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Evaluation of community participation in water quality monitoring by the use of water quality descriptors as a preliminary approach to assessing water quality

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This research was carried out in 1997 at a chosen mine in Zimbabwe in order to determine and assess participation by communities from mining areas in monitoring the quality of water they use through procedures that are alternatives of laboratory experiments. Questionnaires, group discussions and observations were used to collect data on community knowledge in water quality issues. The results show that communities have water quality descriptors derived from their experience. They use these descriptors everyday to discuss the quality of the water they use. These descriptors are closely related to water quality parameters as analyzed in the laboratory. The findings, therefore, show that it is possible to organize communities to continuously and systematically monitor the quality of water in their areas as a preliminary approach to chemical and microbial analyses by research scientists or local water engineers and local environmental health technicians.

Keywords: Water pollution, community participation.

Introduction

Water pollution is an issue of concern in Zimbabwe. Increased water pollution has resulted from the nation's desire to meet the agricultural, energy and commercial needs of the country. Practitioners and theorists have grappled with ways and means of solving the water quality problem. One approach, which is in vogue, is organizing communities for their own strategies to address the issue through environmental education (Caduto, 1983).

The challenges of teaching chemical pollution to community members are many. Very few people are in a position to understand the chemical processes occurring in water. It is difficult for the researchers to discuss chemical pollution of water with mine communities because they may not understand the required chemical principles. The mining communities may not have the time required for them to participate in such a long-term benefit activity. As a result of these and other possible reasons, the majority of mining communities remain illiterate to environmental concerns like water pollution (Gough and Robottom, 1993). Communities must be educated on the negative effects of chemical pollution. For example that continuous pollution of water by mining activities allows accumulation of hazardous chemicals in water and fish. The same chemicals eventually accumulate in people through food chains.

Normally researchers on the impact of mining activities on water quality liase with mine authorities to get a brief outline of their practice. This helps to guide researchers on possible pollutants to look for and give appropriate recommendations. The local communities are not consulted throughout the study. Exclusion of local communities results in low levels of implementation of arising recommendations (O' Donoghue, 1991; Mazzucato, 1997).

Various studies have argued for the use of environmental education in sustainable development (Fien,1993; O' Donoghue,1991; van Rensberg, 1994). Chapter 4 of Agenda 21 stresses the need for environmental literacy in all levels of society. This approach requires development of strategies that allow all levels of community to participate. An analysis of the causes of major environmental issues in a local context is encouraged. This leads to changes in environmental values and lifestyles (Fien, 1993).

The purpose of this research was to determine and assess community based water quality descriptors as used by the mining community to monitor the quality of water they use. Specifically, the following objectives were set:

1. To determine the water quality descriptors used by the mining community to monitor the quality of water in the river and the dam.
2. . To relate the mine community water quality descriptors to the results from chemical analysis research.
3. To determine the extent to which the mine community can participate in monitoring water quality.
4. To determine community knowledge of possible sources of water pollution and possible solutions to water quality problems.

Methods and materials

Study area

The selected mine is situated about 50 km NW of Harare the capital city of Zimbabwe. In this area, there is commercial farming in the rainy season. Agro-chemicals are washed into the river and finally reach the dam which supplies drinking water to the local residents (Zaranyika *et al.*,1994, Zaranyika *et al.*, 1997). Seepage from the mine dumps and effluent from gold processing also get to the dam (Zaranyika *et al.*, 1994, Zaranyika *et al.*, 1997). Sewage tanks are situated up hill with respect to the river and dam so seepage from the sewage tanks may contaminate the river and dam water.

Sample and data collection

The mining community consists of about 500 residents. Out of these, 160 were randomly sampled for the study. Four research assistants were trained and administered questionnaires. The questionnaires facilitated collection of information on water experiences related to colour, taste, smell, cooking, bathing, laundry, gardening and health. Principle researchers led group discussions. Each group consisted of about 10 people. The discussions covered all the sections listed above. Causes and solutions to the water problems were also included in the discussion. Three research assistants from the mine carried out observations regarding water use. They were briefly trained on how to record the data using a structured format. They recorded information on general use of water resources in the area and observable signs of water pollution.

Data analysis

Both quantitative and qualitative methods of data analysis were used. Quantitative methods were used to summarize participant information. Qualitative methods were used to analyze the rest of the questionnaire, group discussions and observations.

Details of participants were recorded in different categories in Table 1 and expressed as percentages. The water quality descriptors used by communities were recorded in Table 2. These descriptors were extracted and summarized from questionnaires, and group discussions. The community's reasons for water pollution and possible solutions were also extracted and recorded in Table 2. The observations recorded were analyzed for significant data on water quality.

Results

Participation information

The information collected from participants is as given in Table 1 below.

Table 1: A summary of participant information.

Section	Category	Percentage (N=160)
A	***Gender***	
	Male	20
	Female	80
B	***Age (years)***	
	15-25	32
	26-35	37
	36-40	13
	46-55	6
	over 55	1
	unknown	11
C	***Marital status***	
	Single	11
	Married	89

D	***Level of Education***	
	Never went to school	25
	Up to grade seven	27
	Up to O' level	31
	Up to tertiary level	17
E	***Employment status***	
	Unemployed	81
	Employed	19

The responses obtained from the study are as summarized in Table 2.

Table 2: Summary of information on water quality gathered from participants.

Parameter	Community descriptor	Cause	Solution
Colour	Reddish, greenish	Summer water run-off and water tanks	Fetch bore hole water for drinking then use tap water for other purposes.
Taste	Oily, salty, heavy, not quenching, bitter	Too much soda added during water purification, dam water is not natural water	
Smell	Medicines, stale	Dirt in the dam, mine waste in the water	
Cooking	Leaves brown and white deposits, foams when boiled, stains pots and milk precipitates out	Generally dirty water that is hard	Boil water and decant before cooking
Laundry	Soap foams slightly, forms precipitates in used water	There is some oil in water, excess soda	Use boiled water, add sunlight liquid to the laundry water, use rain water during summer
Bathing	Soap foams slightly, water sticks on the skin		
Gardening	White deposits on garden soil,	Water has cyanide, salty water	
Health	Stomach aches	Sewage burst pipes Sewage flows into water ways Waste from milling in the gold mine Poor water purification	Reduce water entering the water body, use machines to monitor water quality

Discussion

The majority (80 per cent) of the participants were women. At the time the data was collected, most men were at work. As more women participate in these environmental activities, they end up being more environmentally aware than men are. Most interviewees (72 percent) had lived in other areas besides the mine so they had enough background to give comparative information on water quality. Fifty two percent had gone into Grade 7 and 81 percent were not employed. This implies that non-participatory approaches to environmental education like broadcasting and press articles fail to reach the mine community because of socio-economic reasons.

The results show that community members have a way of describing water quality using colour, taste, smell, cooking, laundry, bathing, gardening and health experiences. These descriptors are defined through the experience that the communities have had over a long period of time.

According to WHO (1980) guidelines for drinking water, the water should be colourless, with no smell and sharp taste. The mine community describes their water as sometimes reddish especially during the rainy season. The taste was described as bitter especially when the dam was drying up. Most residents described the smell as normal for the greater part of the year but some said the water sometimes smells like medicines.

For those who have gardens, they reported that white precipitates remained on the soil after watering. The garden soil was different from the soil outside the garden. Farm residents reported that there was a difference in taste between the rape watered with dam water and that watered using bore hole water. Chemical analysis of vegetable material would be required before definite conclusions are made.

Most participants did not answer the questions under health. Given the complexity of factors causing illness, further detailed and focussed research that involves local clinics would be required. Chemical and microbial analyses would be very important in this regard.

Effluent from the mine was identified as the major source of water pollution. The water flowing in the river was described as water from the mine processes and not natural water. Responses like 'cyanide from the mine causes water to be hard' were common although on further probing, the participants did not give adequate explanations of the concepts cyanide and water hardness.

The mine community had suggestions on how to solve their water problems. Some suggested re-channeling effluent from the mine to other reservoirs not used as source of water. Others suggested more efficient water purification systems at the mine considering the amounts of pollutant that have to be removed. However, some believed that there was nothing that could be done since they depended on the mine for a living. Such debate and discussion shows that the community members think of how they can solve water quality problems.

Some of the experiences related by the communities confirm what has already been found in the laboratory analysis (Zaranyika *et. al.*, 1994, Zaranyika *et. al.*, 1997).

The river and dam water was analyzed for chemical parameters in the laboratory. The white deposits in kettles and cooking pots recorded in Table 2 indicate high water hardness of 220 to 1895 mg $CaCO_3$ / litre (Zaranyika *et. al.*, 1994) as studied in the laboratory. The high water hardness also explains the non-foaming of soap and precipitates observed during laundry and bathing. These precipitates are salts of cations like magnesium and calcium responsible for water hardness.

Some of the descriptors given by communities require further chemical analysis before relationships can be drawn. For example, milk precipitating in tea could be low pH, grime attaching to skin when bathing could be presence of hydrophobic compounds and reddish strains in pots could be high levels of iron salts.

From the above discussions, it can be seen that the mining community can participate in monitoring water quality. It is not crucial for them to learn chemical principles and instrumentation before they can monitor water quality. They can easily monitor improvements or deterioration in water quality using everyday experiences . Research findings from the laboratory can also be explained in terms of the descriptors that they have been shown to understand. However, not all water quality parameters are immediately experiential. There are long term effects and problems that communities may not readily detect which would require laboratory experiments. Also parameters like levels of dissolved oxygen may not be detectable from experience but from laboratory experiments.

The observations recorded by research assistants who are from the mine showed they can generate useful information that can be used in monitoring water quality. For example, when Zaranyika *et al.*, (1997), did the laboratory investigations of the water quality, where the point source of heavy metals was the mine only. However, these research assistants recorded the activities of the gold panners who used dam water to wash the gold. This kind of initial information can be very useful in designing the research programme or in interpretation of research results.

Conclusion

This research shows that it is possible to develop community based water quality descriptors. These descriptors can be explained using laboratory findings. Hence the mine community can use these descriptors to monitor changes in the quality of the water. The community members can also participate in generating information that can be used in water quality monitoring research in the laboratory.

However, the community needs to be made aware of the dangers of relying solely upon these water quality descriptors and the need to constantly consult with the relevant local authorities (water engineers and environmental health technicians) for scientific interpretation of their observations and advice to avoid unnecessary panic or use of polluted water. They also need to be educated on the possible sources of pollution and methods of preventing pollution of water bodies.

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