* 3 - 4 M	12	17.6	5	6.3		7	5.9	14	15.6	
	* 4 - 5 M	14	20.6	29	36.7		21	17.6	21	23.3	
	* > 5 M	24	35.3	28	35.4		32	26.9	24	26.7	
	* NOT KNOWN	14	20.6	14	17.7		11	9.2	23	25.6	

Note: Chi-squared test for intervention vs. control comparison # p <0.50

8. Presence and conditions of a latrine :

As shown in Table 4.4.10, a sharp increase in the number of latrines in the intervention villages can be found, whereas in the control villages only a small increase is noticed. The trends here are an effect of the intervention.

The new (shallow) UNICEF latrines consist of a slab and pit lining only. The construction of walls and doors is considered the responsibility of the household. Many people have constructed the latrine outside the walls of the house, without constructing any walls and doors yet. Hence, significant differences between control and intervention appear at 3 and 6 months with respect to questions 76,77 and 78.

As shown in Table 4.4.11 the sanitary conditions of the latrines in both control and intervention communities are fairly good. The overall scores for type of villages are almost the same. No relation with the intervention can be assessed.

An important observation was reported by the Environmental Sanitation Team, which cannot be derived from the questionnaire on environmental observations in house. It concerns the use of the new UNICEF latrines. A fair number of these latrines are not used for their intended purpose yet. People either did not complete the construction or, e.g. use it as a place for storage. With respect to this situation, it should be noted that part of the latrines were purchased by people who already possessed a latrine and continued using the latter. The observations on the latrines were carried out for the latrine that was actually used.

TABLE 4.4.10 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE AND 11 MONTHS - Latrine -

		BASELINE					11 - MONTHS				
		INTERV.		CONTROL			INTERV.		CONTROL		
Q*	OBSERVATION	NR.	%	NR.	%		NR.	%	NR.	%	
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	137		117		S#
75	LATRINE INSIDE HOUSE/COMPOUND	68	50.0	79	66.9	#	119	86.9	90	76.9	#
		68	100.0	79	100.0		119	100.0	90	100.0	
76	LATRINE INSIDE WALLS OF THE HOUSE	66	97.1	79	100.0		105	88.2	89	98.9	#
77	LATRINE HAS WALLS AND DOOR	48	70.6	57	72.2		58	48.7	63	70.0	#
78	DAYLIGHT CAN ENTER THE LATRINE	49	72.1	61	77.2		103	86.6	69	76.7	
79	PIT IS COVERED WITH SLAB	60	88.2	68	86.1		119	100.0	88	97.8	
80	FAECES VISIBLE ON SLAB	8	11.8	16	20.3		32	26.9	7	7.8	#
81	HOLE CLOSED BY COVER	16	23.5	17	21.5		41	34.5	27	30.0	
82	WATER AVAILABLE IN LATRINE	24	35.3	22	27.8		20	16.8	28	31.1	#
83	MUD/WATER PONDING IN LATRINE	36	52.9	39	49.4		70	58.5	53	58.9	
84	WALK THROUGH FAECES/DIRT TO LATRINE	13	19.1	21	26.6		32	26.9	13	14.4	#
85	COLLECTING PIT INSIDE WALLS OF HOUSE	55	80.9	77	97.5	#	93	78.2	88	97.8	#
86	DEPTH OF THE PIT										#
	* 1 - 2 M	0	0.0	0	0.0		27	22.7	0	0.0	
	* 2 - 3 M	4	5.9	3	3.8		21	17.6	8	8.9	
	* 3 - 4 M	12	17.6	5	6.3		7	5.9	14	15.6	
	* 4 - 5 M	14	20.6	29	36.7		21	17.6	21	23.3	
	* > 5 M	24	35.3	28	35.4		32	26.9	24	26.7	
	* NOT KNOWN	14	20.6	14	17.7		11	9.2	23	25.6	

TABLE 4.4.11 SANITARY INDEX SCORE FOR ALL LATRINES AT BASELINE AND 11 MONTHS
- Sanitary conditions in the latrine -

	BASELINE SURVEY		11 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.33	0.35	0.34	0.34

4.5.4 Handpump survey

In order to assess all traditional handpumps before and after the intervention, and the new pumps after the intervention, a special observation list was designed. Besides questions about the state of maintenance and functioning of the pump, several conditions were identified that are indicative for the environmental cleanliness around the pump and are thought to influence the risk of contamination of the well and/or pump and thereby the water that is fetched from this pump. The following key-variables were identified for the assessment of handpumps :

1. Presence, location and type of pump.
2. Operation and maintenance.
3. Environmental conditions at the pump-site.

Below, the findings and conclusions are presented for each of the above-mentioned key variables comparing changes in intervention and control villages between the baseline and 11 months surveys.

1. Presence, location and type of pump :

As shown in Table 4.4.12, the pump density in both type of villages slightly increased; for the control communities however on a significant lower level. It appears that some traditional handpumps in the intervention villages have been removed, while some new traditional handpumps in the control villages have been installed.

TABLE 4.4.12 RESULTS PUMP SURVEY - ALL PUMPS IN FIRST SET AT BASELINE AND 11 MONTHS
- Presence, location and type of pump -

		BASELINE				11 - MONTHS			
		INTERV.		CONTROL		INTERV.		CONTROL	
Q*	OBSERVATION	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL HOUSEHOLDS SURVEYED $	136		118		137		117	
	TOTAL PUMPS SURVEYED	84	100.0	51	100.0	92	100.0	56	100.0
	Pump density (pumps/household)	0.61		0.43	S#	0.67		0.48	S#
11	PUMP INSIDE HOUSE/COMPOUND	77	91.7	39	76.5 #	69	75.0	42	75.0
12	NEW PUMP (AFTER INTERVENTION)	0	0.0	0	0.0	21	22.8	0	0.0 #

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

The number of pumps inside the house/compound has only decreased for the intervention villages, which is due to the fact that new UNICEF pumps are communal.

On closer examination of the data on new pumps only (see Table 4.4.17), it is concluded that 48 % of the UNICEF pumps are located inside a house or compound. This practice is in contrast with the supposed communal character of the new pumps. Sometimes UNICEF placed a pump inside a compound because of pressure from the community or its leaders. Also, after installation, some people extended their compound with additional fencing in order to appropriate the new pump.

2. Operation and maintenance of pump :

As shown in Table 4.4.13, the number of pumps giving water decreases in both control and intervention villages after the intervention. The difference in number of pumps giving water remained the same in favour of the control villages.

As shown in Table 4.4.14, at baseline both the pumps in intervention and control communities score average on the maintenance index, although the pumps in the intervention villages are in a slightly better condition. After the intervention, the state of maintenance improves considerably in the intervention villages, whereas in the control villages a slight deterioration is visible. The improvement in the intervention villages is clearly due to the new UNICEF pumps, but also to the upgrading of old pumps contributes to this score. All new handpumps show an optimal maintenance status at the 11 months survey (see Table 4.4.17).

TABLE 4.4.13 RESULTS PUMP SURVEY - ALL PUMPS IN FIRST SET AT BASELINE AND 11 MONTHS
- Operation and maintenance of pump -

		BASELINE				11 - MONTHS			
		INTERV.		CONTROL		INTERV.		CONTROL	
Q*	OBSERVATION	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL PUMPS SURVEYED	84	100.0	51	100.0	92	100.0	56	100.0
13	PUMP GIVES WATER	82	97.6	51	100.0	83	90.2	53	94.6
		82	100.0	51	100.0	83	100.0	53	100.0
14	PUMP LEAKS WHILE PUMPING	6	7.3	5	9.8	4	4.8	0	0.0
15	SPOUT BROKEN	2	2.4	1	2.0	1	1.1	0	0.0
16	PUMP LOOSE AT BASE	9	10.7	13	25.5 #	8	8.7	12	21.4 #
17	PUMP HANDLE LOOSE	70	83.3	25	49.0 #	46	50.0	41	73.2 #
18	CEMENT/CONCRETE FLOOR PRESENT	1	1.2	1	2.0	26	28.3	5	8.9 #
		1	100.0	1	100.0	26	100.0	5	100.0
19	CRACKS IN CONCRETE FLOOR	1	100.0	1	100.0	1	3.8	1	20.0 #

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.4.14 MAINTENANCE INDEX SCORE FOR ALL PUMPS AT BASELINE AND 11 MONTHS
- Maintenance conditions of the pump -

	BASELINE SURVEY		11 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL
MAINTENANCE INDEX SCORE (0-1)	0.41	0.37	0.28	0.38

3. Environmental conditions at the pump-site :

As shown in Table 4.4.15, the availability of drainage is significantly higher in the intervention areas, while also the increase in drainage facilities at the 11 months survey is more pronounced for this type of village. A larger part of the drainage provisions in the intervention villages function; however the drainage function has particularly increased in the control villages.

On closer examination of the new UNICEF pumps (see Table 4.4.18), drainage facilities do not always function. This is also illustrated by the high prevalence of water ponding around the new pumps. From field inspection it appeared that the drainage facilities as provided by the intervention were not adequate and often poorly constructed (see section 4.4.3).

With respect to the overall environmental conditions around the pumps (see Table 4.4.16), it can be concluded that the conditions for the intervention villages clearly improve in comparison to the control villages and became more average.

With respect to the changing number of pumps near the latrines (Table 4.4.15, q. 26), it should be noted that this may be due to differences in interpretation of the data collector.

TABLE 4.15 RESULTS HANDPUMP SURVEY FOR ALL PUMPS AT BASELINE AND 11 MONTHS
- Environmental conditions at pump-site -

		BASELINE				11 - MONTHS			
		INTERV.		CONTROL		INTERV.		CONTROL	
q*	OBSERVATION	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL PUMPS SURVEYED	84	100.0	51	100.0	92	100.0	56	100.0
20	PROVISION FOR DRAINAGE AVAILABLE	46	54.8	15	29.4 #	73	79.3	24	42.9 #
		46	100.0	15	100.0	73	100.0	24	100.0
21	Provision for drainage functions	27	58.7	4	26.7	51	69.9	14	58.3 #
22	WATER PONDING AROUND PUMP	68	81.0	42	82.4	71	77.2	49	87.5
23	GARBAGE AROUND PUMP	70	83.3	35	68.6	66	71.7	41	73.2
24	ANIMALS AROUND PUMP	34	40.5	15	29.4	28	30.4	16	28.6
25	ANIMAL FAECES AROUND PUMP	54	64.3	19	37.3 #	30	32.6	12	21.4
26	LATRINE NEAR PUMP	12	14.3	20	39.2 #	49	53.3	29	51.8

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.16 SANITARY INDEX SCORE FOR ALL PUMPS AT BASELINE AND 11 MONTHS
- Environmental conditions at the pump-site -

	BASELINE SURVEY		11 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.68	0.61	0.55	0.59

TABLE 4.17 RESULTS OF HAND PUMP SURVEY FOR NEW UNICEF PUMPS ONLY
AT 11 MONTHS - Location, operation and maintenance of new pump -

Q* OBSERVATION	BASELINE NR.	BASELINE %	11-MONTHS NR.	11-MONTHS %
TOTAL PUMPS SURVEYED	0		21	
11 PUMP INSIDE HOUSE/COMPOUND	0	0.0	10	47.6
13 PUMP GIVES WATER	0	0.0	21	100.0
	0	0.0	21	100.0
14 Pump leaks while pumping	0	0.0	0	0.0
15 SPOUT BROKEN	0	0.0	0	0.0
16 PUMP LOOSE AT BASE	0	0.0	0	0.0
17 PUMP HANDLE LOOSE	0	0.0	0	0.0
18 CEMENT/CONCRETE FLOOR PRESENT	0	0.0	20	95.2
	0	0.0	20	100.0
19 Cracks in concrete floor	0	0.0	0	0.0

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.18 RESULTS OF HAND PUMP SURVEY FOR NEW UNICEF PUMPS ONLY
AT 3 AND 6 MONTHS SURVEY - Environmental conditions at pump site -

Q* OBSERVATION	BASELINE NR.	BASELINE %	11-MONTHS NR.	11-MONTHS %
TOTAL PUMPS SURVEYED	0		21	
20 PROVISION FOR DRAINAGE AVAILABLE	0	0.0	21	100.0
	0	0.0	21	100.0
21 Provision for drainage functions	0	0.0	17	81.0
22 WATER PONDING AROUND PUMP	0	0.0	11	52.4
23 GARBAGE AROUND PUMP	0	0.0	10	47.6
24 ANIMALS AROUND PUMP	0	0.0	4	19.0
25 ANIMAL FAECES AROUND PUMP	0	0.0	4	19.0
26 LATRINE NEAR PUMP	0	0.0	8	38.1

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

4.4.5 Water use at the pump observations

In order to assess the water use at the pump, several key-variables were identified:

1. General data on pump used.
2. Quantity of water collected.
3. Other water use activities at the pump:
   - hand washing;
   - child bathing;
   - washing cooking utensils;
   - washing clothes;
   - washing food/vegetables;
   - other activities.
4. Status of person collecting and hygienic practices.

Below, the findings and conclusions are presented for each of the above-mentioned key variables comparing changes in intervention and control villages between the baseline and 11 months surveys.

1. General data on pump used :

As shown in Table 4.4.19 all of the observed (sentinel) households use a handpump. Contrary to the environmental observations in house, only one hand pump is used by the sentinel households (except for one). Half of the hand pumps used in the intervention communities are new pumps (this is consistent with the observations in the environmental conditions in house survey).

TABLE 4.4.19 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE AND 11 MONTHS SURVEYS
- General data on pumps used -

Q* OBSERVATION	BASELINE				11 - MONTHS			
	INTERV.		CONTROL		INTERV.		CONTROL	
	NR.	%	NR.	%	NR.	%	NR.	%
TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
11 NR OF NEW PUMPS USED	0	0.0	0	0.0	16	50.0	0	0.0
12 NR. OF OBSERVATION FORMS COMPLETED	20	100.0	20	100.0	32	100.0	20	100.0
Nr of households not using pumps	0		0		0		0	
13 Observed pump inside house/compound	5	25.0	6	30.0	7	21.9	10	50.0
14 Pump distance from house								
* 0 - 25 M	19	95.0	16	80.0	21	65.6	19	95.0
* 25 - 50 M	1	5.0	3	15.0	6	18.8	0	0.0
* 50 - 100 M	0	0.0	1	5.0	5	15.6	1	5.0
* > 100 M	0	0.0	0	0.0	0	0.0	0	0.0
15 HOUSEHOLDS USING 2nd TRADITIONAL PUMP	0		0		1		1	
16 Second pump inside house/compound	0		0		0		0	
17 Pump distance from house								
* 0 - 25 M	0		0		0		0	
* 25 - 50 M	0		0		0		0	
* 50 - 100 M	0		0		1		0	
* > 100 M	0		0		0		1	
18 HOUSEHOLDS USING 3rd TRADITIONAL PUMP	0		0		0		0	
19 Third pump inside house/compound	0		0		0		0	
20 Pump distance from house								
* 0 - 25 M	0		0		0		0	
* 25 - 50 M	0		0		0		0	
* 50 - 100 M	0		0		0		0	
* > 100 M	0		0		0		0	

2. Quantity of water collected :

Using average household sizes for the sentinel household (derived from census data: 9.9 for the intervention villages, 10.3 for the control villages), the average use per capita per day is estimated.
As shown in Table 4.4.20, the average use of water for the sentinel households in intervention communities remain on the same level. However, a considerable decrease in the use of water is observed in the control villages, possibly due to already suggested colder weather. In that case the same water use level in the

intervention villages may be caused by messages of the Health Education Team like "use as much water as needed...".

It should be noted that, for both control and intervention communities, these volumes are considered relatively low, when compared with WHO guidelines (see Chapter 4.2.4) for table of WHO guidelines).

TABLE 4.4.20 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE AND 11 MONTHS SURVEYS - General data on pumps used -

Q* OBSERVATION	BASELINE INTERV. NR.	%	BASELINE CONTROL NR.	%	11 - MONTHS INTERV. NR.	%	11 - MONTHS CONTROL NR.	%
TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
TOTAL NR OF OBSERVATIONS	20		20		32		20	
Nr of times no collection/activities during observation period	0		1		5		4	
21 TOTAL NR OF COLLECT. PER OBSERV.								
Range	9 - 37		0 - 24		0 - 47		0 - 29	
Median	12.5		11.0		11.0		9.0	
Mean	14.7		11.4		11.2		10.4	
St.Dev.	6.9		5.7		9.6		8.3	
22 TOT. VOLUME COLLECTED PER OBSERVATION								
Range	50 - 368		0 - 356		0 - 572		0 - 296	
Median	134		131		133		118	
Mean	155		145		152		119	
St.Dev.	73		93		138		88	
VOLUME PER CAPITA PER DAY (*)	15.7		14.1		15.4		11.6	

(*) Calculated using average (sentinel) household size, based on census data

3. Other water use :

Table 4.4.21 demonstrates a considerable drop of all 'other water use' in both the intervention and control communities at the 11 months survey. Apart from hand washing and washing kitchen utensils, 'other water use' activities are not common.

Although one of the health messages was aimed at stimulating people to wash their hands with running water, the opposite effect of this was seen at the pump-sites.

4. Status of person collecting water and hygienic practices :

As shown in Table 4.4.22, virtually always women (about 95 %) and generally persons older than 20 years of age, collect the water. The distribution of the age of persons collecting water between intervention and control communities became equal.

TABLE 4.4.21 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE AND 11 MONTHS SURVEYS - Other water use, totals -

Q* OBSERVATION	BASELINE INTERV. NR.	BASELINE INTERV. %	BASELINE CONTROL NR.	BASELINE CONTROL %	11 - MONTHS INTERV. NR.	11 - MONTHS INTERV. %	11 - MONTHS CONTROL NR.	11 - MONTHS CONTROL %
TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
TOTAL NR OF OBSERVATIONS	20		20		32		20	
25 NR OF TIMES HAND WASHING								
Range	0 - 12		0 - 20		0 - 10		0 - 15	
Median	3.5		5.0		1.0		1.5	
Mean	4.2		6.9		2.0		2.9	
St.Dev.	3.5		5.6		2.6		4.2	
26 NR OF TIMES CHILD BATHING								
Range	0 - 1		0 - 10		0 - 2		0 - 4	
Median	0.0		1.0		0.0		0.0	
Mean	0.1		2.3		0.1		0.3	
St.Dev.	0.2		2.8		0.4		1.0	
27 NR OF TIMES WASHING KITCHEN UTENSILS								
Range	0 - 30		0 - 10		0 - 7		0 - 6	
Median	6.5		5.0		0.0		2.0	
Mean	7.6		5.8		1.0		2.4	
St.Dev.	7.7		3.0		1.8		2.1	
28 NR OF TIMES WASHING CLOTHES								
Range	0 - 4		0 - 8		0		0	
Median	0.0		3.0		0.0		0.0	
Mean	0.6		3.1		0.0		0.0	
St.Dev.	1.1		2.8		0.0		0.0	
29 NR OF TIMES WASHING FOOD/VEGETABLES								
Range	0 - 3		0 - 5		0 - 1		0 - 1	
Median	0.0		0.0		0.0		0.0	
Mean	0.6		1.4		0.0		0.2	
St.Dev.	1.0		1.9		0.2		0.4	
30 NR OF TIMES OTHER ACTIVITIES								
Range	0 - 10		0 - 10		0 - 9		0 - 5	
Median	0.0		2.0		0.0		2.0	
Mean	1.9		2.4		1.3		1.9	
St.Dev.	2.7		3.0		2.3		1.7	

Both in intervention and control communities, generally open containers are used which are difficult to close. This is also reflected by the absence of actually closed containers. The number of collections clearly increased in the intervention villages and slightly decreased in the control villages. It should be noted that water collection practises may be strongly subject to the daily weather conditions.

The number of times that containers are washed/rinsed before collecting the water decreases significantly at the 11 months survey in both intervention and control villages. From the viewpoint of health, this is a negative development. It should be noted here that when several collections are done in a row, the container is washed only at the first collection.

TABLE 4.4.22 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE AND 11 MONTHS SURVEYS - General data on pumps used -

Q*	OBSERVATION	BASELINE				11 - MONTHS			
		INTERV. NR.	%	CONTROL NR.	%	INTERV. NR.	%	CONTROL NR.	%
	TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
	TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
	TOTAL NR OF COLLECTIONS OBSERVED	294	100.0	227	100.0	358	100.0	208	100.0
WHO	PERSON COLLECTING IS FEMALE	284	96.6	214	94.3	336	93.9	200	96.2
WHO	AGE GROUP DISTRIBUTION								
	* < 10 YEARS	35	11.9	28	12.3	34	9.5	19	9.1
	* 10 - 20 YEARS	109	37.1	36	15.9	96	26.8	51	24.5
	* > 20 YEARS	150	51.0	163	71.8	228	63.7	138	66.3
HOW	CONTAINER TYPES USED								
	* TYPE 1 SMALL BUCKET	16	5.6	5	2.2	77	21.5	23	11.1
	* TYPE 2 BIG BUCKET	26	9.2	11	4.8	46	12.8	6	2.9
	* TYPE 3 BIG TASHT	0	0.0	0	0.0	2	0.6	0	0.0
	* TYPE 4 SMALL TASHT	2	0.7	2	0.9	0	0.0	0	0.0
	* TYPE 5 BASTELLAH BIG	0	0.0	12	5.3	0	0.0	8	3.8
	* TYPE 6 BASTELLAH SMALL	84	29.6	20	8.8	51	14.2	48	23.1
	* TYPE 7 BASIN SMALL	47	16.5	83	36.6	10	2.8	16	7.7
	* TYPE 8 BASIN BIG	24	8.5	37	16.3	120	33.5	54	26.0
	* TYPE 9 BIG JERRYCAN	23	8.1	19	8.4	9	2.5	8	3.8
	* TYPE 10 SMALL JERRYCAN	4	1.4	3	1.3	6	1.7	2	1.0
	* TYPE 11 QULAH	11	3.9	8	3.5	0	0.0	0	0.0
	* OTHER TYPES	57	20.1	27	11.9	37	10.3	43	20.7
	CONTAINER WASHING	240	81.6	184	81.1	118	50.0	108	55.7
	CONTAINER CLOSED	13	4.4	1	0.4	0	0.0	0	0.0
HOW MUCH	VOLUME PER COLLECTION								
	Range	1 - 40		1 - 60		1 - 60		1 - 30	
	Median	10		10		10		10	
	Mean	10.5		12.8		13.6		11.4	
	St.Dev.	6.3		8.1		7.5		7.3	

4.4.5 Water quality assessment

In order to assess the water quality of pumps and zirs, used by the sentinel households, the following variables were observed/analyzed:

1. General sampling information.
2. Bacteriological water quality for pumps and zirs.
3. Chemical water quality of pumps.

Below, the findings and conclusions are presented for each of the above-mentioned key variables comparing changes in intervention and control villages between the baseline and 11 months surveys.

1. General sampling information :

Table 4.4.23 shows total numbers of samples taken and analyzed. At the 11 months survey, both in intervention and control areas less zirs were used and thus not sampled. This appears to be structural, but a relation with the intervention is not clear. An impact from colder weather can not be excluded in this respect.

TABLE 4.4.23 RESULTS WATER QUALITY ANALYSIS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE AND 11 MONTHS SURVEY. - General sampling information -

Q* OBSERVATION	BASELINE INTERV. NR.	BASELINE INTERV. %	BASELINE CONTROL NR.	BASELINE CONTROL %	11 - MONTHS INTERV. NR.	11 - MONTHS INTERV. %	11 - MONTHS CONTROL NR.	11 - MONTHS CONTROL %
TOTAL HOUSEHOLDS SURVEYED	20		20		20		20	
- TOTAL NR OF FORMS ENTERED	20		20		33		21	
- NR OF FORMS FOR PUMPS ONLY	0		0		13		1	
- NR OF HOUSEHOLDS NOT USING A ZIR	0		0		4		5	
- TOTAL NR OF ZIRS ANALYSED	20		20		16		15	
- NR OF HOUSEHOLDS NOT USING PUMPS	0		0		0		0	
- TOTAL NR OF PUMP SAMPLES	20		20		33		21	
- NR OF SAMPLES FROM UNICEF PUMPS	0		0		17		0	
- NR OF SAMPLES WITH STERILIZED SPOUT	0		0		0		0	

2. Bacteriological water quality of pumps and zirs :

In Table 4.4.24 the results of the bacteriological analysis of pumps used by the sentinel households are shown. These results show that the number of pumps which show contamination with faecal coliforms have slightly dropped. This drop is even more pronounced for the control villages, despite the presence of new wells in the intervention villages.

The results are not satifactory, since only 50 % of all pumps are new UNICEF pumps and still 40 % of these new pumps show faecal contamination to some degree (see Table 4.4.25). It can be noticed that only three new pump were still heavily contaminated (5 positive tubes). More details on water quality in general and bacteriological contamination of the new pumps in particular, can be found in the Annex 1 on water quality investigations.

The bacteriological analyses on the zirs show that all samples from the zir are heavily contaminated with faecal coliforms in both intervention and control villages. Not any changes have been observed in this respect. So even the water collected from bacteriologically safe pumps gets contaminated during transportation and/or domestic use. As concluded in the previous chapters the conditions around the zir are not very hygienic and containers for collecting water are usually not closed after filling.

Apparently the health messages concerning the need to cover the zir and avoidance of hand contamination of the zir water have no effect.

TABLE 4.4.24 RESULTS WATER QUALITY ANALYSIS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, AND 11 MONTHS SURVEY. - Bacteriological water quality zir and pump -

		BASELINE				11 - MONTHS			
		INTERV.		CONTROL		INTERV.		CONTROL	
a*	OBSERVATION	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL NR OF ZIRS ANALYSED	20	100.0	20	100.0	16	100.0	15	100.0
	RESULTS BACTERIOLOGICAL ANALYSIS ZIRS								
	* nr of positive tubes = 0	1	5.0	0	0.0	0	0.0	0	0.0
	* nr of positive tubes = 1	0	0.0	0	0.0	0	0.0	0	0.0
	* nr of positive tubes = 2	0	0.0	0	0.0	0	0.0	0	0.0
	* nr of positive tubes = 3	0	0.0	1	5.0	0	0.0	0	0.0
	* nr of positive tubes = 4	0	0.0	2	10.0	0	0.0	0	0.0
	* nr of positive tubes = 5	19	95.0	17	85.0	16	100.0	15	100.0
	- TOTAL % OF ZIR SAMPLES CONTAMINATED		95.0		100.0		100.0		100.0
	TOTAL NR OF PUMPS ANALYZED (a)	20	100.0	20	100.0	33	100.0	21	100.0
	RESULTS BACTERIOLOGICAL ANALYSIS PUMPS								
	* nr of positive tubes = 0	5	25.0	6	30.0	10	30.3	9	42.9
	* nr of positive tubes = 1	3	15.0	1	5.0	2	6.1	5	23.8
	* nr of positive tubes = 2	0	0.0	3	15.0	2	6.1	0	0.0
	* nr of positive tubes = 3	2	10.0	0	0.0	3	9.1	2	9.5
	* nr of positive tubes = 4	2	10.0	0	0.0	2	6.1	0	0.0
	* nr of positive tubes = 5	8	40.0	10	50.0	14	42.4	5	23.8
	- TOTAL % OF PUMP SAMPLES CONTAMINATED (a)		75.0		70.0		70.0		57.0

(a): Samples from non-sterilized pumps only

TABLE 4.4.25 RESULTS WATER QUALITY ANALYSIS FOR ALL NEW UNICEF HANDPUMPS IN THE FIRST SET AT "ZERO TIME" AND 11 MONTHS SURVEY - Bacteriological analysis

		"ZERO TIME"				11 - MONTHS			
		INTERV.		CONTROL		INTERV.		CONTROL	
a*	OBSERVATION	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL NR OF PUMPS ANALYSED	21	100.0			21	100.0		
	RESULTS BACTERIOLOGICAL ANALYSIS PUMPS								
	* nr of positive tubes = 0	7	33.0			12	57.1		
	* nr of positive tubes = 1	2	9.5			2	9.5		
	* nr of positive tubes = 2	3	14.3			2	9.5		
	* nr of positive tubes = 3	0	0.0			1	4.8		
	* nr of positive tubes = 4	2	9.5			1	4.8		
	* nr of positive tubes = 5	6	28.6			3	14.3		
	- TOTAL % OF PUMP SAMPLES CONTAMINATED		66.0				42.1		

(a): Samples from non-sterilized pumps only

ANNEX 1

WATER QUALITY INVESTIGATIONS

1. INTRODUCTION

Water from traditional UNICEF handpumps which are used by the sentinel households, are examined on the presence of faecal coliforms. This is mainly done during the three outcome surveillances (3, 6 and 11 months).

However, specific water quality investigations have been carried out particularly since the water from new handpumps appeared to be contaminated with faecal coliforms. The following activities were therefore initiated and monitored on their impact on the water quality:

- disinfection of new handpump wells
- disinfection of handpump spouts
- two sampling methods for zirs
- well development programme
- laboratory analyses quality control

Prior to the discussion of these activities, some background information is presented on the potential sources of contamination.

2. BACKGROUND INFORMATION

The top soil of the traditionally occupied land of Assyut Governorate is usually clayey. The clayey top of the soil is underlain by sand and gravels from which groundwater can be tapped. The layers of sand and gravel are called the aquifer. The traditional handpumps usually extract water from the top of the aquifer which is in the order of magnitude of 5 to 10 m below the ground surface. The new India Mark II handpumps from UNICEF were installed at a depth of approximately 35 m below the ground level (g.l.). Figure I.1 schematically shows the situation.

Contamination of the extracted water can be caused along various lines. Principally the in figure I.1 indicated potential sources of pollution should be distinguished:

a. **Natural groundwater at a depth of 35 m - g.l.**
Groundwater at this depth which infiltrated many years ago cannot be contaminated with faecal coliforms since survival times of these bacteria are much shorter. Literature provides survival times in groundwater of a few hours to less than half a year (RIGW/IWACO 1989).

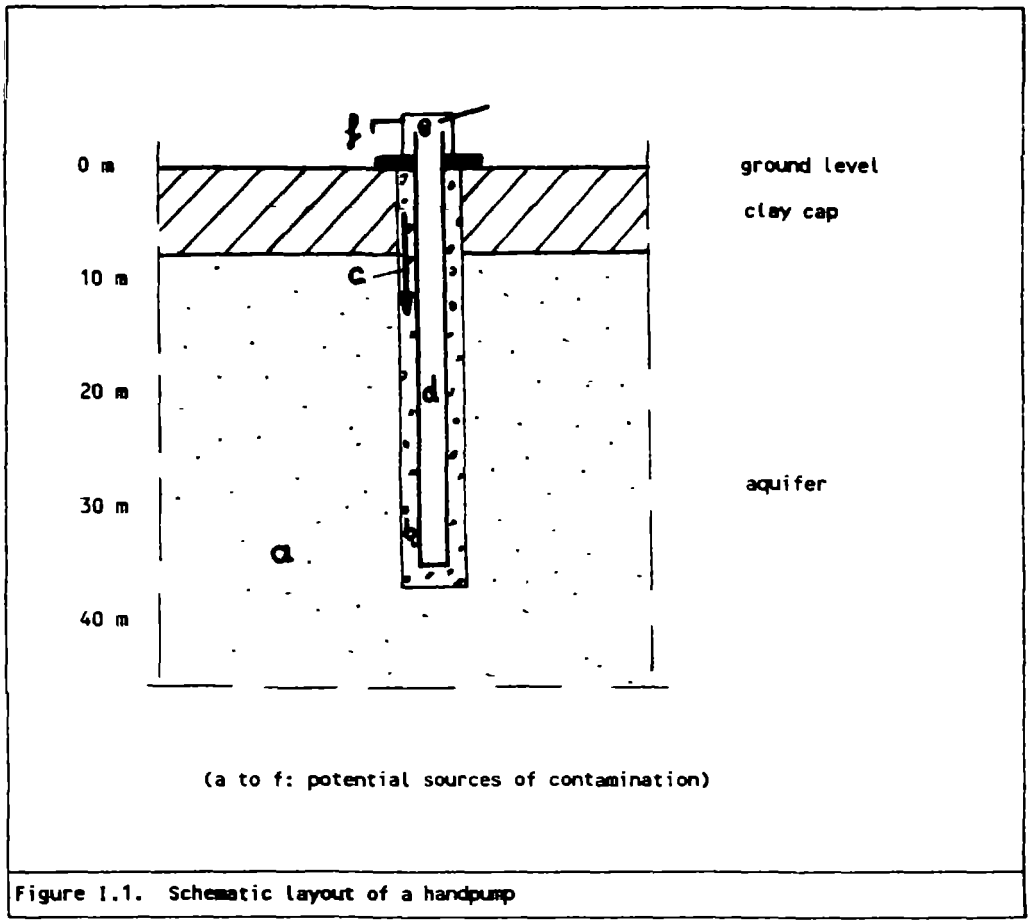


Figure I.1. Schematic layout of a handpump

b. **Construction of the borehole/well**
Contamination of the borehole probably occurred during the drilling of the borehole; also the drilling equipment or the pipes of the wells itself could have been contaminated already.

c. **Infiltration through the borehole**
The borehole was probably refilled by collapsing soil around. Therefore, the hydraulic conductivity of the borehole material is probably much bigger than the surrounding soil. However, the pressure difference between top of the aquifer and a depth of 35 m - g.l. is probably so little that contamination through this path may be considered as negligible.

d. **Inside the well**
The inside of the well may also be contaminated by, for example, storage on dirty locations prior to the well construction.

e. **Inside the handpump**
Also handpumps could have been contaminated at the storage locations.

f. **Spout of the handpump**
The spout of the India Mark II handpump is directed downward. This avoids a return flow of water back into the well. Contrary to this, traditional handpumps are started up by pouring water into the well. Moreover, the spouts of handpumps are often touched, particularly by children.

Figure I.2. India Mark II handpump

3. DISINFECTION OF THE NEW HANDPUMP WELLS

The new handpump wells were disinfected by the contractor upon completion of the well. Due to the observed contamination with faecal coliforms part of the wells have been disinfected twice. Disinfection is done with tablets (sodium-dichloro-isocyanurate) and powder (calcium-hypochlorite) (UNICEF 1991). The tablet is dropped into the well and a solution of about 300 grams of agent powder is poured into the well from the top (inside and outside) of the pump (UNICEF 1991). The actual application of these chemicals has not been monitored.

Subsequent to the disinfection the contractor usually requests the community not to use the pump for 48 hours. In some cases the pump handle was removed to prevent children from pumping water.

Table I.1 presents an almost complete schedule with the dates of installation and disinfections for each village (UNICEF 1991).

Table I.1 Installation and disinfection of wells for each village

	Construction and Initial disinfection	Second disinfection
Helba	21 to 23 September	10 October
El Mazani	23 to 26 September	27 October
Omram	15 to 19 October	28 October
Eliwah	25 to 28 October	-
Ammar	9 to 15 October	28 October
El Tahrir	19 to 25 October	-
Hebish	17 to 22 December	-
Khalil Salim	20 to 22 November	-
El Sheikh Erian	22 to 27 November	-
Hashim	12 to 22 December	-

4. Evaluation of results for all new handpump wells

The water quality from all new handpump wells has been extensively monitored on faecal coliforms. Analyses were performed at least after the first disinfection, after the second disinfection (4 ezbas only) and during the outcome surveillances (3, 6, 11 months). Table I.3 shows all individual results except for the results of those samples in which residual chlorine was measured.

All results are expressed as the numbers of positive tubes which are directly related to the concentration of faecal coliform in the sample (MPN-index/100 ml). The relationship between the number of positive tubes and this index is indicated in table I.2.

Table I.2. Realationship nr. positive tubes and MPN index

Nr. of positive tubes	MPN of faecal coliforms per 100 ml
0	< 2.2
1	2.2
2	5.1
3	9.2
4	16.0
5	> 16.0

Table I.3 Faecal coliform analyses for new wells

Pair	Intervention village	Date	% *	Number of positive tubes **
a	Helba	(7/10)	90	(5,5,3,5,5,5,1,5,5,5)
		(11/11)	40	(4,1,2,1,5,0,0,0,0,0)
		(24/12)	40	(4,1,0,0,5,2,0,0,0,2)
		(9/3)	10	(0,0,0,0,5,0,0,0,0,0)
b	Mazani	(12/10)	100	(5,5,2,5,5,4,5,5,5,5,5)
		(30/11)	73	(0,5,2,5,5,2,5,0,4,5,0)
		(19/11)	36	(0,0,2,3,0,0,0,5,2,1,1)
		(1/3)	18	(0,1,0,3,0,0,0,0,0,2,0)
c	Omram	(9/11)	78	(4,1,0,2,5,2,4,0,4)
		(31/12)	67	(1,5,5,2,5,0,3,0,5)
		(26/3)	32	(0,3,0,0,1,0,3,0,0)
d	Eliwah	(9/11)	50	(1,4,5,0,5,5,0,0)
		(6/1)	62	(5,4,5,2,1,1,0,5)
		(6/1)	87	(4,5,5,1,5,5,5,5)
		(31/3)	12	(0,0,0,2,0,1,0,0)
e	Ammar	(7/11)	62	(0,4,0,0,5,5,5,4)
		(14/1)	75	(0,0,5,4,5,5,5,4)
		(4/4)	37	(0,1,0,5,2,5,0,0)
f	El Tahrir	(13/12)	50	(2,5,1,0,2,5,1,0,0,3)
		(23/1)	40	(0,5,0,0,5,4,1,0,0,4)
		(24/4)	50	(4,0,1,0,5,2,4,5,0,0)
g	Hebish	(22/1)	91	(5,5,5,5,5,5,0,5,5,5,4,5)
		(2/3)	66	(2,0,0,3,5,5,3,0,5,5,0,4)
h	Khalil Salim	(22/1)	87	(2,5,1,5,3,2,2,-)
		(2/2)	62	(0,5,5,5,5,4,0,0)
		(3/5)	50	(3,1,4,3,1,0,0,2)
i	Erian	(22/1)	62	(5,1,5,1,2,2,0,5)
		(16/2)	50	(5,2,0,0,0,5,2,0)
j	Hashim	(11/1)	91	(5,5,5,5,5,3,5,3,5,5,0,5)
		(7/2)	67	(1,5,5,4,5,3,0,1,2,1,5,2)
		(11/5)	67	(0,0,2,2,0,4,5,2,1,3,2,2)

(* : percentage of samples with >1 positive tube (MPN) (> 2.2 faecal coliform per 100 ml
(**: the subsequent well numbering for each village is from 501,502, etc.)

Water from most of the new wells was heavily contaminated (>16 faecal coliform/100 ml) subsequent to the first disinfection after construction. Some of the wells clearly improved after the second disinfection. However, the wells which were not treated with a second disinfection showed important water quality improvements at three to six months after installation. A few of the wells remained heavily contaminated, probably due to pollution source b (figure I.1), which location might not have been reached by the disinfection ~~procedure~~. A contamination source in the top of the well or the handpump itself (pollution source a in figure I.1) can not be excluded.

4. DISINFECTION OF THE HANDPUMP SPOUTS

The ~~reports~~ spouts of particularly traditional handpumps was investigated in order to identify whether contamination of the spouts may influence the water quality results. From 19 to 24 November 1990 the spouts of a number of randomly selected traditional handpumps were disinfected with alcohol and flame. Samples were taken before and after the disinfection procedure. All samples were analysed on faecal coliforms. Table I.4 presents the analyses results.

Figure I.3. Disinfection of traditional handpump spout

Table I.4 Faecal coliforms for spout sterilization programme

Pair	Intervention				Control			
			Tubes				Tubes	
	Nr.	Village	I	II	Nr.	Village	I	II
a	1	Helba	5	5	2	Sharif	0	0
			5	5			5	5
b	3	Mazani	0	1	4	Tameya	3	3
			5	5			0	1
c	5	Omram	4	5	6	Abu Nafis	3	2
			5	5			3	2
d	7	Eliwah	5	5	8	El Komm	1	0
			5	5				
e	9	Ammar	0	0	10	El Bakhaytah	1	1
			0	1			2	1
f	11	El Tahrir	4	2	12	El Akarmak	0	0
			5	5			5	4
g	13	Hebish	5	5	14	El Ashalany	4	5
			5	5			5	5
h	15	Khalil Salim	0	0	16	El Sheikh Solim.	5	5
			5	5			5	5
i	17	El Mahrubi	5	5	18	Abostaourous	5	5
			2	3			2	1
j	19	Hashin	3	4	20	Mahrouky	5	5
			5	5			2	3

(tubes: number of tubes contaminated:
I: before sterilization; II: after sterilization)

The concentrations of faecal coliforms before and after sterilization of the handpump spout show hardly any differences. The significance of this finding is very high. Possible contamination of the spouts of handpumps has consequently no impact on the water quality results. Further sampling without disinfection of the spouts was therefore recommended.

Consequently contamination of the spouts of the new handpumps (source f pollution source f of figure I.1) can also be neglected since these are much less vulnerable to contaminate the well water.

5. TWO SAMPLING METHODS FOR ZIRS

The spoons which are used to sample the zirs are disinfected before every sampling. Alcohol and flaming are applied as disinfection methods as figure I.4 shows. The spoon is entered into the zir a few seconds after flaming which causes a "ssss" sound. The impact of this cooling off on the number of faecal coliforms in the sample was considered negligible because of the relatively large sample volume.

In February and in June some experiments were carried out to prove this. Samples were taken from some selected zirs directly after flaming and a few minutes after flaming. The results are shown in table I.5.

Table I.5. Faecal coliforms for sampling method zirs.

Ezba	Pump Nr.	Nr. of positive tubes *	**	Pump Nr.	Nr. of positive tubes *	**
Helba	016	5	5	019	5	5
Mazany	006	0	1	016	5	5
Akarmah	003	0	0	010	5	4
El-Bakhaytah	001	1	1	008	2	1
Abo Nafis	004	3	2	014	3	2
Al-Tamyah	002	3	3	003	0	1
El-Sherif	004	0	0	006	5	5
El-Komm	006	1	0	014	0	4
El-Tahrir	008	4	2	007	5	5
Ammar	004	0	1	013	0	0
Eliwah	012	5	5	021	5	5
Omran	002	4	5	004	5	5
Hashim	004	3	4	005	5	5
El-Sheikh Eman	017	5	5	004	3	3
Khalil Salim	009	0	0	017	5	5
Hebish	001	5	5	006	5	5
El-Mahrouky	002	5	5	017	2	3
Abostaourous	011	5	5	015	2	1
El-Sheikh Soliman	003	5	5	005	5	5
Azkalany	003	4	5	004	5	5

* : positive tubes before sterilization
**: positive tubes after sterilization

No effect was observed between the two sampling methods. Consequently the original sampling method was recommended to remain the same.

6. WELL DEVELOPMENT PROGRAMME

Water from part of the new handpumps remained heavily contaminated at three months after construction, including the two disinfections as mentioned in section 3 of this annex.

It appeared that the wells have not been developed by pumping directly after construction. Therefore a well development programme was initiated to investigate possible contamination in the borehole outside the well (source b). The programme was applied on five still heavily contaminated new wells and consisted of the following steps.

Figure I.4. Disinfection of the sampling spoon.

- pumping of the well for 2 to 4 hours by electrical pump (21-2-1991);
- disinfection of the well and addition of some water containing disinfectant to ensure disinfection outside the screen (22-2-1991);
- the pumps themselves were disinfected separately (22-2-1991):
- pumping of the well for 1 hour (27-2 to 8-3-1991);
- analyses on faecal coliforms and residual chlorine were regularly carried out.

Tables I.5 and I.6 contain the analyses results of faecal coliform and residual chlorine analysis.

Table I.6. Faecal coliform analyses during the well development programme (number of positive tubes)

Ezba-pump:	Mazany		Hashim		
Minutes of pumping:	504	508	503	505	509
	21/2/1991	21/2/1991	21/2/1991	21/2/1991	21/2/1991
0	0	0	5	0	4
30	1	0	3	2	3
60	1	0	5	0	1
90	1	0	3	1	2
120	0	0	4	1	2
150	1	0			1
180	1	0			1
240		0			
	8-3-1991	8-3-1991	4-4-1991	27-2-1991	27-2-1991
0	0	0	5	1	0
5	0	1	5	1	0
15	0	0	5	1	0
30	0	0	5	0	0
60	0	1	5	0	0

Table I.7. Residual chlorine analyses during the well development programme (mg/l) liters pumping

Ezba-pump:	Mazany	Hashim			
Liters of Pumping:	504	508	503 27/2/91	505 27/2/91	509 27/2/91
0				0.3	3
100				0	0.1
200				0	0 *
300				0	0
400				0	
500			0.3	0	

* after 15 min of not pumping: 0.1 mg/l

The results can be summarized as follows:

- The water from three wells hardly contained any faecal coliforms at the beginning of the test and remained so.
- One well improved considerably during electrical pumping and faecal coliforms were eventually absent after sterilization;
- One well continued to have a notorious contamination source. However, serious improvement of the water quality appeared during the six month surveillance.

It is expected that part of the wells would improve after well development. Therefore an additional well development programme was recommended for heavily contaminated (faecal coliform > 16/100 ml) new handpump wells.

However, the results illustrate that a sufficient decrease of faecal coliform in pumped water can also be reached by just waiting long enough (6 months?).

9. LABORATORY ANALYSIS QUALITY CONTROL

The reliability and consistency of all results from faecal coliform analyses depend on a very sincere execution of sampling and laboratory procedures according to strict prescriptions. All prescriptions have been included in the data management report of the Environmental Sanitation Survey. The following must be considered in this respect.

- Sampling and laboratory procedures have regularly been checked and remained the same during the whole project period (according to Standard Methods 1985).
- Every day sterile samples have been analysed in addition to the field samples. Those analyses showed an absence of faecal coliforms without exception.

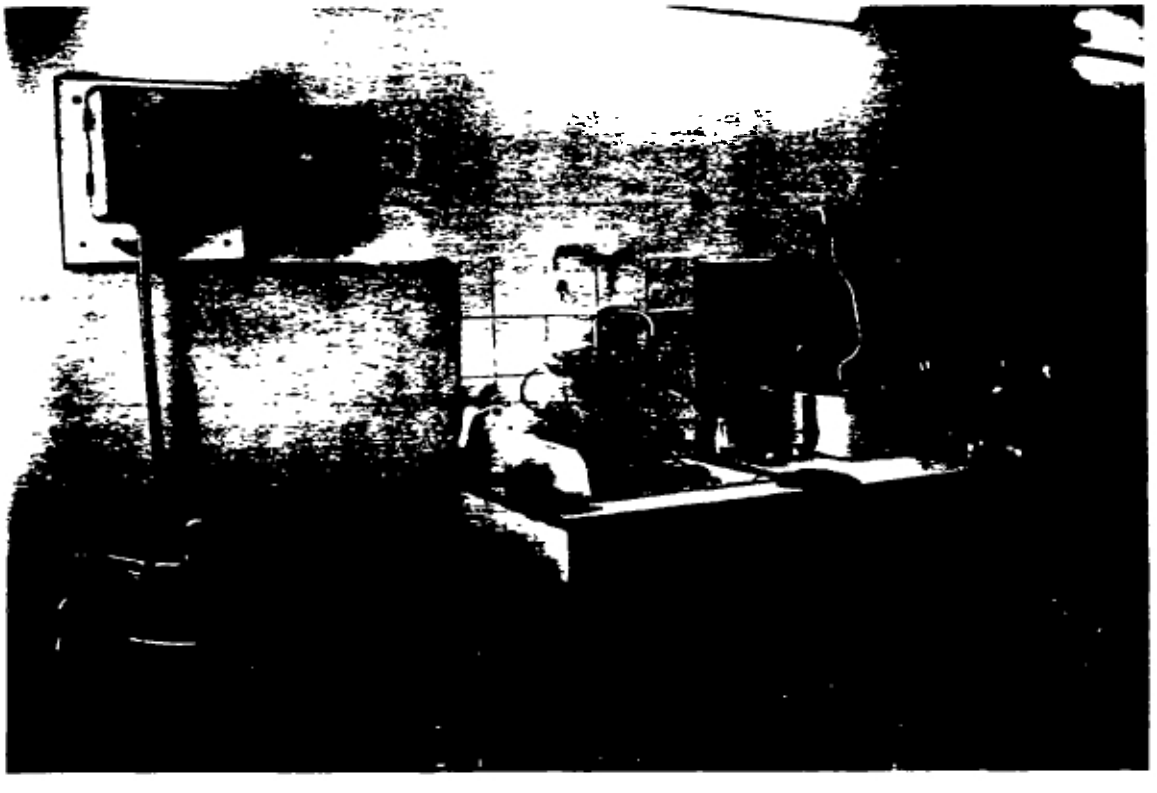


Figure I.5. Assyut laboratory Water Treatment Company

- The analyses results before and after disinfection of the spout as mentioned in section 4, can be considered as duplicate samples. The high consistency in these results strongly indicate an almost perfect reproduction, possible with the current laboratory procedure for faecal coliform analyses.
- Table I.3, section 3 reviews the faecal coliform content of water from new handpump wells after various subsequent time intervals. The results of most of the wells show a relatively high consistency, which means that the water contains the same or a lower level of faecal coliforms through time.

Sampling and laboratory procedures as applied in the Assyut laboratory can be regarded as optimal, despite the fact that inaccuracies can never be neglected for 100%. The accuracy of the analyses seems sufficient for the project needs.

10. CONCLUSIONS AND RECOMMENDATIONS

Faecal coliforms in new wells

The presence of faecal coliforms in new India Mark II handpump wells is probably due to bacteria which entered the borehole of the wells during the construction. Disinfection of the handpump wells and well development may urge the improvement of the water quality. However, the natural die-off of faecal coliforms continues because of limited survival periods (6 months?).

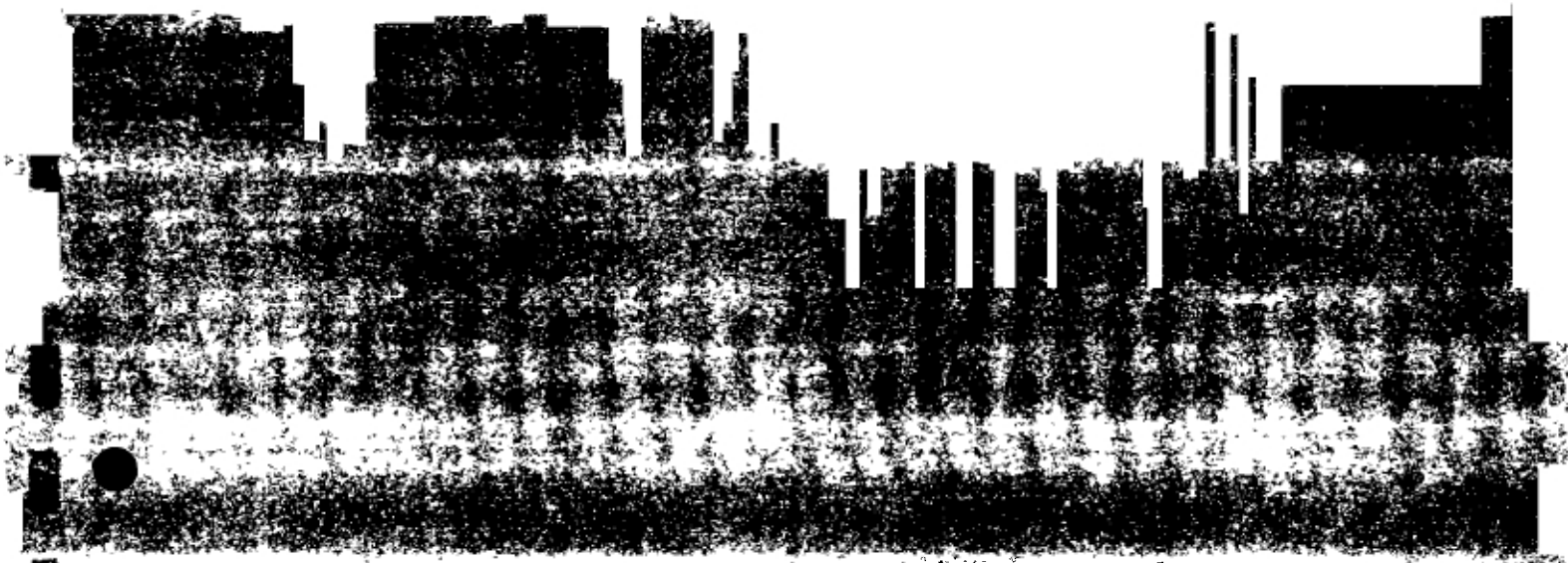
Future projects may consider disinfection of the borehole which is, however, difficult to carry out. A side effect of this is the introduction of residual chlorine which might remain in the pumped water for a considerable period of time. Some more patience in obtaining acceptable water quality results seem to be a proper alternative for cleaning measures. Unfortunately, the length of this monitoring project is rather limited considering natural die-off rates of faecal coliforms.

Sampling procedures

The disinfection of handpump spouts does not affect the water quality results. Furthermore, also the disinfection of sampling spoons directly prior to the sampling of zirs does not have any impact on the results. The sampling methods therefore remained the same as initially prescribed.

Laboratory procedures

The laboratory analyses on faecal coliform show reliable and consistent results. The accuracy of the analyses seems sufficient for the project needs. The laboratory procedures therefore also remained the same throughout the project.



ANNEX 2

CALCULATIONS FOR SANITARY INDEXES

For the purpose of summarizing and comparing the various individual observations, a number of indexes have been defined;

* In-House Sanitary Index (SI-H); summarizing observations concerning cleanliness of the living/working areas;
* Sanitary Index Zir area (SI-Z); summarizing observations the cleanliness of the area near the zir;
* Sanitary Index Latrines (SI-L); summarizing the cleanliness and sanitary conditions in the latrine;
* Maintenance Index Pumps (MI-P); summarizing observations on the state of maintenance of pumps;
* Sanitary Index Pumps (SI-P); summarizing observations on the sanitary conditions of the pump-site.

All the above-mentioned indexes are evaluated on a scale of 0 - 1. The following interpretation is used for the value of the indexes ;

- 0 - 0.20 good
- 0.21 - 0.40 fairly good
- 0.41 - 0.60 average
- 0.61 - 0.80 fairly bad
- 0.81 - 1.00 bad

The indexes are calculated using the following formulae :

SI-H = (2*(Q13+Q14+Q15)+(Q19+Q20+Q21)+(Q25+Q26+Q27)+ 2*(Q30+Q31+Q32)+(Q36+Q37+Q38)+(Q41+Q42+Q43))/ (N*24)
in which N is the total nr of households observed.

SI-Z = (Q68+Q69+Q70+Q71)/(Q60*4)

SI-L = ((Q75-Q78)+(Q75-Q79)+Q80+(Q75-Q81)+Q83+Q84)/ (Q75*6)

For the above mentioned indexes, Q refers to the number of confirmative responses at this specific question/observation in the observation list "Environmental Conditions in the House".

MI-P = (Q14+Q15+Q16+Q17+(Q13-(Q18-Q19)))/(Q13*5)

SI-P = ((Q13-Q21)+Q22+Q23+Q24+Q25)/(Q13*5)

For these indexes, Q refers to the observation number in the observation list "Pump Survey".

TABLE 3.1 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS
- Cleanliness living areas -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
11 SPEC.PLACE FOR COOKING IN HS/CP	540	96.3	481	98.6	#	544	97.3	489	98.8		543	97.0	487	98.8	
	540	100.0	481	100.0		544	100.0	489	100.0		543	100.0	487	100.0	
12 Place separated by fencing	139	25.7	152	31.6	#	130	23.9	137	28.0		149	27.4	136	27.9	
13 Animals visible at this place	308	57.0	241	50.1	#	208	38.2	162	33.1		232	42.7	178	36.6	#
14 Animal faeces visible at this place	320	59.3	240	49.9	#	265	48.7	200	40.9	#	291	53.6	231	47.4	
15 Garbage visible at this place	470	87.0	382	79.4	#	470	86.4	374	76.5	#	480	88.4	382	78.4	#
16 SPEC.PLACE WASHING UTENSILS IN HS/CP	471	84.0	419	85.9		491	87.8	433	87.5		486	86.8	459	93.1	#
	471	100.0	419	100.0		491	100.0	433	100.0		486	100.0	459	100.0	
17 Place separated by fencing	26	5.5	31	7.4		31	6.3	47	10.9	#	31	6.4	31	6.8	
18 This place at the pump	111	23.6	62	14.8	#	88	17.9	68	15.7		104	21.4	66	14.4	#
19 Animals visible at this place	286	60.7	253	60.4		257	52.3	204	47.1		264	54.3	213	46.4	#
20 Animal faeces visible at this place	313	66.5	253	60.4		298	60.7	245	56.6		301	61.9	266	58.0	
21 Garbage visible at this place	427	90.7	362	86.4		456	92.9	364	84.1	#	446	91.8	389	84.7	#
22 SPEC.PLACE WASHING CLOTHES IN HS/CP	534	95.2	470	96.3		538	96.2	463	93.5		539	96.3	481	97.6	
	534	100.0	470	100.0		538	100.0	463	100.0		539	100.0	481	100.0	
23 Place separated by fencing	26	4.9	32	6.8		22	4.1	40	8.6	#	40	7.4	28	5.8	
24 This place at the pump	18	3.4	37	7.9	#	37	6.9	42	9.1		39	7.2	41	8.5	
25 Animals visible at this place	323	60.5	276	58.7		262	48.7	207	44.7		271	50.3	219	45.5	
26 Animal faeces visible at this place	338	63.3	283	60.2		320	59.5	253	54.6		329	61.0	281	58.4	
27 Garbage visible at this place	468	87.6	376	80.0	#	480	89.2	383	82.7	#	481	89.2	409	85.0	
28 SPEC.PLACE FOR EATING IN HS/CP	544	97.0	483	99.0		545	97.5	488	98.6		543	97.0	489	99.2	#
	544	100.0	483	100.0		545	100.0	488	100.0		543	100.0	489	100.0	
29 Place separated by fencing	89	16.4	70	14.5		115	21.1	83	17.0		136	25.0	84	17.2	#
30 Animals visible at this place	254	46.7	215	44.5		177	32.5	136	27.9		175	32.2	143	29.2	
31 Animal faeces visible at this place	257	47.2	229	47.4		230	42.2	193	39.5		211	38.9	204	41.7	
32 Garbage visible at this place	415	76.3	322	66.7	#	396	72.7	308	63.1	#	403	74.2	332	67.9	#
33 SPEC.PLACE FOR BATHING IN HS/CP	549	97.9	486	99.6	#	550	98.4	491	99.2		548	97.9	491	99.6	#
	549	100.0	486	100.0		550	100.0	491	100.0		548	100.0	491	100.0	
34 Place separated by fencing	463	84.3	403	82.9		502	91.3	420	85.5	#	511	93.2	433	88.2	#
35 place inside the latrine	217	39.5	229	47.1	#	216	39.3	226	46.0	#	243	44.3	239	48.7	
36 Animals visible at this place	140	25.5	133	27.4		89	16.2	93	18.9		100	18.2	130	26.5	#
37 Animal faeces visible at this place	185	33.7	183	37.7		186	33.8	162	33.0		168	30.7	197	40.1	#
38 Garbage visible at this place	324	59.0	266	54.7		288	52.4	236	48.1		318	58.0	302	61.5	
39 SPEC.PLACE FOR SLEEPING IN HS/CP	553	98.6	487	99.8		552	98.7	493	99.6		552	98.6	493	100.0	
	553	100.0	487	100.0		552	100.0	493	100.0		552	100.0	493	100.0	
40 Place separated by fencing	476	86.1	403	82.8		488	88.4	412	83.6	#	482	87.3	399	80.9	#
41 Animals visible at this place	116	21.0	112	23.0		72	13.0	58	11.8		82	14.9	74	15.0	
42 Animal faeces visible at this place	154	27.8	136	27.9		122	22.1	95	19.3		100	18.1	101	20.5	
43 Garbage visible at this place	320	57.9	245	50.3	#	275	49.8	254	51.5		313	56.7	266	54.0	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.2 SANITARY INDEX SCORE FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS
- Environmental conditions in living/working areas -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.55	0.52	0.49	0.45	0.50	0.49

TABLE 3.3 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS - Provision for animals -

	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
Q*	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
44 SPEC. PLACE FOR ANIMALS IN COMPOUND	540	96.3	446	91.4	#	554	99.1	473	95.6	#	554	98.9	468	94.9	#
	540	100.0	446	100.0		554	100.0	473	100.0		554	100.0	468	100.0	
45 This place is separated by fencing	402	74.4	367	82.3	#	362	65.3	351	74.2	#	397	71.7	383	81.8	#
46 SPEC. PLACE FOR ANIMALS IN HOUSE	499	88.9	403	82.6	#	509	91.1	427	86.3	#	510	91.1	416	84.4	#
	499	100.0	403	100.0		509	100.0	427	100.0		510	100.0	416	100.0	
47 This place is separated by fencing	375	75.2	349	86.6	#	386	75.8	345	80.8		392	76.9	349	83.9	#
48 ANIMALS HAVE ACCESS TO THE HOUSE	489	87.2	391	80.1	#	518	92.7	405	81.8	#	534	95.4	417	84.6	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.4 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS - Provision for garbage -

	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
Q*	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
49 CONTAINER FOR GARBAGE COLLECTION	131	23.4	140	28.7		276	49.4	207	41.8	#	354	63.2	276	56.0	#
50 GARBAGE DUMPED AT SPECIAL PLACE	243	43.3	177	36.3	#	295	52.8	213	43.0	#	275	49.1	223	45.2	
51 GARBAGE BURNED/BURIED	290	51.7	229	46.9		426	76.2	331	66.9	#	439	78.4	397	80.5	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.5 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS - Provision for waste water -

	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
Q*	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
52 PLACE FOR WASTE WATER DISCHARGE	174	31.0	144	29.5		113	20.2	136	27.5	#	108	19.3	146	29.6	#
	174	100.0	144	100.0		113	100.0	136	100.0		108	100.0	146	100.0	
53 This place is the latrine	56	32.2	66	45.8	#	58	51.3	89	65.4	#	58	53.7	81	55.5	
54 Water ponding at place for discharge	95	54.6	86	59.7		80	70.8	83	61.0		75	69.4	106	72.6	
55 WATER PONDING IN HOUSE/COMPOUND	425	75.8	350	71.7		499	89.3	426	86.1		533	95.2	454	92.1	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.6 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS - Handpumps -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
56 NR. OF HOUSEHOLDS USING HANDPUMPS	518	92.3	465	95.3		557	99.6	477	96.4		559	99.8	473	95.9	
	518	100.0	465	100.0		557	100.0	477	100.0		559	100.0	473	100.0	
57 Pump is new (after intervention)	0	0.0	0	0.0		316	56.7	0	0.0	#	353	63.1	0	0.0	#
58 Pump inside house/compound	254	49.0	169	36.3	#	224	40.2	171	35.8		207	37.0	183	38.7	
59 Distance to the pump										#					#
* 0 - 25 M	308	59.5	268	57.6		331	59.4	279	58.5		337	60.3	271	57.3	
* 25 - 50 M	154	29.7	123	26.5		153	27.5	107	22.4		160	28.6	115	24.3	
* 50 - 100 M	48	9.3	58	12.5		70	12.6	66	13.8		58	10.4	68	14.4	
* > 100 M	8	1.5	16	3.4		3	0.5	25	5.2		4	0.7	19	4.0	
87 HOUSEHOLDS USING SECOND PUMP ($)	9	1.6	17	3.5		189	33.8	51	10.3	#	160	28.6	71	14.4	#
	9	100.0	17	100.0		189	100.0	51	100.0		160	100.0	71	100.0	
88 Pump is new (after intervention)	0	0.0	0	0.0		119	63.0	0	0.0	#	91	56.9	0	0.0	#
89 Pump inside house/compound	2	22.2	3	17.6		40	21.2	2	3.9	#	38	23.8	3	4.2	#
90 Distance to the pump										#					#
* 0 - 25 M	2	22.2	3	17.6		63	33.3	7	13.7		63	39.4	11	15.5	
* 25 - 50 M	1	11.1	8	47.1		72	38.1	16	31.4		69	43.1	21	29.6	
* 50 - 100 M	3	33.3	4	23.5		49	25.9	19	37.3		25	15.6	27	38.0	
* > 100 M	3	33.3	2	11.8		5	2.6	9	17.6		3	1.9	12	16.9	
91 HOUSEHOLDS USING THIRD PUMP ($)	1	0.2	0	0.0		7	1.3	3	0.6		2	0.4	2	0.4	
	1	100.0	0	100.0		7	100.0	3	100.0		2	100.0	2	100.0	
92 Pump is new (after intervention)	0	0.0	0	0.0		4	57.1	0	0.0		0	0.0	0	0.0	
93 Pump inside house/compound	0	0.0	0	0.0		0	0.0	0	0.0		1	50.0	0	0.0	
94 Distance to the pump															
* 0 - 25 M	0	0.0	0	0.0		2	28.6	0	0.0		1	50.0	0	0.0	
* 25 - 50 M	1	100.0	0	0.0		1	14.3	1	33.3		1	50.0	0	0.0	
* 50 - 100 M	0	0.0	0	0.0		4	57.1	1	33.3		0	0.0	2	100.0	
* > 100 M	0	0.0	0	0.0		0	0.0	2	66.7		0	0.0	0	0.0	

($): Observations started at the end of baseline survey
Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.7 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS
- Water storage -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
60 WATER STORED IN ZIR/CONTAINER	456	81.3	442	90.6	#	356	63.7	398	80.4	#	411	73.4	418	84.8	#
	456	100.0	442	100.0		356	100.0	398	100.0		411	100.0	418	100.0	
61 Zir/container is covered	349	76.5	371	83.9	#	279	78.4	332	83.4		342	83.2	366	87.6	
62 Long-handled dipper visible near zir	5	1.1	6	1.4		1	0.3	2	0.5		2	0.5	2	0.5	
63 Cup visible near zir	297	65.1	289	65.4		207	58.1	250	62.8		242	58.9	285	68.2	#
64 Cup/dipper is on the floor	28	6.1	38	8.6		22	6.2	23	5.8		19	4.6	21	5.0	
65 Cup/dipper is inside zir/container	2	0.4	2	0.5		0	0.0	0	0.0		0	0.0	1	0.2	
66 Cup/dipper on top of zir/container	176	38.6	206	46.6	#	131	36.8	150	37.7		156	38.0	173	41.4	
67 Animals have access to cup/dipper(*)	51	17.2	64	22.1		42	20.3	70	28.0		27	11.1	22	7.7	
68 Animals visible near container/zir	222	48.7	198	44.8		86	24.2	89	22.4		127	30.9	123	29.4	
69 Faeces visible near container/zir	268	58.8	223	50.5	#	156	43.8	137	34.4	#	185	45.0	166	39.7	
70 Garbage visible near container/zir	365	80.0	310	70.1	#	268	75.3	244	61.3	#	307	74.7	287	68.7	
71 Mud/water ponding near container/zir	363	79.6	297	67.2	#	300	84.3	291	73.1	#	375	91.2	358	85.6	#

(*) : The percentages for question 67 are calculated in relation to the total number of times a cup was visible.
Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.8 SANITARY INDEX SCORE FOR ALL ZIRS AT BASELINE, 3 AND 6 MONTHS
- Environmental conditions around the zir -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.66	0.58	0.56	0.47	0.60	0.55

TABLE 3.9 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS
- Provision for handwashing -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
72 STORAGE/BASIN FOR HANDWASHING	139	24.8	169	34.6	#	185	33.1	166	33.5		194	34.6	165	33.5	
	139	100.0	169	100.0		185	100.0	166	100.0		194	100.0	165	100.0	
73 Water in basin	44	31.7	70	41.4		60	32.4	57	34.3		58	29.9	58	35.2	
	44	100.0	70	100.0		60	100.0	57	100.0		58	100.0	58	100.0	
74 The water in basin is fresh	19	43.2	29	41.4		19	31.7	22	38.6		13	22.4	32	55.2	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.10 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS AT BASELINE, 3 AND 6 MONTHS
- Latrine -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	561	100.0	488	100.0	S#	559	100.0	495	100.0	S#	560	100.0	493	100.0	S#
75 LATRINE INSIDE HOUSE/COMPOUND	362	64.5	302	61.9		497	88.9	320	64.6	#	505	90.2	320	64.9	#
	362	100.0	302	100.0		497	100.0	320	100.0		505	100.0	320	100.0	
76 Latrine inside walls of the house	348	96.1	296	98.0		463	93.2	309	96.6	#	457	90.5	312	97.5	#
77 Latrine has walls and door	207	57.2	189	62.6		228	45.9	195	60.9		216	42.8	197	61.6	#
78 Daylight can enter the latrine	240	66.3	239	79.1		367	73.8	245	76.6		370	73.3	269	84.1	#
79 Pit is covered with slab	330	91.2	272	90.1		489	98.4	309	96.6		498	98.6	312	97.5	
80 Faeces visible on slab	43	11.9	67	22.2	#	98	19.7	52	16.3		82	16.2	54	16.9	
81 Hole closed by cover	72	19.9	84	27.8	#	125	25.2	84	26.3		149	29.5	93	29.1	
82 Water available in latrine	84	23.2	95	31.5	#	82	16.5	100	31.3	#	72	14.3	94	29.4	#
83 Mud/water ponding in the latrine	211	58.3	178	58.9		286	57.5	195	60.9		310	61.4	216	67.5	
84 Walk through faeces/dirt to latrine	110	30.4	76	25.2		105	21.1	59	18.4		148	29.3	85	26.6	
85 Collecting pit within walls of house	334	92.3	280	92.7		443	89.1	292	91.3		420	83.2	286	89.4	#
86 Depth of the pit										#					#
* 1 - 2 M	6	1.7	1	0.3		77	15.5	7	2.2		115	22.8	10	3.1	
* 2 - 3 M	19	5.2	13	4.3		62	12.5	27	8.4		32	6.3	19	5.9	
* 3 - 4 M	43	11.9	42	13.9		43	8.7	44	13.8		38	7.5	36	11.3	
* 4 - 5 M	64	17.7	88	29.1		80	16.1	64	20.0		61	12.1	55	17.2	
* > 5 M	124	34.3	78	25.8		137	27.6	94	29.4		151	29.9	99	30.9	
* NOT KNOWN	106	29.3	80	26.5		98	19.7	84	26.3		108	21.4	101	31.6	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.11 SANITARY INDEX SCORE FOR ALL LATRINES AT BASELINE, 3 AND 6 MONTHS
- Sanitary conditions in the latrine -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.37	0.34	0.33	0.32	0.34	0.33

TABLE 3.12 RESULTS HANDPUMP SURVEY FOR ALL PUMPS AT BASELINE, 3 AND 6 MONTHS SURVEY
- Presence, location and type of pump -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%	S#	NR.	%	NR.	%	S#	NR.	%	NR.	%	S#
TOTAL HOUSEHOLDS SURVEYED	561		488			559		495			560		493		
TOTAL PUMPS SURVEYED	300		207			369		214			359		219		
Pump density (pumps/household)	0.53		0.42			0.66		0.43			0.64		0.44		
11 PUMP INSIDE HOUSE/COMPOUND	257	85.7	162	78.3		283	76.7	163	76.2		266	74.1	162	74.0	
12 NEW PUMP (AFTER INTERVENTION)	0	0.0	0	0.0		96	26.0	0	0.0	#	96	26.7	0	0.0	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.13 RESULTS HANDPUMP SURVEY FOR ALL PUMPS AT BASELINE, 3 AND 6 MONTHS SURVEY
- Operation and maintenance of pump -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%	S#	NR.	%	NR.	%	S#	NR.	%	NR.	%	S#
TOTAL PUMPS SURVEYED	300		207			369		214			359		219		
13 PUMP GIVES WATER	290	96.7	188	90.8		320	86.7	188	87.9		311	86.6	189	86.3	
	290	100.0	188	100.0		320	100.0	188	100.0		311	100.0	189	100.0	
14 Pump leaks while pumping	24	8.3	16	8.5		17	5.3	12	6.4		7	2.3	8	4.2	
15 SPOUT BROKEN	3	1.0	0	0.0		1	0.3	0	0.0		2	0.6	0	0.0	
16 PUMP LOOSE AT BASE	86	28.7	86	41.5	#	72	19.5	79	36.9		57	15.9	79	36.1	#
17 PUMP HANDLE LOOSE	204	68.0	125	60.4		172	46.6	129	60.3	#	194	54.0	162	74.0	#
18 CEMENT/CONCRETE FLOOR PRESENT	22	7.3	7	3.4		109	29.5	7	3.3	#	119	33.1	8	3.7	#
	22	100.0	7	100.0		109	100.0	7	100.0		119	100.0	8	100.0	
19 Cracks in concrete floor	5	22.7	3	42.9		11	10.0	2	28.6	#	10	8.4	1	12.5	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.14 MAINTENANCE INDEX SCORE FOR ALL PUMPS AT BASELINE, 3 AND 6 MONTHS
- Maintenance conditions of the pump -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
MAINTENANCE INDEX SCORE (0-1)	0.41	0.44	0.30	0.43	0.30	0.46

TABLE 3.15 RESULTS HANDPUMP SURVEY FOR ALL PUMPS AT BASELINE, 3- AND 6 MONTHS SURVEY
- Environmental conditions at pump-site -

Q*	BASELINE SURVEY					3 - MONTHS SURVEY					6 - MONTHS SURVEY				
	INTERV.		CONTROL		S#	INTERV.		CONTROL		S#	INTERV.		CONTROL		S#
	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL PUMPS SURVEYED	300		207			369		214			359		219		
20 PROVISION FOR DRAINAGE AVAILABLE	147	69.0	72	34.8	#	226	61.2	96	44.9	#	227	63.2	87	39.7	#
	147	100.0	72	100.0		226	100.0	96	100.0		227	100.0	87	100.0	
21 Provision for drainage functions	98	66.7	44	61.1		191	84.5	66	68.8	#	158	69.6	41	47.1	#
22 WATER PONDING AROUND PUMP	242	80.7	160	77.3		291	78.9	178	83.2		259	72.1	177	80.8	#
23 GARBAGE AROUND PUMP	246	82.0	154	74.4		305	82.7	170	79.4		258	71.9	159	72.6	
24 ANIMALS AROUND PUMP	111	37.0	68	32.9		163	44.2	80	37.4		127	35.4	76	34.7	
25 ANIMAL FAECES AROUND PUMP	130	43.3	84	40.6		175	47.4	87	40.7		133	37.0	73	33.3	
26 LATRINE NEAR PUMP	102	34.0	102	49.3	#	206	55.8	131	61.2		179	49.9	116	53.0	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.16 SANITARY INDEX SCORE FOR ALL PUMPS AT BASELINE, 3 AND 6 MONTHS
- Environmental conditions at the pump-site -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.63	0.64	0.66	0.67	0.59	0.66

TABLE 3.17 RESULTS HANDPUMP SURVEY FOR NEW UNICEF PUMPS ONLY AT 3 AND 6 MONTHS SURVEY - Location, operation and maintenance of new pump -

Q*	3-MONTHS		6-MONTHS	
	NR.	%	NR.	%
TOTAL PUMPS SURVEYED	96	100.0	96	100.0
11 PUMP INSIDE HOUSE/COMPOUND	48	50.0	49	51.0
13 PUMP GIVES WATER	96	100.0	96	100.0
	96	100.0	96	100.0
14 Pump leaks while pumping	0	0.0	1	1.0
15 SPOUT BROKEN	0	0.0	0	0.0
16 PUMP LOOSE AT BASE	4	4.2	5	5.2
17 PUMP HANDLE LOOSE	0	0.0	0	0.0
18 CEMENT/CONCRETE FLOOR PRESENT	96	100.0	96	100.0
	96	100.0	96	100.0
19 Cracks in concrete floor	9	9.4	7	7.3

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.18 RESULTS HANDPUMP SURVEY FOR NEW UNICEF PUMPS ONLY AT 3 AND 6 MONTHS SURVEY - Environmental conditions at pump-site -

	3-MONTHS		6-MONTHS	
Q*	NR.	%	NR.	%
TOTAL PUMPS SURVEYED	96	100.0	96	100.0
20 PROVISION FOR DRAINAGE AVAILABLE	92	95.8	93	96.9
	92	100.0	93	100.0
21 Provision for drainage functions	81	84.4	86	89.6
22 WATER PONDING AROUND PUMP	75	78.1	64	66.7
23 GARBAGE AROUND PUMP	78	81.3	59	61.5
24 ANIMALS AROUND PUMP	37	38.5	17	17.7
25 ANIMAL FAECES AROUND PUMP	35	36.5	20	20.8
26 LATRINE NEAR PUMP	41	42.7	34	35.4

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 3.19 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEYS - General data on pump used -

Q*	BASELINE SURVEY				3 - MONTHS SURVEY				6 - MONTHS SURVEY			
	INTERV.		CONTROL		INTERV.		CONTROL		INTERV.		CONTROL	
	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%
TOTAL HOUSEHOLDS SURVEYED	100		100		100		100		100		100	
11 NR OF NEW PUMP USED	0	0.0	0	0.0	81	59.6	0	0.0	87	64.0	0	0.0
12 NR OF OBSERVATION FORMS COMPLETED	92	100.0	93	100.0	136	100.0	96	100.0	136	100.0	97	100.0
Nr of households not using pumps	8		7		0		4		0		3	
13 OBSERVED PUMP INSIDE HOUSE/COMPOUND	36	39.1	37	39.8	28	20.6	31	32.3	30	22.1	34	35.1
14 PUMP DISTANCE FROM HOUSE												
* 0 - 25 M	71	77.2	67	72.8	100	73.5	62	64.6	94	69.1	65	67.0
* 25 - 50 M	15	16.3	14	15.2	29	21.3	20	20.8	31	22.8	14	14.4
* 50 - 100 M	2	2.2	10	10.9	6	4.4	12	12.5	10	7.4	17	17.5
* > 100 M	4	4.3	2	2.2	1	0.7	2	2.1	1	0.7	1	1.0
15 HOUSEHOLDS USING 2nd TRADITIONAL PUMP	4	100.0	8	100.0	7	100.0	13	100.0	2	100.0	21	100.0
16 Second pump inside house/compound	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
17 Pump distance from house												
* 0 - 25 M	0	0.0	1	12.5	3	42.9	3	23.1	0	0.0	5	23.8
* 25 - 50 M	1	25.0	2	25.0	0	0.0	5	38.5	0	0.0	7	33.3
* 50 - 100 M	3	75.0	3	37.5	2	28.6	4	30.8	2	100.0	7	33.3
* > 100 M	0	0.0	2	25.0	2	28.6	1	7.7	0	0.0	2	9.5
18 HOUSEHOLDS USING 3rd TRADITIONAL PUMP	0	100.0	0	100.0	1	100.0	1	100.0	0	100.0	3	100.0
19 Third pump inside house/compound	0		0		0	0.0	0	0.0	0		0	0.0
20 Pump distance from house												
* 0 - 25 M	0		0		1	100.0	0	0.0	0		0	0.0
* 25 - 50 M	0		0		0	0.0	0	0.0	0		1	33.3
* 50 - 100 M	0		0		0	0.0	0	0.0	0		1	33.3
* > 100 M	0		0		0	0.0	1	100.0	0		1	33.3

TABLE 3.20 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEYS - Water collections at pump. totals -

Q*	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %
TOTAL HOUSEHOLDS SURVEYED	100	100	100	100	100	100
TOTAL NR OF OBSERVATIONS	92	93	136	96	136	97
Nr. of times no collection/activities during observation period	3	1	8	6	13	3
21 TOTAL NR OF COLLECTIONS PER OBSERV.						
Range	0 - 44	0 - 36	0 - 34	0 - 24	0 - 48	0 - 27
Median	13	11	10	8	10	8
Mean	13.9	11.7	10.9	8.9	10.9	9.2
St.Dev.	7.6	6.8	7.4	5.7	9.2	6.0
22 TOT. VOLUME COLLECTED PER OBSERVATION						
Range (liters)	0 - 580	0 - 577	0 - 590	0 - 360	0 - 600	0 - 530
Median	161	147	157	140	140	132
Mean	175	158	163	139	157	143
St.Dev.	104	100	122	84	129	91
VOLUME PER CAPITA PER DAY (*)	17.6	15.3	22.3	13.4	21.5	13.8

(*) Calculated using average (sentinel) household size, based on census data

915 960 994 996 993 600 5

TABLE 3.21 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEYS - Other water use, totals -

Q*	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %
TOTAL HOUSEHOLDS SURVEYED	100	100	100	100	100	100
TOTAL NR OF OBSERVATIONS	92	93	136	96	136	97
25 NR OF TIMES HAND WASHING						
Range	0 - 13	0 - 20	0 - 10	0 - 7	0 - 20	0 - 17
Median	2	1	0	0	1	0
Mean	2.8	2.8	1.4	1.1	1.9	1.2
St.Dev.	2.8	4.0	2.2	1.7	3.6	2.5
26 NR OF TIMES CHILD BATHING						
Range	0 - 5	0 - 10	0 - 1	0	0 - 4	0 - 2
Median	0	0	0	0	0	0
Mean	0.2	0.5	0.0	0.0	0.0	0.0
St.Dev.	0.9	1.6	0.0	0.0	0.4	0.3
27 NR OF TIMES WASHING KITCHEN UTENSILS						
Range	0 - 30	0 - 18	0 - 15	0 - 10	0 - 10	0 - 9
Median	2	2	0	0	0	0
Mean	3.5	3.1	1.5	1.6	1.2	1.0
St.Dev.	4.8	3.7	2.6	2.5	1.7	1.7
28 NR OF TIMES WASHING CLOTHES						
Range	0 - 6	0 - 8	0 - 2	0 - 2	0 - 5	0 - 1
Median	0	0	0	0	0	0
Mean	0.5	0.8	0.1	0.0	0.1	0.0
St.Dev.	1.1	1.8	0.3	0.2	0.5	0.1
29 NR OF TIMES WASHING FOOD/VEGETABLES						
Range	0 - 3	0 - 5	0 - 6	0 - 4	0 - 4	0 - 5
Median	0	0	0	0	0	0
Mean	0.4	0.6	0.1	0.3	0.2	0.2
St.Dev.	0.9	1.3	0.7	0.8	0.6	0.7
30 NR OF TIMES OTHER ACTIVITIES						
Range	0 - 18	0 - 10	0 - 7	0 - 7	0 - 9	0 - 6
Median	0	0	0	0	0	0
Mean	1.8	1.3	0.7	0.4	0.7	0.4
St.Dev.	3.1	2.4	1.6	1.2	1.6	1.0

TABLE 3.22 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEYS - Who collects water, how and how much -

	Q*	BASELINE SURVEY				3 - MONTHS SURVEY				6 - MONTHS SURVEY			
		INTERV.		CONTROL		INTERV.		CONTROL		INTERV.		CONTROL	
		NR.	%	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%
	TOTAL HOUSEHOLDS SURVEYED	100		100		100		100		100		100	
	TOTAL NR OF COLLECTIONS OBSERVED	1281	100.0	1091	100.0	1477	100.0	883	100.0	1489		897	
W H O	Person collecting is female	1203	93.9	1025	94.0	1417	95.9	850	96.26	1406	94.4	868	96.8
	AGE GROUP DISTRIBUTION												
	* < 10 YEARS	100	7.8	94	8.6	117	7.9	19	2.2	119	8.0	42	4.7
	* 10 - 20 YEARS	353	27.6	274	25.1	471	31.9	273	30.9	427	28.7	200	22.3
	* > 20 YEARS	828	64.6	723	66.3	889	60.2	591	66.9	943	63.3	655	73.0
H O W	CONTAINER TYPES USED												
	* TYPE 1 SMALL BUCKET	83	6.9	86	7.9	87	5.9	65	7.4	97	6.5	71	7.9
	* TYPE 2 BIG BUCKET	93	7.7	183	16.8	221	15.0	117	13.3	174	11.7	115	12.8
	* TYPE 3 BIG TASHT	14	1.2	9	0.8	1	0.1	0	0.0	5	0.3	6	0.7
	* TYPE 4 SMALL TASHT	3	0.2	5	0.5	13	0.9	5	0.6	2	0.1	1	0.1
	* TYPE 5 BASTELLAH BIG	60	5.0	71	6.5	57	3.9	57	6.5	45	3.0	60	6.7
	* TYPE 6 BASTELLAH SMALL	342	28.4	178	16.3	210	14.2	137	15.5	315	21.2	127	14.2
	* TYPE 7 BASIN SMALL	165	13.7	143	13.1	90	6.1	40	4.5	58	3.9	62	6.9
	* TYPE 8 BASIN BIG	229	19.0	196	18.0	543	36.8	292	33.1	566	38.0	345	38.5
	* TYPE 9 BIG JERRYCAN	49	4.1	30	2.7	67	4.5	10	1.1	8	0.5	20	2.2
	* TYPE 10 SMALL JERRYCAN	32	2.7	28	2.6	22	1.5	30	3.4	40	2.7	18	2.0
	* TYPE 11 GULAH	16	1.3	16	1.5	5	0.3	1	0.1	8	0.5	1	0.1
	* OTHER TYPES	195	16.2	146	13.4	161	10.9	69	7.8	171	11.5	71	7.9
	CONTAINER WASHING	735	57.4	670	61.4	651	44.1	442	50.1	569	38.2	388	43.3
	CONTAINER CLOSED	19	1.5	17	1.6	14	0.9	12	1.4	7	0.5	8	0.9
H O W M U C H	VOLUME PER COLLECTION (Liters)												
	Range	1 - 60		1 - 60		1 - 80		1 - 60		1 - 60		1 - 60	
	Median	10		10		20		20		20		20	
	Mean	12.6		13.5		15.0		15.4		14.4		15.5	
	St.Dev.	8.7		8.3		7.2		7.4		7.6		7.4	

TABLE 3.23 RESULTS WATER QUALITY ANALYSIS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEY
- General sampling information -

Q*	BASELINE SURVEY				3 - MONTHS SURVEY				6 - MONTHS SURVEY			
	INTERV.		CONTROL		INTERV.		CONTROL		INTERV.		CONTROL	
	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%
TOTAL HOUSEHOLDS SURVEYED	100		100		100		100		100		100	
- TOTAL NR OF FORMS ENTERED	104		100		164		123		138		124	
- NR OF FORMS FOR PUMPS ONLY	4		0		64		23		38		24	
- NR OF HOUSEHOLDS NOT USING A ZIR	11		6		34		21		23		11	
- TOTAL NR OF ZIRS ANALYZED	89		94		66		79		77		89	
- NR OF HOUSEHOLDS NOT USING PUMPS	8		7		0		4		0		3	
- TOTAL NR OF PUMPS ANALYZED	96		93		164		119		138		121	
- NR UNICEF PUMPS ANALYZED	0		0		91		0		88		0	
- NR OF STERILIZED PUMPS ANALYZED	0		0		20		9		0		0	

TABLE 3.24 RESULTS WATER QUALITY ANALYSIS FOR ALL SENTINEL HOUSEHOLDS DURING BASELINE, 3 AND 6 MONTHS SURVEY
- Bacteriological water quality zir and pump -

Q*	BASELINE SURVEY				3 - MONTHS SURVEY				6 - MONTHS SURVEY			
	INTERV.		CONTROL		INTERV.		CONTROL		INTERV.		CONTROL	
	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%
TOTAL NUMBER OF ZIRS ANALYZED	89	100.0	94	100.0	66	100.0	79	100.0	77	100.0	89	100.0
- RESULTS BACTERIOLOGICAL ANALYSIS ZIRS												
* nr. of positive tubes = 0	4	4.5	0	0.0	0	0.0	2	2.5	0	0.0	0	0.0
* nr. of positive tubes = 1	0	0.0	1	1.1	0	0.0	2	2.5	1	1.3	1	1.1
* nr. of positive tubes = 2	0	0.0	0	0.0	2	3.1	2	2.5	2	2.6	1	1.1
* nr. of positive tubes = 3	0	0.0	2	2.1	4	6.3	6	7.6	2	2.6	1	1.1
* nr. of positive tubes = 4	1	1.1	2	2.1	6	9.4	8	10.1	7	9.1	3	3.4
* nr. of positive tubes = 5	84	94.4	89	94.7	52	81.3	59	74.7	65	84.4	83	93.3
- TOTAL % OF ZIR SAMPLES CONTAMINATED		95.5		100.0		100.0		97.5		100.0		100.0
TOTAL NUMBER OF PUMPS ANALYZED (a)	96	100.0	93	100.0	144	100.0	110	100.0	138	100.0	121	100.0
RESULTS BACTERIOLOGICAL ANALYSIS PUMPS												
* nr. of positive tubes = 0	25	26.0	28	30.1	39	27.1	37	33.6	63	45.7	30	24.8
* nr. of positive tubes = 1	11	11.5	4	4.3	13	9.0	6	5.5	12	8.7	10	8.3
* nr. of positive tubes = 2	4	4.2	9	9.7	7	4.9	13	11.8	7	5.1	9	7.4
* nr. of positive tubes = 3	13	13.5	3	3.2	15	10.4	7	6.4	9	6.5	17	14.0
* nr. of positive tubes = 4	2	2.1	4	4.3	23	16.0	11	10.0	11	8.0	5	4.1
* nr. of positive tubes = 5	41	42.7	45	48.4	47	32.6	36	32.7	36	26.1	50	41.3
TOTAL % OF PUMP SAMPLES CONTAMINATED (a)		74.0		69.9		72.9		66.4		54.3		75.2

(a): Samples from non-sterilized pumps only

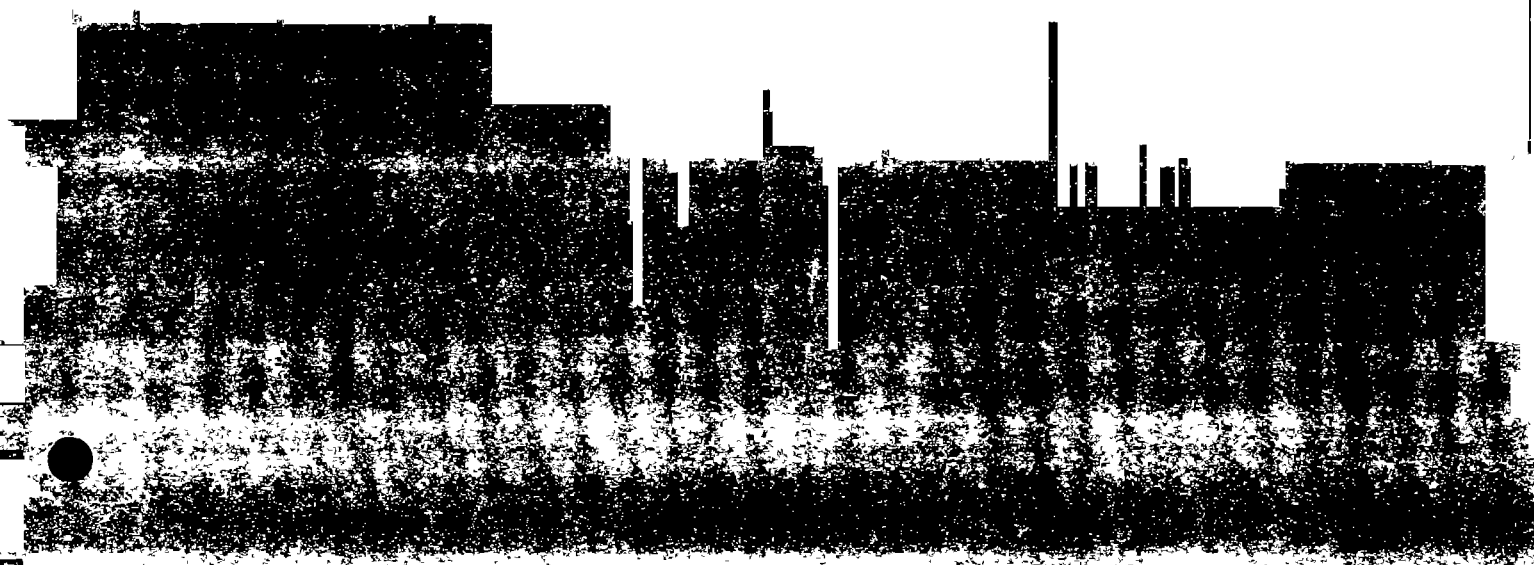
TABLE 3.25 RESULTS WATER QUALITY ANALYSIS FOR ALL NEW UNICEF HANDPUMPS AT "ZERO-TIME", 3 AND 6 MONTHS SURVEY - Bacteriological analysis -

	"ZERO-TIME"		3-MONTHS		6-MONTHS	
	INTERV. NR.	%	INTERV. NR.	%	INTERV. NR.	%
TOTAL NR OF UNICEF PUMPS INSTALLED	96		96		96	
TOTAL NR OF SAMPLES TAKEN	158		134		96	
NR. OF SAMPLES FROM STERIL. PUMPS	10		38		0	
-RESULTS BACTERIOLOGICAL ANALYSIS a)						
* nr of positive tubes = 0	40	27.0	32	33.3	50	52.1
* nr of positive tubes = 1	11	7.4	12	12.5	10	10.4
* nr of positive tubes = 2	15	10.1	9	9.4	11	11.5
* nr of positive tubes = 3	6	4.1	6	6.3	6	6.3
* nr of positive tubes = 4	10	6.8	8	8.3	9	9.4
* nr of positive tubes = 5	66	44.6	29	30.2	10	10.4
-TOTAL % OF ANALYSIS CONTAMINATED		73.0		66.7		47.9

a): Samples from non-sterilized pumps only

TABLE 3.26 RESULTS WATER QUALITY ANALYSIS FOR ALL NEW UNICEF HANDPUMPS AT "ZERO-TIME" - Chemical analysis -

	"ZERO-TIME"	
	INTERV. NR.	%
RESULTS CHEMICAL ANALYSIS TOTAL NR OF SAMPLES ANALYSED	96	
-CHLORIDE		
Range	20 - 370	
Median	80	
Mean	85	
Std. Dev.	61	
-IRON		
Range	0.1 - 1.6	
Median	0.6	
Mean	0.7	
Std. Dev.	0.3	
-HARDNESS		
Range	100 - 889	
Median	360	
Mean	363	
Std. Dev.	163	
-pH		
Range	7.2 - 8.2	
Median	7.6	
Mean	7.6	
Std. Dev.	0.24	
-MANGANESE		
Range	0 - 1.7	
Median	0.6	
Mean	0.67	
Std. Dev.	0.39	



ANNEX 4

FIGURES OF THE PROXIMATE IMPACT ANALYSIS OF THE INTERVENTION FOR ALL VILLAGES IN [illegible]

(Figures 1 - 15)

FIGURE 1

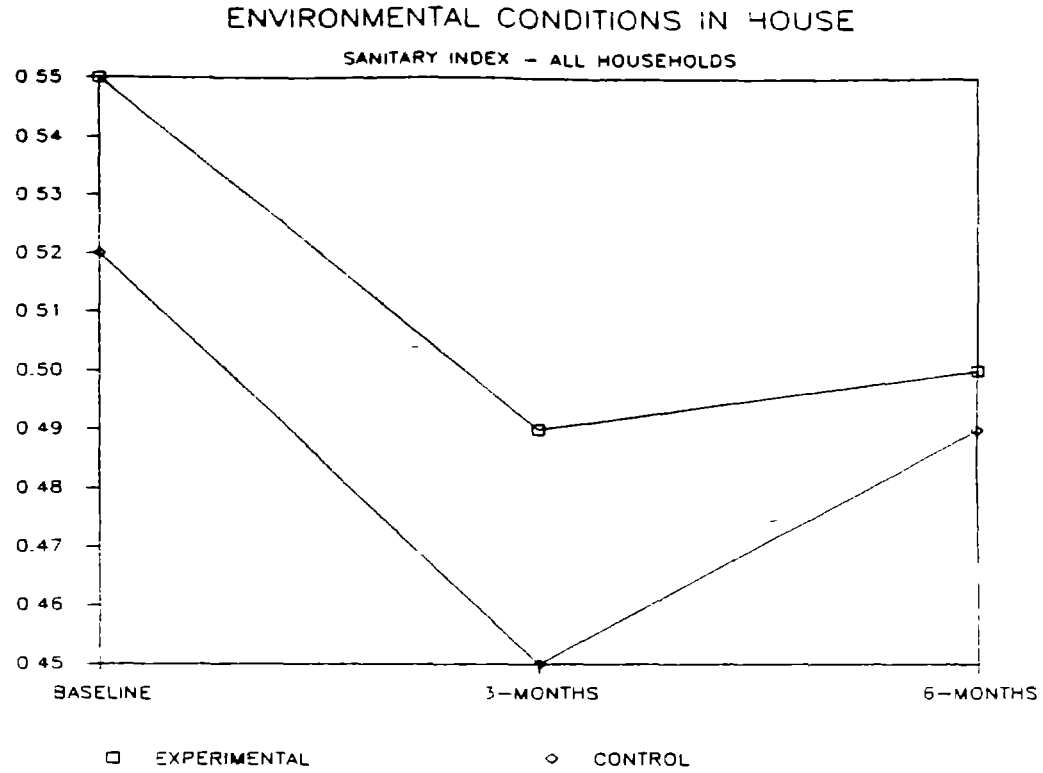


FIGURE 2

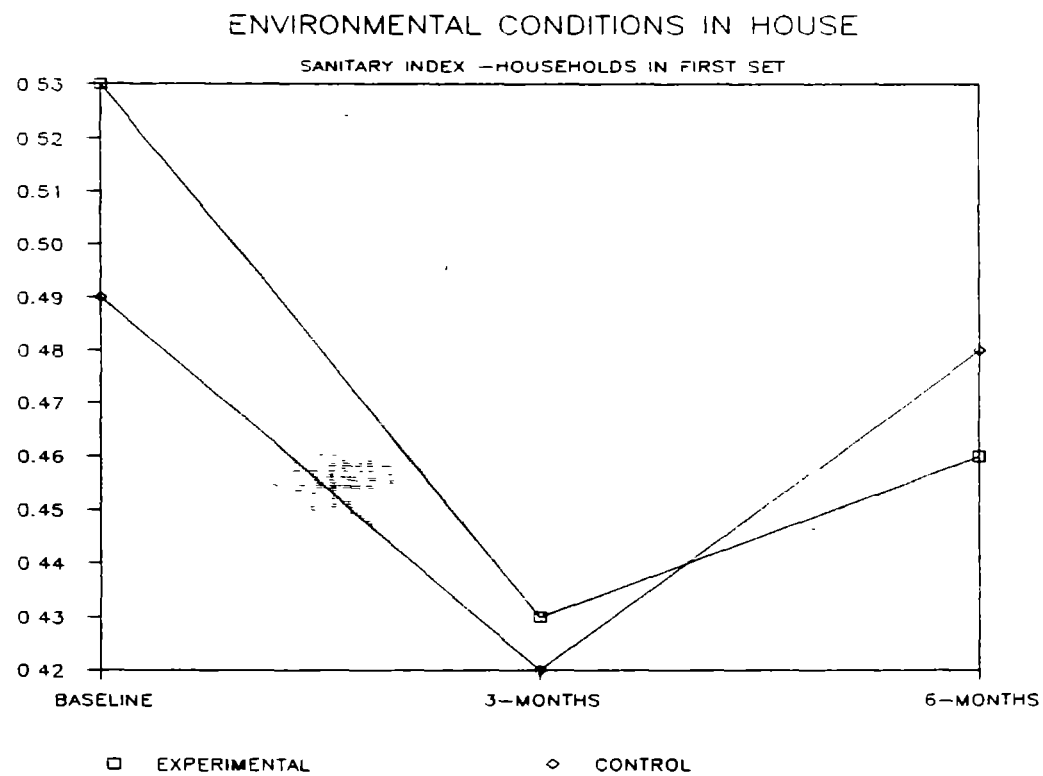


FIGURE 3

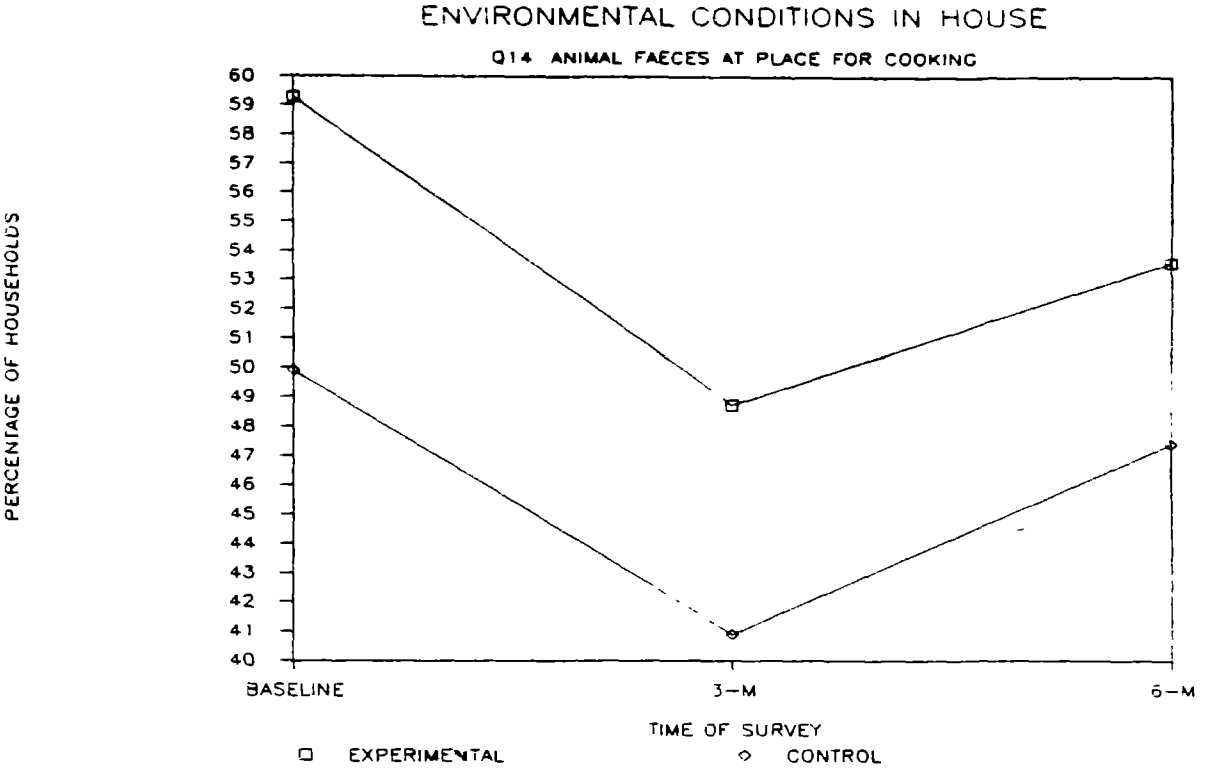


FIGURE 4

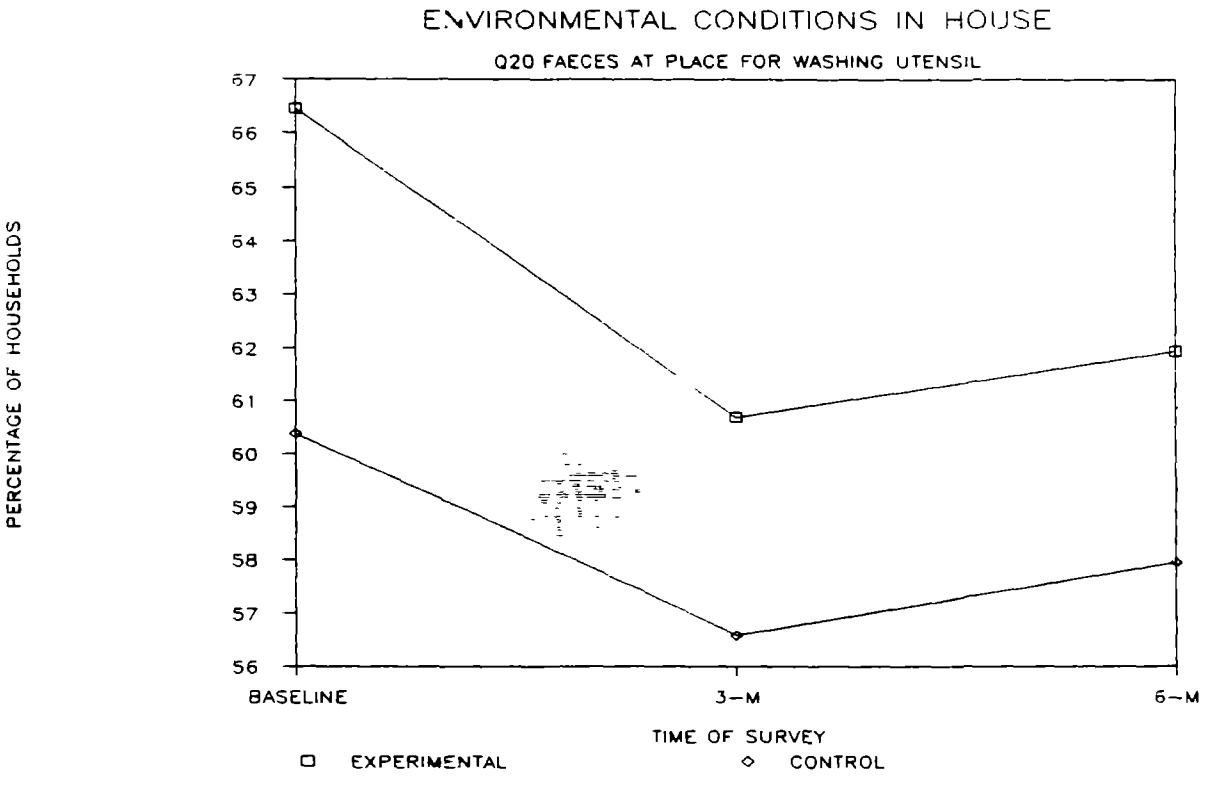


FIGURE 5

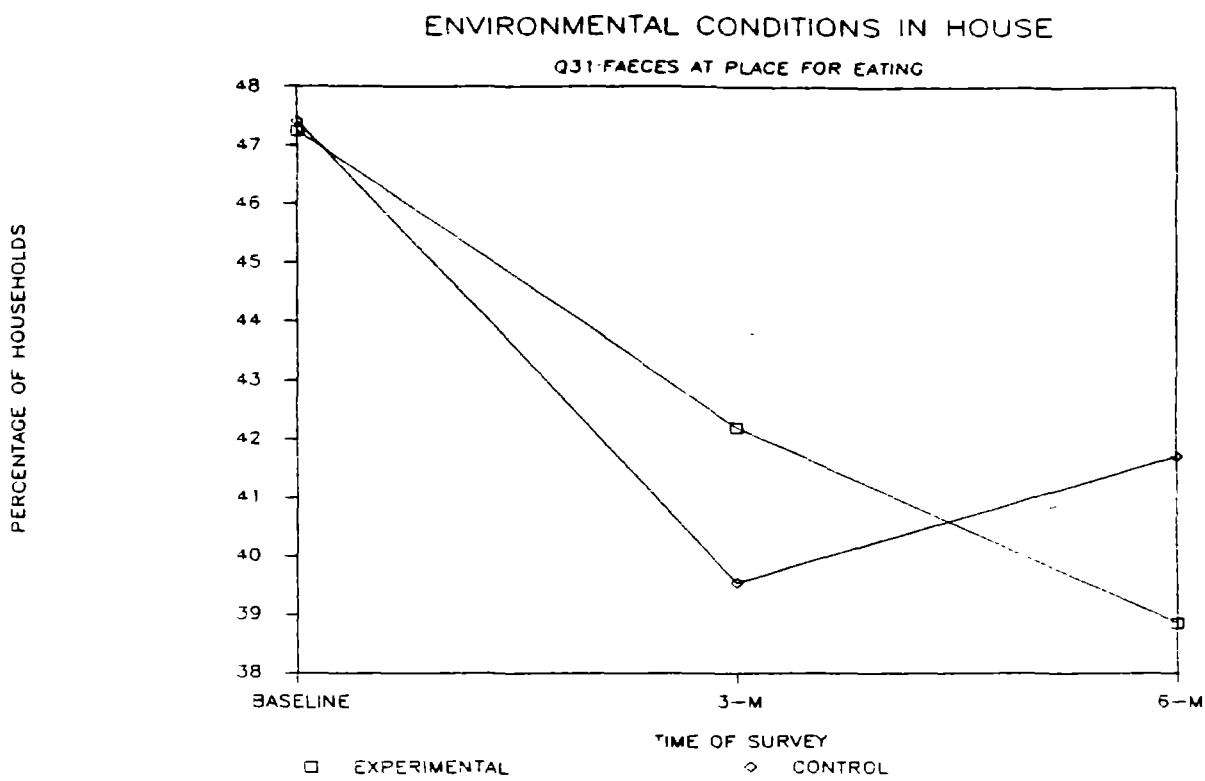


FIGURE 6

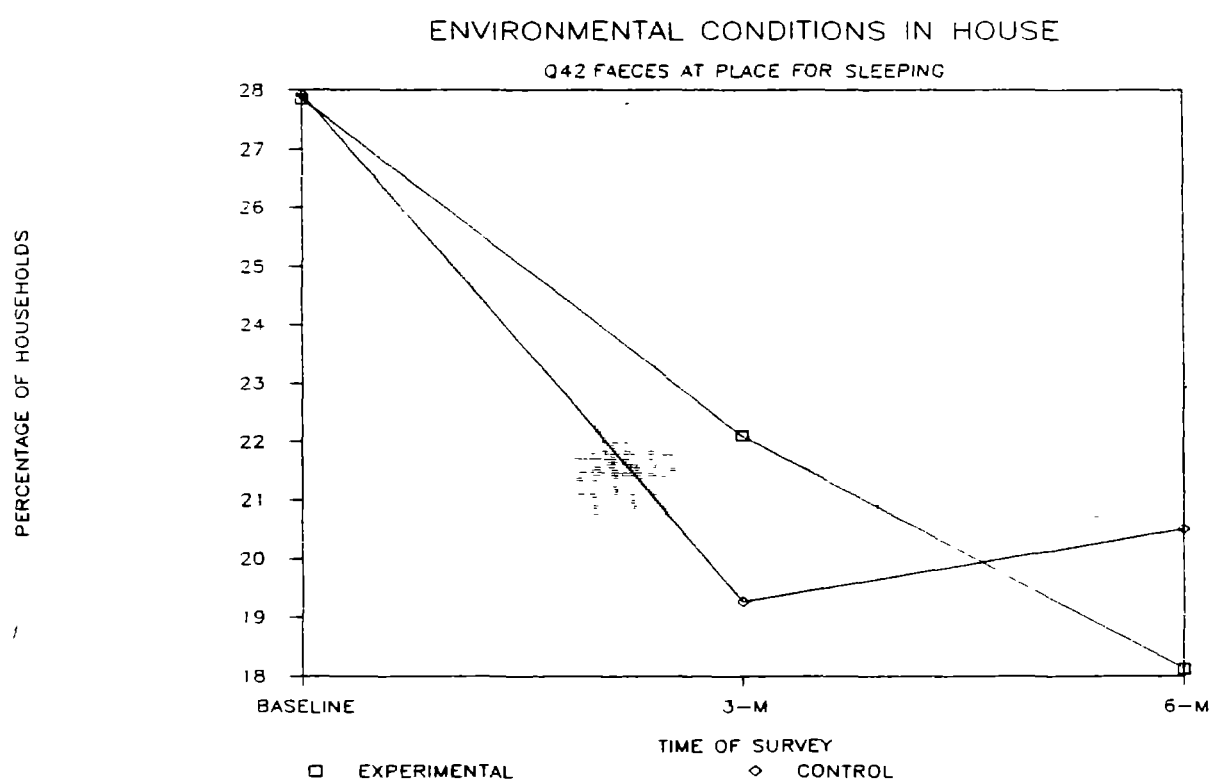


FIGURE 7

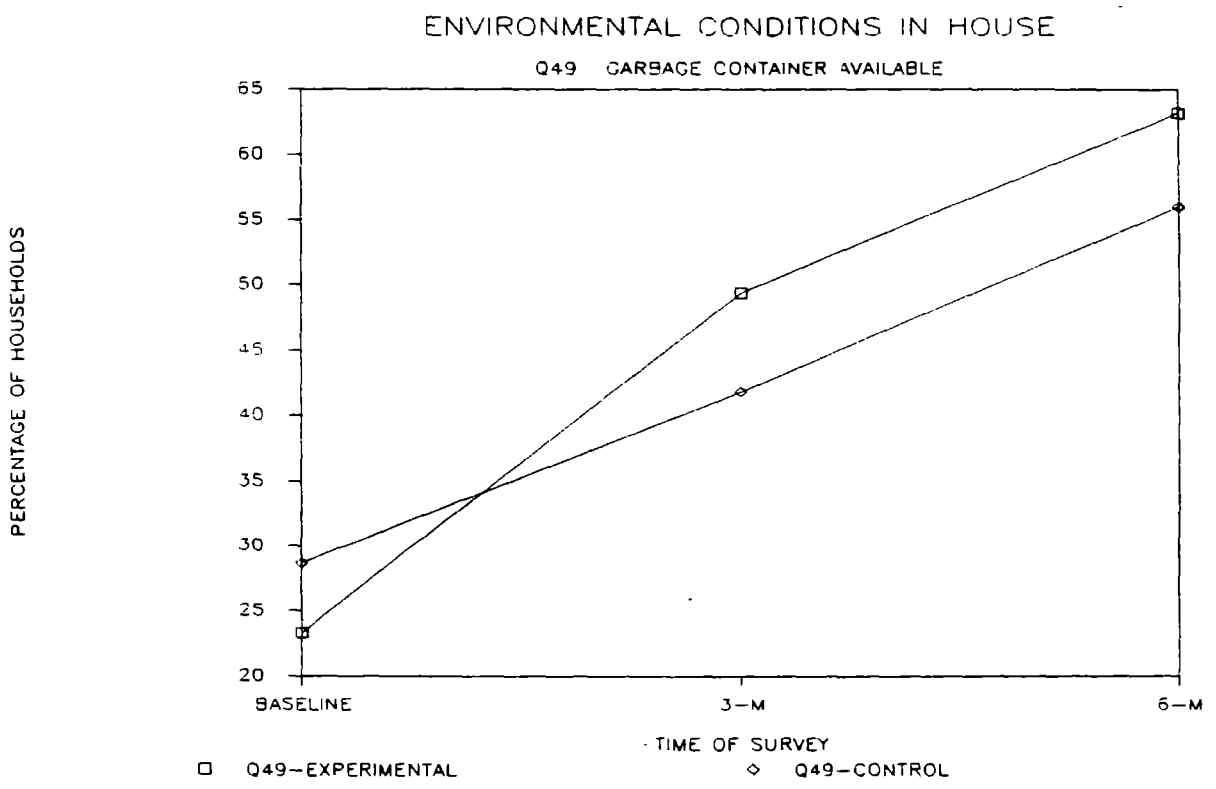

ENVIRONMENTAL CONDITIONS IN HOUSE
Q49 GARBAGE CONTAINER AVAILABLE
PERCENTAGE OF HOUSEHOLDS
65
60
55
50
45
40
35
30
25
20
BASELINE
3-M
6-M
TIME OF SURVEY
Q49-EXPERIMENTAL
Q49-CONTROL

FIGURE 8

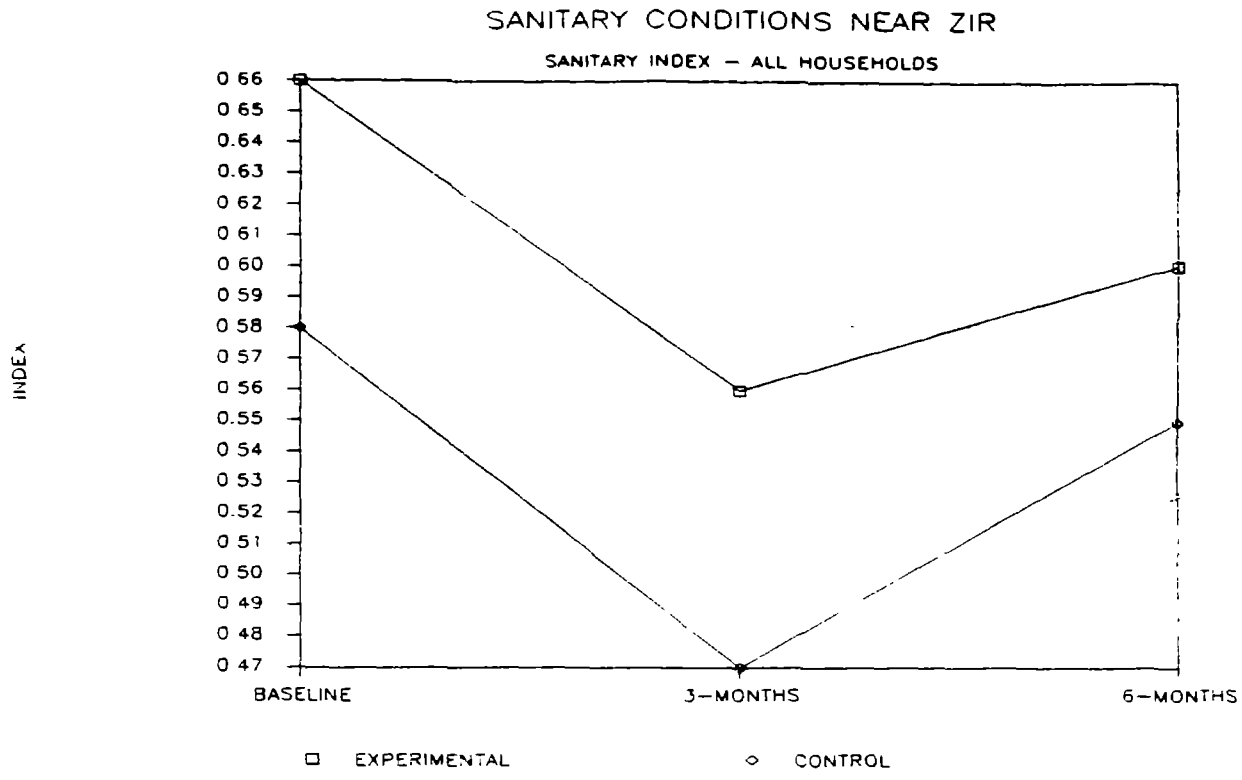


FIGURE 9

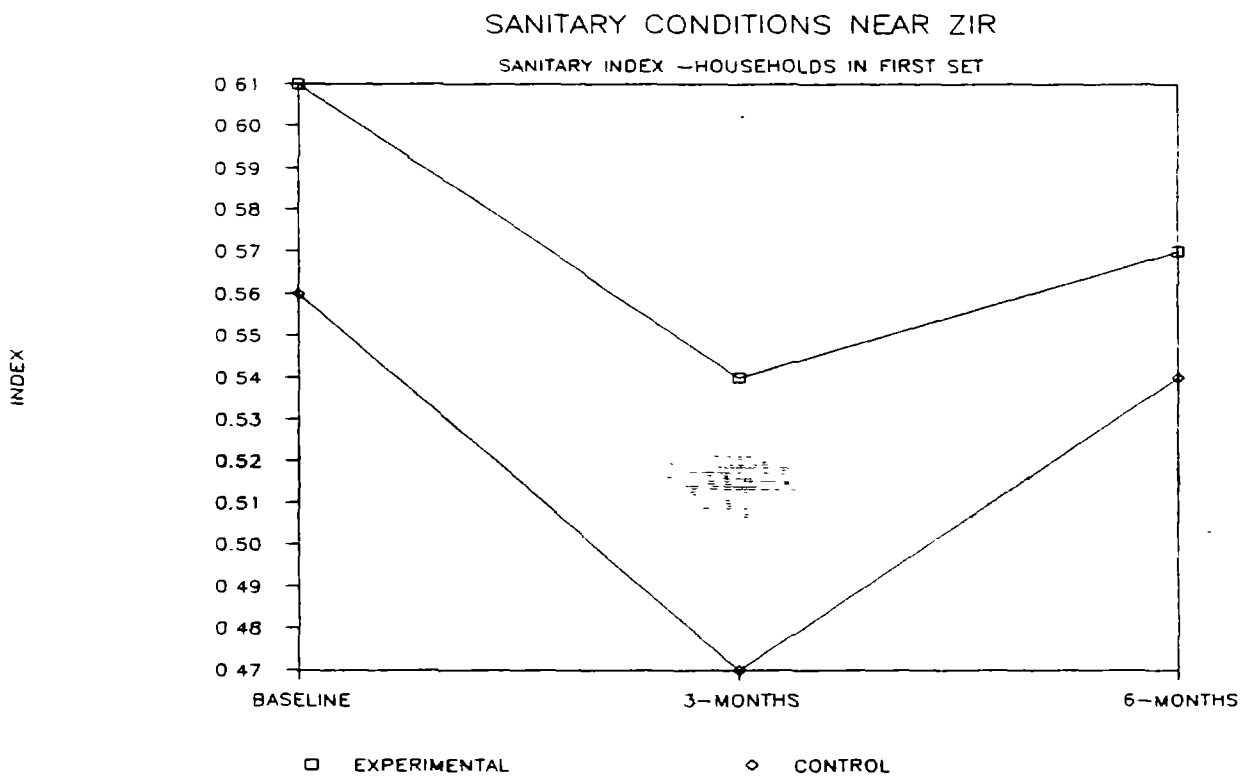


FIGURE 10

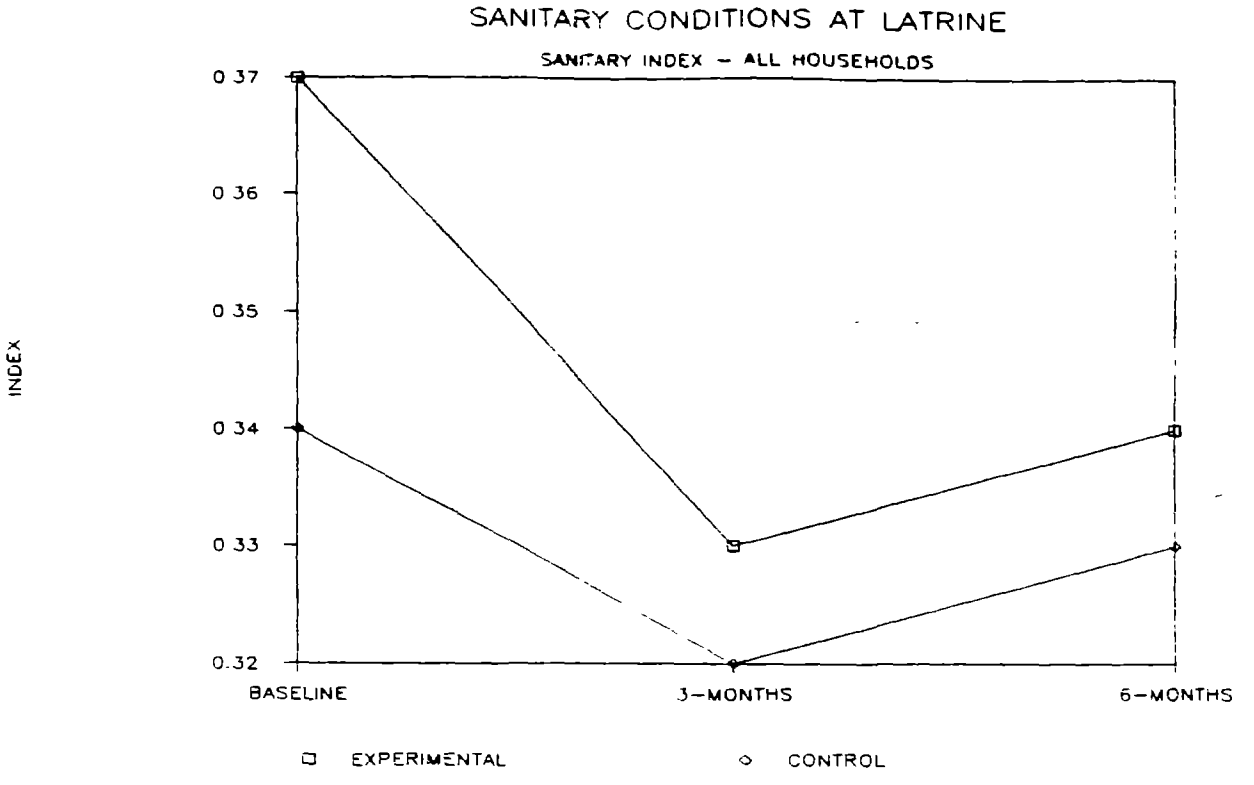


FIGURE 11

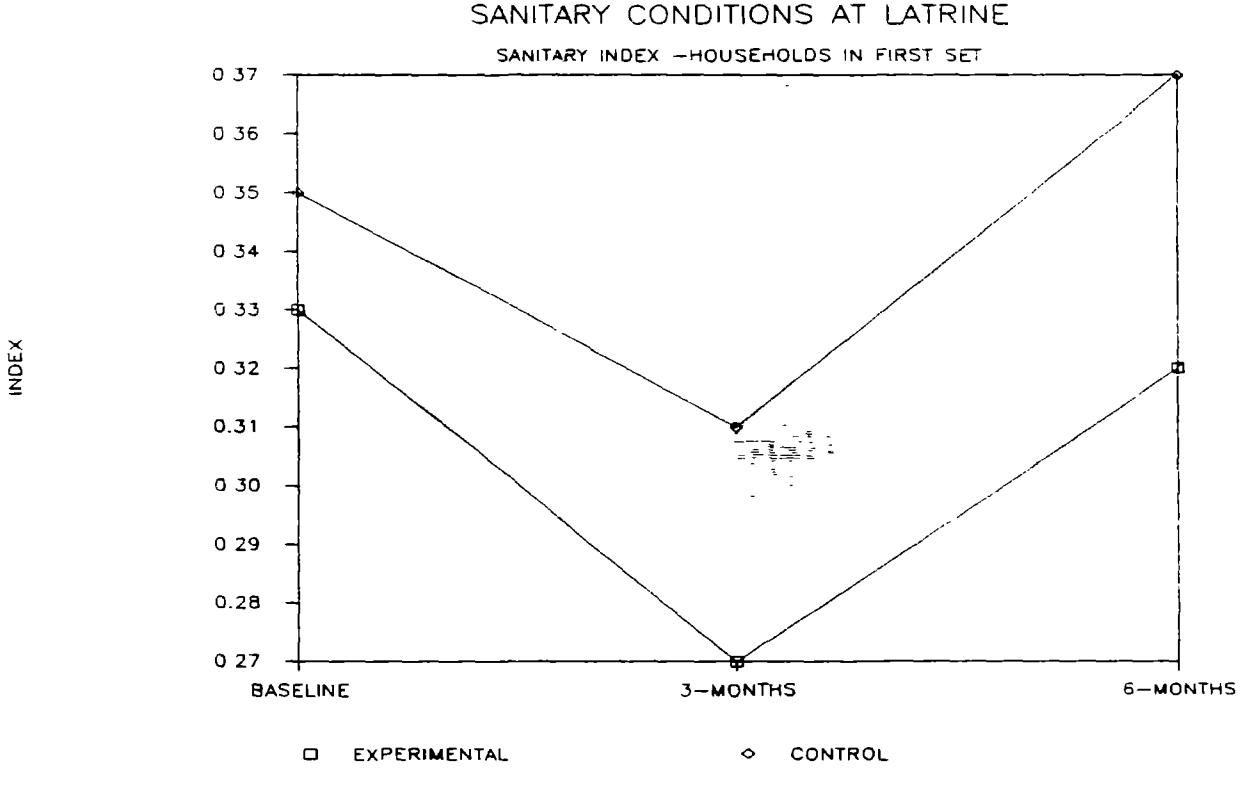


FIGURE 12

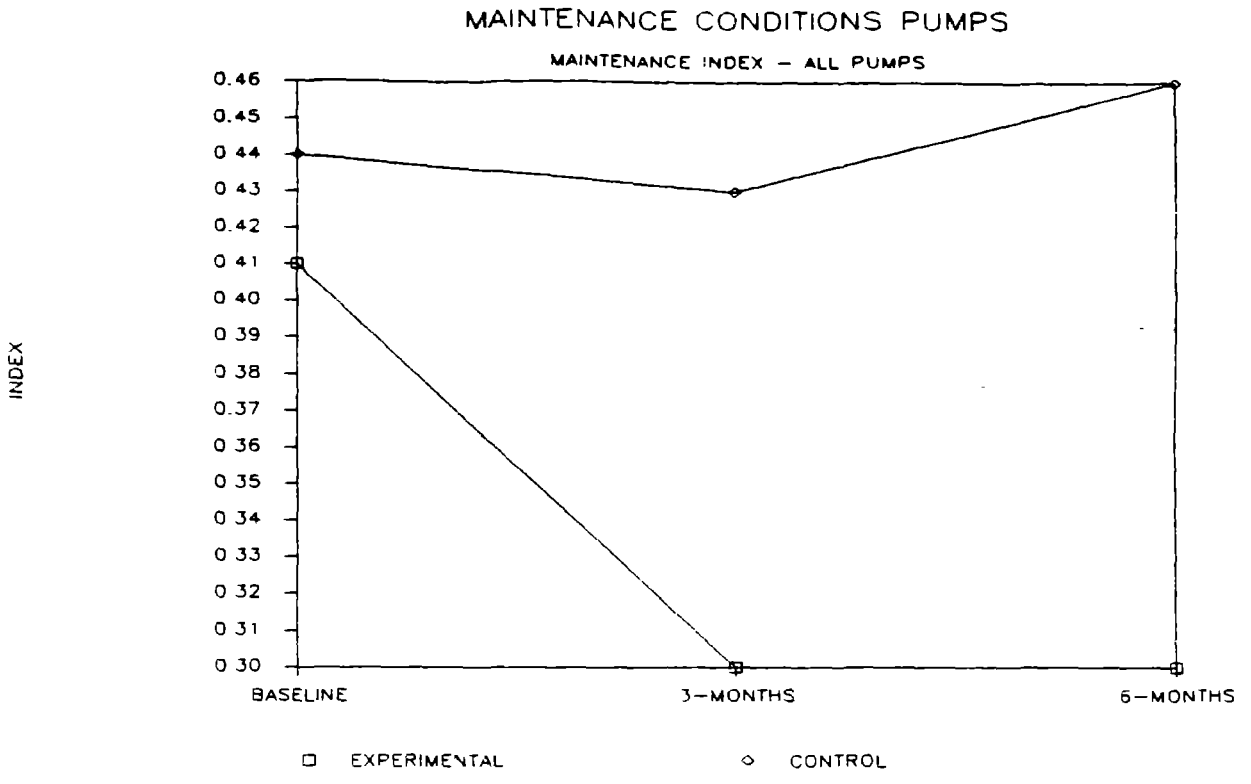


FIGURE 13

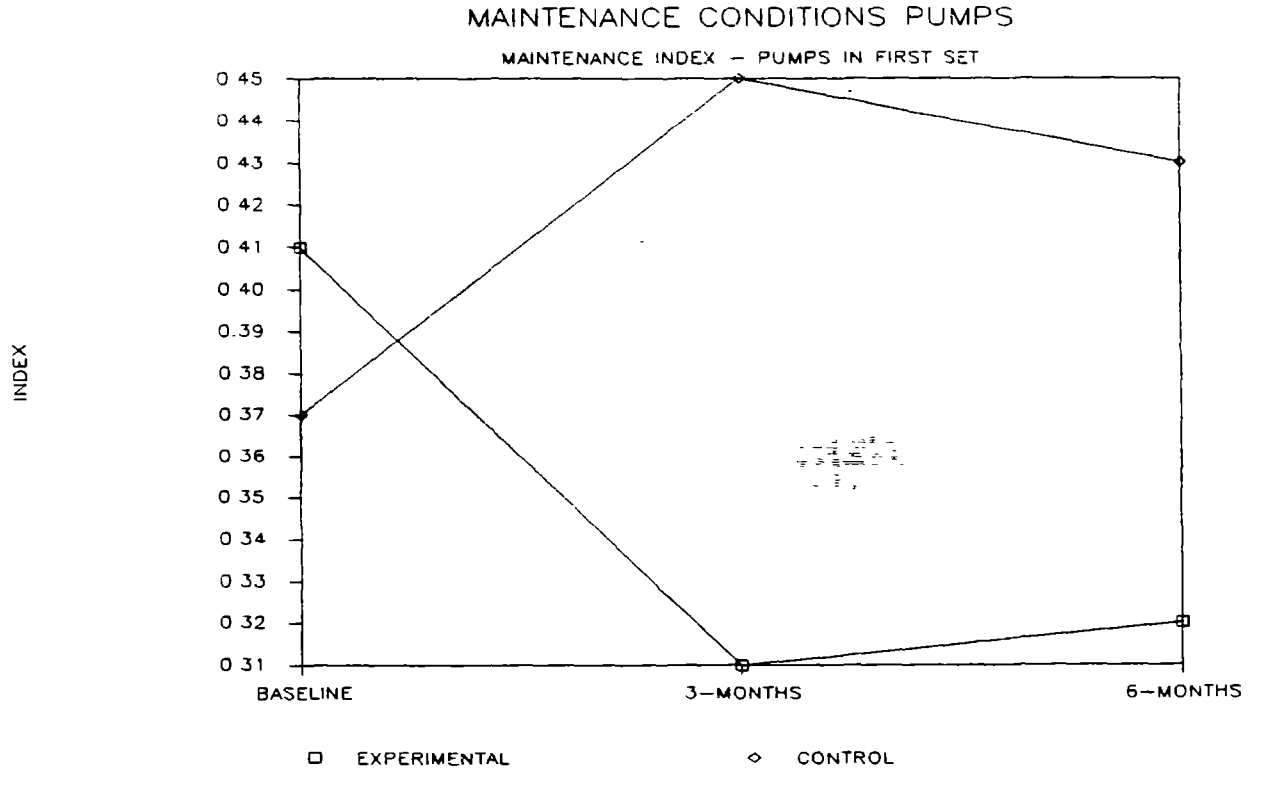


FIGURE 14

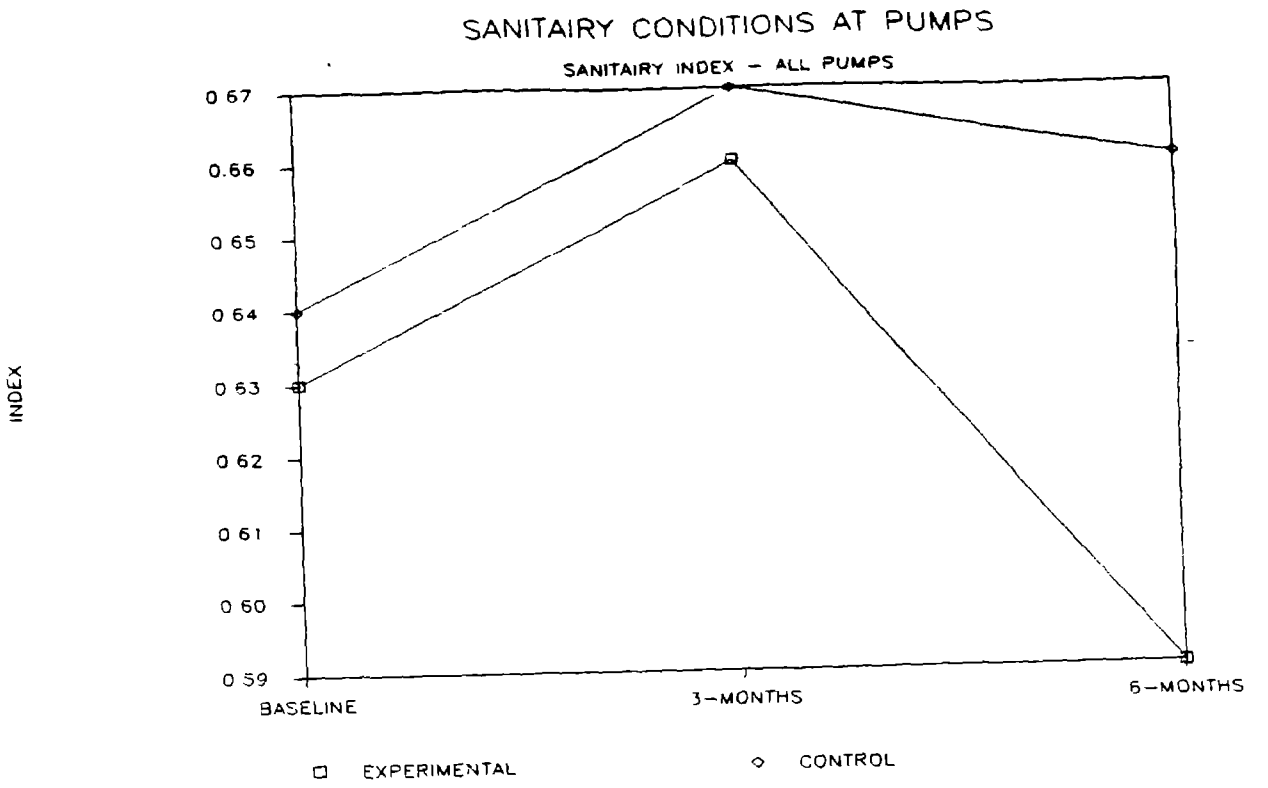


FIGURE 15

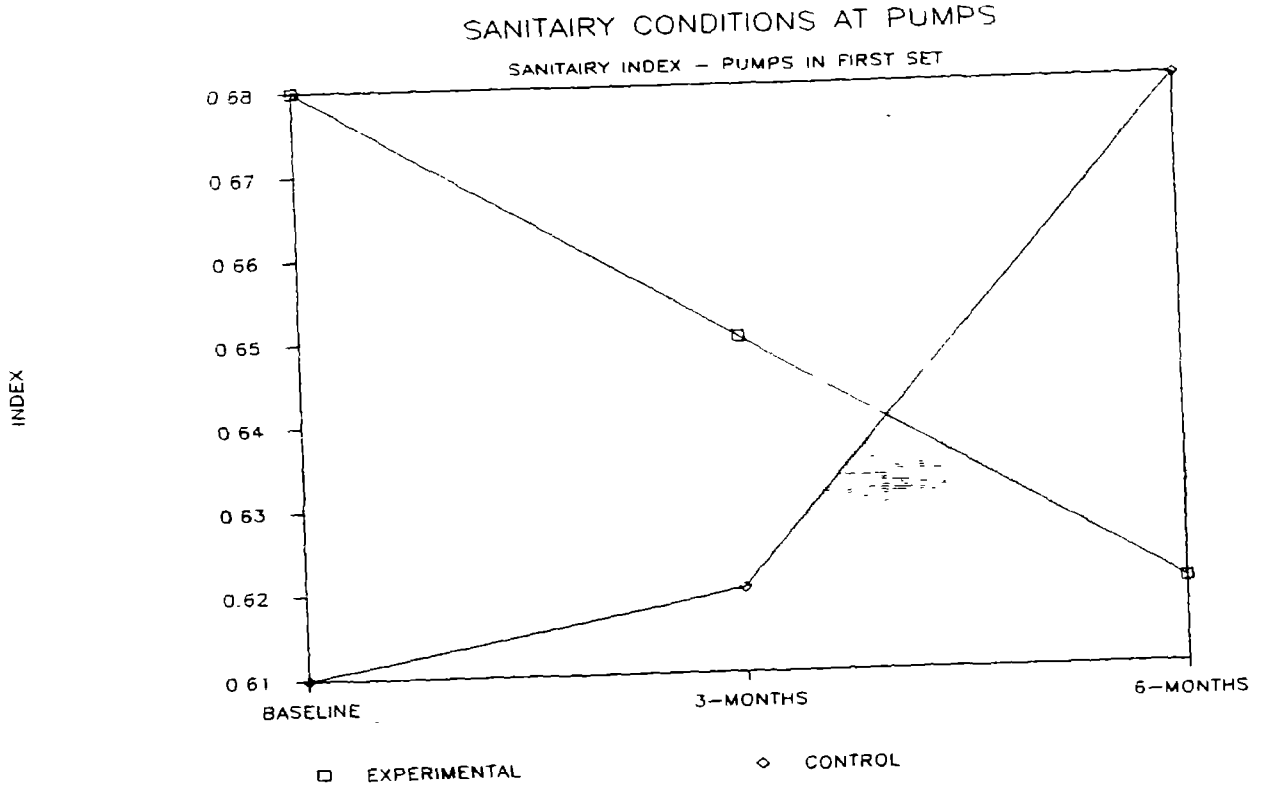


FIGURE 16

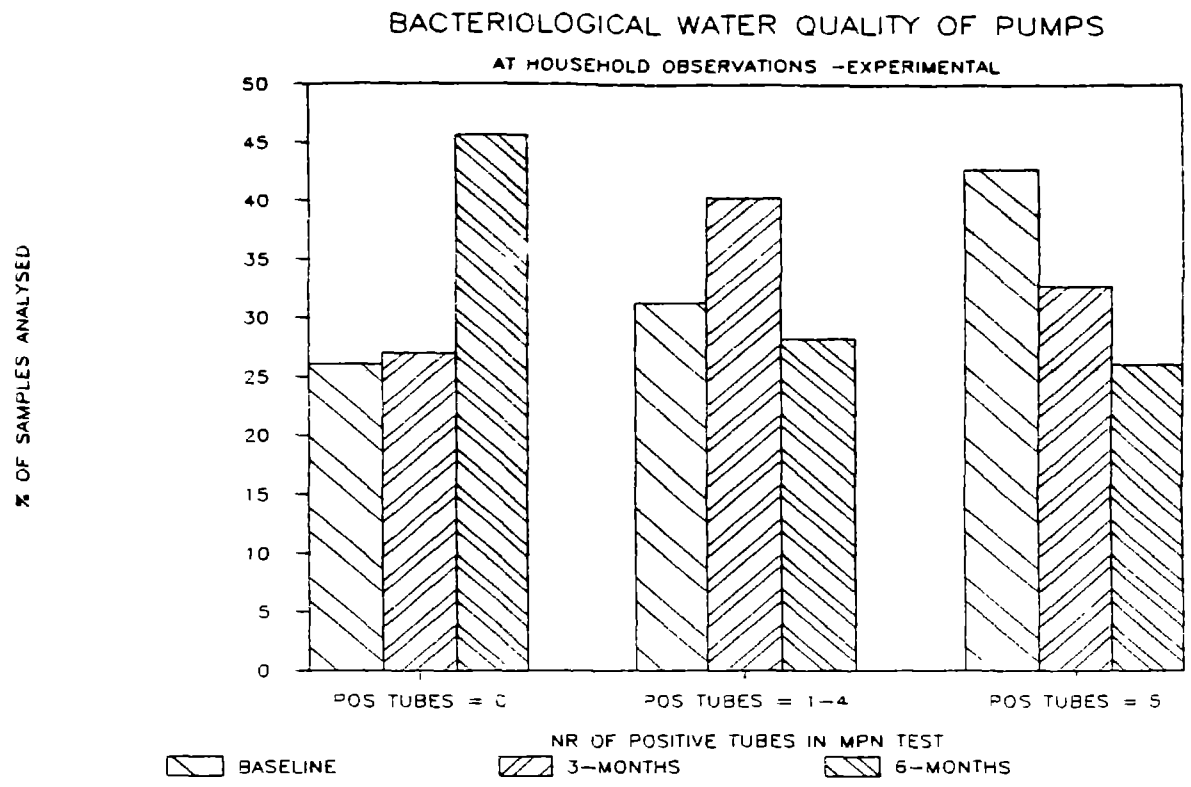


FIGURE 17

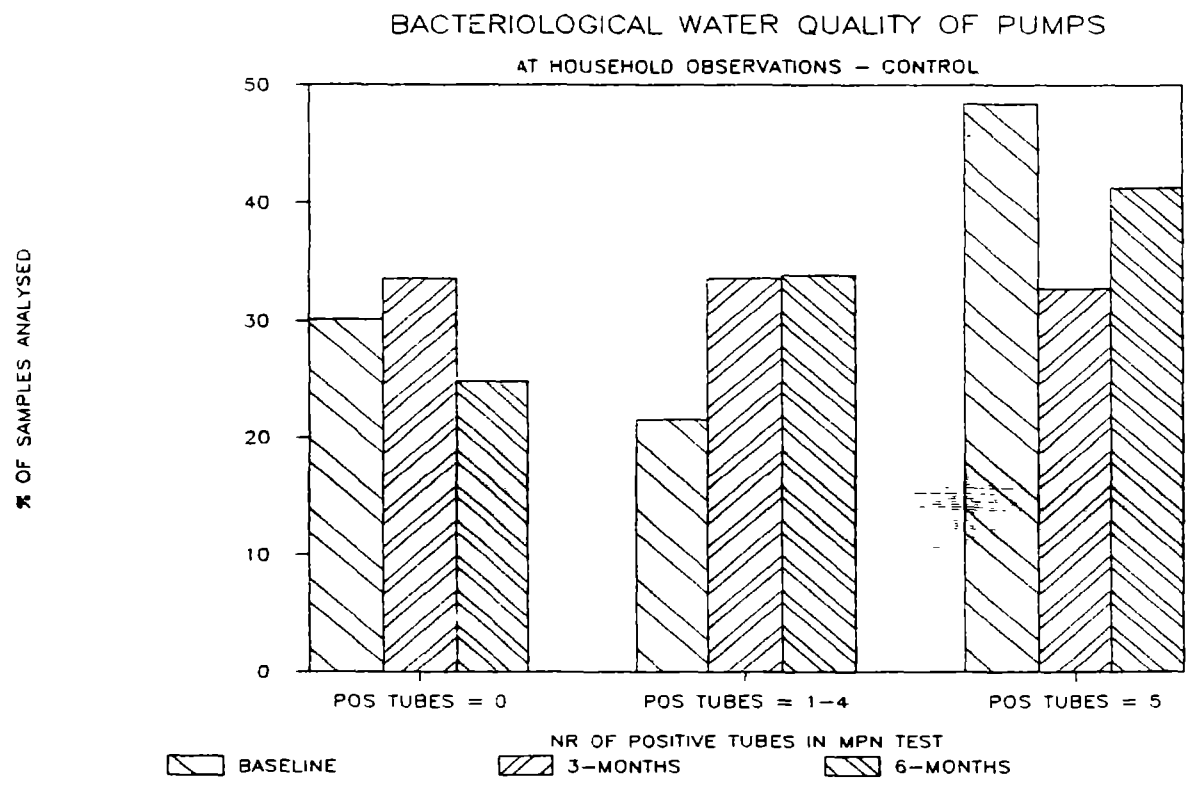
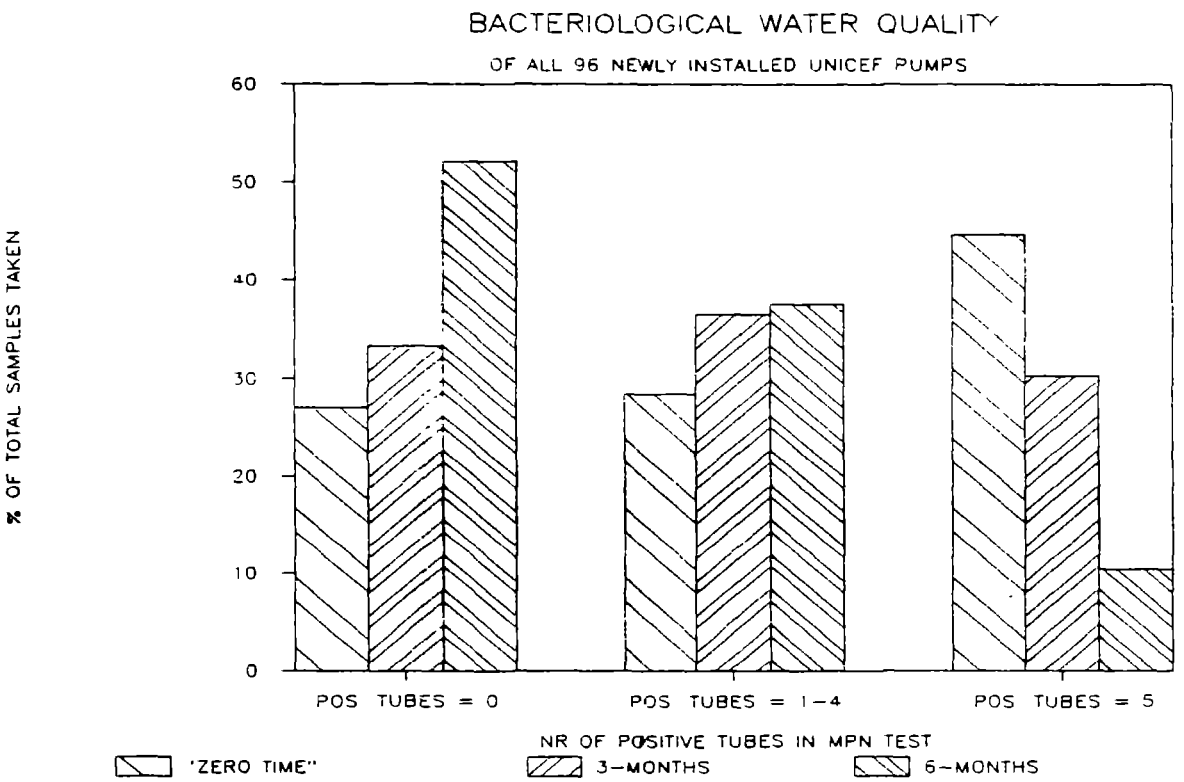


FIGURE 18


BACTERIOLOGICAL WATER QUALITY
OF ALL 96 NEWLY INSTALLED UNICEF PUMPS
% OF TOTAL SAMPLES TAKEN
60
50
40
30
20
10
0
POS TUBES = 0
POS TUBES = 1-4
POS TUBES = 5
NR OF POSITIVE TUBES IN MPN TEST
"ZERO TIME"
3-MONTHS
6-MONTHS

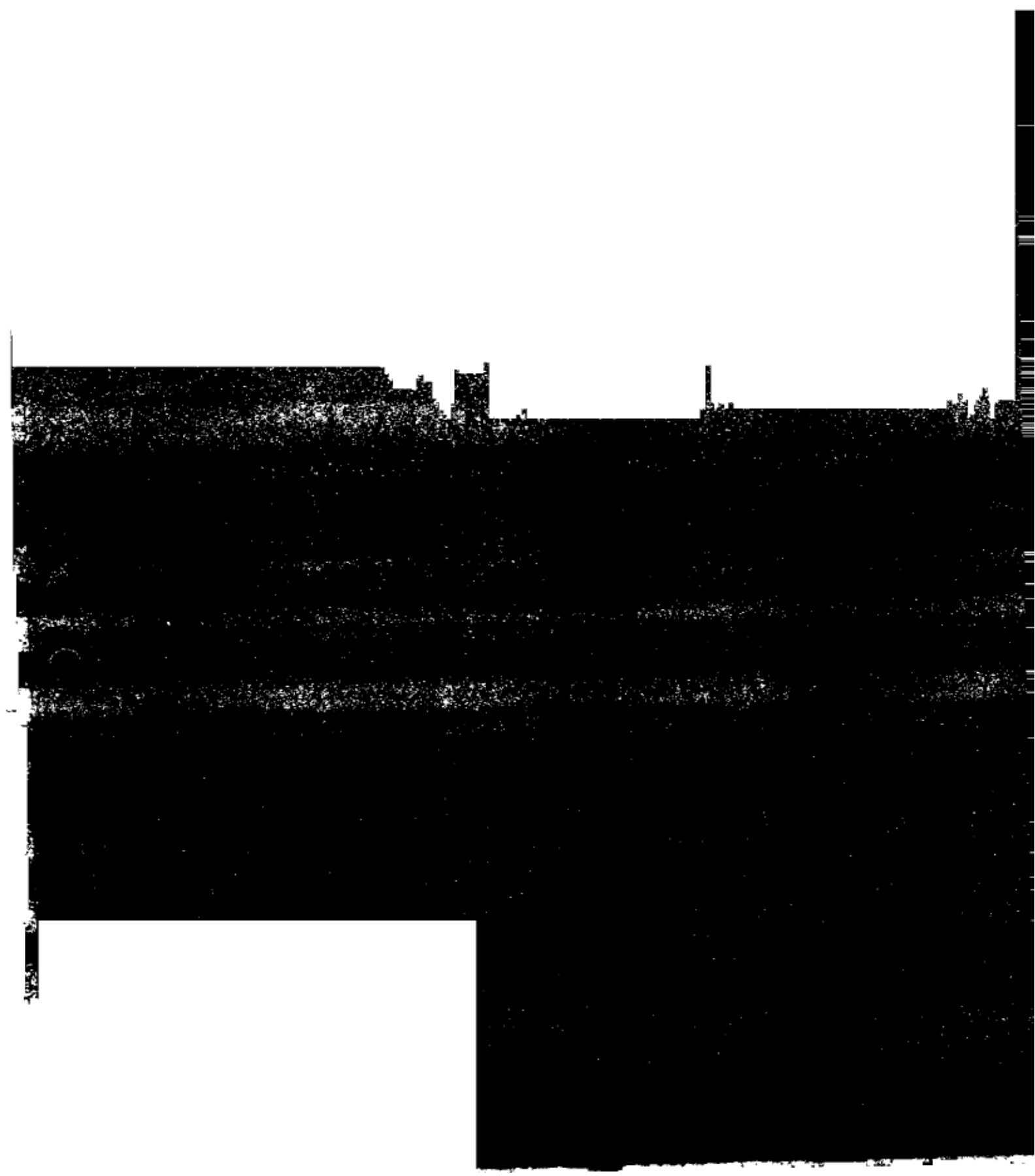


TABLE 4.1 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Cleanliness in living areas -

		BASELINE					3 - MONTHS					6 - MONTHS				
		INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
Q*	OBSERVATION	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
11	PLACE FOR COOKING IN HOUSE/COMPOUND	130	95.6	118	100.0		134	98.5	118	99.2		134	97.8	115	100.0	
		130	100.0	118	100.0		134	100.0	118	100.0		134	100.0	115	100.0	
12	PLACE SEPARATED BY FENCING	41	31.5	43	36.4		42	31.3	44	37.3		61	45.5	54	47.0	
13	ANIMALS VISIBLE AT THIS PLACE	64	49.2	63	53.4		42	31.3	43	36.4		36	26.9	39	33.9	
14	ANIMAL FEACES VISIBLE AT THIS PLACE	75	57.7	45	38.1	#	46	34.3	43	36.4		61	45.5	43	37.4	
15	GARBAGE VISIBLE AT THIS PLACE	111	85.4	77	65.3	#	114	85.1	80	67.8	#	121	90.3	90	78.3	#
16	PLACE FOR WASHING UTENSILS IN HOUSE	97	71.3	101	85.6	#	114	83.8	99	83.2		108	78.8	107	93.0	#
		97	100.0	101	100.0		114	100.0	99	100.0		108	100.0	107	100.0	
17	PLACE SEPARATED BY FENCING	3	3.1	7	6.9		8	7.0	12	12.1		9	8.3	10	9.3	
18	THIS PLACE AT THE PUMP	51	52.6	24	23.8	#	39	34.2	20	20.2	#	39	36.1	20	18.7	#
19	ANIMALS VISIBLE AT THIS PLACE	52	53.6	67	66.3		51	44.7	56	56.6		58	53.7	53	49.5	
20	ANIMAL FEACES VISIBLE AT THIS PLACE	58	59.8	63	62.4		50	43.9	53	53.5		61	56.5	62	57.9	
21	GARBAGE VISIBLE AT THIS PLACE	90	92.8	79	78.2	#	104	91.2	82	82.8		102	94.4	100	93.5	
22	PLACE FOR WASHING CLOTHES IN HOUSE	129	94.9	113	95.8		134	98.5	108	90.8	#	132	96.4	110	95.7	
		129	100.0	113	100.0		134	100.0	108	100.0		132	100.0	110	100.0	
23	PLACE SEPARATED BY FENCING	6	4.7	8	7.1		7	5.2	8	7.4		12	9.1	9	8.2	
24	THIS PLACE AT THE PUMP	5	3.9	17	15.0	#	9	6.7	13	12.0		9	6.8	13	11.8	
25	ANIMALS VISIBLE AT THIS PLACE	73	56.6	72	63.7		51	38.1	55	50.9		59	44.7	54	49.1	
26	ANIMAL FEACES VISIBLE AT THIS PLACE	78	60.5	58	51.3		55	41.0	58	53.7		75	56.8	62	56.4	
27	GARBAGE VISIBLE AT THIS PLACE	109	84.5	74	65.5	#	116	86.6	84	77.8		125	94.7	101	91.8	
28	PLACE FOR EATING INSIDE HOUSE	134	98.5	118	100.0		134	98.5	118	99.2		134	97.8	115	100.0	
		134	100.0	118	100.0		134	100.0	118	100.0		134	100.0	115	100.0	
29	PLACE SEPARATED BY FENCING	16	11.9	13	11.0		28	20.9	23	19.5		40	29.9	29	25.2	
30	ANIMALS VISIBLE AT THIS PLACE	68	50.7	67	56.8		41	30.6	44	37.3		32	23.9	38	33.0	
31	ANIMAL FEACES VISIBLE AT THIS PLACE	69	51.5	49	41.5		45	33.6	47	39.8		49	36.6	42	36.5	
32	GARBAGE VISIBLE AT THIS PLACE	100	74.6	69	58.5	#	95	70.9	71	60.2		102	76.1	87	75.7	
33	PLACE FOR BATHING INSIDE HOUSE	134	98.5	116	98.3		136	100.0	118	99.2		135	98.5	115	100.0	
		134	100.0	116	100.0		136	100.0	118	100.0		135	100.0	115	100.0	
34	PLACE SEPARATED BY FENCING	92	68.7	84	72.4		128	94.1	104	88.1		130	96.3	109	94.8	
35	PLACE INSIDE THE LATRINE	32	23.9	59	50.9	#	43	31.6	63	53.4	#	50	37.0	68	59.1	#
36	ANIMALS VISIBLE AT THIS PLACE	41	30.6	28	24.1		22	16.2	16	13.6		18	13.3	16	13.9	
37	ANIMAL FEACES VISIBLE AT THIS PLACE	48	35.8	39	33.6		34	25.0	23	19.5		36	26.7	34	29.6	
38	GARBAGE VISIBLE AT THIS PLACE	74	55.2	56	48.3		68	50.0	39	33.1	#	82	60.7	65	56.5	
39	PLACE FOR SLEEPING INSIDE HOUSE	136	100.0	117	99.2		136	100.0	118	99.2		136	99.3	115	100.0	
		136	100.0	117	100.0		136	100.0	118	100.0		136	100.0	115	100.0	
40	PLACE SEPARATED BY FENCING	127	93.4	94	80.3	#	127	93.4	99	83.9	#	130	95.6	95	82.6	#
41	ANIMALS VISIBLE AT THIS PLACE	31	22.8	36	30.8		18	13.2	15	12.7		10	7.4	19	16.5	#
42	ANIMAL FEACES VISIBLE AT THIS PLACE	37	27.2	33	28.2		21	15.4	18	15.3		27	19.9	21	18.3	
43	GARBAGE VISIBLE AT THIS PLACE	66	48.5	53	45.3		64	47.1	48	40.7		73	53.7	64	55.7	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.50$

TABLE 4.2. SANITARY INDEX SCORE FOR ALL HOUSEHOULDS IN THE FIRST SET AT BASELINE, 3 AND 6 MONTHS -Environmental conditions in living/working areas -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.53	0.49	0.43	0.42	0.46	0.48

TABLE 4.3. RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Provision for animals -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%	S#	3 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#	6 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
44 PLACE FOR ANIMALS INSIDE COMPOUND	131	96.3	106	89.8		134	98.5	114	95.8		135	98.5	111	96.5	
	131	100.0	106	100.0		134	100.0	114	100.0		135	100.0	111	100.0	
45 PLACE SEPARATED BY FENCING	115	87.8	99	93.4		98	73.1	89	78.1		104	77.0	93	83.8	
46 PLACE FOR ANIMALS INSIDE HOUSE	111	81.6	98	83.1		106	77.9	108	90.8	#	106	77.4	104	90.4	#
	111	100.0	98	100.0		106	100.0	108	100.0		106	100.0	104	100.0	
47 PLACE SEPARATED BY FENCING	98	88.3	92	93.9		97	91.5	93	86.1		97	91.5	90	86.5	#
48 DO ANIMALS HAVE ACCESS TO THE HOUSE	114	83.8	102	86.4		124	91.2	103	86.6		121	88.3	105	91.3	

Note: Chi-squared test for intervention vs. control comparison # $p < 0.05$

TABLE 4.4 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Provision for garbage -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%	S#	3 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#	6 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
49 CONTAINER FOR GARBAGE COLLECTION	6	4.4	40	33.9	#	31	22.8	27	22.7		82	59.9	70	60.9	
50 GARBAGE DUMPED AT SPECIAL PLACE	43	31.6	14	11.9	#	85	62.5	37	31.1	#	80	58.4	40	34.8	#
51 GARBAGE BURNED/BURRIED	34	25.0	13	11.0	#	102	75.0	48	40.3	#	104	75.9	80	69.6	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.5 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Provision for waste water -

Q* OBSERVATION	BASELINE INTERV. NR.	%	CONTROL NR.	%	S#	3 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#	6 - MONTHS INTERV. NR.	%	CONTROL NR.	%	S#
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
52 PLACE FOR WASTE WATER DISCHARGE	21	15.4	38	32.2	#	19	14.0	42	35.3	#	21	15.3	43	37.4	#
	21	100.0	38	100.0		19	100.0	42	100.0		21	100.0	43	100.0	
53 IS THIS PLACE THE LATRINE	10	47.6	29	76.3	#	9	47.4	34	81.0	#	10	47.6	26	60.5	
54 WATER PONDING AT PLACE FOR DISCHARGE	8	38.1	17	44.7		9	47.4	20	47.6		16	76.2	31	72.1	
55 WATER PONDING IN HOUSE/COMPOUND	57	41.9	52	44.1		112	82.4	90	75.6		127	92.7	110	95.7	

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.6 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Handpumps -

Q*	OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
56	NR. OF HOUSEHOLDS USING HANDPUMPS	136	100.0	118	100.0		136	100.0	118	99.2		137	100.0	115	100.0	
		136	100.0	118	100.0		136	100.0	118	100.0		137	100.0	115	100.0	
57	PUMP NEW (AFTER INTERVENTION)	0	0.0	0	0.0		69	50.7	0	0.0	#	79	57.7	0	0.0	#
58	PUMP INSIDE HOUSE/COMPOUND	76	55.9	36	30.5	#	52	38.2	37	31.4		57	41.6	39	33.9	
59	DISTANCE TO THE PUMP										#					
	* 0 - 25 M	82	60.3	70	59.3		71	52.2	82	69.5		82	59.9	75	65.2	
	* 25 - 50 M	47	34.6	41	34.7		48	35.3	25	21.2		41	29.9	25	21.7	
	* 50 - 100 M	7	5.1	78	66.1		17	12.5	7	5.9		13	9.5	10	8.7	
	* > 100 M		0.0	0	0.0		0	0.0	4	3.4		1	0.7	5	4.3	
87	HOUSEHOLDS USING SECOND PUMP $	0	0.0	0	0.0		65	47.8	16	13.4	#	48	35.0	16	13.9	#
							65	100.0	16	100.0		48	100.0	16	100.0	
88	PUMP NEW (AFTER INTERVENTION) $	0	0.0	0	0.0		31	47.7	0	0.0	#	26	54.2	0	0.0	#
89	PUMP INSIDE HOUSE/COMPOUND $	0	0.0	0	0.0		20	30.8	0	0.0	#	14	29.2	0	0.0	#
90	DISTANCE TO THE PUMP $										#					#
	* 0 - 25 M	0	0.0	0	0.0		21	32.3	5	31.3		22	45.8	4	25.0	
	* 25 - 50 M	0	0.0	0	0.0		22	33.8	7	43.8		14	29.2	7	43.8	
	* 50 - 100 M	0	0.0	0	0.0		18	27.7	3	18.8		9	18.8	4	25.0	
	* > 100 M	0	0.0	0	0.0		4	6.2	1	6.3		3	6.3	1	6.3	
91	HOUSEHOLDS USING THIRD PUMP $	0	0.0	0	0.0		2	1.5	0	0.0		1	0.7	1	0.9	
							2	100.0	0	100.0		1	100.0	1	100.0	
92	PUMP NEW (AFTER INTERVENTION) $	0	0.0	0	0.0		1	50.0	0	0.0		0	0.0	0	0.0	
93	PUMP INSIDE HOUSE/COMPOUND $	0	0.0	0	0.0		0	0.0	0	0.0		0	0.0	0	0.0	
94	DISTANCE TO THE PUMP $															
	* 0 - 25 M	0	0.0	0	0.0		1	50.0	0	0.0		0	0.0	0	0.0	
	* 25 - 50 M	0	0.0	0	0.0		0	0.0	0	0.0		1	100.0	0	0.0	
	* 50 - 100 M	0	0.0	0	0.0		1	50.0	0	0.0		0	0.0	1	100.0	
	* > 100 M	0	0.0	0	0.0		0	0.0	0	0.0		0	0.0	0	0.0	

($): Observations started at the end of baseline survey
Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.7 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Water storage -

Q* OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
60 WATER STORED IN ZIR/CONTAINER	122	89.7	106	89.8		118	86.8	97	81.5		104	75.9	85	73.9	
	122	100.0	106	100.0		118	100.0	97	100.0		104	100.0	85	100.0	
61 ZIR/CONTAINER COVERED	91	74.6	93	87.7	#	101	85.6	81	83.5		86	82.7	82	96.5	#
62 LONG HANDLED DIPPER VISIBLE	1	0.8	2	1.9		0	0.0	1	1.0		1	1.0	0	0.0	
63 CUP VISIBLE	51	41.8	54	50.9		67	56.8	54	55.7		56	53.8	55	64.7	
64 CUP/DIPPER ON THE FLOOR	12	9.8	22	20.8	#	9	7.6	11	11.3		5	4.8	5	5.9	
65 CUP/DIPPER INSIDE CONTAINER ZIR	0	0.0	1	0.9		0	0.0	0	0.0		0	0.0	0	0.0	
66 CUP/DIPPER ON TOP OF ZIR/CONTAINER	19	15.6	39	36.8	#	39	33.1	33	34.0		33	31.7	29	34.1	
67 ANIMALS HAVE ACCESS TO CUP/DIPPER	10	8.2	24	22.6	#	10	8.5	20	20.6	#	5	4.8	9	10.6	
68 ANIMALS VISIBLE NEAR CONTAINER/ZIR	66	54.1	68	64.2		29	24.6	36	37.1		20	19.2	17	20.0	
69 FAECES VISIBLE NEAR CONTAINER/ZIR	67	54.9	55	51.9		43	36.4	37	38.1		45	43.3	32	37.6	
70 GARBAGE VISIBLE NEAR CONTAINER/ZIR	80	65.6	68	64.2		91	77.1	57	58.8	#	79	76.0	61	71.8	
71 MUD/WATER PONDING NEAR ZIR	88	72.1	48	45.3	#	92	78.0	55	56.7	#	97	93.3	76	89.4	

(*) : The percentages for question 67 are calculated in relation to the total number of times a cup was visible.
Note: Chi-squared test for intervention vs. control comparison. # $p < 0.05$

TABLE 4.8 SANITARY INDEX SCORE FOR ALL ZIRS AT BASELINE, 3 AND 6 MONTHS - Environmental conditions around the zir -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.61	0.56	0.54	0.47	0.57	0.54

TABLE 4.9 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Provision for handwashing -

Q* OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
	INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%		INTERV. NR.	%	CONTROL NR.	%	
TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
72 STORAGE/BASIN FOR HANDWASHING	17	12.5	36	30.5	#	29	21.3	26	21.8		50	36.5	33	28.7	
	17	100.0	36	100.0		29	100.0	26	100.0		50	100.0	33	100.0	
73 WATER IN BASIN FOR HANDWASHING	5	29.4	5	13.9		7	24.1	8	30.8		18	36.0	14	42.4	
	5	100.0	5	100.0		7	100.0	8	100.0		18	100.0	14	100.0	
74 WATER IN BASIN IS FRESH	4	80.0	4	80.0		4	57.1	3	37.5		2	11.1	8	57.1	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.10 RESULTS ENVIRONMENTAL CONDITIONS IN HOUSE OBSERVATIONS FOR ALL HOUSEHOLDS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS - Latrine -

Q*	OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
		INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
		NR.	%	NR.	%	S#	NR.	%	NR.	%	S#	NR.	%	NR.	%	S#
	TOTAL HOUSEHOLDS SURVEYED	136		118		S#	136		119		S#	137		115		S#
75	LATRINE INSIDE HOUSE/COMPOUND	68	50.0	79	66.9	#	122	89.7	88	73.9	#	121	88.3	84	73.0	#
		68	100.0	79	100.0		122	100.0	88	100.0		121	100.0	84	100.0	
76	LATRINE INSIDE WALLS OF THE HOUSE	66	97.1	79	100.0		108	88.5	87	98.9	#	105	86.8	83	98.8	#
77	LATRINE HAS WALLS AND DOOR	48	70.6	57	72.2		54	44.3	62	70.5	#	50	41.3	62	73.8	#
78	DAYLIGHT CAN ENTER THE LATRINE	49	72.1	61	77.2		102	83.6	61	69.3	#	94	77.7	61	72.6	
79	PIT IS COVERED WITH SLAB	60	88.2	68	86.1		118	96.7	83	94.3		119	98.3	81	96.4	
80	FAECES VISIBLE ON SLAB	8	11.8	16	20.3		23	18.9	17	19.3		19	15.7	15	17.9	
81	HOLE CLOSED BY COVER	16	23.5	17	21.5		39	32.0	20	22.7		43	35.5	17	20.2	#
82	WATER AVAILABLE IN LATRINE	24	35.3	22	27.8		15	12.3	24	27.3	#	19	15.7	22	26.2	
83	MUD/WATER PONDING IN LATRINE	36	52.9	39	49.4		51	41.8	40	45.5		78	64.5	58	69.0	
84	WALK THROUGH FAECES/DIRT TO LATRINE	13	19.1	21	26.6		17	13.9	10	11.4		30	24.8	21	25.0	
85	COLLECTING PIT INSIDE WALLS OF HOUSE	55	80.9	77	97.5	#	101	82.8	87	98.9	#	91	75.2	82	97.6	#
86	DEPTH OF THE PIT										#					#
	* 1 - 2 M	0	0.0	0	0.0		9	7.4	0	0.0		46	38.0	0	0.0	
	* 2 - 3 M	4	5.9	3	3.8		41	33.6	2	2.3		7	5.8	7	8.3	
	* 3 - 4 M	12	17.6	5	6.3		9	7.4	13	14.8		10	8.3	12	14.3	
	* 4 - 5 M	14	20.6	29	36.7		12	9.8	22	25.0		13	10.7	14	16.7	
	* > 5 M	24	35.3	28	35.4		34	27.9	34	38.6		34	28.1	32	38.1	
	* NOT KNOWN	14	20.6	14	17.7		17	13.9	17	19.3		11	9.1	19	22.6	

TABLE 4.11 SANITARY INDEX SCORE FOR ALL LATRINES AT BASELINE, 3 AND 6 MONTHS - Sanitary conditions in the latrine -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.33	0.35	0.27	0.31	0.32	0.37

TABLE 4.12 RESULTS PUMP SURVEY - ALL PUMPS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS
- Presence, location and type of pump -

Q* OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL HOUSEHOLDS SURVEYED $	136		118			136		119			137		115		
TOTAL PUMPS SURVEYED	84	100.0	51	100.0		96	100.0	55	100.0		97	100.0	55	100.0	
Pump density (pumps/household)	0.61		0.43		S#	0.71		0.46		S#	0.71		0.48		S#
11 PUMP INSIDE HOUSE/COMPOUND	77	91.7	39	76.5	#	75	78.1	40	72.7		67	69.1	38	69.1	
12 NEW PUMP (AFTER INTERVENTION)	0	0.0	0	0.0		21	21.9	0	0.0	#	21	21.6	0	0.0	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.13 RESULTS PUMP SURVEY - ALL PUMPS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS
- Operation and maintenance of pump -

Q* OBSERVATION	BASELINE					3 - MONTHS					6 - MONTHS				
	INTERV.		CONTROL			INTERV.		CONTROL			INTERV.		CONTROL		
	NR.	%	NR.	%		NR.	%	NR.	%		NR.	%	NR.	%	
TOTAL PUMPS SURVEYED	84	100.0	51	100.0		96	100.0	55	100.0		97	100.0	55	100.0	
13 PUMP GIVES WATER	82	97.6	51	100.0		86	89.6	52	94.5		86	88.7	51	92.7	
	82	100.0	51	100.0		86	100.0	52	100.0		86	100.0	51	100.0	
14 PUMP LEAKS WHILE PUMPING	6	7.3	5	9.8		9	10.5	8	15.4		3	3.5	3	5.9	
15 SPOUT BROKEN	2	2.4	1	2.0		0	0.0	0	0.0		1	1.0	0	0.0	
16 PUMP LOOSE AT BASE	9	10.7	13	25.5	#	11	11.5	25	45.5	#	9	9.3	20	36.4	#
17 PUMP HANDLE LOOSE	70	83.3	25	49.0	#	48	50.0	35	63.6		61	62.9	39	70.9	
18 CEMENT/CONCRETE FLOOR PRESENT	1	1.2	1	2.0		22	22.9	2	3.6	#	22	22.7	1	1.8	#
	1	100.0	1	100.0		22	100.0	2	100.0		22	100.0	1	100.0	
19 CRACKS IN CONCRETE FLOOR	1	100.0	1	100.0		3	13.6	0	0.0	#	1	4.5	0	0.0	#

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.14 MAINTENANCE INDEX SCORE FOR ALL PUMPS AT BASELINE, 3 AND 6 MONTHS
- Maintenance conditions of the pump -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
MAINTENANCE INDEX SCORE (0-1)	0.41	0.37	0.31	0.45	0.32	0.43

TABLE 4.15 RESULTS HANDPUMP SURVEY FOR ALL PUMPS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS

- Environmental conditions at pump-site -

Q* OBSERVATION	BASELINE				3 - MONTHS				6 - MONTHS			
	INTERV.		CONTROL		INTERV.		CONTROL		INTERV.		CONTROL	
	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%	NR.	%
TOTAL PUMPS SURVEYED	84	100.0	51	100.0	96	100.0	55	100.0	97	100.0	55	100.0
20 PROVISION FOR DRAINAGE AVAILABLE	46	54.8	15	29.4 #	66	68.8	24	43.6 #	73	75.3	24	43.6
	46	100.0	15	100.0	66	100.0	24	100.0	73	100.0	24	100.0
21 Provision for drainage functions	27	58.7	4	26.7	52	78.8	20	83.3	47	64.4	8	33.3 #
22 WATER PONDING AROUND PUMP	68	81.0	42	82.4	78	81.3	49	89.1	76	78.4	48	87.3
23 GARBAGE AROUND PUMP	70	83.3	35	68.6	86	89.6	45	81.8	74	76.3	45	81.8
24 ANIMALS AROUND PUMP	34	40.5	15	29.4	42	43.8	19	34.5	36	37.1	20	36.4
25 ANIMAL FAECES AROUND PUMP	54	64.3	19	37.3 #	43	44.8	17	30.9	42	43.3	18	32.7
26 LATRINE NEAR PUMP	12	14.3	20	39.2 #	61	63.5	35	63.6	51	52.6	25	45.5

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.16 SANITARY INDEX SCORE FOR ALL PUMPS IN FIRST SET AT BASELINE, 3 AND 6 MONTHS
- Environmental conditions at the pump-site -

	BASELINE SURVEY		3 - MONTHS SURVEY		6 - MONTHS SURVEY	
	INTERV.	CONTROL	INTERV.	CONTROL	INTERV.	CONTROL
SANITARY INDEX SCORE (0-1)	0.68	0.61	0.65	0.62	0.62	0.68

TABLE 4.17 RESULTS OF HAND PUMP SURVEY FOR NEW UNICEF PUMPS IN FIRST SET ONLY AT 3 AND 6 MONTHS - Location, operation and maintenance of new pump -

Q* OBSERVATION	3-MONTHS		6-MONTHS	
	NR.	%	NR.	%
TOTAL PUMPS SURVEYED	21		21	
11 PUMP INSIDE HOUSE/COMPOUND	9	42.9	9	42.9
13 PUMP GIVES WATER	21	100.0	21	100.0
	21	100.0	21	100.0
14 Pump leaks while pumping	0	0.0	1	4.8
15 SPOUT BROKEN	0	0.0	0	0.0
16 PUMP LOOSE AT BASE	0	0.0	0	0.0
17 PUMP HANDLE LOOSE	0	0.0	0	0.0
18 CEMENT/CONCRETE FLOOR PRESENT	21	100.0	21	100.0
	21	100.0	21	100.0
19 Cracks in concrete floor	2	9.5	1	4.8

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.18 RESULTS OF HAND PUMP SURVEY FOR NEW UNICEF PUMPS ONLY
AT 3 AND 6 MONTHS SURVEY - Environmental conditions at pump site -

Q*	OBSERVATION	3-MONTHS NR.	3-MONTHS %	6-MONTHS NR.	6-MONTHS %
	TOTAL PUMPS SURVEYED	21		21	
20	PROVISION FOR DRAINAGE AVAILABLE	21	100.0	21	100.0
		21	100.0	21	100.0
21	Provision for drainage functions	17	81.0	21	100.0
22	WATER PONDING AROUND PUMP	17	81.0	14	66.7
23	GARBAGE AROUND PUMP	18	85.7	13	61.9
24	ANIMALS AROUND PUMP	9	42.9	1	4.8
25	ANIMAL FAECES AROUND PUMP	8	38.1	3	14.3
26	LATRINE NEAR PUMP	11	52.4	8	38.1

Note: Chi-squared test for intervention vs. control comparison, # $p < 0.05$

TABLE 4.19 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEYS - General data on pumps used -

q* OBSERVATION	BASELINE		3 - MONTHS		6 - MONTHS	
	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %
TOTAL HOUSEHOLDS SURVEYED	20	20	20	20	20	20
11 NR OF NEW PUMPS USED	0 0.0	0 0.0	14 48.3	0 0.0	17 56.7	0 0.0
12 NR. OF OBSERVATION FORMS COMPLETED	20 100.0	20 100.0	29 100.0	20 100.0	30 100.0	20 100.0
Nr of households not using pumps	0	0	0	0	0	0
13 Observed pump inside house/compound	5 25.0	6 30.0	8 27.6	11 55.0	7 23.3	11 55.0
14 Pump distance from house						
* 0 - 25 M	19 95.0	16 80.0	21 72.4	19 95.0	20 66.7	18 90.0
* 25 - 50 M	1 5.0	3 15.0	8 27.6	1 5.0	5 16.7	1 5.0
* 50 - 100 M	0 0.0	1 5.0	0 0.0	0 0.0	4 13.3	1 5.0
* > 100 M	0 0.0	0 0.0	0 0.0	0 0.0	1 3.3	0 0.0
15 HOUSEHOLDS USING 2nd TRADITIONAL PUMP	0	0	2	0	2	4
16 Second pump inside house/compound	0	0	0	0	0	0
17 Pump distance from house						
* 0 - 25 M	0	0	1	0	0	0
* 25 - 50 M	0	0	0	0	0	2
* 50 - 100 M	0	0	1	0	2	1
* > 100 M	0	0	0	0	0	1
18 HOUSEHOLDS USING 3rd TRADITIONAL PUMP	0	0	0	0	0	1
19 Third pump inside house/compound	0	0	0	0	0	0
20 Pump distance from house						
* 0 - 25 M	0	0	0	0	0	0
* 25 - 50 M	0	0	0	0	0	0
* 50 - 100 M	0	0	0	0	0	1
* > 100 M	0	0	0	0	0	0

TABLE 4.20 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEYS - General data on pumps used -

q* OBSERVATION	BASELINE		3 - MONTHS		6 - MONTHS	
	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %
TOTAL HOUSEHOLDS SURVEYED	20	20	20	20	20	20
TOTAL NR OF OBSERVATIONS	20	20	29	20	30	20
Nr of times no collection/activities during observation period	0	1	1	0	2	0
21 TOTAL NR OF COLLECT. PER OBSERV.						
Range	9 - 37	0 - 24	0 - 34	3 - 24	0 - 34	1 - 25
Median	12.5	11.0	9.0	8.0	5.5	8.0
Mean	14.7	11.4	11.7	9.6	9.2	9.1
St.Dev.	6.9	5.7	8.5	5.8	8.7	5.8
22 TOT. VOLUME COLLECTED PER OBSERVATION						
Range	50 - 368	0 - 356	0 - 590	35 - 360	0 - 421	20 - 420
Median	134	131	137	115	76	127
Mean	155	145	177	151	128	142
St.Dev.	73	93	157	102	122	91
VOLUME PER CAPITA PER DAY (*)	15.6	14.1	17.9	14.7	12.9	13.8

(*) Calculated using average (sentinel) household size, based on census data

TABLE 4.21 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEYS - Other water use, totals -

Q* OBSERVATION	BASELINE		3 - MONTHS		6 - MONTHS	
	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %	INTERV. NR. %	CONTROL NR. %
TOTAL HOUSEHOLDS SURVEYED	20	20	20	20	20	20
TOTAL NR OF OBSERVATIONS	20	20	29	20	30	20
25 NR OF TIMES HAND WASHING						
Range	0 - 12	0 - 20	0 - 10	0 - 6	0 - 6	0 - 5
Median	3.5	5.0	0.0	2.0	1.0	0.0
Mean	4.2	6.9	1.5	1.7	1.3	1.3
St.Dev.	3.5	5.6	2.5	1.8	1.8	1.8
26 NR OF TIMES CHILD BATHING						
Range	0 - 1	0 - 10	0	0	0 - 1	0 - 2
Median	0.0	1.0	0	0	0.0	0.0
Mean	0.1	2.3	0.0	0.0	0.0	0.1
St.Dev.	0.2	2.8	0.0	0.0	0.2	0.4
27 NR OF TIMES WASHING KITCHEN UTENSILS						
Range	0 - 30	0 - 10	0 - 12	0 - 7	0 - 7	0 - 5
Median	6.5	5.0	1.0	2.0	1.0	1.0
Mean	7.6	5.8	2.5	2.6	1.7	1.7
St.Dev.	7.7	3.0	3.4	2.3	1.9	2.0
28 NR OF TIMES WASHING CLOTHES						
Range	0 - 4	0 - 8	0 - 2	0 - 2	0 - 1	0 - 1
Median	0.0	3.0	0.0	0.0	0.0	0.0
Mean	0.6	3.1	0.1	0.7	0.0	0.1
St.Dev.	1.1	2.8	0.4	1.1	0.2	0.2
29 NR OF TIMES WASHING FOOD/VEGETABLES						
Range	0 - 3	0 - 5	0 - 2	0 - 3	0 - 1	0 - 1
Median	0.0	0.0	0.0	0.0	0.0	0.0
Mean	0.6	1.4	0.1	0.7	0.0	0.1
St.Dev.	1.0	1.9	0.5	1.1	0.2	0.3
30 NR OF TIMES OTHER ACTIVITIES						
Range	0 - 10	0 - 10	0 - 6	0 - 2	0 - 5	0 - 3
Median	0.0	2.0	0.0	0.0	0.0	0.0
Mean	1.9	2.4	1.0	0.2	0.8	0.5
St.Dev.	2.7	3.0	1.8	0.5	1.4	0.8

TABLE 4.22 RESULTS WATER USE AT THE PUMP OBSERVATIONS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEYS - General data on pumps used -

Q*	OBSERVATION	BASELINE				3 - MONTHS				6 - MONTHS			
		INTERV. NR.	%	CONTROL NR.	%	INTERV. NR.	%	CONTROL NR.	%	INTERV. NR.	%	CONTROL NR.	%
	TOTAL HOUSEHOLDS SURVEYED	20		20		20		20		20		20	
	TOTAL HOUSEHOLDS SURVEYED	20		20		20		20		20		20	
	TOTAL NR OF COLLECTIONS OBSERVED	294	100.0	227	100.0	338	100.0	192	100.0	275		181	
WHO	PERSON COLLECTING IS FEMALE	284	96.6	214	94.3	325	96.2	191	99.5	274	99.6	175	96.7
WHO	AGE GROUP DISTRIBUTION												
	* < 10 YEARS	35	11.9	28	12.3	31	9.2	3	1.6	22	8.0	2	1.1
	* 10 - 20 YEARS	109	37.1	36	15.9	121	35.8	51	26.6	92	33.5	21	11.6
	* > 20 YEARS	150	51.0	163	71.8	186	55.0	138	71.9	161	58.5	158	87.3
HOW	CONTAINER TYPES USED												
	* TYPE 1 SMALL BUCKET	16	5.6	5	2.2	21	6.2	3	1.6	38	13.8	2	1.1
	* TYPE 2 BIG BUCKET	26	9.2	11	4.8	47	13.9	29	15.1	39	14.2	12	6.6
	* TYPE 3 BIG TASHT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	1.7
	* TYPE 4 SMALL TASHT	2	0.7	2	0.9	0	0.0	5	2.6	2	0.7	1	0.6
	* TYPE 5 BASTELLAH BIG	0	0.0	12	5.3	0	0.0	2	1.0	0	0.0	5	2.8
	* TYPE 6 BASTELLAH SMALL	84	29.6	20	8.8	15	4.4	34	17.7	42	15.3	30	16.6
	* TYPE 7 BASIN SMALL	47	16.5	83	36.6	42	12.4	27	14.1	37	13.5	3	1.7
	* TYPE 8 BASIN BIG	24	8.5	37	16.3	121	35.8	70	36.5	92	33.5	80	44.2
	* TYPE 9 BIG JERRYCAN	23	8.1	19	8.4	48	14.2	4	2.1	2	0.7	15	8.3
	* TYPE 10 SMALL JERRYCAN	4	1.4	3	1.3	8	2.4	0	0.0	5	1.8	1	0.6
	* TYPE 11 QULAH	11	3.9	8	3.5	2	0.6	0	0.0	1	0.4	0	0.0
	* OTHER TYPES	57	20.1	27	11.9	34	10.1	18	9.4	17	6.2	29	16.0
	CONTAINER WASHING	240	81.6	184	81.1	169	50.0	107	55.7	123	44.7	90	49.7
	CONTAINER CLOSED	13	4.4	1	0.4	3	0.9	5	2.6	0	0.0	0	0.0
HOW MUCH	VOLUME PER COLLECTION												
	Range	1 - 40		1 - 60		1 - 20		1 - 60		1 - 20		1 - 60	
	Median	10		10		20		20		10		20	
	Mean	10.5		12.8		15.2		15.8		13.9		15.7	
	St.Dev.	6.3		8.1		6.1		8.2		6.2		8.4	

TABLE 4.23 RESULTS WATER QUALITY ANALYSIS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEY. - General sampling information -

Q* OBSERVATION	BASELINE		3 - MONTHS		6 - MONTHS	
	INTERV. NR.	CONTROL NR.	INTERV. NR.	CONTROL NR.	INTERV. NR.	CONTROL NR.
TOTAL HOUSEHOLDS SURVEYED	20	20	20	20	20	20
- TOTAL NR OF FORMS ENTERED	20	20	38	20	32	25
- NR OF FORMS FOR PUMPS ONLY	0	0	18	0	12	5
- NR OF HOUSEHOLDS NOT USING A ZIR	0	0	3	3	4	5
- TOTAL NR OF ZIRS ANALYSED	20	20	17	17	16	15
- NR OF HOUSEHOLDS NOT USING PUMPS	0	0	0	0	0	0
- TOTAL NR OF PUMP SAMPLES	20	20	38	20	32	25
- NR OF SAMPLES FROM UNICEF PUMPS	0	0	20	0	16	0
- NR OF SAMPLES WITH STERILIZED SPOUT	0	0	8	0	0	0

TABLE 4.24 RESULTS WATER QUALITY ANALYSIS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE, 3 AND 6 MONTHS SURVEY. - Bacteriological water quality zir and pump -

Q* OBSERVATION	BASELINE				3 - MONTHS				6 - MONTHS			
	INTERV. NR.	%	CONTROL NR.	%	INTERV. NR.	%	CONTROL NR.	%	INTERV. NR.	%	CONTROL NR.	%
TOTAL NR OF ZIRS ANALYSED	20	100.0	20	100.0	17	100.0	17	100.0	16	100.0	15	100.0
RESULTS BACTERIOLOGICAL ANALYSIS ZIRS												
* nr of positive tubes = 0	1	5.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
* nr of positive tubes = 1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
* nr of positive tubes = 2	0	0.0	0	0.0	1	5.9	0	0.0	0	0.0	1	6.7
* nr of positive tubes = 3	0	0.0	1	5.0	0	0.0	1	5.9	1	6.3	0	0.0
* nr of positive tubes = 4	0	0.0	2	10.0	1	5.9	2	11.8	2	12.5	1	6.7
* nr of positive tubes = 5	19	95.0	17	85.0	15	88.2	14	82.4	13	81.3	13	86.7
- TOTAL % OF ZIR SAMPLES CONTAMINATED		95.0		100.0		100.0		100.0		100.0		100.0
TOTAL NR OF PUMPS ANALYZED (a)	20	100.0	20	100.0	30	100.0	20	100.0	32	100.0	25	100.0
RESULTS BACTERIOLOGICAL ANALYSIS PUMPS												
* nr of positive tubes = 0	5	25.0	6	30.0	8	26.7	9	45.0	14	43.8	11	44.0
* nr of positive tubes = 1	3	15.0	1	5.0	2	6.7	2	10.0	2	6.3	2	8.0
* nr of positive tubes = 2	0	0.0	3	15.0	2	6.7	2	10.0	2	6.3	4	16.0
* nr of positive tubes = 3	2	10.0	0	0.0	4	13.3	0	0.0	1	3.1	4	16.0
* nr of positive tubes = 4	2	10.0	0	0.0	3	10.0	1	5.0	3	9.4	1	4.0
* nr of positive tubes = 5	8	40.0	10	50.0	11	36.7	6	30.0	10	31.3	3	12.0
- TOTAL % OF PUMP SAMPLES CONTAMINATED (a)		75.0		70.0		73.3		55.0		56.3		56.0

(a): Samples from non-sterilized pumps only

TABLE 4.25 RESULTS WATER QUALITY ANALYSIS FOR ALL NEW UNICEF PUMPS IN FIRST SET AT "ZERO-TIME", 3 AND 6 MONTHS SURVEY
- Bacteriological analysis -

	"ZERO-TIME"		3-MONTHS		6-MONTHS	
	NR.	%	NR.	%	NR.	%
TOTAL NR OF UNICEF PUMPS INSTALLED	21		21		21	
TOTAL NR OF SAMPLES TAKEN	63		42		21	
NR. OF SAMPLES FROM STERIL. PUMPS	0		21		0	
RESULTS BACTERIOLOGICAL ANALYSIS(a)						
* nr. of positive tubes = 0	18	28.6	10	47.6	17	81.0
* nr. of positive tubes = 1	3	4.8	5	23.8	1	4.8
* nr. of positive tubes = 2	6	9.5	2	9.5	1	4.8
* nr. of positive tubes = 3	2	3.2	2	9.5	1	4.8
* nr. of positive tubes = 4	3	4.8	0	0.0	0	0.0
* nr. of positive tubes = 5	31	49.2	2	9.5	1	4.8
TOTAL % OF SAMPLES CONTAMINATED		71.4		52.4		19.0

(a): Samples from non-sterilized pumps only

TABLE 4.26 RESULTS WATER QUALITY ANALYSIS FOR SENTINEL HOUSEHOLDS IN THE FIRST SET DURING BASELINE FOR TRADITIONAL HANDPUMPS AND ZERO TIME FOR NEW UNICEF PUMPS - Chemical analysis -

Q* OBSERVATION	BASELINE		ZERO TIME	
	INTERV. NR.	CONTROL NR.	INTERV. NR.	CONTROL NR.
RESULTS CHEMICAL ANALYSIS				
TOTAL NR OF SAMPLES ANALYSED	20	20	21	
16 CHLORIDE (mg/l)				
Range	20 - 240	15 - 50		
Median	71	22.5		
Mean	92	25.8	141	
Std.Dev.	62.7	9.4		
17 IRON (mg/l)				
Range	0.1 - 0.4	0.1 -1.2		
Median	0.1	0.2		
Mean	0.2	0.3	0.8	
Std.Dev.	0.1	0.3		
18 HARDNESS (mg CaCO3/l)				
Range	184-680	230-490		
Median	335	376		
Mean	375	368	500	
Std.Dev.	124	71		
19 pH (-)				
Range	7.4-7.9	7.2-7.9		
Median	7.6	7.7		
Mean	7.6	7.7	8.0	
Std.Dev.	0.2	0.2		
20 MANGANESE (a) (mg/l)				
Range	0 - 1.2	0 - 1.7		
Median	0.5	0.5		
Mean	0.5	0.8	0.8	
Std.Dev.	0.3	0.6		

(a): analysed during 3 month survey