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Case Study 16

Water quality and management in peri-urban Kumasi, Ghana

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INTRODUCTION

This short paper reports some preliminary results from an investigation of water quality and water use in the peri-urban area around Kumasi, Ghana. The issues focused on here are: 1) an assessment of the consequences of land use practices within peri-urban watersheds around Kumasi; 2) the implications of this for the downstream rural sub-catchment area; 3) development and implementation of 'good practice' guidelines to improve awareness and management of water resources.

Kumasi has a semi-humid tropical climate, with a total average annual rainfall of 1340mm (Cornish et al, 1999). The rainfall distribution is weakly bimodal, with a main peak between March and June, and a secondary peak in September to October. Kumasi itself lies across the top of a local watershed at approximately 280m asl. The terrain is moderately dissected (amplitude of relief up to 30m) with slopes commonly of 5^o to 15^o. Two subcatchments (one small – c. 35 km^2; one larger – c. 200 km^2) were identified which were representative of the range of environmental conditions and human activities in the Kumasi peri-urban zone. The headwaters of both these subcatchments are part-rural (though becoming urbanised) and part-urban. Twelve water sampling points were identified, in a range from predominantly rural, through more urbanised, to sites representative of urban pollution. Monthly water quality sampling was initiated at these points in September 1999. Eight villages were selected in the peri-urban area, close to these water quality sampling points, and a detailed questionnaire survey of water-related issues was undertaken.

With a rapidly-expanding city of approximately 1 million people (Government of Ghana, 1996), the principal land pressures are in the peri-urban zone, where agricultural land is gradually being converted to housing, predominantly one-storey private housing. Traditional authorities still continue to play a major role in the rural/peri-urban villages, particularly in respect of land allocation and land sales. Elected Unit Committees have responsibility for maintenance of facilities such as communal toilets and refuse dumps. These Unit Committees are as yet newly formed, and their functions appear to conflict to some extent with the specifically water-oriented Water and Sanitation Committees (WATSANs) which have also been set up in four of the survey villages.

PRELIMINARY FINDINGS

Water resources in the peri-urban area around Kumasi are prejudiced by a variety of activities. Principal among these are: 1) river water pollution especially within and downstream from urban Kumasi, attributed to untreated sewerage and other domestic waste, hospital waste, industrial waste, including an assortment of chemicals and possibly heavy metals, oils from informal motor repair businesses; sawmills, brewing, abattoir, urban and rural runoff, including agricultural chemicals and residues, leachate from groundwater into the river system of any of the above pollutants; 2) contamination of boreholes and wells situated close to polluted watercourses by one or more of the pollutants listed under 1; 3) contamination of boreholes and wells by leachate from pit latrines located upslope from them; 4) unplanned and unregulated waste tipping, both by villagers and by urban dwellers, with inadequate if any management and mitigation measures; and 5) localised heavy resource exploitation e.g. sand winning, deforestation for agriculture and wood use, and new urban and peri-urban housing and industrial/commercial premises.

In order to demonstrate the effects of pollution (both urban and peri-urban) on water quality, two sites are contrasted from the River Owabi, which flows through agricultural land close to the village of Maase, upstream of Kumasi, then through the north-west margins of the city itself, where it is joined by other tributaries from the urban area, as at Atafua (7km downstream from Maase), a rapidly-urbanising agricultural village (Table 1). The river then flows into the Owabi Reservoir, which is used by Ghana Water Company to supply Kumasi. Ten months' data indicate significant differences downstream in most parameters. Significant variability and some seasonal effects due to changing discharges are also apparent, and these results must be regarded as provisional at this early stage.

TABLE 1
Water quality data, September 1999 to June 2000 in stream at Maase(upstream) (n = 10) and in river at Atafua (downstream) (n = 8). Mann-Whitney test for differences in measured variables. * three readings only so far.

Variable	Maase (n = 10)		Atafua (n = 8)		Significance level	
	Mean	St. Dev.	Mean	St. Dev.		
pH	5.50	0.62	7.25	0.22	0.001	HS
Turbidity (NTU)	21.08	22.29	198.58	370.07	0.007	HS
Electrical Conductivity (µs/cm)	44.36	19.25	209.64	106.75	0.001	HS
Total Dissolved Solids (mg/l)	21.43	5.38	114.13	52.99	0.001	HS
Ammonia (mg N/l)	0.05	0.07	1.04	1.27	0.01	HS
Nitrate (mg N/l)	0.05	0.06	1.83	3.80	0.63	NS
Nitrite (mg N/l)	0.02	0.04	0.11	0.17	0.02	HS
Phosphate (mg/l)	0.42	0.34	1.67	2.56	0.03	S
Dissolved Oxygen (mg/l)	3.17	1.59	2.56	1.25	0.20	NS
Oils & gases	8 *		10 *		-	
Coliform 37^{0}C (per 100ml)	690 *		7300 *		-	
Coliform 44^{0}C (per 100ml)	280 *		5070 *		-	

In the absence of a piped water supply outside the urban area, many newly-built private houses are reliant on individual boreholes or hand-dug wells for a domestic water supply. Sources of drinking water varied between the villages depending on the sources of water available, its quality, the season and the ability to pay. In all villages, people were aware of the growing levels of pollution in the streams and rivers, and the health problems it could cause. Children were reported as suffering most, as they tended to more careless with hygiene, and as they swam in the rivers. Dysentery, cholera and bilharzia were among the diseases to which children were reported as being susceptible. These effects are reported as being more prevalent downstream of Kumasi however the, as yet embryonic, system of reporting through Village Unit Committees has produced little remedial action so far.

An increase in residential development has occurred in all the villages over the last 20 years, especially in the villages with electricity close to Kumasi. However, even in the most rural village surveyed, about half the land was reported to be zoned for housing development. Village lands (both Stool (symbol of authority of the Chief) and family lands) have been sold by the chiefs to individuals for housing plots. The pattern of development was similar in all the villages, with the new residential areas comprising a mix of individual villa-type houses and incomplete or undeveloped plots which were often being farmed on a temporary basis until building work started. Intensive backyard farming is carried out around many of the new houses.

The refuse dumps were a cause of concern in almost all the villages. They were often poorly sited, upstream and close to rivers so that rubbish was washed into the streams, especially in the rainy season. As villages have grown, dumps that were previously on the edge of the village have become surrounded with houses.

All the villages had communal latrines. In addition some of the larger and more modern houses had their own private toilets. The private toilets were either pit, Ventilated Improved Pit (VIP) or (only in villages with piped water) flush toilets with septic tanks. It is not known what proportion of houses had their own toilets. Waste water from houses was thrown into open channels and drains. There was no drainage system in any of the villages other than gutters built along some the roads which channelled the water down into the streams. Some of the modern houses had plastic guttering and pipes to carry the waste water away from the house, but these also fed into open gutters in the village.

DEVELOPMENT OF GOOD PRACTICE

The aims here are to improve awareness and to emphasise better management practices. This part of the project is at an early, formative stage. The strategies adopted are through communication and inculcation of a feeling of 'ownership', and hence responsibility, for the environment in general and water quality in particular. In addition to leafleting in English and the local Twi language, testing of a possible system of environmental self-monitoring was initiated by placing simple water quality test kits (manufactured in South Africa) in five Junior Secondary Schools and one High School whose catchments included the villages close to water quality sampling points. These kits are designed for use by children, youth and community groups as part of their formal education (where this relates to their syllabus) or as part of broader community education and awareness of the state of their local environment.

The driving hypothesis saw schoolchildren and teachers as key potential adopters and disseminators of awareness and 'good practice' in relation to daily behaviour affecting the local environment in general, and water quality in particular. Local assistance from the Kumasi offices of the Environmental Protection Agency (EPA) and the Ghana Water Company (GWC) in visiting schools and providing advice has been invaluable in maintaining a support network.

The tests carried out in the first phase of the project (September 1999 to July 2000) include: visual estimation of number of types of pollutant near the site; visual inspection of the water; water life; water temperature; pH; dissolved oxygen and turbidity

At this point, 10 months after the start of the project, the 5 JSSs are supporting the project enthusiastically, and have started the process of taking their newly-acquired knowledge of water quality issues to their communities. In three cases this has taken the form of plays acted out by the pupils in front of community gatherings, as part of the wider dissemination and community participation activities of the project. The High School chosen (a prestigious fee-paying school) has been unable to implement the project successfully owing to the more stringent requirements of their curriculum. The inference from this is that the JSS level (approximately 11 to 14 years old) is an appropriate level at which to focus this effort in the Ghanaian context.

There were initial teething problems, but sufficient feedback from schools has now been received to reflect upon the schools experience in the light of the emerging patterns of laboratory analyses. The immediate intention here is to inform the schools of the 'scientific' quality of their water sources, and to look specifically as to how this compares with the indicator measurements taken by the schools. This will help the schools to refine their techniques, and at the same time identify any problematic water sources.

The 5 JSSs have now been issued with an improved water quality test kit, with a wider range of tests, which will provide a more systematic description of water condition. The kit provides quantitative measures of the following parameters: pH; turbidity; water temperature; and a qualitative assessment of: coliform bacteria; dissolved oxygen; electrical conductivity; nitrate; nitrite; orthophospate. This will enable the pupils and their teachers to monitor the relative health of their water sources, and to identify any qualitative changes in them. Major fluctuations or measurements that cause concern will be reported to EPA and GWC for verification and follow-up.

THE CONTINUING PROJECT

It is clear from the studies so far that water quality is prejudiced by a variety of activities and from a range of locations, agricultural, industrial and domestic. A thorough investigation of stakeholders' attitudes to water resources and their usage in particular, and to environmental awareness in general, will be pursued, partly using PRA techniques, through the main phase of this research. This will include examination of the rationale behind existing land use and land management practices which affect water resource use. Project outputs will include manuals of ‘best practice’ for village committees to consider while making land use decisions, which might affect water resources and their use.

Continuing water quality monitoring at key sites will provide a more secure data base against which schools’ test kit outputs can be monitored and techniques refined. Raising environmental awareness of water quality issues in particular will be targeted by the schools themselves, through presentations to their villages, and through liaison with Unit Committees and WATSANS.

In order to assist in data availability at planning and at local levels, the data base is being prepared for entry into KUMINFO, a Geographical Information System developed by Natural Resources Institute, University of Greenwich and the Institute for Renewable Natural Resources (IRNR), University of Science and Technology, Kumasi, installed and supported at IRNR through DFID funding.

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