25th WEDC Conference Addis Ababa, Ethiopia, 1999

INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Acceptability/utilisation of sand-abstraction water supplies

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MANY COMMUNITIES IN many countries are dependent on groundwater for all their water needs. However, this may not always in fact be the most reliable nor sustainable answer. Quite frequently, for one reason or another, handpumps are in disrepair and it is not uncommon to find groundwater contaminated with mineral salts to such a degree that many people would prefer an alternate water supply. A survey recently undertaken in the Dongamuzi Ward of the Lupane District of N.W. Zimbabwe showed that the water supply situation had totally broken down.

Of the 25 water sources listed in the ward only 8 were found to be operational and of those, only 4 were providing water of an acceptable quality. People stated that they were unable to use water from the boreholes as the water was unpalatable and from 4 boreholes so caustic that it irritated the skin to a considerable degree. Water from 3 boreholes was seen to be black with coal. Within the most densely populated part of the Ward only 1 pump was operational. Whilst this was used extensively, analysis showed the water to be of poor palatability. It was also seen to be impossible for just 1 pump to supply the needs of all would be users.

As a result of this people had reverted to the unsafe water supplies they had traditionally used and were walking long distances to open and shallow pits in river beds and dam basins. A walking distance of up to 10 kilometres to the further homesteads was recorded.

Of the 3 dams within the ward, one was completely dry, and people were abstracting water from 'emergency', shallow infiltration wells which had been dug into the dry silt of the dam basin. The exposed ends of poles protruding from the 'wells' of the previous season showed that people regularly resorted to this practice.

At the time of the final survey carried out in early November, all the dams were dry and all water was being drawn from these shallow wells. Bacteriological tests on the open-surface water and water from the shallow wells showed very high rates of contamination. Unfortunately it was not possible to establish the full degree of contamina-

Table 1. Microchemical analysis of water sources in Dongamuzi ward

	Recommended Limit	Max Allowed Limit	Source Borehole 2	Source Borehole 7	Source Borehole 16	Source Open Sand	Source 'Safe' Sand
Conductivity (mS/m)	70	300	**460**	**400**	**940**	50	40
pH	6 - 9	5,5 - 9,5	7,3	7,5	8,1	7,9	7,3
Turbidity (NTu)	1,0	5,0	30	**120**	**55**	20	6,5
Total Hardness	20-230	650	**1100**	110	370	130	120
Calcium ($CaCo_3$)	NS	NS	**780**	20	100	120	68
Magnesium ($CaCo_3$)	100	150	**320**	90	**270**	10	52
Sodium (Na)	100	400	**390**	**600**	**910**	20	9,7
Potassium (K)	NS	NS	6,5	4,0	5,8	1,5	1,5
Iron (Fe)	0,1	1,0	**6,6**	**11,0**	0,9	0,5	1,1
Manganese	0,05	1,0	**2,6**	0,4	0,2	0,1	2,8
Alkalinity ($CaCo_3$)	NS	NS	610	190	500	360	200
Chloride	250	600	22	**110**	58	2	8
Sulphate	200	600	**1600**	**1700**	290	1,7	< 0,01
Phosphate	NS	NS	0,1	< 0,01	< 0,01	< 0,01	< 0,01
Ammonia Total Nitrate Nitrogen	6,0	10,0	0,3 < 0,01	0,1 < 0,01	0,5 0,5	< 0,01 < 0,01	< 0,01 < 0,01
Fluoride	1,0	1,5	0,9	< 0,01	< 0,01	< 0,01	< 0,01
Approx Dissolved Salts	500 (WHO)	1500 (WHO)	**2300**	**2000**	**4700**	250	200
Oxygen Absorbed 4hr, 27°C	NS	NS	2,0	< 0,01	8,0	3,3	< 0,01

tion as it was only possible to obtain a pathogen count to 500. Above 500, counts have been recorded as 'Too Numerous To Count' (TNTC).

People further to the east and in the vicinity of the Dongamuzi River had also resorted to the use of traditional, seasonal water supplies where considerable use was being made of the of the traditional 'sand-abstraction' system. At least 25 shallow sand-wells had been excavated down to the river bed to a minimum depth of 4.00 metres. The quality of this water was appreciably more acceptable than the shallow wells in the dam basins but unfortunately at such a depth it was difficult for people to abstract it in any quantity at this late stage of the dry season. However it was seen that the surrounding community was totally dependent on the 'sand-abstraction' system.

From the fore going it can be appreciated that the entire infrastructure of the operational and maintenance system had broken down throughout the ward and that people had to resort to traditional and emergency sources of water, whatever its appearance and potability.

Groundwater supplies are thus not being utilised and the various communities have resorted to their traditional methods of water abstraction from shallow supplies. The shallow 'infiltration wells' in dam basins can be seen to be completely inadequate and unsafe. The traditional technology of 'sand-abstraction' however is both acceptable and effective in the provision of clean and safe water.

However, the open wells, as well as being deep and dangerous to users with unstable walls also create a problem during the rains. When the river initially flows, the protective thorn fences are washed into the wells and trap the silt and finer sediment. This in turn clogs up the river and makes it difficult for people to dig wells in the optimum sites in the following season.

Options for improvement

In such situations pumped systems utilising well-points or infiltration galleries have been developed to abstract clean, safe water from the sand. However, at this particular site survey work does need to be undertaken in order not to over abstract water and thus to deplete such an important water supply.

Although well-points could be used, probably the most effective way of abstracting water from the Dongamuzi River would be to lay infiltration pipes on or below the bed of the river and then back-fill with an aggregate rather than the fine sandstone particles which make up both the river sediment and the surrounding land. This infiltration pipe would then drain into an offset false well on the river bank from which water could be easily abstracted by either a bucket and windlass or a suitable hand pump.

A study is presently being carried out to establish the subsurface flow, likely retaining capacity of the river and anticipated water loss during the dry season.

Conclusion

From the study it is apparent that people have long obtained their domestic water from 'sand-abstraction' wells in the river. Further to this, an effective management strategy has been developed for what is the most reliable and accessible source of water for the people.

Extensive and efficient use is made of the water in the Dongamuzi river using traditional 'sand-abstraction' wells. However, the open wells are easily polluted and are difficult to maintain because of the ingress of sediment into them.

The system is of particular benefit as it can be guaranteed not to contain excessive levels of mineral salts and thus is much more palatable and acceptable to the local users.

Significant opportunities exist for the development and up-grading of traditional 'sand-abstraction' systems with infiltration galleries and well-points. Simple, low technology abstraction systems which can be easily operated and managed and meet the needs of rural communities are able to provide the conditions that will ensure uncontaminated, safe water and safety for users during the drawing of water.

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Table 2. Chemical analysis of water sources in Dongamuzi ward

Lab Ref	Source	48hr plate count/ml	Coliforms per 100ml	Faecal/Coliform per 100ml	Comments
PA 3046	Madala Dam	TNTC	positive	positive	Water heavily contaminated with bacteria including the faecal type. Water should be disinfected prior to consumption
PA 3047	Dongamuzi River	TNTC	positive	positive	
PA 3048	Madala Well 1	TNTC	positive	positive	
PA 3049	Madala Well 2	TNTC	positive	positive	
PA 3050	Wenlock Sand Abstraction	12	negative	negative	Bacteriologically good potable water

TNTC = Too Numerous To Count