Land and water resources management

1. These guidelines do not constitute a manual for natural resources management but expose some critical issues and key concepts the user should keep in mind when examining the environment and social impacts of projects which involve modification of the land's surface contour or cover or commitment of significant quantities of groundwater or surface water to various human uses. These questions are particularly relevant to preparation and review of the plan for mitigating impacts on land and water resources that must be included in every environmental and social assessment report.

2. This document is written with no particular type of ecosystem in mind; and the reader should consult the section on "inter-sectoral Issues" if sociocultural issues related to land and water resources are concerns for sensitive ecosystems.

3. Land and water resources are considered together because of the inescapable causal relationships between them. Any change in the way one is managed may have an effect on the other, especially if insufficient attention is given to their interactions.

Environment and Land Management

4. Almost any development projects will have disturbance on the land surface. When the area involved is small, the environmental impact may be minimal but the cumulative impacts of many disturbances can be substantial. The projects that comprise land modifications and that are of

concern are listed below and many of them are developed in other operational guidelines.

- clearing (Roads infrastructure)
- topsoil removal
- grading
- filling (wetlands; coastal zone management; roads infrastructure)
- draining (wetlands)
- development of green culture spaces (agricultural production management , natural forests management, plantation and reforestation)
- paving (roads infrastructure)
- building construction
- waste disposal (solid waste collection and disposal; wastewater collection, treatment,

The direct and immediate environmental impacts of these modifications can be grouped into four categories: loss of habitat, loss of soil productivity, modified hydrology, soil contamination.

Loss of habitat

5. All activities listed cause habitat loss. The severity of the impact is not only the type of habitat converted but also how the processing is performed. If natural sites, wetlands, rainforests and other ecosystems are at stake, the team responsible for carrying out the environmental and social impacts assessment will analyse considered options and will possibly propose new (see "natural sites "guidelines).

Loss of soil productivity

6. Some forest soils once stripped of their natural cover become laterized or are subject to rapid erosion and essentially infertile. The removal of topsoil made during grading also reduces soil productivity. Erosion causes the same effect and may, in addition, reduce the quality of water resources. The conversion of high quality agriculture land to urban developing also reduces productivity. The assessment of environmental and social impacts may recommend the following mitigation measures: avoidance of construction on steep slopes, retention of forest cover, stockpiling and replacement of topsoil, conservation of prime agricultural land, use of good cultivation practices, control of erosion and sedimentation through use of mulch during construction, rapid replacement of vegetative cover, construction of siltation basins and barriers of straw or filter fabric to protect waterways.

Modification of Hydrology

7. Land clearing, grading, filling, paving or construction of building alter patterns of surface runoff and infiltration and lead to the formation of basins, flooding, increased frequency of floods or rising of water level downstream, a lowering of groundwater and its power and increasing the weakness of rivers low flow. Operational measures include construction techniques that maintain or replace drainage ditches, retention structures in order to avoid the increased runoff and ways to offset the decrease in infiltration (porous pavement, infiltration ponds, etc..) and conserving undeveloped spaces in areas where the groundwater recharge is essential.

Soil Contamination

8. Poorly designed or managed irrigation systems can cause soil salinization. The disposal of hazardous waste or solid waste and wastewater in the soil that are not carried out appropriately can also be a source of contamination. Mitigation measures relating to irrigation systems are described in the BOAD Operational Guidelines on irrigation and drainage.

Land Clearing

9. Land clearing for agricultural purposes is treated separately because the impact on the environment depends on soil composition and method of clearing used. In general, the consequences of clearing activities are more severe in UEMOA space because of high temperatures that accelerate the chemical alteration of soils and rainfall intensity process that increases the extent of erosion.

Land Clearing Methods

10. There are three basic methods of clearing often used in the same project:

a) Manual methods -felling or cutting vegetation, allowing a drying period, and then burning the debris;

b) (b) Mechanical methods -using heavy equipment (e.g., bulldozers, heavy chains and tractors) to fell trees and cut and lay down underbrush, windrowing (raking debris into rows or piles), burning, and final clearing of the residue;

c) chemical methods -using herbicides to establish areas for crops, either leaving dead trees standing, felled, or burned.

11. Mechanical methods have significant incidence on environment because they cause topsoil loss or inversion, destruction of soil structure, and compaction leading to increased runoff. The mechanical and manual methods use burning, which often reduces soil nutrient content and the activities of beneficial soil organisms as well as contributing to elevated atmospheric carbon dioxide concentrations. Chemical techniques have been shown to have less consequence on soil. However, the long-term effects of herbicide use in UEMOA are not well known.

Post-Clearing Land Management

12. Inadequate post-clearing management practices, for instance lack of manuring, failure to employ soil conservation practices, and repeated fires have often led to reduction in soil fertility to the point at which agricultural production cannot be sustained, as a result soils are abandoned and infested by weed.

Environment and Water Resources Management

13. Water resource management issues that may emerge during environment impact assessment are related to water use or land occupation decisions that influence the quantity or quality of surface water or groundwater. Any changes in quantity or quality may in turn affect the various uses the particular water resource can contribute to or alter the functions of a natural system related to water.

The actions related to development projects which may alter water quality or quantity include:

14. Pollution of surface water by directly discharged effluents, contamination by nonponctual or diffuse pollutant sources, contamination by atmospheric pollutants, pollution of ground or surface water by wastes disposed of on or beneath the land, increased runoff due to land clearing, grading, paving , drainage of land or channel modification, and the decreased flow of surface waters due to their diversion, containment, irrational exploitation and finally reduction in water table or artesian flow resulting from activities impeding groundwater recharge or excessive groundwater withdrawals.

Environmental Impacts of Increased Runoff

15. Increased runoff results from any activities that make the land surface less permeable, "smoother" or both. The flow as well as the runoff volume can be increased and result in a declining of water tables, more frequent or more intense flooding, longer or more severe low-flow periods and finally scour or bed siltation of rivers. Changes in the natural surface runoff can alter or eliminate wetlands and harm agriculture based on seasonal flooding to irrigate and sustain soil fertility. Measures of structural and non-structural mitigation can be incorporated into projects where these impacts were anticipated.

Environmental Impacts of Reduced Surface Water Flow

16. If the overall flow of surface water is reduced significantly by impoundment, diversion, or consumptive use, downstream users and natural systems will be impacted. There are two common causes of the flow reductions are

growth in the watershed in excess of that which existing water resources can support or overcommitment of water resources from failure to take all uses and users into consideration in project planning. Immediate effects may result: the decline in water quality due to less dilution capacity of pollutants; seasonal or perennial shortage of water for downstream users, a loss of wetlands and finally increasing salinity and hydrodynamic changes in estuaries.

17. Each of these impacts may in turn give rise to secondary effects such as the decline of shellfish harvests, the shortfall of industry and commerce based on water and reduced hydroelectric output. Mitigation measures are few and most expensive; relocation of factories or import water from other watersheds are examples. A rational approach is to implement preventive measures where the planning and management of water resources will be established throughout the watershed. The terms of reference for the assessment of environmental impacts of a project that uses vast amounts of water which provides a diversion or require an analysis of the availability and use of existing water resources , planned and projected to prevent these effects.

    The effects of lowering the water table or reducing artesian flow on the environment.

18. The high cost of meeting the drilling and pumping of deeper wells is the most obvious consequence of the reduction of water resources. Greater consequences can be interrupted water supply or termination of artesian conditions in a given due to the overexploitation of the surrounding well developed. Coastal wells may become unusable if the salt water enters the aquifers that supply fresh water is shrinking. Finally and more long term, land subsidence, caused by a decrease in the pressure of the water in the basement, can occur over a wide range and represent a virtually irreversible effect. Mitigation measures are similarly scarce and difficult to implement.

They are to fill the lost power or replace the power supply in saltwater by a groundwater surface water supply. Attempts to address the invasion of salt water in ground received only little success. If it is possible to prevent the land subsidence, there is not, on the other hand, means technical, realistically, to reverse the situation once that the phenomenon occurred.

Planning and management of a watershed

19. The use of water and land that are interdependent. There is every reason to expect that decisions on the use of water in an area of a watershed include the opportunities and constraints for users who reside elsewhere in the basin. These considerations support the idea that an integrated watershed planning permit to ensure that water resources are not exploited, that upstream users do not deprive those opportunities that lie downstream projects that achieve their purposes and methods and extent of growth are proportionate to the availability of water resources. Tools and technical knowledge necessary for this type of planning and management exist, the difficulty is rather institutional. Water resources that do not respect political boundaries, it is necessary to establish institutions with the capacity and powers to influence decisions on land use and water use in areas where multiple jurisdictions overlap. These areas, in turn, must demonstrate that they are willing to recognize the authority of such an institution. The team responsible for preparing the evaluation of environmental impacts shall, for projects that are based on planning and management of the entire watershed, carefully examine the institutional structure, determining whether strengthen and whether it is politically rational to expect that these efforts bear fruit.