Water quality investigations - El Cacao

In response to a request from Condor SA, Nuevas Esperanzas undertook a preliminary study of water quality in the community of El Cacao on 5th November 2008 using field-based analytical techniques. Samples were taken from seven wells in the community using the means of drawing water (pumps, buckets) present at each well. The analyses undertaken were as follows:

Physical characteristics

- Measurements were made of Total Dissolved Solids (TDS), temperature and pH using a combined conductivity, temperature and pH probe (Hanna Instruments HI 98129).
- Turbidity was measured using a calibrated potable turbidity meter (Wagtech potalab turbidimeter WT3020)

Biological characteristics

- Analysis for thermotolerant faecal coliforms (*E. coli*) was carried out using a portable laboratory based on membrane filtration (Oxfam DelAgua). Samples of 10 ml and 100 ml were filtered and incubated at 44° on a Lauryl Sulphate culture medium for 18 hours.

Chemical characteristics

- A small range of chemical parameters were measured for samples taken from the rainwater harvesting system and from the well for comparison, using a precision electronic colorimeter (Wagtech potolab photometer 7100). The parameters measured were Sulphate, Ammonium, Nitrate, Nitrite, Flouride, Calcium Hardness (Calcicol) and Chloride.

The results of these analyses were as follows:

	Catalina Rivas	Ronald Rivas	Faustino Rivas	Transito Matamoro	Vicente Matamoro	Communal Well	Fabio Espinoza	Bottled water (control)
Turbidity (NTU)	0.46	0.93	0.06	0.96	0.49	0.32	0.33	-
Total dissolved solids (mg/l)	416	410	410	346	346	353	381	502
pH	6.45	6.40	6.31	6.35	6.49	6.30	6.23	6.4
Temperature(°C)	28.8	28.1	29.0	29.3	27.9	28.2	28.3	-
Faecal coliforms (E. coli/100 ml)	270	460	51	>2000	60	0	830	0
Calcium hardness (mg/l)	217	70	127	95	122	135	200	.
Sulphate (mg/l)	0	0	35	5	5	10	23	.
Chloride (mg/l)	3.2	5.0	3.9	4.1	1.8	1.9	5.9	.
Nitrate (mg/l)	0.34	1.74	2.30	0.56	1.54	1.34	0.58	.
Nitrite (mg/l)	-	0.06	0	0.01	0.03	0.01	0.06	-
Ammonium (mg/l)	0.01	0.1	0.22	0.14	0.19	0.06	0.06	-
Fluoride (mg/l)	0.54	0.80	0.25	0.63	0.00	0.84	0.15	.
Arsenic (µg/l)	<10	<10	<10	<10	<10	<10	<10	-

Sanitary surveys

Sanitary surveys are qualitative observations of wells which allow the risk of contamination to be assessed according to given criteria, such as the adequacy of drainage and the distance to the nearest latrine. These surveys complement microbiological analyses of water quality in that they assess the likelihood that a well may become contaminated, irrespective of how contaminated it actually is on the day the sample is taken for microbiological analysis.

Name:	**Catalina Rivas**
Approx. depth (m):	~10 m
Closest latrine (m):	30 m
Well type:	Hand dug with concrete surround
Pump type:	Unprotected rope pump
Cover:	Concrete cover slab
Drainage:	No drainage but well pumps into a trough

Name:	**Ronald Rivas**
Approx. depth (m):	~7 m
Closest latrine (m):	>30 m
Well type:	Hand dug with concrete surround
Pump type:	Unprotected rope pump
Cover:	Zinc/wood, well fitting
Drainage:	Natural drainage

Name:	**Faustino Rivas**
Approx. depth (m):	Unknown
Closest latrine (m):	20 m
Well type:	Hand dug with concrete surround
Pump type:	Diesel pump
Cover:	Zinc, well fitting
Drainage:	No drainage - muddy

Name:	**Transito Matamoro**
Approx. depth (m):	~10 m
Closest latrine (m):	>30 m
Well type:	Hand dug with concrete surround
Pump type:	Unprotected rope pump
Cover:	Zinc, well fitting
Drainage:	No drainage but not wet

Name:	**Vicente Matamoro**
Approx. depth (m):	~10 m
Closest latrine (m):	20 m
Well type:	Hand dug with brick surround
Pump type:	Bucket and windlass
Cover:	Zinc, opened to draw water
Drainage:	No drainage but not wet

Name:	**Communal well**
Approx. depth (m):	Unknown
Closest latrine (m):	~10 m (4 school latrines uphill)
Well type:	Borehole (drilled by CARITAS)
Pump type:	Unprotected rope pump
Cover:	Concrete well head
Drainage:	Good concrete apron

Name:	**Fabio Espinoza**
Approx. depth (m):	Unknown
Closest latrine (m):	>30 m
Well type:	Hand dug with concrete surround
Pump type:	Unprotected rope pump
Cover:	Zinc cover and tiled roof
Drainage:	No drainage or trough

Other Samples

Two samples were also taken in nearby El Zapote. It is rumoured that the arsenic in the groundwater is high in this area, and the residents have been advised not to use this water for human consumption. Mains water is now supplied to this community. The samples were taken from a borehole with an open top that has not been used for a number of years and a well covered with a corrugated metal sheet where the water was used regularly for washing clothes. The result for Arsenic at both of these sites was <10ppb.

Discussion

All parameters measured are within acceptable limits with the exception of the presence of faecal coliforms. The presence of *E. coli* in all of the well samples, with the exception of the communal well is outside acceptable limits.

On the day of sampling the Arsenic results from all well samples taken in El Cacao were <10ppb. This is within the acceptable limits. However these results need to be treated with caution as the Arsenic results from samples taken in nearby El Zapote, where high levels of arsenic contamination have been found previously, were also <10ppb. The low levels of arsenic could be therefore be due to dilution from recent recharge, or because of problems with the analysis. The method used is generally regarded to be one of the most reliable but the absence of any positive results raises some concerns.

As a follow-up to this water quality survey, additional information on the arsenic problem has been obtained. *La Prensa* (2nd March 2001) reported that high arsenic levels have been found in the communities of El Zapote, Soledad de la Cruz, El Carrizo, Agua Fría and Las Cañas. Most scientific attention appears to have been given to the community of El Zapote:

BUNDSCHUH, Jochen (2007), *Geogenic Arsenic in Sedimentary Aquifers of Southwestern Sebaco Valley, Nicaragua,* Geological Society of America *Abstracts with Programs,* Vol. 39, No. 6, p. 518

> "In 21 of 57 water samples collected from wells of this alluvial aquifer, arsenic concentrations ranged from 10 to 122 µg/l, exceeding the national and the WHO limit of 10 µg/l for arsenic in drinking water. Several hot spots with high groundwater arsenic were identified, e.g. El Zapote Village with 122 µg/l. This is the same locality where in 1996 a high concentration of 1320 µg As/l was found in a well drilled into the highly fractured hardrock aquifer, and which supplied drinking water to the population since 1994."

GOMEZ, Alina (2004), *Chronic Arsenicosis in El Zapote, Nicaragua,* International Conference *Evaluation and Management of Drinking Water Sources Contaminated with Arsenic,* Universidad de Chile, Santiago, November 2004

> "The first Central American cases of arsenicosis were reported in 1996 in El Zapote, rural community of 125 inhabitants, located in the valley of Sebaco, north of Nicaragua. This population ingested during two years (1994-1996) arsenic contaminated water from a public tube-well containing 320µg of inorganic arsenic (As) per liter of water. Contamination was also detected in private hand wells used before 1994 and after 1996 (45-66µg As/l)."

GOMEZ, Alina (2002), *Monitoreo y Atención de Intoxicados con Arsénico en El Zapote, Municipio de San Isidro, Departamento de Matagalpa, Nicaragua 1994-2002,* UNICEF

> "…detectaron nuevas fuentes de agua contaminadas en comunidades vecinas a El Zapote, incluyendo un manantial que contenía 100 µg As/litro de agua, localizado en El Carrizo."

Recommendations

The wells at El Cacao are typical of rural communities in Nicaragua in terms of their construction, levels of hygiene and faecal contamination. The communal well appears to be the most reliable water source within the community and in order to reduce waterborne disease, this should be recommended

as the most reliable source from a microbiological perspective. Measures which could be taken to improve drinking water quality from contaminated wells include improvements to well protection, drainage aprons and pumps, as well as the promotion of water filters which could significantly improve the water from wells registering more than 10 E. coli/100 ml. The most appropriate system for this type of community is the 'Filtron' ceramic filter. The successful introduction of water filters would depend on a well-organised education campaign and adequate follow-up over a number of months.

The physico-chemical water quality appears to be acceptable, but in view of the uncertainty regarding the negative results of the arsenic analysis and the potential seriousness of arsenic poisoning, it is recommended that further analysis is undertaken of wells in El Cacao and neighbouring communities. This analysis should be undertaken at different times of year and, where possible, wells should be purged prior to sampling. This would ensure that samples taken are representative of groundwater found within the formation. The accuracy of the analytical method used should also be compared against laboratory results.

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