Introduction

The following checklist is based on the environmental quality account taxonomy (see Annex 4). Code numbers allow the easy identification within the hierarchy:

for example, number 153 refers to "Eutrophication"

1 water resources
15 Water quality: surface water
153 eutrophication

The full range of important environmental elements which may be affected by irrigation project activities (e.g. low flow regime, saltwater intrusion) is covered. In addition, information is provided (if applicable) on

* Activities with direct influence and which may impair the environmental quality or which may lead to conflicts over resource uses
* Activities with indirect influence
* Potential natural risks
* Directly affected natural resources or assets
* Indirectly affected resources (higher order impacts)
* Indicators
* Standards.

References are made to

GTZ-reader *Irrigation and the Environment. A review on environmental issues.* Vol. 1 and Vol 2. GTZ. Eschborn, Petermann (1993) and

Mock and Bolton 1991(draft) HR Wallingford, UK.

Example: Code number 1 5 2

1 Water Quality

15 Surface Water

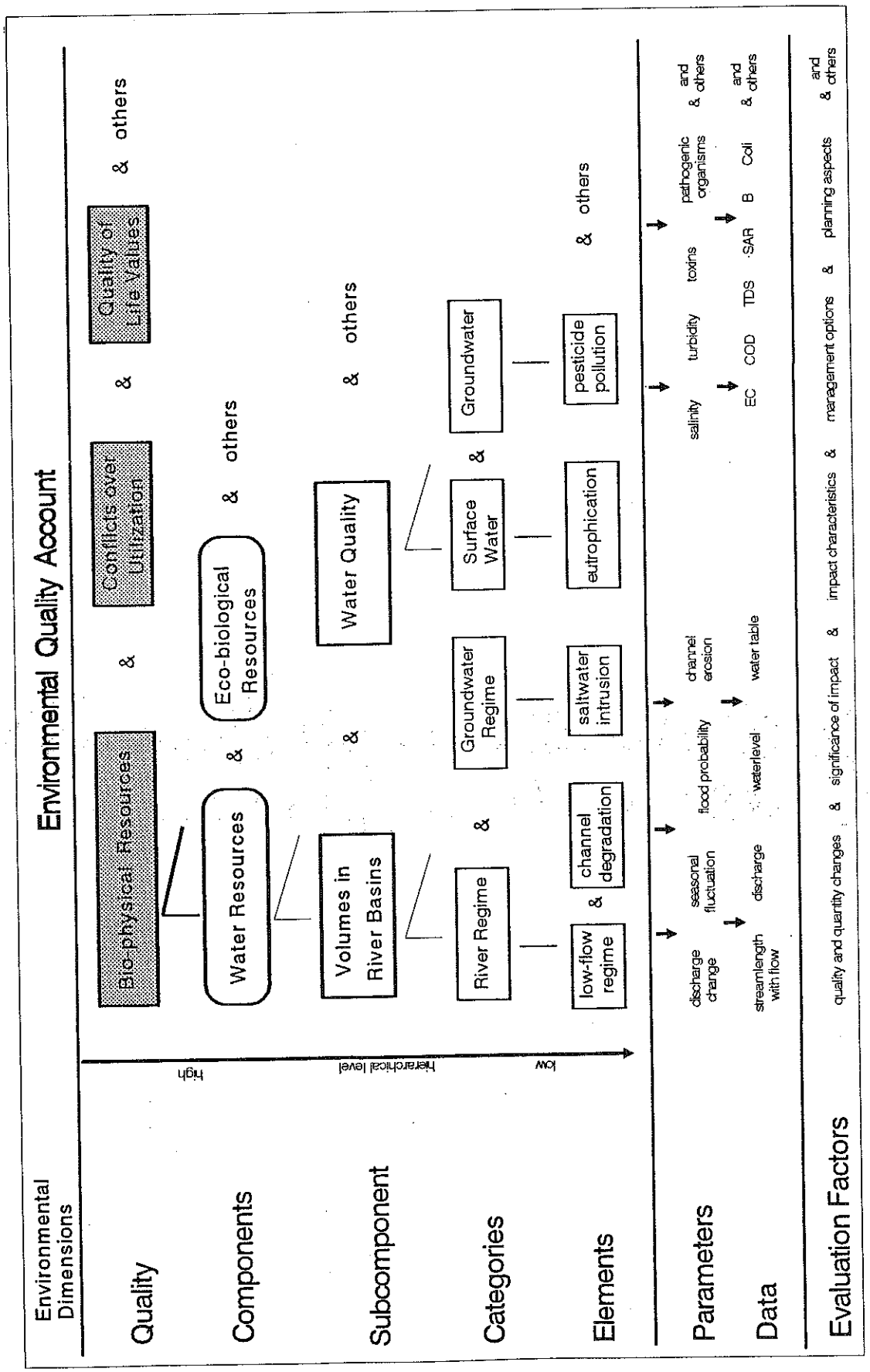
Activities with direct influence: water use (irrigation) and removal (drainage) systems, pest and weed control, and fertilizer use. Indirect influence: tillage and planting systems (mechanisation), water supply systems (pumping).
Natural risks: irrigation water quality (e.g. associated with the use of sewage water).
Directly affected resources: groundwater quality, soil resources (contamination).
Potential higher order impacts: eco-biological resources, public health, other water users.
Indicators: physico-chemical and biological parameters.

152 Salinity increase (extract of questions:)

Are changes in the water management, land development and tillage practices leading to increased saline return flow and to salinity increase which can affect biological communities or domestic, agricultural or industrial water users in the basin?

Indicators: electrical conductivity (EC in dS/m), total dissolved solids (TDS in ppm)
Standards vary with use in agriculture; sometimes USDA standards are used, otherwise FAO standards or national standards are applicable.

Hierarchical system of environmental quality account (see also Annex 4)



Environmental quality account (numbering system of the checklist)

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Water Quality

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- 7 Scenery, natural beauty
- 8 Cultural heritage
- 9 Social welfare and economic development
- 10 Resettlement. Migrants-Evacuees

1 Water Resources

Water volumes and river systems

11 River regime

- Activities with direct influence: water supply, flood control and drainage
- Activities with indirect influence: irrigation system, cropping system (water requirements)
- Directly affected resources: groundwater regime, river system, local waterbodies
- Potential higher-order impacts: biological resources (e.g. wetlands), human development (competition with other water supplies, navigation, fisheries, hydroelectricity), public health
- Indicators: quantities of water, flow characteristics, character of reservoir
- Other indicators: precipitation, runoff, geomorphology, climate, soils, geology, ecologically sensitive areas, human and economic development (see also UNESCO 1987).

111 Low-flow regime

Is the low-flow regime of the river substantially changed by the project (e.g. by more than 10 or 30 or 60% in low-flow periods) and does this benefit or damage aquatic ecosystems, existing or potential downstream abstractions, hydropower, navigation, recreational uses, or other uses?

Indicators: flow duration (average, beginning, end) stability, minimum discharge, periods (duration, frequency)

112 High-flow and floods

Are high water characteristics and/or floods of the river and adjacent floodplains substantially changed (e.g. by more than 10/30/50%) by the project as a result of changes in abstraction, retention, reservoir releases, flood protection works, river canalisation or surface drainage works and does this lead to an increase or decrease in flood damage or change land use restrictions outside the project?

Indicators: peak duration, volume, frequency, discharge and stage, speed of flood-waves, flood superposition with joining rivers, duration or extent of flooding in downstream sections

113 Annual discharge (discharge hydrograph)

Is the total annual discharge substantially changed by the project (e.g. by more than 5/ 10/20%) and does this benefit or damage aquatic ecosystems, existing or potential downstream abstraction, hydropower, navigation, or recreational uses?

Is the discharge hydrograph substantially changed (outside the average periods of low flow and floods) and does this benefit or impair aquatic ecosystems, existing or potential downstream abstraction, or other users?

Indicators: flow conditions such as depth, duration, volume, frequency, seasonal fluctuation

114 Flow compensation

Can the operation of water reservoirs or surface storage compensate for adverse affects noted above in 111, 112, 113 ?

Activities with direct influence: operation of flood retention reservoirs, storage tanks

Indicators: water balance reservoirs/tanks, changes in mean water levels and variations, fluctuations of seasonal downstream flow volumes, depths, frequencies

12 Groundwater regime

- Activities with direct influence: water supply from groundwater, flood control and water removal systems, irrigation system (water use)
- Activities with indirect influence: irrigation system, cropping system
- Affected resources: river regime, local waterbodies, soils, biological resources (especially wetlands), human development (competition), public health
- *Main indicators*: character of groundwater: variations in time, horizontal and vertical movement, elevations, volumes
- *Other indicators*: flow characteristics in rivers, geomorphology, climate, soil status, geologicy, ecologically sensitive areas, human and economic development

121 Watertable fluctuations

Are water abstraction or percolation leading to substantial (seasonal) fluctuations in groundwater levels which effect other users or vegetation inside/outside of the area?

122 Watertable rise

Are increased infiltration and percolation (from irrigation, seepage, other subsurface return flows and floodplain inundation) leading to a rise of the watertable. Is this unwanted or harmful to other users or ecosystems outside the command area. Does waterlogging of agricultural or other developed land in the command area occur as a consequence of watertable rise?

123 Watertable fall

Are increased groundwater abstractions or reduced infiltration due to river canalisation, drainage or flood protection works leading to depletion of the groundwater system and affecting wells and springs which supply the project or other users of streams and lakes in the vicinity?

124 Seawater/ Brackish water intrusion

Are increased groundwater abstractions (or reduced infiltration as under 1.5) or enhanced land drainage leading to the intrusion of saline waters into shallow aquifers which can affect agricultural, domestic or industrial users and natural ecosystems in estuaries or inland areas?

Indicators: water quality (EC); groundwater flow characteristics, e.g. horizontal flow

13 River system

- Activities with direct influence: water supply, flood control
- Activities with indirect influence: irrigation and cropping system, infrastructure works
- Directly affected resources: local waterbodies
- Potential higher-order impacts: biological resources, human development (navigation, fisheries)
- *Indicators*: river bed configurations, morphology, run-off conditions, estuaries/deltas.

131 Stream bed morphology

Will the project affect the geomorphological status of the downstream river sections, its sediment load or transporting capacity or sediment deposition rate on flood plains through changes in the quantity or seasonal distribution of flows or flood peaks in the river, inputs of sediment through erosion, the abstraction of clear water or the flushing of sediment control structures?

Indicators: morphometric characteristics of the cross section, characteristics of the suspended and bed sediments, including particle-size-distribution, longitudinal slope

132 Bank erosion

Is the project leading to scouring or bank erosion in the river?

Indicators: visible erosion damage, morphometric characteristics

132 Channel degradation

Is scouring, aggradation or bank erosion in the river (whether caused by the project or not) endangering the structural stability or proper functioning of the project's river headworks, offtake structures, weirs or pump inlets, its canal network, drainage or flood protection works, or the free flow of its drainage system?

Indicators: visible structural damage or malfunctioning, morphometric characteristics

134 Estuarine configuration

Is the project leading to changes in the hydrological or sediment regimes of the river which can affect delta formation or estuary and coastal erosion?

Indicators: delta configuration, salt water intrusion (see also 1.6), littoral drift and morphometric characteristics, sediment deposition, runoff, longitudinal slope of the stream, flow characteristics

14 Local waterbodies

- Activities with direct influence: flood control and drainage system, irrigation system
- Indirect influence: water supply system
- Directly affected resources: surface waters, groundwater regime, soils, microclimate
- Potential higher-order impacts: biological resources, public health, other water users
- *Indicators*: visible effects of erosion, siltation, wetness, flow characteristics, characteristics of reservoirs, lakes and ponds

141 Canal erosion

Is scouring, aggregation or bank erosion of water delivery and disposal system endangering the structural stability or proper functioning of irrigation and drainage canals or structures or flood protection works?

Indicators: visible erosion damage, morphometric characteristics of cross section; Indirect indicators: efficiency of irrigation canals, ponds and drainage, wetness around leakage or spills, rising groundwater table

142 Siltation

Is sediment deposition in irrigation and/or drainage canals, hydraulic structures or storage reservoirs or on the cultivated land in or around the project (either via the irrigation system or through flooding of the river) or the reduced deposition of beneficial silt, leading to difficulties of irrigation operation or land cultivation or loss of fertility ?

Is the reduced deposition of beneficial silt on cultivated land in or around the project (either via erosion control measures on fields or flood control measures in the river or reservoir storage) leading to loss of fertility or difficulties of project operation or land cultivation or increased demands for fertilisers?

Indicators: visible erosion damage, morphometric characteristics; efficiency of irrigation and drainage canals

143 Ponds (small lakes, impoundments)

Are rising water tables, improper water management (overirrigation, uncontrolled tailwater losses, canal seepage etc.), improper tillage or heavy traffic (surface compaction), uncontrolled flooding, uncontrolled drainage disposal, or construction activities (borrow pits) leading to freshwater ponds (impoundments or stagnant water) affecting crop production, creating vector-breeding habitats, causing soil degradation or affecting water quality (through anaerobic processes and organic pollution)?

Indicators: morphology (area, depth, location, exposure), water balance (inflow/outflow), evaporation, changes in water levels and variations

144 Salt marshes (or salt water lakes)
As 143 but permanent or seasonal brackish, saline or alkaline lakes, and ponds

145 Hinterland effect
Is the project leading to loss of natural vegetation, land degradation and increased erosion in the surrounding region through population pressure, changes in animal husbandry, increased dryland farming, deforestation, infrastructure development, and economic activities stimulated by the project?
Indicators: erosion, woodland/forestry degradation, sediment load in rivers, sedimentation of lakes

Water quality

15 Surface water

- Activities with direct influence: water use (e.g. irrigation) and drainage) systems, pest and weed control, fertilizer use
- Indirect influence: land husbandry (e.g. tillage, planting, mechanisation), water supply (e.g. pumping); livestock farming and facilities
- Natural risks: irrigation water quality (potential upstream pollution)
- Directly affected resources: groundwater quality, soil contamination
- Potential higher-order impacts: biological resources, public health, other water users
- *Indicators*: physico-chemical and biological parameters

151 Particle pollution by sedimentation and turbidity
Are changes in the pattern of water abstraction and re-use in the basin, or flow regulation due to the project, leading to changes in sediment load which can affect biological communities or domestic, agricultural or industrial water users in the basin?
Are changes in water management within the command area, land development manipulations and land modifications or tillage practices leading to increased surface runoff or return flow and to subsequent impacts of sedimentation which can affect wetlands, domestic, agricultural or industrial water users in the watershed?
Indicators: turbidity, total suspended solids. Indirect: soil erosion, canal erosion

152 Salinity increase
Are changes in the water management, land development and tillage practices leading to increased saline return flow and to an increase of salinity which can affect biological communities or domestic, agricultural or industrial water users in the basin?
Are changes to the pattern of water abstraction and re-use in the basin or flow regulation due to the project leading to changes in salinity which can affect biological communities, domestic, agricultural or industrial water users in the river basin?
Indicators: electrical conductivity (EC), total dissolved solids (TDS ppm)

153 Eutrophication
Are changes in the application of fertilisers, transport of organic matter, water management, land development, or land husbandry practices leading to increased return flow with harmful levels in nitrogen and phosphorus (or other nutrients) which can affect biological aquatic communities or which render water unsuitable for domestic or other uses?
Are changes to the pattern of water abstraction and re-use in the basin or flow regulation due to the project leading to changes in the concentrations of nutrients which can affect biological communities or domestic, agricultural or industrial water users in the basin?
Are excessive nutrient pollutants causing anaerobic conditions to develop in natural lakes and pools or wetlands downstream?

Indicators: P and N concentrations in surface waters, pH, trophic status (biomass production and turnover), oxygen contents, in combination with BOD and organic carbon, chlorophyll *a* contents

154 Pesticide pollution

Are toxic and persistent pesticides being introduced to such levels that improper handling or use may cause environmental and water use problems in the project area or downstream (rivers, lakes, evaporation wet lands, depressions, deltas, estuaries)?

Are changes in the application of pesticides, water management, tillage and cropping practices leading to increased irrigation return flow with harmful concentrations of pesticides which can affect biotic communities or which render water unsuitable for domestic or other uses in the basin?

Indicators: specific components in water samples (especially if organophosphates, carbamates, or synthetic pyrethroids are in use) (see also "soil contamination")

Indirect indicators: COD, BOD, biological indicators. Note: Analysing pesticides in water samples remains difficult and expensive and requires special laboratories. Hence, surveillance monitoring of the proper use (handling, storage, application) of pesticides and a brief assessment of the possible environmental fate and transport of the pesticides are invaluable: Where does the pesticide go? How long does it persist? What is its pattern and rate of degradation?

The following pesticide indicators can be used to assess the ecological risks: avian/mammalian data: avian single dose oral LD50, avian dietary LC50, wild mammal toxicity, avian reproduction, honeybee acute contact LD50, honeybee foliar residue toxicity; freshwater fish acute toxicity, freshwater/saltwater invertebrate acute toxicity, fish early life stage study; aquatic organism accumulation, aquatic invertebrate life-cycle study. For example, the German standard: total pesticide concentrations should be less than 0.1 ug/l

155 Microbiological/organic pollution

As a result of the project and its associated settlements, are organic compounds and pathogens being introduced or concentrated to such levels that human health and water use problems or other environmental problems are caused in the project area or downstream?

Indicators: pathogens, especially faecal coliforms (TC) and intestinal nematodes/helminths (egg count of Ascaris, Trichuris, hookworms); organic components, total dissolved organics (as dissolved carbon)

156 Toxic element pollution

Are significant levels of toxic substances such as boron, selenium or heavy metals, accumulating or being introduced, mobilised or transmitted in irrigation supplies or surface waters due to the project?

Indicators: concentrations of Cd, Mn, Ni, Co, Zn, Al, Cu, Cr(iii), Pb, Hg, Fe

International and national standards are available, e.g. FAO, WHO, EU but the may need local adjustments

157 Acidification

Are significant levels of acidifying substances accumulating or being introduced by irrigation supplies or being mobilised or transmitted by water use or water removal systems due to the project?

Indicators: pH, anionic composition, e.g. SO_4, Al and heavy metal concentrations

158 Petrochemical pollution

Are petrochemicals being released which can affect biological communities or water supply systems? Sources: machines and vehicles, infrastructure development

Indicators: petroleum products (gasoline, diesel fuel, kerosene, fuel oil, lubricating oil, solid and liquid wastes, etc.)

16 Groundwater quality

- Activities with direct influence: water use (irrigation) and drainage systems, pest and weed control, fertilizer use
- Indirect influence: land husbandry, mechanisation, water supply (e.g. pumping)
- Natural risks: inherent groundwater quality, geological stratification and presence of saline layers or layers/strata with high metal contents
- Directly affected resources: surface water quality, soils
- Potential higher-order impacts: biological resources, health, downstream water users
- *Indicators*: physical-chemical parameters, biological parameters

161 Salinity increase

Are changes in water management, soil amelioration, land development, tillage practices and cropping pattern leading to increased leaching of salts to the groundwater, causing a high concentration of harmful salts?

Indicators: see 152

162 Nutrient pollution

Are changes in the application of fertilisers, water management, land development, and tillage or planting practices leading to increased leaching of nutrients at harmful levels of nitrogen and phosphorus which can affect soil biotic activity render the groundwater unsuitable for domestic or other uses?

Indicators: see 153

163 Pesticide pollution

Are toxic and persistent pesticides being introduced into agricultural production to such levels that improper handling or excessive use may cause environmental (soil biotic activity) and groundwater use problems in the project area or in the vicinity?

Are changes in the application of pesticides, water management and land husbandry practices leading to increased deep percolation with high concentrations of pesticides that groundwater is rendered unsuitable for domestic or other uses? Does groundwater flow towards open waterbodies before pesticides will be degraded?

Indicators: see 154

164 Microbiological/organic pollution

Are organic compounds and pathogens being introduced or concentrated to such levels that human health and water use problems or other environmental imbalances are caused in the project area or in the vicinity?

Indicators: see 155

165 Toxic element pollution

Are significant levels of toxic substances such as boron, selenium or heavy metals accumulating or being introduced, mobilised or transmitted into groundwater due to the project?

Indicators: see 156

166 Acidification

Are soil formation processes (e.g. the oxidation of pyrite), due to the project, initiated which release significant levels of acid to groundwater and drainage water that toxic Al-concentrations may occur in groundwater and soils (Acid-sulphate soils)

Indicators: see 157

167 Petrochemical pollution

Are petrochemicals being released which can affect biological communities or water supplies (domestic or agricultural)? Sources: machines and vehicles, infrastructure development. *Indicators*: see 158

2 Soils

The following soil conditions may be affected by agricultural and irrigated land development:

- soil erosion (accelerated water and/or wind erosion/accumulation)
- soil salinity and sodicity
- soil tilth (compaction, porosity, aeration)
- soil wetness (structure, internal drainage)
- organic matter status, composition and cycle
- nutrient availability and balance
- leaching losses (nutrients, salts)
- biotic activity (macro- and micro-organism)
- soils as filter, buffer and transformer of pollutants (excessive concentrations of nutrients, pesticides, metals, etc.)

21 Soil erosion

Activities with direct influence: irrigation system and application rates, land development, land husbandry

Activities with indirect influence: cropping system, water delivery, flood control, drainage

Natural risks: slopes, high soil erodibility, high climatic erosivity (water, wind)

Directly affected resources: river regime, river system, local systems, surface water quality, soil physical status, humus status, bio-chemical soil fertility, air quality (only wind erosion).

Potential higher-order impacts: biological resources, other land uses, economic development (reservoirs, competition with other water users, navigation, fisheries, hydroelectricity).

Indicators: soil profile changes by topsoil loss or accumulation in agricultural lands, siltation in canals, wetlands or reservoirs, run-off, river bed configuration, reservoir changes, turbidity of surface water

211 Canal erosion

Is increased erosion along artificial waterways caused by unprotected banks, or areas of cut and fill, inadequately protected drainage channels (natural or artificial) and flood freeways?

Indicators: visible damage, erosion, sedimentation, local wetness along canals

Indirect indicators: efficiency of irrigation system (see also 14, local systems)

212 Erosion by water

Is increased soil loss or sedimentation caused within or close to the project by changes in land use, land modification or manipulation, or caused by irrigation-, tillage and cropping systems?

Indicators: visible/measured soil erosion or accumulation, air photo evidence, measurement of erosion and accumulations. *Indirect indicators*: sediment load in surface waters, siltation of canals or channels, lakes etc.: turbidity, suspended and bed sediments, river bed/lake morphology; indirect erosion assessment: erodibility index of factors contributing to erosion: (e.g. USLE: rainfall erosivity, soil erodibility, slope, topography, vegetation cover/land use)

213 Erosion by wind

Is increased soil loss by wind erosion caused within the project or close to the project by changes in vegetation cover, tillage or cropping pattern, removal of hedges or other natural or artificial windbreaks and shelterbelts?

Indicators: visible/measured soil erosion or accumulation; air photo evidence. *Indirect indicators*: erodibility index (e.g. Woodruff/Sidoway equation: soil erodibility/aggregates; surface roughness, climatic index (wind velocity), length of field, vegetation cover)

22 Soil Phases

Soil phases are soil mapping units distinguished by characteristics that affect the use of the soil. Here, characteristics are included that may change rapidly over time and space, caused naturally or by human impacts.

Activities with direct influence: water supply (quality), water use systems, water removal systems, soil amelioration, land modifications and manipulations.

Activities with indirect influence: flood control, crop selection and cropping systems, fertilizer use, tillage and planting systems.

Natural risks: poor irrigation water quality, inherent soil salinity, sodicity, acidity, unfavourable soil stratification, low infiltration or subsoil permeability, shallow groundwater and poor drainage, negative climatic soil-water balance, extreme soil temperatures.

Affected resources: surface or groundwater qualities, physical and bio-chemical soil status.

Potential higher order impacts: biological resources (fauna/flora, biological imbalances, wetlands), optional land uses, economic development (competition for water supply), public health.

Indicators: status of salinity, sodicity, acidity and soil moisture status.

221 Soil salinity

Is the project leading to progressive accumulation of salts in soils of the project area because of inadequate leaching and drainage, high and/or saline water tables (including saltwater intrusion), saline water/sewage applications, introduction of salts by fertilisers, and waterlogging caused by tillage systems

Indicators: total salinity of soil-water extracts (EC-measurements), anionic composition (salts) of extracts; visible salt efflorescences/crusts; indirect indicators/factors: irrigation water salinity, groundwater depth and salinity, inherent soil salinity, waterlogging, internal drainage and land drainage, water removal system design and operation/maintenance; irrigation systems and water use efficiency, crop selection and cropping systems, tillage systems.

222 Soil sodicity (alkalinity)

Is the project leading to increasing sodicity in the soils of the project area because of inadequate leaching and drainage, high and/or saline watertables (including saltwater intrusion), sodic irrigation water/sewage applications, or the introduction of alkaline salts by fertilisers?

Indicators: pH, SAR- or ESP-values (sodium ratios)

223 Soil acidity

Is the project leading to acidification in soils of the project area because of increased nitrification/humification, introduction of acidic materials (fertilisers, sewage, excreta, etc.), inadequate leaching and drainage, high and/or saline water tables (including saltwater intrusion), land development in sulphate soils, mobilisation by increased lateral and vertical soil water movements?

Indicators: water & soil pH, concentrations in soil & water of SO_4, NO_3, NH_4, H^+, Al

224 Waterlogging/ Ponding/ Wetness

Is the project leading to unwanted waterlogging in soils of the project area or its vicinity because of poor water scheduling, inadequate drainage, land development, land manipulation or modification, and tillage?

Indicators: soil profile morphology (e.g. mottled or gleyed horizons, wetness classes), redox potential, soil compaction and surface crusting, actual soil moisture content, soil aeration status, soil moisture characteristics, infiltration rates and hydraulic conductivity, groundwater depth and seasonal fluctuations.

23 Soil physical properties

Activities with direct influence: land development and agricultural production development.
Activities with indirect influence: cropping systems, irrigation systems, drainage systems
Natural risks: inherent soil qualities, poor land drainage, poor irrigation water quality, climatic parameters (temperature, soil-water balance)
Directly affected resources: soil (agricultural productivity and other optional uses of land).
Indicators: profile changes, water retention, porosity, bulk density, infiltration/permeability.

231 Profile modifications

Are soil amelioration, land manipulation or modification, and tillage systems leading to profile modifications that adversely affect natural productivity of soils i.e. that of the indigenous plant communities and fauna (productivity as related to the resilience of impacted plant communities)?

Indicators: natural profile morphology, soil texture, others see 232

232 Soil tilth

Are soil amelioration, land manipulation or modification, tillage and cropping systems leading to changes that adversely affect soil tilth (physical conditions as related to the ease of tillage, fitness as a seedbed, and its impedance to seedling emergence and root penetration)?

Indicators: soil structure (aggregates) status, bulk density, pore size distribution, field capacity, available water capacity, soil strength, consistency, gypsum, carbonates

233 Internal drainage

Are tillage systems, land modification or manipulation leading to adverse changes in internal drainage (rootzone down to the local watertable)?

Indicators: hydraulic conductivity, deep percolation ratio, stratification, watertable depth (see also 224, 12, 143)

24 Bio-chemical status

Activities with direct influence: land development and agricultural development (crop selection, cropping, tillage and planting systems, pest & weed controls, fertilizer use, post harvest operations).

Activities with indirect influence: irrigation and drainage systems

Natural risks: inherent soil qualities, irrigation water quality, climatic parameters (temperatures, climatic soil-water balance).

Directly affected resources: agricultural productivity and other optional uses of land,

Indirectly affected resources: adjacent fauna and flora including migrating wildlife, public health (communicable and non-communicable diseases, general well being).

Indicators: soil fertility status, soil biotic activity, presence of toxic substances

241 Fertility (actual and potential)

Inherent soil fertility is determined by profile depth, texture, structure, water- and air status, soil temperature, sorption characteristics, soil reaction and redox potential, nutrient cycles/balances, organic matter status, soil micro- and macrofauna, vegetation and the presence of toxic substances.

Are irrigation and drainage systems, crop selection, cropping, tillage and planting systems, pest and weed controls, and fertilisation or other effects due to the project leading to changes in the project area or the vicinity which can adversely affect actual or potential soil fertility?

Indicators: actual yield levels, easily available nutrient contents: N,P,K, available micronutrients (Fe, Mn, Cu, Zn, Co, etc.), cationic balances/antagonisms: Ca:Mg ratio, Ca:Na ratio, Mg:K ratio, Ca/K ratio, pH, pH-related toxicity levels of microelements (B, Fe, Al, etc.). Na in soil solution (SAR).

Potential fertility: mineral composition: gypsum, carbonates, organic matter (OM), organic N, C:N ratio, total P, cation exchange capacity CEC, base saturation (BSP), exchangeable sodium percentage ESP

242 Biotic activity

Are water use systems, land development and agricultural practices (crop selection, cropping- tillage and planting systems, pest and weed controls), fertilizer use and harvesting operations leading to changes in biotic activity within the project area which can affect agricultural productivity?

Are sewage or excreta applications leading to concentrations of pathogens that restrict normal biotic activity and affect crop quality and/or public health?

Indicators: indirect biological activity indicators are: C-mineralization (as oxygen demand or CO_2-release), N-mineralization, enzymatic activities, bacteria-fungi: number, activity and composition of soil microflora, -fauna (bacteria, fungi, algae, protozoa, etc.), invertebrates (nematodes, worms, arthropods), mammals: status and variations in total population and community composition.

Indicators for sewage or excreta pathogens: faecal coliform and intestinal nematode eggs; selected pathogens: enteroviruses, bacteria (Shigella spp., Salmonella spp., Vibrio cholerae), helminths (Ascaris lumbrioscoides eggs); see WHO-standards.

243 Pesticide contamination

Are significant levels of toxic pesticides accumulating in the soils due to the project and its associated settlements? Are these accumulations affecting biotic activity for a period longer than 30/60 days?

Are the least toxic (to mammals, bees or fish), least persistent and least mobile pesticides in use? Are pesticides adequately handled, stored, labelled and applied? Is safe disposal of empty pesticide containers ensured?

Indicators: concentration of specific pesticides; ecotoxicological indicators: biotic activity (CO_2-production), nitrification, toxicity (LD-values), persistence, mobility. Factors of semi-quantitative prognosis of susceptibility of soils to contamination are (1) solubility, volatility, fixation, aerobic/anaerobic degradation, and mobility of a specific pesticide, (2) binding strength in soils (humus, clay, pH). degradation (temperature, soil moisture, biotic activity) (see Blume et al. 1992).

244 Toxic element contamination

Are toxic concentrations of metals and other toxic elements present in the soils of the project area or its vicinity due to the project through e.g. wastewater re-use or through mobilisation of materials already present (parent material)? A toxic level indicates danger of bioaccumulation, accumulation in food chains or potential for groundwater pollution (see also 156).

Indicators: mineral contents of soil parent material in the project area or its vicinity; filter and buffer capacity of soils (depending on humus, clay, sesquioxides, pH); for example, Cd can be used as an indicator of toxic concentrations of metals.

3 Climate and Air

31 Microclimate

Activities with direct influence: reservoirs, water use systems, land use change, land manipulation (hedgerows, woodlots, windbreaks and shelterbelts etc.)

Affected resources: biological resources, soil

Is the project causing microclimatic changes which affect agricultural productivity, terrestrial habitats of ecologically sensitive areas or general well-being?

Indicators: evapotranspiration, wind speed, temperatures, rainfall pattern, shading,

32 Air quality

Activities with direct influence: water lifting and distribution systems, mechanisation of land development, tillage/planting systems, harvesting; infrastructure development; health controls, waste disposal (or waste burning).

Affected resources: public health, amenity. Indirectly: local and global climate

321 Particulate emissions

Is the project causing particulate emissions (soil particles, smoke etc.) through wind erosion, vehicle emissions or biomass burning?

Indicators: transport type and frequency, farm operation mechanisation, on-farm processing types, burning practices, wind erosion see 213

322 Radiatively active gas emissions

Is the project, either directly or indirectly through associated processing operations (on-farm), causing substantially increased emissions of gases which contribute to climate change? Gases in irrigated agriculture can be: CO_2, CH_4, N_2O, CFCs.

Indicators: N-fertiliser applications, paddy rice production (water management controls the actual amount of gas emissions), cattle, transport, industrial processing,

323 Pathogenic/toxic gas emissions

Is the project, either directly through pesticide or wastewater/excreta applications and combustion gases or indirectly through associated industrial processing, infrastructure development and health controls, causing substantially increased gas emissions which contribute to air pollution?

Indicators: transport type and frequency, pesticide application methods, wastewater application methods, chemical health controls, industrial processing; gases include O_3, SO_2, NO_x.

33 Noise

Is the project during construction or operation causing noise levels which are hazards or nuisances to workers or nearby residents?

Indicator: noise level, type of machines and engines in use.

4 Biological Resources

Biological resources comprise terrestrial and wetland/aquatic habitats and changes caused by agricultural and irrigated land projects may act on both. Wetlands are considered individually because of their outstanding importance in preserving the world's biological diversity and integrity (IUCN 1990). Attention should be paid to the whole ecosystem status, including management and conservation aspects of whole area, as well to individual fauna and flora characteristics which constitute the ecosystem in combination with water, soil and air resources. Unfortunately, there is no overall consensus in the use of evaluation criteria for the selection of sites of nature conservation importance. The following indicators can be used: size, rarity, diversity, naturalness, fragility, typicalness, resilience (e.g. Beanlands and Duinker 1993, Knauer 1993).

Terrestrial habitats

Activities with direct influence: water use systems, field drainage, land occupation, crop selection, cropping and tillage systems, pest and weed controls.

Activities with indirect influence: groundwater abstraction; drainwater disposal, flood control; chemical health controls.

Off-site impacts: changes of river flow and groundwater regime; contamination of soil organism and non-target plants, migrating wildlife.

41 Ecosystem status

Are legally protected areas, areas under international conventions or otherwise ecologically sensitive areas directly or indirectly affected by the project?

Indicators: area, ecological importance (relative valuation of functions, attributes and economic values), number of fauna and flora species affected.

411 Protected areas

Are protected areas (categories see IUCN 1994; or national systems of conservation areas) directly or indirectly affected by project developments?

412 Riparian forests

Is riparian forest directly or indirectly affected by the project?

413 Forest/Woodland

Is the existence of forests/woodlands directly or indirectly affected by the project?

413 Other Ecologically Sensitive Areas (EAS)

Are other ecologically sensitive areas directly or indirectly affected by the project? (others than 411 to 413). Ecologically sensitive areas may (a) provide protection of steep slopes, especially watershed areas, against erosion, (b) support important vegetation on soils of inherently low productivity (which would yield of little value to human communities if transformed), (c) regulate water flow, (d) provide conditions essential for the perpetuation of species of medicinal and genetic conservation value, (e) maintain conditions vital for the perpetuation of species which enhance the attractiveness of the landscape or the viability of protected areas, (f) provide critical habitat for threatened species (ADB Environment Paper No.4, 1988).

42 Flora

Is the project causing significant changes in the existing vegetation (indigenous or man-made habitats) within the project area or its vicinity that would affect the vegetation characteristics and integrity of the whole ecosystem (see Rees 1980)?

Indicators: plant communities, plant diversity, threatened species, endemic species, natural productivity. Details are shown in the attached table.

421 Plant communities

Is the project causing reduction in populations and communities, distribution and character of plant communities that would be significant for the whole ecosystem? Are there natural populations that are particularly susceptible to human activities?

422 Plant diversity

Is the project causing significant loss in plant diversity that would affect the whole ecological region? Significance is mainly influenced by resilience.

423 Threatened species

Is the project causing loss or damage to threatened species that would require protection (see species checklists of IUCN or local agencies)? Would the loss of certain plant species deny food or habitat to other threatened wildlife?

424 Endemic species

Is the project causing loss of endemic species (see species checklists of IUCN or local agencies) that would require protection?

425 Natural productivity

Will the project activities damage the natural productivity of ecosystems? Will nutrient flow be disrupted significantly?

Indicator property	Potential effects	Required information	Parameters	Information source
plant communities	ecosystem status and habitat changes Populations: Are there any unique populations/communities that are of scientific or optional value? Are there natural populations that are particularly susceptible to human activities? Are there threatened species which require protection? Would the loss of certain plant species deny food or habitat to wildlife?	national or international species checklists (e.g. IUCN categories): endangered, vulnerable, rare, intermediate, insufficiently known, threatened, commercially threatened species providing food and cover for wildlife species providing human food species providing materials for cottage industry	loss of habitat decrease in species (diversity) decrease in number decreased resilience altered nutrient cycling change of species diversity change of food web diversity change of productivity disturbance of natural communities change of soils and water availability	Professionals: Ecologist Botanist Landscape ecologist/geographer Agronomist Hydrologist Soils specialist Land use planner Government departments: wildlife natural resources forestry hydrology agriculture environment University specialists: forestry ecology botany geography zoology landscape ecology agriculture, soils environmental sciences Non-governmental organisations, environmental groups
plant diversity	Does diversity of any community render it susceptible to human activities?	field inventories of populations and communities: distribution & character, vertical structure & horizontal patterns, interrelations, interactions importance & value distribution, extent of impacted area, change in biomass, frequency of diseases, yield, growth rates genotype & phenotypic diversity	species diversity indices importance value curves to plot relative importance of species (to various stakeholders)	
natural productivity	Will project impair productivity or disrupt nutrient flow, e.g. selective concentration, dilution of substances, leaching, transport?	nutrient levels, carrying capacity impacted areas, disturbance of natural communities, soils and erosion, slope, drainage pattern, water balance, microclimate	productivity level, carrying capacity of different communities, nutrients in soils leaching losses soil loss rate nutrient budget	

modified after: Rees 1980

4 Fauna

Is the project causing changes in the population and distribution of animals and birds within the project area that would significantly affect the fauna population of the region?
Indicators: species diversity, threatened or endemic species, wildlife and wildlife migration.

431 Species diversity
Is the project causing loss of species diversity which would be significant for the whole ecosystem and the region?

432 Threatened species
Is the existence of threatened species significantly changed in the whole ecosystem/region? Consult Red Lists of threatened animals (IUCN; national agencies).

433 Endemic species
Is the existence of endemic species significantly changed in the whole region?

434 Wildlife
Is the existence of other wildlife in the region significantly changed?

435 Wildlife migration
Does the project affect migration patterns of wildlife/birds without mitigating?

44 Biological Imbalances

Is the project leading to biological imbalances (fauna and flora including soil organism) which will necessitate economic and/or ecological implications in terms of structural damages or the increased use of agro-chemicals?

Indicators: pests, weeds, animal diseases, aquatic weeds, animal imbalances

441 Pests

Are agricultural diseases and pests - favoured by land development, land husbandry, irrigation, drainage or flood control - likely to significantly reduce yields, hamper cultivation or necessitate extra applications of pest and diseases controls?

442 Weeds

Are crops weeds - favoured by cropping systems, land husbandry, irrigation, drainage, flood control - significantly likely to reduce yields, hamper cultivation or necessitate extra applications of herbicides?

443 Animal diseases

Are domestic animals in the project or vicinity exposed to new diseases and parasites, or are existing risks increased as a result of project activities?

444 Aquatic weeds

Are parts of the water supply, irrigation delivery and drainage infested with aquatic vegetation or algae which would significantly hamper operation of reservoirs and hydraulic infrastructures or impair water quality?

445 Animal imbalances

Is the project leading to animal imbalances (rodents, birds, insects, etc.) through habitat modification or manipulation (extinction of predators, increased food supply and shelter, reduced competition, etc.) which would also affect other land use systems?

Wetlands and aquatic habitats

Activities with direct influence: land occupation, land modification (e.g. infill), land drainage, mining and quarrying of material for construction or soil amendments, flood control.

Activities with indirect influence: surface and groundwater water abstraction, water management, drainwater disposal, pest and weed controls, health controls.

Causative factors: changes in river and groundwater regime; subsidence, saltwater intrusion, water pollution (discharge of pesticides, salts, nutrients), sediment diversion, soil and non-target plant contamination (migrating wildlife).

45 Freshwater systems

Is the project causing significant hydrological and ecological changes that would affect wetlands and aquatic freshwater habitats within the project area or the watershed? Are these affected areas legally protected, under international conventions, otherwise ecologically sensitive, or of ecological importance for the region?

Areas of potential changes are: perennial and temporary riverine, lacustrine, marshes (palustrine) and human-made wetlands (see IUCN 1990).

Indicators of wetland and aquatic habitat values are:

functions: groundwater recharge and discharge, flood control, shoreline stabilisation, erosion control, sediment and toxin retention, nutrient retention, biomass export, storm protection, micro-climate stabilisation, water transport, recreation

products: forest, wildlife, fisheries, forage, freshwater supply

attributes: biological diversity, uniqueness to culture and heritage

451 Perennial Riverine

Is the project causing substantial changes in perennial riverine habitats (rivers and streams, including waterfalls, inland deltas)?

Indicators: loss of value, areal extent of impact, uniqueness of areas affected

452 Temporary riverine and floodplains

Is the project causing substantial changes in temporary riverine habitats (seasonal rivers and streams, floodplains, including river flats, seasonally flooded grassland, flooded basins)?

Indicators: loss of value, areal extent of impact, uniqueness of areas affected

453 Lacustrine

Are lacustrine habitats (seasonal or permanent freshwater lakes or ponds) substantially changed through project activities?

Indicators: loss of value, areal extent of impact, uniqueness

454 Swamps and marshes (palustrine systems)

Are emergent marshes and swamps on inorganic soils, permanent peat-forming swamps or shrub swamps, seasonally flooded woodlands, and swamp forests substantially changed by project activities?

Indicators: loss of value, areal extent of impact, uniqueness

455 Human-made wetlands

Are human-made wetlands substantially changed or damaged by project activities such as aquaculture/mariculture, salt exploitation, industrial pits or mining pools, or reservoirs (see also 53)

Indicators: loss of value, areal extent of impact, uniqueness

46 Saltwater Systems

Is the project causing significant hydrological and ecological changes that would affect wetlands and aquatic saltwater habitats in the catchment? Are these affected areas legally protected under international conventions, otherwise ecologically sensitive, or of ecological importance for the region?

Areas of potential changes are: estuarine, lagoons and salt lakes (see IUCN 1990).

Indicators of wetland and aquatic habitat values are:

functions: groundwater discharge, flood control, shoreline stabilisation, erosion control, sediment and toxin retention, nutrient retention, biomass export, storm protection, micro-climate stabilisation, water transport, recreation

products: forest, wildlife, fisheries, forage

attributes: biological diversity, uniqueness to culture and heritage

461 Estuarine

Are estuarine habitats (subtidal, intertidal marshes) substantially changed through project activities?

Indicators: loss of value, areal extent of impact, uniqueness,

462 Lagoons

Are lagoon habitats (brackish to saline lagoons connected with the sea) substantially changed through project activities?

Indicators: loss of value, areal extent of impact, uniqueness

463 Salt lakes

Are salt lake habitats (permanent/seasonal, brackish, saline or alkaline flats and marshes) substantially changed through project activities?

Indicators: loss of value, areal extent of impact, uniqueness

47 Fauna and Flora

Is the project causing changes in wetland/aquatic habitats that would imply loss or damage to aquatic plants or animals in the region?
Indicators: threatened and endemic plant and animal species, fish populations

471 Threatened plants
Is the project causing loss or impairment of threatened species that would require protection (species checklists, see IUCN or national references)? Would the loss of certain plant species deny food or habitat to threatened wildlife species?

472 Endemic plants
Is the project causing loss of endemic species that would require protection in the regional context?

473 Fish populations
Is the project causing substantial changes in fish populations which are of importance for the regional system?

474 Threatened fauna
Is the project causing loss or damage to threatened animals that would require protection (species checklists, see IUCN or national references) in the regional context?

475 Endemic fauna
Is the project causing loss of endemic animals that would require protection in the regional context?

5 Conflicts over use of resources

51 Land use competition

Activities with direct influence: land occupation, water supply systems, crop production and infrastructure developments.

511 Land use for crop production
Is the project in direct competition for land with other crop production systems? If yes, is this competition addressed in land use plans or does this competition lead to conflicts with other land users? Is cropland scarce in the region? Are adjacent crop production systems significantly affected by project development? Does the project lead to a reduction in land use pressure within the region through increased and secured production on the same piece of land (as a land saving development)?
Indicators: land use systems, land pressure, land use intensity, crop production.

512 Land use for livestock
Is the project area used by traditional livestock holders which are not being favoured by the project? Is rangeland scarce in the region? Is the project indirectly causing livestock encroachment into ecologically sensitive areas (hinterland effect). Is livestock production included in the new land use plan, e.g. by extra fodder supply?
Indicators: land use systems, land use pressure, land use intensity, land use plans, integrated land use systems for livestock plus crop production

513 Competition with other land uses
Is the project in direct competition for land with other users, e.g. urban or industrial?
Indicators: land use systems, land use pressure, scarcity of land, land use intensity, land use plans, urban developments

52 Use of non-renewable resources

Activities with direct influence: water supply, flood control and water removal systems
Activities with indirect influence: irrigation system, cropping system
Indicators: degree of mechanisation, automatization, market orientation of crop production

521 Fossil water exploitation (mining)

Does the project use fossil groundwater in quantities which are substantially higher than traditional irrigation uses which can, in the near future, restrict regional water supply and seriously restrict options in the long-term?

Indicators: ratio of replenishment to abstraction in local aquifers

522 Fuel resources

Does the project significantly increase the consumption of fuel in excess of traditional uses and in the context of national and urban developments.

Indicators: transport requirements, machinery requirements, water lifting systems, on-farm and off-farm processing. Indirect requirements associated with production of farm machines and infrastructure developments, etc.

523 Building materials

Does the project use scarce building materials in the region. Is this use substantially in excess of traditional uses or significant in the context of other urban and rural developments in the region?

Indicators: range of construction activities for water supply, irrigation and water removal systems, availability of building materials.

524 Other minerals of value

Does the project use or hamper the use of other minerals of value in the region?

Indicators: use of specific minerals

53 Conflicts over development activities

Activities with direct influence: land occupation, water supply, flood control and drainage
Activities with indirect influence: irrigation systems, cropping, pest and weed control, fertilizer application, impairments of biological resources
Indicators: loss of value (economic, option losses), reversibility and reparability of changes
Agricultural and irrigated land development can exert positive or negative changes on the following other development activities or infrastructure in the catchment:

531 Reservoirs
532 Rural water supply
533 Urban water supply
534 Industrial water supply
535 Irrigation water supply (other irrigation systems in the catchment)
536 Other agricultural water supplies
537 Flooding (e.g. flood recession farming)
538 Navigation
539 Fisheries/Aquaculture
540 Natural resources industry (cottage industry, indigenous food supply, handicraft materials)
541 Tourism industry and recreational activities
542 Forestry/woodland uses (e.g. for firewood, construction material, see also 540)
543 Development plans

Is the project in line with policy goals, national or sectoral programmes and regional development plans? Are other project developments hampered by activities of the project?

6-10 Effects on quality-of-life values

6 Public health

61 Communicable diseases

Are communicable diseases hazards and risks changed by project activities?

Activities with direct influence: reservoirs and tanks, sewage re-use, flood control, irrigation and drainage systems, health control measures

Activities with indirect influence: cropping patterns, land husbandry

Indicators: health hazards (pre-existing diseases, endemic or epidemic diseases) hypersensitivity, acute toxicity, mutagenesis, carcinogenesis, other chronic effects.

Health risks associated with wastewater use are assessed in terms of wastewater quality indicators (see 155): physicochemical analyses (metals, pH, SAR, EC, nutrients) and bacteriological tests (helminthic eggs, faecal coliforms).

(References: Mara/Cairncross WHO 1989; WHO 1989; Shuval WB 1990; Shuval et al. WB 1986).

Health risks associated with project development are assessed in terms of community vulnerability, environmental receptivity and vigilance of health services.

(Petermann, GTZ 1993; details in: Birley PEEM/WHO 1992; Oomen et al. 1992; WHO 1980)

Community vulnerability

Which diseases are important in the region?
How prevalent are these diseases?
Is there any drug resistance?
Is there a human parasite reservoir?
How could the number of vulnerable people be changed by the project?
Which communities are affected by the project?
Which communities are susceptible to specific diseases?
How will the health status of each community be changed by the project?
Does human behaviour favour contact with vectors or unsafe water?
Do people enter rural habitats for project or other work?
Do human activities at the project site present special problems?
Will the project change human behaviour?

Environmental Receptivity

Which vector species are important in the region?
Which pathogens do or can they transmit?
Is the vector abundant? Does abundance vary seasonally?
Are the vectors more numerous in some places than in others?
Are the vectors resistant to any insecticides?
Will the project affect vector abundance?
Are the vectors abundant on similar projects in the region?
How will the project affect the number of vector breeding sites?
Could new species of vectors colonise the site from elsewhere?
Does the behaviour of the vector favour contact with the human community?
Do the vector species associate with human communities?
Do the vector inhabit undisturbed rural habitats?
Will the project affect vector behaviour?
Will settlement design affect vector abundance and contact?
Is there an animal reservoir of infection which could be affected by the project?
Will the animals invade the project site?
Could the reservoir population increase as a result of the project?
Could the reservoir population be eradicated?

Vigilance of health services

Is there effective, routine control of vectors in the project area?
Are animal reservoirs controlled?
Is pesticide applied effectively? Is there insecticide resistance?
Are vector populations monitored effectively?
Are there effective curative measures for the disease?
Is curative medicine locally available and effectively used?
Are there effective prophylactic drugs and are they accessible?
Can district health services cope with additional project-related workloads?
Has vector control been incorporated in project design or operation?
Does any feature of the design help to prevent vector breeding or contact?
Does the operation schedule ensure periodic destruction of breeding sites?
Can contact with unsafe water be avoided?
Can the project design be modified to reduce health hazards?

611 Vector-borne water-related diseases

Does the project increase or reduce risk?

Diseases: insect vectors biting near water (sleeping sickness), breeding in water (malaria, river blindness, yellow fever, dengue, filariasis)

612 Water-borne (faecal-oral)

Does the project increase or reduce risk?

Diseases: diarrhoea and dysentery, cholera, enteric fever, hepatitis, ascariasis, trichuriasis

Pathogens in excreta and sewage: enteroviruse, bacteria (faecal coliforms, Salmonella, Shigella,), protozoa (cysts), helminths (ascaris, hookworm, taenia)

Indicators: excreted/sewage load, infective dose applied to land/water, infective dose reaches human host, risk of infection

613 Water-washed

Does the project increase or reduce risk?

Diseases: Infectious skin or eye diseases, louse-borne typhus

see also: sewage pathogens (as water-washed diseases)

614 Water-based (vector-borne)

Does the project increase or reduce risk?

Diseases: schistosomiasis, Guinea worm, etc.

62 Non-communicable diseases

Are non-communicable hazards changed by the project?

Activities with direct influence: construction, pest and weed controls, fertilizer use

Causative factors can be: water pollution, soil contamination, air pollution

Indicators: health hazards (pre-existing diseases, endemic or epidemic diseases, etc.) with infections, diseases, hypersensitivity, acute toxicity, mutagenesis, carcinogenesis, other chronic effects

621 Occupational risks with toxins

Are there significant extra occupational risks associated with storage, handling or application of agro-chemicals or other hazardous chemicals caused by the project?

Indicators: acute toxicity, chronic effects. Indirect indicators: transport, handling and use of agro-chemicals, knowledge and training of farmers and extension staff (risk assessment in terms of frequency versus severity)

622 Water pollution

Are there extra risks associated with drinking water caused by the project?

Indicators: nitrogen risks, heavy metal concentrations (see water standards 15, 16)

Is the drinking water actually polluted (e.g. excessive nitrogen)?

Is waste inclusive of excreta disposed of in the vicinity of potable water facilities?

Is a shallow watertable tapped for potable water?

Are there provisions existing or planned for safe excreta disposal?

Are the current or planned N fertilisation rates on fields excessive?

Is there any danger of leaching of fertilisers into shallow groundwater or the river?

Is there danger of N pollution by cattle in the vicinity of potable water facilities?

If there are any risks, are the most susceptible people educated and informed about health hazards?

If there are any risks, are provisions made by the project to provide safe water to these people?

623 Soil/plant (non-target) contamination

Are there extra risks associated with handling, storage or consumption of plants caused by the project?

Indicators: N- and heavy metal analyses of crops for consumption, pesticide residue analyses. Indirect indicators: use of persistent agro-chemicals, excessive fertilisation, increased heavy metal concentration in soils and groundwater

624 Toxic aerosol emissions

Is the project introducing extra risks of pathogenic emissions which affect villages etc. (except occupational risks)?

Indicators: acute toxicity, chronic effects. Indirect indicators: use of agro-chemicals as sprays, aerial spraying

625 Pathogenic emissions

Are any pathogenic emission risks other than water-related (see 612, 613) risks introduced by the project?

Indicators: diseases (e.g. see 612)

626 Injury/Accidents

Are accidents/injuries significantly increased during construction or operation of mechanical equipment?

Indicators: number of injuries, risk assessment in terms of frequency of occurrence and range of consequences or exposure pathways. Indirect indicators: training of farmers, labourers and extension service, risk management instruments.

63 General well-being

631 Public water supply

Are the provisions for domestic water adequate to prevent diseases from unsafe water? Is general access to safe water improved by the project?

Indicators: domestic water supply, number of wells (status and changes)

632 Nutrition

Is the project leading to improved nutrition for the population?

Indicator: malnutrition (status and changes, gender issues)

633 Housing

Are the provisions for housing and population densities such that extra risks of diseases related to housing or location are avoided?

Indicator: housing situation (quantity and quality)

634 Sanitation

Are the provisions for sanitation and refuse disposal adequate to prevent serious threats of oral, faecal, water-washed and other diseases?

Indicator: sanitation situation (status, changes, gender issues)

635 Relocation stress

Are population movements leading to increase in health risks?

Indicators: evidence of new diseases, disease incidents, social disruption

7 Scenery and landscape beauty

Activities with direct influence: land occupation, land modification, reservoirs, infrastructure developments, drainage systems, waste-disposal systems, afforestation

Activities with indirect influence: flood control, changes of river and groundwater regime, soil erosion, cropping pattern

Indicators: areal extent and magnitude of changes, loss of values (non-tangible, economic or optional/scientific losses), reversibility and reparability of damage, uniqueness of affected area, representativeness and completeness, degree of natural appearance, importance for recreational uses. There are no universally accepted standards in aesthetics and diversity, although some standards from industrial countries may be applied as rules of thumbs.

711 Landscape diversity

Is landscape diversity (pattern, landscape elements) changed by the project?

712 Aesthetics

Are landscape aesthetics be impaired by land development, and how are such changes valued by the people affected?

8 Cultural heritage

Activities with direct influence: land occupation, land modification

Activities with indirect influence: flood control and drainage systems

Indicators: loss of values (non-tangible, economic or optional/scientific losses), reversibility and reparability of changes

811 Archaeological sites

Are any archaeological sites being destroyed, damaged or devaluated by the project? Are these places unique in the district, province or at national level? Are mitigating measures possible to preserve valuable parts of the sites?

812 Heritage sites

Are heritage sites being destroyed, damaged or devaluated by the project? Are these places unique in the district, province or at national level? Are adequate compensation possible and accepted by affected people?

813 Monuments

Are cultural or natural monuments being destroyed, damaged or devaluated by the project? Are mitigating measures possible to preserve valuable monuments?

9 Social welfare and economic development

The environmental appraisal is part of the total project appraisal. Such appraisals conventionally include also economic and social studies. Environmental appraisals should not be seen as an appendage to social or economic assessments or vice versa. They should complement each other in integrated assessments by the use of MCA (see Figure 4). However, it has become standard in some countries to include in environmental appraisals some assessment of social and economic impacts (see EIA matrices Working Aid 12-2).

The following list refers to welfare elements that depend partly on the use of natural resources and vice versa and which contribute to quality-of-life values. This analysis should draw upon mainly (separate) specialist studies and interpretations.

911 Regional disparity

Does the project contribute to rural and regional development and counteract regional disparity?

912 Population change

Is the project causing significant demographic changes (population size, density, demographic/ethnic composition) which may create social tensions?

Is the project contributing to balancing the emigration of rural population to towns?

913 Community facilities

Is the project favouring or enhancing the development of community facilities such as infrastructure, access to the area, or extended agricultural production facilities?

914 Equity

Is the project causing significant changes in the distribution of benefits (economic and non-tangible), access to resources and the workload which can create stress within the community or cause individual hardship? Are marginal farmers (or other marginal groups in the project area) addressed by supporting measures?

915 Social acceptance

Is there adequate incorporation of existing land tenure, farming systems or land use types (e.g. properties rights, traditional access to land and water, properties of trees, access to common properties, grazing areas) in project planning? Are predicted changes in land tenure, farming and land use systems accepted by all groups affected? Are the interests of all important social groups (in the project area) being adequately considered in project planning? Are there people outside the project area which may significantly disbenefit from the project? Are there objections identified by individuals or groups of people affected inside and outside the project area?

916 Participation (social-political situation)

Are there adequate user consultation and participation in project planning, implementation and operation? Are other types of public (e.g. environmentalists, business interests, NGOs, media, other pressure groups) consulted during the decision-making process? Which methods of public participation are in use (see stakeholder involvement, chapter 3)? Are these methods using all opportunities with regard to (political) culture of public participation in the country, including traditional approaches to public consultation?

917 Ethnic minority groups

Is the project causing unwanted changes in lifestyle, livelihood or habitation of any social groups which may lead to conflicts, or substantial changes to their traditional behaviour, social organisation or culture?

918 Group development

Does the project contribute to the development of groups (e.g. farmers groups, water user groups) to ensure project success and mechanism to manage conflicts?

919 Employment

Does the project contribute to the creation of new jobs inside and outside the project area, e.g. during construction and/or project operation, seasonal employment?

920 Women in development

Does the project change the status or the role of women in relation to access to and/or control over land and water resources, agricultural inputs, marketing and credit facilities, farm equipment, family decision-making, workload and labour market (on-farm and off-farm employment), group participation, income, social and cultural resources (information, education, extension, social services)? (see also Kerstan 1993, 1995)

921 Amenity

Is the project causing substantial changes in the provision of local amenities?

922 Income

Is the project causing changes in the general levels of income, in the relative distribution of income (individual and family income), and property values?

923 Agricultural production

Is the project aiming at an increase in total agricultural production? Is the project aiming at increasing the cropping intensity (double or triple cropping) and/or in diversification of food production and/or integrated livestock systems? Are the production goals in line with agricultural development policies and programmes?

925 Food security

Is the project contributing to secure food supply at local, district, provincial or national levels?

922 Recreational facilities

Is the project creating new or preserving/improving existing recreational facilities (picnicking, scenic walks, fishing, swimming, etc.) that can be used by local people or for tourism?

10 Resettlement

Activities with direct influence: large reservoirs; land occupation

Activities with local influence only: flood control and drainage systems, infrastructure development

Details in FAO 1988. Environmental guidelines for resettlement projects in the humid tropics

10.1 Migrants

Are there indications that scheduled or unscheduled migrants (e.g. fishing communities, woodcutters) will enter the project area or its hinterland? Has adequate provision been made for settlements, livelihood and integration of these migrants?

10.2 Evacuees

Is compulsory evacuation needed for project development? Has adequate provision been made for the resettlement, livelihood and integration of any people relocated by the project or its associated works? Have alternatives to resettlement been considered? Have the social, economic and environmental backgrounds of the people who will be resettled been fully assessed? Has the proposed resettlement been selected on the basis of the background and needs of the affected people? What alternative locations and possible economic activities have been explored? Have provisions been made in the project design and management plan to assist the evacuees to adapt to their new environment? Are plans for relocation and new economic activities adequately discussed between responsible ministries? Are funds available for implementation of mitigating measures?

ANNEX 6 LIST OF MITIGATION MEASURES

from The World Bank. Environmental Assessment Resourcebook. Volume II. 1991.

Table 8.2 Dams and reservoirs

Potential Negative Impacts	Mitigating Measures
Direct	
1. • Negative environmental effects of construction: • air and water pollution from construction and waste disposal • soil erosion • destruction of vegetation, sanitary and health problems from construction camps	1. • Measures to minimize impacts: • air and water pollution control • careful location of camps, buildings, borrow pits, quarries, spoil and disposal sites • precautions to minimize erosion • land reclamation
2. Dislocation of people living in inundation zone.	2. Relocation of people to suitable area, provision of compensation in kind for resources lost, provision of adequate health services, infrastructure, and employment opportunities.
3. Loss of land (agricultural, forest, range, wetlands) by inundation to form reservoir.	3. Siting of dam to decrease losses; decrease size of dam and reservoir; protect equal areas in region to offset losses.
4. Loss of historic, cultural or aesthetic features by inundation.	4. Siting of dam or decrease of reservoir size to avoid loss; salvage or protection of cultural properties.
5. Loss of wildlands and wildlife habitat.	5. Siting of dam or decrease of reservoir size to avoid/minimize loss; establishment of compensatory parks or reserved areas; animal rescue and relocation.
6. Proliferation of aquatic weeds in reservoir and downstream impairing dam discharge, irrigation systems, navigation and fisheries and increasing water loss through transpiration.	6. Clearance of woody vegetation from inundation zone prior to flooding (nutrient removal); provide weed control measures; harvest of weeds for compost, fodder or biogas; regulation of water discharge and manipulation of water levels to discourage weed growth.
7. Deterioration of water quality in reservoir.	7. • Clearance of woody vegetation from inundation zone prior to flooding. • Control of land uses, wastewater discharges, and agricultural chemical use in watershed. • Limit retention time of water in reservoir. • Provision for multi-level releases to avoid discharge of anoxic water.
8. Sedimentation of reservoir and loss of storage capacity.	8. • Control of land use in watershed (especially prevention of conversion of forests to agriculture). • Reforestation and/or soil conservation activities in watersheds (limited affect). • Hydraulic removal of sediments (flushing, sluicing, release of density currents).
9. Formation of sediment deposits at reservoir entrance creating backwater effect and flooding and waterlogging upstream.	9. Sediment flushing, sluicing.
10. Scouring of riverbed below dam.	10. Design of trap efficiency and sediment release (e.g., sediment flushing, sluicing) to increase salt content of released water.
11. Decrease in floodplain (recession) agriculture.	11. Regulation of dam releases to partially replicate natural flooding regime.

Example: Dams and reservoirs

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
12. Salinization of floodplain lands.	12. Regulation of flow to minimize effect.
13. Salt water intrusion in estuary and upstream.	13. Maintenance of at least minimum flow to prevent intrusion.
14. Disruption of riverine fisheries due to changes in flow, blocking of fish migration, and changes in water quality and limnology.	14. Maintenance of at least minimum flow for fisheries; provision of fish ladders and other means of passage; provide protection of spawning grounds; aquaculture and development of reservoir fisheries in compensation.
15. Snagging of fishing nets in submerged vegetation in reservoir.	15. Selective clearance of vegetation before flooding.
16. Increase of water-related diseases.	16. • Design and operation of dam to decrease habitat for vector. • Vector control. • Disease prophylaxis and treatment.
17. Conflicting demands for water use.	17. Planning and management of dam in context of regional development plans; equitable allocations of water between large and small holders and between geographic regions of valley.
18. Social disruption and decrease in standard of living of resettled people.	18. Maintenance of standard of living by ensuring access to resources at least equalling those lost; provision of health and social services.
19. Environmental degradation from increased pressure on land.	19. • Choice of resettlement site to avoid surpassing carrying capacity of the land. • Increase of productivity or improve management of land (agricultural, range, forestry improvements) to accommodate higher population.
20. Disruption/destruction of tribal/indigenous groups.	20. Avoid dislocation of unacculturated people; where not possible, relocate in area allowing them to retain lifestyle and customs.
21. Increase in humidity and fog locally, creating favorable habitat for insect disease vectors (mosquitos, tsetse).	21. Vector control.
Indirect	
22. Uncontrolled migration of people into the area, made possible by access roads and transmission lines.	22. Limitation of access, provision of rural development and health services to try to minimize impact.
23. Environmental problems arising from development made possible by dam (irrigated agriculture, industries, municipal growth).	23. Basin-wide integrated planning to avoid overuse, misuse, and conflicting uses of water and land resources.
External	
24. Poor land use practices in catchment areas above reservoir resulting in increased siltation and changes in water quality.	24. Land use planning efforts which include watershed areas above dam.

Table 8.4 Flood protection

Potential Negative Impacts	Mitigating Measures
Direct	
1. Flooding of lesser magnitude, but greater duration of floodplain downstream due to dam releases.	1. Adaptation by changes in agricultural practices.
2. Potential for structural failure and floodwaters higher than capacity of control structures/measures, leading to increased risk to life and property because local pre-project adaptations are relaxed or abandoned or increased development on the floodplain has occurred post-project.	2. Implementation of non-structural measures to prevent increased flood risk, and of a flood warning system.
3. Cycle of enrichment and groundwater recharge in floodplain soils broken.	3. Where dams are present, partial mitigation of effect by regulation of discharge to imitate natural flooding in a controlled way.
4. Resettlement of populations and other negative socioeconomic effects on populations and communities affected by the project.	4. • Identification of at-risk population groups or groups who may be adversely affected by flood control measures. • Incorporation of their interests and protection into project planning and cost analysis to minimize losses or provide in-kind compensation for losses.
5. Adverse effects on fisheries and other aquatic resources by disruption of migratory routes, deterioration of habitat and changes in water quality (e.g., sediment load), leading to reduced productivity of riverine, coastal and marine fisheries.	5. • Installation of fish passageways. Protection of reproductive sites for fish. • Incorporation of fishery management, including hatchery and restocking programs.
6. • Negative impacts of channelization measures: • disruption of fish habitat by elimination of pools, riffles and channel irregularities • increased water temperature by removal of vegetation on banks and in stream • increased erosion and sedimentation problems • bed and bank erosion • downstream flooding and sedimentation	6. • Careful selection of engineering options at planning stage. • Limitation of degree of channel modification or maintenance. • Mitigating measures after construction phase. • Minimize reduction of channel length and preserve some meanders. • Limit excavation and fill. • Limit destruction of bank and streamside vegetation. • Replant/reseed banks. • Excavate only one and not both banks, etc. (See Brookes 1988.)
7. Adverse effects of construction.	7. • Minimization of effects by avoiding impediments to natural drainage, uncontrolled run-off and soil erosion, and air pollution. • Provision for adequate filling of borrow areas, control of land clearing, and disposal of spoil. • Limitation of access of vehicles to stream bank.

Example: Flood protection

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
8. Reduction of floodplain grazing, both through ecological changes on the floodplain and intensified development (e.g., irrigated agriculture).	8. • Production of fodder crops and usage of byproducts of irrigated food crops and development of alternative water sources. • Integration of existing rangeland use (e.g., semi-nomadic herding) with planned developments, to ensure substantial grazing and watering possibilities in valley during dry season.
9. Reduction of recession agriculture.	9. Maintenance of natural flooding regime to extent possible in most productive lands (and intensification of production) by maintaining water courses free of flood control structures or installing structures to enable semi-controlled flooding.
10. Obstacles (levees, dikes, etc.) to wildlife passage.	10. Construction of bridges or special crossing places.
11. Loss of wildlands and wildlife habitat.	11. Identification of critical habitats and planning of flood control measures to minimize effects; where habitats or species are dependent on natural flooding regime, minimize disruption of flow in that area to extent possible.
12. Flooding problems created downstream.	12. • Protection of natural overflow areas downstream. • Creation of overflow basins.
Indirect	
13. Improved accessibility, development opportunities in floodplain, and sense of security after flood control measures taken, leading to influx of people with associated agricultural development, deforestation, wildlife poaching, infrastructure development, etc.	13. • Limitation of access, if possible. • Planning for anticipated influx and implementation of companion rural development activities. • Introduction of non-structural control measures.
14. Increased fertilizer use on agricultural fields to compensate for loss of fertility, leading to water pollution and dependence on imported supplies.	14. • Optimal timing and rate of application. • Use of nitrogen fixing cover crops. • Use of organic instead of chemical fertilizers.

Table 8.7 Irrigation and drainage

Potential Negative Impacts	Mitigating Measures
Direct	
1. Soil erosion (furrow, surface).	1. • Proper design and layout of furrows or field avoiding too steep a gradient. • Land leveling. • Design of terraces on hillside minimizing surface erosion hazard.
2. Soil erosion (with sprinkler irrigation on hilly area).	2. Design of sprinkler system minimizing erosion hazard assuring infiltration rate exceeds application rate of the sprinklers.
3. Waterlogging of soils.	3. • Regulation of water application to avoid overwatering (including controlled turn-out to allow cutting off water supply to irrigation ditches). • Installation and maintenance of adequate drainage system. • Use of lined canals or pipes to prevent seepage. • Use of sprinkler or drip irrigation.
4. Salinization of soils.	4. • Measures to avoid waterlogging: • leaching of salts by flushing soils periodically • cultivation of crops with salinity tolerance
5. Scouring of canals.	5. Design of canal system to minimize risk and use of lined canals.
6. Clogging of canals by sediments.	6. • Measures to minimize erosion on fields. • Design and management of canals to minimize sedimentation. • Provision of access to canals for removal of weeds and sediments.
7. Leaching of nutrients from soils.	7. • Avoidance of overwatering. • Replacement of nutrients by fertilizers or crop rotations.
8. Algal blooms and weed proliferation.	8. Reduction of input to and release of nutrients (nitrogen and phosphorous) from fields.
9. Clogging of canals by weeds.	9. • Design and management of canals to minimize weed growth. • Provision of access to canals for treatment or removal of weeds.
10. Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity, nutrients, agrochemicals) affecting fisheries and downstream users.	10. • Improved water management; improved agricultural practices and control of inputs (particularly biocides and chemical fertilizers). • Imposition of water quality criteria.
11. Sea water intrusion into downstream freshwater systems.	11. • Reduction of takeoff to maintain adequate downstream flow. • Recharge of coastal aquifers through injection wells.

Example: Irrigation and drainage

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
12. Reduction of downstream flows affecting flood plain use, flood plain ecology, riverine and estuarine fisheries, users of water, dilution of pollutants.	12. • Relocation or redesign of project. • Regulation of takeoff to mitigate effects. • Compensatory measures where possible.
13. Encroachment on swamps and other ecologically sensitive areas.	13. Siting of projects to avoid or minimize encroachment on critical areas.
14. Alteration or destruction of wildlife habitat or impediment to movement of wildlife.	14. • Siting of project to minimize loss or avoid encroachment on most sensitive or critical areas. • Establishment of compensatory parks or reserved areas. • Animal rescue and relocation. • Provision of corridors for movement.
15. Impediment to movement of livestock and humans.	15. Provision of passageways.
16. Threat to historic, cultural or aesthetic features.	16. • Siting of project to prevent loss. • Salvage or protection of cultural sites.
17. Alteration or loss of flood plain vegetation and disturbance of coastal ecosystems (e.g., mangroves).	17. • Siting of project to less vulnerable area. • Limitation and regulation of water take-off to minimize problems to extent possible.
18. Dislocation of populations and communities.	18. • Siting of project to minimize effect. • Resettlement scheme ensuring at least equal standard of living.
19. Introduction or increase in incidence of water-borne or water-related disease (schistosomiasis, malaria, onchocerciasis, etc.).	19. • Prevention measures: • use of lined canals or pipes to discourage vectors • avoidance of stagnant or slowly moving water • use of straight or slightly curving canals • installation of gates at canal ends to allow complete flushing • filling or draining of borrow pits along canals and roads • disease prophylaxis • disease treatment

Example: Irrigation and drainage

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
20. Disease and health problems from use of wastewater in irrigation.	20. • Wastewater treatment (e.g., settling ponds) prior to use. • Establishment and enforcement standards for wastewater use.
21. Conflicts over water supply and inequalities in water distribution throughout service area.	21. Means to ensure equitable distribution among users and monitor to assure adherence.
22. Overpumping of groundwater.	22. Limitation of withdrawal so that it does not exceed "safe yield" (recharge rate).
Indirect	
23. Increased pollution and health hazards from downstream industrial and municipal pollutants caused by decreased flow (decreased dilution) of river water.	23. • Control of waste sources downstream. • Reduction of water take-off.
External	
24. Water quality deteriorated or made unusable by upstream land use and pollutants discharge.	24. • Control of land use in watershed areas. • Control of pollution sources. • Water treatment prior to use.

Valuation of Wetlands

(modified after: Claridge IUCN 1992)

Method

Comparison of wetlands

Valuation of wetlands is carried to be able to decide:

- whether or not environmental losses resulting from development will be acceptable;
- whether a certain wetland should be included in the proposed development or should be made a nature reserve;
- how to manage specific wetlands sustainable.

A system for classifying and ranking is needed to make the information collected from different disciplines and different points of view useful for assessing the conservation significance of an area. Such a system should express the values of a wetland in a way that provides a basis for making comparison and environmental assessment.

The valuation system

Any valuation should be based upon information that can be checked. For many areas, there are wetland "stories" or other indigenous information and these must be cross-checked with scientific records.

Characteristics are objective descriptions, e.g. area, size, shape, climate, soils, species present, vegetation structure, biomass production, land use, other physical and biological processes.

Benefits are attributes, functions and (present or potential) uses that derive from its single or combined characteristics.

Attributes are non-economic or preservation values of an area such as:

- biological diversity (richness of flora, fauna or natural processes; significant gene pool);
- scenic beauty (high rated aesthetic value, wilderness);
- historical or cultural value (sites of significance to national or local history; presence of distinctive way of life, or product use patterns; symbolic, educational, social or spiritual place for a community);
- scientific value (reference or monitoring sites; evolutionary significance; potential source of information on processes or natural systems);
- uniqueness (presence of rare, endangered or endemic species, ecosystems).

Function is the combination of characteristics that supports or protects human activity or property without being used directly. Such indirect use values include:

- water quantity regulation (flood control, flow regulation, erosion control, aquifer recharge)
- water quality regulation (adsorption or retention of pollutants or sediments, nutrient export from mangroves);
- habitat for fish (nursery or feeding area for marine or riverine species);
- habitat for wildlife (feeding, drinking, resting, roosting, etc. area for amphibians, reptiles, birds or mammals).

Use of wetland is the direct utilisation of one or more of its characteristics. Such direct uses are benefits gained by people through, for example:

- plant production (terrestrial or aquatic species);
- animal production (terrestrial or aquatic species);
- mineral production (e.g. gems, sand, clay, salt, coral, etc.);
- storage or supply of irrigation water, drinking water, industrial water; generation of hydropower;
- tourism or recreation;
- research and education;
- waste (water) disposal (e.g. discharge of drainage water, domestic or industrial effluents, dumping of solid wastes);
- land development.

Values

Attributes, functions and uses can be assigned values. The value of a benefit may be affected by one or more characteristic of a wetland. For instance, a wetland may have a water storage function, but the value of this may not be high because there are no population centres or flood-prone cultivated areas close by. Values can be expressed in various monetary or non-monetary units and in terms of regional, national and international significance of the benefit.

The following scale is applied:

⇒ Level 5: very high importance; highly significant at national/intentional level

⇒ Level 4: high importance: highly significant at regional level, some at national level

⇒ Level 3: Medium importance: highly significant at the local level, some significance at the regional scale

⇒ Level 2: low importance: moderate or low significance

⇒ Level 1: insignificant

To allow easy comparison, the valuation is presented in a standardised way. In a one-page format, the various benefits (attributes, functions, uses) are displayed, each with an easily visible indication of its value on the 5-level scale.

Apart from providing a tool for rating the relative importance or for assessment of effects, the system also allows policy planning and decision-making for EIA, as demonstrated by the following matrix:

attributes/functions / uses	value level	1	2	3	4	5
value level	1					
	2	A			B	
	3					
	4	C			D	
	5					

A no measure required
B conservation required to maintain benefits and uses
C sustainable management of the resource required
D conservation urgently required

Case study Bundula National Park (Sri Lanka)

1 ATTRIBUTES (non-use values; preservation values)

1A BIOLOGICAL DIVERSITY (high floral and faunal richness)	1	2	3	4	**5**
1B SCENIC/LANDSCAPE BEAUTY (situated in National Park; pleasant surroundings)	1	2	3	4	**5**
1C HISTORICAL OR CULTURAL VALUE (some archaeological sites present)	1	2	3	**4**	5
1D SCIENTIFIC VALUE (baseline data established; significance for monitoring high)	1	2	3	4	**5**
1E UNIQUENESS (endemic, rare or endangered birds, mammals and reptiles)	1	2	3	4	**5**

2 FUNCTIONS (indirect use values)

2A WATER QUANTITY REGULATION (some flood buffer capacity)	1	**2**	3	4	5
2B WATER QUALITY REGULATION (no significance)	1	**2**	3	4	5
2C HABITAT FOR "FISH" (restricted connection with sea; low species diversity)	1	2	**3**	4	5
2D HABITAT FOR WILDLIFE (large numbers of birds and mammals use the wetland)	1	2	3	4	**5**

3 USES (direct use values)

3A PLANT PRODUCTION (wood extraction; cattle feed)	1	2	3	**4**	5
3B ANIMAL PRODUCTION (cattle; fisheries)	1	2	3	**4**	5
3C MINERAL PRODUCTION (salt and shells, potential for garnet sand)	1	2	3	4	**5**
3D WATER STORAGE OR SUPPLY; ENERGY (for salt production)	1	**2**	3	4	5
3E TOURISM/RECREATION (on the programme of tour operators; bird watching)	1	2	3	4	**5**
3F RESEARCH/EDUCATION (census work is carried out; visitor's centre planned for)	1	2	3	**4**	5
3G WASTE(WATER) DISPOSAL (drainage water inflow)	1	2	3	**4**	5
3H LAND DEVELOPMENT (some cultivation present)	1	**2**	3	4	5

Result of the case study: The wetlands of the N.P. are placed in sector D

Environmental design considerations for rural development projects

Checklist from: HARZA Engineering prepared for USAID Washington D.C. (1980)

Case Study: Lake Chilwa Small Scale Irrigation Projects (Petermann. GTZ 1991).

Explanation: HA - MA - LA - high/medium/low adverse; 0 none or insignificant;
LB - MB - HB - low/medium/high beneficial

LAKE CHILWA –

A. PROJECT TYPE (Road, Industry, etc.): Irrigation

B. PROJECT PHASE (Planning/Design. etc.): Planning

C. PROJECT COMPONENT (Routing, Site location, etc.): Intake structures, on-field water management; infrastructure

D. PROJECT DECISION POTENTIAL IMPACTS:

1. Agricultural Lands

a) Are there cultivable lands in the project area?	Yes X	No	Unk
b) Will project decision result in more or improved cultivable land?	Yes X	No	Unk
c) Will project decision result in less or damaged cultivable land?	Yes	No X	Unk

ESTIMATED IMPACT ON AGRICULTURAL LAND.....ND..HA..MA..LA..O..LB..MB..(HB)

2. Soil Erosion

a) Will project decision help to prevent soil loss or erosion?	Yes X	No	Unk
b) Will project decision directly cause or worsen soil loss or erosion?	Yes	No X	Unk
c) Could project decision indirectly lead to practices that could cause soil loss or erosion?	Yes	No X	Unk
d) Is it necessary to consult a soils scientist?	Yes	No X	Unk

ESTIMATED IMPACT ON SOIL EROSION.....ND..HA..MA..LA..O..(LB)..MB..HB

3. Slope Stability

a) Does project decision involve actual modification of slopes?	Yes	No X	Unk
b) Will project decision affect stability of slopes indirectly?	Yes	No X	Unk
c) Will project decision result in other conditions that could affect slope stability?	Yes	No X	Unk
d) Could project decision cause people, livestock or property to be located where existing unstable slopes could be a hazard?	Yes	No X	Unk
e) Is it necessary to consult a geotechnical engineer?	Yes	No X	Unk

ESTIMATED IMPACT ON SLOPE STABILITY.....ND..HA..MA..LA..(O)..LB..MB..HB

4. Energy-Mineral Resources

a) Do energy-mineral resources exist in project area?	Yes___	No X	Unk___
b) Will project decision help to develop, now or in the future, important energy-mineral resources?	Yes___	No X	Unk___
c) Will project decision cause significant consumption of additional energy-mineral resorces such as engine fuels?	Yes___	No X	Unk___
d) Could project decision prevent or impede future development of essential energy-mineral resources?	Yes___	No X	Unk___
e) Is it necessary to consult with a minerals agency or mining engineer?	Yes___	No X	Unk___

ESTIMATED IMPACT ON ENERGY/MINERAL RESOURCES.....ND..HA..MA..LA..(O).LB..MB..HB

5. Surface Water Quantity

a) Do surface water resources exist in project area?	Yes X	No___	Unk___
b) Is information available on present and future demands on water resources as result of the project?	Yes X	No___	Unk___
c) Will project decision help to increase or preserve available surface water supplies by such things as improved drainage/run-off conditions?	Yes X	No___	Unk___
d) Will project decision increase demand or cause loss of available surface water either directly or indirectly?	Yes X	No___	Unk___
e) Is it necessary to consult a hydrologist?	Yes X	No___	Unk___

ESTIMATED IMPACT ON SURFACE WATER QUANTITY.....ND..HA..MA..(LA)..O..(LB)..MB..HB

6. Surface Water Quality

a) Is information available on present water quality?	Yes___	No X	Unk___
b) Will project decision lead to additional natural or man made discharges into surface waters?	Yes X	No___	Unk___
c) Will project decision help to improve or protect surface water quality?	Yes X	No___	Unk___
d) Could project decision cause deterioration of surface water quality either directly or indirect?	Yes X	No___	Unk___
e) Is it necessary to consult a water quality engineer or agency?	Yes X	No___	Unk___

ESTIMATED IMPACT ON SURFACE WATER QUALITY.....ND..HA..MA..LA..O..(LB)..MB..HB

7. Ground Water Quantity

a) Do ground water resources exist in project area?	Yes___	No X	Unk___
b) Is information available on present and future demands on water resources as result of the project?	Yes___	No X	Unk___
c) Will project decision help to increase or preserve available ground water supplies by such things as improving recharge conditions?	Yes X	No___	Unk___
d) Will project decision increase demand or cause loss of available ground water either directly or indirectly?	Yes___	No X	Unk___
e) Is it necessary to consult a geohydrologist?	Yes___	No X	Unk___

ESTIMATED IMPACT ON GROUND WATER QUANTITY.....ND..HA..MA..LA..O..(LB)..MB..HB

8. Ground Water Quality

a) Is information available on present water quality?	Yes___	No X	Unk___
b) Will project decision cause any natural or man made discharges into ground aquifers?	Yes X	No___	Unk___
c) Will project decision help to improve or protect ground water quality?	Yes X	No___	Unk___
d) Could project decision cause deterioration of ground water quality either directly or indirectly?	Yes X	No___	Unk___
e) Is it necessary to consult with a ground water quality specialist?	Yes___	No X	Unk___

ESTIMATED IMPACT ON GROUND WATER QUALITY.....ND..HA..MA..LA..O..(LB)..MB..HB

9. Air Quality

a) Is information available on existing air quality?	Yes___	No X	Unk___
b) Will project decision produce any air emissions directly?	Yes___	No X	Unk___
c) Will project decision help to reduce existing air pollution sources such as open burning operations?	Yes___	No (rice) X	Unk___
d) Could project decision lead to practices that worsen air quality such as causing increased road traffic or industrialization?	Yes___	No X	Unk___
e) Could project decision lead to a change in engine use or fuel combination that could cause serious air problems?	Yes___	No X	Unk___
f) Is it necessary to consult an air quality specialist?	Yes___	No X	Unk___

ESTIMATED IMPACT ON AIR QUALITY.....ND..HA..MA..LA..(O.)..LB..MB..HB

10. Noise

a) Is noise now a problem in project area?	Yes___	No X	Unk___
b) Will project help in reducing undesirable noise conditions?	Yes___	No X	Unk___
c) Will project cause temporary or sustained increases in noise generating conditions such as heavy machinery or road travel?	Yes___	No X	Unk___
d) Could project cause movements of people to high noise level locations?	Yes___	No X	Unk___
e) Is it necessary to consult a noise specialist?	Yes___	No X	Unk___

ESTIMATED IMPACT ON NOISE.....ND..HA..MA..LA..(O.)..LB..MB..HB

11. Aquatic Ecosystems

a) Are there any aquatic ecosystems of the types listed below which, by nature of their size, abundance or type, can be considered significant or unique?

rivers?	Yes X	No___	Unk___
streams?	Yes___	No___	Unk___
lakes?	Yes X	No___	Unk___
ponds?	Yes___	No___	Unk___

b) Are these systems essentially:

pristine?	Yes___	No___	Unk X
moderately degraded?	Yes___	No___	Unk X
severely degraded?	Yes___	No___	Unk___

11. (Cont.)

c) Are these systems used by the local people:			
i) Consumptively			
For drinking water?	Yes X	No	Unk
For irrigation?	Yes X	No	Unk
For livestock?	Yes X	No	Unk
ii) Non-consumptively			
For Washing and Bathing?	Yes X	No	Unk
For Waste Disposal?	Yes	No	Unk X
For Transportation?	Yes	No X	Unk
For Harvest of non-domesticated plants or animals as food, fiber fur or other useful product?	Yes	No X	Unk
d) Will the project directly affect consumptive use of water?	Yes X	No	Unk
e) Will the project directly or indirectly affect either non-consumptive or consumptive uses of these ecosystems by:			
Use or production of toxic materials (both during construction and/or operation) which might enter these systems?	Yes	No X	Unk
Alteration of drainage patterns?	Yes	No	Unk X
Increasing erosion?	Yes	No X	Unk
Causing increase in populations so as to place added stress on their systems?	Yes	No X	Unk

ESTIMATED IMPACT ON AQUATIC ECOSYSTEMS.....ND..HA..MA..LA..(O)..(LB)..MB..HB

12. Wetland Ecosystems

a) Are there any wetland ecosystems of the types listed below which, by nature of their size, abundance or type, can be considered to be significant or unique?			
not affected → Marsh?	Yes X	No	Unk
Swamp?	Yes X	No	Unk
Bog?	Yes	No	Unk
Flood Plain?	Yes X	No	Unk
Estuary?	Yes	No	Unk
b) Are these systems:			
pristine?	Yes	No	Unk X
Moderately degraded?	Yes	No X	Unk (X)
severely degraded?	Yes	No X	Unk
c) Are these systems used by local people for:			
Drinking Water?	Yes X	No	Unk
Livestock Water?	Yes X	No	Unk
Washing and Bathing?	Yes X	No	Unk
Waste Disposal?	Yes	No	Unk X
Agriculture?	Yes X	No	Unk
Harvest of non-domesticated plants or animals as food, fur, or fiber.	Yes X	No	Unk
d) Is there currently a trend towards draining wetlands in the project area for conversion to some other use?	Yes X	No	Unk

only floodplains affected

existing use

← floodplains

12. (Cont.)

e) Will the project either directly or indirectly affect wetlands by:			
Changing population or land use practices so as to increase drainage of wetlands for use as agricultural, industrial or urban land?	Yes X	No	Unk
Use or production (either during construction and/or operation) of toxic materials which might enter wetlands?	Yes	No ?	Unk X
Use the water directly?	Yes X	No	Unk
Alter drainage patterns so as to affect wetlands?	Yes X	No	Unk
Increase erosion so as to affect wetlands?	Yes	No X	Unk

ESTIMATED IMPACT ON WETLAND ECOSYSTEMS.....ND..HA..MA..(LA..O)..LB..MB..HB

13. Terrestrial Ecosystems

a) Are there any terrestrial ecosystems of the types listed below which, by nature of their size, abundance or type, could be classified as significant or unique?			
Forest?	Yes	No X	Unk
Savanna?	Yes	No X	Unk
Grassland?	Yes	No X	Unk
Desert?	Yes	No X	Unk
b) Are these ecosystems:			
Pristine?	Yes	No	Unk
Moderately Degraded?	Yes	No	Unk
Severely Degraded?	Yes	No	Unk
c) Are there present trends towards alteration of these ecosystems through cutting, burning, etc. to produce agricultural, industrial, or urban land?	Yes	No X	Unk
d) Does the local population use these ecosystems to obtain non-domesticated:			
Food plants?	Yes	No X	Unk
Medicinal plants?	Yes	No X	Unk
Wood products?	Yes	No X	Unk
Fiber?	Yes	No X	Unk
Fur?	Yes	No X	Unk
Food Animals?	Yes	No X	Unk
e) Will the project require clearing or alteration of:			
Small areas of land in these ecosystems?	Yes	No X	Unk
Moderate areas of land in these ecosystems?	Yes	No X	Unk
Large areas of land in these ecosystems?	Yes	No X	Unk
f) Does the project rely on any raw materials (wood, fiber) from these ecosystems?	Yes	No X	Unk
g) Will the project decrease use of products from these ecosystems by producing or providing substitute materials?	Yes	No X	Unk
h) Will the project cause increased population growth in the area, bringing about increased stress on these ecosystems?	Yes	No X	Unk

ESTIMATED IMPACT ON TERRESTRIAL ECOSYSTEMS.....ND..HA..MA..LA..(O.)LB..MB..HB

14. Endangered Species

a) Is the existence of endangered species in the project area:			
Very unlikely	Yes	No	Unk
Probable	Yes X	No	Unk
Highly probable	Yes	No	Unk
Documented fact	Yes	No X	Unk
b) Are these species:			
Of scientific interest only	Yes	No	Unk X
Of scientific interest and highly sought after by local people for food, hides, sale to animal dealers.	Yes	No	Unk
c) Will the project affect the habitat of these animals:			
Directly by destruction of habitat?	Yes	No	Unk X if yes (a)
Indirectly by altering habitat through changing drainage, land use.	Yes	No	Unk
d) Will the project increase ease of access to these habitats?	Yes	No X	Unk
e) Will the project increase population in the project area, thus placing increased pressure on these species and/or on their habitat?	Yes	No X	Unk

ESTIMATED IMPACT ON ENDANGERED SPECIES.....ND..HA..MA..LA..(O)..LB..MB..HB ?

15. Migratory Species

a) In the project area are there any:			
Migratory fish?	Yes	No X	Unk
Migratory birds?	Yes X	No	Unk
Migratory Mammals?	Yes	No	Unk X
b) Are these species used by local people for food, fur, or other products?	Yes X	No	Unk
c) Will the project require any dams, roads, pipelines or other alignments which could interfere with these migratory animals?	Yes	No X	Unk
d) Will the project destroy any habitats (resting, feeding, reproductive) which are critical to these species?	Yes	No X	Unk
e) Will increased population place additional stress on these species?	Yes	No X	Unk

ESTIMATED IMPACTS ON MIGRATORY SPECIES.....ND..HA..MA..LA..(O)..LB..MB..HB

16. Beneficial Plants

a) Do non-domesticated plants occur in the project area which are used or sold by local people as:			
Food?	Yes	No X	Unk
Fiber?	Yes	No X	Unk
Fuel?	Yes	No X	Unk
Ornament?	Yes	No X	Unk
Medicine?	Yes	No	Unk X
Forage?	Yes	No X	Unk
Building Material?	Yes	No	Unk
b) Do these plants occur in:			
Undisturbed habitats?	Yes	No	Unk
Moderately disturbed habitat?	Yes	No	Unk
Severely disturbed habitat?	Yes	No	Unk
c) Are these plants:			
Utilized heavily?	Yes	No	Unk
Utilized moderately?	Yes	No	Unk
Utilized only occasionally?	Yes	No	Unk

16. (Cont.)

d) Is this use:

Peculiar to the local population?	Yes___	No___	Unk___
Universal in the region or country?	Yes___	No___	Unk___

e) Will the project:

Decrease habitat for these plants?	Yes___	No___	Unk___
Increase habitat for these plants?	Yes___	No___	Unk___
Increase access to these plants?	Yes___	No___	Unk___
Provide substitute products or the necessary money to replace the use of these plants?	Yes___	No___	Unk___
Increase use of these plants through increased population?	Yes___	No___	Unk___

ESTIMATED IMPACT ON BENEFICIAL PLANTS.....ND..HA..MA..LA(O).LB..MB..HB

17. Beneficial Animals

a) Do non-domesticated animals occur in the project area which are used or sold by the local people as:

Souvenir products?	Yes___	No X	Unk___
Food?	Yes___	No X	Unk___
Fur?	Yes___	No X	Unk___
Pets?	Yes___	No___	Unk___

b) Do these animals occur in:

Undisturbed habitats?	Yes___	No___	Unk___
Moderately disturbed habitats?	Yes___	No___	Unk___
Severely disturbed habitats?	Yes___	No___	Unk___

c) Are these animals:

Utilized heavily?	Yes___	No___	Unk___
Utilized moderately?	Yes___	No___	Unk___
Utilized only occasionally?	Yes___	No___	Unk___

d) Is this use:

Peculiar to the local population?	Yes___	No___	Unk___
Universal to the region or country?	Yes___	No___	Unk___

e) Will the project:

Decrease habitat for these animals?	Yes___	No___	Unk___
Increase habitat for these animals?	Yes___	No___	Unk___
Increase access to these animals?	Yes___	No___	Unk___
Provide substitute products or necessary money to replace the use of these animals?	Yes___	No___	Unk___
Increase the use of these animals by increased population?	Yes___	No___	Unk___

ESTIMATED IMPACTS ON BENEFICIAL ANIMALS.....ND..HA..MA..LA(O).LB..MB..HB

18. Pest Plants

a) Are there currently any pest plant problems in the project area?	Yes___	No X	Unk___
b) Are there any potential pest plant species known to exist in the project area?	Yes___	No___	Unk X

c) Are these pest plants associated with:

Severely disturbed land?	Yes___	No___	Unk___
Agricultural land?	Yes___	No___	Unk___
Stagnant or polluted water?	Yes___	No___	Unk___

18. (Cont.)

d) Will the project?	Yes___	No___	Unk___
Increase habitat for pest plants?	Yes___	No___	Unk___
Decrease habitat for pest plants?	Yes___	No___	Unk___
Provide opportunity for control of pest plants?	Yes___	No___	Unk___
Increase the possibility of introduction of pest plants through increased commerce?	Yes___	No___	Unk___

ESTIMATED IMPACTS ON PEST PLANTS.....ND..HA..MA..LA.(O.).LB..MB..HB

19. Pest Animals

a) Are there currently any problems with pest animals in the project area?	Yes___	No___	Unk X
b) Are there any animals in the project area which, under altered ecological conditions, have the potential for becoming pest species?	Yes___	No___	Unk X
c) Are these species associated with:			
Severely degraded land?	Yes___	No___	Unk___
Agricultural land?	Yes___	No___	Unk___
Aquatic Habitats?	Yes___	No___	Unk___
d) Will the project:			
Increase habitat for pest animals?	Yes___	No___	Unk___
Decrease habitat for pest animals?	Yes___	No___	Unk___
Increase the possibility of introduction of pest animals through increased commerce?	Yes___	No___	Unk___
Provide the opportunity for control of pest animals?	Yes___	No___	Unk___

ESTIMATED IMPACT ON PEST ANIMALS.....ND..HA..MA..LA.(O.).LB..MB..HB

20. Disease Vectors

a) Are there known disease problems in the project area transmitted through vector species such as mosquitos, flies, snails, etc.?	Yes X	No___	Unk___
b) Are these vector species associated with:			
Aquatic habitats?	Yes X	No___	Unk___
Forest habitats?	Yes___	No___	Unk X
Agricultural Lands?	Yes___	No___	Unk X
Degraded habitats?	Yes___	No X	Unk___
Human settlements?	Yes X	No___	Unk___
c) Will the project:			
Increase vector habitat?	Yes___	No X	Unk___
Decrease vector habitat?	Yes___	No___	Unk X
Provide opportunity for vector control?	Yes X	No___	Unk___
d) Will the project work force be a possible source of introduction of disease vectors not currently found in the project area?	Yes___	No ?	Unk X
e) Will increased access to and commerce with the project area be a possible source of disease vectors not presently occurring in the project area?	Yes___	No X	Unk___
f) Will the project provide opportunities for vector control through improved standards of living?	Yes X	No___	Unk___

ESTIMATED IMPACT ON DISEASE VECTORS.....ND..HA..MA..LA..O.(LB..MB..HB

21. Public Health

a) Are vector-borne diseases an important part of the local public health situation?	Yes X	No	Unk
b) Are there clinics or other disease control programs in operation or planned for the area?	Yes X	No	Unk
c) Will the project decision result in an increase in disease vector density or distribution?	Yes	No X	Unk
d) Will the project decision result in workers or other persons entering the area with contagious or vector-borne diseases?	Yes	No	Unk X
e) Will the project decision result in clearing operations that could expose workers to disease vectors?	Yes	No X	Unk
f) Will the project decision increase the hazard of accident to the local population?	Yes	No	Unk X
g) Will the project decision improve opportunities for the local population to receive health care?	Yes X	No	Unk
h) Is it necessary to consult with a public health specialist?	Yes X	No	Unk

ESTIMATED IMPACT ON PUBLIC HEALTH.....ND..HA..MA..LA..O..(LB..MB.)HB

22. Resource/Land Use

a) Are the natural resources of the area under intensive use pressure?	Yes X	No	Unk
b) Are lands in the project area intensively developed?	Yes X	No	Unk
c) Will the project decision increase pressure on land resources?	Yes	No X	Unk
d) Will the project decision result in decreased holdings by small land owners?	Yes	No X	Unk
e) Will the project decision increase depletion rates of natural resources?	Yes	No X	Unk
f) Should a land use planner be consulted?	Yes	No X	Unk

ESTIMATED IMPACT ON RESOURCES AND LAND USE.....ND..HA..MA..LA..(O.)LB..MB..HB

23. Conventional/Nonconventional Energy Sources

a) Will the project increase the demand for conventional energy sources (petroleum, hydropower)?	Yes	No X	Unk
b) Will the project increase the demand for nonconventional energy sources (fuelwood, dung, agricultural wastes)?	Yes	No X	Unk
c) Should an energy planner be consulted?	Yes	No X	Unk

ESTIMATED IMPACT ON ENERGY SOURCES.....ND..HA..MA..LA..(O.)LB..MB..HB

24. Distribution Systems

a) Are the production/distribution networks for agricultural and manufactured commodities fully understood?	Yes ?	No	Unk
b) Will the project decision enhance the equitable distribution of these products?	Yes	No	Unk X
c) Will the project decision increase the demand for certain commodities within or outside the area?	Yes X	No	Unk

24. (Cont.)

d) Will the project decision decrease the demand for certain locally produced goods?	Yes___	No___	Unk X
e) Will the project decision improve the ease with which consumers in the area obtain commodities?	Yes___	No___	Unk X
f) Will the project decision decrease the production of certain vital commodities?	Yes___	No X	Unk___
g) Is it necessary to consult a social anthropologist?	Yes X	No___	Unk___

ESTIMATED IMPACT ON DISTRIBUTION SYSTEMS.....ND..HA..MA..LA..O..LB..MB..HB

25. Employment

a) Is the potential work force in the area fully employed?	Yes___	No___	Unk X
b) Will the project decision substantially increase the rate of employment?	Yes X	No___	Unk X ?
c) Will the project decision remove job opportunities in the area?	Yes___	No X	Unk___
d) Will the project decision result in drawing workers from other local employers?	Yes___	No X	Unk___
e) Is it necessary to consult with a socioeconomist?	Yes X	No___	Unk___

ESTIMATED IMPACT ON EMPLOYMENT.....ND..HA..MA..LA..O..(LB.)..MB..HB

26. At-Risk Population

a) Are the adverse impacts of the project unequally distributed in the target population?	Yes___	No X	Unk___
b) Have the at-risk groups been identified?	Yes___	No___	Unk X
c) Have all possible actions been identified that would lessen the impact on at-risk groups?	Yes___	No___	Unk X
d) Is the assistance of a social anthropologist required to adequately answer these questions?	Yes___	No___	Unk___

ESTIMATED IMPACT ON AT-RISK POPULATION....ND..HA..MA..LA..(O.)..LB..MB..HB

27. Migrant Populations — refugees not considered

a) Are there presently certain mobile groups in the target population?	Yes___	No X	Unk___
b) Will the project decision result in immigration of people to the area?	Yes___	No X	Unk___
c) Are local institutions and agencies adequately geared to handle this influx?	Yes___	No___	Unk X
d) Will the project decision result in the movement of people out of the area?	Yes___	No X	Unk___
e) Can their probable destinations be predicted?	Yes___	No___	Unk X
f) Are local institutions and agencies or receiving agencies able to handle these migrant groups?	Yes X	No___	Unk___
g) Is it necessary to consult a social anthropologist?	Yes X	No___	Unk___

ESTIMATED IMPACT ON MIGRANT POPULATIONS.....ND..HA..MA..LA..(O.)..LB..MB..HB

28. Community Stability

a) Are the interrelationships of various social groups in the project area understood?	Yes X	No	Unk
b) Will the project decision establish institutions that will improve these interrelationships?	Yes X	No	Unk
c) Will the project decision create competition among social groups that would reduce community cohesion?	Yes	No X ?	Unk X
d) Is it necessary to consult a social anthropologist?	Yes X	No	Unk

ESTIMATED IMPACT ON COMMUNITY STABILITY.....ND..HA..MA..LA..O..LB..MB..HB

29. Cultural and Religious Values

a) Have studies been conducted of the cultural values of the project area?	Yes	No	Unk X
b) Are the cultural characteristics unique to the project area adequately known?	Yes	No X	Unk
c) Will the project decision adversely affect the religious attitudes of area residents?	Yes	No X	Unk
d) Are there special superstitions or religious taboos that will affect the acceptance of the project by the target population?	Yes	No	Unk X
e) Is it necessary to consult a social anthropologist?	Yes	No X	Unk

ESTIMATED IMPACT ON CULTURAL AND RELIGIOUS VALUES.....ND..HA..MA..LA..O..LB..MB..HB

30. Tourism and Recreation

a) Is there at present a significant degree of tourism in the area?	Yes	No X	Unk
b) Is there unexploited tourism or recreation potential in the area?	Yes	No X	Unk
c) Will the project decision result in more effective utilization of present or future tourism opportunities?	Yes	No X	Unk
d) If so, will this adversely affect the lifestyles of local people?	Yes	No	Unk
e) Will the project decision adversely affect an existing or potential tourist or recreation attraction?	Yes	No X	Unk

ESTIMATED IMPACT ON TOURISM AND RECREATION.....ND..HA..MA..LA..O..LB..MB..HB

31. Nutrition

a) Have adequate data been gathered on the nutritional levels in the project area?	Yes	No	Unk X
b) Do these data differentiate among various population subgroups, by age, sex or social level?	Yes	No	Unk X
c) Will the project decision result in changed food habits in the target population?	Yes X	No	Unk
d) Will these changes result in higher caloric levels and improved nutritional characteristics?	Yes X	No	Unk
e) Are the services of a nutrition specialist required?	Yes	No X	Unk

ESTIMATED IMPACT ON NUTRITION.....ND..HA..MA..LA..O..LB..MB..HB