

NATURAL RESOURCES SYSTEMS PROGRAMME

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Peri-urban Natural Resources Management at the Watershed Level, Kumasi, Ghana

Project Leader

Dr D.F.M. McGregor

Organisation

Royal Holloway, University of London

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1. Executive Summary

This Project has taken forward research on the Kumasi PUI under the NRSP by focusing attention on a more holistic approach to natural resource management at the watershed scale, entailing working with a wide range of stakeholders.

New primary research was to be minimised. The most substantive issues on which such work proved necessary were:

- the extent and precise nature of water pollution in peri-urban areas, to provide a baseline water quality database
- the natural resource-based and other activities of urban industries and peri-urban micro-enterprises that might impact upon peri-urban environmental quality
- current natural resource use and environmental management practices by peri-urban communities
- the perceptions and priorities of peri-urban villagers in relation to current NR use and environmental conditions, and potential improvements thereto
- the extent to which the KMA and four surrounding District Assemblies were engaging with Local Agenda 21 processes, either autonomously or through linkages with ICLEI, and what impact these might have on sustainable development in the PUI.

The principal research and monitoring activities were:

- a two-year monitoring programme of water quality
- raising awareness of existing environmental problems, particularly but not exclusively with respect to water quality and pollution, through participatory methods such as the use of basic water testing kits by junior secondary school pupils and through local radio broadcasts and the production of widely distributed leaflets
- bringing the various stakeholders together to discuss these problems and to explore ways forward through a succession of round table discussions, workshops and field visits to contentious areas
- facilitating self-help and mutual help, through the compilation of resources such as a Directory of Development and Environmental Organisations, and an annotated Bibliography of relevant materials
- using participatory methods, formulating and testing guidelines for community-based diagnosis of environmental problems and appropriate actions to address them
- studying the communities' responses to, and adoption of, a series of experimental interventions designed as participatory demonstration microprojects in line with the priorities previously expressed in each village and focusing on low-cost or no-cost interventions.

Levels of participation and enthusiasm regarding the demonstration projects varied greatly, and results therefore ranged from excellent to disappointing. Responsiveness throughout the Project, and the uptake of Project interventions, was generally most pronounced in the more rural villages, where communal spirit and identity, and the role of traditional leaders were still most evident.

Following the adoption by DFID and the NRSP of poverty reduction as primary objective during the life of this project, it became necessary to adapt our research

programme accordingly. We sought to meet the challenge by including a wide spectrum of people in focus groups and participatory appraisals, by ensuring that poor villagers benefited from awareness-raising activities, and that the micro-interventions we demonstrated would be affordable. A participatory Watershed Management Framework, developed and tested with community and other stakeholder participation, also forms a mechanism for linking the individual villages with the wider PU zone and urban context.

We conclude that the PUI is most appropriately conceived of as something of a continuum (although not necessarily with a simple linear form) between the poles of 'true' urban and rural. The width and nature, and even particular boundaries, of the PUI are dynamic and subject to rapid change according to the pace of urban growth and related processes.

The implications of this for natural resource use, environmental quality and NR-based livelihoods that emerged from our research include:

- we found no evidence of unique or distinctive NR uses and livelihood activities that we might associate with the PUI
- rather, as villages begin to experience urban influences, their rural character starts to change, with a progressive shift towards combinations of rural and urban features, activities and facilities. It is these combinations and their rapidly changing complexion, that seem best to characterise the PUI
- in terms of natural resources, there is a progressive shift from agriculture and pastoral land-use towards residential and then commercial or industrial use, with associated increases in land values but losses of entitlement on the part of some farmers if appropriate compensation is not forthcoming, and hence a sometimes dramatic impact on their livelihoods. Water pollution from inappropriate disposal of the growing volumes of human waste and refuse, and from industries, is pronounced, even from the headwaters of streams.
- In terms of livelihood strategies, the increase of urban pressures leads to adaptation and diversification for most people, particularly the relatively and absolutely poor. Certain environmentally harmful activities that use natural resources do tend to concentrate in peri-urban areas, where the land or other resources are still available. Examples include car washing adjacent to rivers or streams, and stone crushing for the roadbuilding and construction industries. However, even these are not distinctively peri-urban, and not all those who carry them out are peri-urban residents
- Awareness of these processes and problems was surprising low among peri-urban villagers and other stakeholders.
- Awareness-raising and the taking of appropriate actions are therefore important priorities among all stakeholders. This project has developed and piloted an innovative, participatory and sustainable mechanism for doing this within a collaborative and co-management context, the Water Management Framework. This holds considerable promise in taking forward the Project purpose and that of the NRSP in the Kumasi context.

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Abbreviations

ADP	Aerial Digital Photography
BIRD	Bureau of Integrated Rural Development, KNUST
CEDEP	Centre for the Development of People
CLF	Community Level Facilitator
DFID	Department for International Development, UK
EPA	Environmental Protection Agency, Ghana
GIS	Geographical Information System
GOAN	Ghana Organic Agriculture Network
GWC	Ghana Water Company
IRNR	Institute of Renewable Natural Resources, KNUST
IWMI	International Water Management Institute
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame Nkrumah Institute of Science and Technology
KUMINFO	Kumasi Information System
NRI	Natural Resources Institute, University of Greenwich
NRSP	Natural Resources Systems Programme
PRA	Participatory Rural Appraisal
PUI	Peri-Urban Interface
RHUL	Royal Holloway, University of London
VCS	Village Characterisation Survey
WMF	Watershed Management Framework

NB: In view of the structure of this Report, and to avoid unnecessary duplication, all references cited will be found at the end of the Scientific Annexe

2. Background

The NRSP goal within which this Project was commissioned was “*Management of peri-urban resources optimised through improved productivity and energy efficiency; crop production intensified on a sustainable basis; productive potential increased by the greater use of ‘waste’ materials and recycling of resources.*”

Within this, the principal researchable constraint focused upon was the perceived necessity for better watershed management in the peri-urban zone around Kumasi, Ghana’s second city. Recognising the complexity of this issue, and to provide a ‘doable’ research project within this, the agreed key Project focus was on management of water resources, as a distinctive but critical part of the Natural Resource base.

This Project was derived in concept from work carried out under DFID-funded Projects R6448 *Peri-Urban Baseline Studies, Kumasi* (Holland *et al.* 1996) and R6799 *Kumasi Natural Resources Management Project: Inception Report* (Blake *et al.* 1997). In particular, R6799 Project staff at the Natural Resources Institute, University of Greenwich, first proposed the idea of looking at holistic watershed management as a template for integrated natural resources management in the rapidly-changing peri-urban zone around Kumasi.

Project R6799 was generating significant bodies of information on natural resource use, but there was little on water-related issues. Accordingly, this Project has generated substantial new knowledge regarding water resources, water use and quality, and the types and relative importance of water resource pollution; and the development of local environmental management structures and tools appropriate to communities with little financial capital. A complicating natural factor locally is that, as Kumasi lies across a local drainage divide, pollution generated within the city is frequently carried downstream from the city into the peri-urban zone.

This has entailed working with a wide range of stakeholders, from villagers and peri-urban micro-enterprise operators to the respective local and regional authorities, parastatal corporations, official agencies and urban industries with activities affecting, or responsibilities pertaining to, the PUI.

A key requirement of the original commissioned Project was that new primary research was to be minimised, and restricted to filling of specific, necessary gaps. Several such gaps were identified, and substantial new knowledge subsequently generated by the additional research undertaken (see Section 4 below).

Following the adoption by DFID and the NRSP of poverty reduction as primary objective during the life of this project, it became necessary to adapt our research programme accordingly. However, since our Project was focused on sustainable natural resource utilisation at the watershed scale, rather than on identifying poor people *per se*, it was not appropriate to devote the time and resources to undertaking detailed research that accords fully with the asset-vulnerability framework or livelihoods strategy, even though this has now been adopted an ‘official’ DFID methodology. Although our work schedule was already well advanced, we were able

to modify our later activities to some extent in order to focus more on the poor, and especially to seek to ensure that they were included explicitly in the participatory demonstrations and Watershed Management Framework (WMF) process (see Sections 4 and 5 below).

The implications of two other changes during the Project to our originally conceived research activities warrant mention here:

- the need to maintain the DFID-funded (Project R6799) KUMINFO Geographical Information System (GIS) for the duration of the Project; its funding came to an end with the completion of Project R6799 in 2000; accordingly we were awarded a supplementary grant to maintain and develop KUMINFO until the end of this Project and to help the IRNR to formulate and implement a business plan to become self-sustaining by that time. It also enabled us to utilise KUMINFO for additional research purposes.
- the importance attached by the NRSP management to evaluation of each activity and intervention, which emerged through the Mid-Term Review process, necessitated an extension to the planned evaluation activities in order to attempt assessments of the leaflet and radio broadcasts, as well as the more sustained research activities of schools' water testing and the demonstration projects within the WMF.

3. Project Purpose

The Project Purpose was: *Impacts of urban growth on land use patterns and natural resources degradation identified and incorporated into strategies for peri-urban planning and management.*

It was initially anticipated that the major data requirements would be derived from prior or on-going DFID-funded projects. With respect to R6799, it was agreed that both projects would benefit from the development of stakeholder surveys specifically focusing on water-related issues. This had been covered in general terms by the R6799 Village Characterisation Study, but in-depth supplementation and updating were required, including the development of PRA techniques to investigate water resources, water use and quality, the types and relative importance of pollution. Where practicable, joint sites were chosen for study, and data-sharing included baseline land use/farming systems data and soils data. The regional spread of data from R6799 was anticipated to be of importance in supplementing watershed-based data to verify generic diagnostic frameworks for watershed management within a GIS.

Further, it was envisaged that the research would also link to the DFID-established KUMINFO GIS database (available both in the Institute of Renewable Natural Resources, Kumasi (IRNR) and in the UK at Natural Resources Institute, University of Greenwich (NRI)), in using and refining the baseline data already present, and in providing appropriate additional datasets, and linking through to the work being undertaken by Project R6880 *Development of Methods of Peri-Urban Natural Resource Information Collection, Storage, Access and Management.*

Since this has been a research rather than a technical assistance project, large-scale remedial or even preventative work on the ground was beyond its scope. We concentrated on:

- raising awareness of existing problems through participatory methods such as the use of basic water testing kits by junior secondary school pupils (Scientific Annexe, Section 4.8), through local radio broadcasts and the production of widely distributed leaflets (Scientific Annexe, Section 4.3), and through the development and testing of a Community Handbook for Environmental Management (Appendix D)
- bringing the various stakeholders together to discuss these problems and to explore ways forward, by means of community meetings, focus group and round table discussions, as well as annual workshops with associated field visits to familiarise stakeholders with the variety of conditions in the PUI and to see activities promoted by the project (Scientific Annexe, Section 4.3)
- facilitating self-help and mutual help, through the production of guidelines for community-based diagnosis of problems and appropriate actions to address them, i.e. the Water Management Framework (Scientific Annexe, Section 6) and through the compilation of resources such as a *Directory of Development and Environmental Organisations and Institutions in and around Kumasi*, and an annotated Bibliography of relevant materials (Scientific Annexe, Appendices G and H respectively)
- finding some appropriate mechanism for demonstrating these principles and remedial actions to villagers and other stakeholders, in the manner of pilot or demonstration projects (Scientific Annexe, Section 7), and through the production of guidelines for community-based diagnosis of problems and appropriate actions to address them, i.e. the Water Management Framework (Scientific Annexe, Section 6)

4. Outputs

N.B. *Specific outputs on the revised Project Logframe are indicated in square brackets as appropriate [...]*

Output 1: Inception Phase addressed the characterisation of the water resource environment and sought to identify the gaps in knowledge. This Output was fully achieved.

Although the project remit required us to minimise the amount of new primary data collection by collating and integrating existing material from the predecessor projects as far as possible, we rapidly identified and proceeded to fill several important gaps in relation to knowledge about current natural resource use and management, and environmental quality.

The most substantive issues on which primary data collection subsequently proved necessary – and on which substantial new knowledge was therefore generated – were:

- the extent and precise nature of water pollution in peri-urban areas, to provide a baseline water quality database [1C, 1D, 1E; 2B]
- the natural resource-based and other activities of urban industries and peri-urban micro-enterprises that might impact upon peri-urban environmental quality [1D; 2A]
- current natural resource use and environmental management practices by peri-urban communities [1B, 1C, 1D; 2A]
- the perceptions and priorities of peri-urban villagers in relation to current NR use and environmental conditions, and potential improvements thereto [1B, 1E; 2A]
- the extent to which the KMA and four surrounding District Assemblies were engaging with Local Agenda 21 processes, either autonomously or through linkages with ICLEI, and what impact these might have on sustainable development in the PUI [1E; 2A]
- the generally low levels of awareness among all stakeholders about the state of the peri-urban environment and the exploitation of natural resources, and ways to raise the profile of such issues, including the extent to which schoolchildren could be motivated to disseminate environmental messages within their communities [1E; 2C, 2F]
- the perceptions and priorities of peri-urban villagers, in particular, in relation to current NR use and environmental conditions, and potential improvements thereto, including their willingness and ability to adopt low- or no-cost strategies to address NR problems [1E; 2F].

Since this research was conducted during part of the Inception and Main Research Phases, it properly constitutes parts of both Outputs 1 and 2. Accordingly, cross-reference is made above to the appropriate outputs in Output 2.

The network of research partners [1A] is set out in Scientific Annexe, Section 3.2. This finally included Ghanaian collaborators from research and teaching institutes at Kwame Nkrumah University of Science and Technology, Kumasi (IRNR, BIRD) and at Sunyani Polytechnic; from government organisations (Ghana Water Company and the Environmental Protection Agency), and from local NGOs (CEDEP and GOAN).

The literature review of Phillips *et al.* (1999), which appeared shortly after the start of this Project, was useful in providing a review of literature pertaining to the PUI, but it was noticeable how little literature was available on watershed management in peri-urban areas elsewhere, other than that conducted in Hubli-Dharwad under NRSP. In view of this exhaustive literature review, it was unnecessary to undertake a fresh comprehensive review. We confined ourselves to the cognate aspects not covered in Phillips *et al.* (1999). [1F]

Output 2: Analysis of the watersheds and development of strategies for sustainable management. This Output was very largely achieved within the temporal and financial constraints of the Project.

The outputs from our new primary research have been reported in detail in Section 4 of the Scientific Annexe. These data represent an important resource in themselves, not least as substantial contributions to new knowledge about Kumasi's PUI. For instance, we collected probably the most detailed time-series of data on urban and peri-

urban water quality in Ghana (Scientific Annexe, Section 4.7), the first systematic attempt to assess the contributions of urban industries and peri-urban micro-enterprises there to pollution and NR exploitation in the PUI (Scientific Annexe, Section 4.2), and the first detailed analysis of the levels of awareness among villagers and other stakeholders of the nature and extent of the problems, and of appropriate methods to address them (Scientific Annexe, Sections 4.2, 4.4, 4.9). Importantly, however, this was not research for its own sake, but vital information for the more applied central project purpose of incorporating this new knowledge into peri-urban planning and management strategies. Hence, all the research findings contributed towards the participatory process of raising local awareness of existing problems and of possible ameliorative actions and solutions by various stakeholders.

Human activity in the watersheds [2A] was analysed through a series of investigations. A survey of the practices and attitudes of stakeholders using the watersheds [2A1, 2A2, 2A4] (Scientific Annexe, Section 4.2) pointed up a general concern for environmental degradation, but a lack of appreciation of the consequences of actions damaging to the environment. 'Awareness' was thus seen as particularly lacking, and a clear requirement for subsequent Project activities.

Key to this was the identification and prioritisation of problems affecting water resources in the watershed areas, and the effects on peri-urban environments (Scientific Annexe, Section 3.4). The principal problems observed by the Project team and/or reported to us during the course of the research, 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; formal and informal abattoirs
 - 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 through seepage from the watercourse.
3. Contamination of boreholes and wells by leachate from pit latrines and refuse dumps 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.
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 terms of the summary of views expressed by local people, during preliminary scoping surveys and community visits, and observations made by the investigators, these are approximately in descending priority order. It is recognised, however, that

the particular problem or problems perceived as most important vary with particular site conditions, for example with proximity to a major point source of pollution such as a factory or workshop.

An assessment of the impact of farming systems on water resources [2A3] indicated that the use of chemical fertilisers were localised and probably currently not a major polluting activity. This was subsequently borne out by the results of water quality sampling.

Water and environmental quality [2B]

A two-year monitoring record of water quality undertaken by the Project in a range of situations in the peri-urban interface, both upstream and downstream of the city, indicates clearly the extent and nature of pollution ([Table 1](#)) (Scientific Annexe, Section 4.7). These monthly data have been supplemented by short-term investigations of pollution 'hot spots'. Together, these datasets provide clear evidence of progressively increasing pollution from the relatively unpolluted headwaters through the city and back into the peri-urban zone to the south of Kumasi. Coliform bacterial counts rise rapidly downstream from the headwaters, indicating ubiquitous contamination of the streams and rivers by human excrement ([Table 1](#)).

Table 1 Average values for monthly sampling sites, September 1999 to September 2001

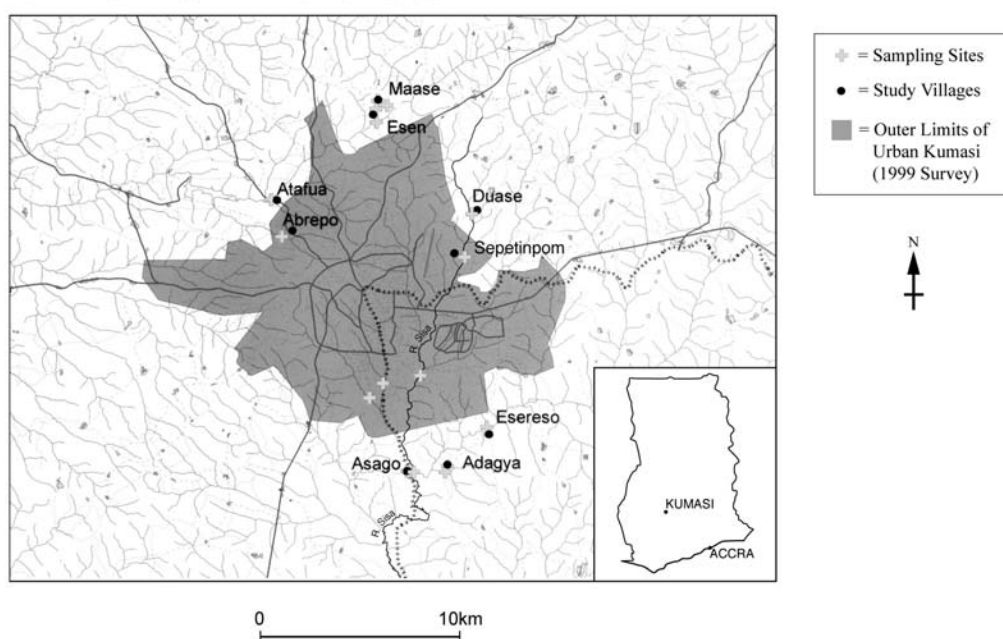
	Site	pH	Turbidity (NTU)	Conductivity ($\mu\text{s.cm}^{-1}$)	TDS (mg.l^{-1})	Suspended solids (mg.l^{-1})	Ammonia N (mg.l^{-1})	Nitrate N (mg.l^{-1})	Nitrite N (mg.l^{-1})	Phosphate (mg.l^{-1})	Dissolved O (mg.l^{-1})	Chloride (mg.l^{-1})	Oils & Greases (mg.l^{-1})	Coliform 37°C (/100ml)	Coliform44°C (/100ml)
1	Maase (Asuabena)	6.02	17.23	44.67	22.65	11.60	0.04	0.08	0.01	0.71	4.42	11.44	3.63	1436	539
2	Maase borehole	6.44	1.67	81.08	47.82	0.67	0.07	0.15	0.00	1.37	3.91	11.33	1.50	437	246
3	Essen (Asubri)	7.05	74.65	96.42	61.99	78.11	0.34	0.68	0.05	1.23	2.79	7.89	8.57	3821	3648
4	Atafua (Owabi)	7.13	118.54	226.21	126.67	144.89	0.93	1.15	0.10	1.04	3.60	30.11	10.67	8168	5700
5	Chief's Palace (Akosu)	7.41	85.66	427.75	261.09	97.11	10.58	1.33	0.05	1.16	3.27	29.14	7.38	14821	12672
6	Duase (Sisa)	7.22	53.96	143.75	82.05	29.00	0.71	0.86	0.05	0.91	5.31	12.67	9.50	6611	3307
7	SePETINpom (Sisa)	7.21	57.95	162.31	94.12	46.00	0.59	1.09	0.04	0.75	4.45	17.28	12.13	9233	5958
8	Atonsu (Sisa)	7.12	87.20	579.78	278.46	140.00	17.95	1.16	0.02	4.13	1.79	46.11	23.20	14160	10953
9	Kaase (Subin)	7.45	64.47	497.88	263.20	37.89	6.20	0.91	0.11	3.94	2.92	49.78	21.17	11420	10549
10	Daban (Daban)	7.38	29.51	377.95	225.73	29.78	5.33	1.11	0.17	1.39	2.96	33.11	25.62	5301	3655
11	Esereso (Oda)	7.41	38.28	129.67	77.32	61.78	0.66	0.89	0.02	0.85	6.98	15.00	7.38	3685	2527
12	Adagya borehole	5.82	1.61	169.71	94.14	1.89	0.20	2.89	0.01	0.62	4.93	16.09	2.33	4	1
13	Adagya (Ankoni)	7.07	46.01	176.00	102.65	25.33	0.56	1.22	0.01	0.97	3.23	12.94	6.14	7219	3948
14	Asago hand-dug well	6.51	15.43	167.06	92.40	14.38	0.18	1.65	0.03	0.81	4.18	15.5	3.75	1136	550
15	Asago (Sisa)	7.30	86.78	465.59	339.63	96.56	19.15	1.52	0.05	7.13	2.45	51.11	20.75	16364	12168
16	Asago new borehole	6.08	3.29	180.87	91.67	6.00	0.28	3.82	0.00	1.35	4.27	-	-	-	-
	Recommended drinking water limits		5.00 *	400 @	1000 *		0.5 @	50.00 *	0.1 @			25.00 @	0.01 @		0 *

* WHO @ EU

Specific pollution ‘hot spots’ have been identified, and short-term monitoring indicates that this requires fuller investigation (Scientific Annexe, Section 4.7). Specific measurements taken at industrial outfalls call into question the claims of larger industries not to be major polluters. Further investigations would be required to establish linkages between the longer-term record of pollution and the effects on this of individual polluting events.

The effects of urban pollution are most keenly felt downstream of the city, where, in addition, preliminary research at Asago (see [Figure 1](#)) shows a significant build-up of heavy metals in fish tissue, river and overbank sediments (Scientific Annexe, Section 4.8). This has important implications for human health, and warrants further investigation.

Figure 1: Project villages and water quality sampling sites



Rainfall records from Kumasi Airport show a significant decline of total rainfall in recent decades. Together with progressively increasing abstraction of groundwater due to continuing urbanisation and the apparently unregulated increase of individual boreholes and hand-dug wells, this situation indicates progressively increasing demands on a diminishing aquifer. Although assessed here as not as yet problematic (Scientific Annexe, Section 4.7), should these climate and urbanisation trends continue, some prejudicing of aquifer water seems inevitable. Already, there is evidence of contamination of the relatively shallow groundwater tapped by hand-dug wells, downstream of the city (site 14, [Table 1](#)).

The deterioration in water quality as the city is approached is mirrored by a deterioration in the general condition of the natural environment. Soil erosion is not a major problem compared with many other developing areas, but significant erosion occurs in villages, undermining houses and gulying roads. One obvious contributor to this is the practice of clearing all vegetation from house frontages on village roads. Sand winning areas are also conspicuously degraded and, despite mandatory permit

conditions requiring it, the rehabilitation of these areas by replacing topsoil was not seen in the Project area.

Litter is more or less ubiquitous, and is exacerbated by the presence of informal refuse dumps along roads and on river banks. KMA collections from village dumps are irregular at best, and this undoubtedly presents a health hazard. More generally, there is no culture of not littering among local residents, while wind-blown polythene bags also represent a significant problem.

The discharge of effluents and sawmill and carpentry waste into the rivers further exacerbates this situation, the effects of which are seen most obviously downstream of the industries concerned and in the peri-urban zone beyond, where, following flood waves, the floodplain is littered with sawmill debris and faecal wastes (Scientific Annexe, Section 4.5.2). This situation is worsened by the presence in the floodplain area of a set of KMA temporary settlement ponds, which are breached and seen to overflow into the main river. This picture of, effectively, using the rivers as an informal dump for wastes of all sorts completes the circle of deteriorating environmental and water quality. Some sawmills also dump and burn substantial quantities of wood offcuts, shavings and sawdust, either on their own premises or on vacant land in the peri-urban area. This generates substantial smoke and dust pollution.

In order to test the feasibility of a possible system of **environmental self-monitoring [2C, 2F]**, a pilot scheme was initiated in September 1999 by placing relatively simple water quality test kits in five Junior Secondary Schools and one High School the catchments of which 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 principal aims of this part of the wider Project were, firstly, to test the effectiveness of relatively simple water quality test kits at schools' level as a relatively low-cost means of improving environmental awareness (and also contributing to science education); and, secondly, to encourage the schools to use their newly-acquired knowledge for the wider benefit of their communities. Underlying this is the aim of increasing community awareness of the necessity to protect the most vital of natural resources for peoples' health and wellbeing.

The details of this successful innovation are given in Scientific Annexe, Section 4.8, and an evaluation is provided in Scientific Annexe, Section 7.

Output 2D, watershed characterisation framework developed using KUMINFO proved to be more problematic. Essentially, as developed in the Scientific Annexe, Section 5, the data available proved to be less extensive than had been anticipated, and operational difficulties (detailed in Scientific Annexe, Section 5) effectively prevented other than demonstrations of the potential of KUMINFO for watershed modelling (Scientific Annexe, Section 5.9).

Outputs 2E and 2F can be conflated here by reference to the Scientific Annexe, Section 6 (Watershed Management Framework) and Appendix D (Community

Handbook for Environmental Management). The Watershed Management Framework is a 'stand-alone' document developed with, and tested by, stakeholders and within the communities through a participatory methodology. It presents information on how to resolve the practical problems faced by communities in respect of water resource use and environmental protection of the watersheds, what the roles and responsibilities of the various stakeholder groups should be, how communities can mobilise resources to resolve problems and set about implementing microprojects. It is accompanied by a more pictorial reference guide to watershed protection (Community Handbook) and by a directory of contact points for assistance on environmental matters (Appendix G). The communities concerned evaluated these outputs positively on the whole, and made constructive suggestions for improvement (Scientific Annexe, Section 7) [2G].

These key Project outputs will be delivered in their final form to communities and stakeholders shortly. Longer-term follow-up evaluations of these would be appropriate in the future, and they can be further developed and used as a catalyst for closer cooperation between stakeholders at all levels.

Evaluations during the term of the Project [2G] of necessity took place towards the end of its life, but most interventions were received positively by the communities and by decision-makers. The key questions here are those of sustainability at the community level and uptake at the decision-making level, and those are now outside the Project's ability to monitor or indeed promote. With hindsight, the Project would have pressed for a set of evaluations to be funded after a period (a minimum of 6 months) had elapsed since dissemination outputs had been in place.

Output 3: Monitoring the effectiveness of practical solutions

The sustainable establishment of low-cost methods of environmental/pollution monitoring [3A] has not yet been fully achieved, although there are plans in place which could achieve this. Already the EPA is more proactive in monitoring and investigating water quality issues. In addition, the schools-based water quality monitoring is still being sustained by EPA, with some residual Project funds, and negotiations are in progress with both the national EPA and the West Africa office of the International Water Management Institute (IWMI) to build upon this initiative. IWMI are particularly interested in further development of bioindicators of water quality as an additional means of no-cost monitoring. Further, EPA is presently intending to initiate Environment Clubs, starting with the Project schools.

An encouraging development has taken place recently in Cameroun, where a number of schools have raised funds to purchase and maintain test kits.

Output 3B, use of KUMINFO as an interactive medium for environmental education, has been partially achieved (Scientific Annexe, Section 5). The GIS system has been linked to undergraduate teaching at IRNR, and demonstrations have been given to a range of non-academic and institutional stakeholders. Part of the focus here is to make KUMINFO self-sustaining, and steps are proceeding towards that ultimate goal. There is huge potential for development of a wider contribution

towards environmental education, but this will require significant staff effort to achieve.

The development and testing of the WMF and the implementation of demonstration 'best practice' activities [3C] was achieved. However, time did not permit protracted evaluation and monitoring of how these activities were being sustained.

Output 4: Dissemination through the life of the project; 'selling' the practical solutions

Throughout the Inception and main phases, discussions with villagers during the participatory research exercises, the industrial surveys and key informant interviews explored perceptions regarding the forms of information and good practice dissemination and communication most likely to be appropriate to different constituencies. The outcome was the decision to provide a diverse suit of outputs and to disseminate these via different media. Evaluation of initial activities also enabled us to diversify the subsequent forms of dissemination. The range of outputs comprised:

- A cartoon-based leaflet (with both English and Twi editions) raising awareness about water and sanitation issues in villages. This was produced by CEDEP in 2000 and distributed to the eight study villages; to participants in our annual Project workshops in 2000, 2001 and 2002; to organic farmers countrywide via GOAN, and to other groups where CEDEP was working;
- A series of three annual Project workshops, with associated fieldtrips to relevant sites in and around some of the study villages in the PUI. These provided an important vehicle for dissemination of project outputs and environmental messages, the obtaining of feedback during consultations on ideas for the WMF and demonstration micro-projects, and so forth.
- Two radio phone-in broadcasts on local FM stations. These were led by Dr. Nsiah-Gyabaah, joint local Project Coordinator, predominantly in Twi, and were also recorded;
- a Directory of organisations, institutions and companies with activities and expertise in the development-environment field, for use by villagers and other interested parties to enable them to ascertain the most appropriate source of advice or assistance in pursuit of more appropriate and sustainable local environmental utilisation and management. This is attached as Appendix G;
- laminated posters illustrating key aspects of good environmental practice in relation to village water use and sanitation, for display in village schools and clinics;
- laminated display posters illustrating different development-environment and natural resource problems in peri-urban Kumasi, and how the Project was seeking to address the relevant ones, for display in the KMA offices and those of Project partner organisations;
- an illustrated handbook of good practice in relation to water and sanitation issues, and more general aspects of village and watershed-scale sustainable environmental management, known as the Watershed Management Framework (WMF), for use by Chiefs, UCs and WATSANs, and DA, KMA and NGO staff (Scientific Annexe, Section 6);

- a simplified, pictorial version of this – the Community Handbook for Environmental Management (Appendix D)
- demonstrations of good practice and how to improve the village environment, by means of micro-projects (tree planting, erosion control, water harvesting, mulching and other organic farming methods) relating to natural resource utilisation and associated livelihoods, the subsequent maintenance and utilisation (degree of ‘ownership’) of which by villagers was studied and assessed (Scientific Annexe, Sections 6 and 7);
- an annotated Bibliography of books, journal articles, official publications and reports, and grey literature on relevant aspects of natural resources, environmental issues and development in Kumasi and relevant parts of the country, as a resource for researchers. This is attached as Appendix H.
- a consolidated list of Project outputs, which is attached as Appendix I.

The Project has thus undertaken a wide range of dissemination strategies to ensure as full as possible exposure within the range of local stakeholders. Significant behavioural changes at community level are reported as a result (Scientific Annexe, Section 7). It must be said that despite sustained interest in the Project and its outputs by local decision-makers, it has proved more difficult to implement action on their behalf. A useful follow-up exercise in this respect would be to re-evaluate with them, their reactions to the WMF, and to focus with them on implementation of its principal recommendations.

5. Research Activities

Given the size, shifting boundaries and rapidly changing nature of the PUI, the methodology adopted, following an initial reconnaissance during the Inception Phase, was to concentrate our attention on a representative sample of watersheds and village communities within them. Accordingly, we identified that part of the Owabi catchment feeding the Owabi Dam, and the Sisa-Oda catchment as appropriate examples of the ‘inner zone’ of the PUI where the impacts of rapid urbanisation are most pronounced. These watersheds were used for water quality monitoring along transects that covered the changes in stream/river conditions as the water approaches, then flows through and out of the urban area (Scientific Annexe, Sections 3.5, 3.6 and 3.13). For reasons of practicability and in order to facilitate integration of different aspects of the research, the water sampling points were selected close to the sample of eight villages chosen to represent the spectrum of conditions in the PUI ([Figure 1](#)). These range from essentially urban in the cases of Abrepo and Sepetinpom to predominantly rural in the cases of Adagya and Asago. Only two of these villages (Duase and Asago) had been included in the databases compiled by project R6448 and R6799; accordingly, we had to undertake baseline surveys in them all in order to ensure a common database and to update earlier material where it was available (Scientific Annexe, Sections 3.7 and 3.13). Indeed, on the basis of the range of conditions we encountered, we found it most useful to conceptualise the PUI as approximating a continuum (albeit not with a uniform or linear gradient) between the poles of ‘rural’ and ‘urban’. Equally, it is important to regard the inner part of the PUI as part of the functional urban area rather than as an entirely separate zone (Scientific Annexe, Section 2.1).

The principal research and monitoring activities were:

- regular monitoring of water quality in a range of water sources both upstream and downstream of the city
- raising awareness of existing environmental problems, particularly but not exclusively with respect to water quality and pollution, through participatory methods such as the use of basic water testing kits by junior secondary school pupils and through local radio broadcasts and the production of widely distributed leaflets
- bringing the various stakeholders together to discuss these problems and to explore ways forward through a succession of round table discussions, workshops and field visits to contentious areas
- facilitating self-help and mutual help, through the compilation of resources such as a Directory of Development and Environmental Organisations (Appendix G), and an annotated Bibliography of relevant materials (Appendix H).
- using participatory methods, formulating and testing guidelines for community-based diagnosis of environmental problems and appropriate actions to address them, i.e. the Water Management Framework (Scientific Annexe, Section 6).

Two significant additional research activities were undertaken as a result of needs identified during the Inception or early Main Research Phase:

- The KUMINFO GIS system became a valuable resource throughout the duration of this Project as a result of the supplementary grant awarded (Section 2, Background). This enabled all relevant new data generated to be added and inventorised, and greater utilisation of the software to be made in respect of water quality indicators and related analyses (Scientific Annexe, Section 5).
- In view of a strongly expressed need by the long-studied communities in the Kumasi PUI to obtain some tangible benefit from all the research undertaken there by successive NRSP projects, we extended the research in what was an innovative direction in this region. This involved studying the communities' responses to, and adoption of, a series of experimental interventions designed as participatory demonstration microprojects in line with the priorities previously expressed in each village (Scientific Annexe, Section 7.3). These small and inexpensive interventions had the objective of showing what each household and community could do themselves to address problems and ameliorate conditions at little or no financial cost. We focused on water harvesting as a supplementary source of additional water, and the next highest priorities expressed by villagers, namely the provision of trees and bushes to screen refuse tips, provide shade and fruit; and erosion control measures. This generated substantial new knowledge about perceptions and actual adoption/adaptive behaviour, that will be invaluable in promoting wider dissemination of the Project findings and approach.

Evaluating Project activities and products and interventions

As reported in the Scientific Annexe (Section 7), results are variable but the overall impact of the Project's activities is unmistakable. The leaflets were generally felt to be appropriate, and many respondents appreciated the bilingual production.

Children were particularly enthusiastic about the message of water quality protection. Unfortunately, one key use for the leaflets, namely in adult literacy classes run by CEDEP, and where their impact would have been easy and relevant to evaluate given the controlled context, did not materialise on account of the cessation of those classes.

The water test kits in schools clearly fulfilled an important role and served not only to raise the awareness of the children directly involved and some of their peers, but also to help enliven and make more relevant part of their school syllabus. The extent to which this testing contributed to wider community awareness also varied among the villages, but the plays and poetry readings undertaken by the JSS pupils certainly had an impact at the public durbars. The role of dynamic headteachers and/or science teachers was clearly central – both to the way in which JSS pupils were involved and enthused, and in terms of wider community dissemination. Variation was only to be expected, since we did not prescribe any specific activities; rather, we provided initial demonstrations and made some pertinent suggestions. This enabled us to observe how different staff and groups of pupils responded. To be sure, occasional problems of pupil selection and teacher continuity did arise but overall the results were most encouraging. Furthermore, there is no doubt that the frequent visits by EPA and other Project staff to the villages for liaison and other Project activities, raised the profile of these activities and, more generally, of local environmental problems.

The uptake of, and response to, the various WMF activities, especially the participatory micro-intervention demonstrations, was positive overall, although also variable both within and between villages. In Adagya, Asago and Maase, for instance, a consistent level of widespread interest was evident; elsewhere it was more variable and in the most urban villages of Abrepo and Sepetinpom only a handful of people appeared to engage with the Project more than briefly. A committed chief/*odikro*, Unit Committee or WATSAN chair or secretary would make a substantial difference. Conversely, occasional delays in providing the demonstrations and follow-up extension work by the Project may have contributed to disappointment and a loss of interest. In several cases, the CLFs were able to stimulate interest within a short period toward the end of the Project.

Overall, the experience of these activities and evaluations suggests clearly that

- Levels of participation and enthusiasm regarding the demonstration projects varied greatly, and results therefore ranged from excellent to disappointing. Responsiveness and uptake was generally most pronounced in the more rural villages, namely Adagya, Asago and Maase, where communal spirit and identity, and the role of traditional leaders were still most evident. Conversely, the most urban, i.e. Abrepo and Sepetinpom, had lost much of that ethos, and people were more concerned for their own families and households. Hence any communal activities were far harder to organise or sustain. Even getting a reasonable attendance at research or awareness-raising meetings was difficult, with Project staff having to make repeated and often frustrating visits. In the intermediate villages of Atafua, Esereso and Duase, circumstances varied, in some cases resembling more urban responses and in others more rural. This experience is entirely consistent with the notion of the PUI elaborated above, and where increasing urbanisation is quite rapidly reflected in more urban lifestyles and behaviour, even if the village retains traditional leadership and aspects of its identity and territory. In the final months of the project, we were able to draw on

the Community Level Facilitators (CLFs) identified and trained by Project R7995, and this significantly boosted interest in the communities where the CLFs were more dynamic.

- Depending on their specific nature, evaluation of individual one-off events or products in terms of their impact (as distinct from quality) proved problematic in practice. Relevant examples include the cartoon leaflet and radio broadcasts. It is very difficult to attempt to measure changes in public awareness, let alone behaviour, from single actions and interventions. These are longer term and complex processes, with behavioural change often resulting from cumulative exposure to consistent messages. (Single traumatic events may also have this effect but are not relevant in the present context). Even seeking to measure such changes at the end of the project might be premature. Indeed, it would be instructive to conduct a follow-up evaluation a year or two later in order to see whether the participatory activities and the role of the CLFs have actually become sustainable once financial and support inputs by Project staff have ended.

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6. Environmental Assessment

Although the RD1 of this Project (one of the last to be commissioned under the NRI International management) contained only a relatively simple statement on environmental impacts (Section 18d of the then RD1), we are content to address this issue.

- 6.1** As far as we are aware, no negative environmental impacts have resulted from this research. There have been a number of positive impacts, reported in the Scientific Annexe (summarised in Sections 7 and 8).

Awareness has been reported as having been raised on a number water resource issues, including better protection of water resources from a variety of polluting activities, a more acute perception of the need to link proper hygiene with the use of water for drinking and cooking, an awareness of low-cost methods of controlling soil erosion, a perception of the utility of water harvesting techniques, and the potential of trees and bushes to screen waste tips, latrines and other health-hazardous locations.

- 6.2** Potentially significant environmental impacts of wider dissemination will include better physical protection of spring and river bank sites, less pollution of water (particularly from faecal pollution and misuses of water bodies such as bathing, washing clothes and car washing), a reduction in levels of soil

erosion in and around communities, and better management of waste tips, latrines and the like.

- 6.3** Much of the evidence of raised environmental protection was reported in group discussions with communities, but specific instances (reported in Scientific Annexe, Section 7) include the cessation of use of a spring area for baptismal rituals, the resiting of waste tips in two of the Project villages, a programme of systematic ‘desilting’ of streams set up by one community, reported reduced levels of defecation in the bush, and a general measure of care afforded to screens of trees and bushes planted around waste tips and latrines.
- 6.4** Consolidation of these initiatives would be desirable, through evaluations of what is sustainable, and what is not. Further consideration of how to develop the raised environmental awareness on the ground is recommended. In this context, ensuring sustainability of the schools water test kit project, and the linkages with the EPA Environment Clubs is one of the key ways in which the gains already made in environmental awareness-raising can be augmented

7. Contribution of Outputs

Due to changes in emphasis of the NRSP over the lifetime of this Project, and the Project’s desire to adapt to them, the relevant NRSP purpose in the system logframe will be taken as that which was extant at the latter stages of this Project, namely *‘Benefits for poor people in targeted countries targeted by application, of new knowledge to natural resources management in peri-urban production, systems.’*

In this respect, significant new knowledge has been generated by this Project about natural resource use and perceptions of natural resources, particularly water resources, by stakeholders in the PUI. This new knowledge has been applied to a range of initiatives and interventions which are designed to impact on all stakeholders by promoting holistic watershed management through the WMF and related demonstrations, with a particular focus within that on better water resource use. The principles adopted of self-help, and of low-cost or no-cost solutions, have been targeted towards the poor of the PUI.

Many of the Project initiatives and interventions are gender-sensitive, since it is women who bear the burden of water collection and use, yet often find their voice bypassed in community decisions. The health impacts of cleaner water for drinking and cooking afforded by better water resource protection, and the reality of fewer trips to the borehole with judicious use of water harvesting systems are two examples of benefits offered by the Project’s outputs. The raised awareness of the nature of water pollution further improves the community’s management of its water resource, for the benefit of all.

This Project was not designed to contribute directly to achievement of the NRSP’s goal of improving livelihoods through sustainably enhanced production and productivity of RNR systems, and is therefore unlikely to have a direct impact on peri-urban livelihoods, especially those of poor people. However, it has certainly contributed to the achievement of the NRSP purpose by applying new knowledge to natural resources management in PU production systems. More directly, the Project

has achieved its own purpose of *identifying the impacts of urban growth on land use patterns and natural resources degradation and incorporating this into strategies for PU planning and management* in many ways, through

- the integration of existing data and knowledge about Kumasi's PUI
- the generation of substantial new knowledge about the set of issues and processes identified in Section 8.1 (Scientific Annexe) and about the practices and perceptions and reactions to participatory interventions by villagers and other stakeholders, as summarised in Section 8.2 (Scientific Annexe)
- the raising of awareness about environmental and natural resource problems among stakeholders, especially villagers, and with attention to the particular position of the poor
- research into the responses to, and uptake of, selected micro-project interventions in PU villages designed to promote participatory and sustainable co-management of resources
- the identification and incorporation into the WMF and via the demonstration microprojects as strategies for peri-urban planning and management, of the impacts of urban growth on land use patterns and natural resources degradation

This Project has attained those parts of its purpose that lie within the team's power. The WMF and its constituent components have been formulated and discussed within workshop focus groups and with individuals from the respective local authorities and planning departments, as well as the eight villages. The assumption about political will was partially invalid prior to the general election of December 2000; following the change of government, the situation improved but progress has been slow. The OVI and MOV of take-up and implementation by the policy bodies have therefore not yet been achieved as stated.

Our research leads us to the clear conclusion that the PUI is most appropriately conceived of as something of a continuum (although not necessarily with a simple linear form) between the poles of 'true' urban and rural. The width and nature, and even particular boundaries, of the PUI are dynamic and subject to rapid change according to the pace of urban growth and related processes.

[Table 2](#) summarises in qualitative terms the principal similarities and differences – including some of the aspects just discussed – among the eight villages. The approximate correlation of rapid growth; population change and diversity; infrastructural provision (even if inadequate); and landuse and occupational change with relative proximity and ease of access to Kumasi, is evident. Conversely, poor sanitation and drainage, and inadequate or continuous access to good quality drinking water, are universal problems.

Table 2 Major Differences among the Eight Kumasi Peri-Urban Villages, ordered from most rural to most urban

Village	Similarities and Major Differences
Adagya	<ul style="list-style-type: none"> • slow growth • moderate influence of Kumasi Metropolis • farming is the major occupation • loss of some farmlands to housing and sand winning • strong communal spirit • easy access to Kumasi • poor level of infrastructure • poor sanitation and drainage system
Asago	<ul style="list-style-type: none"> • slow growth • moderate influence of Kumasi Metropolis • farming is the major occupation • loss of some farmlands to housing and sand winning • strong communal spirit • poor access to Kumasi • poor level of infrastructure • poor sanitation and drainage system
Maase	<ul style="list-style-type: none"> • moderate growth • moderate influence from Kumasi Metropolis • farming is the major occupation • loss of some farmlands to housing • strong communal spirit • moderate access to Kumasi • appreciable level of infrastructure • poor sanitation and drainage system
Duase	<ul style="list-style-type: none"> • moderate growth • moderate influence of Kumasi Metropolis • major occupation is still farming • nevertheless, farming is on the decline • increasing loss of some farmlands to housing • easy access to Kumasi • strong communal spirit • appreciable level of infrastructure • poor sanitation and drainage system
Esereso	<ul style="list-style-type: none"> • moderate growth • strong influence of Kumasi Metropolis • farming on the decline • most people still engaged in farming • loss of some farmlands to housing • strong communal spirit • easy access to Kumasi • appreciable level of infrastructure

	<ul style="list-style-type: none"> • poor sanitation and drainage system
Atafua	<ul style="list-style-type: none"> • increasingly rapid growth • easy access to Kumasi • strong influence from Kumasi Metropolis • farming on the decline • farming is still important • increasing loss of farmlands to housing • strong communal spirit • appreciable level of infrastructure • poor sanitation and drainage system
Sepetinpom	<ul style="list-style-type: none"> • strong influence of Kumasi Metropolis • easy access to Kumasi • growing rapidly • loss of almost all farmlands to housing • most people now engaged in non-agricultural occupations • large population of strangers • appreciable level of infrastructure • poor sanitation and drainage system
Abrepo	<ul style="list-style-type: none"> • engulfed by Kumasi • growing rapidly • farming on the decline • most people thus now engaged in secondary occupations • rapid loss of farmlands to housing • large population of strangers • easy access to Kumasi • appreciable level of infrastructure • poor sanitation and drainage system

Source: Field Surveys, 1999- 2000

The implications of this for natural resource use, environmental quality and NR-based livelihoods emerged from our research:

- we found no evidence of unique or distinctive NR uses and livelihood activities that we might associate with the PUI
- rather, as villages begin to experience urban influences – in terms of improved access, changing pressures on land-use and natural resources, increasing pollution, arrival of outsiders seeking affordable accommodation, reduced prices for manufactured goods etc – their rural character starts to change, with a progressive shift towards combinations of rural and urban features, activities and facilities. It is these combinations and their rapidly changing complexion, that seem best to characterise the PUI
- in terms of natural resources, there is a progressive shift from agriculture and pastoral land-use towards residential and then commercial or industrial use, with associated increases in land values but losses of entitlement on the part of some farmers if appropriate compensation is not forthcoming, and hence a sometimes dramatic impact on their livelihoods. Similarly, pressure on woody biomass for fuelwood or through land clearance intensifies and sandwinning

commonly also increases in appropriate areas such as floodplains. Water pollution from the city commonly increases downstream over time, while intensive agriculture or livestock/poultry rearing for urban markets, along with inappropriate disposal of the growing volumes of human waste and refuse, may contaminate the groundwater and rivers

- In terms of livelihood strategies, the increase of urban pressures therefore leads to adaptation and diversification for most people, particularly the relatively and absolutely poor. Where possible, this may result in a combination of rural and urban livelihood activities, e.g. wage labour and cultivation. Otherwise, different non-urban activities may become necessary, using traditional skills (e.g. craft production for urban or tourist markets) or new ones (e.g. motor car repair). Certain environmentally harmful activities that use natural resources do tend to concentrate in peri-urban areas, where the land or other resources are still available. Examples include car washing adjacent to rivers or streams, and stone crushing for the roadbuilding and construction industries. However, even these are not distinctively peri-urban, and not all those who carry them out are peri-urban residents
- Awareness of these processes and problems was surprising low among peri-urban villagers and other stakeholders. In some cases, an apparent lack of awareness might have been used as a strategy for avoiding having to take responsibility or to initiate mitigatory actions which could prove costly and for which there was as yet no strong pressure
- Awareness-raising and the taking of appropriate actions are therefore important priorities among all stakeholders. This project has developed and piloted an innovative, participatory and sustainable mechanism for doing this within a collaborative and co-management context, the Water Management Framework. This holds considerable promise in taking forward the Project purpose and that of the NRSP in the Kumasi context.

Prioritisation of the Poor

As explained earlier, it was difficult to adjust our work programme substantially once the research activities had been commenced. We did conclude that it was inadequate simply to regard all peri-urban villages and villagers as poor – a view proposed by some local collaborators. The evidence from our watershed village characterisation study, and from our on-going contacts with the communities showed clearly that even the smaller villages contained substantial socio-economic differentiation. One interesting example was the take-up of electricity in Asago following the village's connection to the distribution grid during an early stage of our Project.

We were also sensitive to recent poverty discourses that highlight wider dimensions of poverty than income and material assets. In particular, relative access to power is an important differentiator even at this level, for instance, in terms of social distance from the chief or elders, or membership of the political party in power. Vulnerability to shocks is also a major problem of poverty. The WVCS survey revealed the diversity of livelihood activities among individuals and households within the sample of villages, some of which might be correlated with poverty, although our research design (determined at the outset of the Project) was not fine-grained enough to allow such retrospective analysis.

Moreover, since our project was focused on sustainable natural resource utilisation at the watershed scale, rather than on identifying poor people per se, It was not appropriate to devote the time and resources to undertaking detailed supplementary research later on that would accord fully with the asset-vulnerability framework or livelihoods strategy, even though this has now been adopted an 'official' DFID methodology. Rather, we needed to be aware of the major dimensions of differentiation and potential exclusion in the study villages and to take appropriate measures to include and prioritise the poorer segments. Discussions with villagers on the subject also proved difficult as the issue is sensitive and perceptions of poverty vary widely. Certainly, chiefs and elders, and other wealthier individuals did not prove very reliable on this. Teachers, nurses and midwives, by contrast, often have good appreciations of the nature and extent of local poverty.

Ultimately, inclusion of a wide spectrum of people in focus groups and participatory appraisals, ensuring that poor villagers benefited from awareness-raising activities, and that the micro-interventions we demonstrated would be affordable, were the most important mechanisms we adopted to achieve representation of the poor. We also found that, although some of the poor were available during the day on account of their unemployed status, others were too preoccupied with day-to-day survival to attend and participate in Project demonstration activities. Even in project R7995, where the preparation of livelihood plans necessitated a very specific focus on the poor in each community, it proved difficult to ensure this outcome. For instance, the (necessary) literacy requirement for training as a CLF excluded many poor people.

Uptake

We are pleased to report that the Project has been successful in achieving virtually all of its OVIs, albeit in some cases not by the precise dates anticipated. The only OVIs not yet achieved are those that fall beyond the power of the Project to ensure, namely the uptake of all the project outputs by policy bodies (Activity 3C.1 and 3C.2). However, even here there has been partial success to date, through the extensive consultation with, and demonstration activities for, representatives of the diverse set of official and NGO bodies concerned with the PUI. These include the Regional Coordinating Council, Kumasi Metropolitan Assembly, District Assemblies, CWSA and others. Awareness has been raised, liaisons and in some cases (e.g. GWC and EPA) collaborative work undertaken for the first time as a direct result of this Project's activities. The important assumption 3C.1 has been partially valid, especially since the change in political climate since the December 2000 general election. However, the reorganisation and personnel changes in regional and local authorities as a result of the change in government continued through most of 2001, making it difficult to galvanise rapid action in response to the work of this Project, although the response to our contacts and liaison activities was generally more positive. Provided that our local partners are able to maintain some contact and provide some encouragement in the period following the conclusion of this Project, we are hopeful that the WMF will be positively taken up and sustained.

Promotion pathways

A principal promotion pathway is through EPA, who were centrally involved in Project activities relating to water quality sampling and the schools test kit project. The experience gained by EPA staff place the Ashanti Regional Office in a prime position to take forward a more informed and proactive stance in terms of enforcement both of water quality infringements and other environmental degradation such as sand winning in the PUI. EPA are presently planning the launch of Environment Clubs in the Kumasi PUI, starting with the Project schools. They retain a strong interest in collaborative expansion of the test kit project, and this is being explored at the time of writing with IWMI interest.

The JSS schools themselves represent a further promotion pathway. This is at at least two levels. Firstly within the schools themselves there is considerable potential for incorporating the test kit technology into the science curriculum. Clearly this would need approval at national level. The EPA Environment Clubs may prove to be an important catalyst here. Secondly, the new knowledge, awareness-creating, potential demonstrated by the Project can be taken to the communities in a more structured way than hitherto. This would require careful research on the experiences of the Project in this regard.

The District Assemblies, KMA and the Regional Coordinating Council (RCC) represent an important uptake pathway. These were all involved in round table and workshop evaluations of the WMF, and RCC in particular expressed an interest in becoming involved in development and implementation of WMF principles. Political tensions between these various authorities are evident in discussion of a watershed management scheme which crosses political boundaries, and there remain difficulties to be overcome. The recently-installed Chief Executive of KMA has taken an interest in the Project findings. Linked activities include the work of our ESRC-funded PhD candidate, Andrew Bradford, in community-based waste management strategies, and the co-composting initiative of IWMI at the Buobai settlement ponds.

The WMF is designed to link together disparate actions impinging on the environment, as a supportive mechanism for watershed scale co-management involving these authorities. The WMF can also act as a catalyst in the recently-initiated LA21 ('Capacity 21' in local terminology) activities.

Traditional authority is an important uptake pathway, as representatives of the Asantehene can influence the local chiefs/odikros, who in turn may influence the community based organisations and individuals such as the Unit Committees, the WATSAN Committees and the CLFs set up by NRSP Project R7995.

The presence of local NGOs to act as catalysts for promotion and uptake is to be desired. CEDEP is in a particularly good position to act in this regard, as it is already undertaking cognate research activities under the NRSP Projects R7995 and R8090.

8. Publications and other communications materials

Achieved

8.2 Journal Articles

McGregor, D.F.M., Thompson, D.A. and Simon, D. 2002. 'Water quality and management in peri-urban Kumasi, Ghana.' In *Land-Water Linkages in Rural Watersheds. FAO Land and Water Bulletin 9*. Abstract p.66, full paper on CD-ROM. FAO, Rome.

Simon, D., McGregor, D.F.M., Nsiah-Gyabaah, K. & Thompson, D.A. 2002 Poverty elimination, North-South research collaboration and the politics of participatory development *Development in Practice* (In Press, 2003)

Nsiah-Gyabaah, K. 2002 'Population growth, urbanization and water supply: a growing challenge to human and environmental security in the peri-urban interface in Ghana.' *Journal of the University of Science and Technology*, Kumasi, Ghana.

McGregor, D.F.M., Thompson, D.A., Osafo-Acquaah, S., Kotei, N.O. and Poku, K.O. 2002. **The downstream effects of urban pollution on water quality and some implications for rural livelihoods: Kumasi case study.** Submitted to *Ghana Journal of Science*.

8.3 Institutional Report Series

McGregor, D.F.M. and Quashie-Sam, J. 2001. Start with the children. pp3-5 in *NRSP Research Highlights 200-2001: Poverty reduction through partnerships in natural resources research*.

McGregor, D.F.M. 2002. 'Communities protecting water'. *Insights 41*, p.6

8.3 CEDAR/IRNR Research Paper Series

Simon, D. Nsiah-Gyabaah, K., Warburton, H. Adu- Gyamfi , V. & McGregor, D.F.M. 2000. The changing urban-rural interface of African cities: conceptual issues and an application to Kumasi, Ghana. *CEDAR/IRNR Research Paper 1*

McGregor, D.F.M., Thompson, D.A., Kotei, N.O. & Poku, K.O. 2001. Testing a method of environmental self-monitoring: water quality test kit project, peri-urban Kumasi. *CEDAR/IRNR Research Paper 2*

Thompson, D.A., McGregor, D.F.M., Kotei, N.O. & Poku, K.O. 2001. Water quality in peri-urban Kumasi: preliminary results and their significance. *CEDAR/IRNR Research Paper 3*

Adam, M.G. 2001. The interface between agriculture and water in peri-urban Kumasi. *CEDAR/IRNR Research Paper 4*

Simon, D., McGregor, D.F.M., Thompson, D & Nsiah-Gyabaah, K. 2001. Poverty elimination, North-South research collaboration and the politics of participatory local development: Kumasi, Ghana. *CEDAR/IRNR Research Paper 5*

Simon, S., Poku, K.O. & Nsiah-Gyabaah, K. 2001. Survey of large industries in Kumasi: water use and environmental impacts. David Simon, Omane Poku and Kwasi Nsiah-Gyabaah *CEDAR/IRNR Research Paper 6*

Edusah, S., McGregor, D.F.M. & Thompson, D.A. (editors) 2001. Peri-urban natural resources management at the watershed level: workshop report, March 27-28 2001 *CEDAR/IRNR Research Paper 7*

Thompson, D.A., Quashie-Sam, J. & McGregor, D.F.M. 2001. Testing the feasibility of water harvesting as a supplement to clean water supply in peri-urban Kumasi. *CEDAR/IRNR Research Paper 8*

Edusah, S & D. Simon 2002. Land use and land allocation in Kumasi peri-urban villages. *CEDAR/IRNR Research Paper 9*

8.4 Workshop Proceedings

McGregor, D.F.M., Thompson, D.A., Simon, D. Kotei, N.O. & Poku, K.O. 2001. 'The influence of Kumasi on peri-urban water quality: a problem for community health and floodplain agriculture?' pp. 65-76 in G. Cornish (ed.): *Informal Peri-Urban Irrigated Agriculture: Opportunities and Constraints*. Published by HR Wallingford.

McGregor, D.F.M., Thompson, D.A. & Simon, D. 2000. *Water quality and management in peri-urban Kumasi, Ghana*. Case Study 16 in *Land-Water Linkages in Rural Watersheds* FAO Electronic Workshop; FAO, Rome

8.4 Symposium, conference and workshop papers and posters

McGregor, D.F.M., Thompson, D.A., Simon, D., Kotei, N.O. & Poku, K.O. 2001. *The Influence of Kumasi on Peri-Urban Water Quality: a Problem for Community Health and Floodplain Agriculture?* Paper presented at HR Wallingford Project Workshop Informal Peri-Urban Irrigation - Opportunities and Constraints. KNUST, Kumasi, March 2001. KAR Project R7132

McGregor, D.F.M., Simon, D. and Thompson, D.A. 2001. *Peri-urban water quality and supply: changing circumstances and practical interventions in Kumasi, Ghana*. 24pp. Paper presented at international conference: Rural-Urban Encounters: Managing the Environment of the Peri-Urban Interface, Development Planning Unit, UCL, 9-10 November 2001

McGregor, D.F.M., Simon, D. and Thompson, D.A. 2001. *Participatory and sustainable peri-urban natural resource management: Kumasi, Ghana*. Poster presented at international conference: Rural-Urban Encounters: Managing the Environment of the Peri-Urban Interface, Development Planning Unit, UCL, 9-10 November 2001

Nsiah-Gyabaah, K. 2001. *Watershed-level CPR management in Kumasi, Ghana.* Poster presented at NRSP workshop on *Common Pool Resources– developing management strategies that benefit the poor* at York University 2-3 October 2001.

Simon, D. McGregor, D.F.M., Thompson, D.A. & Nsiah-Gyabaah, K. 2001. *Poverty elimination, North South research collaboration and the politics of participatory local development: Kumasi, Ghana.* Paper presented at the American Association of Geographers annual conference, New York, February 2001

Simon, D., Nsiah-Gyabaah, K., Warburton, H., Adu-Gyamfi, V. and McGregor, D.F.M. 2001. *The changing rural-urban interface of African cities: conceptual issues and an application to Kumasi, Ghana.* Paper presented at international conference on African Urban Economics, African Studies Centre, University of Leiden, 9-11 November 2001.

8.5 Newsletter articles

Royal Holloway 2001. *On Campus* (2 articles) and *Annual Report 1998-2000*

Anon, 2001. *EPA in the Regions – Special Project.* Environmental Protection Agency, Ghana Newsletter, 4(1), January-July 2001, 22-23

8.6 Academic Theses

Bradford, A.M. started 2001. Community-based waste management strategies, Kumasi: Ghana. ESRC PhD funding, RHUL.

Poku, K.O. 2001-2002. Aspects of water pollution in peri-urban Kumasi. In preparation, KNUST. (Project provided baseline data, informal supervision (with KNUST staff approval) and funded water quality measurement period.)

8.7 Extension-oriented leaflets, brochures and posters

CEDAR & CEDEP 2000 leaflets – *Water is life, conserve it!!* (English and Twi)

Poster – *Participatory and sustainable peri-urban natural resource management: Kumasi, Ghana*

Poster - *Junior secondary schools play a prominent role in formulating a participatory and sustainable peri-urban natural resource management strategy around Kumasi, Ghana*

Simon, D., D.F.M. McGregor and Thompson, D.A. 2001. *Key environmental problems in and around metropolitan Kumasi, Ghana.* Poster for display in office of Chief Executive of Kumasi Metropolitan Authority, Kumasi.

8.8 Manuals and guidelines

McGregor, D.F.M., Simon, D. and Thompson, D.A. 2000. *Pilot Area Management Plan.* Draft working document for dissemination and testing by project collaborators and Kumasi stakeholders.

McGregor, D.F.M., Thompson, D.A., Kotei, N.O. & Poku, K.O. 2000. *Water quality in peri-urban Kumasi: how to test it and how to protect it.* Manual for participating schools .

McGregor, D.F.M. 2001 *Water Quality Test Kit Project: DFID Project R7330: Peri-Urban Natural Resources Management at the Watershed Level: Kumasi, Ghana*. Five individual Reports providing a commentary on the test results obtained by Junior Secondary Schools in Peri-Urban Kumasi during the period September 1999 to November 2000 (Ampabame No 1, Duase, Esereso, Maase and Sepetinpom).

McGregor, D.F.M., Simon, D. and Thompson, D.A. (eds) 2002. *Watershed Management Framework..*

McGregor, D.F.M. 2002. *Community Handbook for Environmental Management*

KUMINFO, IRNR & CEDAR, RHUL 2002 *Kumasi Bibliography*

KUMINFO, IRNR & CEDAR, RHUL 2002 *Directory of Development and Environmental Organisations and Institutions Operating in and around Kumasi*

8.9 Media presentations (videos, web sites, TV, radio, interviews etc)

McGregor, D.F.M. 2001. Interview for BBC World Service programme "In the Field".

Nsiah-Gyabaah, K. & Benefor, D. 2001. Presentations and Interviews for 2 local radio programmes (Garden City Radio, Kumasi)

8.10 Datasets and software applications

New datasets held in the KUMINFO GIS include:

Water quality (2-year record) in streams around Kumasi

Water-related village characterisation survey

Recorded boreholes and hand-dug wells in peri-urban Kumasi area

Registered plot layouts for selected areas of peri-urban Kumasi

Industry locations and environmental 'hotspots'

Directory of environmental organisations and individuals operational in Kumasi

Bibliography of NRM-related literature, peri-urban Kumasi and related topics

Project web site

<http://www.gg.rhbnc.ac.uk/kumasi.html>

Principal Planned Publication Activities

8.1 Book

With NRSP management approval, we intend to approach a commercial publisher, possibly Earthscan in the first place, with a view to converting the Scientific Annexe into a book. To be discussed with NRSP Management

8.2 Journal Articles

We are presently rewriting the substance of Research Paper 1 for publication in a Development journal.

The water quality data will yield 3 or 4 substantive publications, and preparation for that will commence now. We will target a range of scientific and forefront geographical journals, and intend to publish the results in Ghanaian journals as well as international outlets.

We also intend to write up the schools' test kit project, probably for the journal *Geography*.

Depending on the outcome of negotiations on the proposed book, Research Papers 4, 7 and 9 could be written up for publication.

Integrative papers will be submitted subsequently – possibly 2 or 3 around the general context of the Kumasi PUI – on a resource management theme.

8.3 Institutional Report Series

We intend to produce a research paper on the entire water quality database – in preparation.

8.4 Conference, etc

We have offered to run a 2-module Session at the Royal Geographical Society/Institute of British Geographers Annual Conference (September 2003) on the theme of environmental management in the peri-urban interface. We would contribute papers to that, and would anticipate publication proceedings to follow.

We also intend to promulgate the research at international/national conferences over the next two years.

9. Project Log frame

NARRATIVE SUMMARY	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
<p>Goal Management of peri-urban resources optimised through improved productivity and energy efficiency; crop production intensified on a sustainable basis; productive potential increased by the greater use of 'waste' materials and recycling of resources</p>			
<p>Purpose Impacts of urban growth on land use patterns and natural resources degradation identified and incorporated into strategies for peri-urban planning and management</p>	<p>Implementation of appropriate district and watershed level planning/management systems</p>	<p>Monitoring of policy agenda and public announcements</p>	<p>Political will exists to translate project outputs into practical policies and implementation thereof Target institutions invest in the uptake and application of methodologies and technology</p>
<p>Outputs 1. Inception phase A. Network of research partners established B. Preliminary identification and prioritisation of problems affecting water resources in the watershed areas and the effects on peri-urban inhabitants C. Characterisation of the physical environment, and study watershed areas agreed D. Characterisation of the water resource environment E. Data requirements and data collection methods for physical and socio-economic data identified and designed F. Literature search: watershed management in peri-urban areas elsewhere G. Inception report</p> <p>2. Analysis of the watersheds and development of strategies for sustainable management A. Human activity in the watersheds analysed 1. Stakeholder analysis of those involved in watershed management and use 2. Baseline socio-economic surveys including survey of water use/perceptions of water resources</p> <p>3. Farming system impact on water resources in selected watersheds</p> <p>4. Enhanced understanding gained of existing community watershed activities and management practices in peri-urban interface</p> <p>B. Characterisation of the physical parameters of selected watersheds</p> <p>C. Sustainable and low-cost methods of environmental/pollution monitoring established</p> <p>D. Watershed characterisation framework developed using KUMINFO</p> <p>E. Formulate peri-urban community watershed management recommendations for national, regional and local authorities</p> <p>F. Development of a framework for improved community-based watershed management in peri-urban interface</p>	<p>1. Completion of the Inception phase by September 1999. Report by December 1999</p> <p>2A.1 Analysis of stakeholders completed January 2001 2A.2 Results of village characterisation surveys presented March 2000 Analysis of perception of water resources completed March 2001</p> <p>2A.3 Farm system analysis completed December 1999</p> <p>2A.4 Existing community activities and management practices documented by July 2001</p> <p>2B. 1 Analysis of physical and land use parameters of watersheds completed March 2001 2B.2. Erosion/land degradation risk assessment produced September 2001 2B3. Characterisation of hydrological system and impacts on it drafted by September 2001</p> <p>2C. Establishment of network of monitoring sites December 1999</p> <p>2D. Watershed characterisation framework development within KUMINFO started June 2000; development completed December 2001</p> <p>2E. Draft formulation of strategy proposals and specific policy elements October 2001</p> <p>2F. Development of framework started August 2000, in conjunction with appropriate NGOs and EPA</p>	<p>1. Inception Report produced on time</p> <p>2A-F. Project reports and GIS interface creation and outputs 2A. Presentation of results to village groups/fora. Interim report on findings.</p> <p>Report on management practices completed and relevant information incorporated within KUMINFO</p> <p>2B. Production of erosion/land degradation risk assessment for selected watersheds Production of basic model of hydrological relationships in catchments</p> <p>2C. Local communities' involvement in environmental monitoring 2D. Map/display output</p> <p>2E. Draft consultation manual</p> <p>2F Draft and then final framework (including manual of best practice) completed and applied as key project activities and outputs</p>	<p>1. 1 April 1999 start 1.2 Cooperation of potential partners and stakeholders 1.3 Access to existing databases</p> <p>2. Cooperation of stakeholders during surveys</p> <p>That active management practices exist</p> <p>2.D. Continued access to Kuminfo assured</p>

<p>Outputs (cont)</p> <p>6 Lessons learned from experience of participatory research and the monitoring of microprojects and other interventions by this project to enhance management</p> <p>7 Evaluation of Twi and English leaflets</p> <p>8 Evaluation of schools' use of water test kits and subsequent information, dissemination and behavioural change</p> <p>9 Evaluation of watershed management framework-related demonstration projects</p> <p>10 Evaluation of watershed management framework and best practice manual</p> <p>3. Monitoring the effectiveness of practical solutions</p> <p>A. Establish sustainable and low-cost methods of environmental/pollution monitoring</p> <p>B. Use of KUMINFO as an interactive medium for environmental education</p> <p>C. Evaluate community-based watershed management framework and demonstration activities as stimulants for watershed self-management</p> <p>4. Dissemination through the life of the project: 'selling' the practical solutions</p> <p>Using Twi leaflets, liaison/discussion, workshops, conference presentations, publications, research monograph</p> <p>Development of communication strategies for dissemination of outputs</p> <p>Development of website</p>	<p>2G. Evolution of community perceptions and practices, and impact of microprojects, documented by March 2002</p> <p>2G1 Draft report completed August 2001</p> <p>2G2 Draft report completed September 2001</p> <p>2G3 Evaluation included in FTR</p> <p>2G4 Evaluation included in FTR</p> <p>3A. Establishment of network of monitoring sites December 1999</p> <p>3B1. Augmentation of KUMINFO database and production of maps</p> <p>3B2 local viability and sustainability of KUMINFO established as participatory educational and planning tool</p> <p>3C.1 Prototype framework produced March 2001</p> <p>3C.2 framework tested and refined December 2001; amendments and final versions evaluated by March 2002</p> <p>4. 1 Communication strategy in place March 2000</p> <p>4.2 Dissemination literature system in place March 2000</p> <p>4.3 Working paper series started July 2000</p> <p>4.4 Annual Reports March 2000 and March 2001</p> <p>4.5 Final report presented March 2002, to be followed by submissions to journals and submission of research monograph to commercial publisher</p> <p>10.2 Feedback from workshops/ dissemination seminars</p> <p>10.3 Use of website</p>	<p>3A. Local communities' involvement in environmental monitoring</p> <p>3B1. GIS interface creation and outputs</p> <p>3B2 Use of products by stakeholders; interaction between stakeholders and KUMINFO</p> <p>3C. preliminary evaluation reports drafted August – October 2001; FTR contains final evaluation</p> <p>4. 1 Increased environmental and resource awareness, and changing behaviour, within the local communities</p> <p>4.2 Publication of project results</p> <p>4.3 Citation and peer comment on project output</p> <p>4.4 Reception of, and response to, preliminary and final findings and proposals at workshops/seminars</p> <p>4.5 number of hits on website</p>	<p>2G Stakeholders willing to consider involvement in development of strategies for better environmental management</p> <p>3. 1 Cooperation of stakeholders during site establishment and monitoring</p> <p>3.2 Authorities are willing to transfer proposals into policies</p> <p>3.3 Appropriate NGO and GSWC follow-up of pilot area management plan</p> <p>3.4 Continuing access to KUMINFO assured</p> <p>3.5 KUMINFO staff proactive in interactions with stakeholders</p> <p>4. continued involvement of stakeholders in project activities and outputs</p>
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NB. OVI and MoV numbers not identical as some MoVs are generic

<p>Activities</p> <p>1. Inception Phase</p> <p>A. Network of research partners established:</p> <ul style="list-style-type: none"> liaison with stakeholders at all levels identification of the main participants for the various surveys/research activities <p>B. Preliminary identification and prioritisation of problems affecting water resources in the watershed areas and the effects on peri-urban inhabitants:</p> <ul style="list-style-type: none"> local difficulties regarding water resources management local solutions and establish which ones work and why problems which make local solutions difficult local ideas for reducing perceived difficulties range of land uses, including farming activities, which impinge on water resources Local Agenda 21 issues and principal actors <p>C. Characterise the physical environment, and select target watersheds:</p> <ul style="list-style-type: none"> assessment of hydrological and geomorphological factors assess existing database on hydrological, soil and geomorphological parameters identify existing range of land use 'best practice', identify watersheds for study <p>D. Characterise the water resource environment:</p> <ul style="list-style-type: none"> identify the range of environmental problems related to water resource use identify/confirm the sources of these problems identify the major types of water pollution identify the causes of water pollution identify agriculture/water resource problems in target watersheds identify environmental problem 'hot spots' define (if necessary) supplementary transect locations <p>E. Identify and design data requirements and methods</p> <ul style="list-style-type: none"> ascertain potential for collaborative activities assess existing database design surveys define the need for village characterisation survey design proformas for systematic field observation <p>F. Literature Search</p> <p>G. Inception Report</p> <p>2. Analysis of the watersheds and development of strategies for sustainable management</p> <p>A1. Stakeholder analysis of those involved in watershed management and use</p> <ul style="list-style-type: none"> implement a survey of government bodies with activities in and responsibilities for the watersheds implement a survey of stakeholders who use the watersheds implement a survey of polluting stakeholders analysis of existing institutional capacities, policies and practices in respect of regulation, control and enforcement. (this includes both customary and statutory institutions and practices) assess the effectiveness of environmental control identify any recent or projected changes in local/national ownership which may affect environmental management determine appropriate communication strategies through participatory research and evaluations <p>A2. Socio-economic survey and activities</p> <ul style="list-style-type: none"> implement as necessary a Village Characterisation Survey for those villages which affect the watershed assess the basis of local perceptions using PRA-type methodologies to: <ul style="list-style-type: none"> assess the impact of local land use practices on water resources assess perceived local difficulties regarding water resources management assess the effectiveness of local solutions - what have they actually applied and is it effective assess problems which make local solutions difficult assess local ideas for reducing perceived difficulties assess Local Agenda 21 issues and principal actors encourage local participation to identify better solutions 	<table border="1"> <thead> <tr> <th><i>Year</i></th> <th><i>1998/9</i></th> <th><i>1999/2000</i></th> </tr> </thead> <tbody> <tr> <td>Staff Costs</td> <td>2640</td> <td>20650.4</td> </tr> <tr> <td>Overheads</td> <td>2160</td> <td>22574.3</td> </tr> <tr> <td>Equipment</td> <td>1232</td> <td>400</td> </tr> <tr> <td>Overseas Travel</td> <td>2200</td> <td>16546</td> </tr> <tr> <td>Miscellaneous</td> <td>1350</td> <td>16394</td> </tr> <tr> <td>VAT</td> <td>-</td> <td>-</td> </tr> <tr> <td>TOTAL</td> <td>9582</td> <td>76564.7</td> </tr> <tr> <td><i>Year</i></td> <td><i>2000/1</i></td> <td><i>2001/2</i></td> </tr> <tr> <td>Staff Costs</td> <td>30979</td> <td>15821</td> </tr> <tr> <td>Overheads</td> <td>13323.9</td> <td>12128.3</td> </tr> <tr> <td>Equipment</td> <td>6172</td> <td>400</td> </tr> <tr> <td>Overseas Travel</td> <td>12769</td> <td>9887</td> </tr> <tr> <td>Miscellaneous</td> <td>17178</td> <td>13156.7</td> </tr> <tr> <td>VAT</td> <td>-</td> <td>-</td> </tr> <tr> <td>TOTAL</td> <td>80421.9</td> <td>51393</td> </tr> </tbody> </table>	<i>Year</i>	<i>1998/9</i>	<i>1999/2000</i>	Staff Costs	2640	20650.4	Overheads	2160	22574.3	Equipment	1232	400	Overseas Travel	2200	16546	Miscellaneous	1350	16394	VAT	-	-	TOTAL	9582	76564.7	<i>Year</i>	<i>2000/1</i>	<i>2001/2</i>	Staff Costs	30979	15821	Overheads	13323.9	12128.3	Equipment	6172	400	Overseas Travel	12769	9887	Miscellaneous	17178	13156.7	VAT	-	-	TOTAL	80421.9	51393	<p>1. Inception Report</p> <p>2. 1 Published analyses</p> <p>2.2 Annual and Final Reports</p> <p>2.3 KUMINFO GIS outputs</p>	<p>1. 1 Cooperation of potential partners and stakeholders</p> <p>1.2 Access to existing data bases</p> <p>1.3 Suitable pilot watershed can be identified</p> <p>2. 1 Cooperation with all stakeholders is forthcoming</p> <p>2.2 Field surveys are not disrupted by exceptional weather</p> <p>2.3 Measurements and instruments are not disturbed or vandalised</p>
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<p>A3. Farming system impact on water resource use in selected watersheds</p> <ul style="list-style-type: none"> demands and effects of farming systems on water flows and availability effects of possible changes in water quantity and quality at farm level potential requirements for water conservation measures at farm level <p>A4. Enhanced understanding of existing activities and management practices</p> <ul style="list-style-type: none"> assess from elements abstracted from A1-A3 above assess from perceptual surveys of target communities test existing knowledge through demonstration and PRA-type activities <p>B. Characterisation of the physical parameters of selected watersheds</p> <ul style="list-style-type: none"> establish protocols and take measurements of pollution in selected watersheds <ul style="list-style-type: none"> identify sources, pathways and sinks for significant polluting activities and their effects on water quality identify any annual patterns in hydrological and pollution levels identify effects of pollution on biota establish nature and extent of erosion risk establish nature and extent of land degradation risk establish criteria for local monitoring of degradational activities <ul style="list-style-type: none"> low-cost water quality monitoring: site selection and user training development of leaflets, etc to assist self-monitoring <p>C. Sustainable and low-cost methods of environmental/pollution monitoring established</p> <ul style="list-style-type: none"> identify sites and stakeholders appropriate to the establishment of low-cost water quality monitoring activities identify options to minimise effects of pollutants within the watershed identify ways of reducing existing or perceived water resource problems identify options to attain a land use mix consistent with sustainable use of water identify waste recycling opportunities in selected watersheds using existing database <p>D. Watershed characterisation framework using KUMINFO</p> <ul style="list-style-type: none"> development of watershed characterisation framework within KUMINFO <ul style="list-style-type: none"> digital elevation model of selected watersheds simple model of surface and groundwater hydrology characterisation of areas of erosion and land degradation risk <p>E. Develop policy recommendations at national, regional and district levels (see also 3C below)</p> <ul style="list-style-type: none"> assess effectiveness of current policies which impact on environmental management (particularly water-related issues) assess the implications of any recent or projected changes in local/government ownership which may affect environmental management (particularly water-related issues) <p>F. Develop a community-based watershed management framework (see also 3C below).</p> <p>This will be based on the results of consultation with stakeholders on:</p> <ul style="list-style-type: none"> economic needs of local people requirements of polluting stakeholders interface with national and local policy Local Agenda 21 issues <p>It will be informed by:</p> <ul style="list-style-type: none"> surveys of best practice the physical characteristics of the watershed existing land use practices (including farming) survey information on water resource uses and problems <p>G. Lessons learned by Project to enhance management strategy</p> <ul style="list-style-type: none"> distribution and evaluation of Twi and English leaflets evaluation of schools' use of water quality test kits (see also 3A) evaluation of dissemination of this new knowledge from children to their communities installation and evaluation of watershed management demonstration microprojects distribution and evaluation of watershed management framework and best practice manual 		<p>2D. Map/display output</p>	<p>2B. appropriate sites available and accessible to the project</p> <p>2D. Continued access to KUMINFO assured</p>
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<p>3. Monitoring the effectiveness of practical solutions</p> <p>A. Establish sustainable and low-cost methods of environmental/pollution monitoring and dissemination of appropriate information to stakeholders</p> <ul style="list-style-type: none"> • investigation of feasibility of using low-cost field kits, designed specifically for use in the peri-urban village context for monitoring water quality and pollution problems • establishment of 'user-friendly' visual methods of recognising the onset of water quality deterioration and land use problems such as accelerated erosion • establish pathways for the scientific corroboration of existing or emerging environmental problems, specifically those relating to water resources <ul style="list-style-type: none"> • establish protocols for reporting of unauthorised landuses and land transactions, waste tipping, sand/gravel winning, etc, which affect water resources <p>B. Use of KUMINFO as an interactive medium for environmental planning and education</p> <ul style="list-style-type: none"> • establishment of protocols for inputting environmental information into KUMINFO • investigation of KUMINFO as a demonstration medium for watershed-scale relationships between the physical environment, water resources and human activities • use of KUMINFO to illustrate potential effects of development decisions on the water resource environment, on erosion risk and on land degradation risk • development of a diagnostic framework within KUMINFO to inform watershed management and illustrate water resource linkages with best practice <p>C. Implement community-based watershed management framework: a generic diagnostic framework for watershed management in peri-urban areas</p> <p>The critical research activities which will underpin framework development include (see also 2E and 2F above):</p> <ul style="list-style-type: none"> • consultation procedures described • policies established for environmental protection (particularly water-related issues) • land use allocation criteria described • land use allocation process outlined • map and description of land utilisation types and land mapping units • procedures for representation of applications for consent <p>4. Dissemination through the life of the project: 'selling' the practical solutions using Twi leaflets and local broadcasting network, liaison/discussion, workshops, conference presentations, publications, research monograph</p> <ul style="list-style-type: none"> • liaison/discussion with local government staff regarding local issues - eg Local Agenda 21, use of the watershed • liaison/discussion with national government representatives - eg GWC, EPA, CWSA • liaison/discussion with stakeholders causing pollution and other forms of environmental degradation - eg timber companies • liaison/discussion with local communities both upstream and downstream of sites of degradation via BIRD and CEDEP/GOAN • liaison/discussion with other key informants and stakeholders including private firms, parastatals and official agencies whose activities leave an environmental 'footprint' in the peri-urban area <ul style="list-style-type: none"> • determine appropriate communication strategies - carried out in conjunction with stakeholder surveys • production of a Directory of all agencies with a stake in the Kumasi peri-urban environment • production of a Bibliography of relevant published/unpublished material • workshops will be held in Kumasi at key stages of the project <ol style="list-style-type: none"> (a) to aid in project design (b) to encourage participation in project activities (c) to assist in ensuring uptake pathways (d) to disseminate research progress and results locally and nationally • use of descriptive and information leaflets in Twi to inform stakeholders • use of local broadcasting networks to inform stakeholders of project activities and goals • establishment of Project website • announce research results internationally (professional newsletters, seminars, conferences, email discussion groups and bulletin boards) and link in with international databases eg UNEP • peer refereed journal papers; conference presentations and proceedings; research monograph • dissemination seminar in UK at end of project • liaison/discussion with international interested parties 		<p>3A.1 Field implementation of products of research, including use of field kits by stakeholders</p> <p>3A.2 Pathways for uptake of self-monitoring operational</p> <p>3B. Use of KUMINFO by stakeholders</p> <p>3C. 1 Uptake of project output by policy bodies. 3C.2 Implementation of pilot area management plan through appropriate NGO and GWSC</p> <p>4. 1 Increased environmental and resource awareness at local levels 4.2 Changing behaviour at local levels 4.3 Published output of project</p>	<p>3A. Uptake of products of research by stakeholders</p> <p>3B. Continued access to KUMINFO assured</p> <p>3C. 1 Authorities are willing to transfer proposals into policies 3C.2 Appropriate NGO and GWSC followup</p> <p>4. continued involvement of stakeholders in project activities and output</p>
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Keywords

Awareness-raising

Community perceptions

Environmental co-management

Kumasi PUI

Microprojects

Natural resource use

Peri-urban interface

Pollution

Water quality

Watershed management