

**A Preliminary Assessment of Environmental Issues  
in Ghana**

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## **ACRONYMS**

<b>ADB</b>	<b>African Development Bank</b>
<b>ADRA</b>	<b>Adventist Development and Relief Association</b>
<b>AID</b>	<b>US Agency for International Development</b>
<b>BMP</b>	<b>Best Management Practice</b>
<b>CBO</b>	<b>Community-Based Organization</b>
<b>CFD</b>	<b>Caisse Française de Développement</b>
<b>CIDA</b>	<b>Canadian International Development Administration</b>
<b>CPSP</b>	<b>Country Program Strategic Plan</b>
<b>DANIDA</b>	<b>Danish Development Organization</b>
<b>EC</b>	<b>European Community</b>
<b>EEU</b>	<b>European Economic Union</b>
<b>EEZ</b>	<b>Economic Exclusion Zone</b>
<b>EIA</b>	<b>Environmental Impact Assessment</b>
<b>EMEMP</b>	<b>Environmental Monitoring, Evaluation and Mitigation Plan</b>
<b>EPA</b>	<b>Environmental Protection Agency</b>
<b>EPAT</b>	<b>Environmental Policy, Administration and Training Project</b>
<b>EQPOC</b>	<b>Environmental Quality Project Operating Committee</b>
<b>ERP</b>	<b>Economic Recovery Program</b>
<b>FAO</b>	<b>Food and Agriculture Organization of the UN</b>
<b>FRMP</b>	<b>World Bank Forestry Resources Management Project</b>
<b>GACON</b>	<b>Ghana Association for Conservation and Development</b>

<b>GAPVOD</b>	<b>Ghana Association of Private Voluntary Organizations for Development</b>
<b>GDP</b>	<b>Gross Domestic Product</b>
<b>GEF</b>	<b>Global Environment Fund</b>
<b>GERMP</b>	<b>Ghana Environmental Resources Management Project</b>
<b>GIS</b>	<b>Geographic Information System</b>
<b>GOG</b>	<b>Government of Ghana</b>
<b>GTZ</b>	<b>German Technical Assistance Agency (Gesellschaft für Technische Zusammenarbeit)</b>
<b>ICDP</b>	<b>Integrated Conservation and Development Project</b>
<b>IIED</b>	<b>Institute for International Education and Development</b>
<b>IMF</b>	<b>International Monetary Fund</b>
<b>IRG</b>	<b>International Resources Group</b>
<b>IWM</b>	<b>Integrated Waste Management</b>
<b>JICA</b>	<b>Japanese International Cooperation Agency</b>
<b>KIVPL</b>	<b>Kumasi Improved Ventilated Pit Latrine</b>
<b>LIPOC</b>	<b>Lands Information Project Operating Committee</b>
<b>MEST</b>	<b>Ministry of Environment, Science and Technology</b>
<b>NENGO</b>	<b>Network of Environmental NGOs</b>
<b>NGO</b>	<b>Non-Governmental Organization</b>
<b>NRM</b>	<b>Natural Resource Management</b>
<b>NTAE</b>	<b>Non-Traditional Agricultural Exports</b>
<b>NTE</b>	<b>Non-Traditional Exports</b>
<b>ODA</b>	<b>Overseas Development Administration</b>

<b>PASA</b>	<b>Participating Agency Service Agreement</b>
<b>PID</b>	<b>Project Identification Document</b>
<b>PVO</b>	<b>Private Voluntary Organization</b>
<b>RAMSAR</b>	<b>The Convention on Wetlands of International Importance</b>
<b>RFA</b>	<b>Request for Assistance</b>
<b>RFP</b>	<b>Request for Proposals</b>
<b>RSAU</b>	<b>Remote Sensing Applications Unit</b>
<b>SAP</b>	<b>Structural Adjustment Program</b>
<b>TIP</b>	<b>Trade and Investments Program</b>
<b>UNDP</b>	<b>United Nations Development Programme</b>
<b>UNEP</b>	<b>United Nations Environmental Programme</b>
<b>UST</b>	<b>University of Science and Technology, Kumasi</b>
<b>UNIDO</b>	<b>United Nations International Development Organization</b>
<b>VRA</b>	<b>Volta River Authority</b>
<b>WB</b>	<b>World Bank</b>
<b>WRI</b>	<b>World Resources Institute</b>

## PREFACE

During the course of the next year, USAID Ghana will be preparing its Country Program Strategic Plan for 1997-2001. In anticipation of that effort, the mission requested a preliminary assessment of environmental issues in Ghana. The World Resources Institute was commissioned to field a three-person analysis team. For three weeks, team members surveyed the environmental landscape and analyzed the principal issues and programmatic choices available to AID. They then prepared this report in an attempt to aid in deciding on program content, and to make recommendations concerning them, including - as appropriate - the next steps to be pursued in developing them.

The team which carried out that assessment was comprised of the following individuals:

Mr. Frederick E. Gilbert (Team Leader)	Policy, Legislative and Institutional Framework
Mr. Greg Booth	Sustainable Agriculture and Agropastoral Systems; Forestry; and Biodiversity Management
Dr. James Perry	Agricultural, Mining and Industrial Pollution; Coastal and Water Resources Management, and Urban Sanitation

During their first week in the country, the team meet with and interviewed a wide range of government, university, donor, and PVO/NGO officials. The second week was spent on field visits to Akosombo, Kpong, Akwatia, Cape Coast, Sekondi-Takoradi, Tarkwa, Obuasi, Kumasi, Tamale, Bolgatanga, and Bawku while the third week was devoted to writing up results and debriefing USAID Ghana personnel.

This report begins with an introductory overview of the nature and importance of contemporary environmental problem in Ghana. In Section II, Greg Booth deals with the traditional agriculture and agropastoral sectors as well as the closely associated forestry and biodiversity management sectors. In Section III, James Perry treats the environmental problems largely associated with the modern sectors of Ghanaian life under the headings of commercial agriculture, mining and industry; water and coastal resources; and urban sanitation and water supplies. In Section IV, Frederick E. Gilbert examines crosscutting or trans-sectoral factors including the policy and legislative framework, the institutional framework, governance considerations, civil society and environment, and environmental information management and sharing (which also benefitted from inputs from James Perry). In Section V, Gilbert draws together the main recommendations from all sections of the assessment and considers their implications for the future development of USAID's program in Ghana.

The team wishes to express its gratitude to all the individuals representing Government of Ghana agencies and institutions, the international and Ghanaian NGO communities, the University of Ghana, the University of Science and Technology (Kumasi), World Resources Institute, USAID, and other donor agencies both in Ghana and in Washington as well as various private individuals for sharing their knowledge and insights. Despite all this help, readers will no doubt detect errors and omissions. The responsibility for these, of course, lies with the team.

## EXECUTIVE SUMMARY

This preliminary environmental assessment was carried out by a three-person team from June 18 through July 7, 1995. The team's assignment was to look into virtually all aspects of environmental management in Ghana -- including ongoing USAID-funded environmental activities -- with a view to identifying and assessing the relative priority of program options and recommending new programs and areas for further analysis. Additional information about the team members and their responsibilities can be found in the "Preface". An overview of the main environmental concerns and the biophysical and socio-economic processes which underlie them can be found in the "Introduction".

The following are the main findings of Sections II, III, and IV:

In Ghana's **traditional agriculture and agropastoral sectors**, population growth and stagnant productivity are combining to reduce fallow periods and generate agricultural encroachment into forested areas and onto marginal lands. The results of these trends are losses in soil fertility and vegetative cover, and widespread soil erosion. Land and resource tenure policy frameworks contribute to these degradations in so far as they undermine resource users' incentives to invest in long-term, sustainable land management. The World Bank and DANIDA will be supporting natural resource management (NRM) interventions in conjunction with a newly established Land and Water Management Central Unit within the Ministry of Agriculture. The project, which will work with PVOs and NGOs in a single watershed, will focus on water and soil conservation, soil fertility enhancement, agro-forestry, and afforestation. Additional donor support would be useful to a similar project in coordination with the Bank and DANIDA.

The principal problems in the **forestry sector** are deforestation due to extensification of agriculture and unsustainable logging. Most logging in Ghana takes place off government reserves. In recent years, about 25,000 hectares of closed forests have been cleared from private lands annually. The fact that the government owns all timber species on private land and derives revenue from their exploitation means that private farmers and communities have little or no incentive to conserve these timber species. At this rate it is doubtful if government reserves can sustain the logging industry. The GOG is reviewing its tree tenure policy, and it may be reformed in the near future. The ODA and the World Bank are major donors to the forestry sector in southern Ghana. The management of the considerable forest resources of northern Ghana, however, has been neglected by both the government and donors. The following options are recommended for donors' consideration:

- Provide targeted in-country training of Forest Department technical officers to strengthen implementation; short-term U.S. training for selected staff.
- Promote improved cooperation between government resource managers and communities (with help from PVO/NGOs) in the exploitation of forest reserves

and off-reserve forest resources in accordance with timber and non-timber concession agreements. These concessions would feature a forest reserve management plan developed in collaboration with all interested parties, employ local communities in timber extraction activities, and allow communities to sustainably use non-timber forest products such as bush meat, medicine, and fuelwood.

- Support research on the relationship between cash crops (e.g., cocoa) and indigenous timber species.
- Support studies by the Forest Research Institute and appropriate NGOs on key issues of the relationship between forest ecosystems and timber production management.
- Assist the GOG in establishing a satellite Forest Department planning office for savanna forests in Tamale.
- Provide support to the community forestry activity which the Adventist Development and Relief Association (ADRA) proposes to launch in the Accra-Tema area.

Ghana's biodiversity resources fall under the jurisdiction of both the Game and Wildlife Department and the Forest Department. Since there is a need to conserve animal species in forest reserves, cooperation between these two agencies needs to be developed. Success in the management of biodiversity resources on government reserves depends in large measure on the cooperation of adjacent communities. Ghana requires additional assistance in the following areas:

- Encourage and support a dialogue between the EPA and the Ministry of Lands and Forests on intersectoral approaches to biodiversity management, including community-based models, that draws on USAID experience in Kenya (COBRA) and Madagascar.
- Identify and share with the Department of Game and Wildlife the lessons learned from bush meat breeding programs in other Sub-Saharan Africa countries.
- Promote policy change so that shares of tourism revenues from Kakum and other parks are retained for the operation and upkeep of these facilities and for the benefit of adjacent communities.

**Commercial agriculture, fisheries (including aquaculture), mining, and industry** are assuming increasing importance in the Ghanaian economy. Each can have important negative impacts on soil, air, and water quality. Hence, the monitoring of environmental quality, analysis

and research to understand observed problems, and, when required, measures to mitigate environmental damage are required if these sectors are to be sustainable over the long term. Of particular concern are indications of possible problems with the use of mercury in the gold mining sector (especially the small-scale, legal component). The following options are recommended for USAID's consideration:

- Focus the Environmental Monitoring, Evaluation and Mitigation Plan (EMEMP) more sharply and improve its implementation; support and participate in a strategic planning effort to get concerned governmental agencies to agree on the decisions to be made and the indicators to be monitored for those decisions; and focus near-term data gathering on basic, well-accepted needs while the replanning process goes forward.
- In coordination with the World Bank's activity in support of small-scale mining, provide technical assistance to assess the quantities of mercury used in gold mining, evaluate how it is being used, and recommend alternative practices.

**Aquatic and coastal resources** are also being impacted by unsustainable land uses, industrialization, and, in the case of the mouth of the Volta, by the construction of dams. Coastal zone issues are being aggressively addressed by the World Bank, DANIDA, and the ODA. The following would benefit from donor assistance:

- Provide technical assistance in developing practical water quality laws which integrate the concerns of cognizant agencies and establish procedures for implementing them. This sustained process will require up to five years as there are few, if any, established standards for emissions, effluents, water quality, and other environmental quality norms at present. Altogether, some 20 agencies have some responsibility for managing water resources.
- Provide technical assistance to assess prospects for stopping the spread of the St. Paul's coconut palm blight or for mitigating its effects.

**Urban sanitation and water supplies** are highly vulnerable as a result of Ghana's rapid, and more-or-less haphazard, urbanization. Water supplies are often safe at the source, but contamination in the distribution process is a common phenomenon. This is largely a result of poor distribution facilities and poor management of household and other wastes. Ghana is currently receiving a good deal of donor assistance in the field of urban water supply and sanitation. Solid waste disposal in Accra and other urban areas is another major problem and one that is of great concern to many Ghanaians. Like most urban problems, this has socio-political and financial as well as technical and administrative dimensions. There are indications that the level of concern about solid waste may open the way for a multi-pronged -- yet integrated -- approach called Integrated Waste Management (IWM) that has proven successful in the U.S. and Eastern Europe. Vehicles of various types may be an important and underestimated source of air

pollution. The following options are recommended:

- Support a small-scale, pilot project of roughly five years duration for the development of an Integrated Waste Management project in one of Ghana's smaller urban areas.
- Support research on the transportation-air pollution relationship, its temporal and spacial dynamics, and options for reducing pollution from this source.
- Given its importance as a source of potable water and its relation to the Trade and Investment Program (TIP), the Densu River should receive priority consideration for inclusion in any USAID-supported watershed project.

The section on **crosscutting or trans-sectoral factors** encompasses the **environmental policy, legislative and institutional frameworks plus governance, civil society, and information management and sharing**. The policy and legislative frameworks are still incomplete and problematic though new omnibus environmental legislation is currently being drafted. Meanwhile, the law (Act 490 of 1994) establishing the new Environmental Protection Agency (EPA) provides it with a solid mandate and broad authority for managing the environment. The EPA's structure is well adapted to its role, its staff appears to be of good quality and well-motivated, and its leadership is committed to pursuing its mission realistically through heavy reliance on cooperation from other agencies and the private sector where possible, but through enforcement, including using the court system, when necessary. Major needs to be addressed include the need to develop policy and legislation which not only set appropriate standards and norms, but provide incentives for sound environmental management. A key area of need is land and resource tenure regimes. Appropriate reforms here would greatly encourage sustainable, long-term land resource management as well as investment in general.

Another important problem area is interagency coordination. The resurgence of democracy complicates governance and means that favorable environmental policies and laws will depend increasingly on public awareness of -- and political support for -- sound environmental management. The NGO sector has a vital role to play in both the implementation and the advocacy of environmentally sound policies. Information management and sharing are essential to the formulation and enforcement of policies, regulations, and laws concerning environmental quality. The following actions are most important:

- Provide targeted technical and financial assistance to address policy development, technical, scientific, and institutional needs (e.g., EPA is currently seeking help in developing its capacity for licensing, monitoring with a view to enforcement, setting standards, and using incentives to gain compliance), thereby strengthening EPA's capacity to exercise sound leadership.
- Finance an assessment by U.S. land tenure experts (such as those from the

University of Wisconsin's Land Tenure Center) and a source of systems analysis expertise of the ongoing effort to document the present land tenure situation in Ghana. If possible, sustained involvement of U.S. experts in developing the analytical and informational base for reform of land and resource tenure policy and administration should be supported by USAID.

- Provide grants to PVO/NGOs for building analytical and advocacy capacity and include NGOs (whenever possible) in the planning and implementation of USAID environmental activities and provide Section 116e grants to NGOs for work on governance issues pertinent to the environment.
- Approach EMEMP replanning with the aim of developing a comprehensive, integrated environmental quality monitoring and management system. This should include undertaking a review of GOG assistance requirements in this area.

The USAID projects most involved with environmental management -- **TIP/EMEMP, Natural Resource Conservation and Historic Preservation (Castles and Parks), and the ADRA-Peace Corps Collaborative Community Forest Initiative** -- merit continued USAID support. The latter two have achieved laudable success. (See Section V for a summary of the team's findings.)

In Section V, a **recommended environmental program strategy** is considered. The point of departure for this analysis is the following seven major options that emerged from this assessment: (a) promoting farm and community level application of NRM technologies for soil and water management, including afforestation and agro-forestry, in a single watershed; (b) participating with the World Bank and ODA in institutional strengthening of the Forest Department and helping it to adopt new management methods; (c) using the EMEMP as the springboard for broader support in the form of targeted technical and financial assistance to EPA and its networks in the development of a comprehensive and integrated environmental quality monitoring and management system; (d) undertaking a pilot integrated (solid) waste management (IWM) scheme; (e) promoting and supporting a role for U.S. experts in the documentation and eventual rationalization of Ghana's land tenure administration systems; (f) strengthening the leadership, management, and institutional capacities of EPA, and (g) developing the NRM program management and analytical and advocacy capacities of environmentally-oriented Ghanaian NGOs.

An assessment of the above options, especially in regards to USAID guidance, leads to the conclusion that USAID Ghana's environmental program strategy should be built around an enhanced option (c). Determining reasons for this choice are the fact that the development of a technically sound and pragmatic environmental monitoring and quality management are important to the sustainability of the TIP strategy, while its thematics can accommodate the incorporation of options (d), (e), and (f). Such an activity could be further enhanced through the addition of a modified option (a) to the extent that a single watershed would be selected as a field

laboratory for environmental quality diagnostic work as a follow-up and adjunct to EMEMP monitoring. This would lead to action being taken on environmental quality problems identified in collaboration with district, municipal, and community leaders -- including environmental management committees. The proposed interventions would no doubt include some that would parallel the soil and water management, agro-forestry, and afforestation interventions provided for under the GERMP land management/watershed component and option (a) above. However, they would also -- and, perhaps, mainly -- operate in a different dimension as they would generate field measures of pollution control, pollution mitigation, and waste management -- including solid waste management.

Adding a field dimension brought in through the watershed element would open the way for incorporating the NGO community with the effort. Because the diagnostic and planning work would be governed by an environmental quality (largely pollution control and mitigation) focus, the experience and training received by the NGOs would complement that received by NGOs under the GERMP watershed activity.

The Densu watershed is a compelling candidate for this enhanced option as it is a source of Accra's water supply, and it is being degraded by siltation resulting from the intensity of land use management. The Densu watershed area is also the site of a considerable number of TIP enterprises. The town of Koforidua would be about the right size for a pilot IWM solid waste management project.

## **I. INTRODUCTION**

Economic development has been central to public policy in Ghana since well before independence was achieved in 1957. This and Ghana's annual population growth rate of nearly three percent have had a significantly adverse impact on the country's natural resource base. This impact has occurred primarily through three separate, though interrelated, processes.

First, technological progress has generally failed to keep pace with population growth in the traditional agricultural and agropastoral sectors. The resulting extensification of agriculture has, together with logging, resulted in a progressive decrease of forest resources. Today, only 2.1 million hectares remain of a rain forest that covered 8.2 million hectares of southern Ghana as recently as the turn of the century. In northern Ghana, the extensification of agriculture has resulted in the conversion of pasture lands to agriculture and has led to the overgrazing of remaining pastures. In both northern and southern Ghana, population pressures have caused fallow periods to decline. The attendant degradation of soils has brought with it erosion and fertility losses. These changes have resulted in substantial loss of natural habitat and constitute the main threat to preserving Ghana's rich biodiversity.

Secondly, while economic development efforts have focussed in part on raising productivity and incomes in the traditional sectors, they have mainly produced growth in Ghana's nascent industrial, mining, and, in recent years, export agriculture sectors. Activities in these sectors are more intensive in their use of natural resources and their impact on the environment. Though an alternative to extensification of agriculture, commercial agriculture generally involves greater use of fertilizer and pesticides. But these impact waterways through run-off and leave residues on agricultural products and in the soil. These residues frequently enter the food chain where they cause destruction of wildlife and pose health hazards to humans. Industry and mining also pollute the air and waterways with toxic and other waste.

Thirdly, the development of modern industry, the stagnation of traditional agriculture, the spread of education, and the concentration of social and economic infrastructure in and around urban areas, especially in southern Ghana, have combined to form an urbanization trend that more than doubles the rate of population growth. Urban areas constitute a special environmental problem in that they are particularly subject to industrial pollution. Also, their dense human concentrations entail special environmental hazards such as household waste water and solid waste disposal problems as well as air pollution from vehicular traffic.

How well Ghana manages the environmental problems and needs arising from these processes will determine the quality of its environment well into the 21st century. Much depends on the adequacy of the relevant policy and legislative frameworks as well as on the effectiveness of the Government's institutional and administrative machinery for improving and implementing environmental policy and plans. As democracy takes increasing root in Ghana, environmental legislation and policy will reflect public understanding of, and commitment to, environmental

needs and goals. It is therefore increasingly important that appropriate data are collected on how biophysical and socio-economic processes affect the environment and that these data are then effectively processed and disseminated to inform the policy-making process. If all these elements can be made to mesh, the result should be that legislation and policy will strike a reasonable balance between the need for economic progress and the need for prudent environmental management. If effectively implemented, such policy should produce sustainable economic progress that preserves precious national and global biodiversity and ecological processes.

## **II. TRADITIONAL AGRICULTURE, AGROPASTORAL, FORESTRY, AND BIODIVERSITY MANAGEMENT SECTORS**

### **A. The Sustainability of Agricultural and Agropastoral Systems**

#### **1. Biophysical and Socio-Economic Trends**

Ghana contains approximately 24 million hectares of land, one-third of which is located in the forest zone and two-thirds of which is located in the savanna zone. The common factors in Ghanaian agriculture are the use of bush fallow systems to restore soil fertility and mixed cropping systems to minimize risks (World Bank, 1993). Under traditional circumstances, bush fallow agriculture -- which has been practiced for centuries -- is sustainable. In the Volta Region for example, farmers clear forest land, grow food crops for two or three years and then relocate.

However, systems which were stable as recently as ten years ago are now threatened by mounting population pressure (Yamoah, 1995). In the northern savanna zone, there is little use of purchased inputs and land preparation is generally done manually though oxen are important in some parts of the northern savanna zone (World Bank, 1993). (Livestock herds are concentrated in the northern Guinean and Sudan Savanna Forest Zones (World Bank, 1987)).

As population pressures mount, however, fallow periods shorten and agriculture encroaches into forested and marginal lands. This causes loss of soil fertility, loss of vegetative cover, and soil erosion. Although food production increases in absolute terms, it remains either static or declines per unit of land and labor.

Deforestation has increased due to the pressures on forest resources that come from pit sawing, mechanized gold mines, and the extent of areas now under subsistence and commercial agriculture (Hawthorne and Musah, 1993). Livestock are exacerbating the problem by

consuming the newly regenerated vegetation that emerges following the harvesting of agricultural crops. The livestock problem is most acute in areas having high human population densities in the Upper Eastern region.

The northern savanna, coastal plains, eastern region, and areas within the Brong Ahafo region are experiencing particularly serious land degradation due to the combined effects of an annual population growth rate of three percent and an annual deforestation of some 25,000 hectares.

In 1990, the Ministry of Food and Agriculture projected that food consumption levels will far outstrip production unless the extensive bush fallow farming system is replaced with a more sustainable one. Consequently, the per capita food production has been declining 0.9 percent per year. In addition, arable land holdings will be reduced from four to one acre per person by the year 2020 (Adventist Development and Relief Agency, 1995).

## **2. Government and Donor Activities**

The Government of Ghana is beginning to take steps to reform its land and tree tenure policies. For example, a new draft Forest and Wildlife Policy prepared by the Ghana Forestry Commission is presently being considered by the government. The adoption of the suggested policy changes suggested by the Forestry Commission would go a long way toward alleviating the policy constraints associated with land degradation.

There are also a number of activities in Ghana which are addressing agricultural intensification through technical interventions. A few of these are listed below.

- Agroforestry Unit, Ministry of Agriculture. The unit was established in 1989 under the World Bank Forest Resource Management Project. In response to an increase in soil degradation, the unit is conducting agroforestry trials using exotic tree species and traditional food crops.
- The Adventist Development and Relief Association (ADRA)'s Collaborative Community Forestry Initiative in Northern Ghana. The project has encouraged tree planting for community woodlots, income generation, and intercropping in farmers' fields.
- World Bank Environmental Resources Management Project (GERMP). Under this \$USD 5.2 million dollar project funded by the World Bank and DANIDA, is a watershed land management component that will apply natural resource management (NRM) soil and water conservation technology, including agroforestry and afforestation, at both the farm and community levels.

- The Soils Research Institute. The Institute is currently in the process of conducting a national soil survey to identify areas with soil fertility and erosion problems. The resulting report will also provide recommendations to resolve soil problems. In the future, the Institute plans to have 1:50,000 scale maps for each of Ghana's one hundred and ten districts. The information presently available is in the form of 1:250,000 scale maps (and aerial photography) and is based on work conducted with the United Nations Food and Agricultural Organization in 1964. The maps provide information on soil type, soil capacity, and vegetation types.
- The German GTZ project in Volta Region. Since 1993, GTZ has been attempting to stabilize deforestation through the intensification of agriculture in the Volta Region (Yamoah, 1995).
- The African Development Bank (ADB). The ADB is supporting a number of agricultural activities that are at different stages of development. These include a Kpong Irrigation Project, a planned Rubber Tree Development Project, an AFRAM Plains Development Project, and a planned Small-Scale Irrigation Project.

### **3. Constraints and Opportunities**

Unsustainable agricultural practices are causing land degradation in the form of deforestation, soil erosion, and consequent losses in soil fertility in many areas of the country. Intensifying Ghana's agricultural systems is a key step in reversing these trends.

A major constraint to intensifying agriculture, however, lies in the nature of Ghana's current land tenure and tree tenure systems. The former includes an array of agreements including private ownership, long-term leases, short-term rentals, community management, and open access. No adult member of a community can be denied the right to clear land for farming unless that land has already been assigned to another member of the community. As these land holders have no long-term rights of ownership, they naturally seek to maximize short-term returns. Under conditions of rapid population growth, this has become a major cause of deforestation and associated land degradation (World Bank, 1992).

The present tree tenure system presents a similar scenario in that the State is the legal owner of the forests (Environmental Protection Agency, 1991). Outside of the forest reserves, traditional "stool chiefs" hold title to land on behalf of their people. However, the right to fell and sell timber trees is vested in the government, regardless of whether the trees are located on farms or in private forests. The government may share timber sale revenue or royalties received from timber concessions with the traditional stool chiefs, but they are under no obligation to do so. (Forestry Department, 1995).

Nevertheless, there is room for agroforestry and other tree planting interventions -- which need not involve timber species -- in enhancing the sustainability and productivity of land management. For example, agroforestry technologies can inhibit the growth of weeds and provide shade conditions conducive to the growth of certain agricultural crops (Yamoah, 1995). Agroforestry activities also have the potential to prevent soil erosion, improve soil fertility, and provide fuelwood resources. The availability and use of fruit trees and cashew trees is also proving to be a source of income for some farmers in the northern savanna zone (Adventist Development and Relief Association, 1995).

**USAID has an opportunity to address the above constraints by carrying out a watershed focussed NRM project that would use various farm and community-level technologies for soil and water management, agro-forestry, afforestation, biodiversity management, agricultural productivity, and income generation needs. It may be possible as well to address some of the policy issues - e.g., land and tree tenure - that reduce the incentives for long-term, sustainable management. This approach would produce measurable impacts at the local level and show how the application of NRM technologies enhances agricultural sustainability, rural incomes, and biodiversity. It may be possible as well to shed some light on the incentive effects of land and resource tenure policies. This approach should be coordinated with the World Bank and could involve donors focussing their efforts on different watersheds. Case studies to guide such an effort could be drawn from USAID experiences in Guinea, Senegal, and Madagascar.**

## **B. Sustainability of Forestry Sector Management**

### **1. Biophysical and Socio-Economic Trends**

Ghana's forest cover can be divided into two major zones: the high forest zone covering 8.2 million hectares in southern Ghana, and the savanna zone covering approximately 15.7 million hectares in northern Ghana. The savanna zone can be further divided into four vegetation types: derived savanna, southern Guinea, northern guinea, and sudan savanna.

Established in the 1930s, Ghana has one of the best forest reserve systems in Africa (IUCN, 1988). All reserves are classified as either production forests or protected forests. The production forests are managed for the production of both traditional timber and non-timber products. Protected forests are usually located in ecologically sensitive areas (e.g., water resource areas, steep slopes, or areas having fragile soils).

Ghana faces a severe deforestation problem. It is estimated that at the beginning of the nineteenth century, forests covered 88,000 square kilometers, approximately 40 percent of the country. As the result of agricultural expansion brought about by increasing population and unsustainable logging activities, however, there is virtually no primary rain forest remaining in the country (USAID, 1992).

An important underlying cause of deforestation is Ghana's present tree tenure system. The State is the legal owner of all forests (Environmental Protection Agency, 1991) and farmers do not receive revenue from timber exploited on their farms. In addition, the compensation which farmers receive for damage caused by felling and hauling of timber trees by concessionaires is often inadequate. As long as timber trees have no value to the farmer, there will be no replenishment of indigenous timber trees outside of the forest reserves (Forestry Department, 1995).

The present tree tenure system provides few incentives for farmers to maintain trees on their property. To make matters worse, 70 percent of the commercial timber concessions in Ghana are being conducted on private land outside of the government forest reserves. Only 30 percent of the timber being extracted is planned under forest reserve management plans (Ministry of Lands and Forestry, 1995; Falconer, 1995).

The most dramatic deforestation in Ghana is occurring in those forests which are located outside of the government forest reserves (Environmental Protection Agency, 1991). On average, 25,000 hectares of closed forests on private land have been felled in recent years (Environmental Protection Agency, 1989). At this rate, the remaining 0.5 million hectares of unreserved closed forests will be converted to other land uses within the next 25 years (USAID, 1992).

In addition to the deforestation that results from agricultural expansion, 70 percent of Ghana's commercial timber is extracted from private lands outside of the forest reserves. Only 30 percent of the production timber resources are coming from the government forest reserve system (Ministry of Lands and Forestry, 1995; Falconer, 1995). It is therefore highly unlikely that government managed forest reserves will be able to supply the forest industry with a sustainable source of timber.

Incentives must be found to encourage rural communities to integrate indigenous timber trees into their farming systems. To this end, there is a trend in Ghana toward facilitating the sustainable use of on-farm forest resources at the local level. After reviewing of its forestry planning and enforcement activities, the Forestry Department recognizes the importance of establishing partnerships with rural communities.

## **2. Government and Donor Activities**

- World Bank Forest Resources Management Project (FRMP). Financed by the World Bank and other donors, the FRMP project began in 1989 and was officially completed in June of 1995 although it is presently being considered for a one-year extension. The four components of the project were: forest inventory and management (supported by the British Overseas Agency), rural community forestry (supported by DANIDA), the Ministry of Agriculture's Agroforestry Unit (supported by U.N. Food and Agricultural Organization and DANIDA); and

institutional strengthening.

- African Development Bank Subri Industrial Plantation Project. Daboase, southwestern Ghana. This project is designed to clear 4,000 hectares of natural forest and replant the area with tree plantations. A total of 2,897 hectares of trees have been planted since the project began in 1984 (African Development Bank, 1995).
- Adventist Development and Relief Association (ADRA). Collaborative Community Forestry Initiative in Northern Ghana. The project has encouraged tree planting for community woodlots, income generation, and intercropping in farmers' fields.
- Friends of the Earth. National membership organization with an international affiliation. The organization has a number of reforestation and agroforestry activities in ten communities in the Ashanti region. Similar activities are supported in other regions by Africa 2000 (USAID, 1993). The organization presently has a sacred grove forest project near Accra which they would like to extend to other areas.
- Amasachina Self-Help Association. The association is composed of over three hundred village groups in the northern savanna zone (USAID, 1993). Amasachina is one of the implementing groups associated with the USAID-supported ADRA Collaborative Community Forestry Initiative.
- Ghana Association for the Conservation of Nature (GACON). Kumasi. The purpose of this NGO is to organize local communities to protect sacred grove forests and other traditionally managed forests.
- Forestry Research Institute (FRI). Kumasi. The FRI is conducting research on a number of forest management topics related to timber production and community participation.
- The GTZ project in Volta Region. Since 1993, GTZ has been coordinating a project designed to stabilize deforestation through the intensification of agriculture in the Volta Region (Yamoah, 1995).

In addition to the technical assistance coming from the international community, Ghana is beginning to reassess its own tree tenure policies. A new draft Forestry and Wildlife Policy is now being considered for approval that would "develop a consultative and participatory mechanism to enhance land and tree tenure rights of farmers and ensure access of local people to traditional use of natural products" (Forestry Commission, 1995).

### **3. Constraints and Opportunities**

#### **a. Technical Forestry Training**

Ghana has always had highly educated forest scientists and managers. With its capacity strengthened as a result of the World Bank Forest Resources Management Project, the Forestry Department is now preparing to support strategic planning and implementation activities at the district level. Though the department has management procedures and plans, it does not have a trained staff capable of implementing them. Especially lacking is the technical officer staff which stands at the front lines between the district office and communities (Personal Communication, Forestry Department, 1995). These technical officers need in-service "hands-on" training to supplement their two-year technical forestry school training. Instead of advanced degree training, the technical officers require specific training in: timber production, community participation, concession monitoring, and the development of collaborative management plans (Forestry Department, 1995).

**USAID could support targeted forestry training. The training could be conducted by forestry specialists procured through a PASA agreement with U.S. Peace Corps Office of Training and Technical Support in Washington, D.C. This assistance should be designed to supplement and improve the forestry training presently available at the Sunyani Forestry School or Institute For Renewable Natural Resources. USAID could also identify short-term training opportunities for key technical foresters at the University of Florida in Gainesville or other institutions with experience in tropical forestry.**

#### **b. Ineffective Partnerships Between GOG and Rural Communities**

Another constraint to sustainable forest management is the lack of viable partnerships between Ghana's rural farmers, private forest concessionaires, and the Forestry Department. These partnerships should be based on an enabling policy for the development of contracts between the parties concerned. The contracts should be established with communities for the management of forests on both government reserves and private lands.

In the past, forest reserve planning by the Forestry Department was centralized and did not take proper consideration of the interests and resources of the local communities. The reserves themselves were managed through a system of short-term timber production permits and there was no management whatsoever of non-timber forest products. This approach did not encourage a partnership between the government and local communities for the long-term stewardship of forest resources (Forestry Department, 1995).

The Forestry Department will likely require assistance from NGOs and donors who have experience working with rural communities. For example, rural communities may require assistance to plan and implement sustainable forest management systems with the Forestry Department and private timber concessionaires.

**USAID could facilitate the development of a model partnership between the NGO/PVO community, local communities, and the government land managers. The result would be timber and non-timber concession agreements which would: (a) have a forest reserve management plan which was developed collaboratively with all interested parties; (b) employ local communities to participate in timber extraction, reforestation, and other income generating activities; and (c) allow local communities to make sustainable use of non-timber forest products (e.g., game meat, medicine, and fuelwood).**

**USAID could provide assistance to better understand how indigenous timber trees are integrated into traditional Ghanaian agricultural systems and the incentives required to sustain those systems (e.g., cocoa trees).**

**USAID should continue its support to ADRA and the Peace Corps for the implementation of the Collaborative Community Forestry Initiative in northern Ghana. It could also consider support for the planned ADRA community forestry project in the Accra-Tema area. (It is our understanding that the project proposal is now being considered by USAID/Washington.)**

### **c. Neglect of Forest Management in Northern Ghana**

The forest resources of northern Ghana have been neglected by both the government and the international community. **A northern Ghana Forestry Planning office should be established using lessons learned from forest management activities in the south.**

The combination of land clearing for agriculture, livestock overgrazing, and fuelwood harvesting is diminishing the capital stock of trees. Forest degradation is particularly acute in areas with high human populations and low rainfall. Farmers in the Upper East Region are responding to increasing fuelwood shortages by planting neem and teak trees on a small scale.

With the help of the donor community, the Forestry Department is focusing almost all of its forest management and community forestry efforts on the high forest zone in southern Ghana. The Forestry Department is interested in obtaining assistance from the donors to establish a satellite planning office in Tamale that would re-establish sustainable management practices based on the lessons learned from their activities in the south.

**USAID could determine the type of assistance necessary to establish a satellite Forestry Department planning office in Tamale. Discussions should begin with ADRA and Peace Corps staff regarding the feasibility of such an activity.**

**To promote forest management in the savanna region, USAID could continue to support the community forestry activities of the U.S. Peace Corps and the ADRA Collaborative Community Forestry Initiative. These activities are focused on generating income and providing economic alternatives to unsustainable practices.**

**d. Unsustainable Timber Production Due To a Poor Ecosystem Information Base**

Recent surveys suggest that no sustainable forest production systems are currently being practiced over large areas in West and Central Africa (African Development Bank, 1993). Furthermore, most anecdotal reports of sustainable timber management systems are not supported by credible evidence (World Resources Institute, 1993).

In order for timber production to be sustainable, key questions must be answered regarding the potential negative impacts of proposed land use activities. For example, more information is needed about species-specific natural regeneration requirements, the utilization of lesser known tree species, and the sustainable level of non-timber forest products by rural communities (Ntiama-Baidu, 1995; Forest Research Institute, 1995).

**USAID could support specific Forest Research Institute and NGO studies which answer key management questions regarding tropical forest ecosystems and timber production. This information would then be incorporated into the development of models for the sustainable extraction of timber.**

**C. Sustainability of Biodiversity Management**

**1. Bio-Physical and Socio-Economic Trends**

Biodiversity can be defined as the variety of living organisms which exist on earth. Biodiversity can be further divided into three categories: genetic diversity, individual species, and ecosystem diversity.

While biodiversity resources are important to preserve, they are also an important to rural populations as a source of income, nutrition, building materials, medicine, and other products. In addition, biodiversity resources can contribute to regional and national income through tourism and associated small enterprise development.

Ghana's protected areas are managed by the Department of Game and Wildlife under the Ministry of Lands and Forests. Currently there are four categories of protected areas: national parks, strict nature reserves, wildlife sanctuaries, and game production reserves. Management plans have been created for eight of the protected areas.

In the savanna zone, 7.8 percent of the land is managed under protected reserves. There are three national parks, two game production reserves, and one strict nature reserve. However, only one percent of the forest zone is included within the protected area system. There are two national parks, two wildlife sanctuaries, and three game production reserves.

Ghana's tropical forests maintain much of Ghana's nationally important biodiversity. The southern forest zone covers 34 percent of the country (82,000 square kilometers). Over 2,100 plant species and 818 woody tree species have been identified in the forest zone.

Important wetland habitat for migratory birds exists along Ghana's coast. For example, there are five coastal RAMSAR Convention sites: Muni-Pomadze, Densu Delta, Sakumo, Songor, and Keta (Ntiamao-Baidu, 1995). In addition to being important for habitat for terrestrial wildlife, the mangrove coastal forests are also important breeding grounds for commercial saltwater species.

The total number of wildlife species in Ghana is not known, as detailed studies have not been conducted in all of the country's ecological zones. However, a number of species have been identified by the International Union For The Conservation of Nature for conservation concern. These include: the African elephant (*Loxodonta africana*), chimpanzee (*Pan troglodytes*), and the white-breasted Guineafowl (*Agelastes meleagrides*).

In addition to protected areas managed by the Department of Game and Wildlife, Ghana also has forest reserves which are managed by the Forestry Department. These are managed as both timber production forests and protected forests. Forest reserve management plans are primarily concerned with timber production although the Forestry Department has expressed an interest in integrating conservation issues (Falconer, 1995). Equally important, the Forestry Department is conducting a program to encourage the management of those biologically important resources which are being managed by rural communities outside of government reserves (Falconer, 1995).

Given the importance of Ghana's forest resources, it is important that biodiversity resources be managed both within Department of Game and Wildlife protected areas as well as in the Forestry Department's forest reserves.

## **2. Government and Donor Activities**

- Conservation International and USAID/Ghana Kakum National Park in Cape

Coast project. Conservation International is conducting conservation education and tourism management in the Kakum National Park. The project is part of a larger USAID-supported central region project which is addressing park management and the restoration of historic coastal forts.

- **Global Environmental Facility Ghana Coastal Wetlands Management Project.** This project seeks to maintain the ecological integrity of selected wetlands while also enhancing the benefits derived from those areas by local communities. The project is presently demarcating wetland area boundaries, improving infrastructure, and conducting conservation education activities (Ghana Wildlife Society, 1995).
- **Ghana Association for the Conservation of Nature (GACON).** The people of Ghana have traditionally managed "sacred grove" forests in association with their religious beliefs. GACON is working with rural communities in association with three sacred grove forests in the Ashanti Region: Jackie, Atasomanso, and Kagyasi. GACON is presently demarcating grove boundaries, clearing fire breaks around groves, creating community management committees, and providing communities with tangible benefits associated with the groves (e.g., woodlot production).

According to the Director of the Department of Game and Wildlife, preliminary discussions have been held regarding the need for coordination between the Forestry Department and the Department of Game and Wildlife for the management of protected areas and forest reserves. (These discussions were conducted with the Forestry Commission.) A joint policy statement was prepared in 1994 which recognized the common mission of both departments (Flack, 1994).

### **3. Constraints and Opportunities**

The lack of coordination between government institutions has reduced the effectiveness of Ghana's resource managers. For example, the Forestry Department and the Department of Game and Wildlife have established separate systems for the management of timber and wildlife resources. These two departments have historically not collaborated or coordinated in managing their respective resources (Flack, 1994).

Ghana's Environmental Protection Agency has expressed an interest in inter-ministerial coordination as part of its mission to manage the environment sustainably (Acquah, 1995). This is important, as a coordinated, inter-sectoral approach is clearly needed (World Bank, 1993). For example, agriculture, forestry, and biodiversity resources are integrally linked and should be managed as an integrated system (USAID, 1991).

It is vital for the two departments managing Ghana's government-managed reserves to develop cooperative relationships. While the forest reserves are managed primarily for timber, they contain biologically important resources (Forestry Department, 1995; World Bank, 1987). In addition, the Department of Game and Wildlife's wildlife reserves are affected by local communities' utilization of wood resources.

USAID and the GOG have a unique opportunity to indulge their current interest in developing inter-sectoral approaches to rural development and natural resources management. For example, USAID could identify lessons learned from other USAID Missions in Africa regarding inter-sectoral approaches to the management of protected areas. This information could be used to support a serious dialogue between the Ghana Ministry of Lands and Forests and the Ghana Environmental Protection Agency. Some case study examples might include: (a) USAID/Madagascar support for the institutional strengthening of the National Forestry Department (Debt For Nature Project); and (b) the USAID/Kenya Conservation of Biologically Diverse Resource Areas project.

USAID could also support an international organization or NGO with organizational development expertise in helping the two departments work together effectively. This international organization could also assist the government to establish an overall collaborative approach to land use management at the regional, local, and site-specific levels. Community participation would be part of the process of resolving issues.

Another constraint associated with biodiversity is the absence of a programmatic model for integrating conservation and development. Such a model would demonstrate and measure the potential linkage between rural community development activities and the conservation of protected areas.

For this reason, USAID/Ghana should insist that future NGO protected area activities be linked to basic USAID re-engineering principles, i.e., answering key management questions, measuring impacts, and maintaining implementation flexibility. It should require NGOs to develop management plans which address the needs of local communities and devise monitoring systems which test the linkages between community development activities and biological changes within the protected area.

A more intensive effort is needed to provide communities living adjacent to Ghana's protected areas with viable alternatives to unsustainable forest management practices. The Department of Game and Wildlife is presently experimenting with community development activities in association with the management of protected areas.

Given the importance of bush meat to local communities, the Kakum National Park staff are said to have introduced a grass cutter rodent breeding program to the rural communities. This program is based on information obtained from a bush meat entrepreneur in Accra (Hutchinson,

1995). The Department of Game and Wildlife has also given the rural communities living near the Bia National Park permission to enter the forest to collect edible snails (Department of Wildlife, 1995).

However, further development of pilot projects for the commercial farming of bush meat animals is clearly needed. Such programs need to be undertaken in cooperation with rural communities and government land managers. **USAID/Ghana could assist the Department of Game and Wildlife in identifying lessons learned from bush meat breeding programs in other sub-Saharan Africa countries.**

Policy reform is also needed regarding the management of tourism revenue obtained at the Kakum National Park. It is our understanding that the revenues generated from tourism at this park are not necessarily used to cover the recurring costs of maintaining the park (Hutchinson, 1995). Instead, the revenue is forwarded directly to the National Treasury which is under no obligation to use the revenue to maintain the Kakum National Park or other protected area. By way of contrast, fifty percent of all foreign exchange currency obtained from tourism in Tanzania's national parks are retained and used by the National Parks Department to cover the costs of park operations. Nor has the Kakum National Park developed a revenue-sharing program with adjacent rural communities. Economic benefits for the local rural communities are presently limited to employment associated with park management and tourism.

**USAID/Ghana should conduct discussions with the Department of Game and Wildlife and the Ministry of Lands and Forests regarding the issue of tourism revenue. It could also contact USAID/Kenya to obtain lessons learned regarding the Kenya Wildlife Service's tourism revenue-sharing program.**

### **III. Modern Economic Sectors, Aquatic and Coastal Resources, Urban Sanitation, and Water Supplies**

#### **A. Sustainability of Commercial Agriculture, Fisheries, Mining, and Industrial Management**

##### **1. Biophysical and Socio-economic Trends**

Commercial agriculture is on the increase in Ghana. This increase, however, comes primarily from changes in the practices on current agricultural lands, not their expansion. These practices are generating increased off-site impacts including loss of vegetation, soil degradation and loss, reduced habitat quality, and water quality degradation. Economic programs such as ERP and SAP only increase the emphasis on export crops, and in doing so, the demand for energy and nutrient subsidies. Secondary impacts, such as density of roads and human

populations also have significant biophysical impacts, e.g., increasing forest harvest, agricultural intensity on marginal land, and pressure on aquatic and forest ecosystems. The Upper Densu watershed is a case in point: it has been substantially deforested and converted to commercial agriculture, most conspicuously, pineapple production. There have been increases in population density, in road networks, and in both nutrient and sediment loads in the Densu River.

Fisheries are a significant industry in Ghana. Fish constitute more than 60 percent of the animal protein in Ghana; the fishery sector accounts for 5 percent of Ghana's agricultural GDP and employs 10 percent of the total population. Although more than 75 percent of fish production is consumed locally, fishery products still represent the country's most important non-traditional agricultural export (NTAE). Approximately 85 percent of the output is marine with almost all of the rest coming from Volta Lake where there is a commercial fishing fleet of more than 15,000 canoes. In spite of its importance, fisheries management practices are not currently sustainable: catches per unit effort are declining, managers have inadequate technical knowledge about monitoring trends and the variables driving those trends, and the agencies themselves have failed to develop and implement effective management regulations.

Aquaculture is practiced at a low level of intensity in more than half the Districts in Ghana. Currently there are approximately 1,000 fish culturists raising about 400 tons per year. Although it is not a significant source of fish protein at present, aquaculture has significant potential. Freshwater aquaculture research and experimentation have been conducted in several areas in Ghana (e.g., Volta Lake and the vicinity of Weija Dam) and prawn culture has been attempted in coastal rivers. In addition, there are ongoing research efforts through the University of Ghana at Legon and through the Institute of Aquatic Biology to increase the amount of fish protein availability. When properly managed, aquaculture provides a very valuable protein supplement to rural communities. But it may have adverse downstream water quality impacts.

Off-site impacts from mining are among the environmental issues most frequently raised by the Ghanaians themselves. This is not surprising: mining attracts a great deal of attention as the mining industry is a significant and rapidly growing contributor to the national economy and mining activities are highly visible. There are three major types of mining activity in Ghana: large-scale commercial activities, small-scale legal activities, and small-scale illegal activities (i.e., *galamsey*). The significance of the environmental repercussions varies among the three. Large-scale, commercial mines primarily use either open cast or underground techniques to extract gold and diamonds. In this process, large quantities of soil and parent material are removed and processed. Thousands of hectares of landscape are often disturbed. The environmental impacts from this type of mining includes deforestation, loss of habitat, soil degradation, and soil erosion. Environmental inadequacies in the mining sector include water supply, sanitation, waste disposal and indoor air pollution. Impacts also include cyanide and arsenic that may leave the site in the air or water, large-scale solid waste (e.g., mine spoils), land subsidence and dust, noise, vibration and siliceous air pollution and acid and arsenic emitted into the air. Water pollution is cited as the most troublesome impact of mining activities (NEAP, 1991), but data about such impacts are rarely reported. In fact, Ayensu (1994) reports that, in

spite of the fact that arsenic in air pollution has a severe impact on local vegetation, "...no comprehensive study has been undertaken on the uptake of arsenic by the local [human] population".

From what we were able to determine, most large-scale mines in Ghana appear to be reasonably well-managed and have comparatively limited direct, off-site biophysical impacts. There are reports of air pollution, water pollution, malaria and respiratory diseases near the mines, as well as acidification and arsenic impacts near the processing facilities. Like any large-scale business, the mines have significant positive and negative effects on local communities. For example, although mining activities improve roads and employ many people, they also increase the harvest of forest resources, hunting and fishing pressure, and demands for waste disposal and potable water. The associated demand for housing usually has negative environmental consequences as well.

Many large-scale gold mines use cyanide in both the mining and recovery processes. Cyanide is a highly toxic compound that clearly represents a danger to humans or other animals. However, cyanide decomposes relatively quickly in the environment, so its potential impacts tend to be limited in space and time. There are reports that some of the larger mines use mercury when processing ore. Apparently, most of that mercury is captured and recycled, but the use of any quantity of mercury represents a significant risk to humans and ecosystems far beyond the immediate vicinity of the mine.

Although small-scale legal mines are much more numerous than the large-scale ones, they disturb much smaller amounts of land. Most small-scale legal miners dig less than three meters down into the substrate. Off-site impacts from small-scale diamond miners are principally in the form of erosion and landscape degradation. Small-scale gold miners often use mercury to extract gold from the ore. The mercury-gold amalgam is heated to vaporize the mercury, leaving a gold residue. The resulting escape of mercury constitutes the single most significant issue facing the Ghanaian mining industry today, one that appears to be under-addressed in national-level concerns about health and environmental protection. Mercury has reportedly been found in a variety of commercially important Ghanaian coastal fishes. But as mercury is more easily transported by air than water, there are probably atmospheric releases occurring that have yet to be reported.

The third type of mining is small-scale and illegal and commonly known as *galamsey*. In this practice, ore is typically extracted from stream beds by excavating small holes (e.g., two meters on a side and two meters deep). As the miners are unable to legally purchase mercury, they rely upon hydraulic processing to collect particulate gold. The primary impacts of this activity include open holes left after excavation, erosion, and stream channel alteration. Although *galamsey* receives a great deal of attention in discussions of mining impacts, the miners themselves are substantially constrained by their lack of legal access to supplies and equipment. Though their impact in certain districts might be significant, overall they do not constitute a major threat to Ghana's environmental quality.

Ghana is also undergoing industrialization, the attendant environmental impacts of which are not being managed effectively. Ghanaian industry operates in a regulatory climate of confusion. There are no clear, consistent, or effective laws and policies that mandate environmental responsibilities. As a result, some industries operate responsibly and have relatively low environmental impacts while others have significant environmental impacts but are neither monitored nor effectively managed by regulatory authorities. Effluents from industries are routinely discharged into surface waters with little or no treatment. The principal industries of concern include food processing, brewing, textiles, mining, chemicals, plastics, and rubber. Fruit, vegetable, and vegetable oil refineries discharge more than 80 percent of the total volume and more than 90 percent of the organic load of all industries in the Accra-Tema area. In contrast, metal and wood processing industries are responsible for nearly all the metallic and toxic effluent load. There are minimal requirements for treatment or disposal of any air or water pollutants. Further, GOG personnel have limited resources or experience in monitoring and enforcing existing air and water quality laws.

The significance of industrial air pollution impacts is unclear. The Accra-Tema metropolitan area is heavily industrialized but the factories are neither closely regulated nor monitored by the regulatory authorities. Despite this, a recent study showed that industrial contributions to air quality problems in the Accra-Tema region were relatively small. For example, industrial sources contributed from 1-12 percent of the annual loads of particulates, sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), hydrocarbons, and CO. Power plants contributed 70 percent of the SO<sub>2</sub> load and more than 50 percent of the NO<sub>x</sub> loading (Biney, 1994).

Smaller scale sources (e.g., wood combustion and household energy consumption) are major sources of air quality problems. Benneh et al. (1993) conclude that cooking fuels are the most significant source of household pollution in Accra. Wood combustion contributed more than 70% of the annual load of particulates, hydrocarbons, and carbon monoxide and nearly 40% of the annual NO<sub>x</sub> loading (Biney, 1994). Nearly all families in Accra are subjected to those fumes. In fact, the residential air quality standard of 150 ug/m<sup>3</sup> respirable non-toxic dust is being "grossly exceeded in most households in the metropolis" (Biney, 1994). In other regions of the country, limited industrial sources will further increase the proportion of particulates attributed to household energy consumption, but apparently decreasing the total human health risk.

Emissions from automobiles seem to be a prevalent and rapidly increasing source of urban air pollution. Ghanaian transportation networks are inefficient and automobile exhaust systems are neither monitored nor regulated. Surprisingly however, Biney (1994) found that motor vehicles produced less than 10% of the annual loading of particulates, hydrocarbons, and NO<sub>x</sub>, and about 20% of the SO<sub>2</sub> and CO loadings. The largest vehicular contributor to air quality problems by far turned out to be jet airplane traffic from the Accra's international airport. Biney's findings suggest that further analyses of total air quality loads in the Accra-Tema Area and strategies for their management are appropriate.

## **2. Government and Donor Activities**

Agricultural development in Ghana is well supported by the donor community. The World Bank's **Ghana Environmental Resources Management Project (GERMP)** provides technical and financial support to several aspects of the sector. The Land and Water subset of that Project will assemble local teams of experts that will develop natural resource management interventions. Although the Bank is also sponsoring related agricultural projects (e.g., Small-Scale Irrigation, Agricultural Diversification, Agricultural Marketing and Processing), it is not clear that those projects have environmental components. The FAO is conducting Integrated Pest Management training which should reduce pesticide usage. They are also conducting research and trials, with EC support in hand and ADB support requested, for biocontrol of pests. Meanwhile, the UNDP has provided resources to rehabilitate the Tono-Vea Irrigation Project (Botchie, 1993).

USAID support includes the Trade and Investment Program (TIP) which has a significant environmental component in the Environmental Monitoring, Evaluation and Mitigation Plan or EMEMP (Gaudet, 1992; Anon., 1992b). The TIP is a USD \$80 million program targeted on non-traditional agricultural exports (NTAEs) from a wide variety of products and industries based in the agricultural and natural resources sector. EMEMP is designed to ensure that any negative environmental impacts associated with the TIP are understood and either avoided or mitigated to the greatest degree practical. Implementation of the project is intended to ensure the sustainability of the NTAE sub-sector (Hecht, 1994). Environmental issues to be monitored in Ghana in association with the EMEMP include activities related to the salt mining industry, the shrimp and prawn industry, the forestry and furniture industries, and pineapple farming (Samba, 1994; 1995).

The fisheries sub-sector is managed by the Department of Fisheries of the Ministry of Food and Agriculture. The Department has promulgated rules for harvest that are intended to result in sustainable fishery production. However, offshore fishers who can no longer fish in waters of adjacent countries (i.e., due to the imposition of EEZs) are being forced to return to Ghanaian waters where they are intruding upon the fish formerly available to near-shore fishers. The latter, in turn are resorting to larger nets with smaller mesh sizes, thus threatening the survival of many fish populations. The Department does not have the staff or resources to monitor or enforce its regulations, nor to build adequate models of the effectiveness of those regulations in maintaining sustainable populations. As such, sustainability of the marine fishery is clearly threatened. The World Bank has recently (March 1995) prepared a Staff Appraisal Report proposing a \$10.5 million effort to address this problem.

Mining and industry are principally supported through the private sector. For example, each of the large-scale commercial mines generates large volumes of cash flow for payroll and direct purchases. Funds from those activities are cycled to GOG/Accra and then back to the regions and districts. In rare cases, specific industries or mines take direct supportive action in the form of assistance (e.g., drilling a well for a community). A water resources assessment conducted by the Ashanti Gold Fields Corporation has been cited as a prime example of industrial support for environmental data collection. The industry supported a water resources

assessment whose data were used by GOG agencies and are now available for use in other environmental management efforts. Assuming that taxes and royalties from mining continue to flow to the GOG, a portion of those revenues could reasonably be used to support ongoing data collection and monitoring efforts. This model of industrial support, paired with the flow of resources back to the implementing agencies should be further developed by other elements of the Ghanaian industrial community.

There is some donor support of the mining and industrial sector. Both the World Bank and GTZ apparently have efforts underway to assist in the development and management of small-scale mining. The World Bank apparently agreed in 1991 to support development of a monitoring laboratory in the Takoradi Office of the Department of Mines. Reportedly, that effort is not making much progress. The Montreal Facility (with funds from UNEP, UNDP, UNIDO, and the World Bank) provides resources to Ghanaian industry for the phasing out of industrial chemicals that threaten the ozone layer (Botchie, 1993).

### 3. Constraints and Opportunities

The main constraint facing Ghanaian environmental managers is a lack of effective management (e.g., little or no implementation of existing laws and policies, minimal communication and coordination among peer institutions, and limited use of existing data and technical information) (NEAP, 1991; Botchie, 1993). Existing laws and enforcement agencies have not had the political backing required for effective implementation (IIED, 1992). The new EPA (an Agency created only six months ago from the Environmental Protection Council) does have regulatory authority and responsibility. The Agency is formulating an Environmental Protection Act which will specify emission limits as well as other aspects of industrial practice. A new mining law is also being drafted, apparently by the Mining Commission, that will regulate the environmental impacts of mining. It is unclear how a mining law implemented by one agency will be coordinated with the environmental laws implemented by a sister agency. Coordination and integration of the regulatory climate represents a major constraint. In a reference specific to water quality, the Ghanaian National Environmental Action Plan suggests "[t]here can therefore be no justification for the present diffusion of authority and the implied acceptance of a multiplicity of standards within the country" (NEAP, 1991)

**The most significant opportunity for USAID in this sector is a focus on the effective implementation of the EMEMP aspects of the Trade and Investment Program. This should receive high priority in the Mission's 1997-2001 Strategic Plan.** EMEMP is designed to guide and evaluate a major agricultural program (i.e., TIP). As such, it has a direct relationship to the constraints and opportunities discussed above and to those areas in which USAID has a comparative advantage. The Second Evaluation of EMEMP (Samba, 1995) and the recent review of EMEMPs in four other African countries (Hecht, 1994) suggest clear steps that can be taken in implementing the Ghanaian EMEMP.

A significant focus of the recommendations in all three EMEMP evaluations (Hecht,

1994; Samba, 1994; 1995) has been to refine and implement data collection efforts. However, **data** are simply the results of a series of measurements (e.g., variables describing water or air or soil). **Information** is the result of an interpretation of those data in the context of a particular goal. We are not convinced that data collection per se is the most significant constraint facing the Ghanaian EMEMP. It is clear that data to quantitatively assess and evaluate environmental risks in Ghana are rare: there are serious gaps in time series data in particular and all data collection tends to be ad hoc, sporadic, and poorly supported. However, recent documents discussing Ghanaian environmental management issues have focused on data collection rather than information and decision-making (e.g., NEAP, 1991; IIED, 1992; Botchie, 1993; Samba, 1995). Generally speaking, those reports have perceived the major constraint to be a lack of data rather than a lack of information.

In our view, the emphasis on collection and storage of **[data sets]** should now be replaced with a new emphasis on decision-making and the **[information]** needed for such decisions. Although data are indeed sporadic and limited, it is not clear that a concerted emphasis on data collection and storage at this time would result in significantly better (i.e., more defensible and well-founded) decisions. Our only EMEMP recommendation beyond those of Hecht (1994) and Samba (1995) is that the EMEMP participants clearly identify and become committed to the decisions that are to be made on the basis of the data collected in the EMEMP.

**We suggest that the focus of USAID's EMEMP implementation be on informed decision-making rather than on strict data collection or enforcement of conditions. During the next six months, for example, the program might logically include collection of those relatively few data elements which are well understood and relate to TIP decision-making. That would require a relatively small portion of the energy and resources available in the EMEMP program. The remainder of those resources should be devoted to an explicit strategic planning effort designed to get GOG agencies to programmatically "buy into" the decisions to be made and the indicators to be measured for those decisions. That is, USAID and the GOG agencies, led by the EPA should collectively agree upon reasons why data are being collected, the decisions to be based on those data, and the information required to support those decisions. Such a consensus should readily lead to specific data collection and analysis efforts being undertaken by well qualified Ghanaian personnel. Any tranche conditionality would then follow that data collection and be well supported by the implementing agencies.**

An additional, lower cost and lower priority opportunity is represented by the gold mining industry. Mercury lost to the environment (i.e., to air, soil or water) represents a significant and long-term hazard. USAID could make a significant impact in Ghana and a measurable impact in West Africa by bringing in a knowledgeable consultant who would assess the quantity of mercury used, evaluate the practices in which it is being used, and present viable alternatives. This should be done in collaboration with the small-scale mining efforts currently being assisted by the World Bank. This opportunity could be realized for approximately \$USD 125,000, and would require approximately three months.

## **B. Sustainability of Aquatic and Coastal Resources Management**

### **1. Biophysical and Socio-economic Trends**

Population growth and economic forces in Ghana are causing people to engage in unsustainable land use practices which are degrading the quality of both freshwater and coastal resources. Degraded water quality in turn threatens the health and welfare of human communities. The population of Ghana is growing rapidly; that population may exceed 19 million by 2000 and 27 million by 2010 (based on a 1991 population of 14 million and an annual growth rate of 3.5 percent (IIED, 1992)). Current trends in land use management are toward more intensive cropping practices that require more resource and energy inputs. Water quality in streams and rivers below these agricultural areas is being degraded by sedimentation, excessive nutrient loading, and invasive exotic species.

Ghana's current industrialization also results in adverse water quality impacts. These impacts are generally unregulated and poorly understood. For example, there are no overall procedures regulating extraction from Ghanaian waters. Coastal and lowland wetland ecosystems are increasingly impacted by urbanization and other land use changes. Solid wastes in urban areas are either not collected or are deposited in landfills near bodies of water. A result of all these factors (i.e., population growth, industrialization, an ineffective legislative and policy environment), is that human communities are experiencing increased incidence of water-borne diseases (e.g., Bilharzia, malaria, and Giardia), reduced fishing efficiency (i.e., lower catch per unit effort), impaired transportation, reduced biodiversity of aquatic ecosystems, increased deforestation of mangrove areas, and reduced availability of fish and shellfish habitat.

These water quality impacts are directly attributable to increased population density and associated increases in total and per capita resource and energy consumption. For example, in the Volta Lake area, trends indicate the reduced availability of both fuelwood and fish protein, reduced slope stability along the lake shore, and increased incidence of disease in lakeshore residents. In addition, the ecosystem below the Volta dams has been altered greatly. Before the dams were constructed, the Volta estuary was a productive oyster fishery. Today, saline waters have been blocked by a large sediment bar and the estuary is entirely freshwater. Invasion by aquatic weeds has caused major changes in the riverine system, including significantly increased incidence of Bilharzia, which require expensive remedial management (i.e., harvesting).

In the Western and Central Regions, mineral extraction is increasing: forest lands are being converted to traditional agriculture and now increasingly to commercial agriculture. Off-site impacts include increased erosion, elevated heavy metal content in downstream plant and animal communities, and threats to public health from toxic substances such as mercury and loss of biodiversity. In the Northern and Upper Regions of the country, inefficient land use practices are causing erosion and loss of soil productivity. Many water bodies are laden with sediments,

unsafe for human consumption, and have reduced hydrologic capacity (increasing the risk of wet season flooding and decreasing the availability of dry season storage). Groundwater being tapped for potable use is generally of high quality, but there are isolated locations where high concentrations of fluoride, iron, and manganese threaten the health of those relying on these resources. Management agencies do not have an ongoing data collection program to assess the quantity or quality of groundwaters.

The coastal zone is increasingly being degraded. Although fishing is a very important economic activity, it is not being managed on a sustainable basis. The construction of dams on the Volta River has reduced sediment delivery. As a result, coastal currents east of the mouth of the Volta are sediment starved, resulting in erosion of coastal areas. Stability of many beaches has been reduced by sand harvest (i.e., sand winning for building construction) and a variety of other influences. Industrial and municipal effluents are polluting near-shore and lagoon areas and adversely affecting fisheries. Mangrove ecosystems are threatened by the harvesting of trees for poles and by water quality degradation. The physical stability of coastal dunes and the economic viability of coastal communities are threatened by the loss of coconut trees, apparently from a pathogen. It is possible that other stresses (e.g., poor water quality) are increasing susceptibility to that pathogen.

## 2. Government and Donor Activities

Coastal zone issues are being aggressively addressed by the donor community. The World Bank has a large **Coastal Zone Management Project** in place that includes research as well as action to improve management of five RAMSAR coastal wetlands. A second project, currently being designed, will focus on the coastal zone. The British ODA is conducting a comparatively small effort in mangrove management and a large (UK 15 million pounds) **Southeast Water Supplies Project**. The Danish agency, DANIDA, has provided assistance to the Volta River Authority (VRA) for dredging the mouth of the river and reportedly has expressed an interest in rehabilitating the fishing harbor at Elmina. Apparently, JICA and/or a consortium of private Japanese firms has expressed an interest in assisting with a wastewater treatment facility at Cape Coast. We were told that either the Kuwaiti Fund or OPEC has expressed an interest in restoring the Cape Coast lagoon. The Government of Ghana has active involvement in each of those projects through the Water Resources Research Institute, the Institute of Aquatic Biology, and the Forestry and Fisheries Departments.

Significantly less assistance is being provided for the management of freshwater resources. The VRA (a Ghanaian organization) has just completed a \$USD 2 million RFA for mapping and land use assessment of Volta Lake. A contractor has been selected and work is expected to start by the end of 1995. FAO, with support from the EC, is developing a biocontrol program for aquatic weeds. There are also isolated cases of direct support for specific facilities. For example, the French Development Authority has provided assistance for a wastewater treatment facility for a rubber plant in the Western Region.

### 3. Constraints and Opportunities

Freshwater and marine resources are not being managed effectively. According to the authors of Ghana's NEAP, "[t]he question at issue is one of administrative and legal failure to demarcate clearly the responsibilities of the various bodies concerned with the environment and ensure that these responsibilities are carried out" (NEAP, 1991). Coastal resources are principally the purview of regional authorities; most effective management decisions are taken at the local level through laws and taboos applicable to specific lagoons or water bodies. There is no effective monitoring or control of management practices which might negatively impact coastal resources. In the same way, inland land use decisions are made in the absence of information about, or consideration of, impacts on adjacent bodies of water. Besides being limited in nature and applied at various administrative levels, existing water quality laws and regulations are often overlapping, uncoordinated, and unimplemented. Abstractions in the Volta Basin hypothetically are regulated by the VRA, but the agency does not routinely exercise its regulatory power.

In spite of the significance of the coastal zone to the national economy, the Ghanaian way of life, and the donor community, the management of coastal resources remains sectoral, fragmented, and ineffective (IIED, 1992). Several agencies are responsible for various aspects of coastal zone management and have enacted regulations and procedures for such management. However, those regulations are rarely monitored or enforced by the responsible agency.

**Extensive and ongoing work in the coastal zone is being funded by many donors. Although there are opportunities for additional efforts, our assessment is that Ghana has already reached its institutional absorptive capacity for coastal zone assistance. As a result, USAID should take no action in coastal zone management.**

**The highest priority for donor assistance efforts in this sector should be a focus on assistance in developing and implementing integrated water quality legislation. Although many Ghanaian institutions have the apparent responsibility for oversight and management of water quality, there is significant overlap and confusion and minimal implementation. As one recent study (Gibson et al., 1994) concluded that Ghana has no water quality laws or standards. USAID assistance in strengthening development and implementation of water quality laws and policies could draw upon well-established US institutions (e.g., the US EPA and other public and private sector organizations) and make a significant difference in water quality management practices. This work could complement ODA's training assistance to Ghana's EPA. We suggest that the Mission contract with an organization experienced in legal issues and institutional strengthening (e.g., Environmental Law Institute, US EPA, and Center for International Environmental Law) to work with Ghana's EPA in designing a Water Quality Legislation Project. In such a project, which would be based on the results of the recent UNEP/GOG environmental law overview, Ghana's EPA would receive assistance and support in developing practical water quality laws and policies that integrate interagency concerns. The project would also assist the EPA in developing a procedure for implementing those**

laws. Such an effort could be accomplished for about \$USD 1 million over a five-year period.

Although of much lower priority, an analysis of specific issues would advance management of the Ghanaian environment and USAID Ghana would have a comparative advantage in providing these analyses. For example, the Cape St. Paul coconut blight is having a dramatic impact. If it continues, the welfare of coastal communities will be threatened and shoreline erosion will accelerate. In a recent survey, 86 percent of Western Region farmers identified coconut as the most important crop and 50 percent rated Cape St. Paul Wilt as a significant pest. Although it is possible that ongoing research in Ghana or in other countries is making progress toward resolving this issue, Agyepong et al. (1994) were unaware of any research on the disease. Groups such as the semi-tropical universities of the U.S. (e.g., University of Florida, University of Puerto Rico) and/or the USDA are well positioned to advise on the current state of knowledge about this blight. Apparently there is also forest pathology capability at the University of Science and Technology at Kumasi. **We suggest a consultant be retained to identify future constraints and opportunities to stopping the spread of the disease or to mitigating its impacts (e.g., by planting resistant strains if that is the only viable alternative).** An investment of \$USD 25,000 over six months would allow for an assessment of the issue and an identification of alternatives.

## **C. Sustainability of Urban Sanitation and Water Supplies**

### **1. Biophysical and Socio-Economic Trends**

Ghana is undergoing rapid urbanization as people move from rural areas to cities and from neighboring countries to Ghana in search of jobs in industry, mining, and the service sector. The Accra-Tema metropolitan area had an estimated population of 1.7 million in 1990. That number is expected to rise to four million people by 2010, 2.2 million of which will be in the city of Accra. Increasing urban populations tax infrastructural capacities and result in overburdened transportation, water supply, sanitation, health, and general welfare systems. As a result, Accra has escalating air, noise, and water pollution, poor sanitation, and increased incidence of disease. The annual costs to the Ghanaian economy from such impacts may be as high as 5.5 billion Cedis (\$USD 4.7 million) in 1995 (projected from data in NEAP, 1991).

The growth of the total population, the concentration of the population in relatively small areas, limited municipal waste treatment facilities, and the geographic concentration of industry all have led to highly significant localized impacts on coastal water bodies. The Korle Lagoon is a good example of the effects of urbanization. Located near Accra, the lagoon receives numerous untreated industrial effluents, drainage from a large landfill, and untreated human waste. The lagoon is now a health hazard and is virtually dead from an ecological perspective. Other freshwater and coastal resources in urban areas are similarly threatened. Poor drainage and increasing human populations also lead to increased breeding sites for disease vectors; malaria is

a major health hazard in Accra and ". . . remains by far the most frequently reported health problem at out-patient facilities in Ghana" (Benneh et al., 1993). Another impact of large concentrations of people in small areas is a significant decrease in air quality, with attendant impacts on human health in the Accra-Tema metropolitan area (and presumably in other urban areas as well).

Urbanization in Ghana occurs more or less at random and in response to a wide variety of influences. The GOG does not have any effective urban planning strategies; there is minimal coordination among implementing agencies and little -- if any --planned development of communities. Most services (e.g., water, sewer, energy, and transportation) are provided after the fact in response to demands from residents already in place. There are routine conflicts among agencies responsible for providing those services (e.g., sewer pipes destroyed by power installation and water lines conflicting with transportation services).

Sanitation is one of the most significant environmental issues facing most Ghanaians. Central sewer collection and disposal systems exist only in Tema, Akosombo, and parts of Accra; more than 85 percent of the Ghanaian population does not have access to municipal sanitary facilities. In Accra, only 36 percent of the residents have access to flush toilets. Although there is an ongoing effort to provide facilities such as KIVPL's (improved pit latrines), today as many as 10-15 percent of the population has no access to sanitary facilities. As one study reported "[t]his situation is illustrated vividly in a suburb of Sekondi-Takoradi where 3,250 people occupied 190 houses and shared 16 public toilets" (IIED, 1992).

Any effort to improve the management of Ghana's environment must take an integrated approach. Improving sanitation should be a top priority. As a result of poor sanitation, diseases spread rapidly from mishandled sanitary wastes, open defecation, and untreated municipal wastes. Solving the problem will not be easy. Feacham et al. (1983) examined the relationships between excreta disposal and human disease in Ghana and concluded that "conditions in central Kumasi may be so uniformly unhygienic, and faecal contamination of the environment so widespread that an individual family may receive no protection by virtue of a superior type of toilet or water supply."

Both water availability and water quality impact urban sustainability in Ghana. Barely 30 percent of the people have routine access to potable water; in many rural areas, that percentage is as low as 15 percent. In urban areas, potable water is more readily available, but only about 30 percent of Accra's residents have indoor plumbing while more than 25 percent purchase water from vendors. Metropolitan Accra's water supply comes from two sources: the Volta River at Kpong and the Densu River at Weija. Encroachment, deforestation, and increasingly intensive land use management in catchment areas is degrading the quality of municipal water supplies in several cities. Although urban water supplies are often effectively treated at the point of collection, leaky distribution lines and contaminated in-home storage facilities lead to contaminated water at the tap. One recent study found that 87 percent of the water in home storage facilities was contaminated with faecal coliform bacteria (Benneh et al., 1993).

**Availability** is the principal issue: reliable access to adequate quantities of potable water in Accra is a more significant environmental issue than is **potable water quality** in Accra or other urban areas.

As expressed in a 1994 proposal, improving solid waste management was cited as the GOG's top priority for UNDP funding (Ayensu, 1994). It was the second highest environmental priority in President Rawlings' Vision 2020. Poorly managed solid waste limits tourism potential and causes numerous off-site impacts such as disease, odors, water pollution, and aesthetic problems (e.g., the Korle Lagoon). As Ghana experiences increased urbanization, the pressure on solid waste management systems increases and the effectiveness of overall management decreases: "In 1981, the minimum distance to a collection point in Kumasi was 400 meters, whilst journeys of 1 km were not uncommon." (IIED, 1992). Solid waste management systems in the urban areas of Accra, Cape Coast, Kumasi, Sekondi-Takoradi, and Tamale are more severely stressed today than in 1981, making those journeys even more onerous. In 1981, the GOG -- with assistance from GTZ -- developed and began implementing a solid waste collection system for parts of Accra. However, solid waste management throughout the country has failed to keep pace with population growth. Currently Accra's Waste Management Department (far the most advanced of the country's solid waste disposal programs) is capable of handling only 60 percent of generated waste.

## **2. Government and Donor Activities**

The water supply and sanitation sub-sector have traditionally been heavily supported by the international donor community. CIDA, DANIDA, UNDP, and the World Bank have provided support for rural water supplies for many years. A new USD \$100 million effort was recently announced (June 1995) which will include those donors as well as the Caisse Française de Développement (CFD), which is supporting development of bore holes in the Central Region. The Kuwaiti Fund will support a \$USD 50 million project for Korle Lagoon in Accra, including municipal and industrial waste treatment as well as physical restoration of the lagoon. Numerous other water supply and sewer development efforts have also been conducted, but **they are not reviewed further here because our view is that USAID will not have a comparative advantage in this sub-sector in the immediate future.**

Solid waste management is a frequently cited concern within the Ghanaian population and among representatives of the donor community. However, it receives relatively little attention. GTZ provided assistance to the Accra City Council for a large, three-year (1990-1992) effort on solid waste collection. The World Bank apparently collaborated with the GOG in providing more than 90 percent of the costs for a 1992-1994 **Sanitation and Waste Management Project**, but the degree to which that effort actually involved solid waste management is unclear. The large Kuwaiti Fund-financed Korle Lagoon effort will apparently include some attention to solid waste management. Surprisingly, although the government speaks of waste management as a top priority, we did not encounter any other donor assistance to this subsector.

### 3. Constraints and Opportunities

The most apparent constraint to the effective and sustainable management of the urban sector is the lack of integrated planning and coordinated environmental management. Numerous agencies have overlapping and conflicting responsibilities. A more effectively designed and implemented urban planning process would improve the provision of services and the flow of resources, people, and development. However, it does not appear that such an integrated process is likely in the foreseeable future.

Finances are a significant constraint in any urban development program. Provision of urban support infrastructure such as water, sewer, and solid waste is a very expensive proposition. As there appear to be several large-scale assistance efforts in this sector, it does not appear to us that there is a significant opportunity for further investment in large-scale water or sewer infrastructure at this time.

Solid waste management in Accra and many urban areas of Ghana is a gigantic problem, both technically speaking and from the perspective of socio-political, financial, and administrative constraints. Unfortunately, previous programs in this subsector have been managed as municipal services and thus competed with other priorities for general funds. In addition, they tended to focus mainly on logistical aspects of the problem rather than on financial, social, and political-administrative aspects. As a result, they generally succumbed to budgetary, equipment maintenance, and management problems after a few years. Although the GOG cited solid waste management as its top priority for UNDP funding (Ayensu, 1994), it only proposed undertaking a study of solid wastes volumes and the technologies needed for their disposal.

A new approach is needed, and it appears that the public is ready. Private citizens frequently cite solid waste as an issue of concern -- comments to that effect were made to this team. Benneh et al., (1993) found that, although urban residents put water and sewer services at the top of their priority lists for government action (more than 45 per cent felt that solid waste was a significant issue in their neighborhood), they consider the neighborhood as the appropriate venue for action on garbage and sanitation problems. They also expressed a willingness to pay for improved solid waste control.

Solid waste management is increasingly being approached as a problem that centers largely around community planning and management. An effective strategy for addressing solid waste issues should address multiple constraints (i.e., public perception, the need for cross-jurisdictional cooperation, regulatory reform, and economic and other obstacles impeding self-financing, as well as logistical and technological factors). Addressing those constraints would require action in several areas and on multiple levels (e.g., policy and legislative changes at the municipal, district, regional and/or central level; support for physical infrastructure development such as disposal facilities; support for private sector involvement in the collection and management of the waste stream; involvement with community or neighborhood action groups to increase awareness and public support). Integrated Waste Management (IWM) is one such an

approach which has been successfully implemented on a small to medium scale in the U.S. and Eastern Europe. **A useful way to address Ghana's large solid waste management need would be: (a) to carry out a preliminary assessment of the dimensions and nature of the solid waste management problem in one of Ghana's smaller urban areas, and (b) to launch a five-year, relatively small-scale pilot IWM project to be designed and implemented there. Such a project would cost about \$5 million over about five years.**

Besides local-level solid waste management projects, there are also opportunities for specific, lower priority activities which would provide worthwhile returns. For example, transportation management in urban areas is ineffective. As a result, there are problems with both noise and air pollution. One study has suggested that by far the greatest contributor to the problem is international aircraft. **We suggest that the Mission conduct a small research effort to: a) understand the magnitude of the transportation-air pollution relationship and its spatial and temporal dynamics, and b) to propose alternatives that could be considered by GOG and the donor community. Possible contractors could include University of Ghana scientists and/or US scientists knowledgeable in transportation management. This would require approximately \$USD 50,000 over 18 months.**

The Densu watershed is an important asset for Accra, producing valuable agricultural commodities and water. It is of special interest to USAID because the TIP is designed to increase the production of NTAEs, such as pineapples, which are grown in the Densu Basin. There are concerns that agricultural chemicals are entering the water and that the sedimentation from erosion-prone areas is impacting Weija Dam. As both of those concerns have great significance for the city of Accra, the most valuable approach to understanding and resolving environmental impacts in the Densu Basin would be integrated watershed management. **Because of its importance as a source of potable water and its relationship to non-traditional export promotion programs, the Densu should receive priority consideration for inclusion in any donor-supported watershed project.**

#### **IV. Crosscutting or Trans-sectoral Factors**

##### **A. Government**

##### **1. Overview**

##### **a. Policy and Legislative Frameworks**

Ghana's National Environmental Action Plan (NEAP), adopted in 1991, contains a broad statement of national environmental policy. Its objectives encompass maintenance of ecosystems and ecological processes essential to the functioning of the biosphere, sound management of natural resources, the preservation of biological diversity, the control and mitigation of pollution from development, the integration of environmental considerations into development planning, and the pursuit of environmental goals through international, African, and West African cooperation. The principles to be applied in pursuit of these objectives include: cost-effective pursuit of objectives, optimal sustainable yield in the use of resources and ecosystems, use of incentives in addition to regulatory measures, delegation of decision-making and action to the lowest appropriate level of government, "polluter pays"-type regulations, and public participation in decision-making.

Methodologically and operationally the plan calls for a "preventive approach" aimed at seeing that development proceeds on a sound basis through the promotion of public awareness, the development of procedures for land resource use, the instigation of environmental impact assessments (EIAs) and active measures to protect critical ecosystems, the development of needed staff structures and capacities, and the promotion of needed research.

As is typical throughout the developing world, the specific policy and legal frameworks for giving effect to the above are incomplete and problematic. Much of the considerable law concerning environmental quality and protection that has accrued in Ghana is embedded in ancillary legislation that deals mainly with exploitation and development of natural resources. Much of that is also outdated and incomplete. In addition, powers and responsibilities are often distributed among multiple agencies so that none is recognized as having primary or residual responsibility for the resource or area in question. As a result, much of the existing law has not been implemented. The major exception to this multiple-agency scenario is the Volta River Authority which still is unable to consistently apply its wide-ranging authority in managing the area around Volta Lake and downstream from the Akosombo Dam.

In 1974, the Environmental Protection Council was established by decree. It was to be responsible for coordinating the activities of all governmental bodies concerned with environmental matters. In actuality, however, it served primarily as a forum for those bodies that actually exercised power over aspects of the environment, and its role was essentially advisory.

In 1994, Act 490 created the Environmental Protection Agency (EPA). The agency is responsible for providing policy advice to the appropriate Minister (the Minister of Environment, Science and Technology). It also gives important powers and authorities to the Executive Director of the EPA. These include: issuance of environmental permits; pollution abatement notices; directives and procedures concerning environmental hazards; prescription of standards and guidelines relating to pollution; requiring EIAs; serving of "enforcement notices" to deal with environmental threats; ordering the application of force as necessary; and levying summary fines. The Executive Director has the authority to request information and "attendance" at a specific time and place of any person. Failure to comply is an offense and can result in a fine or imprisonment. With the advice of the Board, the Minister can establish codes and standards relating to the environment. The Act also provides for a National Environmental Fund which receives monies from grants, levies, and donations which may be used for environmental management purposes authorized by the EPA's governing board.

The EPA is now coordinating the formulation of new and streamlined legislation. Proposed new legislation on pesticides and EIAs, for example, are now with the Attorney General and work on an omnibus environmental protection law will soon begin. Though the need to review and update environmental law will continue for years, the law establishing the EPA provides the Agency with a solid mandate and the broad authority to protect and manage the environment for the time being.

#### **b. Institutional Framework**

For purposes of the present discussion, the institutional framework for environmental management consists of the apex agency responsible for cross-sectoral coordination of environmental management, the supervisory ministry responsible for environmental policy, and the various coordinating mechanisms by which environmental policy is developed and implemented across agency lines.

The EPA is a semi-autonomous corporate body governed by a Board. It is supervised by a Minister responsible for policy who may give instructions to its Executive Director and who exercises certain environmental authorities on the advice of the Board. Though the Ministry of Environment, Science and Technology has directorates for policy and research, it is clearly dependent in these areas on the advice and staff support of the EPA. The team detected no sign of the tension that sometimes marks relations between apex agencies and supervising ministries.

EPA is organized into five divisions, each headed by a deputy director and each comprising a number of departments headed by assistant directors. One division, Regional Programs, is the contact and control point for the EPA offices in each of Ghana's ten regions. Departments exist for Environmental Quality, Information Support Services, Environmental Law, Natural Resources, Environmental Education, Built Environment, Mining and Industry, Environmental Inspectorate, Environmental Assessment and Audit, Conventions and Project

Implementation, Finance, General Administration, and Human Resource Development.

The Information Support Services Department houses EPA's information management system and is the center of the Environmental Information System. The Environmental Quality Department will house a laboratory (currently under construction) and will analyze the samples resulting from testing conducted by various other departments and networks. The Natural Resources Department is responsible for analyzing natural resource management issues, while the Built Environment Department is responsible for environmental issues related to human settlements such as sanitation. The Mining and Industry Department is responsible for analysis and standards setting while the Environmental Inspectorate Department is responsible for on-site monitoring and enforcement. The Environmental Assessment and Audit Department is responsible for administration of the Environmental Impact Assessment requirements and the Conventions and Project Implementation Department is responsible for the analytical and programmatic follow-through related to international conventions. The Education Department is responsible for public awareness and relations with NGOs as well as formal and informal education.

Most of the departments are charged with coordinating and backstopping operational or non-operational inter-agency networks whose memberships generally include twenty bodies. The former, called Project Operations Committees, deal with Coastal Wetlands, Land Information (LIPOC), Land and Water Management, Environmental Quality and Studies and Investigations.

The EPA is fairly well staffed with 115 on-board direct hire staff, comprised of 40 program personnel and 75 support staff (including administrative and financial professionals). These people are supplemented by some 21 program and 22 administrative contract personnel. Of these, 20 program and 17 support staff have been assigned to the EPA's ten regional offices. Three deputy directors and four temporary assistant directors are currently at their desks.

Only 25 per cent of EPA's recurrent budget is available for non-salary requirements whereas the average for central government agencies is reported to be one-third of all recurrent expenses and 50 percent apart from debt service.

The EPA is well structured for its trans-sectoral coordination role as well as its direct operational responsibilities. Its leadership is dedicated to exercising a catalytic role through cross-sectoral coordination and to a partnership with other government agencies and the private sector, including NGOs. It is also resolved to use its enforcement powers when necessary. The EPA appears to be sound in its philosophical orientation. As far as outsiders can judge from limited contacts, the key managers are generally well qualified, energetic, and highly motivated. While gaps remain in the EPA's senior management structure, it seems likely that these will be suitably filled in due course. It is also worth noting that the EPA is purposefully moving into some new areas. In 1993 five EIAs were processed; in 1994 there were 48, and 75 have been processed so far in 1995. It is apparent that the Environmental Education Department is moving

forward systematically and vigorously to implement the education strategy that was developed with ODA assistance. This is also true of its work with the NGO community where a workshop was recently held. Work in other areas, however, such as land information and environmental quality, seems to be moving along slowly and with some difficulty.

### **c. Governance Considerations**

The resurgence of parliamentary government has made the process of governance more complicated. Nor does it always produce the outcomes that seem desirable from the standpoint of sound economic and environmental management. A recent move to raise timber royalties to bring them into better alignment with the value of timber resources was defeated because of industry lobbying efforts -- an activity which, conducted properly, is entirely legitimate. Concession allocation reforms will soon go to Parliament and there is some concern about the prospects of this measure. This development points to the need for greater public awareness of, and effective political support for, environmental protection and the sustainable management of natural resources.

There are areas where governmental agencies exercise control over private sector activities without sufficiently clear ground rules, transparency, and accountability to concerned private parties. One such area -- land and resource tenure -- is discussed below. Another need is addressed by the review and improvement of the existing environmental legal framework as described above (see section 1).

## **2. Donor Activity**

The \$USD 18.1 million World Bank Ghana Environmental Resource Management Project (GERMP) is funding institutional support to the EPA for the construction and equipping of its headquarters, the equipping of regional offices and library facilities, the development of a management system, and related other needs. An 984,000 pounds sterling ODA project is providing technical assistance and training for EPA staff in a variety of areas important to the environmental management functions of the EPA and collaborating institutions (e.g., in environmental economics to the University of Ghana). In the GERMP framework, the World Bank and DANIDA are financing the development of an environmental information network based on the collection of existing information and its subsequent processing into a GIS data bases and 1:250,000 scale maps containing information on environmental quality, topographic, present land use, land ownership, meteorological qualities, and land suitability. With modest AID assistance, the EPA is currently spearheading a pilot environmental quality monitoring effort known as the Environmental Monitoring, Evaluation and Mitigation Program (EMEMP). Its mission is to collect and analyze information on the environmental impacts of the USAID Trade and Investment Promotion program. The UNEP assisted the EPA in preparing an overview of environmental law.

### 3. Constraints and Opportunities

There is a broad consensus that land degradation resulting from inadequate land management is Ghana's most pervasive and fundamental environmental problem. The main cause of this degradation is Ghana's rapid rate of population growth and its attendant pressure on agricultural and pastoral lands and conversion of forests to agricultural uses. In such a situation of forced adaptation, the incentives to resource users assume a special importance, one that merits sustained policy attention.

The EPA is moving aggressively to address gaps and anomalies in the current legislative framework, especially those concerning the planning and regulation of resource use. To feed into this important work, the EPA should give special attention to the incentives for sustainable environmental management embodied in current and proposed legislation, policy, and operating procedures. This is needed to balance the influence of agencies and interests whose first priority is not necessarily long-term sustainability and environmental protection.

Ghana's confusing and incoherent mosaic of land and resource tenure regimes and the unpredictability and opaqueness of the interplay between them weakens resource users' incentives to manage natural resources for long-term sustainability. Those wanting more than traditional, usually undocumented, tenure under their traditional chief, can seldom get more than a 99-year lease. Obtaining a formal lease of any duration can consume a lot of time, involve difficult communications, and unanticipated and onerous expenses. Whenever the government takes land, compensation may not be based on market value.

The combined effect of the incoherence and unpredictability of existing systems of land allocation and transference interferes with the play of market forces and probably depreciates the land's value as a productive asset. With help from the World Bank and DANIDA, the Government has set in motion an effort to document and record land holding patterns throughout the country. This process appears to be moving too slowly, particularly in regards to traditional land tenure systems.

One reason may be the dominant role of the Lands Commission which is the pre-eminent stakeholder in the status quo and thus commands little confidence among traditional authorities and the rural population. There is a good chance that an appraisal of the current approach by a U.S. source of land tenure expertise (e.g., The University of Wisconsin's Land Tenure Center) and of systems analysis expertise (e.g., the Implementing Policy Change network) would lead to a more productive approach and a U.S. role in its implementation. **Promoting the involvement of qualified U.S. institutions and experts in documenting, rationalizing, and streamlining the administration of land and resource tenure. This could make an important difference in the rate of progress and the quality of outcome. A coherent, transparent, and predictable system of land tenure administration would strengthen the incentives for long-term investment in general and in natural resources management in particular, thus**

**yielding substantial equity and governance benefits as well. This process would cost \$50,000 for the initial assessment and thereafter average about \$250,000 annually for five to ten years.**

It is inherent in the EPA's newness and the rapidity with which its workload is growing that it is encountering needs that were not anticipated when the existing pattern of donor assistance was programmed. Currently EPA is seeking help in developing its capacity for licensing, for monitoring with a view to enforcement, in setting standards, and in using incentives to gain compliance. No doubt other needs will continue to emerge for which the U.S. would be a logical source of assistance.

Though as of yet unarticulated by the EPA, one such area is the management of interagency coordination. Frustrations voiced by participants in the Lands Information Project Operating Committee (LIPOC) suggest that there is a need for the application of improved approaches and methods to this work. There is abundant evidence that getting agencies -- even those in the same field (e.g., water resources, urban services, and administration) -- to work together toward a goal that transcends the lowest common denominator of shared interest, is extremely difficult. Additional or revised structures may be required.

**All the above considerations underscore the fact that sound environmental management in Ghana depends pre-eminently on the EPA's continuing development into a technically strong, credible agency capable of articulating environmental needs clearly and forcefully in the face of opposing interests and of exercising operational leadership in implementing environmental policy through inter-agency coordination. Unless a World Bank-funded twinning arrangement with the Philadelphia Office of the U.S. EPA will meet the above needs (which seems doubtful as of this writing), USAID should join the World Bank, ODA, and DANIDA in providing the EPA with targeted technical assistance and training in order for it to address those policy development, scientific, technical, and managerial needs and issues where the U.S. has special expertise. Providing such assistance to EPA will contribute to its ability to formulate visions that transcend sector and resource-oriented agencies' interests. This would require about \$350,000 annually for a period of five years.**

## **B. Civil Society and the Environment**

Owing to a rapid expansion in recent years, the number of Ghanaian NGOs and community-based organizations (CBOs) taking an interest in the environment and carrying out natural resource management activities at the farm and community level now exceeds 50 and may be approaching one hundred. Most are very young and operate on only a limited scale although a few, such as Friends of the Earth, are local affiliates of international bodies though the relationships seem to involve little financial support. As of this writing, it is highly doubtful that any of the Ghanaian NGOs are certifiable to receive direct support from USAID. They and many

community-based organizations have received financing for small projects under the GEF and Africa 2000 small grants programs administered by the cognizant secretariats operating under the UN umbrella. This funding is released in small amounts, mostly for specific commodity procurements in a manner similar to Ambassador's Special Self-Help Funds in the average U.S. Embassy.

NGOs do contribute to environmental awareness through non-formal educational activities and publicity programs. But the scope of these programs is limited and NGO capacity for, and interest in, this is only beginning to develop. Friends of the Earth and the Green Earth Organization already have capacity in this area while the members of another body, the Green Forum, are all media professionals.

To date, the networking of environmental NGOs has been encouraged by Africa 2000 and the EPA Environment Education Department. There is a body called the Network of Environmental NGOs (NENGO), but its membership does not include a number of the more important NGOs and PVOs. Another umbrella organization is the Ghana Association of Private Voluntary Organizations for Development (GAPVOD). It was started with UNDP funding, but became relatively inactive once that funding ended. An initiative of the Social Welfare Department that would require all NGOs to associate with an NGO Advisory Council (whose board would consist primarily of government appointees) is widely viewed as a threat to the independence of NGOs.

The potential role of Ghana's NGO community is significant and should be nurtured. **Environmentally-oriented NGOs and CBOs have unique roles to play both in carrying out NRM programs in the field and in advocating environmental causes and transparency in government processes. As a result, they should be proactively involved wherever appropriate in Mission environmental programs and targeted in the programming of funds for the PVO/NGO sector and of Section 116e grants.**

### **C. Environmental Information Management and Sharing**

The EPA is at the center of an environmental information system that is being developed through the Lands Information Project Operating Committee (LIPOC) under the chairmanship of the National Development Planning Commission. Nearly 20 agencies have some role to play in the operation of this system which benefits from World Bank and DANIDA funding. The exercise will result in a GIS data base containing information such as land use, soil type, soil suitability, and land ownership, all of which will be recorded on 1:250,000 scale maps. Thereafter, effort will focus on the development of maps suitable for work at the district and micro-watershed levels.

The EPA has overall responsibility for monitoring the quality of the national environment. The Agency is young and still in the process of being defined. EPA intends to

retain ultimate responsibility for data collection, its storage and analysis, and for acting upon that information (e.g., through enforcement). It will house the central data management and reporting unit plus a laboratory that will conduct some of the testing of sample materials collected in the monitoring process.

However, the Agency will arrange for other institutions to implement specific aspects of the monitoring program. This delegation of responsibility will be transacted done through the Environmental Quality Project Operating Committee (EQPOC). For example, since the Institute of Aquatic Biology and the Water Resources Research Center have experience and capability in water quality monitoring, they will most likely be involved in long-term water resource monitoring. In the meantime, the EPA has designed a nationwide water quality sampling effort that is intended to lead to guidelines and then water quality standards. Those standards would then be used to regulate dischargers. Sampling of that network is scheduled to begin in July, 1995. In general, water quality monitoring capability (i.e., collection and analysis of samples) is strong in Ghana. An apparent weakness is synthesizing those data into information and presenting that information in a way that is useful in decision-making.

The Mines Department and the Factories Inspectorate have traditionally been responsible for health and safety in mines and industries, respectively. They will be offered training, equipment, and contracts for the environmental monitoring of their subsectors. There are no routine air quality sampling programs and a dearth of trained air quality samplers and managers. ODA has agreed to provide support for air quality monitoring, but that training is part of the World Bank-sponsored GERMP and its implementation has been delayed. The ODA project ends in 1996, and there is some concern that it may not come to fruition. Several institutions such as the Health Department and others have conducted sampling efforts for disease vectors. There have been massive efforts on "Oncho" and significant efforts on "Schisto" as well as other disease vectors. However, like most industrial, municipal, and ambient water quality analyses, they have been discrete in space and time, rather than ongoing monitoring programs.

When fully implemented, the EMEMP will mark the operational beginning of true environmental quality monitoring in Ghana. Though its implementation is not being managed through EQPOC, the EMEMP committee includes many of the same actors. Their experience will contribute significantly to the development of the broader environmental quality monitoring and management effort. **Given its importance to USAID and to the larger, more integrated effort, EMEMP provides USAID with a strategic opportunity to contribute decisively to the establishment of a comprehensive, integrated environmental monitoring system in Ghana. This however, requires shifting away from implementing EMEMP as a self-contained entity and approaching it as a pilot project that is part of a larger effort. Drawing first on any World Bank analysis already prepared for the GERMP, USAID should undertake a detailed review of Ghana's assistance needs in the area of environmental quality monitoring and management with a view to making this a major focus of USAID assistance. The review would cost \$50,000 and could lead to additional assistance to EMEMP and the wider EPA/EQPOC effort on the level of roughly \$400,000 annually for**

**five years.**

## V. Overall Conclusions and Recommendations

### A. Performance of Selected Ongoing Projects

#### 1. TIP/EMEMP

Though it presently suffers from implementation problems arising from budgetary operational problems and poor coordination among the participating agencies, EMEMP provides USAID with a strategic opportunity to make a decisive contribution to the establishment of a comprehensive and integrated environmental monitoring system.

As recommended elsewhere, recasting EMEMP to enhance its contribution to the development of the broader environmental monitoring system will entail an assistance needs assessment that should, *inter alia*, consist first and foremost of an analysis of the strategic and managerial decisions for which data are required. This assessment, which will include the input of stakeholders, should analyze data collection needs and their implications.

During the six months that the study will take, EMEMP efforts should be focused on the collection of data that are already understood to be needed for TIP decision-making. Thereafter, EMEMP would be reviewed, and revised as necessary, in light of the study and plans for the national monitoring system, and proceed as a pilot stage of the larger program.

More aggressive management by USAID of the EMEMP is needed to assure that the GOG budgetary releases are forthcoming in a timely way and that budgeted funds are applied proactively to meet offshore procurement needs.

#### 2. Natural Resource Conservation and Historic Preservation (Castles and Parks) Project

The team did not have time to visit the Castle component of this project. The Parks component is making progress in the development of tourist facilities and interpretation at Kakum. USAID Ghana should continue to support the Kakum Forest Park as a target of opportunity, but with emphasis on addressing the interests and concerns of the adjacent local community (e.g., through sharing in the revenues of park and the prevention or mitigation of elephant damage). There is also a need to proceed with the development of a management plan, including a tourism plan, which should include an impact monitoring and mitigation element.

### **3. Collaborative Community Forestry Initiative**

Team members visited this ADRA-Peace Corps project in northern Ghana which is successfully encouraging the planting of trees in community woodlots and on farmers' lands. As this project is generating revenue and having a positive impact on the environment of the project area, it merits continued USAID support.

#### **B. Program Strategy Options and Recommendations**

##### **1. Main Options**

Seven main programmatic options emerge from the array of possible interventions identified in this assessment as having merit. These are:

- (a) promoting farm and community-level application of NRM technologies for soil and water management, including afforestation and agro-forestry, in one watershed;
- (b) participating with the World Bank and ODA in institutional strengthening of the Forest Department and helping it to adopt new management methods;
- (c) using the EMEMP as the spring board for broader support in the form of targeted technical and financial assistance to EPA and its networks in the development of a comprehensive and integrated environmental quality monitoring and management system;
- (d) undertaking a pilot integrated (solid) waste management (IWM) scheme;
- (e) promoting and supporting a role for U.S. experts in the documentation and eventual rationalization of Ghana's land tenure administration system;
- (f) strengthening the leadership, management, and institutional capacities of the EPA; and
- (g) developing the NRM program management, analytical, and advocacy capacities of environmentally-oriented Ghanaian NGOs.

##### **2. Criteria for Selection**

Current Agency guidelines Technical Annex B: Environment of Guidelines for Strategic Plans provide that environmental activities address threats which rank as severe against one or more of the following three environmental objectives: safeguarding the environmental underpinnings of broad-based growth; protecting the integrity of critical ecosystems; and ameliorating and preventing environmental threats to public health. Lesser objectives include an

activity's prospects for success; the degree to which it reinforces or complements ongoing activities and the program strategy; and how much it adds to the management burden of the Mission either because of its management intensity or because of its technical requirements. This latter consideration militates against small, self-standing activities unless they entail very little monitoring and management responsibility for the Mission such as is the case with a cooperative agreement with a PVO or university.

### **3. Assessment of Options**

Under option (a), a farm and community-level NRM activity in a watershed would address environmental threats to the sustainability of economic growth and the integrity of ecosystems, objectives which the World Bank and DANIDA are already committed to address in the same way. It would undoubtedly be useful for such activities to be launched simultaneously by other donors in other watersheds in different agro-climatic zones. But considering that one of the goals would be to provide training to Ghanaian NGOs (and U.S. PVOs) as well as the staff of the nascent Land and Water Management Central Unit of the Ministry of Agriculture, there may be some absorptive capacity problems. Given that USAID Ghana has been out of smallholder agriculture for many years, there is little synergy between this activity and the rest of the program.

As for option (b), there appears to be room for additional donor effort in strengthening the Forest Department through technical staff training and the application of new management strategies featuring cooperation with communities and other resource management agencies. However, it is by no means clear that these needs would go unaddressed without USAID involvement. New management strategies are well known in African environmental circles and USAID can share its experience without taking on a new program area with little relation to the existing program. If the establishment of a Forest Department Planning Office for northern Ghana would be valuable to the ADRA-Peace Corps Collaborative Community Forestry Initiative, that activity could perhaps be amended to provide some of the needed help.

Option (c), retooling EMEMP to support a USAID-assisted strategy for development of a comprehensive and integrated environmental quality monitoring and management system, addresses an environmental threat that has serious implications for the sustainability of balanced growth, the integrity of ecosystems, and public health. As such, it would complement and strengthen the Mission strategy.

As the existence of EMEMP demonstrates, USAID Ghana has -- as a result of TIP -- an important stake in the future of environmental quality management. EMEMP and the larger effort to create a national system and program need each other. EMEMP is a pilot effort which can serve as a laboratory for the development of the national system. On the other hand, EMEMP is unlikely to succeed if it and the national system go down divergent paths. Thus, EMEMP presents USAID Ghana with a strategic challenge and an opportunity. The World Bank

GERMP project allocates \$USD 2 million to the environmental quality component of an environmental information system, but this will not cover much more than start-up costs.

Meanwhile, the management of environmental quality goes well beyond the operation of an information system. For example, it will require establishing standards for emissions and effluents and for water and air quality. These will need to be embodied in draft legislation and implementation procedures. EPA will need help in these areas and in others related to the development of environmental quality policy and legislation. There will be a need for research and consultancies about specific environmental threats such as the use of mercury in gold mining. Although the ultimate users of this assistance will often be specialized agencies, it can be programmed and delivered through or in coordination with the EPA so as to enhance the Agency's capacities and its coordinating role.

Option (d), using the IWM approach to address the solid waste management needs of a small urban area, responds to a growing concern of many Ghanaians and to an environmental threat that touches all three of the criteria of USAID guidance. Although there is a real risk that the IWM approach may not succeed given the considerable challenges that it will face, on the other hand, the odds seem favorable enough to merit a try and a successful outcome would bring substantial public health, aesthetic, and environmental benefits. It would also constitute a major breakthrough in governance. As a stand-alone activity, it would fit poorly with the ongoing USAID program. However, a pilot IWM waste management project would fit well within a broader package of technical and financial support to the development of Ghana's environmental quality management capabilities. A more important problem will be how to involve Ghanaian partner institutions in the implementation process who would then be able to apply the methodology in other areas of the country. Putting together the right coalition of partners and assuring proper coordination of the planning, implementation, and evaluation phases of the experiment would be the role of the EPA.

Option (e), promoting the involvement of U.S. institutional expertise in the documentation and reform of land tenure administration, is of such fundamental importance that it should be pursued as part of any broad package of USAID support to environmental management. If it cannot be explicitly included as assistance, it would make sense to carry out program-related research in this area with PD&S or other central funding. The initial object of such research would be to understand the impact of the various features of the land tenure system on land management practices, the market value of land, and incentives to invest in various types of agriculture and other land-based sectors. This would make it possible to identify the elements most in need of reform and develop a strategy for reforming them.

Option (f), strengthening the technical, managerial, and leadership capacity of EPA, would not address a specific threat to the environment. Instead, it would address the needs of a body whose effectiveness may be the single most important factor in determining the success of environmental management in Ghana. (For example, reform in policy areas such as land and resource tenure might ultimately depend on the EPA's leadership and management capacity.)

Actions that strengthen the EPA also enhance the development of a comprehensive and integrated environmental quality management system under option (c). For this reason, this option should be incorporated into the pursuit of option (c). Should option (c) not go forward, then option (f) should be expanded to incorporate most of its technical assistance requirement. The choice between options (c) and (f) comes down to the comparative utility of alternative operational objectives and unifying themes.

Option (g), developing the NRM program management, analytical, and advocacy capacities of environmentally-oriented NGOs -- like support to EPA -- derives its high priority from the potential, albeit mostly unrealized, of the NGO community to contribute to the mitigation and prevention of many of the country's environmental problems. Since this capacity development can only be accomplished on a very small scale and not very effectively through formal and informal training, this option is best pursued by associating Ghanaian NGOs in undertakings from which they can learn as they contribute. Thus, this is another option that can be realized through incorporation in another option such as (a), (c), or (d). The fact that it cannot be incorporated into the pursuit of (f) strengthens the case for choosing (c) as the main vehicle for new environmental assistance to Ghana.

#### **4. Recommended Program Strategy**

The foregoing analysis strongly suggests that the best course is to construct USAID Ghana's new environmental assistance package around an enhanced option (c). We have already noted that it can and should be enhanced to incorporate options (d), (e), and (f). However, it could also be further enhanced by inclusion of a modified option (a) to the extent that a watershed is selected as a field laboratory for environmental quality diagnostic work as a follow-up and adjunct to EMEMP monitoring. This would lead to action on environmental quality problems selected for remediation in collaboration with district, municipal, and community leaders -- including environmental management committees. The interventions would no doubt include some that would parallel the soil and water management, agro-forestry, and afforestation interventions provided for under the GERMP land management/watershed component and option (a). However, it would also -- and, perhaps, mainly -- operate in a different dimension as it would generate field measures of pollution control, pollution mitigation, and waste management -- including solid waste management.

The key difference between an environmental quality-oriented watershed activity and option (a) is that under the former, the activities to be planned and undertaken would be identified mainly through environmental monitoring and diagnostic analysis and the tracing to upstream sources of identified negative environmental impacts. Under the latter, the departure point is the farm and community-level NRM problems as elicited through the consciousness raising efforts of technical experts.

Addition of the field dimension through the watershed element would open the way for

associating the NGO community with the effort. Because the diagnostic and planning work would be governed by an environmental quality (largely pollution control and mitigation) focus, the experience and training received by the NGOs would complement that potentially available to NGOs under the GERMP watershed activity.

In selecting a watershed for this enhanced option, the Densu would be a compelling candidate. The Densu at Weija is one source of Accra's water supply, and it is being degraded by siltation arising from the intensity of land use management. The Densu watershed is also the site of a considerable number of TIP enterprises. The village of Koforidua would be about the right size for a pilot IWM solid waste management project.

A key issue that requires early attention in the development of the watershed aspect of this strategic option is the coordination of interested bodies that would be required for its management. Vital as this function is to the environmental management mission of the EPA, the management of watershed operations of NGOs, international consultants, and government agencies in conjunction with multiple local bodies and jurisdictions within the watershed may be inconsistent with all the other important responsibilities that EPA must fulfill.

The following order-of-magnitude estimates for the recommended option and its components are all for USAID costs over a five-year period. The cost of the EPA-focussed core option (c) would be about \$U.S. 3.5 million. Strengthening the EPA's management and leadership capacity would add about \$U.S. 1.5 million. A land tenure reform component might cost around \$U.S. 1.3 million while putting in a watershed field laboratory component would add another \$U.S. 7 million. An IWM solid waste pilot project in one town would cost an additional \$U.S. 5 million. The total cost of the recommended package would thus be roughly \$U.S. 18.3 million.

A package of this size would justify setting up a program funded structure for the management of all USAID inputs. It would be desirable to implement such a project under one prime contract with several subcontractors responsible for each major project element. One subcontractor or subgrantee should be a U.S. PVO whose task it will be to manage the involvement of the Ghanaian NGOs in the watershed component. The management structure could raise the total cost of the project to around \$U.S. 20 million.

In the preparation of the next Country Program Strategy Statement (CPSP), consideration should be given to amending Strategic Objective 1 to read "Sustainably Increase Private Sector NTEs." Under that heading, there should be a new Program Outcome 1.4 along the lines of "Strengthen Environmental Quality Monitoring and Management."

## ANNEX A: BIBLIOGRAPHY

- Abban, J.B. 1986. "The pattern of Industries in Rural Development." In Brown, C.K. (ed.), *Rural Development in Ghana*. Ghana University Press, Accra. pp. 159-164.
- Abu, A. 1973. "A review of the Ghana forest policy statement." *Obeche* 8/9:49-64.
- Adventist Development and Relief Agency. 1995. *Development Project Proposal 1996-2000*. March 15, 1995. Accra, Ghana.
- Adzobu, C. D., O. Ampadu-Agyei and P. Veit. 1991. *Religious Beliefs and Environmental Protection: The Malshegu Sacred Grove in Northern Ghana*. (A From the Ground Up Case Study). World Resources Institute and African Centre for Technology Studies. No. 4, Washington, D.C.
- Adzobu, C.D., O. Ampadu-Agyei and P.G. Veit. 1991. *Community Institutions in Resource Management: Agroforestry by Mobisquads in Ghana*. (A From the Ground Up Case Study). World Resources Institute and African Centre for Technology Studies. No. 3: Washington, D.C.
- Abzobu, D. 1995. Personnal communication. Abidjan, Ivory Coast.
- Acquah, P. 1995. Personnal communication. Director, Environmental Protection Agency. Accra, Ghana.
- Adarkwa, K. 1988. "Basic needs -- water delivery system in mountainous regions of Ghana: a case study of piped water supply on the Akwapim Ridge." *Mountain Research and Development* 8:303-307.
- African Development Bank. 1995. *Republic of Ghana Subri Industrial Plantation Project*. African Development Bank. Supervision mission March 25 - April 7, 1995. Abidjan, Ivory Coast. (11 pp.).
- African Development Bank. 1994(a). *Technical Guidelines For The Implementation of Forest Policy in Africa* (Draft). Abidjan, Ivory Coast.
- Agyepong, G.T., K. Boatteng and T.W. Awadzi. 1994. *Growth Activity Options for the Western Region of Ghana: An Environment-Economy Linkage Study of Selected Rural Activities*. Final Report to the Ghana Government and the World Bank. Published by University of Ghana, Legon. 156 pages.

- Aidoo, Gyamfi. 1995. Personal communication. University of Ghana, Legon. Remote Sensing Application Unit. Accra, Ghana.
- Akrasi, S.A. and N.B. Ayibotele. 1984. "Appraisal of sediment transport measurement in Ghanaian rivers." In *Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984*. IAHS Publication No 144: 301-312.
- Akuoko-Frimpong, H. 1986. "The Need for an Effective Decentralized Framework to Promote Development from Below." In C. K. Brown (ed.), *Rural Development in Ghana*. Accra: Ghana Universities Press, pp. 295-304.
- Amanor, K.S. 1991. "Managing the fallow: weeding technology and environmental knowledge in the Krobo district of Ghana." *Agriculture and Human Values*. 8:1-2, 5-13.
- Amoah, C.M. 1990. "Problems of maintenance of water quality in arid and semi-arid regions of West Africa." In *The State of the Art of Hydrology and Hydrogeology in the Arid and Semi Arid Areas of Africa*. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. pp. 722-735.
- Amonoo Neizer, E.H. and E.M.K. Amekor. 1993. "Determination of total arsenic in environmental samples from Kumasi and Obuasi, Ghana." *Environmental Health Perspectives* 101:46-49.
- Amonoo, E. 1986. "A Strategy for an Integrated Rural Development in Ghana." In C. K. Brown (ed.), *Rural Development in Ghana*. Accra: Ghana Universities Press, pp. 262-284.
- Andah, K., R. Rosso and A.C. Taramasso. 1987. "Role of quantitative geomorphology in the hydrological response of river networks." *Water for the Future: Hydrology in Perspective*. IAHS Publication No. 164. International Association of Hydrological Sciences, Washington, D.C. pp. 93-110.
- Annan, C. K. and A.M. Wright. 1970. "Marine waste disposal in Ghana-water quality evaluation." *Fifth International Water Pollution Research Conference*, San Francisco, July 26-August 1, 1970, 7 pp.
- Anon. 1995. "Korle restoration project starts Sept." *Ghanaian Times* 20 June, 1995.
- Anon. 1994. *Project Memorandum: Lower Volta Mangrove Project: Phase 1:P Assessment of Environmental, Economic and Social Factors*. British High Commission, ODA, London and Accra.

- Anon. 1994. *Forest Land Use Options: Conflicts and Solutions 24th to 28th January 1994 Kumasi, Ghana*. Papers presented at an international workshop organized by the British Council in Collaboration with the Ministry of Lands and Forestry, the Forestry Department and the Ministry of the Environment, sponsored by the Overseas Development Administration (ODA) United Kingdom, The Ghana Timber Millers Organisation, the Association of Ghana Timber Industries, the Forest Products Inspection Bureau and the Ghana Chamber of Mines.
- Anon. 1992a. *Environmental Synopsis of Ghana*. IIED for ODA. 28 pages.
- Anon. 1992b. "Annex O" of Trade and Investment Program (TIP) Initial IIE and EMEMP 25 pages. USAID, Accra.
- Anon. 1992c. *Ecological Knowledge and the Regional Economy: Environmental Management in the Asewewa District of Ghana*. UNSRID and FIS.
- Anon. 1992d. *Protected Area Development in South-West Ghana: Final Report*. Environment and Development Group, Oxford.
- Anon. 1992e. *The Earth Summit and its Relevance to Ghana: Report on Symposium*.
- Anon. 1991. *Ghana: Forests, Wood and People*. Ghana, Timber Export Development Board. 9 pages. Takoradi, Ghana; Timber Export Development Board, Accra.
- Anon. 1990. *Background Notes: Ghana*. U.S. Department of State, Bureau of Public Affairs. Washington, D.C. 7 pages.
- Anon. 1988. *Ghana: Conservation of Biological Diversity and Forest Ecosystems*. Biological diversity profiles. IUCN 22 pages.
- Anon. 1987a. *Report of the First Session of the Working Party on Pollution and Fisheries: Accra, Ghana, 16-20 June 1986*. FAO fisheries report; no. 369. Food and Agriculture Organization of the United Nations, 23 p.
- Anon. 1987b. *Ghana: Forestry Sector Review*. FAO et al., Tropical Forestry Action Plan.
- Anon. 1986. *Ghana Post Report*. U.S. Department of State. 19 pages.
- Anon. 1985. *Ghana: Forestry Sector Analysis*. USAID.
- Anon. 1980. *Draft Environmental Report on Ghana: Country Environmental profiles*. USAID.

- Anon. 1975. *Aquaculture Panning in Africa: Report of the First Regional Workshop on Aquaculture Planning in Africa*, Accra, Ghana, 2-17 July 1975 Aquaculture Development and Coordination Programme (Series); ADCP/REP/75/1. 114 p.
- Anon. 1968a. *Land and Water Survey in the Upper and Northern Regions: Ghana: Final Report*. United Nations Development Programme, Food and Agriculture Organization of the United Nations, 6 pages. CALL NUMBER: DNAL HD1699.G5F66.
- Anon. 1968b. "Economics and finance of water programmes: economic analysis, financial analysis, financing". For 8 volume proceedings see vol. 2, no. 9, field 06b, w69-03305. *International conference on water for peace*, vol 8, pp 708-710, Washington, D.C., U.S. Government Printing Office, 1968. 3 p.
- Asibey, E.O.A. 1978. "Wildlife production as a means of protein supply in West Africa, with particular reference to Ghana." *Proceedings of the Eighth World Forestry Congress*, Jakarta, 16-28 Oct. 1978: World Forestry Congress: Forestry for Food. 1978., No. FFF/8-5, 23 pp.
- Asibey, E.O.A. 1982. The case for high-forest national parks in Ghana. *Environmental Conservation*. 9:293-304.
- Asibey, E.O.A. 1971. "The present status of wildlife conservation in Ghana." *IUCN Publication New Series Supply Paper* Morges, Switzerland: The Union 22:15-21.
- Asiedu-Saforo, K. 1989. "Economic reform and programmes and agricultural development macro policy sequencing in Ghana, 1983-88." *Food-Policy*. 14:359-370.
- Ayensu, E.S. 1994. *Ghana National Capacity 21*, A Proposal by the Government of Ghana Submitted to United Nations Development Programme, Accra. Available from Ministry of Environment, Accra 41 pages.
- Baidoe, J.F. 1978. "The management of the natural forests of Ghana." In *Proceedings of the Seventh World Forestry Congress*, Vol. II.: World Forestry Congress: First technical commission: silviculture. 4. The present and future of tropical rain forests. 5. The effect of silvicultural practices on the human environment, 1978, pp. 2510-2516; Buenos Aires, Argentina.
- Benneh, G. 1985. "Land tenure and agroforestry land use systems in Ghana." In *Land, Trees and Tenure. Proceedings of an international workshop on tenure issues in agroforestry, Nairobi*, May 27-31, 1985 [edited by Raintree, J.B.]. 1987., 163-168; 5 ref. Joint publication with Land Tenure Center (LTC), Madison, Wisconsin, USA. Nairobi, Kenya; International Council for Research in Agroforestry (ICRAF).

- Benneh, G., J. Songsore, J.S. Nablila, A.T. Amuzu, K.A. Tutu, Y. Yangyuoru and G. McGranhan. 1993. *Environmental Problems and the Urban Household in the Greater Accra Metropolitan Area (GAMA) - Ghana*. Stockholm Environmental Institute, Stockholm Sweden. 127 pages.
- Biney, C.A. 1990. "Review of Some Characteristics of Freshwater and Coastal Ecosystems in Ghana." *Hydrobiologia* 208:45-53.
- Biney, C.A. 1994. *The Family and Sustainable Environment Symposium-Sustaining the Environment in Ghana*. Paper presented at 46th Annual New Year, Cape Coast, Ghana. pp. 29-32.
- Biney, C.A. 1995. *Institute of Aquatic Biology, Annual Report*. Accra Ghana. 26 pages.
- Biney, C.A., A.T. Amuzu, D. Calamari, N. Kaba, I.L. Mbome, H.Naeve, P.B.O. Ochumba, O. Osibanjo, V. Redegonde and M.A.H. Saad. 1994. "Review of heavy metals in the African aquatic environment." *Ecotoxicology and Environmental Safety* 28: 134-159.
- Biney, C.A., K.A.A. deGraft-Johnson and A.A. Opoku. 1995. *The State of Wetlands in Ghana*. Institute of Aquatic Biology Technical Report 144.
- Biodiversity Support Program. 1995. *Indigenous vs. Introduced Biodiversity Conservation Strategies: The Case of protected Area Systems in Ghana*. African Biodiversity Series. Number 1 (May, 1995).
- Biswas, S. 1972. "Ecology of phytoplankton of the Volta Lake." *Hydrobiologia* 39:277-288.
- Boatena, Enoch. 1995. Personal communication. Project Coordinator, Soil Science Institute. Accra, Ghana.
- Boateng, I.K. 1986. "Governmental and Voluntary Participation in Ghana's Rural Development Programme." In Brown, C.K. (ed.) *Rural Development in Ghana*. Ghana University Press, Accra. pp. 33-46.
- Botchie, G. 1993. *The Environment in Ghana*. A briefing paper prepared for ICDA-PSU. 18 pages.
- Botchie, G. 1986. "Planning and Implementation of Development Plans in Ghana: An Appraisal." In Brown, C.K. (ed.) *Rural Development in Ghana*. Accra: Ghana Universities Press, pp. 191-200.
- Bowell, R.J., N.H. Morley and V.K. Din. 1994. "Arsenic speciation in soil porewaters from the Ashanti Mine, Ghana." *Applied Geochemistry*, 9:15-22.

- Brown, C.K. 1986. "Urban Bias and Rural Development in Ghana." In Brown, C.K. (ed.), *Rural Development in Ghana*. Ghana University Press, Accra. pp. 201-219.
- Buccowich, Mark. *Memorandum on Ghana Timber Export Development Board (TEDB) Request for USFS/IF Technical Assistance* addressed to Mr. Peter Weisel, Chief TAPS, USAID, Accra, Ghana.
- Buschbacher, R.J. 1990. "Natural forest management in the humid tropics: ecological, social and economic considerations." *Ambio*. 19:253-258.
- Carr, M. (ed.) 1988. *Sustainable Industrial Development: Seven Case Studies*. 190pp. OQEH. London: Intermediate Technology Publications.
- Chartey, K.K.F. November 1990. *The Evolution of Forest Management in the Tropical High Forest of Ghana*. Paper presented at Conference sur la Conservation et l'Utilization Rationnelle de la Foret Dense d'Afrique Centrale et de l'Ouest.
- Cumberlidge, N. 1989. "Description of *Sudanonautes-orthostylis* Bott 1955 a freshwater crab from Nigeria, Cameroon and Ghana with notes on its ecology Decapoda Potamonautidae". *Crustaceana* (Leiden) 56 (3):230-245.
- Currie, R. 1994. "Cutting corners in Ghana." *World Water and Environmental Engineering* 17:38-39.
- Department of Game and Wildlife. 1994. *Mole National Park: The Management Plan*. Department of Game and Wildlife. Accra, Ghana. (92 pp.).
- Deschiens, R. 1971. "Epidemiological and ecological aspects due to the construction of river weirs in the tropical regions." *C R HEBD SEANCES ACAD SCI SER D SCI NAT (PARIS)*. 273(18):1620-1622.
- Environmental Protection Agency. 1991. *Ghana Environmental Action Plan*. Accra, Ghana. (106 pp.).
- Falconer, J. 1995. Personal communication. Forestry Department. Forestry Inventory and Management Project Planning Branch. Kumasi, Ghana.
- Feacham, R.G., M.W. Guy, S. Harrison, S. Iwugo, T. Marshall, N. Mbere, R. Miller and A. Wright. 1983. "Excreta disposal facilities and intestinal parasitism in urban Africa: preliminary studies in Botswana, Ghana and Gambia." *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 77:515-521.

- Flack, S. 1994. "Back to Office Report--Conservation of Biological Diversity in Ghana." World Bank Office Memorandum. 21 pages.
- Food and Agriculture Organization, Forestry Department. 1985. *Changes in Shifting Cultivation in Africa. Seven Case Studies*. FAO Forestry Paper. No. 50/1, 185pp.
- Forestry Department. 1995. *Made in Ghana: Collaborative Forest Management*. Forestry Department. Forestry Inventory and Management Project Planning Branch. Kumasi, Ghana. 15pp.
- Forestry Department. 1995. Personal communication with Mr. Ben Aninakwa. Chief, Planning Officer. Department of Forestry. Kumasi, Ghana.
- Forestry Department. 1995. *Forestry to the Bitter End in Ghana*. Concept Note. Forestry Department. Kumasi, Ghana. March 3, 1995. 11 pp.
- Forestry Research Institute. 1995. Personal Communication. Mr. Abdul Adam. Natural Forest Management Division. Forestry Research Institute. Kumasi, Ghana.
- Freeman, P.H. 1974a. *The Environmental Impact of a Large Tropical Reservoir: Guidelines for Policy and Planning. Based Upon a Case Study of Lake Volta, Ghana, in 1973 and 1974*. Available from the National Technical Information Service, Springfield, VA 22161 as PB-247 430, Price codes: A05 in paper copy, A01 in microfiche. Prepared for the Agency for International Development, 97 p. AID/csd-2608.
- Freeman, P.H. (ed.) 1974b. *Environmental Aspects of a Large Tropical Reservoir - A Case Study of Volta Lake, Ghana*. Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 630, Price codes: A16 in paper copy, A01 in microfiche. Prepared for the Agency for International Development, 360 pp. AID/csd-2608.
- Gaudet, J. 1992. *Sustainability of Trade and Investment Programs in Africa*. Case Study presented at Agricultural Marketing and Agribusiness in Africa Conference, Baltimore, MD. 10 pages.
- Gaudet, J.L. and M. Giasson. 1989. *Summary of Proceedings and Selected Papers: Symposium on the Development and Management of Fisheries in Small Water Bodies, Accra, Ghana, 7-8 December 1987*. Food and Agriculture Organization of the United Nations. FAO fisheries report; no. 425. 190 p. CALL NUMBER: DNAL SH323.F6-no.425.
- Ghana Department of Game and Wildlife. 1994. *Mole National Park: The Management Plan*. Department of Game and Wildlife. Accra, Ghana. 92 pp.

- Ghana Environmental Protection Agency. 1989. *Report of the Working Group on Forestry and Wildlife*. Accra, Ghana.
- Ghana Forestry Commission. 1994. *Draft Forestry and Wildlife Policy, Republic of Ghana*. Dated November 24, 1994. Accra, Ghana. 11 pp.
- Ghana Department of Game and Wildlife. 1995. Personal communication, Accra, Ghana
- Ghana Forestry Department. 1995. *Forestry Inventory and Management Project Planning Branch*. Kumasi, Ghana. 15 pp.
- Ghana Forestry Department. 1995a. *Made in Ghana: Collaborative Forest Management*. Forestry Department. Forestry Inventory and Management Project Planning Branch. Kumasi, Ghana. 15 pages.
- Ghana Forestry Department. 1995b. Personal communication with Mr. Ben Aninakwa. Chief, Planning Officer. Department of Forestry. Kumasi, Ghana.
- Ghana Forestry Department. 1995c. *Forestry to the Bitter End in Ghana*. Concept Note. Forestry Department. Kumasi, Ghana. March 3, 1995. 11 pages.
- Ghana Ministry of Science and Tehcnology. 1994. *Review of Policies and Programs*. Institute of Aquatic Biology. Accra, Ghana. 8 pages.
- Ghana Soil Research Institute. 1995. Personal communication. Accra, Ghana.
- Ghana Wildlife Society. 1995. *Ghana Coastal Wetland Management Project*. National Seminar on Coastal Wetlands. March 8, 1995. Accra, Ghana. 15 pp.
- Gibson J.E., B. Hager and I.F. Pires. 1994. *West and Central Africa Enviroemental Law Study*. Final Report submitted to USAID Abidjan, Cote d'Ivoire. Interntaional Resources Group, Washington, D.C., 217 pages.
- Gill, H. E. 1969. "A ground-water reconnaissance of the Republic of Ghana, with a description of geohydrologic provinces." *United States Geological Survey. Water Supply Paper 1757-K*. Contributions to the Hydrology of Africa and the Mediterranean Region. Washington, D.C., 38 pp.
- Gyamfi-Aidoo, J. 1995. Personal communication. University of Ghana, Legon. Remote Sensing Application Unit. Accra, Ghana.
- Gordon, C. 1988. *Aquaculture in the draw-down of the Volta Lake: present status and prospects*. Paper presented at Third International Wetlands Conference, Rennes, France.

- Gordon, C. 1995a. *Aquaculture Development and Water Quality in Ghana*. Progress Report GNC-1HWRP, 16 pages. Available from University of Ghana, Legon.
- Gordon, C. 1995b. "The Volta Basin Research Project." Abstract of a paper presented at International Conference on Tropical Reservoirs. Available from University of Ghana, Legon.
- Government of Ghana. 1986. *Land Title Registration Law*. P.N.D.C.L. 152.
- Gyamfi-Aidoo, J. 1995. "Review of the Monograph *Adjustment, Agricultural Marketing and Environment: The Case of Ghana*" by T.T. Remel and T. Roe. Report presented to World Resources Institute. 5 pages.
- Hall, J.B. and M.D. Swaine. 1981. *Distribution and ecology of vascular plants in a tropical rain forest*. W. Junk, The Hague, Netherlands.
- Hall, J.B. and M.D. Swaine. 1976. "Classification of closed canopy forest in Ghana." *Journal of Ecology* 64:913-951.
- Hawthorne, W.D. 1990. *Field Guide to the Forest Trees of Ghana*. Natural Resources Institute, Chatham, U.K.
- Hawthorne, W.D. 1993. *Regeneration after Logging in Bia South GPR, Ghana*. ODA Forestry Series No. 3 Natural Resources Institute, Chatham, U.K.
- Hawthorne, W.D. 1994. *Fire Damage and Forest Regeneration in Ghana*. ODA Forestry series No. 4. Natural Resources Institute, Chatham, U.K.
- Hawthorne, W.D. 1995. "FROGGIE - Forest Reserves of Ghana: Graphical Information Exhibitor - Manual for the Program." IUCN/ODA/Forest Department of Ghana.
- Hawthorne, W.D. and M. Abu Juam. 1994. *Forest Protection in Ghana*. Final Report to ODA/Ghana Forest Department. To be published by IUCN, Gland, Switzerland.
- Hawthorne, W. and J. Musah. 1993. *Forest Protection in Ghana*. Forestry Department. Forestry Inventory and Management Project Planning Branch. Kumasi, Ghana. 71 pages.
- Hecht, J.E. 1994. *Environmental Monitoring, Evaluation and Mitigation plans: A Review of the Experiences in Four African Countries*. USAID EPAT Report, 60 pages.
- Hinderink, J. and J.J. Sterkenburg. 1983. "Agricultural policy and production in Africa: the aims, the methods, and the means [Food supply, output, retrospective and forecasting aspects, Ivory Coast, Malawi, Swaziland, Ghana, Nigeria]." *Journal of Modern African Studies*,

London 21:1-23.

- Hutchinson, J. And J.M. Dalziel. 1972. *Flora of West tropical Africa*. Crown Agents, London. Second Revised edition.
- Hutchinson, Charles. 1995. Personal communication. Conservation International. Accra, Ghana.
- IIED. 1992. *Environmental Synopsis of Ghana*. Environmental synopses. Overseas Development Administration, London.
- International Resources Group, Inc. 1992. *Ecotourism: A Viable Alternative For Sustainable Management of Natural Resources in Africa*. Washington, D.C.: International Resources Group.
- Jenik, J. and J.B. Hall. 1966. "The ecological effects of the harmattan wind in the Djebobo massif (Togo Mountains, Ghana)." *Journal of Ecology*. 54:767-79.
- Kapetsky, J.M. 1990. *Overview of the Results of the Fish Farm Survey*. FAO F1: TCP/GHA/0051 Field Working Paper 11. FAO, Rome.
- Kasanga, Kasim. 1994. *Agriculture Land Administration and Social Differentiation: A Case Study of the Tono, Vea, and Fumbisi Belts of North-Eastern Ghana*. Working Paper Series, Joint Committee on African Studies, African Agriculture: Crisis and Transformation, Social Science Research Council, American Council of Learned Societies.
- Kasanga, Kasim. 1994. *Land Tenure Systems and Ecological Degradation in Northern Ghana. What Role for Local Authorities?* The Our Common Estate program of the Royal Institution of Chartered Surveyors, London. (July, 1994).
- Kasanga, Kasim. 1995. "Land Tenure and Regional Investment Prospects: the Case of the Tenurial Systems of Northern Ghana." *Property Management* Vol. 13, No. 2:21-31.
- Kasanga, Kasim. 1995. "Structural adjustment and Land Reform Policies." Editorial opinion. *Journal of Property Evaluation and Investment*. April, 1995.
- Kasanga, Kasim. 1995. "Agricultural Policy and Marginality. Evaluating Small Holder Agricultural Crisis in North-western Ghana." Draft submitted to Commonwealth Association for Development, Export House, London. 82 pages.
- Kasanga, Kasim. 1992. *Agricultural Land Administration and Social Differentiation: A Case study of the Tono, Vea and Fumbisi Belts of North-eastern Ghana*. Working Paper Series: Joint Committee on African Studies African Agriculture: Crisis and Transformation. 43

pages.

- Kilmer, G. 1986. "Vertically agric-business as a means of promoting rural development-the experience of Technoserv Incorporated." In Brown, C.K. (ed.) *Rural Development in Ghana*. Ghana University Press, Accra. pp. 146-158.
- Korang-Amoakoh S., R.A. Cudjoe and R.K. Adjakloe. 1987. Biological control of cassava pests in Ghana. *Insect. Sci. Appl.* 8:905-907.
- Kubiador, C.D.K. 1986. "Policy objectives and strategies for integrated rural development in Ghana." In Brown, C.K. (ed.) *Rural Development in Ghana*. Ghana University Press, Accra. pp. 26-33.
- Langenegger, O. 1990. "Groundwater Quality in rural areas in Western Africa." In *The State-of-the-Art of Hydrology and Hydrogeology in the Arid and Semi-Arid Areas of Africa*. Proceedings of the Sahel Forum, Ouagadougou, Burkina Faso, 18-23 February 1989. International Water Resources Association, Urbana, Illinois. pp. 574-584.
- Larmie, S.A., J. Marivoet and P. Vanouplines. 1989. "Application of Qual2e and Qual2e-Uncas Models to the Densu River in Ghana." In *River Basin Management--V. Advances in Water Pollution Control: A Series of Conferences Sponsored by the IAWPRC*. Pergamon Press, Inc., New York. pp. 133-146.
- Larmie, S.A., R.A. Osafo and N.B. Ayibotele. 1991. "Surface water quality monitoring and pollution control in Ghana." *Water Science and Technology* 24:35-41.
- Livingstone, A. and H.J. McPherson. 1993. "Community management of rural water supplies: Lessons for developing countries from a Western Canadian experience." *Water International* 18:225-232.
- Ly, C.K. 1980. "The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa)." *Marine Geology* 37:323-332.
- Maley, J. and D.A. Livingstone. 1983. "Late Pleistocene and Early Holocene extension of a mountain element in southern Ghana (West Africa): preliminary pollen data [*Olea hochstetteri*]. *C-R-Seances-Acad-Sci-Ser-III-Sci-Vie*." Paris: Gauthier-Villars. 296:761-766.
- Ministry of Lands and Forestry. 1994. Forestry and Wildlife Policy. Personal communication between Ministry and Julia Falconer.
- NEAP. 1991. *Ghana Environmental Action Plan*. Environmental Protection Council, Accra Ghana. 106 pages.

- Norton, A. 1988. *The Socio-Economic Background to Community Forestry in the Northern Region of Ghana*. Overseas Development Administration, London.
- Ntiamoa-Baidu, Y. 1995. *Indigenous vs. Introduced Biodiversity Conservation Strategies: The case of Protected Area Systems in Ghana*. WWF African Biodiversity Series 1: 12 pages.
- Ntiamoa-Baidu. 1995. Personal communication. University of Ghana, Legon. Department of Zoology. Accra, Ghana.
- Ntow, W.J. and M.A. Khwaja. 1989. "Mercury pollution in Ghana (West Africa) coastal commercial fish." *Environmental Technology Letters* 10:109-116.
- Okonjo, C. 1986. "The concept of development." In Brown, C.K. (ed.) *Rural Development in Ghana*. Ghana University Press, Accra. pp. 1-25.
- Overseas Development Agency. 1995. *Non-Timber Forest Products in Southern Ghana*. Kumasi, Ghana. (244 pp.).
- Peirce, M.A. 1984. "Haematozoa of African birds: Some miscellaneous findings." *African Journal of Ecology* 22: 149-152.
- Pelig B.K.B., C.A. Biney and L.A. Antwi. 1991. "Trace metal concentrations in borehole waters from the Upper Regions and the Accra Plains of Ghana." *Water, Air and Soil Pollution* 59:333-345.
- Perry, J.A. 1988. "Networking urban water supplies in West Africa." *Journal of the American Water Works Association* 80:34-42.
- Plumptre, R.A. and D.E. Earl. 1986. "Integrating small industries with management of tropical forest for improved utilization and higher future productivity." *Journal of World Forest Resource Management*. 2:43-55.
- Prah, Edward A. 1994. *Sustainable Management of the Tropical High Forest of Ghana*. Commonwealth Secretariat.
- Powell, J.W. 1986. "The role of a technological university in integrated rural development." In C. K. Brown, ed., *Rural development in Ghana*. Accra: Ghana Universities Press, pp. 181-187.
- Sma, K. 1995. "CEDECOM Grants 55 Million Cedis to Fishmongers." *Daily Graphic* Accra, 29 June, 1995.

- Samba, I. 1995. *Evaluation of the Implementation of the Ghana Trade and Investment Program Environmental Monitoring, Evaluation and Mitigation Plan (EMEMP)*. Second Evaluation USAID, EPC.
- Samba, I. 1994. *Evaluation of the Implementation of the Ghana Trade and Investment Program Environmental Monitoring, Evaluation and Mitigation Plan (EMEMP)*. First Evaluation USAID, EPC.
- Short, J.C. 1983. "Density and seasonal movements of forest elephant (*Loxodonta africana cyclotis*, Matschie) in Bia National Park, Ghana [Calculated using dropping counts]." *African Journal of Ecology* 21:175-184.
- Snrech, S. 1995. *West Africa Long Term Perspective Study*. Club du Sahel SAH/D(94) 439: 66 pages.
- Soil Research Institute. 1995. Personal communication, Accra, Ghana.
- Songsore, J., P.W.K. Yankson and G.K. Tsikata. 1994. *Mining and the Environment: Towards a Win-Win Strategy. (A Study of the Tarkwa-Aboso-Nsuta Mining Complex in Ghana)*. Final Report to the Government of Ghana and the World Bank. Published by the University of Ghana, Legon. 186 pages.
- Swaine, M.D. and T.C. Whitemore. 1988. "On the definition of ecological species groups in tropical rain forests." *Vegetatio* 75:81-86.
- Turnbull, Chris. 1995. Personal communication June 27, 1995. Overseas Development Agency. Kumasi, Ghana.
- Tutu, K.A. and A. Baah-Nuakoah. 1994. *Environmental effects of economic growth of the Western Region of Ghana*. Report submitted to the World Bank as part of the Ghana Western Region Study. University of Ghana, Legon. 70 pages.
- U.S. Agency For International Development. 1991. *Environmental Guidelines for NGO/PVO Field Use in Africa: Sound Environmental Design For Planning and Implementation of Humanitarian and Development Activities*. USAID, Washington, D.C.
- U.S. Agency For International Development. 1991. *Ghana Biodiversity Review*. Accra, Ghana. 155 pages.
- U.S. Agency For International Development. 1992. *An Assessment of the Ghanaian Forest Sector. Prepared for the USAID/Ghana Trade and Investment Program*. Accra, Ghana. 22 pp.

- Van Ess, A. 1995. "\$100M Water Project for 26 Districts." *Daily Graphic Accra, Ghana*, 20 June, 1995.
- Vanderpuye, C.J. 1982. "Further observation of the distribution and abundance of fish stocks in Volta Lake, Ghana." *Fisheries Research*. 1:319-343.
- Wagnre, M.R. and J.R. Cobbinah. 1993. "Deforestation and sustainability in Ghana: the role of tropical forests." *Journal of Forestry*. 91:35-39.
- Wegelin, M., R. Schertenleib and M. Boller. 1991. "Decade of roughing filters: Development of a rural water-treatment process for developing countries." *Aqua* 40:304-316.
- Weissman, S.R. 1990. "Structural adjustment in Africa: insights from the experiences of Ghana and Senegal." *World Development*. 18:1621-1634.
- Werf, E. J. van der. 1986. *Ecologically sustainable agriculture as an effective means to combat desertification in tropical Africa: the case of agriculture in Accra Plains (Ghana)*. 4th ed. Ecoscript; 22. Zandvoort, Holland: Stichting Mondiaal Alternatief.
- White, F. 1983. *The Vegetation of Africa: A descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa*. 350 pages. UNESCO, Paris.
- White, F. 1979. "The Guineo-Congolian region and its relationship to other phytochoria." *Bull. Jar. Bot. Nat. Belg.* 49:11-55.
- White, F. 1978. "The taxonomy, ecology and chorology of African Ebenaceae. 1 The Guineo-Congolian species." *Bull. Jard. Bot. Nat. Belg.* 48:245-358.
- White, F. 1971. "The taxonomic and ecological basis of chorology." *Mitt. Bot. Staatssamml. Munch.* 10:91-112.
- Whittington, D., D.T. Lauria, A.M. Wright, K. Choe, J.A. Hughes and V. Swarna. 1993. "Household demand for improved sanitation in Kumasi, Ghana: A contingent valuation." *Water Resources Research*, 29:1539-1560.
- World Bank. 1987. *Ghana Forestry Sector Review*. Accra, Ghana. 39 pp.
- World Bank. 1992. "Global Environment Facility Memorandum and Recommendation of the Director, West Africa Department of the International Bank for Reconstruction and Development to the Vice President on a Proposed Grant from the Global Environment Trust Fund in an Amount Equivalent to SDR 5.0 Million to the Republic of Ghana for a Coastal Wetlands Management Project." World Bank Report 10690-GH.

World Bank. 1993. *Staff Appraisal Report Republic of Ghana Agricultural Sector Investment Project*. November 10, 1993. Washington, D.C. (81 pp.).

World Bank. 1994. *Back To Office Report--Conservation of Biodiversity in Ghana*. Office Memorandum. July 10, 1994.

World Bank. 1995. *Staff Appraisal Report. Republic of Ghana. Fisheries Sub-Sector Capacity Building Project*. World Bank Report 13877-GHA. 75 pages.

World Resources Institute. 1993. *Surviving The Cut: Natural Forest Management in the Tropics*. Washington, D.C. (71 pp.).

Wong, J. (ed.) 1989. Ghana forest inventory project. Seminar proceedings. 29-30 March, 1989. Accra. 101 pages.

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