American Red Cross Post-Hurricane Mitch Community Reconstruction

Water and Sanitation Baseline Survey in Honduras, Nicaragua, El Salvador, and Guatemala

February 2000

U.S. Centers for Disease Control and Prevention (CDC)

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U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Environmental Health
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Executive Summary

In October and November of 1998, Hurricane Mitch hit Central America causing regional damage, killing an estimated 10,000 people and leaving approximately one-half million people homeless. Damage to the infrastructure left the population without water and sanitation and other services. The American Red Cross (ARC) provided relief and reconstruction assistance to Honduras, Nicaragua, El Salvador, and Guatemala in response to this natural disaster. In response to a need for improved water and sanitation, the ARC planned interventions in over 100 affected communities. Planned interventions included improvements to water quality and accessibility, accessibility to sanitation facilities, and health education. The ARC requested assistance of the Centers for Disease Control and Prevention (CDC) to complete a baseline survey of the water and sanitation resources in select study areas post-Hurricane Mitch and prior to the implementation of the ARC community interventions. Follow-up studies are planned in these communities to assess the effectiveness and sustainability of the interventions.

This report provides results from the water and sanitation baseline survey conducted in February 2000. Guidelines developed by the United States Agency for International Development (USAID) were primarily used to quantify the status of water, sanitation, and hygiene behavior, primarily handwashing. Water samples were analyzed for microbial indicators of fecal contamination to provide a quantitative baseline for water quality. The Sphere Project standards are also used since this work was done post-Hurricane Mitch. Two study areas were selected in each of the four countries. Programming issues in Study Area 2 in Guatemala (Santa Rosa) resulted in a delay in performance of the baseline survey; therefore, the analyses for this area will be submitted as an addendum in a separate report.

The availability of water was analyzed using existing guidelines for non-emergent and emergent situations set by USAID and the Sphere Project (Billig et al., 1999; Sphere 1998). At the time of the baseline survey, all of the communities fell below the non-emergency water availability guideline of 50 liters (L) per person per day set by USAID (Billig et al., 1999). All communities were able to meet the Sphere Project standard of 15 L per person per day, except for Waspam, Nicaragua. Planned interventions include well installation in certain study areas, and providing access to running water and water system repairs in other areas.

USAID guidelines require that 75% of the population have access to and use of hygienic sanitation facilities. All communities in the baseline survey were below the 75% threshold. Planned ARC interventions included household latrines for all study areas but Waspam, Nicaragua, where the ARC plans to provide school-based (public) latrines.

Hand washing indicators demonstrated that, at the time of the baseline survey, 35% or fewer of the primary childcare providers and food preparers in all study areas had adequate hand washing knowledge or appropriate handwashing behaviors. Proper handwashing disrupts fecal-oral transmission of disease-causing microorganisms and is strongly associated with decreased diarrhea rates. Handwashing knowledge and behavior can be increased with community health education programs. Interventions planned by the ARC include not only education, but also to increase in the availability of handwashing facilities.

Water quality analyses showed that in every country, both household and community source waters were contaminated with coliform bacteria. It was difficult to compare, however, because it was not possible to obtain comparable data from the five in-country laboratories used during this study and there was difficulty both in obtaining standard operating procedures and in interpreting the documented laboratory results. The CDC recommends that a standard water analysis technique be used in the follow-up evaluation so that the results can be easily compared.

Programming interventions in water, sanitation and hygiene behavior appear to be on-target to meet USAID and Sphere requirements in all communities except in Waspam, Nicaragua where logistical restraints may limit the ability to meet the sanitation guidelines. Current intervention plans should be modified, if possible, to address the water and sanitation needs of this community.

Follow-up studies are planned for February 2001 for comparison with the baseline survey findings, and in February 2002 to assess program sustainability and provide a historic data set for future ARC water and sanitation interventions.

Introduction

In October and November of 1998, Hurricane Mitch ravaged Central America. Hurricane Mitch was one of the strongest, most devastating hurricanes of the past 200 years. High winds and torrential rains directly affected more than 3 million people. An estimated 10,000 people were killed and a half million others were left homeless. Damages to the region's infrastructure were estimated to exceed $3.6 billion in Honduras alone. The international response to the storm was extensive with hundreds of organizations from all over the world providing services and supplies to those affected in the region.

Background

Following Hurricane Mitch, the American Red Cross (ARC) was active in relief and reconstruction throughout Central America. As part of the reconstruction efforts, the ARC responded to the need for water and sanitation. The CDC, in Honduras, Nicaragua, El Salvador, and Guatemala, identified this need in a series of needs assessments performed in January and February 1999. These assessments showed that the availability of water and sanitation varied greatly from country to country, depending on the severity of the impact of the hurricane. The least access to water and sanitation reported among the affected population was in Nicaragua with 29% (58/201) of households reporting access to a piped water source, and 44% (86/195) of households reporting sanitation facilities: 4% (8/195) having a bathroom and 40% (78/195) having a latrine. Despite the large numbers of people and the large area affected in Honduras, 72% (150/208) of households still reported access to running water. However, the percentage of households with access to water and sanitation was expected to decrease when families that were housed in shelters were relocated to more permanent housing.

In response, the ARC worked to provide water and sanitation to the affected communities by creating individualized interventions based on the communities' existing resources and needs. These interventions included providing households or communities with one or more of the following: running water, latrines, toilets, water system repairs, and/or educational public health programming on hygiene, including hand washing, water treatment, and proper care and use of latrines.

To evaluate the effectiveness of the post-hurricane programming on the affected communities, the ARC requested the assistance of the National Center for Environmental Health of the Centers for Disease Control and Prevention (CDC) to assess the community interventions in accordance with United States Agency for International Development (USAID) Title II provisions.

Purpose

The purpose of the baseline survey is to assess the water and sanitation conditions in each country and to quantify indicators that are associated with health impacts. Improvements in water, sanitation and hygiene behavior are expected to reduce the burden of disease and improve the overall health of a population. The guidelines for a non-disaster setting are delineated in the USAID Title II Water and Sanitation Indicators Measurement Guide (Billig et al., 1999), referred

to as USAID guidelines. The USAID guidelines were developed to establish a consistent measurement of a specific set of Water and Sanitation Impact Indicators for reporting the results to the USAID. The follow-up study will collect the same information to determine the effectiveness of the interventions.

The impact indicators are:

1. Percentage of children under <36 months of age with diarrhea in the last two weeks;
2. Quantity of water used per capita per day;
3. Percentage of food preparers with appropriate handwashing behavior;
4. Percentage of childcare providers with appropriate handwashing behavior;
5. Percentage of population using hygienic sanitation facilities;
6. Percentage of households with year-round access to an improved water source;
7. Percentage of households with access to a sanitation facility;
8. Percentage of recurrent costs for water supply services provided by the community served;
9. Percentage of constructed water supply facilities maintained by the communities served.

To evaluate the ARC water and sanitation interventions based on the USAID Title II requirements, the CDC proposed to:

- Provide information on baseline community water and sanitation resources, knowledge, and practices regarding water and sanitation among the ARC beneficiary households; and

- Evaluate the effectiveness of the intervention program for water and sanitation one and two years after the baseline survey is completed.

The ARC and CDC conducted the baseline survey before the initiation of the water and sanitation interventions and prior to the implementation of a large-scale educational component by the ARC. Water and sanitation interventions were evaluated at the community level and community-specific recommendations were made. The Sphere Project standards are also used which provide minimum standards for disaster response (Sphere, 1998). These standards are also considered in the community evaluations since the baseline survey was done post-Hurricane Mitch.
The same survey will be performed one year after the initial survey, February 2001, and again in February 2002. The assessment in February 2001 will be compared to the baseline survey conducted in February 2000 to assess program effectiveness. Program effectiveness will be measured following the interventions by determining the improvement in the USAID Title II indicators in each study area. The assessment in February 2002 will be compared to both prior assessments to determine program sustainability and program effectiveness. Program sustainability will be measured as the ability of the communities to maintain the improvements in the USAID Title II Impact Indicators over an extended period of time.

Study Design

The following study design was developed by the CDC to gather information to define each impact indicator. Two study areas were selected in each country in the following locations:

Country	Study Area 1	Study Area 2
Honduras	Las Lomas	Marcovia
Nicaragua	Nueva Segovia	Waspam
El Salvador	Las Pozas	La Ceiba
Guatemala	Chiquimula	Santa Rosa*

*Due to programming issues, data was not collected in this community for this baseline survey

A study area is a single community or several communities with similar demographics and living in the same geographical region that were selected by the ARC to receive water and sanitation interventions.

The baseline survey was performed in three parts:

I. Household and Community Surveys
II. Water Sampling and Analysis of Community and Household Water Sources
III. Active Diarrhea Surveillance

Data collection in each study area is reported according to the following outline:

- Community Description
- Planned Interventions
- Demographic Information
- Part I - Household and Community Surveys
- Part II - Water Sampling and Analysis
- Part III - Active Diarrhea Surveillance (only Study Areas 1 and 2 in Nicaragua)
- USAID Guidelines
- Discussion
- Recommendations

Community Description

Because the survey was conducted in four different countries and two distinct areas of each country, the communities receiving water and sanitation interventions varied in size, geography, cultural composition, and type of interventions implemented. The community description information included the number of households, population, form of employment, level of education, source of the community water supply, type of water system, and availability of sanitation facilities. The primary needs of each community as perceived by community leaders are identified as well as the status of the community in receiving aid in resettlement after Hurricane Mitch.

Planned Interventions

The ARC had planned interventions for each study area. The ARC, following Hurricane Mitch, developed these interventions based on the needs assessments performed in each of the four affected countries.

Demographic Information

Demographic information for each community includes actual household size, density, and home ownership.

Part I- Household and Community Surveys

Method

Part I is a cross-sectional survey to evaluate water and sanitation issues and resource availability. Evaluations of the study areas were completed by a household survey and a community survey. A trained interviewer conducted the household survey with the household member responsible for obtaining water for the household, the family member primarily responsible for food preparation, and the primary childcare provider. The parameters evaluated were:

- Water. Identified water source, availability, storage and treatment, and home water use.
- Sanitation. Defined access and use of sanitation facilities, latrines or toilets, and distance to a hand washing area.
- Diarrhea Prevalence and Breast-feeding Practice. Evaluated the number of diarrhea cases and breast-feeding practice in children under <36 months.
- Hygiene Behavior-Hand washing. Evaluated hand washing knowledge and behavior of the person responsible for food preparation in each household and the primary childcare provider.
- Education. Assessed the level of education of the interviewee and the amount of health education each community received.

Surveys were conducted in 100 households that were systematically selected within each of the designated study areas. The household surveys were a combination of interviews and observations made by a visual inspection of the water and sanitation facilities of each household confirming the household's water source, drinking water storage, hand washing area, and the condition and level of use of the household sanitation facility.

Water use was estimated using the number of containers of water carried to the household on the day prior to the interview (households with water supplied by a private spigot were not included in the final analysis of daily per capita water collected or in the calculation of daily per capita water use) because these obtained water on-site. Thus, the indictor could not be used as an accurate measure of use.

Sanitation facilities, latrines or toilets, were considered to be hygienic and in use if each of the following indicators was met:

1. few to no flies present,
2. facility was used by at least one household member >12 months of age, and
3. no waste was observed outside of the latrine.

Additionally, one or more of the following indicators had to be present:

1. signs that the area had been washed recently with water,
2. the presence of a path to the outhouse,
3. signs that the area had been swept,
4. absence of spider webs, and
5. evidence that the facility was functioning properly.

The community surveys were completed jointly in a meeting with the community leaders, the ARC water and sanitation delegate, and the local water board/committee for each community. Questions were included on water source, water system maintenance and cost, community composition, and aid the community was receiving, including food and health care.

Data Analysis

Data were entered into Epi Info 6.02 to generate descriptive statistics. Calculation of impact indicators as established by USAID for Title II funding were performed manually.

Part II- Water Sampling and Analysis

Method

Each community water source and a subset of households from all the communities in a study area were sampled for indicators of fecal contamination. A sample size of 10 households was calculated based on a confidence interval of 95%, a power of 80%, and an assumption that water, sanitation, and educational interventions would decrease the contamination of stored household water by 67% (Pinfold, 1990). To account for non-responses (e.g., people refusing to allow a water sample to be taken), the desired sample size was increased by 20% to 12. All water samples were collected by one of the principal investigators or his/her trained assignees, who systematically selected households for water sampling and analysis. The investigator accompanied interviewers during data collection and collected water samples during household interviews, and rotated from one interviewer to the next until the desired sample size had been collected.

Both the community sample and the household water samples were collected in sterile containers and stored in coolers with ice packs until transported to in-country laboratories of the Ministry of Health for analysis. In Nicaragua, Study Area 2 in Waspam, a DelAgua portable water testing kit was used to process the community and household water samples for enumeration of total coliform bacteria and *E. coli* since there are no laboratories easily accessed in that part of the country. These samples were also tested with the PurTest test kit to analyze for the presence or absence of total coliform bacteria and *E. coli*. This was possible because the manufacturer of the PurTest test kit added an additional indicator to test for the presence of *E. coli* specifically for this study.

Although initial plans by CDC specified that all water samples be processed using the membrane filtration technique for enumeration of *E. coli* (APHA, 1998), some of the in-country laboratories

did not have the capacity to perform enumerative testing for *E. coli*. Many of the laboratories used presence/absence techniques for *E. coli*, and semiquantitative or quantitative techniques to quantify other, more general indicators of fecal contamination, such as total and/or fecal coliform bacteria. Total coliform bacteria include both fecal coliforms and *E. coli.* The presence of fecal coliforms and *E. coli* indicates that water may be contaminated with human or animal waste. Only fecal coliform and *E. coli* results, both quantitative and qualitative, are presented in this baseline survey. Both the planned analyses and those that were actually performed are shown in Table 1.

Table 1. Planned and Actual Analyses Performed on Collected Water Samples Post-Hurricane Mitch
Water and Sanitation Baseline Survey, February 2000

Community	Planned Analysis	Actual Analysis
Honduras, Las Lomas	*E. coli* – in country lab (quantitative) [a]	*E. coli*/total coliforms (+/-)[b] Fecal coliforms (quantitative) [a]
Honduras, Marcovia	*E. coli* – in country lab (quantitative) [a]	*E. coli*/total/fecal coliforms (quantitative) [a]
Nicaragua, Nueva Segovia	*E. coli* – in country lab (quantitative) [a]	*E. coli*/fecal coliforms (semiquantitative)[c]
Nicaragua, Waspam	*E. coli* – DelAgua kit (quantitative) [a] *E. coli*/total coliforms – PurTest (+/-) [b]	*E. coli* – DelAgua kit (quantitative) [a] *E. coli*/total coliforms – PurTest (+/-) [b]
El Salvador, Las Pozas	*E. coli* – in country lab (quantitative) [a]	*E. coli*/fecal coliforms (semiquantitative) [d]
El Salvador, La Ceiba	*E. coli* – in country lab (quantitative) [a]	*E. coli*/fecal coliforms (semiquantitative)[d]
*Guatemala, Chiquimula	*E. coli* – in country lab (quantitative) [a]	E. coli (+/-)[b] Total/fecal coliforms (quantitative) [a]

*Data for the second study area in Santa Rosa is not available in this baseline survey
[a] Membrane filtration technique
[b] Presence/absence test
[c] Expected quantitative results, however, reported as MPN (most probable number)- semiquantitative results
[d] MPN technique

Data Analysis

The data on the presence of fecal coliform bacteria and *E. coli* in the community and household water samples were correlated with the baseline survey responses to assess high-risk community and household water sources.

Part III – Active Diarrhea Surveillance

Method

Active surveillance for diarrhea cases was conducted in both study areas in Nicaragua, Nueva Segovia and Waspam. Diarrhea is defined as three or more watery stools in a day. For this component of the survey, a questionnaire was administered to each participating household to collect detailed information on household income, household wealth (as indicated by the presence of one or more of the following: a radio, television, refrigerator, telephone, scooter or motor bike, and/or automobile) and education level of the primary childcare provider. A census

of each household provided information on the age and sex of household members. The incidence of diarrhea in the previous week was recorded for each household member. Active surveillance of the incidence of diarrhea among members of these households continued with weekly follow-up for four weeks. A trained in-country interviewer with a health background conducted the follow-up visits. The in-country water and sanitation delegate, the water and sanitation promoter, and the health delegate oversaw the data collection. The CDC investigator remained in close contact with the field investigations throughout the follow-up period.

Data Analysis

Univariate descriptive statistics are performed using Epi Info 6.02.

USAID Guidelines

The Title 2 Indicator Guide on Water and Sanitation Indicators Measurement Guide (Billig et al. 1999) was published by the USAID in response to non-emergency situations. It is the primary guide used in assessment of the data from the baseline survey and for the follow-up evaluations.

Discussion

The baseline survey results are summarized and presented by country and study area. Overall, a total of 773 household interviews, 13 community surveys, and 146 environmental samples were collected and analyzed. Table 2 is a summary of the number of surveys and samples collected during the baseline survey, i.e., post-Hurricane Mitch and prior to the planned ARC interventions. Active diarrhea surveillance (Part III) was only conducted in Study Areas 1 and 2 in Nicaragua.

Table 2. Completed Surveys and Water Samples Collected in Each Community Post-Hurricane Mitch
Water and Sanitation Baseline Survey, February 2000

Community	Number of Household Surveys	Number of Community Surveys	Number of Participants in Active Diarrhea Surveillance	Community Water Samples Collected	Household Water Samples Collected
Honduras-Las Lomas	106	1	N/A	1	13
Honduras-Marcovia	92	1	N/A	1	13
Nicaragua-Nueva Segovia	101	1	101	9	23
Nicaragua-Waspam	112	2	112	7	14
El Salvador-Las Pozas	98	1	N/A	4	13
El Salvador-La Ceiba	73	1	N/A	5	14
Guatemala-Chiquimula	191	6	N/A	12	17
Guatemala-Santa Rosa	N/A	N/A	N/A	N/A	N/A
Total Number of Samples in the Region	773	13	213	39	107

N/A – not applicable

Recommendations

Specific recommendations are presented at the end of each section for each study area. Recommendations are specific to the needs of each community with the goal of meeting the USAID guidelines.

Regional Discussion

A regional discussion provides a regional summary and comparison of the conditions with respect to the USAID guideline in the various communities.

Regional Recommendations

Regional recommendations are also provided to address overall programming and evaluation needs in all participating communities.

Conclusion

The CDC reviewed the planned interventions and the baseline conditions of each study area. Recommendations were provided to help focus the interventions and to establish a baseline for evaluation in the follow-up study.

Honduras – Study Area 1 - Las Lomas

A team of 12 interviewers, the ARC in-country water and sanitation delegate, and one CDC investigator traveled by car to Las Lomas from Tegucigalpa and conducted the interviews on February 9-10, 2000. Upon arrival, each interviewer was assigned a different section of the town in which to conduct the interviews. The water samples were taken on February 10 in houses where the interviews were being conducted. The community was very motivated to participate in this study, as demonstrated by the participation rate of close to 100%.

Community Description

Las Lomas is an urban community in the Department of Catacamas in east-central Honduras. A community interview was conducted with the community leaders and the ARC delegate to obtain background information about the community. At the time of the survey, the community council indicated that access to potable water was the community's single greatest need.

Las Lomas is a community of 130 households with a population of 550. The people of this community are mestizo and speak Spanish. A community council governs them. The two most common forms of employment are agriculture and masonry. The education level of the population is generally third grade.

At the time of the survey, the community has not received food aid related to the hardship caused by Hurricane Mitch. The Ministry of Health provides health care to all residents. The health care clinic is located in the Barrio El Hetillo in Catacamas, 6 km from the community of Las Lomas. The community has had no post-Hurricane Mitch health training focusing on sanitation, hygiene, or water use.

The community's water supply comes from a spring in the nearby mountains that feed by gravity into a concrete holding tank, to a distribution system, and then to household spigots. This system has been operational since 1985. Currently, the system does not have the capacity to serve all 130 Las Lomas households. Those households that receive water pay seven limpiras ($0.54) per month for the service. The water is not routinely treated on a community level. The Ministry of Health tested the water in October 1999 and found it to be contaminated with microorganisms. The Ministry of Health subsequently treated the water in the storage tank in November 1999.

Although a few of the households have dry pit latrines, most of the households in Las Lomas have no sanitation facilities.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation and hygiene behavior.

Water

The ARC water intervention includes:

expanding the water system using the currently used spring and supplementing the current water supply with additional water from new groundwater wells, and/or a combination of sources

connecting those households that were not connected to the centralized water distribution system at the time of the baseline survey and providing a household spigot.

Sanitation

The ARC plans to provide household latrines for all homes in the community. The cost of the latrines has not yet been determined. It is expected that the latrines will be completed by December 2000.

Hygiene Behavior-Hand washing

Charlas planned by ARC describing proper hygiene, and the provision of household spigots to those who do not have them are planned in an effort to increase the likelihood that residents of Las Lomas will use appropriate hand washing behavior in the future.

Demographic Information

At the time of the survey, the mean household size was 5.6 people per household. On average, 0.5 children less than 36 months of age lived in each house. Seventy-six percent (80/105) of those interviewed reported that they were living in their own home. Eight percent (8/105) were living with friends or family, and 13% (14/105) were living in a rented house. The remaining 3% (3/105) were living in temporary housing.

Part I – Household and Community Surveys

Water

Water Availability

The residents of Las Lomas used a variety of water sources. The types and distribution of water sources used in Las Lomas changed after Hurricane Mitch. Table 3a summarizes the water sources before and after Hurricane Mitch. Prior to the hurricane, the majority of water was obtained from a household spigot, 54% (57/105). After Hurricane Mitch, 75% (77/103) of the households obtained their water from a household spigot. The shared well and river water sources were no longer used and 4% (4/103) reported buying water in Catacamas (the closest city), while another 4% (4/103) obtained water from a neighbor.

Table 3a. Water Source Before and After Hurricane Mitch
Honduras - Study Area 1 - Las Lomas, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	13% (14/105)	12% (12/103)
Household spigot	54% (57/105)	75% (77/103)
Shared well	13% (14/105)	0% (0/0)
Household well	5% (5/105)	2% (2/103)
River	10% (11/105)	0% (0/0)
Purchased in nearby city	0% (0/0)	4% (4/103)
Obtained from neighbor	0% (0/0)	4% (4/103)
Bottled water	0% (0/0)	1% (1/103)
Nearby family	0% (0/0)	1% (1/103)
Other	0% (0/0)	1% (1/103)

The average volume of water collected by water source is shown in Table 3b. Household spigots provided the greatest volume of water per household, 251 liters (L) per day. The least amount of water was purchased from the nearby city, 44 L/day. Households without a household spigot (N = 28) reported collecting an average of 136 L of water the day before the interview (median 57 L). The average volume of water collected per person per day was 30 L (range: 3 to 247 L/person/day; median: 12 L/person/day). Thirty-eight percent (40/105) of households reported that they had to wait to get water some of the time. Of those who had to wait, 59% (23/39) said that they had to wait longer than one hour, while 36% (14/39) said that they had to wait less than 30 minutes. Seventy-six percent (80/105) of households reported having water all day long, while 68% (71/104) reported having water all year long.

Table 3b. Daily Volume of Water Collected in Each Household by Water Source
Honduras - Study Area 1 - Las Lomas, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared spigot	12	163	19-522	34
Household spigot	77	251	0-895	418
Purchased in nearby city	4	44	38-53	38
Obtained from neighbor	4	75	38-91	91

The distance households traveled to get to their water source ranged from 0 meters (m) to greater than 1 kilometer (km), with a mean distance of 57 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 7 m. Prior to Hurricane Mitch, households reported traveling an average of 3 km (3000 m) to get water (median 8 m) with a range of 0 meters to 80 km. The median distance traveled to get water after Hurricane Mitch decreased from 8 m to 7 m at the time of the survey. Interviewer estimates of distance from the interviewed household to its water source were greater than estimates of the interviewees (i.e., mean distance of 83 m and a median distance of 10 m). As shown in Table 3c, the volume of water collected appeared to have no association with the distance from the household to the water source.

Table 3c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
Honduras - Study Area 1 - Las Lomas, February 2000

Distance (meters)	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
≤ 10	66	227	0-895	38
11-50	21	174	19-447	19
51-100	4	447	76-770	N/A
101-200	6	92	18-254	38
201-500	6	263	34-570	N/A
501-998	1	45	45	45
≥ 999	1	219	219	219

≤ less than or equal to
≥ greater than or equal to
N/A not applicable for this data set

Storage and Treatment

Ninety-one percent (96/105) of households stored water for the home and 100% (105/105) stored drinking water. Seventy-five percent (76/102) stored their drinking water in a covered container. Forty percent (42/105) of households reported treating their drinking water on the day of the survey. Thirty percent (31/103) of households reported always treating their water, 39% (40/103) reported sometimes treating, and 31% (32/103) reported never treating. Fifty-nine percent (60/101) of households reported treating their water with chlorine and 12% (12/101) reported boiling their water. Eighty percent (84/105) of households were observed to get drinking water from their stored water source by dipping in a cup; another 14% (15/105) got drinking water by pouring it into a cup or glass.

Home Water Use

Households reported washing clothes an average of 5 days a week (range: 1 to 7 days per week). Seventy-two percent (75/104) of households reported washing clothes at their home, 15% (16/104) of households reported washing their clothes at a neighbor's house, and 9% (9/104) reported washing their clothes in the river or creek. Eighty-nine percent (93/105) of households bathed in the same place they washed clothing. Eighty-eight percent (92/105) of interviewees reported that they bathed daily. The remaining 12% (13/105) of respondents bathed with a variety of frequencies.

Sanitation

Sixty-three of the 98 households surveyed (64%) reported having access to sanitation, however, 69 sanitary facilities were actually inspected. Of the 63 households reporting access to sanitation, 61 (97% (61/63)) were private and 2 (3% (2/63)) were shared. Ninety-six percent (66/69) of the observed sanitary facilities were dry pit latrines. The remaining 4% (3/69) were pour flush latrines.

Forty-five percent (31/69) of the latrines inspected were found to meet the criteria for hygiene and use. Fifty-three percent (303/567) of the total population of the study area >12 months of

age reported using hygienic sanitation facilities. Forty percent (10/25) of households reported disposing of bowel movements of children <12 months of age into a latrine. Fifty-six percent (14/25) of households reported disposing of the waste outside the home. The mean distance to a hand washing area from the sanitation facility was 20 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 3d summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Forty-three percent (21/49) of children <36 months of age were breast-fed. This percentage was highest in the youngest age groups, ≤6 months and 7 to 12 months, and lower in the older age groups, 13 to 24 months and 25 to 35 months. The data show that as the child increased in age the occurrence of breast-feeding decreased as expected.

Table 3d. Diarrhea Prevalence and Breast-feeding Practice in Children
Honduras - Study Area 1- Las Lomas, February 2000

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	43% (21/49)	27 (13/49)	33 (7/21)	22 (6/28)
6 months	100% (7/7)	0 (0/7)	0 (0/7)	0 (0/0)
7-12 months	46% (6/13)	46 (6/13)	57 (4/7)	33 (2/6)
13-24 months	26% (6/23)	22 (5/23)	50 (3/6)	12 (2/17)
25-35 months	17% (1/6)	33 (2/6)	0 (0/1)	40 (2/5)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months was 27 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months and 7 to 12 month age groups, and decreased the following year in the 13 to 24 month age group but increased in the oldest age group, 25 to 35 months. Overall, the period prevalence for diarrhea was higher for children who were breast-feeding (33 per 100 children) versus those who were not breast-feeding (22 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

Hand washing knowledge and behavior of the household food preparer is shown in Table 3e. Hand washing knowledge and behavior were based on the interviewees' ability to recite key times when they wash their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Seventeen percent (18/105) of food preparers received a passing score. Handwashing after defecation was reported the most frequently, 70% (73/105), and hand washing after cleaning a child's bottom was the least reported, 8% (8/105). In the handwashing demonstration, 100% (104/104) of the women washed their hands with water and 74% (77/104) used soap.

Table 3e. Household Food Preparer Hand washing Knowledge and Behavior
Honduras - Study Area 1 - Las Lomas, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	53% (56/105)
	Before cooking	69% (72/105)
	Before feeding children	19% (20/105)
	After defecating	70% (73/105)
	After cleaning child's bottom	8% (8/105)
How do you wash your hands? (behavior)	Use water	100% (104/104)
	Use soap	74% (77/104)
	Use both hands	99% (103/104)
	Rub hands. 3 times	92% (96/104)
	Dry hands on towel or air dry	38% (40/104)
Total passing score (8 out of 10)		17% (18/105)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 3f. Eighteen percent (19/105) of childcare providers received a passing score of at least 8/10. Hand washing after defecating was reported most frequently, 70% (73/105) and hand washing after cleaning a child's bottom was the least reported, 10% (10/105). The results of the hand washing demonstration were similar to those of the group responsible for food preparation, 99% (103/104) of the women used water to wash their hands and 74% (77/104) used soap.

Table 3f. Childcare Provider Hand washing Knowledge and Behavior
Honduras - Study Area 1 - Las Lomas, February 2000

Childcare Provider		Percent
When do you wash your hands? (knowledge)	Before eating	52% (55/105)
	Before cooking	67% (70/105)
	Before feeding children	21% (22/105)
	After defecating	70% (73/105)
	After cleaning child's bottom	10% (10/105)
How do you wash your hands? (behavior)	Use water	99% (103/104)
	Use soap	74% (77/104)
	Use both hands	98% (102/104)
	Rub hands 3 times	91% (95/104)
	Dry hands on towel or air dry	38% (39/104)
Total passing score (8 of 10)		18% (19/105)

≥ greater than or equal to

Education

Interviewee's Level of Education

Interviewees reported from 0 to 12 years of formal education. The mean level of education was 3 years. Thirty-two percent (33/104) of interviewees had no formal education. Twenty-two percent (23/104) of interviewees had completed at least 6 years of education.

Household Health Education

The Centro de Salud (Salud Publica) conducted a majority of the health education workshops (charlas) reported by the study participants. The survey showed that 21% (19/91) of households reported receiving a charla on proper handwashing behavior, 11% (11/102) of households reported receiving a charla on how to treat household water, and 12% (12/103) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household water samples are summarized in Table 3g. The laboratory of the Ministry of Health in Olancho (Secretaria de Salud, Region de Salud No. 7) analyzed the community water source and household water samples. The presence/absence test for coliform bacteria was done using the commercially available Colilert kit. Fecal coliforms were quantified by using the membrane filtration technique (APHA, 1998).

Table 3g. Community and Household Water Sources Receiving Treatment and Coliform Results Honduras - Study Area 1 - Las Lomas, February 2000

Water Tested	Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	1	0% (0/1)	100% (1/1)	100% (1/1)
Household samples	11	36% (4/11)	64% (7/11)	64% (7/11)

Community Water Source

The community water source is from a nearby mountain spring that is gravity fed to a concrete holding tank that in turn flows to the community's distribution system. The results of the presence/absence test were positive for *E. coli*. The membrane filtration technique was used to measure fecal coliforms in colony forming units (CFU) per 100 milliliter (ml) of water. The water sample from the holding tank contained 140 CFU of fecal coliform per 100 ml of bacteria.

Household Water Samples

Household water samples were taken from water stored in the house for drinking. Household water samples tested positive for *E. coli* by the presence/absence test. The quantitative fecal coliforms test results ranged from 50 to 120 CFU/100 ml. Four households reported treating their water on the day of the interview. Of these households, 75% (3/4) had water that was contaminated with fecal coliforms or *E. coli*. Of the seven households that did not treat their water on the day of the interview, four (57% (4/7)) were contaminated, and three (43% (3/7)) were not contaminated, including one household that purchased bottled water, and two households that obtained water from household taps.

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in Las Lomas are summarized in Table 3h. The USAID guidelines target a 25% decrease in diarrhea rates in children <36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 30 L/person/day that is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 53% (303/567) and also was below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 3h. Impact Indicators
Honduras - Study Area 1 - Las Lomas - February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in the past 2 weeks	27% (13/49)
Per capita daily water use	30 L/person/day
Food preparers with appropriate handwashing behavior	17% (18/105)
Childcare providers with appropriate handwashing behavior	18% (19/105)
Population using hygienic sanitation facilities*	53% (303/567)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation which was 64% (63/98).

Discussion

This study of the conditions in Las Lomas, Honduras was conducted to gather baseline data on water use and presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the following two years after the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

At the time of the survey, the majority of the respondents in the community obtained water from household spigots that were gravity fed from a mountain spring into a concrete holding tank (Table 3a) and lived in their own homes. Seventy-six percent of households reported that they had water all day long, while 68% reported having water all year. The majority of households in Las Lomas were therefore meeting the USAID guidelines for access to an improved water source at the time of the baseline survey. On average, 30 L of water were collected per person per day, an amount that is below the USAID guideline of 50 L per person per day. The volume of water collected varied by water source (Table 3b). All of the houses interviewed had stored water in their homes, for drinking and other household uses. At a household level, residents of Las Lomas took some precautions to maintain water purity. However, 80% of respondents were observed to obtain their drinking water from their stored water supply by dipping in a cup, which could contaminate the water in the container by allowing the water to come into contact with dirty or contaminated hands or cups. This finding indicates that people are likely to be exposed to contaminated water, and that the water may be contaminated at the household level.

Sanitation

Nearly two-thirds of households reported access to sanitation, predominantly dry pit latrines. Of the latrines inspected, 45% met the USAID guidelines for appropriate hygiene and use.

Diarrhea Prevalence and Breast-feeding Practice

There were 27 cases of diarrhea per 100 children <36 months of age in the two weeks prior to the study. Prevalence was lowest (0 cases per 100 children) in infants (≤6 months), 100% who were breast-fed; prevalence was highest (46 cases per 100 children) in the 7 to 12 month age range, 46% who were breast-fed. Overall, a higher percentage of children who were breast-feeding had diarrhea than children who were not breast-feeding (Table 3d). Age may be a confounding variable since younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the risk of diarrhea in breast-fed and not breast-fed infants the survey would need to control for age. However, the number of children <36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Handwashing

Fewer than 20% of food preparers and childcare providers demonstrated appropriate knowledge and practice of handwashing behaviors (Tables 3e and 3f).

Education

Only 21% of respondents reported receiving a charla on appropriate handwashing behavior. Lack of appropriate handwashing behavior among these members of the household could contribute to the contamination of water at the household level, and to direct fecal-oral disease transmission.

Part II - Water Sampling and Analysis

The Ministry of Health laboratory of the Department of Olancho analyzed the water samples. Fecal coliforms were analyzed using a quantitative method, membrane filtration. *E. coli* samples were analyzed by using a presence/absence test which gives no information about the number of organisms present in a water sample.

The presence of any coliform bacteria in a water sample indicates that it has been contaminated with human or animal feces and could cause diarrhea or other illness if ingested. The source water in the community water holding tank was contaminated, and the water may have been further contaminated during collection for storage in the homes by use of contaminated storage containers or by contact with contaminated hands and glasses. The results of the laboratory water analyses confirmed that much of the household water was contaminated. Thus, the people in the community were likely to be exposed to contaminated water from both the community and household sources. Sixty-four percent of household water samples tested positive for fecal coliforms and *E. coli* (Table 3g). Duplicate analysis of the household water samples indicated that there might be problems with quality control in this laboratory. One replicate was positive for the presence of fecal coliforms and *E. coli* and the other replicate was negative. Therefore, the results of the laboratory analyses should be interpreted with caution. For the purposes of data analysis, the sample that was taken in duplicate was considered positive. Although 39% of

respondents indicated that they treat their water at least some of the time, study results indicate that people in this community achieve little success in decreasing the contamination of household water by disinfecting with chlorine in the home.

Recommendations

The CDC recommends the following actions to improve water quality and ensure the successful collection of water quality data future evaluations:

- Water in the tank should be disinfected and the tank should be cleaned, if necessary.
- Pipes leading to and from the tank should be checked for any breaks that could be sources of contamination.

The water in the tank should be tested after these measures are taken to determine if the water source may be contaminated before coming into the tank or during storage. If necessary, chlorine or an alternative disinfectant should be provided for the community water storage tank to ensure that the community is routinely supplied with water free of pathogenic microorganisms.

In the future, it would be beneficial to obtain quality assurance data from the laboratories if water samples are taken to in-country labs for analysis. Alternatively, investigators may use portable water testing kits such as the DelAgua kit for all water sample analyses to ensure the quality of the data collected.

Honduras – Study Area 2 - Marcovia

A team of 10 interviewers, the ARC in-country water and sanitation delegate, and one CDC investigator traveled by car to Marcovia from Tegucigalpa and conducted the interviews on February 7-8, 2000. Upon arrival in the town, each interviewer was assigned a different section of the town in which to conduct the interviews. The water samples were taken on February 8 in houses where the interviewers were conducting interviews. The community was very motivated to participate in this study as demonstrated by the participation rate of nearly 100%.

Community Description

Marcovia is an urban resettlement community made up of people affected by Hurricane Mitch. It is located in the Department of Choluteca in southern Honduras. An interview was conducted with the community leaders and the ARC delegate to obtain background information about the community. At the time of the survey, the community council indicated that water and sanitation was the community's single greatest need.

Marcovia is a resettlement community of 240 households with a population of 1440. At the time of the baseline survey, approximately two-thirds of the families had moved into the resettlement community, while one-third had not yet moved from their previous homes (mostly in nearby "Old" Marcovia). Many of the people moved because Hurricane Mitch had destroyed access to drinking water and/or sanitation services in their old homes, and, while water and sanitation services were not yet completed in the resettlement community, a community well was in place. Most of those who had not yet moved to the resettlement community were either staying with relatives or had water and/or sanitation services in their old homes. The people of this community are mestizo and speak Spanish. A community council governs the people. The two most common forms of employment are agriculture and being a housewife. The education level of the population is generally sixth grade.

At the time of the survey, the community had received no food aid related to the hardship caused by Hurricane Mitch, and the community did not have a health care clinic. However, the people have access to health care at the clinic operated by the Ministry of Health in the old town of Marcovia. In June and November 1999, ARC presented health education programs to the community focusing on sanitation and use of water.

The water supply is a community well built by the ARC. This system has been operational since June 1999. The water was tested by the Centro de Estudios y Control de Contaminantes (CESSCO) in June 1999 and was determined to be free from chemical and microbial contamination.

Although a few of the households that have not yet moved into the resettlement community have dry pit latrines, none of the households in resettled Marcovia have sanitation facilities.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation and hygiene behavior.

Water

ARC plans to build a new water distribution system with a storage tank that will be gravity-fed with water from the newly built well. Each household will have a spigot connected to the distribution system. ARC will provide materials and supplies, and the community members will provide the labor for construction. The monthly cost of the system is estimated to be 30 limpiras ($2.31) per household. The ARC anticipates completion of the expanded water system by July 2000.

No community-level treatment of the well water (e.g., chlorine) is planned by ARC, and should not be necessary if appropriate design precautions are taken against contamination of the water source. In addition, charlas (workshops) on hygiene and proper collection and storage of drinking water are planned to address the issue of household water contamination.

Sanitation

The ARC plans to provide pour-flush latrines to all homes in the community. ARC will provide materials and supplies, and the community members will provide the labor for the construction. It is expected that the latrines will be completed by June 2000.

Hygiene Behavior – Hand washing

The ARC plans charlas on hygiene with the provision of household spigots to increase appropriate hand washing behavior.

Demographic Information

The mean household size was 5.0 people per household. On average, 0.5 children less than 36 months of age lived in each house. Eighty percent (73/91) of the people in these households were living in their own home. Twelve percent (11/91) were living with friends or family, and 8% (7/91) were living in a rented house.

Part I – Household and Community Surveys

Water

Water Availability

Table 4a summarizes the distribution of household water sources before and after Hurricane Mitch. The residents of Marcovia used a variety of water sources. The types and distribution of water sources used in Marcovia changed after Hurricane Mitch. Forty-nine percent (45/92) of households had obtained their water from a household spigot before Hurricane Mitch, compared to 28% (26/92) at the time of the survey. The majority of water was obtained from a shared well, 71% (65/92), compared to 24% (22/92) prior to Hurricane Mitch. The shared spigot, household well, river, and bottled water sources were no longer used after Hurricane Mitch. Water purchased from a truck distributor remained the same at 1% (1/92).

Table 4a. Water Source Before and After Hurricane Mitch
Honduras - Study Area 2 - Marcovia, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	7% (6/92)	0% (0/0)
Household spigot	49% (45/92)	28% (26/92)
Shared well	24% (22/92)	71% (65/92)
Household well	17% (16/92)	0% (0/0)
Bottled water	1% (1/92)	0% (0/0)
River	1% (1/92)	0% (0/0)
Purchased from truck	1% (1/92)	1% (1/92)

The average volume of water collected by water source is shown in Table 4b. Those with a shared well collected the greatest amount of water per household, 465 liters (L) per day. The volume of water collected from a household spigot and water purchased from a truck were about the same. Households without a household spigot reported collecting a mean of 145 L of water on the day before the interview (median 114 L). The average volume of water collected per person per day was 34 L (range: 0 to 209 L/person/day; median: 22 L/person/day). Eighty-four percent (77/92) of households reported that they had to wait to get water. Of those who had to wait, approximately one-third of the respondents (26/80) said that they had to wait between 30 minutes and one hour to get their water, and another one-third (27/80) said that they had to wait longer than one hour. Seventy-eight percent (71/91) of households reported having water all day long, while 85% (77/91) reported having water all year long.

Table 4b. Daily Volume of Water Collected in Each Household by Water Source
Honduras - Study Area 2 - Marcovia, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Household spigot	26	251	0-895	418
Shared well	65	465	60-912	627
Purchased from truck	1	209	209	N/A

N/A Not applicable

The distance households traveled to get to their water source ranged from 0 meters (m) to greater than 30 kilometers (km), with a mean distance of 453 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 30 m. Prior to Hurricane Mitch, households reported traveling on average 192 m to get water (median 4 m) with a range of 0 meters to 7 km. The median distance traveled to get water after Hurricane Mitch increased from 4 m to 30 m at the time of the survey. Interviewer estimates of distance from the interviewed household to the water source were greater than estimates of the interviewees (i.e., mean distance of 456 m and a median of 62 m). As shown in Table 4c, the volume of water collected was lower in households with water sources greater than 50 m away than for those who traveled less than 50 m to collect water.

Table 4c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
Honduras - Study Area 2 - Marcovia, February 2000

Distance (meters)	Number of households	Daily Volume (liters/day)		
		Average	Range	Mode
≤ 10	33	360	11-912	627
11-50	16	220	38-494	243
51-100	9	146	17-254	57
101-200	10	99	0-228	38
201-500	20	137	7-425	41
501-998	1	57	57	57
≥ 999	2	135	60-209	N/A

≤ less than or equal to
≥ greater than or equal to
N/A not applicable for this data set

Storage and Treatment

Ninety-seven percent (89/92) of households stored water for the home, 96% (88/92) stored drinking water. Eighty-eight percent (79/90) stored their drinking water in a covered container. Twenty-six percent (24/92) of households reported treating their drinking water on the day of the survey. Twenty-three percent (21/92) of households reported always treating their water, 32% (29/92) reported sometimes treating it, and 46% (42/92) reported never treating it. Forty-eight percent (44/91) of households reported treating their water with chlorine and 7% (6/91) reported boiling their water. Forty-six percent (42/91) of households were observed to get drinking water from their stored water source by dipping a cup into the water; another 35% (32/91) got drinking water by pouring it into a cup or glass.

Home Water Use

Households reported washing clothes an average of 4.4 times per week (range: 1 to 8 times per week). Fifty-one percent (47/92) of households reported washing their clothes at the house, while 28% (26/92) of households reported washing their clothes in the river or creek. Eighty-six percent (79/92) of households bathed in the same place they washed clothing. Ninety-two percent (84/91) of interviewees reported that they bathed daily. The bathing frequency of the remaining 8% (7/92) of respondents varied from 2 to 21 times per week.

Sanitation

Twenty-six percent (22/83) of households reported having access to sanitation, of those 22 households, 20 (91%) were private and two (9%) were shared. Eighty-two percent (18/22) of the sanitary facilities were observed to be dry pit latrines. The remaining 18% (4/22) were pour-flush latrines.

Forty-five percent (10/22) of the latrines inspected were found to meet the criteria for hygiene and use. Thirty percent (137/460) of the total population in the study area >12 months of age reported using hygienic sanitation facilities. Fourteen percent (4/21) of households reported disposing of bowel movements of children <12 months of age into a latrine. Eighty-six percent

(18/21) of households reported disposing of the waste outside the home. The mean distance to a hand washing area from the sanitation facility was 51 meters.

Diarrhea Prevalence and Breast-feeding Practice

Table 4d summarizes breast-feeding practice and the reported diarrhea prevalence among children less than 36 months of age in the two weeks prior to the baseline survey. Thirty-eight percent (17/45) of children <36 months of age were breast-fed. This percentage was highest in the youngest age groups, ≤6 months and 7 to 12 months, and lower in the older age groups, 13 to 24 months and 25 to 35 months. The data show that as the child increased in age, the occurrence of breast-feeding decreased as expected.

Table 4d. Diarrhea Prevalence and Breast-feeding Practice in Children
Honduras - Study Area 2 - Marcovia, February 2000

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	38% (17/45)	29 (13/45)	33 (7/21)	22 (6/28)
6 months	100% (11/11)	9 (1/11)	9 (1/11)	0 (0/0)
7-12 months	50% (636)	33 (2/6)	33 (1/3)	33 (1/3)
13-24 months	11% (2/19)	42 (8/19)	50 (1/2)	41 (7/17)
25-35 months	11% (1/9)	11 (1/9)	0 (0/1)	25 (2/8)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months of age was 29 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months and 7 to 12 month age groups, and decreased in the 13 to 24 month and 25 to 35 month age groups. Overall, the period prevalence for diarrhea was higher for children who were breast-feeding (33 per 100 children) versus those who were not breast-feeding (22 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

The hand washing knowledge and behavior of the household food preparers are summarized in Table 4e. Hand washing knowledge and behavior were based on the interviewees' ability to recite key times when they wash their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Nineteen percent (17/92) of food preparers received a passing score. Handwashing before cooking was reported the most frequently, 78% (72/92), and hand washing after cleaning a child's bottom was the least reported, 12% (11/92). In the handwashing demonstration, 100% (92/92) of the women washed their hands with water and 72% (66/92) used soap.

Table 4e. Household Food Preparer Hand washing Knowledge and Behavior
Honduras - Study Area 2 - Marcovia, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	60% (55/92)
	Before cooking	78% (72/92)
	Before feeding children	32% (29/92)
	After defecating	60% (55/92)
	After cleaning child's bottom	12% (11/92)
How do you wash your hands? (behavior)	Use water	100% (92/92)
	Use soap	72% (66/92)
	Use both hands	97% (89/92)
	Rub hands. 3 times	84% (76/91)
	Dry hands on towel or air dry	32% (31/92)
Total passing score (8 of 10)		19% (17/92)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 4f. Nineteen percent (17/92) of childcare providers received a passing score of at least 8/10. Hand washing before cooking was reported most frequently, 78% (72/92), and hand washing after cleaning a child's bottom was the least reported, 12% (11/92). In the hand washing demonstration, 99% (91/92) of the women washed their hands with water and 73% (67/92) used soap.

Table 4f. Childcare Provider Hand washing Knowledge and Behavior
Honduras - Study Area 2 - Marcovia, February 2000

Childcare Provider		Percent
When do you wash your hands? (knowledge)	Before eating	62% (57/92)
	Before cooking	78% (72/92)
	Before feeding children	32% (29/92)
	After defecating	58% (53/92)
	After cleaning child's bottom	12% (11/92)
How do you wash your hands? (behavior)	Use water	99% (91/92)
	Use soap	73% (67/92)
	Use both hands	96% (88/92)
	Rub hands. 3 times	84% (76/91)
	Dry hands on towel or air dry	35% (32/92)
Total passing score (8 of 10)		19% (17/92)

≥ greater than or equal to

Education

Interviewee's Level of Education

Interviewees reported from 0 to 8 years of formal education. The mean level of education was 4 years. Twenty-four percent (22/92) of interviewees had no formal education. Forty-six percent (43/92) of interviewees had completed at least 6 years of education.

Household Health Education

The Centro de Salud (Salud Publica) conducted a majority of the health education workshops (charlas). The survey showed that 21% (19/91) of households reported receiving a charla on hand washing; 40% (36/91) of households reported receiving a charla on how to treat household water; and 23% (21/91) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household water samples are summarized in Table 4g. The community water source and household water samples were analyzed using the membrane filtration method (APHA, 1998) for total and fecal coliforms and *E. coli* by the laboratory of the Ministry of Health in Choluteca (Secretaria de Salud, Region de Salud No. 4)

Table 4g. Community and Household Water Sources Receiving Treatment and Coliform Results Honduras - Study Area 2 - Marcovia, February 2000

Water tested	Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	1	0% (0/1)	0% (0/1)	0% (0/1)
Household samples	13	13% (1/8)	85% (11/13)	31% (4/13)

Community Water Source

The community water source was a hand-pumped well constructed by the ARC. This water source did not contain total coliforms, fecal coliforms or *E. coli*.

Household Water Samples

As shown in Table 17, 85% (11/13) of household water samples tested positive for fecal coliforms and 31% (4/13) were positive for *E. coli.* The positive samples ranged from 100 CFU/100 ml (the detection limit) to 3.2 x 10^4 CFU/100 ml for fecal coliform and from 100 to 200 CFU/100 ml for *E.coli*. Two household samples, both from households which took their water from the community hand-pumped well and reported not treating their water, were not contaminated with fecal coliforms or *E. coli*. Sixty-two percent (8/13) of households where water samples were taken, reported whether their water was treated on the day of the interview. Thirteen percent (1/8) of water samples were reported treated. Fifty percent (4/8) of the household water sources that were reported treated or untreated were contaminated by both fecal coliforms and *E. coli.*

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in Marcovia are summarized in Table 4h. The USAID guidelines target a 25% decrease in diarrhea rates in children <36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita

water use was 34 L/person/day which is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 30% and also below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 4h. Impact Indicators
Honduras - Study Area 2 - Marcovia, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	29% (13/45)
Per capita daily water use	34 L/person/day
Food preparers with appropriate handwashing behavior	19% (17/92)
Childcare providers with appropriate handwashing behavior	19% (17/92)
Population using hygienic sanitation facilities*	30% (137/460)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation that was 26% (22/83).

Discussion

This study of the conditions in Marcovia, Honduras was conducted to gather baseline data on water use and presence of sanitary facilities before the ARC water and sanitation project was implemented. These data will be compared to follow-up data that will be collected during the two years following the baseline survey data collection in order to assess the effectiveness of the water and sanitation interventions.

Two-thirds of the affected population in Marcovia had moved to the new resettlement community a few miles from the original community although the water and sanitation services were not yet completed at the resettlement community. Many of the people had moved because Hurricane Mitch had destroyed their access to drinking water and/or sanitation services in their old homes. Most of those who had not yet moved to the resettlement community were either staying with relatives or had water and/or sanitation services in their old homes. These families generally were waiting for the household water and sanitation services to be fully functional before they moved to the new community.

Discussion Part I - Household and Community Surveys

Water

The majority of the people in the community obtained their water from a shared well (Table 4a) and lived in their own homes. The effect of Hurricane Mitch on the community was reflected in the approximately 50% decrease in the number of households obtaining their water from

household spigots (49% before Hurricane Mitch, compared to 28% at the time of the survey). On average, 34 L of water were collected per person per day, an amount that is below the USAID guideline of 50 L/person/day. The people who obtained water from the shared well collected the greatest volume of water each day (Table 4b). The effect of the hurricane was also reflected in the reported distance traveled to obtain water. The mean distance increased approximately 2.5 times, from 192 m before the hurricane to 453 m after Hurricane Mitch.

All of the houses interviewed stored water in their homes for drinking and for other household use. Eighty percent of survey respondents reported waiting to get water; the majority waited for longer than 30 minutes. Seventy-eight percent of respondents reported having water all day, and 85% reported having water all year. The provision of household spigots will provide relief to waiting for water and water availability problems. The water availability for the residents of this community is anticipated to meet USAID guidelines after the household spigots are installed. Time not used in obtaining water can be used for other important functions such as feeding children and making money to provide more or better food for the family.

At a household level, residents of Marcovia took precautions to maintain water purity. Eighty-eight percent of households covered their drinking water storage containers, and 23% reported always treating their water, predominantly with chlorine. However, 46% of respondents were observed to obtain their drinking water from their stored water supply by dipping in a cup, which could potentially contaminate the water in the container by allowing the water to come into contact with dirty or contaminated hands or cups. The prevalence of this practice and the high percentage of household water samples that tested positive for fecal coliform bacteria (85% (11/13)) indicates that a high number of people may be exposed to contaminated water in this community, and that the water is likely contaminated at the household level.

Sanitation

Only 26% of households reported access to sanitation. Most of those who did have access to facilities used dry pit latrines. Of the latrines inspected, 45% met the USAID guidelines for appropriate hygiene and use. The ARC plans to provide latrines for each household, thus increasing access to sanitation to 100%.

By next year, the sanitary intervention of providing household latrines and charlas on proper use and care of the latrines should improve access to sanitary facilities and increase the percentage of those that are hygienic and in use.

Diarrhea Prevalence and Breast-feeding Practice

There were 29 cases of diarrhea per 100 children <36 months of age in the two weeks prior to the survey. Prevalence was lowest (9 cases per 100 children) in infants (≤6 months), 100% who were breast-fed, and was highest (42 cases per 100 children) in the 13 to 24 month age range, when most children (89%) had been weaned from breast-feeding. In each of the age groups, the percentage of children with diarrhea among breast-fed and not breast-fed children was similar (Table 4d). However, the number of children <36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Hand washing

Nineteen percent of food preparers and childcare providers demonstrated appropriate knowledge and practice of hand washing behaviors (Tables 4e and 4f). The same percentage of respondents reported receiving a charla on appropriate hand washing behavior. Lack of appropriate hand washing behavior among these members of the household could contribute to the contamination of water at the household level, and to direct fecal-oral disease transmission. Charlas on hygiene and provision of household spigots should increase the likelihood that residents of Marcovia will use appropriate hand washing behavior in the future.

Part II – Water Sampling and Analysis

The laboratory of the Ministry of Health in the Department of Choluteca analyzed the water samples. The samples were processed by the membrane filtration technique, which is a quantitative method for enumerating bacteria in water samples. The laboratory using this method quantified total and fecal coliform bacteria, as well as *E. coli*. The data from the replicate samples were similar, indicating that quality control in the lab was likely to be adequate. However, the lab provided no routine quality control data. Therefore, the results of the analyses cannot be viewed as definitive.

At the time of the survey, all of the residents who had moved into the resettlement community obtained water from a single community well built by the ARC. The well was constructed to provide a temporary water source while the long-term intervention -- a well, distribution system, and household spigots -- was constructed. The water sample taken from the community well was not contaminated with fecal coliform bacteria or *E. coli* (Table 4g).

The results of the laboratory water analyses confirm that much of the household water is contaminated (Table 4g). While the community well was not contaminated, 85% of household water samples tested positive for fecal coliforms and 32% tested positive for *E. coli*. The water may have been contaminated during collection by contaminated storage containers or it may have been contaminated during storage by contact with contaminated hands and/or glasses. Although 13% of households where water was collected reported treating their water on the day of the interview, 80% of samples reported to have been treated were positive for fecal indicator organisms.

Recommendations

The CDC recommends that since the lab provided no routine quality control data, it would be beneficial to obtain quality assurance data from the laboratories if future water samples are taken to in-country labs for analysis.

Nicaragua – Study Area 1 - Nueva Segovia

A team of eleven interviewers, the ARC in-country water and sanitation delegate and supervisor, and one CDC investigator traveled by bus from Managua to Nueva Segovia. A census was conducted in two communities: 60 households in Dipilto Nuevo on February 7 and 41 households in Dipilto Viejo on February 8, 2000. Upon arrival to the center of town, the interviewers were assigned sections of the community in which to conduct their interviews. There was close to universal participation of the study with 95% (101/106) of contacted households agreeing to participate.

Community Description

CDC conducted a community survey with two members of the town council's water committee on the day of the assessment to obtain general information about the communities and their water-use practices. The president of the town council was not available on the day information was gathered.

Dipilto Nuevo and Dipilto Viejo are two rural communities of approximately 100 households and 340 inhabitants in the state of Nueva Segovia in Nicaragua. It is in a mountainous part of the region next to the Honduran border. There is a paved road that runs between the two communities, although the same town council coordinates services for both. The people in Dipilto Nuevo and Dipilto Viejo were affected by Hurricane Mitch and are working to rebuild their community. Most of the people currently living in either community are originally from the area. The primary occupation is agriculture. The majority of the population has at least a sixth grade education.

At the time that the study was conducted, many homes and latrines were being built. Although at the time of the assessment there was no water system in the community, a system is being planned for this year. Community leaders indicated that the principal need of the community was to reconstruct the water system that was destroyed during Hurricane Mitch.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation and hygiene behavior.

Water

The water intervention the ARC plans to provide will be a combination of household and shared spigots, which are anticipated to meet the USAID guideline (Billig et al., 1999). The ARC anticipates completion of the project by December 1, 2000. The monthly cost of the water system is estimated to be 20 to 30 cordoba per household (between $1.50 to $2.50). In addition, charlas (workshops) on hygiene and proper collection and storage of drinking water are planned to address the issues of household water contamination.

Sanitation
The ARC plans to provide households with dry pit latrines. It is expected that the latrines will be completed by December 1, 2001.

Hygiene Behavior – Hand washing
The ARC intervention includes an educational component on appropriate hygiene behavior.

Demographic Information

The mean household size was 5.1 people per household. The mean number of children less than 36 months was 0.9 per household. Eighty-one percent (82/101) of those interviewed indicated that they were living in their own home. Eight percent (8/101) were living with friends or family, and 7% (7/101) were living in temporary housing.

Part I – Household and Community Surveys

Water
Water Availability
Table 5a summarizes the water sources before and after Hurricane Mitch. Prior to the hurricane, the majority of water was obtained from the river, 32% (32/100). At the time of the baseline survey, the majority of water came from a household spigot, 45% (45/101), which increased from 23% (23/100) before the hurricane. Water collection from a shared spigot (22% (22/101)) increased, but there was a slight decrease in use of the river, shared wells, and household wells. Bottled water and water purchased from a truck were no longer used after Hurricane Mitch.

Table 5a. Water Source Before and After Hurricane Mitch
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	16% (16/100)	22% (22/101)
Household spigot	23% (23/100)	45% (45/101)
Shared well	20% (20/100)	13% (13/101)
Household well	7% (7/100)	2% (2/101)
Bottled water	1% (1/100)	0% (0/100)
River	32% (32/100)	19% (19/100)
Purchased from truck	1% (1/100)	0% (0/100)

The average volume of water collected by water source is shown in Table 5b. The volume of water collected daily varied with the water source, the highest being for those with household wells, 350 liters (L)/day. The least amount of water was from a shared spigot, 80 L/day. Households without household spigots reported collecting an average of 117 L the day before the interview. The average volume of water collected per person per day was 21 L (range: 0 to 220 L/person/day). Sixty-two percent (61/98) of the households reported that they had to wait to get water. Of those who had to wait, approximately one half (32/61) said they had to wait more than one hour, and one third (21/61) said they had to wait between 15 minutes and one hour.

Seventy-seven percent (77/100) of households reported having water all day long and 83% (83/100) reported having water all year long.

Table 5b. Daily Volume of Water Collected in Each Household by Water Source
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared spigot	22	80	20-330	20
Household spigot	42	148	0-810	220
Shared well	13	112	10-440	40
Household well	2	350	40-660	40
River/creek	19	139	0-440	40

The distance households traveled to get to their water source ranged from 0 meters (m) to greater than 1 kilometer (km), with a mean distance of 314 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 8 m. Prior to Hurricane Mitch, households reported traveling an average of 900 m to get water (median 16 m) with a range of 0 m to 20 km. The median distance traveled to get water after Hurricane Mitch decreased from 16 m to 8 m at the time of the survey. Interviewer estimates of the distance from the interviewed household to its water source were lower than those of interviewees (i.e., mean distance of 60 m and a median distance of 3 m). As shown in Table 5c, there was no association between distance traveled and volume of water collected.

Table 5c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Distance (meters)	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
≤10	53	129	0-810	220
11-50	21	94	0-440	40
51-100	6	188	40-440	40
101-200	4	105	48-200	48
201-500	7	243	20-660	40
501-998	-	-	-	-
≥999	7	100	10-330	10

≤ less than or equal to
≥ greater than or equal to

Storage and Treatment

Ninety-four percent (95/101) of households stored water for the home, 93% (93/100) stored drinking water. Eighty-two percent (80/98) were observed to store their drinking water covered. Thirty-six percent (35/98) of households reported treating their drinking water on the day of the survey. Twenty-nine percent (27/93) of household reported always treating their water, 36% (33/93) reported sometimes treating it, and 36% (33/93) reported never treating it. Overall, 58%

(53/92) of households treated their water with chlorine, 9% (8/92) boiled it, and 2% (2/92) used another method. Seventy-two percent (68/95) of households were observed to get drinking water by dipping a cup into the water supply.

Home Water Use

Households reported washing clothes 5 days a week (range: 1 to 7 days per week). Forty-nine percent (48/99) of households reported washing their clothes at their home and 8% (8/99) reported doing so at their neighbor's home. The remaining 43% (43/99) washed their clothing in a river or creek. Eighty-nine percent (89/100) of households bathed in the same place they washed their clothing, with 93% (93/100) of interviewees reporting that they bathed daily.

Sanitation

Ninety-six percent (95/99) of households reported having access to sanitation, of those 95 households, 85 (85%) were private and 10 (11%) were shared. Ninety-eight percent (94/96) of sanitary facilities were observed to be dry pit latrines and 2% (2/96) were water pour flush latrines.

Ninety-one percent (77/85) of the latrines inspected were found to meet the criteria for hygiene and use. Seventy-two percent (358/496) of the total population of the study area >12 months of age reported using hygienic sanitation facilities. Sixty-seven percent (41/61) of households reported disposing of bowel movements of children <12 months of age into a latrine. Eighteen percent (11/61) of households reported disposing of waste outside of the home. The mean distance to a hand washing area from the sanitation facility was 18 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 5d summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Fifty-three percent (31/59) of children <36 months of age were breast-fed. This percentage was highest in the youngest age groups, ≤6 months and 7 to 12 months, and lower in the older age groups, 13 to 24 months and 25 to 35 months. The data show that as the child increased in age, the occurrence of breast-feeding decreased as expected.

Table 5d. Diarrhea Prevalence and Breast-feeding Practice in Children
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	53% (31/59)	29 (17/59)	18 (9/31)	29 (8/28)
6 months	67% (10/15)	27 (4/15)	10 (1/10)	60 (3/5)
7-12 months	75% (9/12)	42 (5/12)	33 (3/9)	67 (2/3)
13-24 months	42% (10/24)	33 (8/24)	63 (5/8)	21 (3/14)
25-35 months	29% (2/7)	0 (0/7)	0 (0/2)	0 (0/5)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months of age was 29 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months and 7 to 12 month age groups, and decreased in the 13 to 24 month and 25 to 35 month age groups. Overall, the period prevalence for diarrhea was higher for children who were not breast-feeding (29 per 100 children) versus those who were breast-feeding (18 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

Hand washing knowledge and behavior of the household food preparer is shown in Table 5e. The measure of handwashing knowledge and behavior was based on the interviewees' ability to recite key times when they wash their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al. 1999). Thirty-three percent (33/100) of food preparers received a passing score. Hand washing before cooking was reported the most frequently, 78% (76/97) and hand washing after cleaning a child's bottom was the least reported, 21% (20/95). In the hand washing demonstration, 98% (97/99) of women washed their hands with water and 80% (79/99) used soap.

Table 5e. Household Food Preparer Hand washing Knowledge and Behavior
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	54% (52/96)
	Before cooking	78% (76/97)
	Before feeding children	35% (34/97)
	After defecating	76% (74/97)
	After cleaning child's bottom	21% (20/95)
How do you wash your hands? (behavior)	Use water	98% (97/99)
	Use soap	80% (79/99)
	Use both hands	94% (93/99)
	Rub hands. 3 times	75% (74/99)
	Dry hands on towel or air dry	62% (61/99)
Total passing score (8 of 10)		33% (33/100)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 5f. Thirty-three percent (32/97) childcare providers received a passing score. Hand washing before cooking was reported the most frequently, 76% (73/96) and hand washing after cleaning a child's bottom was least reported, 23% (22/95). In the hand washing demonstration, 97% (94/97) of the women used water to wash their hands and 79% (77/97) used soap.

Table 5f. Childcare Provider Hand washing Knowledge and Behavior
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Childcare Provider		Percent
When do you wash your hands? (knowledge)	Before eating	54% (51/95)
	Before cooking	76% (73/96)
	Before feeding children	35% (34/97)
	After defecating	75% (73/97)
	After cleaning child's bottom	23% (22/95)
How do you wash your hands? (behavior)	Use water	97% (94/97)
	Use soap	79% (77/97)
	Use both hands	94% (91/97)
	Rub hands 3 times	73% (71/97)
	Dry hands on towel or air dry	61% (59/97)
Total passing score (8 of 10)		33% (32/97)

≥ greater than or equal to

Education

Interviewee's level of education

Interviewees reported from 0 to 13 years of formal education. The mean level of education was 3.4 years. Twenty-five percent (25/101) of interviewees had no formal education. Twenty-four percent (24/101) of interviewees had completed 6 years of education.

Household health education

The Ministry of Health conducted a majority of health education workshops (charlas). The survey showed that 44% (42/96) of households reported receiving a charla on handwashing; 51% (51/100) of households reported receiving a charla on how to treat household water; and 48% (46/95) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household water samples are summarized in Table 5g. At the time of the survey, water samples were taken from several community water sources and a systematic sampling of 15% of the households. The Ministry of Health Laboratory in Ocotal processed and analyzed the water samples. Water samples were tested for fecal coliforms and *E. coli*. Although the lab manager reported verbally that the lab had performed the membrane filtration technique (quantitative), the results were reported under the "MPN" (most probable number) column on the data sheets. MPN is a semi quantitative technique used to estimate the number of bacteria in a sample.

Table 5g. Community and Household Water Sources Receiving Treatment and Coliform Results Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Water Tested		Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	All	9	0%	67% (6/9)	67% (6/9)
	Dipilto Nuevo	5	0%	80% (4/5)	80% (4/5)
	Dipilto Viejo	4	0%	50% (2/4)	50% (2/4)
Household samples	All	19	0%	79% (15/19)	79% (15/19)
	Dipilto Nuevo	12	0%	67% (8/12)	67% (8/12)
	Dipilto Viejo	7	0%	86% (6/7)	86% (6/7)

Community Water Source

A total of 9 water sources were tested; 5 in Dipilto Nuevo and 4 in Dipilto Viejo. Sixty-seven percent (6/9) were contaminated with fecal coliforms and *E. coli*, 80% (4/5) in Dipilto Nuevo and 50% (2/4) in Dipilto Viejo. None of the community sources were treated.

Household Water Samples

Seventy-nine percent (15/19) of household water samples were positive for fecal coliforms and *E. coli*. No households reported treating their water on the day of the survey. Four household samples did not contain any coliform bacteria, 3 were in Dipilto Nuevo and 1 was in Dipilto Viejo.

Part III - Active Diarrhea Surveillance

Active diarrhea surveillance was conducted with all household members in the household survey. The results are provided in Table 5h. The mean age was 22 years with a range of less than 1 to 90 years of age. The average weekly diarrhea prevalence for all age groups was 2.0 per 100 people. The male to female ratio was 1:1. The weekly prevalence of diarrhea for all ages ranged from 4.2 per 100 people (20/477) in Week 1 to 0.4 per 100 people (2/493) in Week 4. The weekly prevalence of diarrhea was highest among children <36 months of age and ranged from 22.0 per 100 people (11/50) in Week 1 to 1.9 per 100 people (1/53) in Week 4. The weekly prevalence of diarrhea in household members ≥65 years was 4.3 per 100 people (1/23) in Week 2 but 0 for all other weeks.

Table 5h. Diarrhea Prevalence by Age and Week
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Age	Diarrhea Prevalence by Week (per 100 people)				
	Weekly Average	Week 1	Week 2	Week 3	Week4
All ages	2.0	4.2 (20/477)	2.2 (11/492)	1.2 (6/493)	0.4 (2/493)
< 36 months	10.7	22.0 (11/50)	13.2 (7/53)	5.7 (3/53)	1.9 (1/53)
. 5 years	7.8	18.1 (17/94)	8.2 (8/97)	4.1 (4/97)	1.0 (1/97)
. 18 years	3.6	8.1 (20/246)	3.5 (9/257)	2.3 (6/258)	0.4 (1/258)
. 65 years	1.1	0 (0/23)	4.3 (1/23)	0 (0/23)	0 (0/23)

< less than
≤ less than or equal to
≥ greater than or equal to

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in Nueva Segovia are summarized in Table 5i. The USAID guidelines target a 25% decrease in diarrhea rates in children <36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 21 L/person/day which is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 72% and just below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluation.

Table 5i. Impact Indicators
Nicaragua - Study Area 1 - Nueva Segovia, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	29% (17/59)
Per capita daily water use	21 L/person/day
Food preparers with appropriate handwashing behavior	33% (32/97)
Childcare providers with appropriate handwashing behavior	33% (33/100)
Population using hygienic sanitation facilities*	72% (358/496)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation which was 96% (95/99).

Discussion

This study of the conditions in Dipilto Nuevo and Dipilto Viejo in Nueva Segovia, Nicaragua was conducted to gather baseline data on water use and presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the two years following the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

The majority of the people in the community obtained their water from a household spigot (45%) and lived in their own homes. Almost all of the people in the survey had access to water all day long and all year long. The per capita use of water was 21 L/person/day. This amount is below the USAID standard of 50 L/person/day in non-emergency situations (Billig et al., 1999). The people who collected the greatest average volume of water each day had household wells (N=2).

Almost everyone stored water in their home, both for drinking and for other household uses. One third of the households reported that they did not treat their drinking water and 72% got water out of the containers by dipping a cup into the container, a practice which could potentially contaminate the water in the container by submerging a contaminated hand or cup into the water. These facts indicate that people are likely to be exposed to contaminated water and that water can be contaminated both at the community and the household level.

Sanitation

Almost all households (96%) had access to sanitary facilities, either private or shared. Ninety-one percent of the sanitary facilities inspected met the criteria for hygiene and use.
By next year, the sanitary intervention should increase the percentage of households with access to sanitary facilities to 100%, and should also increase the percentage of facilities that are hygienic and in use through the educational interventions planned. These interventions are anticipated to help the communities meet water-use guidelines set by the USAID (Billig et al., 1999).

Diarrhea Prevalence and Breast-feeding Practice

The primary childcare providers reported 29 cases of diarrhea per 100 children <36 months of age in the two weeks prior to the survey. Fifty-three percent were breast-fed. Overall, a higher percentage of not breast-fed children had diarrhea than children who were breast-fed (Table 5d). However, age may be a confounding variable since younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the true risk of diarrhea in breast-fed and not breast-fed infants the survey would need to control for age. The number of children under 36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Hand washing

An assessment of handwashing knowledge and behavior of both household food preparers and childcare providers indicates that a third of the participants practiced hygienic methods of washing their hands by USAID standards. Inappropriate hand washing behavior could contribute to the contamination of water at the household level and to direct fecal-oral disease transmission.

Approximately half of the households interviewed reported receiving a charla on handwashing, how to treat household water, and the care and use of latrines. Household health education was attributed primarily to the health promoters from the Ministry of Health. Additional education will increase the percentage of households that receive health education and can be measured in the follow-up survey.

Part II – Water Sampling and Analysis

There were some difficulties in using the laboratory from the Ministry of Health to process the water samples. Laboratory closing time, adequate sample volume, and unclear documentation resulted in this data set not being adequate.

The laboratory closed at 4:00 p.m. which made it difficult for researchers to finish collecting all of the samples for delivery to the laboratory before it closed. Although at least 100 ml of water was collected at every sample site, the lab frequently reported that the samples contained an inadequate volume of water, DPC (demasiado poco cantidad). The laboratory also provided unclear documentation of the results. The laboratory manager verbally reported that they would provide data using the requested method of membrane filtration for quantification of *E. coli*. The results were recorded as MPN, a semi-quantitative technique. In addition, data included reference to OBP (other bacteria present) but the types of bacteria detected were not recorded. The laboratory analysis indicated that 50 to 86% of all samples were contaminated with *E. coli*.

Recommendations

The CDC recommends the use of a portable water testing kit, such as DelAgua, with the PurTest kit to confirm the results for the follow-up evaluations.

Active diarrhea surveillance data should be compared to clinic data in the follow-up evaluation to determine whether clinic data may be used as a surrogate for similar data from households.

Nicaragua - Study Area 2 – Waspam

Study Area 2 in Waspam, Nicaragua consisted of two communities, Andres and Kum. Both are rural communities, which are located in the Gracias a Dios Region of Nicaragua along the Rio Coco (Coco River). Andres is only accessible by river. Kum is accessible by both river and a dirt road. A community interview was conducted with the community leaders and the ARC delegate to obtain background information about the communities. Both communities were very motivated to participate in the study as demonstrated by the almost 100% participation rate. Separate community descriptions are provided but baseline survey data are compiled for both communities.

Community Description

Andres

The community council (the city council chief, the community coordinator, the assistant community coordinator, the judge, the assistant judge, the head of the churches of the community, the head of the women's group, and the head of the elderly group), the regional ARC delegate, and the national ARC delegate completed the community survey in Andres. At the time of the survey, the council felt that their community's greatest need was latrines.

The community of Andres has been in existence for more than 100 years. The community, which is divided into barrios (neighborhoods), consists of 187 houses with a total of 1,908 people. The people of this community are all Miskito Indians and speak Miskito. A council of community members governs them. The primary form of employment is agriculture. The education level of the population is generally second grade. Annually, the community has 2 to 3 feet of flooding and homes are built on stilts. Andres experienced severe flooding after Hurricane Mitch.

The community was receiving food aid from ARC following Hurricane Mitch that stopped in October 1999. The residents have health care that is provided by the Ministry of Health. There is a health post that provides care to the community with a doctor who rotates through the clinic every one to two years. The community had some health education in October 1999 that focused on the proper use of latrines.

The community water supply is primarily the Rio Coco and is augmented by rainwater collected from the roofs. They have three community wells that are not being used. The water from one well was tested nine years ago. When the residents were told it was contaminated, they stopped using it. The second well is near the school and health post, but is dry. The third well was dug recently and was tested by Accion Medica, a local non-government organization (NGO). This well was determined to be 'toxic' and the community has never used it. Wells are difficult to dig in this area because the soil is sandy and collapses. The Ministry of Health addressed the water issue in Andres four months ago by distributing water filters to every household and providing instructions on their use. However, may of the community members were using the filters incorrectly.

The community has no formal sanitation system. A few private homes have sanitation, as does the health post. In 1993, Accion Medica dug 40 latrines in the community, all of which have been destroyed by flooding.

Kum

The community council (the judge, the head of agriculture, some of the members of the water board, the heads of the churches of the community, the head of the women's group, and the head of the elderly group), the regional ARC delegate, and the national ARC delegate completed the community survey. At this time, the council feels that their community's greatest need is to improve and supply the health post.

Kum is a geographically larger community than Andres. The community consists of 362 houses with a total of 1,904 people. The people of this community are all Miskito Indians and speak Miskito. Like Andres, a council governs Kum. The primary form of employment is agriculture. There is an illiteracy rate of approximately 30%. The average education level of the community is fifth grade, but there is a wide range in education. Kum experiences flooding every couple of years, and like Andres, the homes in Kum are built on stilts. Kum also had flooding from the Rio Coco after Hurricane Mitch.

The community was receiving food aid from ARC following Hurricane Mitch that stopped in October 1999. The residents have health care that is provided by the Ministry of Health. There is a health post that provides care to the community with a doctor who rotates through the clinic every one to two years. The health clinic has no medical supplies (medicine) or electricity. The water board provided some health education in October 1999 that was focused on water, wells, and latrines.

The primary water supply for the community is Kum Creek and rainwater collected from the roofs. There are some areas along the creek bank that have been dug out by the residents to collect water. There are also two wells in the community, installed by the ARC as a pilot project, which supply water to a few homes. The ARC pilot project wells have been well received and are currently in use. There is one additional well that is only for use at the health post but reported to be contaminated. The community has problems with sandy soil that collapses when the residents have tried to dig wells. A six-person water board helped arrange the digging of the first two ARC wells. There is no formal payment system for use of the wells, but members of the water board would go house to house to collect funds if a problem with the wells arose. The community has no formal sanitation system. Twelve houses have private pit latrines.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation and education.

Water

The planned ARC interventions for these communities include three community wells in Andres, one well for each barrio, and approximately three community wells in Kum. The ARC will

provide materials and supplies and work through Accion Medica to construct wells and anticipates their completion by May 2001. Households will be charged for maintenance of the wells that will be designed to be flood resistant. The cost has not been determined but estimated to be approximately one US dollar per household per well per year. The funds will be used for system maintenance and wells will be made accessible to all households.

Sanitation

At the time of the survey, sanitation was the greatest community need in Andres, however, there was no sanitation intervention planned. The ARC plans to build shared latrines in Kum. The ARC anticipates completion of the latrines in Kum by May of 2001. All households in Kum should have access to a latrine at the end of this project.

Education

As part of the ARC interventions, health education will be conducted that includes the care and use of latrines.

Demographic Information

At the time of the survey, the mean household size in Waspam (both Andres and Kum) was 8.4 people per household, with the average household having 1.2 children under the age of 36 months. Eighty-eight percent (99/112) of the residents of these households lived in their own home. Ten percent (11/112) of the respondents lived with friends or family and the remaining 2% (2/112) lived in temporary shelters.

Part I – Household and Community Surveys

Water

Water Availability

Table 6a summarizes the water sources before and after Hurricane Mitch. The majority of households, 82% (91/111), relied on the river or creek as their primary source of water after Hurricane Mitch, compared to 89% (100/112) prior to the hurricane. Fourteen percent (16/111) got their water from a shared well and the remaining 4% (4/111) got their water from a spring.

Table 6a. Water Source Before and After Hurricane Mitch
Nicaragua – Study Area 2 – Waspam, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared well	6% (7/112)	14% (16/111)
River/stream	89% (100/112)	82% (91/111)
Other	5% (5/112)	4% (4/111)

The average volume of water collected by water source is shown in Table 6b. Households reported collecting a mean of 94 liters (L) of water the day before the interview. Those with the river or stream as their main source for water reported collecting the greatest amount of water per household, 95 L. Households that used a spring as their water source reported collecting much less (57 L). The mean volume of water collected per person per day was 12 L (range: 1 to 40

L/person/day; median: 10 L/person/day). Ninety-eight percent (110/112) of households reported having water all day long and 94% (105/112) reported having water all year long. Twenty percent (22/112) of households reported that they had to wait for water. Of those who had to wait, approximately one half (8/15) said that they had to wait less than 15 minutes, but one fourth (4/16) said they had to wait for more than one hour.

Table 6b. Daily Volume of Water Collected in Each Household by Water Source
Nicaragua – Study Area 2 – Waspam, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared well	16	86	20-200	110
River/stream	91	95	20-220	110
Other	54	57	40-68	54

The distance households traveled to get to their water source ranged from 0 meters (m) to greater than 1 kilometer (km), with a mean distance of 108 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 23 m. Prior to Hurricane Mitch, households reported traveling an average of 328 m to get water (median 48 m) with a range of 0 m to 12 km. The median distance traveled to get water after Hurricane Mitch decreased from 48 m to 23 m at the time of the survey. Interviewer estimates of distance from the interviewed household to its water source were greater than that of the interviewees (i.e., mean distance of 164 m and a median distance of 100 m).

Storage and treatment

Ninety-eight percent (110/112) of households stored water for the home, and 97% (109/112) stored drinking water. Sixty-four percent (70/109) were observed to store their drinking water covered. Thirty-one percent (34/111) of households reported treating their drinking water on the day of the survey. Twenty percent (22/111) of households reported always treating their water, 56% (62/111) reported sometimes treating it, and 24% (27/111) reported never treating it. Overall, 65% (71/110) of households treated their water with chlorine and 6% (7/110) used water filters. Eighty-six percent (93/108) of households were observed to get drinking water by dipping a cup into the water storage container.

Home water use

Households reported washing clothes an average of 3.7 days a week (range: 1 to 7 days per week). One hundred percent (112/112) of households reported washing their clothes in the river or creek. Ninety-nine percent (111/112) of households bathed in the same place they washed their clothing, and 97% (109/112) of interviewees reporting that they bathed daily.

Sanitation

Twenty-one percent (23/112) of households reported having access to sanitation; of those, 21 (91% (21/23)) were private and two (9% (2/23)) were shared. All sanitary facilities were observed to be dry pit latrines.

Of the 23 latrines inspected, 13 (57% (13/23)) were found to meet the criteria for hygiene and use. Four percent (165/4490) of the total population of the study area >12 months of age reported using hygienic sanitation facilities. Four percent (3/75) of households reported disposing of bowel movements of children <12 months of age into a latrine. The majority of households disposed of the waste outside the home (59% (44/75)) or in the river or creek (37% (28/75)). The mean distance to a handwashing area from a sanitary facility was 28 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 6c summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Fifty-five percent (56/102) of children under 36 months of age were breast-fed. This percentage was highest in the youngest age groups, ≤6 months and 7 to 12 months, and lower in the older age groups, 13 to 24 months and 25 to 35 months. The data show that as a child increased in age, the occurrence of breast-feeding decreased as expected.

Table 6c. Diarrhea Prevalence and Breast-feeding Practice in Children
Nicaragua - Study Area 2 - Waspam, February 2000

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not breast-feeding (per 100 children)
< 36 months	55% (56/102)	49 (50/102)	57 (32/56)	43 (20/46)
6 months	69% (24/35)	60 (21/35)	58 (14/24)	64 (7/11)
7-12 months	94% (15/16)	56 (9/16)	60 (9/15)	0(0/1)
13-24 months	38% (15/39)	38 (15/39)	53 (8/15)	29 (7/24)
25-35 months	17% (2/12)	42 (5/12)	50 (1/2)	40 (4/10)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months of age was 49 cases per 100 children. The prevalence decreased during the first year of life between the ≤6-month age group and the 7 to 12 month age group, and continued to decrease in the 13 to 24 months age group. The prevalence slightly increased in the 25 to 35 month age group. Overall, the period prevalence for diarrhea was higher for children who were breast-feeding (57 per 100 children) versus those who were not breast-feeding (43 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

Hand washing knowledge and behavior of the household food preparer is shown in Table 6d. Hand washing knowledge and behavior was based on the interviewees' ability to recite key times when they wash their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Seventeen percent (19/112) of food preparers received a passing score. Hand washing before cooking was reported the most frequently, 79% (88/112), and hand washing after cleaning a child's bottom was the least reported, 18% (20/112). In the hand

washing demonstration, 99% (110/111) of the women washed their hands with water and 60% (66/111) used soap.

Table 6d. Household Food Preparer Hand washing Knowledge and Behavior
Nicaragua - Study Area 2 - Waspam, February 2000

Household Food Preparer		Percentage
When do you wash your hands? (knowledge)	Before eating	51% (57/112)
	Before cooking	79% (88/112)
	Before feeding children	26% (29/111)
	After defecating	46% (52/112)
	After cleaning child's bottom	18% (20/112)
How do you wash your hands? (behavior)	Use water	99% (110/111)
	Use soap	60% (66/110)
	Use both hands	93% (103/111)
	Rub hands, 3 times	52% (57/110)
	Dry hands on towel or air dry	25% (27/109)
Total passing score (8 of 10)		17% (19/112)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 6e. Nineteen percent (19/102) of childcare providers received a passing score of at least 8/10. Hand washing before cooking was reported the most frequently, 75% (76/102) and hand washing after cleaning a child's bottom was the least reported, 25% (25/102). In the hand washing demonstration, 100% (103/103) of the women used water to wash their hands and 64% (66/103) used soap.

Table 6e. Childcare Provider Hand washing Knowledge and Behavior
Nicaragua - Study Area 2 - Waspam, February 2000

Childcare Provider		Percent
When do you wash your hands? (knowledge)	Before eating	54% (55/102)
	Before cooking	75% (76/102)
	Before feeding children	31% (31/102)
	After defecating	52% (53/102)
	After cleaning child's bottom	25% (25/102)
How do you wash your hands? (behavior)	Use water	100% (103/103)
	Use soap	64% (66/103)
	Use both hands	94% (97/103)
	Rub hands, 3 times	52% (53/102)
	Dry hands on towel or air dry	33% (34/103)
Total passing score (8 of 10)		19% (19/102)

≥ greater than or equal to

Education

Interviewee's level of education

Interviewees reported from 0 to 11 years of formal education. The mean level of education was 3 years. Twenty-seven percent (30/112) of interviewees had no formal education. Eighteen percent (20/112) of interviewees had completed 6 years of education.

Household health education

Accion Medica, a local NGO, and the Ministry of Health conducted a majority of the health education workshops (charlas) in the past. The survey showed that 46% (48/105) of households reported receiving a charla on proper hand washing, 53% (57/108) of households reported receiving a charla on how to treat household water, and 18% (20/110) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The community water source and household water samples were analyzed for total coliforms and *E. coli* using the DelAgua Water Testing Kit. The results of the analyses of the community water source and household water samples are summarized in Table 6f.

Table 6f. Community and Household Water Sources Receiving Treatment and Coliform Results Nicaragua - Study Area 2 - Waspam, February 2000

Water Tested		Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	All	0%	87% (6/7)	87% (6/7)
	Andres	0%	100% (3/3)	100% (3/3)
	Kum	0%	75% (3/4)	75% (3/4)
Household samples	All	27% (3/11)	82% (9/11)	80% (9/11)
	Andres	40% (2/5)	80% (4/5)	80% (4/5)
	Kum	17% (1/7)	83% (5/6)	83% (5/6)

Community Water Source

There were seven community water sources tested: three in Andres and four in Kum. All samples were contaminated with fecal coliforms and *E. coli*, with the exception of the ARC well in Kum. Results ranged from 0 to >999 CFU/100 ml for *E. coli*. Positive results reported as >999 CFU/100 ml indicates the number of coliform colonies were too numerous to count.

Household Water Samples

There were eleven household water samples tested: five in Andres and six in Kum. Eighty-two percent (9/11) of household water samples were positive for fecal coliforms and *E. coli*. Results for *E. coli* ranged from 0 to >999 CFU/100ml. Two household water samples were not contaminated: one was from the river but was reported to be treated by the household; and the second sample was from the ARC well that was not contaminated and also not treated. Fifty percent (5/10) of water samples were reported to be treated on the day of the interview.

Chemical Analysis

It was reported that wells in these communities were contaminated with chemicals and were no longer used. All of the community water sources for Andres and Kum were tested for arsenic and mercury and the Rio Coco only was tested for pesticides. The results are provided in Table 6g.

Table 6g. Chemical Analysis Results for the Community Water Sources
Nicaragua - Study Area 2 - Waspam, February 2000

Chemical	Range :g/L	Maximum Contaminant Level * :g/L	Greater Than the MCL?
Inorganics-Andres and Kum			
Arsenic	0.19 – 12.75	50	No
Mercury	0.009 – 0.019	2	No
Pesticides-Rio Coco only**			
Chlordane	ND	2	No
Endrin	ND	2	No
Heptachlor	ND	0.4	No
Heptachlor epoxide	ND	0.2	No
Lindane	ND	0.2	No
Methoxychlor	ND	40	No
PCB (total)	ND	0.5	No
Toxaphene	ND	3	No

ND not detected
* USEPA, 1999. MCL maximum contaminant level for safe drinking water
** Other pesticides analyzed were not detected-Aldrin, Chlorpyriphos, DDT, DDD, DDE, DEF, Diazinon, Dieldrin, Disulfoton, Endosulfan, Ethion, Fonofos, Malathion, Methyl Parathion, Mirex, Parathion, Perthane, Phorate, s,s,s-Tributylphosphorotrithioate, Trithion and did not have a MCL.

Andres

In addition to the three sources, two wells were tested that were not being used. Both wells were reported contaminated prior to the baseline survey sample collection. The first well in Barrio 3 has not been used in nine years. It is an open string well that was found to be broken with floating debris on the water in the well. The second well was a recently dug closed well. Water is obtained from the well by hand pumping using a large plastic pipe. This method generates a significant amount of sediment in the water collected from this well.

All source waters in Andres were tested for arsenic and mercury and the Rio Coco sample was also tested for pesticides. Water samples tested for arsenic and mercury were below the US Environmental Protection Agency (USEPA) standards for safe drinking water. Pesticides were not detected in the water sample taken from the Rio Coco.

Kum

The ARC-dug well and Kum Creek were tested for arsenic and mercury. Water samples tested for arsenic and mercury were below the USEPA standards for safe drinking water.

Part III – Active Diarrhea Surveillance

Active diarrhea surveillance was conducted with all household members in the household survey and the results provided in Table 6h. The mean age was 20 years with a range of <1 to 86 years. The average weekly diarrhea prevalence for all age groups was 6.6 per 100 people. The male to female ratio was 1:1. The weekly prevalence of diarrhea for all ages ranged from 8.6 per 100 people in Week 1 to 5.1 per 100 people in Week 2. The weekly prevalence of diarrhea was highest among <36 months of age and ranged from 40.5 per 100 people in Week 1 to 21.5 per 100 people in Week 2. The weekly prevalence of diarrhea in household members ≥65 years ranged from 18.5 per 100 people in Week 1 to 0 in Week 4.

Table 6h. Diarrhea Prevalence by Age and Week
Nicaragua - Study Area 2 - Waspam, February 2000

Age	Diarrhea Prevalence by Week (per 100 people)				
	Weekly Average	Week 1	Week 2	Week 3	Week 4
All ages	6.6	8.6 (81/943)	5.1 (47/925)	6.4 (60/942)	6.3 (59/941)
< 36 months	29.4	40.5 (32/79)	21.5 17/79)	27.8 (22/79)	27.8 (22/79)
≥ 5 years	20.5	27.1 (49/181)	15.5 (28/181)	20.0 (36/180)	19.4 (35/180)
≥ 18 years	8.5	11.1 (62/559)	6.8 (37/547)	8.1 (45/558)	8.1 (45/558)
≥ 65 years	8.4	18.5 (5/27)	11.5 (3/26)	3.7 (1/27)	0 (0/27)

< less than
≤ less than or equal to
≥ greater than or equal to

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in Waspam are summarized in Table 6i. The USAID guidelines target a 25% decrease in diarrhea rates in children <36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 12 L/person/day which is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 4% and also below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 6i. Impact Indicators
Nicaragua - Study Area 2 - Waspam, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	49% (50/102)
Per capita daily water use	12 L/person/day
Food preparers with appropriate handwashing behavior	17% (19/112)
Childcare providers with appropriate handwashing behavior	19% (19/102)
Population using hygienic sanitation facilities*	4% (165/4490)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation which was 21% (23/112).

Discussion

This study of the conditions in Waspam, Nicaragua was conducted to gather baseline data on water use and the presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the two years following the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

The majority of the people in the community obtained their water from the river and lived in their own homes. The mean use of water was 12 L/person/day. Since the households surveyed utilized a river source, they had access to water all day and all year round. Ninety-seven percent of the households interviewed had stored water in their homes, for drinking and other purposes. Many unsafe water practices were found: 24% of the households reported that they never treated their drinking water; 36% of households stored their drinking water uncovered; and 86% got water out of the storage containers by dipping a cup into the water, a practice which could potentially contaminate the water in the container if a contaminated cup or hand were submerged into the water. Water filters that were supplied to one community, Andres, were not being properly used or maintained. These facts indicate that people are potentially being exposed to contaminated water, and that the water may be contaminated at the community as well as the household level.

Sanitation

Only 21% of the households surveyed (23/112) had access to sanitary facilities, either private or shared, with only 4% of the total population having access to hygienic sanitation facilities according to USAID guidelines.

Diarrhea Prevalence and Breast-feeding Practice

There were 49 cases of diarrhea per 100 children <36 months of age in the two weeks previous to the survey. Fifty-five percent of children <36 months of age were breast-fed. Overall, a higher percentage of children who were breast-feeding had diarrhea than children who were not breast-feeding (Table 6c). Age may be a confounding variable since younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the risk of diarrhea among breast-fed and non-breast-fed infants the survey would need to control for age. However, the number of children under 36 months of age was too sparse to get a good estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Hand washing

An assessment of hand washing knowledge and behavior of both household food preparers and childcare providers indicated that fewer than 20% of the participants practiced hygienic methods of washing their hands according to USAID standards, a practice which could contribute to the contamination of water at the household level and to direct fecal-oral disease transmission.

Education

Household health education in the past was attributed primarily to health promoters from the Ministry of Health and Accion Medica. Approximately half of the households interviewed reported receiving a charla on hand washing or how to treat household water. Very few households had any education on the care and use of latrines.

Part II – Water Sampling and Analysis

The results of the water analyses confirmed that much of the water in Study Area 2 was contaminated with coliform bacteria. The principal investigators used the DelAgua portable test kit to analyze all water samples in the field in this study area. The test kit used the membrane filtration technique to quantify *E. coli*. The PurTest kit was used to analyze duplicate samples to confirm the presence or absence of coliform bacteria. The results from this test correlated with the membrane filtration technique. Fecal coliforms and *E. coli* were present in 75 to 100% of all the water samples collected. These test results indicate that people in the community were being exposed to contaminated water from the community water sources and from household stored water. The only water source that was not contaminated in Study Area 2 was an ARC-constructed well in Kum.

The DelAgua portable test kit required approximately 25 minutes per sample analysis and the use of a car battery to power an incubator that had to be transported to the study area. The results provided accurate quantification of *E. coli* in the field. The PurTest is a simple presence or absence test and required no incubation. This test only provided qualitative supportive data on the presence or absence of *E. coli* or coliform bacteria. Both techniques proved useful in the field.

Recommendations

The ARC planned water intervention considers three wells per each community. However, the planned water interventions will not meet the USAID or Sphere guidelines and are limited by logistical difficulties such as, poor soil for well installation, difficulty in transporting equipment, and 2 to 3 feet of flooding annually. The USAID guidelines specify that for non-emergency situations there should be 50 L/person/day of water available within 200 m of the household (Billig et al., 1999). In emergency situations, the Sphere guidelines indicate that one well should be provided for every 250 people within 500 m of each household and able to provide 15 L/person/day (Sphere, 1998).

The CDC recommends increasing the number of wells to meet the Sphere guideline of one well per 250 people at the minimum. Eight wells in Andres and eight wells in Kum, for a total of 16 wells, are recommended in Study Area 2. In addition, improvements should be made in the use of the water filters provided to the community in Andres if their use is continued.

The planned ARC sanitation intervention does not meet the Sphere guideline for sanitation and should be revised. Since the USAID guidelines are not met with regard to sanitation in a non-emergency situation, the CDC recommends that the Sphere guidelines be used for these communities. Sphere guidelines require one latrine for every 20 people and latrines in public places (schools). There are significant logistical considerations involved in providing latrines to these communities that includes difficulty in transporting materials, poor soil for supporting the pit latrine design, and 2 to 3 feet of flooding annually. CDC recommends evaluating the feasibility of construction of composting latrines. Despite these challenges, an attempt should be made to address sanitation in one or both of these communities.

The CDC also recommends that diarrhea surveillance data should be compared with the community health post surveillance data to assess the adequacy of using clinical data as a surrogate for household surveillance data in the future.

El Salvador - Study Area 1 - Las Pozas

A team of eight interviewers, the ARC in-country water and sanitation delegate, and one CDC investigator traveled by car to Las Pozas from San Salvador on February 3, 2000 and conducted all of the 98 interviews in a census of the inhabited houses. Upon arrival to the town, each interviewer was assigned to a different section of the town in which to conduct the interviews. Communication between the interviewers and water sampler was facilitated by walkie-talkie. Although there are 184 houses in Las Pozas, not all of these households had families living in them at the time of this study. There was almost universal participation in the study with 98% (97/99) of the people contacted agreeing to participate.

Community Description

The CDC conducted a survey with the two coordinators of the water committee and the local ARC delegate to obtain general information about the community and their water-use practices.

Las Pozas is located in a rural area approximately 20 kilometers off the main highway. The terrain is flat and a small river flows around the community. There are no shops or schools in the community. Houses are located on city blocks separated by unpaved streets. Las Pozas had been divided into three sections (I, II, and III) based on why the people relocated to the community. The total number of households in Las Pozas is 968. The CDC conducted this study in Las Pozas III, the area in which the people affected by Hurricane Mitch relocated. There are 184 houses and an approximate population of 1100 people in Las Pozas III. The people living in the other sections of Las Pozas located there for different reasons; for example, some were victims from the civil war. For the remainder of this report, Las Pozas III will be referred to as Las Pozas.

The majority of the population in Las Pozas is illiterate. The main occupation in the community is agriculture. At the time of the survey, there was no water system in the community. The water system that is being planned for the community will deliver piped water to the houses. The principal need of the community as this time, as described by community leaders, is employment.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned intervention for water, sanitation and hygiene behavior.

Water

The agency CARE is managing the water project for this community. Households will receive piped water to a household tap that will be shared between houses. By next year, the planned water intervention should increase the amount of water used in households, reduce the potential for exposure to contaminated water, and reduce the distance from household to water source. The monthly cost will be 20 colones ($2.29). The water system should be installed and functioning by April of 2001.

Sanitation
The ARC plans to build composting latrines for each household. The latrines are scheduled to be installed and functioning by April 2000.

Education
There is a hygiene education campaign by a NGO called CALMA that started in January 2000 and will be completed in April 2001.

Demographic Information

The mean household size was 3.8 people per household. On average, 0.5 children under the age of 36 months lived in each house. Fifteen percent (15/98) of those living in these households were living in their own home, 83% (81/98) were living in temporary homes, and 2% (2/98) were living with friends or family.

Part I – Household and Community Surveys

Water
Water availability
Prior to Hurricane Mitch, there was more variety in the water sources than after the hurricane. Table 7a summarizes the water sources before and after Hurricane Mitch. Before the hurricane, forty-one percent (39/96) of the households primarily obtained their water from household wells. Thirty-two percent (31/96) obtained their water from shared wells, 19% (18/96) from shared spigots, 4% (4/96) from the river, 3% (3/96) from household spigots, and 1% (1/96) from a distribution truck. After Hurricane Mitch, at the time of the survey, 70% (67/96) of the households obtained their water from a shared well. Twenty-one percent (20/96) of the households obtained their water from the river and now 9% (9/96) obtained their water from a household well.

Table 7a. Water Source Before and After Hurricane Mitch
El Salvador - Study Area 1 - Las Pozas, February. 2000.

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	19% (18/96)	0% (0/96)
Household spigot	3% (3/96)	0% (0/96)
Shared well	32% (31/96)	70% (67/96)
Household well	41% (39/96)	9% (9/96)
River	4% (4/96)	21% (20/96)
Purchased from truck	1% (1/96)	0% (0/96)

The average volume of water collected by water source is shown in Table 7b. The average volume of water collected in each household varied by water source. Households reported collecting a mean of 162 liters (L) of water the day before the interview (median 132 L). More specifically, they reported an average of 43 L/person/day (range: 0 to 264 L/person/day; median: 26 L/person/day). Sixty-eight percent (61/90) of households reported that they had to wait to get

their water. Of the respondents who reported having to wait for water, the majority (62% (38/67)) reported waiting for less than 15 minutes. One fourth (18/67) of these respondents said that they had to wait between 15 minutes and a half hour and 13% (11/67) had to wait for longer than a half hour. Ninety-seven percent (94/97) of the households reported having water all day long, while 66% (63/96) reported having water all year round. Many of the respondents were unsure (29/96) if they had access to water all year round because they had lived in the area for less than a year.

Table 7b. Daily Volume of Water Collected in Each Household by Water Source
El Salvador - Study Area 1 - Las Pozas, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared well	65	154	4- 968	22
Household well	9	188	62- 400	62
River	18	179	22- 455	132

The amount of water stored varied according to where clothes were washed. In general, households where clothes were washed in the river reported lower quantities of water for household use. In households that had facilities for washing clothes (N=9), the average amount of water used the previous day was 209 liters. In households that reported using a neighbor's house to wash clothes (N=1), 792 liters were used on the previous day. In households that washed clothes in the river (N=83), the average amount of water used the previous day was 148 liters.

At the time of the survey, the distance households traveled to get to their water source ranged from 0 meters (m) to 3000 m, with a mean distance of 301 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 150 m. According to the interviewees, prior to Hurricane Mitch household members traveled an average of 97 m to get to their water source (median 10 m) with a range of 0 m to 1000 m. The median distance traveled to get water after Hurricane Mitch increased from10 m to 150 m at the time of the survey. Interviewer estimates of the distance from the interviewees' houses to their respective water sources were less than those of the interviewees. The interviewer's estimation of the distance to the water source ranged from 1 to 700 m, with a mean distance of 221 m. The median distance traveled was the same at 150 m. As shown in Table 7c, the average volume of water was about the same from all distances.

Table 7c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
El Salvador - Study Area 1 - Las Pozas, February 2000

Distance (meters)	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
≤10	10	188	22-400	220
11-50	8	179	22-968	22
51-100	21	121	22-330	44
101-200	24	193	4-792	132
201-500	18	133	8-682	88
501-998	6	163	44-455	44
≥999	6	188	77-330	77

≤ less than or equal to
≥ greater than or equal to

Storage and Treatment

Ninety-three percent (90/97) of households stored water in their homes, 96% (92/96) stored drinking water. Seventy-two percent (64/89) of the households were observed to have stored their drinking water covered. Twenty-five percent (24/97) of the households reported treating their drinking water on the day of the survey. Twenty percent (19/96) of the households reported always treating their drinking water, 35% (34/96) reported sometimes treating their drinking water, and 45% (43/96) reported that they never treated their drinking water. Among the households that reported treating their water, the most common method of treatment was chlorine addition. Eighty-two percent (47/57) of the households reported using chlorine and 12% (7/57) reported use of ash as a purifier. Forty-nine percent (45/92) of the respondents to the questionnaire were observed to get drinking water from their stored water by pouring the water out from the container. Another 48% (44/92) got the drinking water out by dipping a cup into the container.

Home Water Use

Households reported washing clothes an average of 3.9 days a week (range: 1 to 7 days per week). Ninety percent (87/97) of the households reported washing their clothes in the river, while 9% (9/97) reported washing at home and 1% (1/97) reported washing at a neighbor's house. Seventy-nine percent (76/96) of the households bathed in the same place they washed clothing. Seventy-six percent (73/97) reported that they bathed at least once a day, while 11% (11/97) reported bathing three times a week.

Sanitation

Fifty-five percent (53/97) of households reported having access to sanitation. Of those, 44 of 53 (83%) were private and 9 of 53 (17%) were shared. Ninety-eight percent (49/50) of the sanitary facilities were observed to be dry pit latrines. Two percent (1/50) of the sanitary facilities were composting latrines. It should be noted that there was construction of latrines and homes occurring in the community at the time when the survey was conducted.

Seventy percent (35/50) of the latrines inspected met the criteria for hygiene and use. Of these, cleanliness was the most common, with 69% (24/35) having been cleaned recently with water. Fifty-three percent (184/350) of the total study population of the study area >12 months of age reported using hygienic sanitation facilities. Forty-five percent (21/47) of households reported disposing of waste outside when a child <12 months of age had a bowel movement. An equal number of households reported disposing of it in a latrine. One household (2% (1/47)) reported disposing of the contents of the diapers in the river. The mean distance to a hand washing area from a sanitary facility was 13 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 7d summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Forty percent (19/47) of children <36 months of age were breast-fed. This percentage was highest in the youngest age groups, ≤6 months and 7 to 12 months, and lower in the older age groups, 13 to 24 months and 24 to 35 months. The data show that as the child increased with age, the occurrence of breast-feeding decreased as expected.

Table 7d. Diarrhea Prevalence and Breast-feeding Practice in Children
El Salvador - Study Area 1 - Las Pozas, February 2000.

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	40% (19/47)	40 (19/47)	42 (8/19)	39 (11/28)
6 months	87% (13/15)	47 (7/15)	54 (7/13)	0 (0/2)
7-12 months	100% (2/2)	50 (1/2)	50 (1/2)	0 (0/0)
13-24 months	17% (4/23)	39 (9/23)	0 (0/4)	47 (9/19)
25-35 months	0% (0/7)	29 (2/7)	0 (0/0)	40 (2/7)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months of age was 40 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months age group and 7 to 12 month age groups, and decreased in the 13 to 24 month and 25 to 35 month age groups. Overall, the period prevalence for diarrhea was higher in children who were breast-feeding (42 per 100 children) versus those who were not breast-feeding (39 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

Hand washing knowledge and behavior of the household food preparer is shown in Table 7e. Hand washing knowledge and behavior were based on the interviewees' ability to recite key times when they washed their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Twenty percent (19/97) of food preparers received a passing score. Hand washing before eating was reported the most frequently, 74%

(72/97) and hand washing after cleaning a child's bottom was the least reported, 12% (11/96). In the hand washing demonstration, 97% (91/94) of the women washed their hands with water and 78% (73/94) used soap.

Table 7e. Household Food Preparer Hand washing Knowledge and Behavior
El Salvador - Study Area 1 - Las Pozas, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	74% (72/97)
	Before cooking	62% (60/97)
	Before feeding children	30%(29/96)
	After defecating	56% (54/97)
	After cleaning child's bottom	12% (11/96)
How do you wash your hands? (behavior)	Use water	97% (91/94)
	Use soap	78% (73/94)
	Use both hands	83% (78/94)
	Rub hands. 3 times	82% (77/94)
	Dry hands on towel or air dry	38% (36/94)
Total passing score (8 of 10)		20% (19/97)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 7f. Twenty percent (19/93) of childcare providers received a passing score of at least 8/10. Hand washing before eating was reported the most frequently, 74% (70/95) and hand washing after cleaning a child's bottom was the least reported, 12% (11/94). In the hand washing demonstration, 97% (89/92) of the women used water to wash their hands and 78% (72/92) used soap.

Table 7f. Childcare Provider Hand washing Knowledge and Behavior
El Salvador - Study Area 1 - Las Pozas, February 2000.

Childcare Provider		Percent
When do you Wash your Hands? (knowledge)	Before eating	74% (70/95)
	Before cooking	61% (58/95)
	Before feeding children	31% (29/94)
	After defecating	56% (53/95)
	After cleaning child's bottom	12% (11/94)
How do you wash your hands? (behavior)	Use water	97% (89/92)
	Use soap	78% (72/92)
	Use both hands	83% (76/92)
	Rub hands. 3 times	82% (75/92)
	Dry hands on towel or air dry	39% (36/92)
Total passing score (8 of 10)		20% (19/93)

≥ greater than or equal to

Education

Interviewee's level of education

Interviewees reported from 1 to 12 years of formal education. The mean level of education was 2.2 years. Fifty-three percent (51/97) of interviewees had no formal education. Fourteen percent (14/97) of interviewees had completed 6 years of education.

Household health education

Health promoters from the Ministry of Health or CARE-CALMA conducted a majority of the health education workshops (charlas). The survey showed that 50% (48/96) of households reported receiving a charla on handwashing; 53% (50/96) of households reported receiving a charla on how to treat household water; and 51% (49/97) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household waster samples are summarized in Table 7g. A total of 19 water samples were collected from a variety of different community and household water sources in Las Pozas. The same person collected each of these water samples to reduce variability in collection techniques. All of the water samples, both community and household, were tested for *E. coli* and fecal coliforms at the ANDA lab in San Miguel, El Salvador. The number of fecal coliform bacteria and *E. coli* in each water sample was estimated by the multiple-tube fermentation technique and reported as the Most Probable Number (MPN) of organisms present (APHA, 1998). This number, based on probability formulas, is an estimate of the mean density of bacteria in the sample (APHA, 1998).

Table 7g. Community and Household Water Sources Receiving Treatment and Coliform Results El Salvador - Study Area 1 - Las Pozas, February 2000.

Water Tested	Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	4	0% (0/4)	100% (4/4)	100% (4/4)
Household samples	15	13% (2/15)	100% (15/15)	100% (15/15)

Community Water Source

Four community water sources were tested, three community wells and one river. All samples were contaminated with fecal coliforms and *E. coli.*

Household Water Samples

A total of 15 water samples were collected from different households; one water sample was collected from each of 14 different households with a duplicate sample collected in one of the households. All of the 15 household water samples tested positive for fecal coliforms and *E. coli.* Thirteen percent (2/15) of water samples were reported to be treated on the day of the interview.

USAID Guidelines

Impact indicators

The baseline levels of the USAID Impact Indicators in Las Pozas are summarized in Table 7h. The USAID guidelines target a 25% decrease in diarrhea rates in children less than 36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 43 L/person/day which is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 53% (184/350) and also below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 7h. Impact Indicators
El Salvador – Study Area 1 - Las Pozas, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	40% (19/47)
Per capita daily water use	43 L/person/day
Food preparers with appropriate handwashing behavior	20% (19/97)
Childcare providers with appropriate handwashing behavior	20% (19/93)
Population using hygienic sanitation facilities*	53% (184/350)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation which was 55% (53/97).

Discussion

This study of the conditions in Las Pozas, El Salvador was conducted to gather baseline data on water use and presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the two years following the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

The majority of the people in the community obtained their water from a shared well and lived in temporary homes. The mean use of water was 43 L/person/day. Almost all of the people in the

survey had access to water all day long; however, many of the residents were unsure if they had yearly access to the water due to the fact that they yet lived there for one year. The people who averaged the greatest volume of water collected each day had household wells. Almost everyone stored water, both for drinking and for other uses, in their homes. Almost half of the households reported that they did not treat their drinking water and 49% got water out of the containers by dipping in a cup, which could potentially contaminate the water in the container by submerging the hand in the water. These facts indicate that people are being exposed to contaminated water and that water can be contaminated at the community and the household level.

Sanitation

More than half of the households surveyed (53/97) had access to sanitary facilities, either private or shared. Of the households that had access to sanitary facilities, 70% (35/50) of these sanitary facilities met the criteria for being hygienic and in use.

By next year, the sanitary intervention should increase the percentage of households with access to sanitary facilities and increase the percentage of facilities that are hygienic and in use.

Diarrhea Prevalence and Breast-feeding Practice

There were 40 cases of diarrhea per 100 children <36 months of age in the two weeks previous to the survey. Forty percent of the children were breast-fed. Overall, a higher percentage of children who were breast-feeding had diarrhea than children who were not breast-feeding. Age may be a confounding variable; younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the risk of diarrhea in breast-fed and not breast-fed infants the survey would need to control for age. However, the number of children under 36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Hand washing

An assessment of handwashing knowledge and behavior of both household food preparers and childcare providers indicate that less than a third of the participants practiced hygienic methods of washing their hands which could contribute to the contamination of water at the household level.

Education

Household health education was attributed primarily to the health promoters from the Ministry of Health and to CARE/CALMA, a non-governmental organization. Approximately half of the households interviewed reported receiving a charla on handwashing, how to treat household water, and the care and use of latrines. The number of households who have received the hygiene education classes should be increased in the follow-up period.

Part II – Water Sampling and Analysis

The results of the laboratory analyses show that all of the water samples collected were contaminated with fecal indicator organisms. This also indicates that the people in the community were being exposed to contaminated water from the water sources and also in the households. The technique used by the laboratory to analyze all of the water samples was not the

requested method. While the presence or absence of the bacteria was reported, the quantification of those bacteria was not precise, but was estimated with the MPN technique.

Recommendations

It may be beneficial to use a more exact measurement of the degree of contamination of the water (e.g. DelAgua kit) in the assessment in the year follow-up.

El Salvador - Study Area 2 - La Ceiba

A team of seven interviewers, the ARC in-country water and sanitation delegate, and one CDC investigator traveled by car to La Ceiba from San Carlos, El Salvador and conducted a census of the whole community on February 4, 2000. Upon arrival to the center of town, each interviewer was given a map of the community with each of the homes on it, given a list of the names of the owner of the homes, and assigned to different sections of the town. In addition, each interviewer was provided with a guide, who was a volunteer from the community, to help locate the households in a timely fashion. The person who collected the water samples had two guides. Although all of the 102 households in the community were targeted, it was possible to interview the residents of 73 of these homes because of residents were not available at the time of data collection. There was close to universal participation of the study with 96% (73/76) of the households contacted agreeing to participate.

Community Description

The CDC conducted a survey with the president of the community association and the local ARC water and sanitation delegate on the day of the assessment to obtain background information about the community.

La Ceiba is a rural village of approximately 100 homes with a population of 600 people in a mountainous region of El Salvador. Most of the homes are small farms, which are isolated and most are not visible from the central plaza. The center of town has a school, a soccer field, a church, a small shop, and a workshop from which much of the new community construction is taking place. The people in La Ceiba were affected by Hurricane Mitch and are working to rebuild their community. Most of the people currently living in La Ceiba are originally from La Ceiba or from other villages in the same mountainous region. The primary occupation is agriculture. The majority of the population is illiterate. At the time of the survey, there was no water or sanitation system in the community; both are being planned for this year. The principle needs of the community at this time are viewed by the community leaders as being water and the construction of better roads in the town.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation and education.

Water

The ARC plans to install a piped water system with shared household spigots. The water source is a spring with a gravity pipeline to a pump station. The spring and pipeline are schedule to be operational by June 2000.

Sanitation

The ARC plans to install composting latrines in the households by December 1, 2000.

Education
The ARC plans to provide health education on proper hygiene for water use and for latrines. This education will be complete by November 2000.

Demographic Information

The mean household size was 5.6 people per household. On average, 0.6 children under the age of 36 months lived in each house. Seventy-nine percent (56/71) of households were living in their own home, 17% (12/71) were living in temporary homes, 2% (3/71) were living with friends or family.

Part I – Household and Community Surveys

Water
Water Availability
Table 8a summarizes the water sources before and after Hurricane Mitch. Prior to Hurricane Mitch, more people had access to water closer to their homes and did not have to obtain all of their water from the river. Sixty-two percent (41/66) of the households obtained their water from the river, 21% (14/66) from shared spigots, 11% (7/66) from shared wells, 6% (4/66) from a spring. After Hurricane Mitch, water from all sources decreased except from the river that increased to 89% (64/72).

Table 8a. Water Source Before and After Hurricane Mitch
El Salvador - Study Area 2 - La Ceiba, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	21% (14/66)	1% (1/72)
Shared well	11% (7/66)	7% (5/72)
River	62% (4/66)	89% (64/72)
Spring	6% (4/66)	3% (2/72)

The average volume of water collected by water source is shown in Table 8b. The river provided the greatest average volume of water per household. The least amount of water was obtained from a spring. Households reported collecting a mean of 128 liters (L) of water the day before the interview (median 110 L). The average volume of water collected per person per day was 24 L (range: 0 to 100 L/person/day; median: 22 L/person/day). Twenty-nine percent (17/59) of households reported that they had to wait to get their water. Of the respondents who reported having to wait for water, two thirds of the respondents (19/25) reported waiting for less than 15 minutes. Twenty percent (5/25) of the respondents reported waiting between 15 minutes and a half hour and 4% (1/25) had to wait for longer than a half hour. Ninety-seven percent (69/71) of the households reported having water all day long, while 96% (69/72) reported having water all year round. Many of the respondents were unsure if they had access to water all year round because they had lived in the area for less than a year or had used the current water source for less than a year.

Table 8b. Daily Volume of Water Collected in Each Household by Water Source
El Salvador - Study Area 2 - La Ceiba, February 2000.

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared spigot	1	88	NA	NA
Shared well	5	123	22-220	22
River	64	130	22-330	66
Spring	2	66	44-88	44

NA not applicable for this dataset

The distance households currently traveled to get to their water source ranged from 0 meters (m) to 10,000 m, with a mean distance of 778 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 999 m. Prior to Hurricane Mitch, households reported traveling an average of 1,050 m to get to their water source (median 300 m) with a range of 0 m to 15,000 m. The median distance traveled to get water increased from 300 m before Hurricane Mitch to 999 m at the time of the survey. Interviewer estimates of distance from the interviewee's house to their respective water source were slightly less than those of the interviewees. The interviewers' estimation of the distance to the water source ranged from 0 m to 13,000 m with the mean distance of 753 m and a median distance of 500 m. As shown in Table 8c, the volume of water collected appeared to have no association with the distance from the household to the water source.

Table 8c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
El Salvador - Study Area 2 - La Ceiba, February 2000

Distance (meters)	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
≤10	4	95	44-176	44
11-50	1	220	NA	NA
51-100	2	77	66-88	66
101-200	5	97	22-264	22
201-500	23	115	22-220	110
501-998	0	-	-	-
≥999	37	143	44-330	110

≤ less than or equal to
≥ greater than or equal to
NA not applicable to this dataset

Storage and Treatment

All of the households stored drinking water and water for other purposes in their homes (72/72). Eighty-four percent (56/67) of the households were observed to have stored their drinking water covered. Nine percent (6/71) of the households reported treating the drinking water on the day of the survey. Ten percent (7/71) of the households reported always treating their drinking water, 25% (18/71) sometimes treated their drinking water, and 65% (46/71) reported that they never treat their drinking water. Among the households that reported treating their water, the

most common method of treatment was chlorine addition with 82% (22/25) reporting use of chlorine. Other treatment methods were use of ash as a purifier, 8% (2/25), and boiling, 4% (1/25). Fifty-one percent (36/71) of the respondents to the questionnaire were observed to get drinking water from their stored water source by pouring it from the container. The other 48% (35/71) got the drinking water out by dipping a cup into the container.

Home Water Use

Households reported washing clothes an average of 4.1 days a week (range: 0 to 7 days a week). All of the households (71/71) reported washing their clothes in the river. Ninety-nine percent (70/71) of the households bathed in the same place where they washed clothing. Sixty-five percent (46/71) reported that they bathe daily while 20% (14/71) reported bathing 3 times a week.

Sanitation

Eighteen percent (13/71) of households reported having access to sanitation. Of those, 92% (12/13) were private and 8% (1/13) were shared. All of the sanitary facilities (13/13) were observed to be dry pit latrines.

Seventy-five percent (9/12) of the latrines inspected were found to meet the criteria for hygiene and use. A visible path and evidence of being swept were the most commonly observed with 67% (6/9) of the latrines having these characteristics. Forty-four percent (4/9) of the latrines observed appeared as if they had been recently cleaned with water. Fourteen percent (55/393) of the total population of the study area >12 months of age reported using hygienic sanitation facilities. Eighty-one percent (25/31) of households reported disposing of waste outside when a child had a bowel movement. Sixteen percent (5/31) of households reported disposing of waste in a pit latrine. Three percent (1/31) of the households reported disposing of the contents of diapers in the river. The mean distance to a hand washing area from a sanitation facility was 8 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 8d summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Fifty-three percent (19/36) of children <36 months were breast-fed. This percentage was highest in the youngest age group; all children in the ≤6 months age group were breast-fed, 100% (5/5). The data show that as the child increased in age, the occurrence of breast-feeding decreased as expected.

Table 8d. Diarrhea Prevalence and Breast-feeding Practice in Children
El Salvador - Study Area 2 - La Ceiba, February. 2000.

Age	Percent Of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	53% (19/36)	25 (9/36)	32 (6/19)	18 (3/17)
≤ 6 months	100% (5/5)	0 (0/5)	- (0/5)	- (0/5)
7-12 months	75% (3/4)	75 (3/4)	67 (2/3)	100 (1/1)
13-24 months	55% (6/11)	18 (2/11)	17 (1/6)	20 (1/5)
25-36 months	31% (5/16)	25 (4/16)	60 (3/5)	9 (1/11)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months was 25 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months and 7 to 12 month age groups, and decreased in the next age group, 13 to 24 months, but increased slightly in the oldest age group, 25 to 35 months. The 13 to 24 month age group had the lowest prevalence of diarrhea with 18 per 100 children. Overall, the period prevalence for diarrhea was higher for children who were breast-fed (32 per 100 children) versus those who were not breast-feeding (18 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

Hand washing knowledge and behavior of the household food preparer is shown in Table 8e. Hand washing knowledge and behavior were based on the interviewee's ability to recite key times when they wash their hands and to demonstrate good handwashing behavior. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Twenty-eight percent (20/71) of food preparers received a passing score. Handwashing before eating was reported the most frequently, 73% (52/71), and hand washing after cleaning a child's bottoms was the least reported, 24% (17/71). In the hand washing demonstration, 100% (69/69) of the women washed their hands with water and 61% (42/69) used soap.

Table 8e. Household Food Preparer Hand washing Knowledge and Behavior
El Salvador - Study Area 2 - La Ceiba, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	73% (52/71)
	Before cooking	70% (50/71)
	Before feeding children	37% (26/71)
	After defecating	62% (44/71)
	After cleaning child's bottom	24% (17/71)
How do you wash your hands? (behavior)	Use water	100% (69/69)
	Use soap	61% (42/69)
	Use both hands	86% (59/69)
	Rub hands. 3 times	71% (49/69)
	Dry hands on towel or air dry	45% (31/69)
Total passing score (8 of 10)		28% (20/71)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 8f. Twenty-eight percent (19/69) of childcare providers received a passing score of al least 8/10. Hand washing before eating was reported the most frequently, 77% (50/65), and hand washing after cleaning a child's bottom was the least reported, 26% (17/65). In the hand washing demonstration, 100% (63/63) of the women used water to wash their hands and 65% (41/63) used soap.

Table 8f. Childcare Provider Hand washing Knowledge and Behavior
El Salvador – Study Area 2 - La Ceiba, February 2000

Childcare Provider		Percent
When do you wash your hands? (knowledge)	Before eating	77% (50/65)
	Before cooking	75% (49/65)
	Before feeding children	39% (25/65)
	After defecating	66% (43/65)
	After cleaning child's bottom	26% (17/65)
How do you wash your hands? (behavior)	Use water	100% (63/63)
	Use soap	65% (41/63)
	Use both hands	87% (55/63)
	Rub hands. 3 times	73% (46/63)
	Dry hands on towel or air dry	46% (29/63)
Total passing score (8 of 10)		28% (19/69)

≥ greater than or equal to

Education

Interviewee's level of education

Interviewees reported from 1 to 12 years of formal education. The mean level of education was 3.2 years. Sixty-four percent (45/70) of interviewees had no formal education. Seven percent (5/70) of interviewees had completed 6 years of education.

Household health education

Health promoters from the Ministry of Health conducted a majority of the health education workshops (charlas). The survey showed that 31% (22/71) of households reported receiving a charla on hand washing, 48% (34/71) of households reported receiving a charla on how to treat household water, and 27% (19/70) of households reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household water samples are summarized in Table 8g. Nineteen water samples were collected from a variety of different community and household water sources in La Ceiba. The same person collected each of these water samples to reduce variability of collection techniques. All of the water samples were tested for *E. coli* and fecal coliforms at the ANDA lab in San Miguel, El Salvador. The number of fecal coliform bacteria and *E. coli* in each water sample was estimated by the multiple-tube fermentation technique and reported as the Most Probable Number (MPN) of organisms present (APHA, 1998). This number, based on probability formulas, is an estimate of the mean density of bacteria in the sample (APHA, 1998).

Table 8g. Community and Household Water Sources Receiving Treatment and Coliform Results El Salvador - Study Area 2 - La Ceiba, February 2000

Water Tested	Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	*Percent of Samples* Positive for E.coli
Community source	6	0% (0/6)	100% (6/6)	100% (6/6)
Household samples	13	0% (0/13)	100% (13/13)	100% (13/13)

Community Water Source

Two community water sources were tested, five samples came from different locations in the same river and one sample was taken from a spring. The spring was located on the main road on the way out of town. All 6 samples were contaminated with fecal coliforms and *E. coli.*

Household Water Samples

Thirteen household water samples were collected; 1 water sample from 12 different households with a duplicate sample collected in one of these households. All of the samples were taken from water stored in the household. All 13 household water samples were positive for fecal coliforms and *E. coli.* None of the water samples were reported treated on the day of the interview.

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in La Ceiba are summarized in Table 8h. The USAID guidelines target a 25% decrease in diarrhea rates in children less than 36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 24 L/person/day which is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 14% (55/393) and also below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 8h. Impact Indicators
El Salvador - Study Area 2 - La Ceiba, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	25% (9/36)
Per capita daily water use	24 L/person/day
Food preparers with appropriate handwashing behavior	28% (20/71)
Childcare providers with appropriate handwashing behavior	28% (19/69)
Population using hygienic sanitation facilities*	14% (55/393)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation which was 18 % (13/71).

Discussion

This study of the conditions in La Ceiba, El Salvador was conducted to gather baseline data on water use and presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the following two years after the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

The majority of the people in the community obtained their water from the river and lived in their own homes. The mean use of water was 24 L/person/day. Almost all of the people in the survey had access to water all day long, although some people were unsure if they had access all

year round because they hadn't been using it for more than a year at the time of the survey. The people who collected water from the river averaged the greatest volume of water collected each day. All of the households interviewed had stored water in their homes, for drinking and for other purposes. More than half of the households reported that they never treated their drinking water and 48% got water out of the containers by dipping in a cup, which could contaminate the water in the container by submerging the hand in the water. These facts indicate that people are being exposed to potentially contaminated water and that water may be contaminated at the community and the household level.

The water system should increase the amount of water used in households, reduce the potential for exposure to contaminated water, and reduce the distance from household to water source. The planned water intervention should allow this community to meet the recommended USAID and Sphere guidelines.

Sanitation

Less than one third of the households surveyed (13/71) had access to sanitation facilities, either private or shared. Of the households that had access to sanitation facilities and that were inspected, 75% (9/12) met the criteria for hygiene and use.

The sanitary intervention should increase the percentage of households with access to sanitation facilities and increase the percentage of latrines that are hygienic and in use. The planned intervention for sanitary facilities should meet the recommended USAID and Sphere guidelines.

Diarrhea Prevalence and Breast-feeding Practice

There were 25 cases of diarrhea per 100 children <36 months of age in the two weeks prior to the survey. Fifty-three percent of the children were breast-fed. Slightly more children who were breast-fed had diarrhea than those who weren't breast-fed. Age may be a confounding variable; younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the risk of diarrhea in breast-fed and non-breast-fed infants the survey would need to control for age. However, the number of children under 36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior-Hand washing

An assessment of hand washing knowledge and behavior of both household food preparers and childcare providers indicate that less than a third of the participants practiced hygienic methods of washing their hands, which could contribute to the contamination of water at the household level and direct fecal-oral disease transmission.

Education

Household health education was attributed primarily to health promoters from the Ministry of Health. Less than a half of the households interviewed reported receiving a charla on hand washing, how to treat household water, and the care and use of latrines. The planned educational programming should increase the ability of this community to meet the USAID guidelines

Part II – Water Sampling and Analysis

The results of the laboratory analyses confirm water contamination. Fecal contamination, as indicated by the presence of fecal coliforms and *E. coli,* was detected in all of the water samples collected. This indicates that people in the community were being exposed to contaminated water from the community water sources and from the stored water in their households. The technique used by the laboratory that processed all of the water samples was not the quantitative method requested. While the presence or absence of the bacteria was described, the quantification of the bacteria was not precise, but was estimated with the MPN technique.

Recommendations

It may be beneficial to use a more precise technique (e.g., DelAgua kit) to measure the degree of contamination of the water in the assessment at the year follow-up.

Guatemala - Study Area 1 - Chiquimula

The Chiquimula Region of Guatemala is near the border with Honduras. Study Area 1 in this region consists of six communities that were under consideration to receive interventions by the ARC: Anicillio, Despoblado, Guayabo, Plan y Travesia, Santa Barbera, and Urchurja. A total of 191 surveys were computed in these six communities. However, because the ARC has since decided to intervene in three communities: Despoblado, Guayabo, and Plan y Travesia, only the results from these communities will be reported.

This is a rural and mountainous region, and each community is located at least an hour by car from the main road. Community interviews were conducted on February 4-5, 2000 with the community leaders, the ARC water and sanitation delegate, and a CDC investigator to obtain background information on the communities. The community was very motivated to participate in this study this year as demonstrated by the 98% participation rate. Separate community descriptions are provided for each community but baseline survey information is presented collectively.

Community Description

Despoblado

The vice president and treasurer of the community council and the regional ARC delegate completed the community survey in Despoblado. At this time, the council feels that their community's greatest need is improved health care programs.

The community consists of 60 houses with approximately 360 people. The people of this community are Latino and speak Spanish. A council of community members governs them. The primary form of employment is agriculture (corn and coffee). The education level of the community is generally third grade.

At the time of the survey, the community had not received food aid and had no local access to health care. The Ministry of Health provides health care at a health post that is one hour away by car. The community had some health education about sanitation and hygiene in February 1999. According to the regional ARC delegate, it was a training session for the Ministry of Health and there has been no follow up.

The community's water supply is a spring fed gravity system. The system has been in place since October 1991. At the time of the survey, the system was operating at 50% of its original capacity because it was in need of repair. Therefore, not all of the households that are connected received water from the system. Additional houses were built after the water system was constructed, and are not connected to the system. Those households that receive water currently pay 1 quetzal ($0.13) per month for the service. The water is not routinely treated at a community level. At this time, the community has no formal sanitation system. About 15% of the homes have pit latrines.

Guayabo

The health guardian, the secretary of the community council, and the regional ARC delegate, completed the community survey in Guayabo. At this time, the council feels their community's greatest need is water.

Guayabo consists of 120 houses with a total of 760 people. The people of this community are all Latino and speak Spanish. A council of community members governs the people. The primary forms of employment are agriculture (corn, beans, sorghum) and coffee picking. The education level of the community is generally second grade.

As of the time of the study, the community had not received food aid. The community has access to health care at a Ministry of Health health post that is 4 km away in Capajá. The health promoters participated in a training session focusing on sanitation and hygiene in December 1999. The Ministry of Health at the health post in Capajá gave the training.

At the time of the survey, the primary water source for the residents of Guayabo was two hand-dug wells. These wells are located 300 meters from the closest houses in valleys on either end of the town. During dry spells when the wells run dry, residents get their water from local streams. UNIPAR, a non-governmental organization, has donated materials for a water project to the town but at the time of the study they had not returned in a year.

Dry pit latrines were constructed for all homes in 1993. However, only about 60% of the homes still use the latrines.

Plan y Travesia

The community council and the national ARC delegate completed the community survey in Plan y Travesia. At this time, the council feels that their community's greatest need is improving their water system.

The community consists of 225 houses with approximately 1125 people. The people of this community are Latino and speak Spanish. A council of community members governs them. The primary forms of employment are agriculture and coffee picking. Generally, the adults have not had an opportunity to attend school. The children generally have a second to third grade education.

As of the time of the study, the community had not received food aid. The community has local access to health care at a Ministry of Health health post. The whole community received health education about sanitation and hygiene in February 1999 at the health post.

At the time of the survey, the community's main water supply was a capped spring feeding into a tank by gravity, and a distribution system. This system was built in 1987. A landslide during Hurricane Mitch destroyed the tank in October 1998. Approximately two-thirds of the homes have only intermittent water from their taps, and rely on natural wells or the river for their water during times of low water pressure. Additional houses were built after the water system was constructed, and rely on the river for all of their water because they are not connected to the distribution system. The households do not pay a regular fee for the service, but they take up a

collection in emergency situations. The water is not routinely treated at a community level. The Ministry of Health tested the water in August 1999 as part of a national program. They did not inform the citizens of Plan y Travesia of the results of the analysis.

At this time, the community has no formal sanitation system. About 15% of the homes have pit latrines.

Planned Interventions

Based on the needs assessment for this study area following Hurricane Mitch, the ARC planned interventions for water, sanitation, and hygiene behavior.

Water

Despoblado: The ARC plans no physical intervention of the current community drinking water system.
Guayabo: ARC plans to provide a new water system for the community, including connections for each household to the water distribution system. The cost of the system has not yet been determined. ARC anticipates completion of the system by June 2001.
Plan y Travesia: ARC is currently developing their plan for improving the drinking water system for this community. The plan will likely be based on rehabilitating and upgrading the current system.

Sanitation

Despoblado: The ARC plans to provide household latrines for all homes in the community. The cost of the system has not yet been determined.
Guayabo: The ARC plans to provide household latrines for all homes in the community. The cost of the system has not yet been determined.
Plan y Travesia: ARC plans to provide household latrines for all homes in the community.

Hygiene Behavior – Hand washing

Despoblado: ARC plans to provide a hygiene education program targeted to all community members focusing on proper latrine maintenance and use. The education program will be given three times to maximize participation and promote concept retention.
Guayabo: ARC plans to provide a hygiene education program targeted to all community members about proper treatment and storage of household water, latrine maintenance and use, and appropriate hand washing behavior. The education program will be offered three times.
Plan y Travesia: ARC plans to provide a hygiene education program targeted to all community members about proper treatment and storage of household water, latrine maintenance and use, and appropriate hand washing behavior. The education program will be offered three times.

Demographic Information

The mean household size of the three communities in Chiquimula, Guatemala was 6.7 people per household. The average household had 0.8 children under the age of 36 months. Ninety-eight percent (85/87) of households were living in their own home. One percent (1/87) were living with friends or family and the remaining 1% (1/87) were living in temporary shelters.

Part I – Household and Community Surveys

Water

Water Availability

The residents of Chiquimula used a variety of water sources before and after Hurricane Mitch. Table 9a summarizes these water sources. Prior to the hurricane, the majority of water was obtained from a shared well, 33% (29/87). At the time of the survey, the majority of water came from a household spigot, 35% (30/87), the use of which increased after the hurricane. Other water sources include a shared spigot at 25% (22/87), 25% (22/87) from a shared well, 10% (9/87) from the river, 4% (3/87) from a spring, and 1% (1/87) from a stream.

Table 9a. Water Source Before and After Hurricane Mitch
Guatemala - Study Area 1 - Chiquimula, February 2000

Water Source	Before Hurricane Mitch	After Hurricane Mitch
Shared spigot	26% (23/87)	25% (22/87)
Household spigot	18% (16/87)	35% (30/87)
Shared well	33% (29/87)	25% (22/87)
River	18% (16/87)	10% (9/87)
Spring	3% (3/87)	4% (3/87)
Stream	1% (1/87)	1% (1/87)

The average volume of water collected varied by water source and is shown in Table 9b. The river provided the greatest average volume of water per household, 128 liters (L)/day. The least amount of water was from the springs, 38 L/day. Households other than those with a household spigot (N = 54) reported collecting on average 84 L of water the day before the interview (median 59 L). The mean volume of water collected per person per day was 16 L (range: 0 to 201 L/person/day; median 10 L/person/day). Forty percent (30/76) of households reported that they had to wait to get water at least sometimes. Of those who had to wait, 62% (24/39) said that they had to wait less than 15 minutes, while 21% (8/39) said that they had to wait for longer than an hour. Ninety-one percent (79/87) of households reported having water all day long, while 66% (57/87) reported having water all year long.

Table 9b. Daily Volume of Water Collected in Each Household by Water Source
Guatemala - Study Area 1 - Chiquimula, February 2000

Water Source	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
Shared spigot	22	103	40-285	114
Household spigot	30	56	12-250	12
Shared well	22	52	4-134	23
River	9	128	23-604	23
Spring	3	38	23-46	46
Stream	1	114	114	N/A

N/A not applicable for this dataset

The distance households traveled to get to their water source ranged from 0 meters (m) to greater than 1 kilometer (km), with a mean distance of 206 m. A reported distance of 0 m indicates that a water source is located at the home. The median distance traveled to get water was 100 m. Prior to Hurricane Mitch, households reported traveling an average of 422 m to get water (median 120 m) with a range of 0 m to 15 km. The median distance traveled to get water after Hurricane Mitch decreased from 120 m to 100 m at the time of the survey. Interviewer estimates of distance from the interviewed household to their water source were similar to those of the interviewees (i.e., mean distance of 222 m and a median distance of 100 m). As shown in Table 9c, households that traveled 10 m or less to get their water collected slightly more water per day, on average, than those who traveled 11 to 500 m. Those who traveled 1 km or more collected the least amount of water per day, 48 L on average, approximately half of the average volume collected by those traveling 10 m or less (90 L).

Table 9c. Daily Volume of Water Collected in Relation to Distance from Household to Water Source
Guatemala - Study Area 1 - Chiquimula, February 2000

Distance (meters)	Number of Households	Daily Volume (liters/day)		
		Average	Range	Mode
≤ 10	28	90	0-604	46
11-50	13	66	12-171	114
51-100	12	67	23-134	46
101-200	15	72	4-285	46
201-500	12	81	23-163	69
501-998	0	-	-	-
≥ 999	7	48	23-69	57

≤ less than or equal to
≥ greater than or equal to

Storage and Treatment

Eighty-eight percent (76/86) of households stored water for use in the home, 93% (80/86) stored drinking water. Thirty-three percent (26/86) were observed to store their drinking water covered. Twenty-nine percent (24/82) of households reported treating their drinking water on the day of the survey. Twenty-seven percent (20/73) of households reported always treating their water,

27% (20/73) reported sometimes treating it, and 45% (33/73) reported never treating it. Overall, 21% (15/71) of households reported treating their water with chlorine and 37% (26/71) reported boiling their water. Eighty percent (66/83) of households were observed to get drinking water from their stored water source by pouring it into a cup or glass; another 7% (6/83) got drinking water by dipping a cup into the water storage container.

Home Water Use

Households reported washing clothes an average of 3.5 days a week with a range of 1 day per week to 2 times per day. Forty-nine percent (42/86) of households reported washing their clothes at the house, and 42% (36/86) washed in the river or creek. Nine percent (8/86) of households washed their clothes in a spring or a well. Eighty-six percent (73/85) of households bathed in the same place they washed clothing. Forty-one percent (36/87) of respondents bathed 3 times a week, 29% (25/87) reported that they bathed daily, and 18% (16/87) reported that they bathed 2 times a week. The remaining 12% (10/87) of respondents bathed with a variety of frequencies.

Sanitation

Thirty-eight percent (26/69) of households reported having access to sanitation, of those 26 households, 96% (25/26) were private and 4% (1/26) were shared. Ninety-seven percent (29/30) of observed sanitary facilities were dry pit latrines. The remaining 3% (1/30) were pour flush latrines.

Forty-five percent (15/33) of the latrines inspected were found to meet the criteria for hygiene and use. Eighteen percent (98/546) of the total population of the study area >12 months of age reported using hygienic sanitation facilities. Twelve percent (8/67) of households reported that when a child <12 months of age had a bowel movement it was disposed in the latrine. Eighty-two percent (55/67) of households reported disposing of the waste outside. The mean distance to a hand washing area from the sanitation facility was 18 m.

Diarrhea Prevalence and Breast-feeding Practice

Table 9d summarizes breast-feeding practice and the reported diarrhea prevalence among children <36 months of age in the two weeks prior to the baseline survey. Fifty-nine percent (41/69) of children <36 months of age were breast-fed. All children in the ≤6 months and 7 to 12 month age groups were breast-fed. The data show that as a child increased in age, the occurrence of breast-feeding decreased as expected.

Table 9d. Diarrhea Prevalence and Breast-feeding Practice in Children
Guatemala - Study Area 1 - Chiquimula, February 2000

Age	Percent of Children Breast-fed	Period Prevalence of Diarrhea* (per 100 children)	Period Prevalence of Diarrhea Breast-feeding (per 100 children)	Period Prevalence of Diarrhea Not Breast-feeding (per 100 children)
< 36 months	59% (41/69)	28 (19/69)	29 (12/41)	25 (7/28)
6 months	100% (19/19)	21 (4/19)	21 (4/19)	0 (0/0)
7-12 months	100% (16/16)	50 (8/16)	50 (8/16)	0 (0/0)
13-24 months	20% (5/25)	28 (7/25)	0 (0/5)	30 (6/20)
25-35 months	11% (1/9)	0 (0/9)	0 (0/1)	0 (0/8)

* Illness occurred within 2 weeks prior to the baseline survey
< less than
≤ less than or equal to

The period prevalence of diarrhea in children <36 months of age was 28 cases per 100 children. The prevalence increased during the first year of life between the ≤6 months and 7 to 12 month age groups, and decreased the following year in the 13 to 24 and 25 to 35 month age groups. Overall, the period prevalence for diarrhea was slightly higher for children who were breast-feeding (29 per 100 children) versus those who were not breast-feeding (25 per 100 children).

Hygiene Behavior-Hand washing

Household Food Preparer

The hand washing knowledge and behavior of the household food preparer is shown in Table 9e. Hand washing knowledge and behavior was based on the interviewee's ability to recite key times when they wash their hands and to demonstrate good handwashing technique. Unanswered questions were considered a "no" response. A passing score was eight correct questions out of ten (8/10) (Billig et al., 1999). Twenty-one percent (18/86) of food preparers received a passing score. Handwashing before cooking was reported the most frequently, 84% (72/86), and hand washing after cleaning a child' bottom was the least reported, 20% (17/86). In the handwashing demonstration, 99% (78/79) of the women washed their hands with water and 54% (43/79) used soap.

Table 9e. Household Food Preparers Hand washing Knowledge and Behavior
Guatemala - Study Area 1 - Chiquimula, February 2000

Household Food Preparer		Percent
When do you wash your hands? (knowledge)	Before eating	50% (43/86)
	Before cooking	84% (72/86)
	Before feeding children	24% (21/86)
	After defecating	35% (30/86)
	After cleaning child's bottom	20% (17/86)
How do you wash your hands? (behavior)	Use water	99% (78/79)
	Use soap	54% (43/79)
	Use both hands	80% (63/79)
	Rub hands. 3 times	61% (48/79)
	Dry hands on towel or air dry	30% (24/79)
Total passing score (8 of 10)		21% (18/86)

≥ greater than or equal to

Primary Childcare Provider

Hand washing knowledge and behavior of the primary childcare provider is shown in Table 9f. Twenty percent (17/85) of childcare providers received a passing score of at least 8/10. Hand washing before cooking was reported the most frequently, 84% (72/86) and hand washing after cleaning a child's bottom was the least reported, 21% (18/84). In the handwashing demonstration, 99% (77/78) of the women used water to wash their hands and 55% (43/78) used soap.

Table 9f. Childcare Provider Hand washing Knowledge and Behavior
Guatemala - Study Area 1 - Chiquimula, February 2000

Childcare provider		Percent
When do you wash your hands? (knowledge)	Before eating	51% (43/84)
	Before cooking	84% (72/86)
	Before feeding children	25% (21/84)
	After defecating	37% (31/84)
	After cleaning child's bottom	21% (18/84)
How do you wash your hands? (behavior)	Use water	99% (77/78)
	Use soap	55% (43/78)
	Use both hands	78% (61/78)
	Rub hands. 3 times	58% (45/78)
	Dry hands on towel or air dry	32% (25/78)
Total passing score (8 of 10)		20% (17/85)

≥ greater than or equal to

Education

Interviewee's education level

Interviewees reported from 0 to 5 years of formal education. The mean education level was one year. Eighty-one percent (70/87) of interviewees had no formal education. Eleven percent (10/87) of interviewees had completed at least 3 years of education.

Household health education

The Centro de Salud (Salud Publica) conducted a majority of the charlas (workshops). The survey showed that 21% (19/91) of households reported receiving a charla on hand washing, 40% (36/91) of households reported receiving a charla on how to treat household water, and 23% (21/91) reported receiving a charla on the care and use of latrines.

Part II - Water Sampling and Analysis

The results of the analyses of the community water source and household water samples are summarized in Table 9g. The in-country laboratory, Inlasa, Industrio y Laboratorio de Analysis, in Guatemala City, analyzed the community water sources and household water samples. Water samples were collected from all communities on the morning of February 5 and were driven 2.5 hours to Inlasa in Guatemala City. Water samples were tested for *E. coli* by the presence-absence test (APHA, 1998), and total coliforms, fecal coliforms, and *E.coli* were quantified by using the membrane filtration technique (APHA, 1998).

Table 9g. Community and Household Water Sources Receiving Treatment and Coliform Results Guatemala - Study Area 1 - Chiquimula, February 2000

Water Tested	Sample Size (N)	Water Treated	Percent of Samples Positive for Fecal coliforms	Percent of Samples Positive for *E. coli*
Community source	3	0% (0/3)	33%(1/3)	33%(1/3)
Household samples	7	29% (2/7)	14% (1/7)	0% (0/7)

Community Water Source

Three community water sources were tested from two of the three communities. One sample was taken from the first tap after the storage tank in Despoblado, to represent the storage tank water quality since the tank was located too far from the community to access during the study. The two other source water samples were taken from the two main wells that supply water for the community of Guayabo. No water samples were taken from the community of Plan y Travesia because of time constraints in getting samples to the laboratory in Guatemala City for analysis. Plan y Travesia is located approximately two hours by car from the main road.

One of the three community water samples tested positive for indicators of fecal contamination. The water sample from the tank in Despoblado tested negative for *E. coli* and fecal coliforms. Two water sources were tested in Guayabo, one well tested positive for fecal coliforms (210 CFU/100 ml) and *E. coli*, and the sample from the other well tested negative. Fecal coliforms are measured in colony forming units per 100 milliliter (CFU/100 ml).

Household Water Samples

There were 7 households sampled in Chiquimula, 4 in Despoblado and 3 in Guayabo. Fourteen percent (1/7) of household water samples tested positive for fecal coliforms. This sample contained 190 CFU/100 ml fecal coliforms by the membrane filtration technique. No household samples tested positive for *E. coli* by the presence/absence test.

Twenty-nine percent (2/7) of household water sampled were reported to be treated on the day of the interview. Neither of these samples tested positive for fecal coliform bacteria or *E. coli*. Of the five household samples that were reported as not treated, one sample tested positive for fecal coliforms. This household obtained water from the well that also tested positive for fecal coliform bacteria.

USAID Guidelines

Impact Indicators

The baseline levels of the USAID Impact Indicators in Chiquimula are summarized in Table 9h. The USAID guidelines target a 25% decrease in diarrhea rates in children less than 36 months of age and a 50% increase in the use of appropriate hand washing behavior following implementation of sanitation-related programs including physical and/or educational interventions. The per capita water use was 30 L/person/day that is below the USAID non-emergency guideline of 50 L/person/day. Total population use of hygienic sanitation facilities was 18% and also below the USAID target level of 75%. Changes in the community's ability to meet these indicators will be evaluated in comparison to the results of the one- and two-year follow-up evaluations.

Table 9h. Impact Indicators
Guatemala - Study Area 1 - Chiquimula, February 2000

Impact Indicator	Percent
Children < 36 months with diarrhea in past 2 weeks	28% (19/69)
Per capita daily water use	16 L/person/day
Food preparers with appropriate handwashing behavior	21% (18/86)
Childcare providers with appropriate hand washing behavior	20% (17/85)
Population using hygienic sanitation facilities*	18% (98/546)

* This figure is calculated by: (number of people > 12 months old who use the sanitation facilities) / (number of people > 12 months old in the study population)

Annual Impact Indicators

The USAID Annual Impact Indicators measure the impact of intervention program performance. Data could only be collected for one of the four annual monitoring indicators because the intervention had not yet been implemented. The Annual Impact Indicator that could be assessed for the baseline survey is the percentage of households with access to sanitation that was 38% (26/69).

Discussion

This study of the conditions in Chiquimula, Guatemala was conducted to gather baseline data on water use and presence of sanitation facilities before the ARC water and sanitation project was implemented. These data will be compared to data that will be collected the two years following the baseline survey data collection to assess the effectiveness of the water and sanitation interventions.

Part I – Household and Community Surveys

Water

The majority of the people in the community obtained their water from a household spigot (Table 9a) and lived in their own homes. On average, 16 L of water were collected per person per day, which is well below the USAID guideline of 50 L per person per day. The volume of water collected varied by water source (Table 9b). Ninety-one percent of households reported that they had water all day long, while 66% reported having water all year. Ninety-three percent of the houses interviewed had stored water in their homes, for drinking and for other purposes. Thirty-three percent of households covered their drinking water storage containers, and 27% reported always treating their water, predominantly with chlorine. Eighty percent of respondents were observed obtaining their drinking water from their stored water supply by pouring it into a cup. Only 7% got their drinking water by dipping in a cup, which could contaminate the water in the container by allowing the water to come into contact with dirty or contaminated hands or cups. These data indicate that people are taking some precautions against contaminating their water (e.g., pouring drinking water out instead of dipping into the stored water), but that other behaviors for preventing contamination could be improved (e.g., covering drinking water storage containers).

Sanitation

Thirty-eight percent of households reported access to sanitation, predominantly dry pit latrines. Of the latrines inspected, 45% (15/33) met the USAID guidelines for appropriate hygiene and use. By next year, the sanitary intervention of providing household latrines and charlas on proper use and care of the latrines should improve access to sanitary facilities and increase the percentage of those that are hygienic and in use to meet USAID and Sphere guidelines.

Diarrhea Prevalence and Breast-feeding Practice

There were 28 cases of diarrhea per 100 children <36 months of age in the two weeks previous to the survey. Prevalence was lowest in children 25 to 35 months (0 per 100 children), followed by children ≤6 months of age (21 per 100 children), 100% of whom were breast-fed, and was highest (50 per 100 children) in the 7 to 12 month age range, 100% of whom also were breast-fed. Overall, a slightly higher number of children who were breast-feeding had diarrhea than children who were not breast-feeding (Table 9d). Age may be a confounding variable since younger children have a higher risk for diarrhea and are the most likely to be breast-fed. Therefore, to evaluate the risk of diarrhea in breast-fed and non-breast-fed infants the survey would need to control for age. However, the number of children under 36 months of age was too sparse to get a reliable estimate of the true diarrhea rates of the breast-fed and not breast-fed children.

Hygiene Behavior - Hand washing

Twenty-one percent of food preparers and 20% childcare providers demonstrated appropriate knowledge and practice of hand washing behaviors (Tables 9e and 9f). Twenty-one percent of respondents reported receiving a charla on appropriate hand washing behavior. Lack of appropriate hand washing behavior among these members of the household could contribute to the contamination of water at the household level, and to direct fecal-oral disease transmission. ARC planned charlas on hygiene and improvements to the water systems should increase the likelihood that residents of these communities in Chiquimula will use appropriate hand washing behavior in the future.

Part II – Water Sampling and Analysis

Inlasa laboratory, in Guatemala City, processed the water samples. The samples were not analyzed for *E. coli* by the method requested (membrane filtration), but rather by the presence/absence test, which gives no information about the number of organisms present in a water sample. Fecal coliform bacteria were quantified using the membrane filtration technique. Analysis of one of the source water samples was conducted in duplicate. The results of the duplicate analysis indicated that there might be problems with quality control in this laboratory. One replicate was positive for the presence of fecal coliforms and *E. coli* and the other replicate was negative. Therefore, the results of the laboratory analyses should be interpreted with caution. For the purposes of data analysis, the sample that was taken in duplicate was considered contaminated. One household water sample tested positive for fecal coliforms and negative for *E. coli*. This is possible because *E. coli* is a subset of fecal coliform bacteria. However, since the household obtained its water from a source that was contaminated with *E. coli*, it is surprising that *E. coli* was not detected in the household sample.

At the time of the survey, the major water sources for these communities were spring fed gravity systems (in Despoblado and Plan y Travesia) and hand-dug wells (in Guayabo). The water sample taken from one of the wells in Guayabo was contaminated with fecal coliform bacteria and *E. coli*. The water samples from the other well in Guayabo and from the tank in Despoblado were not contaminated. The contaminated well should be disinfected after which the well should be retested for fecal coliform bacteria and *E. coli.*

Fourteen percent (1/7) of household water samples tested positive for fecal coliforms, and zero tested positive for *E. coli* (Table 9g). The contaminated water sample was taken from a household that obtained its water from the well that was also contaminated with fecal coliforms. This indicates that people in the community were likely to be exposed to contaminated water from the contaminated water source and from the water stored in their households. Twenty-nine percent (2/7) of households where water was collected reported treating their water on the day of the interview (Table 9g). Neither of the water samples taken in these households was contaminated with fecal coliforms or *E. coli*. The sample that tested positive for fecal coliforms was one of five households that did not treat their water on the day of the interview. These data indicate that people in this community are successfully avoiding contamination and/or using treatment to decrease the contamination of household water.

Education

In the communities where water interventions are planned (Plan y Travesia and Guayabo), charlas on hygiene and proper collection and storage of drinking water are planned to address the issue of in-home contamination of water. This type of educational programming, focusing on proper handwashing behavior and collection and storage of drinking water, is also appropriate for the community of Despoblado although no drinking water intervention is planned.

Recommendations

Although logistical considerations precluded taking household and community water samples from Plan y Travesia during the baseline survey, it would be very beneficial to have some indication of the community and household water quality before the water intervention and hygiene education programming are implemented to compare on a qualitative basis with the water quality that is measured during the post-intervention assessments.

CDC recommends extending the educational component of the intervention in Despoblado to include messages about proper hand washing behavior and collection and storage of household water.

In the future, it would be beneficial to obtain quality assurance data from the laboratories if water samples are taken to in-country labs for analysis. An alternative is to use portable water testing kits such as the DelAgua kit for all water sample analyses to ensure the quality of the data collected.

Regional Discussion

The purpose of the baseline survey was to assess the water and sanitation conditions in each country and to quantify each indicator associated with a health impact. The USAID guidelines were used to quantify these impact indicators and to establish a consistent measurement of each impact indicator for comparison in the follow-up surveys. The guidelines for a non-disaster setting are delineated in the USAID Title II Water and Sanitation Indicators Measurement Guide (Billig et al., 1999). The Sphere Project also provides minimum standards for disaster response (Sphere, 1998). These standards were also considered in the community evaluations since the baseline survey was done post-Hurricane Mitch. A summary of the ability of each community to comply with the USAID Impact Indicators is provided in Table 10. Each parameter that was evaluated in the household and community surveys is discussed on a regional basis in the following sections.

Table 10. Summary of Impact Indicators by Country from the Baseline Survey
Water and Sanitation Baseline Survey, February 2000

Impact Indicator	USAID Guidelines *	Honduras		Nicaragua		El Salvador		Guatemala
		Las Lomas	Marcovia	Nueva Segovia	Waspam	Las Pozas	La Ceiba	Chiquimula
Children <36 months with diarrhea in the past 2 wks	25% decrease	27%	29%	29%	49%	40%	25%	28%
Per capita daily water use – L/person/day **	50	30	34	21	12	43	24	16
Food preparers with appropriate hand washing behavior	50% increase	17%	19%	33%	17%	20%	28%	21%
Childcare providers with appropriate hand washing behavior	50% increase	18%	19%	33%	19%	20%	28%	20%
Population using hygienic sanitation facilities	75% usage	53%	30%	72%	4%	53%	14%	18%
Annual Impact Indicator								
Households with access to sanitation	75%	64%	26%	96%	21%	55%	18%	38%

* changes in the impact indicators will be calculated after the intervention has been implemented
** excludes households with spigots which may not have been measured accurately

Table 11 is a summary of the proposed goals for each impact indicator to meet in the follow-up evaluation. The necessary change is estimated as the difference between the compliance each indicator in the baseline study and the USAID target compliance level. For example, in Las Lomas, 27% of the children <36 months had diarrhea in the past two weeks. The USAID guidelines target a 25% decrease in the two-week period prevalence of diarrhea after completion

of water and sanitation infrastructure improvements and hygiene education. Therefore, a goal of 20% diarrheal prevalence is sought, which represents a decrease of 7% from the baseline level.

Table 11. Summary of Proposed Goals for Each Impact Indicator by Country
Water and Sanitation Baseline Survey, February 2000

Impact Indicator	USAID Guidelines	Honduras		Nicaragua		El Salvador		Guatemala
		Las Lomas	Marcovia	Nueva Segovia	Waspam	Las Pozas	La Ceiba	Chiquimula
Children <36 months with diarrhea in the past 2 wks	25% decrease Nec. Change*	27% -7%	29% -7%	29% -7%	49% -12%	40% -10%	25% -6%	28% -7%
	Goal	20%	22%	22%	37%	30%	19%	21%
Per capita daily water use – L/person/day	50 Nec. Change*	30 +20	34 +16	21 +29	12 +38	43 +7	24 +26	16 +34
	Goal	50	50	50	50	50	50	50
Food preparers with appropriate hand washing behavior	50% increase Nec. Change*	17% +9%	19% +10%	33% +17%	17% +9%	20% +10%	28% +14%	21% +11%
	Goal	26%	29%	50%	26%	30%	42%	32%
Childcare providers with appropriate hand washing behavior	50% increase Nec. Change*	18% +9%	19% +10%	33% +17%	19% +10%	20% +10%	28% +14%	20% +10%
	Goal	27%	29%	50%	29%	30%	42%	30%
Population using hygienic sanitation facilities	75% usage Nec. Change*	53% +22%	30% +45%	72% +3%	4% +71%	53% +22%	14% +61%	18% +57%
	Goal	75%	75%	75%	75%	75%	75%	75%
Annual Impact Indicator								
Households with access to sanitation	75% Nec. Change*	64% +11%	26% +49%	96% NA	21% +54%	55% +20%	18% +57%	38% +37%
	Goal	75%	75%	75%	75%	75%	75%	75%

* Nec. Change: necessary change to meet USAID goal. The value is the difference in the compliance to the indicators in the baseline survey and the follow-up survey.
NA not applicable

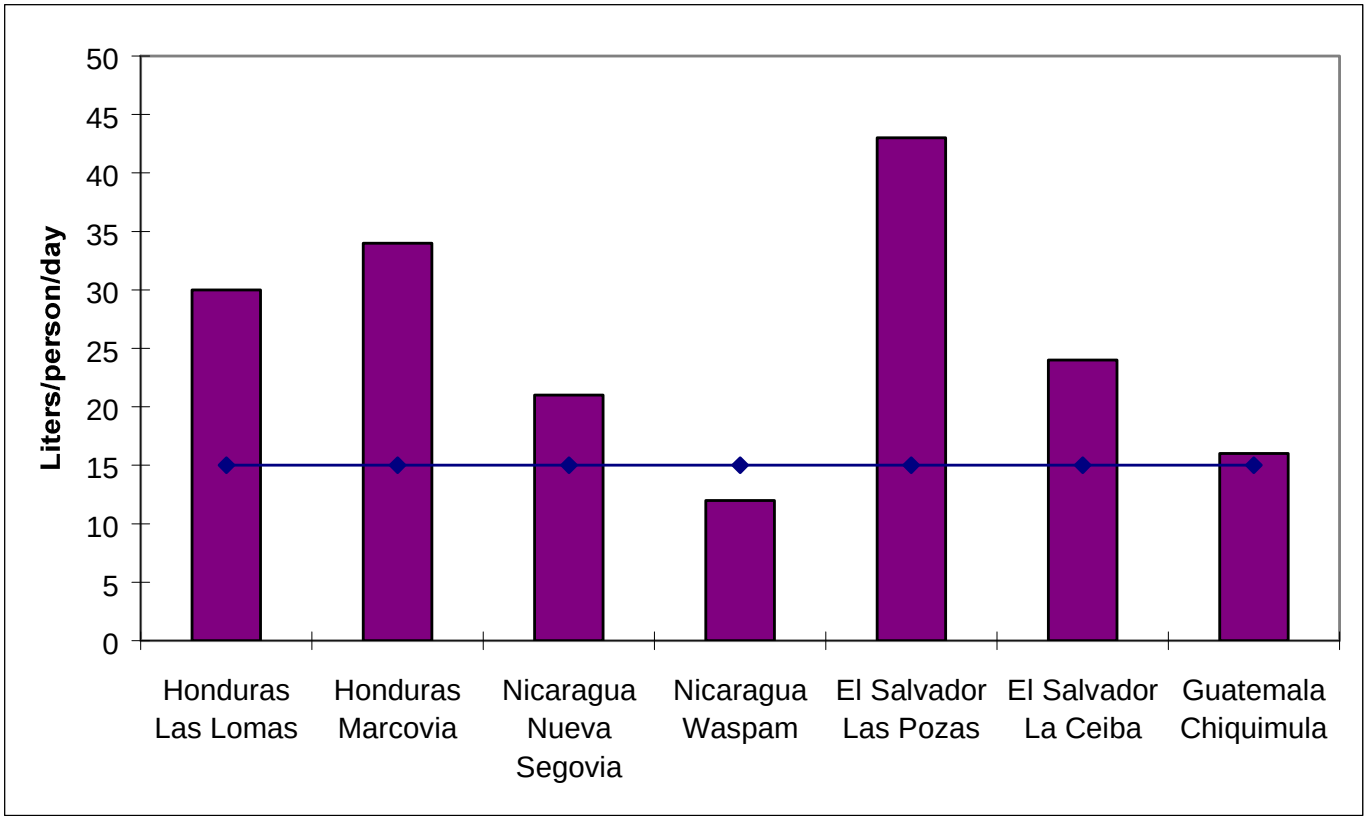
Water

The goals for adequate water delivery per the USAID guidelines include adequate volume and distance traveled to a water source. The collection of at least 50 liters (L) of water per person per day and from a water collection point within 200 meters (m) of each household is considered

adequate. The Title II guidelines also state that the household should not have to "spend a disproportionate part of their day" to obtain water by waiting in a long line or by collecting water from a source with an inadequate flow rate.

At the time of the baseline survey, none of the communities in the survey were able to provide the non-emergency water volume of 50 L/person/day as shown in Table 10 and in Figure 1. Figure 1 shows the liters of water per person per day compared to the USAID and Sphere Project guidelines. With regard to distance to a water source, the mean distance for all communities was greater than the 200 m guideline, except for Las Lomas, Honduras (57 m) and Waspam, Nicaragua (108 m). All communities in the study areas had to wait to obtain water and wait times varied from less than 15 minutes to more than 1 hour. Flow rates from the water source were not recorded in the survey.

Figure 1. Liters of Water per Person per Day by Study Area-pre ARC Intervention
Water and Sanitation Baseline Survey, February 2000



Line indicates the Sphere Project standard for emergency response (15 L/person/day).
USAID guideline for water volume is 50 L/person/day.

The Sphere Project for disaster response guidelines indicate that, in order to meet essential drinking, cooking, personal and domestic hygiene needs, all community members should collect at least 15 L of water per person per day. To assure access to a sufficient quantity of water, public water collection points should be located so that there is at least one water collection point per 250 people, and the maximum distance from any household to a water collection point is 500 m. In Waspam, the average volume of water used per person per day was 12 L, which is below

the minimum level required in emergency settings according to the Sphere Project. All other communities were able to obtain water to meet this standard. The residents of all communities except La Cieba (mean 778 m) traveled, on average, less than 500 m to get water. Water volume and average distance traveled to a water source met the disaster response standards set by the Sphere Project.

Sanitation

To have the maximum health impact, USAID guidelines call for at least 75% of the population to have and use a hygienic sanitation facility, i.e., a toilet or latrine (Billig et al., 1999). All communities in the baseline survey were below the 75% usage rate as shown in Table 10. Interestingly, the highest and lowest usage rates in this study were found in Nicaragua, where a 72% usage rate was estimated in Nueva Segovia and 4% in Waspam.

Hygiene Behavior-Hand washing

Hand washing knowledge and behavior is addressed by developing community health education programs. Hand washing disrupts fecal-oral transmission of disease and is strongly associated with decreased diarrhea rates. The target set by USAID is to improve indicators of appropriate hand washing behavior by 50%. As shown in Table 10, less than 35% of both the food preparers and childcare providers in all communities exhibited appropriate hand washing behaviors.

Water Sampling and Analysis

Water quality analyses showed that a high percentage of both household and community source waters were contaminated with fecal coliforms. Table 12 is a summary of the fecal coliform results for all study areas.

Table 12. Summary of Microbial and Chemical Analysis of Water Samples for All Study Areas Water and Sanitation Baseline Survey, February, 2000

Water Source	Honduras		Nicaragua		El Salvador		Guatemala
	Las Lomas*	Marcovia*	Nueva Segovia	Waspam*	Las Pozas	La Ceiba	Chiquimula
E. coli results / Fecal coliform results							
Community water source	+ / 140 CFU/100ml	- / -	+ / +	0 - >999 CFU/100 ml / +	+ / +	+ / +	+ / +
Household water samples	+ / 50-120 CFU/100ml	100-200 CFU/100ml / 100-3.2x10^4 CFU/100 ml	+ / +	0 - >999 CFU/100 ml / +	+ / +	+ / +	- / +
Chemical Analysis							
Arsenic	NA	NA	NA	<MCL	NA	NA	NA
Mercury	NA	NA	NA	<MCL	NA	NA	NA
Pesticides	NA	NA	NA	<MCL	NA	NA	NA

* Quantitative results available for this study area

CFU/100 ml: colony forming units formed in 100 ml of sample. Quantitative measure of coliform organisms.
<MCL: less than the US Environmental Protection Agency maximum contaminant level for safe drinking water (USEPA, 1999)
+: positive results, -: negative results
NA: not applicable

Concern arose over the contamination of the water supplies in Waspam with arsenic, mercury, and pesticides. Therefore, additional water samples of ground water (well water) and surface water (river/creek water) were collected and sent to the United States Geological Survey (USGS) in Colorado for analysis. The results for arsenic, mercury and several different pesticides were below the United States Environmental Protection Agency's (USEPA) standards for safe drinking water (USEPA, 1999) or not detected.

Analytical techniques and reporting for fecal indicator organisms varied from laboratory to laboratory and country to country. Although all laboratories were requested to quantify *E. coli* using the membrane filtration technique, these results were obtained from only two sources: 1) the DelAgua portable water testing kit that was used by the principal investigators in the field (Waspam, Nicaragua); and 2) one in-country laboratory (the Ministry of Health Laboratory, in Choluteca, Honduras). Analysis was provided free of charge by each in-country laboratory. The investigation was compromised since comparable data could not be obtained from each of the five in-country laboratories used during this study. There was also difficulty in obtaining standard operating procedures and interpreting the documented laboratory results.

Regional Recommendations

As part of the community survey, the community leaders were asked to identify the primary community need. Table 13 is a summary of the needs of each community or study area, the planned ARC interventions, the current status of each intervention, and the CDC recommendations to better focus the interventions and improve the evaluation process.

Table 13. Community Needs, Planned Interventions and Recommendations

Country/ Study Area	Perceived Community Need	Planned Intervention	Status of Intervention as of December 2000	Recommendation By CDC
Honduras				
Las Lomas	Potable water	- Supplement current system with groundwater wells - Connect houses to system - Household latrines - Charlas-hygiene, and water use	-Installed water meters -In progress -Yes -Yes, basic sanitation education	• Check water system piping • Disinfect contents of water tank if needed • Q/A from the lab • DelAgua Test Kit for future evaluations
Marcovia	Water and sanitation	- New water system-spigots - Household latrines - Charlas-hygiene, care and use of latrines	-Yes, plus water meters -Yes, constructed -Yes, sanitation, education	• Q/A from the lab
Nicaragua				
Nueva Segovia	Re-build the water system	- More household/shared spigots - Access to sanitation-hygienic - Charlas-hygiene, water use, sanitation	-Not known -Yes, constructed -Yes, sanitation education	• DelAgua Test Kit for future evaluations • Clinic data-diarrhea comparison • Hygiene and water use education
Waspam	Andres-latrines	- Wells - (3)	-In progress	• Build 8 wells • Improve use of water filters • Latrines • Clinic data-diarrhea comparison
	Kum-better health center	- Wells - (3) - Shared latrines (school) - Charlas-latrines care and use	-Built 7 wells -Built 2 (school) -Yes	• Build 8 wells • More latrines • Clinic data-diarrhea comparison

El Salvador				
Las Pozas	Employment	- Water system - Sanitation-inc. access - Charlas-hygiene	-Piping installed, some water meters -Yes, latrines -Yes, hygiene education (ongoing)	• Sample analysis-precise method-DelAgua Test Kit for future evaluations • Water use and sanitation education
La Ceiba	Water and better roads	- New water system - Household latrines - More charlas-all topics	-Yes -Yes, 40% complete -Yes, hygiene	• Sample analysis-precise method-DelAgua Test Kit for future evaluations
Guatemala				
Chiquimula	Despoblado-better health care	- Household latrines - Charlas-hygiene, water use, and sanitation	-Not known -Not known	• DelAgua Test Kit for future evaluations • Water use and sanitation education
	Guyabo-water	- New water system-household connections - Household latrines - Charlas-hygiene, water use, and sanitation	-In progress -Yes, constructed -Yes, hygiene, latrine construction and maintenance	• DelAgua Test Kit for future evaluations • Water use and sanitation education
	Plan y Travesia-improve the water system	- Fix/upgrade water system - Household latrines - Charlas-hygiene, water use, and sanitation	-Installed water meters -Yes, constructed -Yes, hygiene, latrine construction and maintenance	• Q/A samples • Baseline water samples • DelAgua Test Kit for future evaluations • Water use and sanitation education

Water

The CDC recommends that household water meters be installed in a subset of homes that have water spigots prior to the follow-up survey so that the daily per capita water use of homes with household spigots can be estimated. In the baseline survey, the volume of water used in each household was extrapolated by asking how much water was carried to the house in the 24 hours prior to the interview. The number of people in each home was divided by the total volume of water used in that home to obtain the daily per capita water use in each household. The daily per capita water use for all households was averaged to obtain the mean daily per capita water use for each community. When household spigots were available, people did not need to carry water to their homes, and the self-reported volume of water carried to the household did not provide an accurate estimate of household water use. Therefore, when the homes in each community are provided with spigots, the daily household water used should be measured using a flow meter.

If household water meters are not feasible, then a central meter on the community water system may be used as a proxy. An adequate flow rate of 0.125 liters per second, the Sphere standard, should be attained by the water system. If household meters are used, readings should be taken on days when water is not used to provide water to gardens or livestock because these uses are not considered in the standards for per capita daily water use.

The CDC also recommends that all households have access to private or shared spigots, except for Waspam, Nicaragua where wells are recommended. This will bring all households within both USAID's non-emergency and Sphere's emergency guidelines for reducing the distance to a water source. If water flow is adequate, the per capita daily water use should also increase.

The CDC recommends that the number of wells for Andres and Kum be increased to 8 community wells, a total of 16 wells altogether. The proposed intervention for each community in Waspam was to provide 3 community wells, meaning one well for 667 people in Andres and one well for 367 people in Kum. This ratio of wells to people is not considered sufficient to meet Sphere minimum standards and indicates that more wells are needed to attain the 250 people per water collection point.

Sanitation

The planned intervention for all communities, except Waspam, focuses on building household latrines. Minimum sanitation standards set by the Sphere Project (Sphere, 1998) include:

a maximum of 20 people per toilet;
arranging toilet use by household and/or segregated by gender;
locating toilets no more than 50 meters or one minute's walk from dwellings; and
having public toilets available in public places.

Although the logistics of latrine construction in Waspam may be difficult, an attempt to address this need should be considered because the community council of Andres identified latrines to be the community's greatest need. The ARC plans to build shared latrines in Kum. The latrine design in Waspam will need to take into account annual flood patterns. Composting latrines with a raised vault design should be considered.

Hygiene Behavior-Hand washing

The CDC recommends health education through charlas to address proper hand washing. Hand washing behaviors are encouraged by placing hand washing facilities near sanitation facilities and by providing a sufficient amount of water. All of these issues will be addressed in the study areas being provided with household latrines and household spigots. If a sanitation component is added to interventions planned in Waspam, hand washing facilities should be placed near sanitation facilities.

The CDC believes that in the follow-up survey it may be necessary to adjust the scores of the households without children because they are less likely to perform behaviors associated with childcare. The USAID indicators rely on the interviewee to spontaneously recite the times that they wash their hands. Two of the USAID indicators refer to hand washing activities specific to

childcare: 1) washing hands after cleaning a child's bottom, and 2) washing hands before feeding children.

Water Sampling and Analysis

In comparison of baseline to follow-up study results, the CDC will only be able to compare the number of households and community water sources testing positive or negative for *E. coli* since some of the in-country laboratories did not have the capacity to perform enumerative testing for *E. coli* during the baseline study. Many of the laboratories used the presence/absence techniques for *E. coli*.

The CDC recommends standardizing the analyses utilized by field personnel. The in-country personnel should be trained in the use of portable water testing kits, such as the DelAgua test kit. For the follow-up evaluation, all water samples should be tested using the DelAgua test kit and the PurTest kit should be used as a confirmatory and backup method. The team may also consider investigating in-country referral laboratories familiar with the membrane filtration technique for *E. coli* quantification.
Additional regional recommendations include:

1. Continue with scheduled water and sanitation interventions giving latitude to the in-country delegates to individualize programming as needed.
2. Re-test water community water sources in all study areas using a portable water testing kit such as the DelAgua kit.
3. Conduct a baseline survey in the Study Area 2 in Santa Rosa, Guatemala.
4. Continue with plans for follow-up evaluations in all study areas in February 2001.

Conclusion

Programming interventions appear to be on target to meet USAID guidelines. The communities in Waspam do not meet some of the Sphere requirements for emergency situations. An effort should be made to help these communities meet the Sphere Project standards at a minimum. All other programs should continue as scheduled and be re-assessed in February 2001. A baseline evaluation should be done for Study Area 2 in Guatemala. The initial survey for the second study in Guatemala should be conducted in February 2001, and the program should be reassessed in February 2002. Continuity of study coordinators, interviewers, study instruments and consistent laboratory methods will be helpful in reducing the variability between the two data sets.

The collection of follow-up data in February 2001 and the subsequent comparison with these baseline data will allow an evaluation of the effectiveness of the intervention in terms of improved quality and quantity of water, and reduced cost and effort needed to access water.

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