Watershed management programs to reduce flooding impacts should include revegetation and afforestation programs to promote infiltration and reduce surface runoff volumes. This approach ties in with responses to other types of environmental degradation, including controlling soil degradation and erosion, increasing forest reserves, and promoting wildlife habitat (see previous sections). Management programs fall under the approach of controlling flooding through the use of non-structural measures, rather than engineered works.

Construction in floodplains should be carefully planned to allow for historic flood flows. Constructed works should minimize the restriction of flood flows, as restriction diverts the flow upstream or channels it downstream to impact there. When a highway was constructed from Aba to Calabar, the crossing of the Cross River was achieved by building a bridge across the river and elevating the highway on a dike across the floodplain. As a result, seasonal flood waters back up behind the bridge and dike and flow laterally through an area which was originally prime forest land. The innundation has killed most of the trees and degraded almost 2,000 ha into a seasonal swamp. The Cross River Basin Development Authority is conducting a feasibility study on diking the river banks to prevent the flood waters from spreading to the forest area. However, this plan would only transfer the floodwater downstream, and would be enormously expensive, as many kilometers of dikes would need to be constructed.

Watershed management is generally based on some maximum assumed rainfall event, and control programs, setbacks, and building requirements are keyed to those assumptions. In exceptional storms, flood volumes can be generated that exceed these estimates; the resulting flooding has the potential to cause catastrophic damage. Small, decentralized structural measures can be used to "take the edge" off of flood volumes to prevent extensive damage. These facilities frequently employ the concept of offline storage with later release as flows decrease.

(5) Water Pollution, Water Hyacinth, and Eutrophication

Adequate quality of water is as much a requirement as adequate quantity if Nigeria is to be able to implement a policy of sustainable development of its water resources. The primary causes and consequences of

water quality contamination were discussed in Section 11.2.1. Table 11-19 summarizes those causes and consequences, and lists approaches to addressing the problems. These approaches are discussed below.

TABLE 11 - 19 APPROACHES TO SOLUTIONS - WATER POLLUTION, WATER HYACINTH, AND EUTROPHICATION

| Problem | Primary Causes and Results | Needs (Approaches to Solutions) |
|---|---|---|
| | **CAUSES** | |
| Contamination of surface water and groundwater | Uncontrolled discharges of municipal and industrial effluents | Controls and enforcement of discharge requirements; wastewater treatment for industrial, municipal, and irrigation return flows |
| | Land use practices that promote erosion | |
| | Improper use of agricultural fertilizers and chemicals | Improved watershed management, including drainage controls, requirements on runoff quality from selected areas, and revegetation / afforestation |
| | **RESULTS** | |
| | Proliferation of aquatic weeds | Improved urban and rural land use planning, especially in groundwater recharge areas; in recharge areas, goals should be to increase total vegetated areas, increase areas dedicated to forest reserves, and restrict grazing to minimize bacterial contamination |
| | Contamination of water supplies | |
| | Loss of fishery, wildlife resources | |
| | | Improved urban and rural land use planning, especially near surface waters; in these areas, restrictions on activities that directly impact water quality should be enforced, including auto servicing areas (fluids are commonly dumped directly onto the ground, where they leach into groundwater or are mobilized directly into surface waters in rainfall runoff), waste disposal facilities, and soil mining for building materials |
| | | Improved agricultural practices, including farming methods and fertilizer use (through education) Emphasize installation / maintenance / upgrading of sanitation facilities |
| | | Emphasize installation / maintenance / upgrading of solid waste management facilities |
| | | Promote aquatic weed control strategies and/or alternative uses ("harvesting" for organic fertilizer, animal feed supplement, etc.) |

The FMWRRD is currently implementing a program to build and operate a network of water quality laboratories to monitor water quality in surface waters used for potable supplies and irrigation (Hashidu, 1992). This monitoring effort should also be extended to groundwater resources (NRCC, 1992b). Groundwater is generally better than surface water for use as a water supply - groundwater has fewer sanitation requirements. Oteze (1990) tested for 24 elements at 12 locations in the Rima Group outcrop; in almost all cases the water quality met WHO standards for drinking water. Boron levels in some areas makes groundwater unsuitable for irrigation of some crops (citrus, etc.); however, groundwater is not a likely source of irrigation water, as the NWRMP targets groundwater supplies for domestic use. Blending with treated surface water will generally eliminate any problems with constituent concentrations.

However, source protection also important; groundwater pollution takes longer to control, remove, and is more expensive than remediation of a surface source, making measures that emphasize prevention cost-effective (Iwugo, 1987).

Watershed management should include evaluation and control of non-point source (NPS) runoff into water sources; this evaluation will include determining compatible land uses in the watershed upstream of water sources to prevent pollution inputs (FGN, 1989). Mbuno and Ibrahim-Yusef (1993) have suggested the creation of aquifer protection zones to enhance water quality. NPS runoff pollution can also be effectively controlled by maintaining vegetated setbacks around rivers, lakes, and other water supplies (FMAWRRD and NCF, 1986).

Waste discharge guidelines have been promulgated for industrial effluents, petroleum refining and exploration, and industries producing agricultural chemicals (FGN, 1991). FEPA should move to establish reasonable but expedient schedules for these industries to achieve compliance with published standards.

New industries should be encouraged to adopt in-plant waste reduction and pollution prevention strategies as part of their design and operation plans (FGN, 1991). Effluent requirements have been published for discharges from service industries, which includes auto servicing areas (FGN, 1991). Watershed management plans should also appropriately locate these

facilities to reduce the potential for contaminants entering water bodies as a result of accidental spills or surface washoff during rains.

Watershed management policies regarding drainage controls and requirements on runoff quality should be specifically applied to construction projects; uncontrolled runoff from road construction and land clearing for building construction has historically been a primary cause of sediment accumulation in water bodies, as well as degrading soils and leading to gully erosion (World Bank, 1990). Siltation resulting from this runoff promotes growth of aquatic weeds, increases treatment costs, increases water turbidity (killing vegetation and driving away fish), decreases the capacity of reservoirs, and impairs navigation. Water pollution resulting from mining activities can be controlled through afforestation, or by diverting process water to settling areas before release; sometimes treatment to reduce solids and neutralize pH levels (addition of lime, etc.) is also required (Iwugo and Mahendra, 1992).

Watershed management activities must also include control of pollution from agricultural chemicals (NRCC, 1992b). Management plans should address use levels and locations for fertilizers, pesticides, herbicides, and other substances. At the State and National levels, regulatory bodies must regulate all aspects of production, sale, use, and disposal of agriculture chemicals and fertilizers. While FEPA is directly responsible for monitoring most discharge activities, and lists standards for agricultural chemicals (FGN, 1991), other agencies should also move to implement monitoring programs for soil and water, flora, and fauna (FEPA, 1991). Organic or benign alternatives for pesticide and fertilizer use should also be pursued (Aina and Adepipe, 1991). Ojiegbe (1990) suggests the promotion of shifting cultivation (with rotating bush fallow) and crop rotation; the specific program will be dependent on local soil characteristics and require education of farmers by the local extension contact.

Waste disposal (both proper and improper) is a significant source of contaminants entering waters all over Nigeria. Any reduction in the amount of waste being disposed would immediately benefit the nation's waters; however, there is no financial incentive for any form of recycling to reduce the waste stream. Pricing policies for many items that figure prominently in waste disposal should be examined to help relieve the burden on water resources (World Bank, 1990). The need for implementation of controlled landfill

techniques, possibly used to simultaneously reclaim damaged lands, should be examined (Ojiako, 1989).

Management within local coastal watersheds is critical to protect the quality of groundwater in the coastal zone. Local watersheds are the source of most of the limited groundwater that is increasingly used as a potable source by coastal residents. Effluent pollution and increased salinization resulting from oil exploration and dredging are the immediate threats to this important source (Amadi, 1992).

The water hyacinth problem is tied directly to the reduction in water quality in surface waters, resulting from pollutant discharges and unregulated runoff of agricultural fertilizers. Water hyacinth thrives on the increased levels of nutrients in the water, and benefits from and contributes to eutrophication of these waters (FEPA, 1991).

The problem of uncontrolled water hyacinth growth choking the waterbodies of Nigeria will diminish with decreases in the level of pollutant inputs into those water bodies. Measures discussed above (waste treatment facilities, sanitation facilities, improved watershed management) will reduce nutrient levels in those water bodies, and the weeds will no longer proliferate so rapidly and extensively. During the implementation period of these control measures, direct control and reduction of the water hyacinth problem can be accomplished through alternative uses of weed biomass. These uses include as cattle fodder (mixed with traditional feeds in combinations of up to 50 percent weed), as fertilizer after drying or composting (the residue is high in organic content, nitrogen, and potassium), or as fuel (after drying; the ashes can then be used as a fertilizer)(Reza, 1990).

(6) Water-related Diseases

The guinea worm, transmitted only by drinking contaminated water, is one of the most important water-related disease affecting the Nigerian population (Larrson, 1989). Provision of clean drinking water to the population will effectively eliminate the guinea worm problem.

The guinea worm infection cycle travels from human to intermediate host and back to the human through contaminated water. The life cycle of the worm can be interrupted in three places:

(a) Prevent Entrance of Parasite to Water Bodies

Enters from victim to water through skin; need to exclude infected persons from contact with water bodies.

(b) Prevent Intermediate Cyclops Stage

This is the intermediate host that carries the parasite; use insecticide (poisoning) or extreme heat/cold (cooling is most effective; shading or deepening of ponds can be implemented) to eradicate the host.

(c) Prevent Ingestion of Contaminated Water

Drink only clean water (education of the population will be necessary to explain the disease cycle and how to break it); introduce proven sanitation methods (filtering of water with cloth or sand; boiling; chlorination).

As noted in Table 11-1, provision of a clean, reliable source of drinking water will eliminate or help eradicate many water-related diseases. The design of such water supply systems, for small community use, should make them simple to clean and maintain; such designs are currently available at reasonable cost. The NWRMP recommends the implementation of many small dams and reservoirs to provide local sources of water for drinking and irrigation. Communities could take water piped from these small supply dams; this decentralized system could be easily maintained by the users with proper education of the local population.

Other water-related diseases can be controlled through education of the population and interdiction by extension agents regarding proper irrigation system design, control of disease vectors, and proper supply and use of clean drinking water.

(7) Socio-Economic Impacts

The primary socio-economic impact associated with water-related projects is resettlement of communities that are moved to accommodate the project. Any assessment of the environmental impact and cost-benefit of future water resources projects must take into account costs associated with the wide range of changes associated with resettlement of populations.

(8) Environmental Impact Assessment of Water-Related Projects

The focus of the NWRMP is to recommend water resources projects to meet the needs of Nigeria through the year 2020. These recommendations involve upgrading of existing projects or initiation of new projects. There are a number of benefits related to upgrading and/or modifying existing projects, versus construction of new projects. Major benefits include the fact that structures are already in place and the land required for the project is already dedicated.

Implementation of these water resources projects will have some effects on the surrounding natural, human, and socioeconomic environment. As part of the evaluation process of selecting the water resources projects for recommendation in the NWRMP, the potential for each project to affect the environment will be one of the selection criteria examined. Table 11-20 summarizes the primary causes and results of the environmental effects of water resources projects, as well as approaches to ensure adequate review and oversight of these types of projects.

TABLE 11-20 APPROACHES TO SOLUTIONS - ENVIRONMENTAL IMPACT ASSESSMENT

| Problem | Primary Causes and Results | Needs (Approaches to Solutions) |
|---|---|---|
| | **CAUSES** | |
| Water resources projects may initiate or exacerbate environmental degradation | Lack of historic emphasis on environmental needs has allowed the natural environment to degrade | Apply environmental significance criteria to determine if impacts are significant (detailed in Table-5.10-11); implement design changes or mitigation measures to reduce or eliminate impacts |
| | Historically, little coordinated statutory or enforcement structure to safeguard the environment | Coordinate reviews of environmental assessments of other Ministries' projects (i.e., NEPA-hydropower; Works & Housing infrastructure; NNPC-minerals exploration and development; FEPA-industrial pollution control) |
| | **RESULTS** | |
| | Projects have historically been implemented with no focus on environmental problems | Use the evaluation process as a required part of the feasibility evaluation for all water resources projects |
| | Lack of coordination between responsible Ministries for projects that affect wide sectors of the economy and populace | Follow up with monitoring to determine impact levels, and to see that mitigation measures are implemented and achieving stated goals |
| | Several projects in the same area may result in cumulative impacts, even though individual project impacts are not significant by themselves or readily apparent | |

The primary causes and results of environmental degradation resulting from water resources development, as listed in Table 11-20, are self-explanatory. NWRMP will focus on approaches to dealing with implementing a procedure to recognize potential environmental effects and determine if and how the projects could be modified (or abandoned, in extreme cases) to prevent such degradation.

Environment evaluation as discussed in this Chapter focuses on the impact of existing or proposed water resources development projects. To extend the focus of this evaluation effort beyond water resources projects, or into more general environmental areas, would increase the scope of the analysis by one or more orders of magnitude. The procedure discussed in this Chapter can be modified and expanded to be applicable for the environmental impact analysis of other types of projects (roads, building construction, etc.).

As part of the NWRMP, it is recommended that this evaluation should be conducted on existing water resources development projects, projects

recommended for modification to improve coverage or efficiency, or proposed projects that have advanced to the stage of pre-feasibility studies. The types of water resources development projects to be included in the evaluation should include:

- hydropower dams
- reservoir dams
- irrigation dams/associated distribution systems
- diversion structures (including water transfer schemes)
- boreholes
- fadama irrigation projects
- river ports/river navigation
- sewage treatment plants
- soil erosion projects
- flood control projects
- fisheries development projects

The areas of environmental impact that should be included in the evaluation include the following:

A. Impacts on the Natural Environment
   i. water hyacinth and other aquatic weeds
   ii. surface and groundwater supply/contamination
   iii. wildlife/biodiversity losses or gains
   iv. fisheries losses or gains
   v. deforestation
   vi. soil degradation
   vii. gully erosion
   viii. coastal erosion

B. Impacts on Human Health
   i. incidence of diseases
   ii. incidence of vectors
   iii. nutrition losses and gains

C. Impacts on socio-economic parameters
   i. occupation changes
   ii. income level changes
   iii. relocation/resettlement requirements
   iv. cultural changes

An ongoing problem in Nigeria is the lack of coordination between responsible agencies in evaluating the environmental impacts of water resources projects. Different ministries are responsible for different types of projects, and have historically conducted their own in-house feasibility studies, which may or may not include environmental considerations. As discussed earlier in this subsection, the variety of types of water resources projects, and the areas of environmental impact resulting from those projects, are very broad. A standardized evaluation procedure used by all affected agencies is required (FGN, 1989; World Bank, 1990; Ekeh, 1991). Since "prevention is always less costly than remediation" (Baum and Tolbert, 1985), these reviews should be conducted prior to project implementation (NEST, 1991), as demonstrated deficiencies can be more profound and damaging than the impacts of the project itself (Rahman and Bisset, 1990).

Just as adequate and accurate background information is necessary for the successful design of a water resources project, post-project information regarding the economic, social, and environmental consequences of the project is required to guide future regulatory actions and approaches. Post-project monitoring is required to gage the success of the project, assure that mitigation measures are achieving stated goals, and to provide an ongoing database for future project evaluations (FGN, 1989; Ekeh, 1990; Rahman and Bisset, 1990; Ajao, 1993).

Details regarding approach, criteria, and implementation of an Environmental Impact Assessment procedure for water-related projects are presented in Appendix 11-1.

(9) Need for Management of Environmental Resources

Significant environmental problems that must be addressed on a regional as well as a project basis include drought and desertification, long-term reduction of flows in major rivers, soil degradation, deforestation, soil erosion, coastal erosion, losses of wildlife and fisheries, flooding, water pollution, dislocation and resettlement of large groups of people, an water-related disease.

The present state of environmental degradation in Nigeria demands that agencies responsible for water resources management take a proactive

rather than a reactive role in management of environmental resources. Appendix 11-1 A&B discuss the approach and procedure for implementing this proactive role. At the present time, the agency charged with overseeing environmental impact assessments of development projects, FEPA, appears to be unprepared to assume at leadership role in water resources and environmental management.

Given this situation, FMWRRD must be prepared to take unilateral action, if necessary, to assure that watershed integrity is maintained and strengthened, and that environmental resources, and hence water resources, are protected. This approach is discussed further Appendix 11-1. These actions should be regional rather than local in scope, and address the regional divisions.

# APPENDIX 11 - 1

## A. MANAGEMENT APPROACH

## B. PROPOSED PROCEDURE FOR ENVIRONMENTAL IMPACT ASSESSMENT FOR FOR WATER RESOURCES PROJECTS

## C. GUIDELINES FOR ENVIRONMENTAL IMPACT ASSESSMENT OF WATER RESOURCES PROJECTS

## D. REFERENCES

### A. Management Approach

**Environmental Impact Assessment in the Context of Water Resources Development Projects.** Environmental Impact Assessment (EIA) is a process used in the project planning and management cycle to predict the environmental consequences and to plan appropriate measures to reduce the adverse effects of proposed development projects. Such development projects may involve agricultural/natural resources (irrigation, dams, reservoirs, forestry, land clearing, etc.), industry ( petroleum refining, tannery, brewery, etc.) or infrastructure (housing, water-supply, sewerage, roads, airports, harbor, etc.). Such major development projects may generate adverse environmental impacts as a result of their improper location, inappropriate design, unplanned construction, unskilled and poor operation and maintenance, and the misuse of natural resources. The projects may generate adverse impacts on water quality (flora and fauna), air quality (ozone layer and greenhouse gases), the landscape, and other features of the natural environment, which are major determinants of human health and well-being.

The major role of the EIA process is to identify and describe environmental hazards which may ensue from a project, and then specify necessary environmental protection measures (EPM) or an environmental management plan (EMP) for the project, which should include: (1) mitigation measures necessary to reduce predictable adverse effects; (2) measures for offsetting probable adverse effects; and (3) other technical and institutional measures for environmental enhancement. It is likely that all water resources development projects will require some form of EIA. The EIA requirements for

water resources projects in Nigeria are summarized in Decree No.-86 - Environmental Impact Assessment Decree 1992 (FRN, 1992).

Water resources development projects are generally distinguished by one or more of the following general characteristics:

(a) water is introduced into the project (e.g. irrigation scheme, water supply scheme, etc.) from outside the project area;

(b) a water storage system (e.g. a dam, reservoir or aquifer, etc.) is usually included;

(c) a facility for excess water discharge (e.g. spillway, storm water overflow, etc.) is generally provided;

(d) a network of channels or canals for inter-system transfer of water to and within the project or scheme (e.g. irrigation canals, water supply aqueducts, etc. ); and

(e) a drainage system to remove excess or/and used water (e.g. irrigation drainage canals, etc.).

Water resources development projects, by their very nature, generate a wide range of environmental impacts (see Table 11-3). Human health impacts of water resources development projects, as well as water quality impacts, ecological impacts, and socioeconomics, are the most significant impacts in water resources projects. Two primary approaches to environmental management in the water resources sector will be detailed in this section: 1) watershed management and 2) Environmental Impact Assessment.

Watershed Management. Watershed Management considers the requirements and implications of the entire watershed when formulating and implementing development planning and policies. As was discussed in Chapter 11, it is recognized that one action affects many different types of environmental resources, and can cause many types of environmental problems.

Section 11. 2. 3 of the NWRMP addressed a variety of basic environmental "needs" in the water resources sector, and advanced some preliminary approaches to solutions to those needs. However, a management philosophy needs to be adopted, and a management program needs to be

formalized and vigorously implemented within FMWRRD, that addresses these issues on a regional rather than a local basis.

**Environmental Impact Assessment.** The use of Environmental Impact Assessments as an integral part of environmental resources planning grows out of the recognition that water resources development projects have the potential to affect the natural systems that support human life. Recognition of that fact will lead to the use of EIA in the following manner:

- use of EIA as an integral part of water resources development project management cycle (DPPC, 1992).
- Implementation of the steps in the EIA process must be standard policy for all projects expected to have an environmental impact (FRN, 1992). These steps are more fully developed in Section B of this Appendix.
- The FMWRRD will develop procedures for coordinating and performing environmental impact assessments in conjunction with projects funded by Federal, State, or local governments (CEC, 1993).
- The FMWRRD will develop procedures for coordinating and performing environmental impact assessments in conjunction with projects funded by private developers.
- Working with other Ministries as appropriate, the FMWRRD will structure and implement the environmental review process with ongoing structured planning efforts (regarding housing, infrastructure, etc.) at several levels of government (country, region, sector, project) (ADB, 1993).

The approach will emphasize early evaluation of potential environmental impacts, coordination with other Ministries as required, and promote communication with and notification of affected parties. The goal of the approach will be to promote information exchange and consultation (FRN, 1992) consistent with FEPA/Decree 86 requirements (FRN, 1992). The approach will involve the public as well as government, to help promote "tenure" and local ownership of project elements, in keeping with the NWRMP approach to smaller, de-centralized facilities serving local populations.

To assure that all applicable projects have been thoroughly reviewed for their potential impact, the approach will include the issuance of a Certificate of Completion (similar to FRN [1992], p. 993, 42.), which indicates that the FMWRRD has reviewed and approved all aspects of any proposed water resources development project, and has stipulated conditions regarding project planning, construction, and operation that protect the natural environment and the affected population.

(1) EIA Decree (FEPA)

The EIA Decree (FRN, 1992) is the basis for all environmental impact assessment of water resources development projects. The decree requires environmental assessment for many types of water resources projects and projects affecting watershed management. It is the basis for the stated approach to early impact assessment, coordination/communication/notification, and provides a structured approach to the evaluation of potential environmental impacts.

(2) Water Resources Decree

The Water Resources Decree (FRN, 1993) gives the FMWRRD significant powers to implement measures for watershed management and resource protection. Significant power to control activities in any watershed area is vested in the Secretary for Water Resources. It can be used as the basis for development of an aggressive management and enforcement program to protect and maintain water resources in Nigeria.

The mandate of the Water Resources Decree gives the FMWRRD broad latitude in the area of watershed management. In some areas, the EIA Decree may fail to adequately protect water resources; in those cases, the Secretary for Water Resources must be prepared to impose additional requirements to protect those resources. In the interest of watershed protection, however, the NWRMP recommends several areas where requirements need to be strengthened as compared to those in the EIA Decree. Table 11-A-1 lists the comparative requirements for the major project categories listed in the EIA Decree, and lists recommended requirements specific to FMWRRD approval, as well as the areas of interest for FMWRRD that are affected by each project type.

As was shown from Table 11-5, a total 92 dams and reservoirs (approximately 29 percent of all dams/reservoirs) have surface areas greater than 100 hectares, while only 23 (7 percent) have surface areas greater than 1,000 ha. Fifty-six (17 percent) have surface areas greater than 200 hectares. Thus, based on the FEPA EIA study requirement standard (FRN, 1992; see Table11. 2-1), only 56 dams and reservoirs (17 percent) in the country will merit EIA study. (With the requirement usually adopted in the other developing countries for EIA to be carried out on dams/reservoirs having surface areas greater than 1,500 ha, only 23 dams and reservoirs will merit EIA study.) This situation demonstrates the need for FMWRRD to set its own standards and implement the EIA approach to water resources development and oversight and watershed management.

## Table 11 - A - 1

## Proposed FMWRRD Requirements for Projects Needing EIA

| Project Type | FEPA Requirement* | Proposed FMWRRD Requirement | FMWRRD Areas of Interest |
|---|---|---|---|
| 1. Agriculture | Clearing of forest area > 500 ha | > 50 ha | Watershed management, Water pollution |
| 2. Airports | longer than 2,500 m | any length | Watershed management, Water pollution |
| | in State/national parks | also in forest reserves, wildlife reserves | |
| 3. Drainage and Irrigation | construction of lake > 200 ha | same | Water-related disease, Water pollution, eutrophication, Wildlife/fisheries losses, Reduced flow availability downstream, Socio-economic factors |
| | conversion of wetland, wildlife habitat, virgin forest > 100 ha | any; freeze on development preferable | Watershed management, Deforestation, Wildlife/fisheries losses, Socio-economic factors |
| | irrigation project size > 500 ha | > 50 ha | Watershed management, Water pollution, Water-related disease, Socio-economic factors |
| 4. Land reclamation | coastal reclamation > 50 ha | same | Coastal erosion, Wildlife/fisheries losses |
| 5. Fisheries | new harbors | same | Coastal erosion, Wildlife/fisheries losses, Water pollution |
| | harbor expansion > 50 percent | same | Coastal erosion, Wildlife/fisheries losses, Water pollution |
| | clearing > 50 ha of coastal mangroves for aquiculture | same | Coastal erosion, Wildlife/fisheries losses, Water pollution |

## Table 11 - A - 1 (Continued)
## Proposed FMWRRD Requirements for Projects Needing EIA

| Project Type | FEPA Requirement* | Proposed FMWRRD Requirement | FMWRRD Areas of Interest |
|---|---|---|---|
| 6. Forestry | > 50 ha hill forest converted to other land use | same | Watershed management, Soil degradation, Wildlife/fisheries losses, Water pollution |
| | logging or conversion to other uses in designated catchment or protected areas | same; freeze on development preferable | Watershed management, Soil degradation, Wildlife/fisheries losses, Water pollution |
| | logging > 500 ha | same | Watershed management, Soil degradation, Wildlife/fisheries losses, Water pollution |
| | conversion of mangrove swamps for industrial, housing, or residential use > 50 ha | same | Watershed management, Soil degradation, Wildlife/fisheries losses, Water pollution |
| | clearing of mangrove swamps on islands adjacent to national marine parks | same | Watershed management, Soil degradation, Wildlife/fisheries losses, Water pollution |
| 7. Housing | development > 50 ha | same | Watershed management |
| 8. Industry | several types | same for each type | Watershed management, Water pollution |
| 9. Infrastructure | several types | same for each type | Watershed management, Water pollution |
| 10. Ports | new or expanded | same for each type | Coastal erosion, Water pollution |

## Table 11 - A - 1 (Continued)
## Proposed FMWRRD Requirements for Projects Needing EIA

| Project Type | FEPA Requirement* | Proposed FMWRRD Requirement | FMWRRD Areas of Interest |
|---|---|---|---|
| 11. Mining | lease size > 250 ha | same | Watershed management, Soil degradation, Deforestation, Water pollution |
| | ore processing facilities | same | Watershed management, Water pollution |
| | dredging > 50 ha | any | Coastal erosion, Wildlife/fisheries losses |
| 12. Petroleum | development of oil/gas fields | same | Watershed management, Water pollution |
| | construction of offshore pipelines > 50 km | construction of offshore pipelines > 5 km | Coastal erosion, Water pollution Wildlife/fisheries losses |
| | separation, processing, handling, and storage facilities | same | Watershed management, Water pollution |
| | refineries | same | Watershed management, Water pollution |
| | product/storage depots within 3 km of designated areas and > 60,000 barrels | product/storage depots within 3 km of designated areas and > 5,000 barrels | Watershed management, Water pollution |
| 13. Power Generation/ Transmission | steam-generated power stations > 10 m W | same | Watershed management Water pollution Wildlife/fisheries losses |
| | dam/hydro schemes | any | Watershed management, Water pollution, Wildlife/fisheries losses Socio-economic factors, Reduced flow availability downstream |
| | combined cycle power stations | any | Watershed management, Water pollution Wildlife/fisheries losses |

## Table 11 - A - 1 (Continued)
## Proposed FMWRRD Requirements for Projects Needing EIA

| Project Type | FEPA Requirement* | Proposed FMWRRD Requirement | FMWRRD Areas of Interest |
|---|---|---|---|
| 13. Power Generation/ Transmission (continued) | nuclear power stations | any | Watershed management, Water pollution, Wildlife/fisheries losses Socio-economic factors, Reduced flow availability downstream |
| 14. Quarries | within 3 km of designated areas | any | Watershed management, Soil degradation, Water pollution |
| 15. Railways | new routes or branch lines | same | Watershed management |
| 16. Transportation | mass rapid transit projects | same | Watershed management |
| 17. Resort and Recreational Development | coastal resorts > 80 rooms | same | Watershed management Coastal erosion, Deforestation, Wildlife/fisheries losses, Water pollution |
| | hill station resorts > 50 ha | same | Watershed management, Soil degradation, Deforestation, Wildlife/fisheries losses, Water pollution |
| | facilities in National Parks | same | Watershed management, Soil degradation, Deforestation, Wildlife/fisheries losses, Water pollution |
| | facilities on islands that are potential national parks | same | Watershed management, Soil degradation, Deforestation, Wildlife/fisheries losses, Water pollution |

## Table 11 - A - 1 (Continued)
## Proposed FMWRRD Requirements for Projects Needing EIA

| Project Type | FEPA Requirement* | Proposed FMWRRD Requirement | FMWRRD Areas of Interest |
|---|---|---|---|
| 18. Waste Treatment and Disposal | toxic/hazardous wastes (several types) | same | Watershed management, Water pollution, Socio-economic factors, Water-related diseases |
| | municipal solid waste (several types) | same | Watershed management, Water pollution, Socio-economic factors, Water-related diseases |
| | municipal sewage (several types) | same | Watershed management, Water pollution, Socio-economic factors, Water-related diseases |
| 19. Water Supply | dam with reservoir > 200ha | same | Water-related disease, Water pollution, eutrophication, Wildlife/fisheries losses, Reduced flow availability downstream, Socio-economic factors |
| | groundwater development > 4,500$m^3$/day | 500$m^3$/day | Desertification, Watershed management, soil degradation, Wildlife/fisheries losses, Reduced flow availability downstream, Socio-economic factors |

* Decree No. 86, Environmental Impact Assessment Decree (FRN, 1992)

## B. Proposed Procedure for Environmental Impact Assessment for Water Resources Projects

The following sections detail a proposed procedure for the preparation of Environmental Impact Assessment reports for or within the FMWRRD.

### (1) General Overview

Section of this Appendix discussed the need for and approach to environmental impact assessment for all water-related development projects. This section details the procedure for implementing such assessments. The types of projects to be considered for environmental assessment are specified in the EIA decree; recommendations for additional assessment requirements were presented in Table11-A-1.

The methodology for preparation of EIA reports has been detailed by a number of international funding agencies (see for example CEC, 1993). In general, most categorize projects based on their potential environmental impacts (for example, projects are placed into Category A, B, or C, with Category A being most likely to cause environmental harm [ADB, 1993]). This categorization specifies the level of environmental analysis required for each project type (ADB, 1993).

Unfortunately, the categorization developed by some agencies is reversed; in CEC [1993], the A, B, and C levels are reversed compared to ADB, with Category A being least likely to cause environmental harm, and C most likely to require EIA. These levels should be clearly defined in any guidance document developed or adopted for EIA in Nigeria.

CEC (1993) gives examples of many types of water resources development project, and provides sample environmental impact checklists for 16 types of projects, including such types as Rural and Urban Water and Sanitation, Waste Disposal, Irrigation, etc. ADB (1993) indicates that some water resources development projects require no environmental documentation (i.e., no checklist). However, CEC (1993) requires that a checklist documentation be prepared for all water resources projects, and that is the approach recommended for the NWRMP.

Minimum content requirements for the EIA process are included on page 980 of the EIA Decree (FRN, 1992). In some cases, the NWRMP recommends more stringent requirements for FMWRRD projects where water resources are potentially threatened. These additional requirements were detailed in Table11-A-1. The NWRMP also recommends that FMWRRD review all projects that potentially affect water resources; if the developer of the water resource is a private company or individual, FMWRRD should review and approve the details of the project before forwarding the documentation to FEPA for review and approval.

(2) Approach to Proposed Project Cycle and Review

In evaluating the potential of a development project to affect water resources, FMWRRD should implement a consistent process of consultation and review that combines planning, regional and local needs and concerns, and access to information to allow the widest possible discussion of potential environmental impacts. A generic project cycle is presented in Table11-B-1 that lists a total of six major project stages, and briefly outlines the activities that take place during each stage. The details of activities in each stage are more fully discussed in later subsections of Section B.

The EIA Decree of 1992 (FRN, 1992) specifies that all projects meeting certain size requirements must undergo an environmental review procedure. The timing of this review procedure should be such that projects move forward with dispatch, while at the same time providing for adequate coordination and notification, and to allow interested and affected parties to submit input regarding the proposed project.

A proposed review procedure and time frame for project review and approval is presented in Table11-B-2. This proposed time frame includes all of the activities specified in the EIA Decree (FRN, 1992), and includes provision for project review by FEPA in all cases, and by FMWRRD prior to FEPA review when the development project is being performed by another Ministry or by a private party and has the potential to affect water resources. A similar process was described by DPPC (1992).

(3) Project Concept and Scoping

This step brings together the various planning elements that are responsible for planning for future growth, matching human needs with resources, and maintaining environmental resources. This step formalizes the description of the requirements for the proposed project and the goals that the project is expected to accomplish (i.e., provide drinking water for a population of 10,000persons; provide a specified volume of water to irrigate 5,000ha; or to increase commercial wood forests in a state by 50,000ha to provide for wood product needs over the next ten years) (Table11-B-1). The Statement of Purpose and Need is developed by the project proponent or its consultant. While this step is not specifically called for by the EIA Decree (FRN, 1992), it is recommended as a way to document project plans and to assist in evaluating the proposed project in terms of existing planning activities.

The EIA Decree specifies the need for "pre-notice" of a project to FEPA (Table11-B-2)(FRN, 1992). This step alerts FEPA that a project requiring environmental evaluation has advanced to the stage of being seriously considered; environmental evaluation will be necessary for the project to continue further. The Project Concept Announcement also notifies other agencies and the public that a project is in the advanced planning stage. These interested parties may now submit input regarding the purpose, need, and potential environmental effects of the project. The project proponent should consider this input for the final design of the project. To allow adequate time for input from agencies and individuals, a minimum of 30-days should be allowed for this stage of the project cycle (Table11-B-2).

The product of this stage of the project review cycle is a firm description of the proposed project, adequately documented and justified, and modified as necessary by agency and public input, that can move forward to the environmental screening stage.

## Table 11 - B - 1
## Generic Water Resources Project Cycle

| Project Stage | Project Activities |
|---|---|
| Project Concept | Planning activities<br>Statement of Purpose and Need |
| Pre-feasibility | Project site selection and configuration<br>Identify alternatives to be considered<br>Scoping of significant issues (notification, consultation)<br>Studies as required for assessment<br>Initial environmental evaluation (Screening Report) |
| Feasibility | Environmental impact assessment (EIA)<br>Detailed assessment of proposed project and alternatives<br>Identification of mitigation needs<br>Detailed design of mitigation measures, monitoring needs |
| Design/Engineering | Incorporate required mitigation as necessary based on EIA results and FEPA/FMWRRD requirements |
| Implementation | Construction, operation<br>Monitoring and evaluation<br>Conformance to expected design and operation specifications<br>Success/failure of mitigation measures |
| Post-implementation | Evaluate future design/operation requirements<br>Evaluate future mitigation requirements<br>Add information to database of project effects for reference on future projects |

## Table 11 - B - 2
## Proposed Review Procedure for Water Resources Projects

| Step | Activities | Reference* | Recommended Time Period |
|---|---|---|---|
| 1. Statement of Purpose and Need | developed by proponent | recommended | as required |
| 2. Project Concept Announcement and Notification of Screening Report Preparation | prepared by proponent | p. 980, 2(3) | minimum 30 days |
| | following announcement, conduct scoping discussions with appropriate agencies<br>public may submit input regarding scope<br>alternatives defined<br>studies as required<br>feasibility study | | |
| 3. Screening Report | required for all projects<br>prepared by proponent or consultant<br>description of project and alternatives<br>checklist of potential environmental impacts<br>explanatory text<br>if private, approval by FMWRRD required | | as required |
| 4. Forward Approved Screening Report to FEPA for Review | FEPA review | p. 984,17(2) | minimum 30 days |
| | public review period<br>response to FMWRRD/proponent<br>if approved and no EIA required, FMWRRD gives approved to implement<br>if approved and EIA required, continue to 5. | p. 987, 22(3) | |

## Table 11 - B - 2
## Proposed Review Procedure for Water Resources Projects

| Step | Activities | Reference* | Recommended Time Period |
|---|---|---|---|
| 5. Prepare EIA Report | prepared by proponent or consultant<br>environmental evaluation<br>project impacts, cumulative impacts<br>alternatives evaluation<br>recommended mitigation measures<br>if private, approval by FMWRRD required before forwarding to FEPA | | as required |
| 6. Forward Approved EIA Report to FEPA for Review | FEPA review | p. 984, 17(2) | minimum 30 days |
| | public review period<br>FEPA response to FMWRRD/proponent<br>approval/disapproval requirements (design, mitigation, monitoring, etc.)<br>permits as required | p. 988, 25(1) | |
| 7. Certification Announcement by FEPA | | p. 933, 42 | as required |
| 8. Monitoring | by proponent or consultant<br>documentation of mitigation monitoring and other requirements<br>submit to FMWRRD and FEPA as required | p. 999, 57(2) (a) | as required |

* Decree No. 86 : Environmental Impact Assessment Decree 1992 (FRN, 1992)

(4) Screening Report

A Screening Report is required for all projects addressed by the EIA Decree (FRN, 1992). For projects that potentially affect watershed integrity, FMWRRD may place additional documentation and review requirements on the project proponent (see Section A of this Appendix).

The Screening Report is essentially an environmental checklist, comparing a detailed description of the proposed project to specified evaluation criteria to determine if potential environmental impacts are minor or potentially serious. The results of the Screening Report may lead the project proponent to modify the project to avoid some potentially serious environmental problems.

Project alternatives which may achieve the aims of the project are also formulated at this stage. If environmental information required to make a general determination regarding the effects of the project is lacking, environmental studies should be identified and implemented to provide the needed information.

The result of this stage of the project cycle is a formal Screening Report that describes the project and its alternatives, and evaluates the project for potential environmental impacts. The Screening Report must be reviewed and approved by FEPA (see Table11-B-2 and FRN, 1992) before the project can proceed. If the project affects water resources, and FMWRRD has placed additional requirements on the project proponent (or if the project is privately funded), FMWRRD should review and approve the Screening Report prior to it being submitted to FEPA (Table11-B-2).

An example format for the Screening Report is shown as Appendix 7. ADB (1993) also has suggested formats for screening (called an initial environmental examination, or IEE, by ADB).

(5) Feasibility

This step in the project cycle is used to evaluate the feasibility of the project in terms of its potential impact on the environment and its potential effect on sustainable development of natural resources in Nigeria.

This evaluation requires a detailed analysis of the impacts of the project in an Environmental Impact Assessment report. In the Pre-Feasibility stage (Project Concept and Scoping, Section B (3)), the project proponent identified significant issues through the scoping process, and conducted any studies required to provide information to analyze potential environmental impacts of the project. The EIA report uses this information to provide a detailed environmental assessment of the proposed project and its feasible alternatives. The determination as to whether any element of the proposed project will potentially have a significant impact on environmental resources is based on the used of defined significance criteria in each environmental area (see Section B (6)). The EIA report should identify mitigation measures to assure that potentially-significant impacts are reduced to non-harmful levels. If mitigation for some environmental impacts is required, the EIA should recommend a monitoring program to be implemented during project construction and/or operation to assure that the recommended measures are adequate to reduce the impact to a level of insignificance.

The EIA Decree specifies that FEPA must review and approve any EIA report prepared for a project in Nigeria (Table 11-B-2)(FRN, 1992). In addition, a public review period must be provided so that affected communities and individuals can make known their concerns regarding the proposed project. FEPA should consider the input of affected agencies and individuals when deciding to approve a project EIA, and in recommending and approving appropriate mitigation measures and monitoring programs.

The outcome of this step is an approved project ready to go forward with design and construction, subject to the requirements of FEPA and FMWRRD regarding permit conditions (mitigation measures) for construction and operation, and monitoring requirements to assure that environmental guidelines are met. FEPA is required by the EIA Decree (FRN, 1992) to issue a Certification Announcement that the project has received adequate environmental review (Table 11-B-2).

A sample Table of Contents for an EIA report is presented in Appendix 8. ADB (1993) also presents suggested formats for EIA reports.

(6) Significance Criteria for EIA

The criteria which will indicate whether the potential environmental impact is significant are listed in Table 11-B-3 for each potential impact area. In some areas criteria are listed; in others the specific criteria require development. Sources are listed in the table where criteria were extracted from existing documents; other listed criteria are suggested. In all cases, the criteria should be developed in such a way that:

- agencies affected by the project or that are responsible for its implementation should agree on the criteria used (Ajao, 1993).
- the criteria should be reasonable rather than exotic, based on economic, social, and environmental concerns.
- the criteria should be defendable based on past experience and statutory mandate, and enforceable based on agency mission and powers.

The criteria listed in Table 11-B-3 are suggested criteria for use in evaluating the environmental effects of proposed projects. As noted in Table 11-B-3, some of the significance criteria were taken from previous publications regarding water resources and environmental protection in Nigeria; however, it would be presumptive to completely define these criteria in the NWRMP, or make the criteria so rigid as to be inflexible. FMWRRD should draft general significance guidelines and tailor them to specific water development projects on a case-by-case basis. The criteria will likely vary by region and for different projects.

## Table 11 - B - 3
## Environmental Impact Assessment Significance Criteria for Water Resources Development Projects

| Impact Area | Criteria | | Source |
|---|---|---|---|
| | EXISTING PROJECTS | PROPOSED PROJECTS | |
| **NATURAL ENVIRONMENT** | | | |
| Water hyacinth/ aquatic weeds | to be developed | Presence of nuisance weeds in the project area | |
| Surface/ groundwater quality | Exceeds WHO standards for drinking water | same | FGN, 1991- FEPA standards |
| | Exceeds statutory effluent quality limitation standards | same | |
| Surface and groundwater quality | Exceeds sustainable yield | same | |
| | Loss of beneficial uses (agriculture, navigation, etc.) | same | |
| | Affects special habitats | same | |
| | to be developed | Increases impervious area or reduces recharge | |
| | to be developed | Alters direction of flow of groundwater or surface water | |
| | to be developed | Encroaches on areas designate for groundwater recharge | |
| Wildlife/ biodiversity | Reduces genetic diversity | same | NRCC, 1992b |
| | to be developed | Impacts designated species | |
| | to be developed | Encroaches on designated areas: must be compatible with management plans for those areas | FRN, 1991 |
| | to be developed | Encroaches on designated habitat (mangrove forest, rain forest, wetland) | |
| Fisheries | to be developed | Impacts designated species, reduces yields | |

## Table 11 - B - 3
## Environmental Impact Assessment Significance Criteria for Water Resources Development Projects

| Impact Area | Criteria | | Source |
|---|---|---|---|
| | to be developed | Encroaches on designated area | FRN, 1991 |
| | to be developed | Encroaches on designated habitat (mangrove forest, wetland) | |
| | to be developed | Compatible with applicable coastal zone management plans | |
| Deforestation | | Encroaches on designated areas (reserves, etc.) | NRCC, 1992b |
| Soil degradation | to be developed | NALDA land-clearing guidelines | NRCC, 1992b |
| | to be developed | Exposes soils to uncontrolled runoff | |
| | to be developed | Reduces watershed integrity (loss of quality, increased erosion) | NRCC, 1992b |
| Soil erosion | to be developed | Affects infrastructure function | |
| | to be developed | Affects use of water courses (navigability, etc.) | |
| Coastal erosion | to be developed | to be developed | |
| HUMAN HEALTH | | | |
| Diseases | Pre/post project incidence of malaria, guinea worm, schistosomiasis, onchoceriasis, leptospirosis in project area | same | |
| Vectors | Pre/post project incidence of mosquitoes, blackflies, aquatic mollusks in project area | same | |

## Table 11 - B - 3
## Environmental Impact Assessment Significance Criteria for Water Resources Development Projects

| Impact Area | Criteria | | Source |
|---|---|---|---|
| | EXISTING PROJECTS | PROPOSED PROJECTS | |
| **HUMAN HEALTH** | | | |
| Nutrition | Significant difference ($p<0.05$) in child body weight in project area compared to control | same | NRCC, 1992b |
| **SOCIO - ECONOMIC PRAMETERS** | | | |
| Occupation changes | to be developed | to be developed | |
| Income level changes | to be developed | to be developed | |
| Relocation requirements | to be developed | to be developed | |
| Cultural changes | Changes or eliminates cultural practices | to be developed | |
| | Affects culturally-reserved areas | to be developed | NRCC, 1992b |

(7) Design/Engineering

Following approval by FEPA and FMWRRD, the project is ready to move forward into final design, incorporating as necessary any design changes or mitigation measures to minimize impacts on the environment (Table 11-B-2).

(8) Implementation

Project implementation includes the construction and operation of the project, and the implementation of any monitoring programs specified by FEPA or FMWRRD to assure that environmental impacts are minimized (Table 11-B-1). Periodic reports should be filed by responsible agencies to confirm that the construction of the project conforms to the approved design, and, following the

beginning of operation, that the project is operating in an expected and acceptable manner (Table 11-B-2).

The results of the monitoring programs should be examined by regulatory agencies to confirm that the environment is responding as predicted to the construction and operation of the project. If unexpected environmental effects are observed, additional measures may need to be implemented to protect environmental resources.

(9) Post-Implementation

Historically, Nigeria has not performed Environmental Impact Assessments on water resources development projects, or maintained data related to the environmental impacts of those projects. As discussed in other sections of the NWRMP, the need is great for developing and maintaining these data, which can then be used to evaluate the design and operation requirements for future projects, as well as determine the level of success of mitigation measures to reduce environmental impacts (Table 11-B-1).

Recommendations regarding the requirements for compiling such a database, and recommendations for pilot monitoring projects for a representative variety of water resources development projects, are detailed in Section C of this Appendix.

## C. Guidelines for Environmental Impact Assessment of Water Resources Projects

This section presents guidelines for developing environmental impact assessments for several types of water resources projects. The major project categories correspond to those addressed in Chapter 11 of the NWRMP: dam and reservoir projects; river basin development projects; and water supply projects. For each category, recommendations regarding impact assessment, monitoring, and proposed studies are detailed.

An environmental impact associated with all types of water-related projects is impacts on the health of local inhabitants. A discussion of these impacts and approaches to their assessment is presented first, and should be considered when determining an assessment approach for any project from the three major categories discussed above.

### (1) Environmental Health Impacts and Water-Related Diseases

The health component of EIA generally starts with the screening of environmental parameters to identify those with health significance. Only environmental parameters which have a health significance (called, for convenience, environmental health parameters) are considered in the subsequent stages of the analysis. Epidemiological studies provide the most important means of assessing the health significance of an environmental parameter. However, epidemiological studies and data are generally lacking in developing countries such as Nigeria. Table11-C-1 presents checklists of the parameters for use in environmental health impact assessment. In view of the lack of epidemiological data in the developing countries, recourse is often made to assessing the state and degree of water-related diseases which inevitably result from the planning and implementation of water resources development projects.

### (2) EIA Study and Environmental Monitoring Guidelines for Dams and Reservoirs

**Impact Assessment.** Approaches such as those outlined in Appendix 6 should be used in choosing the key or major impacts to be assessed in dam and reservoir projects. Using the type of questionnaire/checklist developed for the

water supply projects, and also taking into consideration local, state, and national environmental policies, standards, legislations, priorities, care should be taken in analyzing the nature and significance of these impacts before choosing appropriate mitigation measures.

**Monitoring.** Both industrialized and developing countries recognize the fact that EIA as such is merely a prediction of what may happen once a project is implemented. It is not the actual development, but only a scenario. It will remain necessary to monitor the actual development during preparation, commissioning, and operation of the project. Monitoring is the repetitive observation of phenomena within a pre-defined framework of time and place. Data collected during a monitoring program must be processed, stored, retrieved and presented.

By comparing actual results and observations with predictions and standards, undesirable developments can be recognized, corrected, reduced, and if possible eliminated. Monitoring can be used both as a tool for post-project auditing and as a method of evaluating the quality of the EIA. It also provides an early warning of pollution problems, natural resource degradation, and interference with other interests of society.

**Proposed Studies.** The NWRMP should initiate systematic EIA studies and environmental monitoring programs on selected dams and reservoirs in the country. Candidate dams and reservoirs should be selected from the six Regional divisions which have taken principal geographical features and climatic-agroecological factors into account. The initial EIA study and environmental monitoring program, which should be undertaken by a multidisciplinary team over a 12-month period, should monitor the following parameters:

(a) rainfall

(b) stored water volume in the reservoir

(c) annual volume of sediment transported into reservoir

(d) water quality at dam discharge and at various points along the river (such as: salinity, pH, temperature, electrical conductivity, turbidity, dissolved oxygen, suspended solids, phosphates, nitrates)

## Table 11 - C - 1

## Checklists of Parameters for Use in Environmental Health Impact Assessment

**Disease agents**

Biological

- parasites
- helminths
- protozoa
- bacteria
- mycobacteria
- Rickettsia
- viruses

Physical

- noise
- vibration
- inert dust
- ionizing radiation
- non-ionizing radiation
- excessive temperature/humidity

Chemical

- toxic chemicals
- heavy metals
- organics
- inorganics
- fermentable organics

**Environmental health factors**

Primary

- urban air pollution
- indoor air pollution
- toxic wastes
- radioactive leakage
- noise levels
- improper solid waste disposal
- improper liquid waste disposal
- lack of proper drainage
- unstable structures (accidents)

Secondary

- increase of vector population resulting from increase in food supply, habitat, or reproduction sites

**Exposure pathway of toxic chemicals**

- food
- drinking water
- skin contact
- air breathed

**Exposed populations for hazardous industrial plants**

- workers
- their families
- surrounding population
- consumers of products

**Risk groups**

- infants
- children of preschool age
- pregnant women
- elderly people
- handicapped people
- workers in hazardous plants
- persons suffering from specific chronic diseases
- persons with specific genetic deficiencies

(e) hydrogen sulfide and methane generation behind the dam

(f) limnological sampling of microflora, microfauna, aquatic weeds and benthic organisms

(g) fisheries assessment surveys (species, populations, etc.) in the river and reservoir

(h) wildlife (species, distribution, numbers)

(i) vegetation changes (cover, species composition, growth rates, biomass, etc.) in the upper watershed, reservoir drawdown zone, and downstream areas;

(j) increases in erosion in the watershed

(k) impacts on wildlands, species, or plant communities of special ecological significance

(l) public health and disease vectors

(m) in- and out-migration of people to area

(n) changes in economic and social status of resettlement populations and people remaining in the river basin.

The EIA study and environmental monitoring of dams and reservoirs will yield reliable data which will ensure the systematic incorporation of environmental considerations and impacts into the integrated NWRMP being currently carried out.

(3) EIA Study and Environmental Monitoring Guidelines for River Basin Development

**EIA Guidelines for Fisheries Projects.** As has been indicated above, the creation of reservoirs has helped to boost Nigeria's fishing industry. However, dams are known to have serious adverse effects on fish populations in downstream areas as a result of the trapping of nutrients in the reservoirs, as well as the non-flooding of breeding areas, such as back-swamps. These phenomena, as well as the drastic decline in the quantity and species (or variety) of fish caught below some Nigerian dams such as the Kainji, Bakolori and Tiga, have been observed and, in the case of the Kainji, systematically documented.

Fishery resources, as part of the living environment, are sensitive to perturbations and pollution resulting from human activities. Fishery activities

or projects may also affect other sectors of the environment. In drawing up an EIA study guideline, it is important to distinguish between capture fisheries, which involves the exploitation of wild stocks of fish, and aquaculture, which is fish farming. The former is predominant in Nigeria, while the latter is gradually being introduced.

**Capture Fisheries.** The most productive areas for fishing are areas of high biological productivity, which in Nigeria are rivers and floodplains, coastal and brackish waters, and lakes and reservoirs; coral reefs, swamps, and zones of oceanic upwelling can also support major fisheries. Fish stocks are a biologically-renewable resource and are vulnerable to over-exploitation. The relevant major impacts are briefly discussed below.

**Changes in aquatic ecosystem:** There are complex interreactions between different fish species and between fish and other aquatic organisms. Changes in the numerical balance between fish species, as a result of selective fishing methods, can cause significant shifts in faunal composition;

**Depletion of species:** Overfishing, especially when selective fishing is applied, may lead to a severe decline of a particular species. Populations of non-target species are also affected, in particular when non-selective gear is used. Accidental catches of endangered species, such as marine mammals and turtles, may seriously affect the survival of these species.

**Destruction of natural aquaculture:** Some fishing methods, such as dynamiting, use of chemicals and trawling over coral reefs, cause severe and long-term damage to the bottom substrata and the organisms it harbours.

**Aquaculture.** Depending on the cultured species, fish and shrimp farming can be effectuated in fresh, brackish or marine waters. Depending on the scale at which aquaculture activities take place, they can have more or less adverse impacts on the environment as discussed below.

**Water pollution:** Discharge of nutrient-rich waters from culture ponds in the surrounding waters may lead to eutrophication. Also, pollution may be caused by antibiotics and pesticides used in

aquaculture. Furthermore, wastes from processing plants may be dumped into the natural waters.

**Water-related diseases:** Stagnant water in ponds provides a habitat for snails and breeding of mosquitoes that are vectors for diseases.

**Introduction of exotic species:** Release or accidental escape of exotic species from the fish ponds may have an impact on the existing aquatic fauns and flora (e.g., Tilapia).

**Conflicts on water use:** Fresh water requirements for aquaculture may be in conflict with the water demands for agriculture or human consumption.

**Loss of natural habitat:** Aquaculture projects based on marine species are currently implanted in a brackish water environment, such as mangrove swamps. Fish pond construction may, therefore, result in the loss of natural habitat and nursery areas for important capture fishery resources.

The significance of the aforementioned key environmental impacts of fisheries projects have to be analysed, evaluated, and mitigated in the EIA of these projects.

**EIA Guidelines on Mining Projects.** Most commercial mining projects involve material handling within the mining area and to and from the processing facilities, and as a result require fleets of large excavating and transporting equipment, conveyors, pipelines, or rails. A large mining operation is a major industrial complex with several hundreds or thousands of workers, and which requires significant infrastructure (roads, railroads, water supply, etc.). Significant environmental impacts are, therefore, to be associated with mining projects, as has been indicated above. Some or the significant impacts associated with mining operations are discussed below.

(a) **Loss of natural vegetation and wildlife habitat:** Surface mining leads to a significant disruption of the natural environment. It often takes place in previously inaccessible areas, and sometimes near or in environmentally sensitive areas. The magnitude of impact depends also on the size of the excavated area. Vegetation and animal life can be significantly affected by clearing for mining and transport facilities. Access to the area is increased for settlers, and natural vegetation and wildlife will be affected by agricultural practices, hunting, and wood cutting.

(b) **Loss of scenery:** As has been indicated in the case of Jos Plateau, mining has significant visual impacts. Open-cast mining implies the displacement of large amounts of rocks and soil. Underground mining wastes are dumped on the ground as spoil, slag, or tailings.

(c) **Changes in hydrology:** Underground and surface drainage patterns are altered irrevocably. The quantity of water in aquifers in the vicinity can thus be seriously affected. This aspect needs to be thoroughly investigated in the NWRMP.

(d) **Soil degradation:** The removal of tree and shrubs, which act as wind breaks and soil stabilizers, can accelerate soil erosion and lead to landslides. Subsurface working may lead to soil subsidence.

(e) **Pollution:** The material excavated in the mines is often toxic. Its toxicity and concentration determine the significance of the impact. Precipitation may leach the toxic materials into groundwaters or surface water sources. Furthermore, blasting may cause dust pollution. The pollution from mines may be trans-boundary.

(f) **Social impacts:** Noise and vibration from blasting or drilling reach high levels, affecting the local population and the workers. Hearing of the workers is impaired by extended high noise levels. Serious accidents may occur, because mining often involves blasting and use of heavy equipment. Excavated areas may cave in, especially during underground mining in unstable soils. The improved access to the surrounding forest may lead to the spread of spontaneous settlements and shifting cultivation in forest areas.

(g) **Loss of land and resettlement:** The land which is mined is lost for other purposes. People living in the project site must be resettled, because the land is needed for mining and for the allocation of a buffer zone.

(4) EIA Study and Environmental Monitoring Guidelines for Water Supply Projects

Water supply projects are executed mainly for their beneficial health impacts. However, if they are not properly planned, designed, and implemented, they may have negative health impacts. During the preliminary environmental assessment (PEA) or the initial environmental examination (IEE) of the EIA process, a project may be assigned to Category 1 (or A), 2 (or B), or 3 (or C), which are defined as follows:

Category 1 (or A) : Projects which may have significant environmental impacts, requiring detailed field review and full environmental impact assessment (EIA) study;

Category 2 (or B) : Projects with limited environmental impacts that can be mitigated by applying specific measures or changes in project planning and design; and

Category 3 (or C) : Projects not anticipated to result in adverse environmental impacts, for which environmental assessment is normally unnecessary.

Most water supply projects are screened into Categories 1 (or A) or 2 (or B) by most international and regional funding agencies (e.g. the World Bank, the European Economic Commission, the Asian Development Bank, the African Development Bank, etc.). Typically, large-scale urban water supply and sanitation schemes are generally screened in Category 1, while small-scale (without impoundments) or rural water supply schemes are generally screened into Category 2 (or B) . In Nigeria, the 1992 Decree 86 on EIA stipulates that EIA must be carried out for water supply schemes where there is: (a) construction of dams, impounding reservoirs with a surface area of 200 hectares or more; or (b) groundwater development for industrial, agricultural or urban water supply of greater than 4,500 cubic meters per day. In Thailand, EIA are required for a dam or reservoir with a surface area greater than 1,500 hectares.

**Analysis of Nature and Significance of Impacts.** The various environmental problems and impacts associated with water supply projects have been discussed above, each of the impacts found to be significant (moderate or major) are studied in greater detail. The significance of certain environmental impacts can be assessed by contrasting the predicted magnitude of impact (e.g. location, volume, concentration) against a relevant environmental quality standard. Impact significance should also be assessed by taking due regard of those environmental priorities and preferences held by society or community but for which there are no quantifiable objectives. Particular attention needs to be focused on environmental preferences and concerns of those likely to be affected by the project.

In view of the foregoing, the following documents are relevant in assessing the significance of impacts of water supply projects in Nigeria :

1. Federal Environmental Protection Agency, 1991. Guidelines and Standards for Environmental pollution Control in Nigeria. Federal Environmental Protection Agency (FEPA), Lagos, Nigeria.
2. World Health Organization, 1993. Guidelines for Drinking Water Quality: Volume 1, Recommendations. WHO, Geneva.
3. National and State Planning Regulations (e.g. Land Use Act; Strategic Watershed Plans, "Town and Country Planning Laws of Nigeria"; etc.).
4. Federal Environmental Protection Agency, 1989. National Policy on the Environment. Federal Environmental Protection Agency (FEPA), Lagos, Nigeria.
5. Federal Government of Nigeria, 1976. River Basins Development Authorities Act No. 25. Federal Ministry of Justice, Lagos.
6. Policy and Guidelines documents of international and/or local Non-Governmental organizations.

**Proposal for the EIA Study and Environmental Monitoring of Selected Water Supply Schemes in Nigeria.** Nigeria's economy was very strong in the early 1970s because of high oil prices, and the country had no hesitation in spending on large-scale and capital-intensive projects such as highways, airports, power stations, ports, dams, water supply schemes, and irrigation projects. Large dams were particularly popular because they were expected to satisfy the needs of supplying large irrigation projects, which would fulfill the dreams of the OFN Program and at the same time provide much-needed municipal water supplies in the ever-growing villages, towns and cities of Nigeria. However, in the late 1970s and 1980s, the economic fortunes of Nigeria suddenly changed for the worse, cash ran out, and the construction of several projects came to a halt. Many water supply schemes are, therefore, still at various stages of completion; treatment plants and distribution systems of several schemes are still to be completed.

No systematic environmental impact assessments (EIAs) were carried out for any of the major water resources development projects which were initiated in Nigeria in the "oil-boom" era of the early and mid-1970s; EIA was never seriously discussed as a project planning and decision-making tool in

Nigeria in the 1970s and most of 1980s. The 1992 Decree-86 on Environmental Impact Assessment is even now hardly being implemented because the responsible regulatory agency (FEPA) lacks the required trained technical manpower to administer an EIA study and review the ensuing EIA report. Summaries of EHIAs of some major water resources projects which have been carried out in Nigeria are summarized in Appendices 3, 4, 5.

As has been indicated above, water and environmental quality monitoring is a very neglected and uncoordinated activity in the Nigerian water resources development sector. In view of this, coordinated baseline water and environmental quality data will generally be unavailable for the execution of EIA studies in the near future.

Although the surface water resources of Nigeria are usually demarcated into eight Hydrological Areas (HAs) and the groundwaters resources into eight hydrogeological Areas (HGAs), the present National Water Resources Master Plan (NWRMP) study has adopted a system in which Nigeria has been divided into the six regions, and which has taken into account the principal geographical features and climatic-agroecological regions.

The National Water Resources Master Plan (NWRMP) has already produced an extensive and detailed database on various aspects of water resources development in Nigeria, including the types of water supply sources in the six regions listed on Table11-21. It is suggested that at least three (3) water supply schemes (2 surface sources and 1 ground source) be selected in each of the six regions for a one-year (12-month) systematic EIA study and environmental monitoring program. This study will yield reliable data which will ensure the systematic incorporation of environmental considerations and impacts into the NWRMP currently being developed. The proposed study will also provide the much-needed practical and "hands-on" training in EIA and environmental monitoring for the staff of the Federal Ministry of Water Resources and the River Basin Development Authorities.

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# APPENDIX 11 - 2

## A. ENVIRONMENTAL PROBLEMS COMMONLY ASSOCIATED WITH COMMUNITY WATER SUPPLY (CWS) SYSTEMS

## B. OTHER ASPECTS OF CWS SYSTEMS OF ENVIRONMENTAL INTEREST TO BE MANAGED BY PROJECT PLANNING

## APPENDIX 11- 2A
## ENVIRONMENTAL PROBLEMS COMMONLY ASSOCIATED WITH COMMUNITY WATER SUPPLY (CWS) SYSTEMS

### A. Problems Relating to Project Siting

1. Pollution of water supply source by upstream waste inflows from communities, industries, agricultural runoff, and soil erosion runoff.
2. Abstractions of raw water for CWS conflicting with other beneficial water uses (for both surface and groundwaters).
3. For groundwater sources, hazard of land subsidence caused by excessive groundwater pumping.
4. Resettlement:
5. Impairment of historical/cultural monuments/areas.

### B. Problems Relating to Design Phase (Including Assumptions Made in Design Phase on O&M Services to be Provided)

1. Polluted/contaminated water served in distribution system (DS): This is a common problem in DCs and is usually due to one or more of the following:

(a) inadequate O&M for filters and chlorinators

(b) lack of chlorine residual monitoring in DS

(c) fluctuation pressures due usually to excessive leaking in DS, causing inflow of pollutants/contaminants

2. Inadequate protection of water source (intakes or wells) from surface runoff pollution.

3. Excessive growth of algae in distribution reservoirs.

4. Increase in production of sewage beyond capabilities of community SEO facilities.

5. Inadequate disposal of sludges from water treatment plants: These sludges can generally be satisfactorily disposed of by engineered landfilling.

6. Unsatisfactory raw water quality due to excessive total dissolved solids (TDS), chlorides, nitrates, fluorides and other constituents present at concentrations above acceptable limits and which cannot be removed by feasible treatment processes.

7. Inadequacies in raw water quality which may be difficult to correct by treatment under DC conditions (special design expertise required):

(a) excessive pathogenic pollution

(b) excessive mineral constituents (Fe, Mn, color, hardness and turbidity)

8. Inadequate buffer zone around pumping and treatment plants as needed for alleviating noise and other possible nuisances to neighboring properties and for protecting these facilities from dam by outsiders.

9. Inadequate design of facilities for receiving/storing/handling chlorine cylinders so that, with proper O&M, workers (and neighbors) will not suffer from toxicity from chlorine gas escaping to environment.

10. Impairments commonly associated with transmission lines and access roads:

(a) encroachment into precious forest/ecology zones

(b) impairment of environmental aesthetics

(c) continuing soil erosion from exposed areas not resurfaced or revegetated

## C. Problems During Construction Stage

1. **Erosion and silt runoff during construction:** The project construction plan should include provision for control of silt runoff during the construction stage that could adversely affect downstream beneficial uses or property values, including use of temporary holding ponds if necessary.

2. **Resurfacing of exposed areas:** The construction plan should include provision for resurfacing/replanting of exposed areas that will

otherwise result in continuing excessive erosion and silt runoff and in continuing depreciation of environmental aesthetics.

3. **Other construction hazards:** Will the project involve other construction period hazards of the types delineated in the problems during construction stage?

4. **Monitoring:** The construction plan should include provision for monitoring during the construction period to ensure contractor's compliance with specified constraints.

### D. Problems Resulting from Inadequacies of Operations and Maintenance

1. Delivery of water to DS which is unsafe due to poor O&M of treatment processes (especially mud accumulations in filters) and inadequate chlorination.

2. Lack of adequate monitoring of chlorine residuals in DS as a check on safety of water in DS.

3. Delivery of water to DS which is corrosive due to inadequate attention to feeding of corrective chemicals.

* Reproduced from: Asian Development Bank, 1990. Environmental Guidelines for Selected Infrastructure Projects. Asian Development Bank, Manila.

## APPENDIX 11 - 2B
## OTHER ASPECTS OF CWS SYSTEMS OF ENVIRONMENTAL INTEREST TO BE MANAGED BY PROJECT PLANNING

The following items are to be managed by Bank staff in the engineering, economic/socioeconomic, and financial disciplines:

### A. ENGINEERING DESIGN

1. Potential problems of traffic jams and of interference with other utilities in some streets.

2. Depth of pipe trenches (sufficient to prevent damage from surface traffic).

3. Attention to DS piping routing (to avoid passing through areas heavily contaminated with sanitary/industrial wastes).
4. Hazards from water and sewer pipes in same trench.
5. Need for standby power and/or elevated storage to ensure continuity of pressure in the DS.
6. Need to ensure availability of raw water supply for emergency purposes in case of breakdown of transmission lines, dry-up of supply in drought period, etc.
7. Prevention of cross-connections in DS connections to buildings.
8. Settling of street surface due to inadequate backfilling.
9. Inadequate metering for measurement of quantities of water produced.
10. Provision of household water meters which are suited to conditions of water turbidity and of flow variations.

## B. ECONOMIC, SOCIOECONOMIC AND FINANCIAL ASPECTS

1. Adequacy of service in poverty areas.
2. Affordability of service by poor people (with consideration of possible cross-subsidies).
3. Alternative services for poor people areas:

(a) public standpipes
(b) tank truck services

* Reproduced from: Asian Development Bank, 1990. Environmental Guidelines for Selected Infrastructure Projects. Asian Development Bank, Manila.

# APPENDIX 11 - 3

# MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE KAINJI DAM PROJECT

# APPENDIX 11 - 3
# MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE KAINJI DAM PROJECT

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| | |
|---|---|
| NAME OF PROJECT: | Kainji Dam |
| TYPE OF PROJECT: | Hydro-electric power, irrigation, and navigation |
| LOCATION: | River Niger, Nigeria |
| DATE: | 1964 to 1968 |
| EFFECTS: | Increased prevalence of urinary schistosomiasis (Schistosoma-haeatobium), but only at localized foci around the shoreline, where infection rates increased from 30 percent in 1970 to 70 percent in 1972. Only around 5 to 10 percent of the shoreline supported the vector snail (Bulinus globosus).<br><br>Elimination of Simulium damnosum, vector of- onchocerciasis, both around the lake and for 10-miles- downstream of the dam. |
| CAUSE OF EFFECTS: | Sharply-sloping banks and wave action prevented water weed growth, which would have encouraged vector snail establishment.<br><br>Schistosomiasis only occurred in limited areas:<br>• where there was intensive human activity, e.g. ferry jettys;<br>• on the eastern shoreline where the banks were relatively flat and so supported vegetation, which provides shade and humidity for aestivating vector snails.<br><br>High water turbidity did not favor snail establishment.<br><br>Onchocerciasis was reduced because of:<br>• reduced water flow upstream of the dam destroyed Simulium damnosum breeding sites;<br>• periodic changes in lake level due to seasonal flooding provided an unfavorable environment for Simulium damnosum as well as for the snail vector of schistosomiasis, Bulinus globosus;<br>• frequent adjustments of spillway release to match the varying lake level caused river level variations downstream of the dam and preventing Simulium damnosum breeding for 10 miles downstream. |

| | |
|---|---|
| MITIGATION MEASURES: | During construction phase:<br>• Implementation of an onchocerciasis and malaria control program to project the dam labor force<br>• Simulium damnosum breeding sites treated with 0.33 ppm to 2 ppm DDT for 3minutes each 10 days. |
| SUCCESS OF MITIGATION MEASURES: | During construction phase:<br>• Simulium damnosum was reduced in treated areas. Rapid reappearance and recolonisation of breeding sites, however, indicated that neither larvae nor adults were completely eliminated. (Re-infestation may have occurred from untreated areas some distance from the lake);<br>• Simulium damnosum eggs and pupae were not susceptible to DDT;<br>• effect on malaria incidence hard to assess. The disease continued to be highly prevalent, probably due to mosquitoes developing resistance to DDT. |
| RECOMMENDATIONS: | Molluscicides should be used at focal points where schistosomiasis was prevalent.<br>Health education to prevent establishment of schistosomiasis.<br>Prevention of weed growth on eastern shoreline which may result in swampy conditions suitable for the vector snail. |

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# APPENDIX 11 - 4

# MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE MALUMFASHI AGRICULTURAL DEVELOPMENT PROJECT

# APPENDIX 11 - 4
# MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE MALUMFASHI AGRICULTURAL DEVELOPMENT PROJECT

| | |
|---|---|
| NAME OF PROJECT: | Malumfashi Agricultural Development Project. |
| TYPE OF PROJECT: | Irrigated agricultural development with up to 50 small earth dams. |
| LOCATION: | Malumfashi, Katsina State, Nigeria. |
| DATE: | 1977 to 1978 |
| EFFECTS: | Increased incidence and transmission rate of schistosomiasis, especially Schistosoma haemotobium. |
| CAUSE OF EFFECTS: | Significant changes in the proportions of different snail species present in low-earth dam lakes to give dominance byBulinus globosus, previously limited as water sources dried up during dry season. B. globosus is the major secondary host of Schistosoma haemotobium.<br><br>Increased human water contact activities (fishing, bathing, swimming and playing), predominantly among males, who account for 77 percent of environmental egg contamination and 83 percent of infected population. |
| MITIGATION MEASURES: | None noted |
| SUCCESS OF MITIGATION MEASURES: | No information available |
| RECOMMENDATIONS: | None made directly, but warning given that with the construction of more small dams planned, and with potential increased in human/water contact through development of fish farming possible, schistosomiasis is likely to remain at a high level in the absence of control measures. |

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# APPENDIX 11 - 5

# MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE LOWER ANAMBRA IRRIGATION PROJECT, ANAMBRA STATE, NIGERIA

## APPENDIX 11 - 5

## MAJOR ENVIRONMENTAL HEALTH IMPACTS OF THE LOWER ANAMBRA IRRIGATION PROJECT, ANAMBRA STATE, NIGERIA

| | |
|---|---|
| NAME OF PROJECT: | Lower Anambra Irrigation Project (LAIP) |
| TYPE OF PROJECT: | Irrigated agricultural development for rice cultivation using reservoir impoundment and pumping. |
| LOCATION: | Omo, Oyi L.G.A., Anambra State, Nigeria |
| DATE: | 1981 to 1992 (EIA Study in 1992) |
| EFFECTS: | The population suffered high morbidity and mortality, especially in under-five year olds, due to diarrhoea and gastroenteric diseases. These diseases, as well as malaria, filariasis and infectious eye diseases, were the main types of reported water-related diseases. |
| CAUSE OF EFFECTS | Poor personal and domestic hygiene and inadequate sanitation.<br>Poor nutritional status. |
| MITIGATION MEASURES: | Construction of improved water supplies and excreta disposal facilities in collaboration with DFRRI. |
| SUCCESS OF MITIGATION MEASURES: | Not known as there have not been any follow-ups since recommendations in 1993 |
| RECOMMENDATIONS: | The following recommendations were made to be incorporated into future water supply improvement schemes to achieve significant reductions in water related diseases:<br>• Personal body washing and clothes washing facilities should be constructed to improve personal hygiene;<br>• major change in disposal of excreta (under 10% of households had latrines);<br>• health education program to improve domestic and personal hygiene. Program to be directed at specific unhygienic practices;<br>• health education program to improve food hygiene plus an investigation into key areas of food contamination;<br>• improvement in rural health services to record and treat water-related diseases more effectively. |

Reference:
Iwugo, K.O., 1993. Environmental Impact Assessment Study of the Lower Anambra Irrigation Project (LAIP) in the Oyi L.G.A. of Anambra State, Nigeria.

# APPENDIX 11 - 6

# ENVIRONMENTAL EFFECTS COMMONLY ASSOCIATED WITH MAJOR DAM AND RESERVOIR PROJECTS (INCLUDING HYDROPOWER)

# APPENDIX 11 - 6
# ENVIRONMENTAL EFFECTS COMMONLY ASSOCIATED WITH MAJOR DAM and RESERVOIR PROJECTS (INCLUDING HYDROPOWER)

Experience in the DMCs in planning/design/construction and operation of major dam/reservoir projects have shown that a large number of adverse environmental effects can result from such projects, and that these can be mitigated or offset to a considerable degree by careful planning/design/construction/operation. The environmental aspects discussed below relate to the dam/reservoir, per se, and not to follow-up projects which make use of the stored water such as hydropower generation and irrigation systems.

Detailed discussions of all the environmental parameters noted below are given in the "Guidelines for Preparing Environmental Impact Assessment for Water Resource Projects in Developing Countries".

## A. Environmental Problems Due to Project Location

1. **Resettlement:** Resettlement of population in inundated area. This problem has often been serious in past projects because of failure to include sufficient funds in the project core budget to cover appropriate resettlement costs, including rehabilitation etc.
2. **Encroachment into watershed:** The access roads build for the project and the new lake will often serve to accelerate inroads into the watershed by farmers, hunters, timber exploiters, etc., thereby accelerating losses in forests and wildlife.
3. **Encroachment on historical/cultural monuments/areas:** This must be carefully evaluated and, if precious items are believed to exist in the area to be inundated, a program for finding and salvaging these should be undertaken prior to inundation.
4. **Watershed erosion/silt runoff:** If the existing condition of erosion/silt runoff in the watershed is sufficient to jeopardize the life of the dam by an excessive filling rate, consideration must be given to

expanding the project to include a watershed reforestation and/or regreening program (to be included in the project's core budget).

5. **Impairment of navigation:** Will the dam itself impair downstream navigation and, if so, what provisions may be made to offset this loss?

6. **Impairment of groundwater hydrology:** Will the reservoir result in waterlogging in the vicinity and, if so, how can damages be feasibly offset?

7. **Migrating valuable fish species:** Will the dam obstruct valuable migrating fisheries and, if so, how can these losses be offset?

8. **Inundation of mineral resources:** Will the reservoir cause loss of valuable mineral resource development potentials?

9. **Other problems from flooding of inundated area:** This usually eliminates productive farmlands or forest, displaces and endangers wildlife in the area, displace the existing riverine fisheries, greatly alters the hydrologic regime, and may induce earthquake hazards.

## B. Environmental Problems Associated with Design (Including Assumptions on Operations and Maintenance)

1. **Road erosion:** A common environmental problem is continuing erosion from exposed areas resulting from construction of access roads without suitable provisions for resurfacing or revegetating the exposed areas.

2. **Pre-impoundment reservoir site preparation:** If the reservoir fishery will be important, it is generally preferable not to clear the reservoir site except to remove valuable timber, in order to leave nutrients for the remaining vegetation.

3. **Water rights conflicts:** This involves a balancing of conflicting needs for use of the stored water for hydropower, irrigation, flood control, and other purposes such as maintaining low flows and fluctuating reservoir levels to control disease vectors.

4. **Fish screens:** To prevent entry of fish into power plant water intake

## C. Environmental Problems Due to Construction

1. **Soil erosion/silt runoff:** From erosion in borrow and cut-and-fill areas due to lack of adequate planning and controls during construction, and lack of resurfacing exposed areas.

2. Other construction hazards

(a) **safety of workers:** Provision of protection against accidents.

(b) **sanitation at workers' camp:** To protect against communicable disease hazards from poor sanitation.

(c) **water-related diseases:** Hazards from imported workers who are carriers of water-oriented diseases and from malaria.

(d) **other disturbances:** Dust/odor/fumes/noise vibrations.

(e) **quarrying hazards:** Hazards from blasting and hauling of materials.

(f) **environmental aesthetics:** Valuable scenery may be despoiled by non-reconditioned borrow areas.

(g) **construction monitoring:** Construction monitoring is essential to ensure that the construction procedures will be sensitive to the problems noted above.

## D. Environmental Problems Relating to Project Operations

1. **Downstream flow variations:** May be disruptive to downstream fisheries and other downstream beneficial uses.

2. **Depreciation of downstream inundation fisheries:** While the lessening of flood flows by the reservoir will reduce downstream flooding hazards, this can also reduce inundation fisheries (traditionally an important source of protein for rural poor).

3. **Downstream erosion:** Release of turbidity-free waters often results in considerable downstream erosion of banks and river beds.

4. **Lack of reservoir management:** The reservoir usually becomes a rich fishery, resulting in establishment of fishing villages around the lake. Without proper reservoir management, (1) the fishery yields will be less than they should be; (2) fishing will be overexploited and illegal methods utilized; (3) fishing rights will often be taken over by immigrants who displaced local fishermen; (4) new villages may

become sanitation/public health messes; (5) social conflicts in drawdown agriculture; (6) others.

5. **Eutrophication:** Trapping of nutrients in reservoir may result in (1) impairment of water quality for downstream beneficial uses; and (2) weed blooms which interfere with power generation and with operation of irrigation canals.

6. **Water quality:** Water should be withdrawn from reservoir at optimal depths to obtain optimal water quality (avoid heavily eutrophies surface waters and anaerobic bottom waters).

7. **Insect vector disease hazards:** If necessary for control of hazards from vector species favored by the reservoir, reservoir operations may need to be modified for control purposes, such as managed reservoir depth fluctuations.

8. **Estuarine and marine fisheries impacts:** By trapping of nutrients, the project may exercise serious adverse effects on downstream estuarine and nearshore marine fisheries.

9. **Reservoir bank stability:** Will the reservoir slopes be stable or will sloughing off result from time to time and, if so, how can the banks be stabilized?

10. **Post-construction monitoring:** Continuing periodic monitoring is essential for ensuring proper attention to environmental issues in project operations.

## E. Potential Environmental Enhancement Measures (Excluding Irrigation and Related Downstream Aquaculture and Community Water Supply in the Irrigation Service Zone)

1. **Reservoir fishery:** Proper management of the new reservoir fishery is important not only for increasing yields but to prevent the problems noted in (D)(5) above and to ensure fishing rights will be allocated first to fishermen previously dependent on the disrupted riverine fishery.

2. **Drawdown agriculture:** This is another potential that may be of real value to the rural poor.

3. **Downstream community water supply:** The reservoir storage may be the only good source of water for downstream community water supplies in the dry season and, if so, this feature should be considered as an integral component of the project.

4. **Downstream aquaculture:** Downstream aquaculture potentials will usually be greatly enhanced by the availability of a reliable source of

fresh water throughout the year and, if so, this should be considered as a project component.

5. **Forestry/wildlife reserves:** Because of the adverse effects of the project in facilitating and accelerating encroachment into the upper watershed, it may be desirable to include (or a project component) provision of forest/wildlife parks/resources in the upper watershed while this is still feasible.

* Reproduced from: Asian Development Bank, 1990. Environmental Guidelines for Selected Infrastructure Projects. Asian Development Bank, Manila.

# APPENDIX 11 - 7

# SAMPLE INITIAL STUDY AND ENVIRONMENTAL CHECKLIST FOR WATER RESOURCES DEVELOPMENT PROJECTS

# INITIAL STUDY AND CHECKLIST

(Article IV — Guidelines)

| LEAD AGENCY | DISTRICT | DATE |
|---|---|---|
| | | |

| PROJECT TITLE/NO. | CASE NO. |
|---|---|
| | |

| PREVIOUS ACTIONS CASE NO. | ☐ DOES have significant changes from previous actions.<br>☐ DOES NOT have significant changes from previous actions. |
|---|---|
| | |

PROJECT DESCRIPTION:

PROJECT LOCATION

| PLANNING DISTRICT | | STATUS:<br>☐ PRELIMINARY<br>☐ PROPOSED _____<br>☐ ADOPTED date |
|---|---|---|
| EXISTING ZONING | MAX. DENSITY ZONING | PROJECT DENSITY |
| PLANNED LAND USE & ZONE | MAX. DENSITY PLAN | ☐ DOES CONFORM TO PLAN<br>☐ DOES NOT CONFORM TO PLAN<br>☐ NO PLAN |
| PLAN DENSITY RANGE | PROJECT DENSITY | |

## DETERMINATION (to be completed by Lead Agency)

On the basis of the attached initial study checklist and evaluation:

| | |
|---|---|
| **NEGATIVE DECLARATION** | ☐ I find the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared. |
| **CONDITIONAL NEGATIVE DECLARATION** | ☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because the mitigation measures described on an attached sheet have been added to the project. A CONDITIONAL NEGATIVE DECLARATION WILL BE PREPARED. (See attached condition(s).) |
| **ENVIRONMENTAL IMPACT REPORT** | ☐ I find the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required. |

SIGNATURE TITLE

INITIAL STUDY CHECKLIST (To be completed by Lead Agency)

## BACKGROUND

PROPONENT NAME | PHONE

PROPONENT ADDRESS

AGENCY REQUIRING CHECKLIST | DATE SUBMITTED

PROPOSAL NAME (If applicable)

## ENVIRONMENTAL IMPACTS

(Explanations of all "yes" and "maybe" answers are required to be attached on separate sheets.)

| | YES | MAYBE | NO |
|---|---|---|---|
| **1. EARTH. Will the proposal result in:** | | | |
| a. Unstable earth conditions or in changes in geologic substructures? | | | |
| b. Disruptions, displacements, compaction or overcovering of the soil? | | | |
| c. Change in topography or ground surface relief features? | | | |
| d. The destruction, covering or modification of any unique geologic or physical features? | | | |
| e. Any increase in wind or water erosion of soils, either on or off the site? | | | |
| f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake? | | | |
| g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards? | | | |
| **2. AIR. Will the proposal result in:** | | | |
| a. Air emissions or deterioration of ambient air quality? | | | |
| b. The creation of objectionable odors? | | | |
| c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally? | | | |
| d. Expose the project residents to severe air pollution conditions? | | | |
| **3. WATER. Will the proposal result in:** | | | |
| a. changes in currents, or the course or direction of water movements, in either marine or fresh waters? | | | |
| b. Changes in absorption rates, drainage patterns, or the rate and amounts of surface water runoff? | | | |
| c. Alterations to the course or flow of flood waters? | | | |
| d. Change in the amount of surface water in any water body? | | | |
| e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity? | | | |
| f. Alteration of the direction or rate of flow of ground waters? | | | |
| g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? | | | |
| h. Reduction in the amount of water otherwise available for public water supplies? | | | |
| i. Exposure of people or property to water related hazards such as flooding or tidal waves? | | | |
| j. Significant changes in the temperature, flow, or chemical content of surface thermal springs. | | | |
| **4. PLANT LIFE. Will the proposal result in:** | | | |
| a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops and aquatic plants)? | | | |
| b. Reduction of the numbers of any unique, rare or endangered species of plants? | | | |
| c. Introduction of new species of plants into an area, or is a barrier to the normal replenishment of existing species? | | | |
| d. Reduction in acreage of any agricultural crop? | | | |

| | YES | MAYBE | NO |
|---|---|---|---|
| **5. ANIMAL LIFE.** Will the proposal result in: | | | |
| a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)? | | | |
| b. Reduction of the numbers of any unique, rare or endangered species of animals? | | | |
| c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals? | | | |
| d. Deterioration to existing fish or wildlife habitat? | | | |
| **6. NOISE.** Will the proposal result in: | | | |
| a. Significant increases in existing noise levels? | | | |
| b. Exposure of people to severe noise levels? | | | |
| **7. LIGHT AND GLARE.** Will the proposal | | | |
| a. Produce new light or glare from street lights or other sources? | | | |
| b. Reduce access to sunlight of adjacent properties due to shade and shadow | | | |
| **8. LAND USE.** Will the proposal result in an alteration of the present or planned land use of an area? | | | |
| **9. NATURAL RESOURCES.** Will the proposal result in: | | | |
| a. Increase in the rate of use of any natural resources? | | | |
| b. Depletion of any non-renewable natural resource? | | | |
| **10. RISK OF UPSET.** Will the proposal involve: | | | |
| a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions? | | | |
| b. Possible interference with an emergency response plan or an emergency evacuation plan. | | | |
| **11. POPULATION.** Will the proposal result in: | | | |
| a. The relocation of any persons because of the effects upon housing, commercial or industrial facilities? | | | |
| b. Significantly change in the distribution, density or growth rate of the human population of an area? | | | |
| **12. HOUSING.** Will the proposal: | | | |
| a. Affect existing housing, or create a demand for additional housing? | | | |
| b. Have a significant impact on the available rental housing in the community? | | | |
| c. Result in significant demolition, relocation or remodeling of residential, commercial, or industrial buildings or other facilities? | | | |
| **13. RIGHT OF WAY.** Will the proposal result in: | | | |
| a. Reduced front/side lot area? | | | |
| b. Reduced access? | | | |
| c. Reduced off-street parking? | | | |
| d. Creation of abrupt grade differential between public and private property? | | | |
| **14. Transportation/Circulation.** Will the proposal result in: | | | |
| a. Generation of significant additional vehicular movement? | | | |
| b. Significant effects on existing parking facilities, or demand for new parking? | | | |
| c. Impact upon existing transportation systems? | | | |
| d. Alterations to present patterns of circulation or movement of people and/or goods? | | | |
| e. Alterations to waterborne, rail or air traffic? | | | |
| f. Significant increase in traffic hazards to motor vehicles, bicyclists or pedestrians? | | | |
| **15. PUBLIC SERVICES.** Will the proposal have a significant effect upon, or result in a need for new or altered governmental services in any of the following areas: | | | |
| a. Fire protection? | | | |
| b. Police protection? | | | |
| c. Schools? | | | |
| d. Parks or other recreational facilities? | | | |
| e. Maintenance of public facilities, including roads? | | | |
| f. Other governmental services? | | | |

| | YES | MAYBE | NO |
|---|---|---|---|
| **16. ENERGY.** Will the proposal result in: | | | |
| a. Use of exceptional amounts of fuel or energy? | | | |
| b. Significant increase in demand upon existing sources of energy, or require the development of new sources of energy? | | | |
| **17. UTILITIES.** Will the proposal result in a need for new systems, or alterations to the following utilities: | | | |
| a. Power or natural gas? | | | |
| b. Communications systems? | | | |
| c. Water? | | | |
| d. Sewer or septic tanks? | | | |
| e. Storm water drainage? | | | |
| f. Solid waste and disposal? | | | |
| **18. HUMAN HEALTH.** Will the proposal result in: | | | |
| a. Creation of any health hazard or potential health hazard (excluding mental health)? | | | |
| b. Exposure of people to potential health hazards? | | | |
| **19. AESTHETICS.** Will the proposed project result in: | | | |
| a. The obstruction of any scenic vista or view open to the public? | | | |
| b. The creation of an aesthetically offensive site open to public view? | | | |
| c. The destruction of a stand of trees, a rock outcropping or other locally recognized desirable aesthic natural feature? | | | |
| d. Any negative aesthetic effect? | | | |
| **20. RECREATION.** Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities? | | | |
| **21. CULTURAL RESOURCES:** | | | |
| a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site? | | | |
| b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object? | | | |
| c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values? | | | |
| d. Will the proposal restrict existing religious or sacred uses within the potential impact area? | | | |
| **22. MANDATORY FINDINGS OF SIGNIFICANCE.** | | | |
| a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | | | |
| b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals. | | | |
| c. Does the project have impacts which are individually limited, but cumulatively considerable?* | | | |
| d. Does the project have environmental effects which cause substantial adverse effects on human beings, either directly or indirectly? | | | |

* "Cumulatively considerable" means that the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

**DISCUSSION OF ENVIRONMENTAL EVALUATION** (Attach additional sheets if necessary)

| PREPARED BY | TITLE | TELEPHONE | DATE |
|---|---|---|---|
| | | | |

# APPENDIX 11 - 8

## SAMPLE TABLE OF CONTENTS FOR ENVIRONMENTAL IMPACT ASSESSMENT REPORT

### SAMPLE TABLE OF CONTENTS FOR EIA REPORT

LIST OF FIGURES



LIST OF TABLES

# APPENDIX 11 - 9

## PRIORITY PROJECT FOR CONSIDERATION BY EXTERNAL AGENCY

## APPENDIX 11-9

## PRIORITY PROJECT FOR CONSIDERATION BY EXTERNAL AGENCY

Several discussions have been made of the needs and categories to be assisted by the external agencies, and a high priority has been given to a proposed "EIA Study and Environmental Monitoring Program for Dam Projects" which should be implemented during an early period of the National Water Master Action Plan Period by 2000 for subsequent proper implementation of the recommended NWRMP towards 2020.

Provisional Terms of Reference on this technical cooperation program with the insistence of the external agency(s) are given below:

(1) Background

Major dams are large social investments, usually built to fulfill one or more of four primary purposes: irrigation, domestic and industrial water supply, energy production, and flood control. By their very nature, dams and their associated reservoirs create changes in the pre-existing environment. Water is impounded, upstream areas are inundated, people are frequently displaced from the reservoir area. There are also downstream effects that result from changes in the quantity, quality, timing, and use of water flow. In addition, the dam body itself is subject to the interception of water-related environment between upstream and downstream. Some of these impacts are positive, others are negative. In general, causality may go in two directions: dams have impacts on the environment and the environment, in turn, can have major impacts on dams. Whatever the direction of causality, the important point is that because of these environmental effects, the production of goods and services for which dam projects are built is either enhanced or reduced. The key to this environmental approach is to emphasize that all these impacts together are caused by the dam project and affect the project viability and its cost and benefit in both physical and social terms.

The JICA-assisted National Water Resources Master Plan Study has identified that the number of dams as completed or under construction as of 1991 has reached 160 sites with a total effective storage of $30.7 \times 10^9$ cu.m with a technical sense that the river runoff in Nigeria is definitely seasonal with the

wet season between July and September; accordingly, the dam and reservoir are basically required to mobilize the surface water throughout the year for water supply and use objectives. Nigeria's economy was substantially strong in the early 1970s because of the high oil prices, and the Federal Government of Nigeria had no hesitation at all in spending on large-scale and capital intensive projects including dams. In particular, large dams were popular with the vision to satisfy the needs of supplying large irrigation projects for self-sufficiency of foods and to provide the much needed domestic water supply for the ever growing population; however, the economic opportunity of Nigeria during the period of the late 1970s to date suddenly changed for the worse, and the construction of several large water projects came to a halt being still at various stages of completion for water distribution and service facilities.

The JICA-assisted NWRMP Study has also demonstrated that it is inconceivable that a systematic environmental impact assessment (EIA) was carried out for any of the major dam and reservoir projects which were initiated in the oil-boom era of the early and mid 1970s, and the EIA was never seriously examined as a project planning and decision making tool in the 1970s and most of the 1980s. In addition, the Environmental Impact Assessment Decree, No.86 of 1992 which requires the EIA for many types of the water resources projects and programmes is hardly being implemented because the Federal Environmental Protection Agency (FEPA), a responsible regulatory agency certainly lacks the required trained technical manpower to administer the EIA Study and review the Environmental Impact Statement (EIS). It also has been pointed out that the water and environmental quality monitoring is a very neglected and uncoordinated activity in the Nigerian Water Resources Development Sector; in view of this, the coordinated baseline water and environmental quality data are generally unavailable for execution of the EIA Study.

(2) Outline of the Proposed Program

The JICA-assisted NWRMP has presented preliminary guidelines for developing the EIA for some types of the water resources projects including dam and reservoir, water supply and others for FEPA and FMWRRD considerations and reference to subsequent action programs. A discussion of the environmental impacts associated with all types of water-related projects and approaches to their assessment has been made first, and the

recommendations regarding the impact assessment, monitoring and proposed studies have been included.

In this connection, the Federal Ministry of Water Resources and Rural Development (FMWRRD) is asking the external agencies for implementation of a technical assistance program of EIA Study and Environmental Monitoring Guidelines for Dams and Reservoirs. It is expected that this TA program will yield the reliable data which will ensure the systematic incorporation of environmental considerations and impacts into the planning, implementation and operations of subsequent dam projects, and also will provide the much needed practical and "hands-on" training in EIA for the staff of FMWRRD and relevant organizations.

The proposed EIA Study and Environmental Monitoring Program which should be carried out for some of the existing and proposed major dams to be selected as representative samples will monitor the following parameters:

(i) Physical Resources - - - - Hydrology and quality of surface water and groundwater, soils, geology and seismology. erosion and sedimentation, and others.

(ii) Ecological Resources - - - - Climate, fisheries, aquatic biology, terrestrial wildlife, forests, and so on.

(iii) Human Use Values - - - - Agriculture and irrigation, aquiculture, water supply, navigation, recreation, power, flood control, dedicated area use, industry, agro-industry, mineral development, highways and railways, and land use.

(iv) Quality-of-Life Values - - - - Socio-economic, resettlement, cultural and historical, aesthetic, archaeological, public health, nutrition, etc.

The above-listed parameters should be applied in choosing the key or major impacts to be assessed in the selected dam and reservoir projects using the types of questionnaire and checklist developed and also taking into account local, State and Federal environmental policies, standards, legislations, priorities in analyzing the nature and significance of these impacts before selecting appropriate mitigation measures. Every country recognized the fact that the EIA as such is merely a prediction of what may happen once a project is implemented. Since it is only a scenario, it remains necessary to monitor the

actual development during the period of preparation, commissioning and operations of the project. Monitoring is a repetitive observation of the phenomena within a pre-defined framework of time and place. Data collected during the monitoring period should be processed, stored, retrieved and presented. By comparing the actual results with predictions and standards, undesirable development may be recognized, corrected, reduced and, if possible, eliminated. Monitoring can be used both as a tool for post-project auditing and as a method of evaluating the quality of the EIA. It also provides an early warning of a variety of environmental problems, natural resources degradation and interference with other interests of the societies concerned.

(3) Terms of Reference

3.1 Objective

General objective for the Technical Assistance on the EIA study and Environmental Monitoring Program for Dam Projects is to prepare the guidelines for EIA Study and environmental management plan inclusive of mitigation measures for future projects of dams and reservoirs which are large in size and frequently part of some of the largest capital investments made by the Government representing major, long-term commitments of scarce capital resources. More particularly, the following specific objectives may be given below:

- EIA Study and monitoring of related parameters for representative dam projects: five for existing (Challawa Gorge, Watari, Goronyo, Zaira & Alau) and five for proposed (Zungeru, Karaduwa, Garma (1), Mayo Ine & Sendam).
- Preparation of coordinated water and environmental quality baseline data for EIA Study projections.
- Guidelines for EIA Study and environmental management plan inclusive of protection measures.
- Transfer of the environmental management skills and technologies to Nigerian personnel in Nigeria and donor country.

## 3.2 Agencies

The Technical Assistance Program should serve as a suitable practical training outfit for the technical staff of the FMWRRD which is the implementing agency of the NWRMP and also is the lead agency for this Program Study. It would also be desirable to involve the National Water Resources Institute (NWRI), River Basin Development Authorities (RBDAs), Federal Environmental Protection Agency (FEPA), National Electric Power Plc. (NEPA), Federal Ministry of Agriculture and Natural Resources (FMANR), and State Governments concerned. This Program will also be implemented in full consultation with the National Water Resources Manpower Training Program to be separately introduced.

## 3.3 External Input

The eternal agency will dispatch a survey and study team of required experts with the provision of equipment and materials to support proper implementation of this Technical Assistance Program. The team may be composed of the experts in the field of leadership, water resources planning, environmental assessment, dam and reservoir, river, hydrology, hydrogeology, socio-economy, and specific environmental factors such as fishery, botany, zoology, water quality chemistry and others concerned with environmental impacts.

## 3.4 Scope of Work and Implementation Schedule Proposed

Major items to be involved in the Study and related implementing schedule during the proposed period of two years from mid-1998 are outlined below:

| Item | 1 st Year | | | | 2 nd Year | | | | 3 rd Year | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 6 | 9 | 12 | 1 | 4 | 7 | 10 | 3 | 6 | 9 | 12 |
| 1. Preparatory Work | | | | | | | | | | | | |
| 2. EIA Study and Monitoring of Related Parameters for Representative Project: | | | | | | | | | | | | |
| Project Survey | | | | | | | | | | | | |
| Field EIA Study and Monitoring | | | | | | | | | | | | |
| 3. Preparation of Coordinated Water and Environmental Quality Baseline Data | | | | | | | | | | | | |
| 4. Supplementary Field Survey: | | | | | | | | | | | | |
| 5. Guidelines for EIA Study and Environmental Management Plan: | | | | | | | | | | | | |
| 6. Reporting: | | | | | | | | | | | | |
| Inception | | | | | | | | | | | | |
| progress (1) | | | | | | | | | | | | |
| Interim | | | | | | | | | | | | |
| Progress (2) | | | | | | | | | | | | |
| Draft Final | | | | | | | | | | | | |