Annexes

Environmental Appraisals for Agricultural & Irrigated Land Development

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ANNEX 1A. CHECKLIST OF ENVIRONMENTAL DATA

Type of data set	Existing	Non-existing	Unknown
Policy & Programmes			
National policy on regional development			
National environmental policy			
National environmental plans/ programmes / strategies			
Resource management plans			
- Land use			
- Water resources			
- Fishery			
- Protected areas			
- Other relevant plans			
District environmental management plans			
Other relevant government			
- policies at regional level			
- programmes at regional level			
Guidelines for EIA			
General guidelines for EIA			
Sector guidelines for EIA			
- water resources development			
- agricultural development			
- natural resources conservation			
Regulations & Standards for Environmental Laws			
Water laws			
- licensed water use			
- licensed waste emissions			
- water quality standards			
- sewage re-use regulations			
Land use regulations			
Agro-Chemical use regulations			
Protected areas regulations			
Other regulations			

Annex 1a cont.

Type of data set	Existing	Non-existing	Unknown
Socio-Economic Data - national level - provincial level - local level Land use systems Land tenure other ..... other			
Natural Resources Data Basic data on the State of The Environment Sectoral data on - agricultural resources - water resources - protected areas			
Maps/Satellite images Aerial photographs - national scale - local level Topographic maps - national level - local level Land use maps - national level - local level			
Climatic data - Rainfall data - Climatic water balance			
Hydrological maps/data - Watershed characteristics - Stream flow & gauging data - Surface water quality - Sewage quality/ emission - Groundwater volumes/quality			
Soil suitability maps/data Soil fertility data Soil salinity data Soil erosion data			

Annex 1a cont.

Type of data set	Existing	Non-existing	Unknown
Bio-Resources Survey data on wildlife Vegetation maps/data Aquatic ecosystems data Wetlands Other ..... **Public health data** - Community vulnerability - Receptivity of environment - Vigilance of health service - Regional endemic diseases - Health risks (project level)			
Environmental Monitoring National pollution monitoring plans Agricultural monitoring plans - National level - Province/local level - Other ..... **Existing Monitoring** - Hydrology (river system) - Aquifer characteristics - Water quality status - Land use changes - Soil fertility status - Land tenure systems - Other ..... **Ecological studies on** - Marine environments - Lakes - Upper watersheds - Streams - Terrestrial ecosystems - Aquatic ecosystems - Other			

modified after Asian Development Bank. Guidelines for Integrated Regional Economic-cum-Environmental Development Planning. ADB, Manila, 1988

ANNEX 1B. CHECKLIST FOR PROJECT ARRANGEMENTS

key questions	adequate	inadequate	not applicable	remark
National Institutions Does project plan involve - financial planning institution - environm. planning agency - town/country planning agency - other affected line agencies?				
Provincial/Local Institutions Does project plan involve - provincial planning authority - environment planning unit - other relevant planning units - affected line agencies: - health - water resources - land use planning - agricultural extension services - other ..... ?				
Central Government Level Are roles/responsibilities defined - environm. policy programmes - environmental monitoring - regional environm. strategies?				
Project level Is provincial steering or advisory committee established /involved Is project steering committee - established - involved in environm. issues? Is budget sufficient for environment. monitoring plans? Is monitoring linked to national or district devel. plans?				

Annex 2 Interaction Matrix for Initial Environmental Appraisal

Impacts of irrigation schemes may be attributed to water supply systems, drainage and flood control, land development, agricultural production development (as a part of the whole farming system), health control measures and infrastructure development (Working Aid 2).

Interaction matrix I provides a first guide to evaluate the environmental importance of a specific activity of an irrigation scheme. These activities may exert negative/detrimental or beneficial/enhancing effects on the following environmental assets (details in Annex 4):

- natural resources: water, soil, climate/air, biological resources;
- conflicts over natural resources (if used as services and goods);
- quality of life values.

It is clear that effects may vary in time, space and intensity, and they may act directly or indirectly through another environmental factor. The relevance of effects is evaluated for each interaction in terms of

- specific relevance (very significant first order impacts);
- direct relevance (first order impacts of some significance);
- indirect relevance (significant higher order impacts);
- special-case relevance (site- or project-specific relevance);
- minor relevance (first or higher order impacts of minor significance);

For example, the construction of reservoirs or tanks is likely to have a specific impact on the river regime. The water use system (planning/design) may be of minor relevance for land use competition but system components may be directly relevant for the use of non-renewable resources.

However, causal factors and their environmental effects can be determined only through site- and project-specific analyses. Therefore, this matrix can only assist in identification of potentially significant environmental concerns for screening projects at an early stage of environmental appraisal. There is no single formula to determine the significance or acceptability of an impact, but there are some criteria. Significance can be described, for example, in terms of *magnitude/severity*, *prevalence/extent*, *duration*, *frequency*, *probability*, *importance* or value attached to the change by society, or whether *mitigation* and *compensation* are possible.

Interaction Matrix II shows causal factors which may influence the siting, planning and design, operation and maintenance, and controlling of a project.

Interaction Matrix III shows the potential influence of political and legal framework conditions, planning systems, and general standards of technical design and planning on the type of impact on various environmental components.

Irrigation activities and likely relevance of environmental impacts

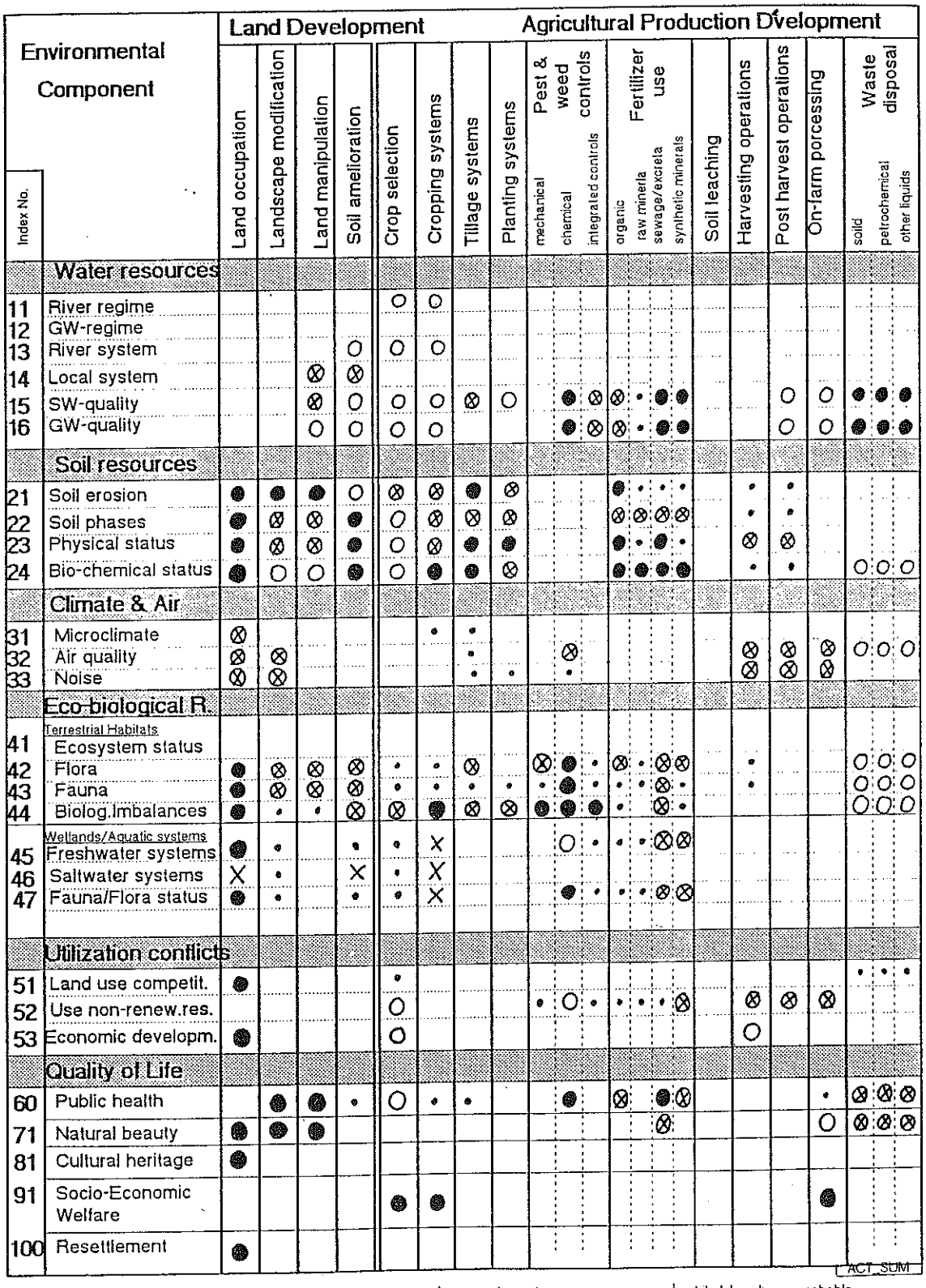
Index No.	Environmental Component	Water Supply: SW-reservoirs/lakes	SW-storage/tanks	SW-abstraction	GW-abstraction	Sewage reuse	Drainwater reuse	Saline water use	Irrigation System: Flood control	Planning & Design: Delivery system	Operation & Maintenance: Delivery system	Planning & Design: Water use system	Operation & Maintenance: Water use system	Water Removal: Planning & Design: Field drainage system	Operation & Maintenance: Field drainage system	Planning & Design: Drainage outlet system	Operation & Maintenance: Drainage outlet system	Planning & Design: Drainwater disposal	Operation & Maintenance: Drainwater disposal
	Water resources																		
11	River regime	●	○	●	•	+	○+	○+	●	○	○	○	○	•	•	⊗		●	⊗
12	GW-regime	⊗	○	●	•				⊗	•	•	•	•	•	•	•	•	●	⊗
13	River system	○	○	○	●		○	○	⊗	⊗	⊗	⊗	⊗	●	●	⊗	⊗	⊗	⊗
14	Local system	○	○	⊗	○		○	X	⊗	○	○	○	○			●	●	●	●
15	SW-quality	⊗	○	⊗	•	●+	●+	●+	•	•	•	•	○	⊗	⊗	○	•	●	●
16	GW-quality	○	○	•	●	●+	●+	●	•	•	•	•	○	•	•	○	•	⊗	⊗
	Soil resources																		
21	Soil erosion	X		○					⊗	⊗	⊗	⊗	●	⊗	⊗	⊗	⊗	○	○
22	Soil phases					●	●	●	⊗	•	○	⊗	●	⊗	●	•	•	•	•
23	Physical status					⊗			⊗	•	○	⊗	●	⊗	●	•	•	•	•
24	Bio-chemical status					●	⊗	○	○	•	•	○	⊗	○	⊗	•	•	•	•
	Climate & Air																		
31	Microclimate	⊗	X	•	•	•	•	•	X			⊗						⊗	•
32	Air poilution	•	X	⊗	⊗	○	○	○				○							
33	Noise	•	X	X	X														
	Eco-biological R.																		
	Terrestrial Habitats																		
41	Ecosystem status	●			○	⊗	•	•	●	○	•	•	•	•		•		⊗	•
42	Flora	●			○	○	○	○	●	○	•	•	○	•		•		⊗	•
43	Fauna	●			○	•	•	•	●	•	•	•	○	•		•		•	•
44	Biolog.Imbalances	○			○	⊗	•	•	○	○	○	○	○					⊗	•
	Wetlands/Aquatic systems																		
45	Freshwater systems	●		○	○	○	○	○	●	•	•	•	•	•		•		⊗	•
46	Saltwater systems	X		○	X	X	X	⊗	X	•	•	•	•	X		X		⊗	•
47	Fauna/Flora status	●		○	○	•	•	•	●	•	•	•	•	•		•		⊗	•
	Utilization conflicts																		
51	Land use competit.	●		○	○	•	•	•	○	○	•	•	•	•	•			○	•
52	Use non-renew.res.	⊗	⊗	⊗	●	○	○	•	•	⊗	•	⊗	•			⊗		⊗	•
53	Economic developm	●		⊗	⊗	⊗+	⊗+	⊗	○	⊗	⊗	⊗	⊗	•	•	•	•	⊗	•
	Quality of Life																		
60	Public health	⊗	⊗	•	•	●	⊗	⊗	●	⊗	○	⊗	⊗	⊗	⊗	⊗	○	⊗	•
71	Natural beauty	●				○	○	○	X	•		•		X	•	X	•	⊗	•
81	Cultural heritage	●							X	X				•	•	•	•	X	•
91	Socio-Economic Welfare	●							○										
100	Resettlement	●							X									X	

ACT_SUM

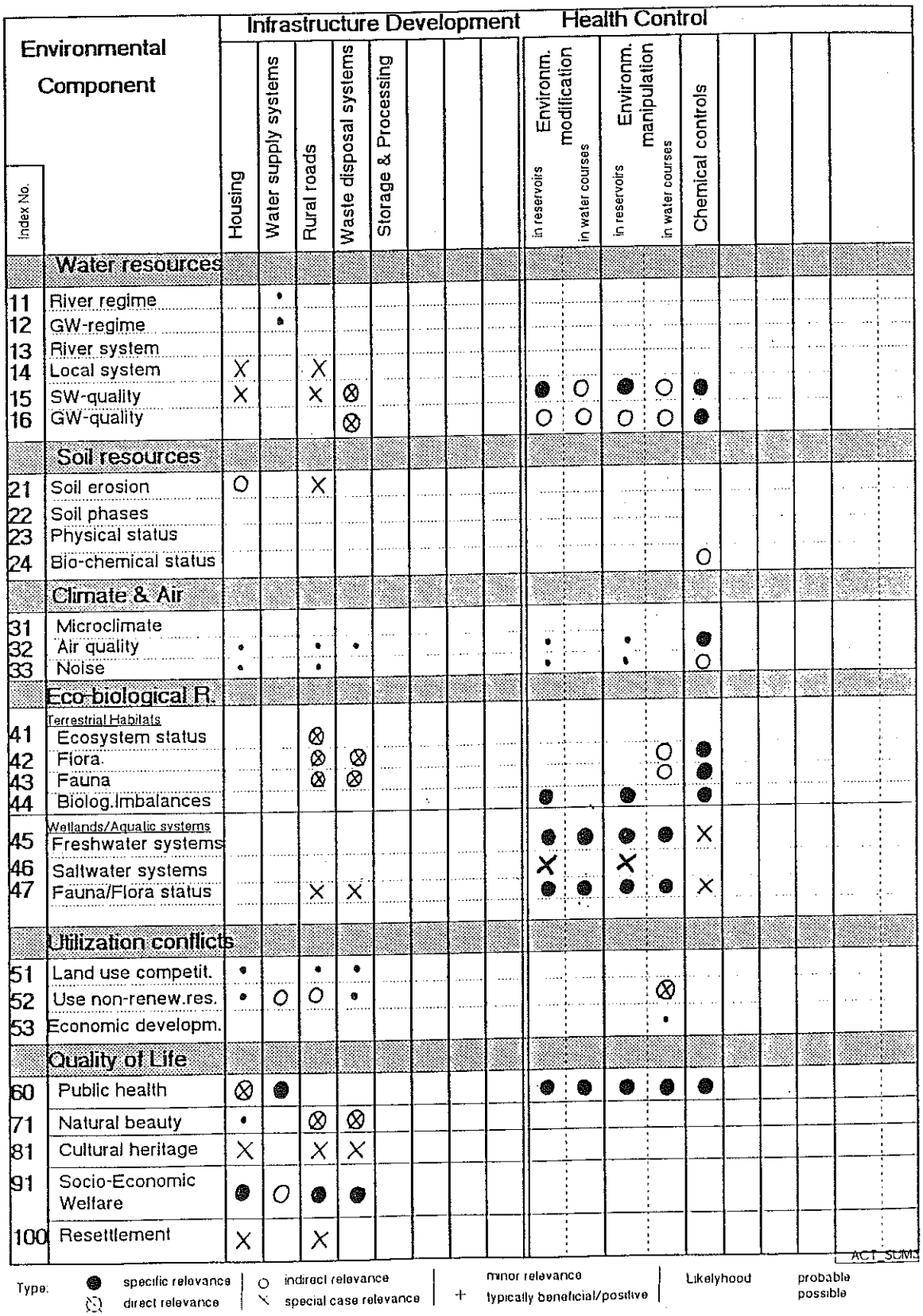
Type: ● specific relevance ⊗ direct relevance ○ indirect relevance X special case relevance • minor relevance + typically beneficial/positive

Likelyhood: probable possible

Irrigation activities and likely relevance of environmental impacts



Irrigation activities and likely relevance of environmental impacts



Potential impact of planning and design on environmental components

Type of impact	Siting	Agricultural Production Planning			Technical Design				Operation & Maintenance	Monitoring Controlling
		Cropping Systems	Tillage Systems	Pest Controls	Water Supply	Water Distribution	Water Management	Drainage		
river flow impairments	●	□	–		●	○	●	○	○	+
stream degradation	–		○		●	○	○	○	○	+
local sedimentation/scouring	–		○		○	○	●	○	●	+
local impoundments	–	■	●			○	●	●	●	+
surface water overdraft	○	■			●	■	○		○	+
groundwater overdraft	○	■			●	■	○		○	+
sw-pollution: salinisation	○									
sw-pollution: eutrophication	○									
sw-pollution: sediment load	○									
sw-pollution: pathogens	–									
sw-pollution: other toxins	–									
gw-pollution: salinisation	○									
gw-pollution: nutrients	○									
gw-pollution: toxins										
soil erosion	●	■	●	○		○	●	○	●	+
soil salinisation	●	■	○				●	●	●	+
waterlogging	○	■	●			○	●	●	●	+
soil tilth degradation	○	●	●				●		●	+
soil fertility degradation	●	●	○	○			○		●	+
alteration or loss of protected areas	●				■		+	+	+	
alteration or loss of vulnerable areas, wetlands	●	■			■		○	●	○	+
threat to endangered/endemic flora/fauna	●	●	■	○				–	○	+
threat to other wildlife	●	●		○				–	–	
other biological impairments	○	○	○	●			○	○	–	+
conflicts over land uses	●	■	–							
conflicts over water uses	●	■	–		●	+	+	●	●	+
conflicts over uses of non-renewable resources		●		●	●				○	
conflicts over compatibility with area planning	●	●			●					
water-related disease risks	○	■	–	●		●	●	●	●	+
threat to cultural heritage	●				—					
dislocation of people	●									

type of influence: indirect ■ major direct ● minor direct ◎ supporting + marginal –

ANNEX 2 INTERACTION MATRIX III

Potential impact of framework conditions on environmental components

Type of impact	Agricultural Policy	Water Policy	Regional Planning	Water Res. Planning	Land Use Planning	Technical Design	Agricultural Planning	Operation & Maintenance: Proj Manag	Operation & Maintenance: Adviser	Operation & Maintenance: Farmer	Monitoring Controlling	
river flow impairments		■	+	●	+	●	■	+	+	●	+	
stream degradation			+	●		●		+	+	+	+	
local sedimentation/scouring				–		○	–	○	○	●	+	
local impoundments				–	–	●	○	+	+	●	+	
surface water overdraft	■	■	+	●	+	●	●	●	+	○	+	
groundwater overdraft	■	■	+	●	+	●	●	●	+	○	+	
sw-pollution: salinisation		■		■	+	○	●	●	+	○	+	
sw-pollution: eutrophication	■	■		■	+	+	●	○	+	○	+	
sw-pollution: sediment load				■	+	●	●	●	+	○	+	
sw-pollution: pathogens				■	+	●	●	●	+	○	+	
sw-pollution: other toxins	■	■		■	+	○	●	●	○	○	+	
gw-pollution: salinisation		■		■	+	●	●	●	●	●	+	
gw-pollution: nutrients	■	■		○	+	–	●	●	●	●	+	
gw-pollution: toxins	■	■		○	+	–	●	●	●	●	+	
soil erosion				+	■	●	■	○	○	●	+	
soil salinisation		■		+	■	●	■	●	○	●	+	
waterlogging		■		+	■	●	■	○	○	●	+	
soil tilth degradation	■				○	+	●	●	○	●	+	
soil fertility degradation	■				■	+	●	●	○	○	+	
alteration or loss of: protected areas	■		●	●	●	–	–	–	–	–		
alteration or loss of: vulnerable areas, wetlands	■	●	●	●	●	○	○	–	–	–	+	
threat to: endangered/endemic flora/fauna			●	○	●	○	○	○	–	–	+	
threat to: other wildlife			●	○	●	○	●	○	–	–	+	
other biological impairments					○	○	●	○	●	●	+	
conflicts over: land uses	●	–	●	–	●	–	○	–	–	–	+	
conflicts over: water uses	○	●	○	●	○	○	■	+	+	+	+	
conflicts over: uses of non-renewable resources	●	■	○	○	–	●	●	+	+	+	+	
conflicts over: compatibility with area planning						■	■	+	+	+		
water-related disease risks		–	●	–	○	●	○	○	●	●	+	
threat to cultural heritage	■		●	–	●	○	–	–	–	–		
dislocation of people	■		●	○	●	○	○	–	–	–		

type of influence: indirect ■ major direct ● minor direct ◎ supporting + marginal –

I. Checklist for Initial Environmental Appraisal (agriculture, irrigation)

Environmental deterioration and conflicts due to project location

Disruption of hydrology and conflicts over water use/supply rights by
- abstraction of river water and downstream effects;
- abstraction of groundwater;
- modification of land drainage and regional flooding pattern;
- inappropriate location of water storage systems.

Inappropriate selection of land for agricultural development (related to land suitability)
Impediments to other land users (rangeland, rainfed, irrigation, hunting areas, etc.)
Encroachment into ecologically sensitive areas (protected areas,wetlands,forests, etc.)
Effects on wildlife and their migratory routes
Displacement of villagers and damage to their habitat
Damage to sites of historical and cultural value

Environmental problems related to technical design

Insufficient integration into existing land use plans (or regional development plans)
Lack of integrated water resources planning (watershed management plans)
Conflicts over land use, land tenure and water rights and their inequitable distribution
Inappropriate storage of water in reservoirs/tanks and inefficient conveyance systems
Suitability of water for specific irrigation systems, crops and cropping pattern
Feasibility of water user groups, co-operatives, etc.
Adequacy of drainage system and disposal of brackish/contaminated water
Use of agro-chemicals to control weds and pests in intensified agriculture
Mechanisation and its impacts on soils, biodiversity, air quality and energy consumption
Inadequate measures to maintain soil productivity and to prevent soil erosion
Increasing biological imbalances & loss of biodiversity
Inadequate measures to control health hazards (water-related, vector-borne)

Environmental problems associated with construction

Destructive land clearing and site preparation methods; reservoir and canal site preparation
Lack of pollution control and waste management standards
Infrastructure development (access roads etc.)
Other construction hazards, e.g. safety-, sanitation- and health hazards to workers

Environmental problems resulting from project operation

Uncontrolled/excessive water abstraction; lack of multipurpose reservoir management
Inefficient water management at field level; excessive water use, runoff
Inadequate soil tilth and fertility management
Inappropriate systems for storage, application and disposal of agro-chemicals
Uncontrolled disposal of waste water; uncontrolled solid waste disposal
Lack of maintenance of supply and drainage canals; uncontrolled flooding
Lack of monitoring (natural resources uses, farm operation, public health, etc.)

Other considerations at the planning stage

Use of non-renewable water and energy; unwanted population migration; cultural and economic changes.

II. Guidance to the Matrix for Initial Environmental Scoping

The following guidance serves to identify any potentially harmful impact of agricultural or irrigated land developments, and to amplify the extent and type of additional environmental surveys that may be required to establish the environmental management plan. The results may be compiled in the attached *Matrix for Initial Environmental Scoping* (modified and extended after ADB 1987).

Site selection (project location)

Disruption of hydrology: Depending on total volumes and seasonal flow pattern water abstraction from a river can reduce yield to downstream water users, causing shortage. Drainage of saline or polluted water from agricultural fields or farms can cause problems for other users downstream. Upstream water abstraction can cause pollution problems in downstream reaches due to reduced dilution in low flow season. Diversion of river water can cause seawater intrusion into estuaries and deltas.

Are traditional water user rights or water allocation by modern water master plans adequately considered in the project location? Special attention must be given to transbasin diversions and water abstractions from lakes or rivers along international borders.

Groundwater abstraction: If groundwater abstraction exceeds recharge, the watertable will fall in the project area and in neighbouring areas. This may cause damage to natural vegetation or agricultural fields and shortage of water supply to domestic or industrial users.

Flood hazards: Flood control structures can create or increase flooding in neighbouring and downstream areas. Does the project give attention to natural and newly created flood risks to agricultural fields, structures and settlements?

Land drainage: Is the regional drainage pattern adequate to meet project needs, e.g. to control salinity or soil wetness in agricultural fields? Intensification of drainage in the project area may cause groundwater rise in neighbouring areas. Do concepts for land drainage consider the whole situation in the watershed (off-side effects)?

Encroachment into forests or wetlands: The conversion of land for agriculture or infrastructure (roads, hydraulic infrastructure, buildings) may cause irreversible loss of important forests or ecologically sensitive areas (ESA, see Working Aid 7). If forests are close to the development areas, *hinterland* effects may lead to increased forest use, poaching, etc. Does the project consider these effects adequately (alternative alignments or sites) and are there mitigation measures or user restrictions? Do local people and farmers agree? Does the project consider the movement (migration) of cattle and wildlife under present and future conditions? Are corridors or buffer zones provided?

Encroachment into traditional settlement areas. Many areas are in use by traditional groups, for example ethnic minorities. Does the project consider traditional uses and land tenure adequately?

Destruction of historical or cultural places. Sensitive siting can avoid or minimise damage.

Land suitability. The land needs to be suitable for long-term agricultural and irrigation development. Depending on the type of land use, there are specific ecological criteria to be fulfilled (see FAO guidelines for soil suitability and land evaluation). The development of marginal sites need special attention and measures to avoid, for example, salinization, sodification, acidification, excessive wetness or erosion. Site selection should consider the land management capacity of the users, the technologies available and the local needs for agricultural products. In general, only sites with a high production potential should be developed for intensified agriculture and irrigation.

Technical planning (design and assumption of operation and maintenance)

Watershed. Degradation (e.g. erosion, deforestation) in the upper watershed may impair irrigation efficiency causing excessive siltation and floods. Is the project based on realistic runoff rates and silt or flood hazards? Should the project include additional watershed management in the activities in the hinterland ?

Diversion of surface water. Plans of water abstraction to meet irrigation requirements must consider actual and future conflicts over scarce water with other users. Agricultural planning (crops, cropping pattern, anticipated yield levels) and irrigation methods as well as irrigation schedule must be in line with water availability within the catchment.

Overuse of groundwater. Groundwater use should avoid significant watertable fall which may lead to land subsidence, brackish water intrusion, or indirect damage of ecosystems.

Suitability of water for irrigation. Irrigation with water of poor quality (silt, salts, heavy metals, pesticides, pathogens) can cause sedimentation, soil contamination, salinization or health problems.

Water reservoirs, ponds, tanks, large canals. Does the project give adequate attention to potential health hazards of newly created vector habitats (water-related diseases); to excessive aquatic weed growth; and to seepage with potential impacts on groundwater rise, excessive wetness, salinization, increased field water requirements, etc.?

Canal system. Will the project ensure equitable distribution of water throughout the command area? Does the design incorporate adequate protection against scouring? Does the design and maintenance plan provide for protection against sedimentation and weed control? Does design include gates that may allow flushing?

Drainage system. Insufficient drainage can cause local wetness, groundwater rise and evaporation lakes (in dry areas) which may cause damage to agricultural fields, settlements or natural ecosystems.

Land husbandry. Does the project provide sound land husbandry measures for intensified agricultural production? Mechanisation, monoculture, intensification, diversification, high-yielding varieties and increased livestock activities usually bring increased demand for farm inputs and long-term soil degradation. Are farmers and the agricultural extension services prepared to accept site-specific, best-management-practices, for intensified production? Are land husbandry practices directed towards the maintenance of soil productivity? Tillage, crop management and water management practices must consider site-specific requirements as well as farmers management capacities and economic conditions. Does the project promote integrated farm production systems or regenerative agriculture (e.g. Pretty 1995)? Are the farmers and the agricultural extension services prepared to adopt or promote site-appropriate technologies?

Use of Agrochemicals. Does the project plan provide measures for competent handling, storage and application of agrochemicals (fertilisers, pesticides, soil amendments, etc.). Will the project plan result in the selection of environmentally acceptable pesticides (e.g. least fish toxic, rapidly degradable)? Does the agricultural development plan consider integrated pest management and or other agronomic means to minimise needs for agrochemicals to minimise damage to water, fauna and flora and people (occupational and public health hazards)?

Health hazards. Water-related disease incidence can increase or decrease due to changes in vector habitats and peoples contact with vectors. Does project design consider biological, mechanical, chemical or other health controls in design, operation and maintenance standards? Are there adequate health and safety standards dealing with toxical chemicals, machine operation or other farm operations?

Land tenure. Does the project provide development opportunities to all interested farmers? Will the project ensure reasonably equal access to land and water for agricultural production? Will the project provide sufficient opportunities also for landless people, for example employment as farm labour or other works? How will the project benefits be distributed between landowners and landless people and between genders?

Water user associations and other agricultural user groups. Does the project plan provide realistic assumptions to develop these organisations? Does the project plan make appropriate use of existing social and political systems? Does the farm families have realistically sufficient financial resources (or access to credit) to implement all parts of the development plan?

Cropping intensification, mechanisation and irrigation: They usually bring increased demand for farm energy.

Water supply: Does the planning give attention to the use of water for domestic supply or other uses such as aquaculture?

Construction phase

Infrastructure construction. Environmental damage and health risks are often associated with lack of standard environmental protection or safety regulations and their enforcement, for example careless handling with hazardous material (toxics, inflammables, incendiaries, explosives), machine operation, disposal of solid or liquid wastes, or dust, odour and fumes. This may cause erosion and pollution of air, soil and water, or create nuisance to people, fauna and damage flora. Modern standards for environmental control need to be strictly observed. Technologies applied should be according to the state-of-art.

Land preparation: Does the construction plan provide for proper control of erosion and rehabilitation of exposed sites, for example for cut-and-fill areas, waste disposal sites?

Farm and irrigation operation

Water abstraction. Is the project recording the abstraction of river water and field applications? Is the project using water in efficient and equitable ways? Is the operation and maintenance plan realistic in terms of experience of water users? Is the extension service capable to guide sound use of water? Are there provisions to optimise the use of water at the field level? Are there provisions to regulate water consumption in periods of shortage?

Groundwater. Are changes in groundwater hydrology observed, including the effects on other groundwater users? Are there provisions to regulate the use of groundwater?

Soil fertility. Is the project likely to maintain or improve soil fertility? Are there concepts and means for amelioration and the promotion of site specific best-management-practices? Are there plans to monitor important changes in chemical or physical soil fertility?

Water related diseases: Are realistic preventive or curing control measures planned? Is an efficient monitoring system implemented? Are public health services integrated in the proposed control measures?

Waste management. Is a monitoring system developed to control health hazards and environmental pollution caused by solid or liquid wastes or the use of agrochemicals?

Enhancement measures. Is the project providing facilities to implement additional measures which enhance the wise use of natural resources in the area, for example aquaculture, agro-forestry or watershed management?

Overall aspects of environmental concern

Non-renewable resources. Will the project significantly adversely affect the national energy situation to an unwarranted degree? Will the project make unwarranted accelerated use of other scarce resources in favour of short-term development gains?

Migration. Will the project result in an undesirable influx of people?

Income and regional disparity. Will the project lead to or intensify undesirable increase of income gap between poor and rich farmers, between genders, or increase the disparities between regions.

Nature conservation. Will the project lead to or accelerate the unwarranted loss in environmentally sensitive, precious and irreplaceable natural resources?

Abbreviations used in the following matrix for project activities

SWS -	surface water storage
SWA -	surface water abstraction
GWA -	groundwater abstraction
SEW -	sewage water re-use
DRW -	drainage water re-use
LAO -	land occupation & clearance
LMO -	land modification
LMA -	land manipulation
IRC -	irrigation system: conveyance system
IRF -	irrigation system: field water distribution system
IRM -	general irrigation water management (scheduling etc.)
DRS -	drainage system (layout/operation)
TIL -	tillage system
CRO -	cropping system
FER -	fertilizer storage & application, soil amendments
PES -	pest & weed control; pesticide storage, handling, application
INF -	infrastructure (housing, roads, farm roads, farmstead, etc.)
HEA -	health control measures

Abbreviations used for environmental components

AQ -	air quality, climate
FA -	fauna (specified as aquatic aFA or terrestrial tFA species)
FL -	flora (specified as aquatic aFL or terrestrial tFL species)
GW -	groundwater (aquifer level: lGW; water quality; qGW)
PH -	public health (regarding water-related and vector-borne diseases)
LA -	landscape pattern
LU -	land use system
SE-	socio-economic or socio-cultural values
SO -	soil fertility
SW -	river (surface) water; water volumes (vSW) or water quality (qSW)

III. Matrix for Initial Environmental Scoping (modified after ADB 1988)

		Interventions Affecting Environmental Components and Categories	Potential Environmental Impacts	Initial Environmental Appraisal				Kind of Information required
				Score 1-8	No Info avail.	Key Impact	Sign. User Competition	Envir. Evaluation Categories
Effects due to site location	SWA SWS	Disruption of river hydrology	Conflicts over water supply; water quality changes					SW, GW
	GWA	Disruption of groundwater aquifers	Conflicts over water supply; water quality changes					GW
	SWS SWA	Regional flooding/ drainage hazards	Hazard to other land users and biological resources					SW
	LAO	Encroachment into forests	Loss of biological resources,;impact on hydrology					LU, FL, FA
	LAO	Encroachment into wetlands	Loss of biological resources; impact on river regime					LU, FL, FA
	LAO	Encroachment into other ESAs	Conflicts over land use; loss of biological resources					LU, FL, FA
	LAO	Impediment to movement of wildlife, cattle	Conflicts over land use; economic losses					LU, FA, FL
	LAO	Encroachment into tribal land	Conflict over land use; socio-economic disruption					LU, SE,
	LAO	Impairment of historical/cultural sites	Loss of socio-cultural values; economic losses					CH, SE, LA,
	LAO	Adequacy of land suitability	Selection of unsuitable land or problem soils					SO, LU
	LAO	Encroachment into other land uses	Conflict over land use; socio-economic imbalances					LU, LA, AQ
Problems from oversights in planning and design		Watershed erosion; Hinterland degradation	Sedimentation, water quality, accelerated erosion					LU, SO, SW, SE
	IRS IRM	Surface water abstraction	Downstream user conflicts; river channel degradation					SW
	SEW DRW	Use of water of inferior quality	Soil contamination, water pollution, health problems					SW, GW, SO
	IRS IRM	Excessive groundwater use	User conflicts; waterlable problems; saline intrusions etc					GW
	SWA SWS	Water storage and irrigation system	Biological imbalances; water quality; user conflicts					SW, GW, SO, PH
	TIL CRO	Tillage and cropping system	Need for agrochemicals, machinery, excessive water					SO, LU, SW, GW
	IRM CRO	Adequacy of irrigation supply system						
	DRS IRM	Adequacy of drainage (internal & land drainage)	Waterlogging, soil fertility problems; water quality					GW, SO, LU
	PES FER	Selection and use of agricultural chemicals	Downstream water quality problems					SW, GW, SO, AQ, LU
	TIL CRO	Maintenanance of soil productivity (fertility)	Salinization, alkalinization, sodification, erosion etc					SO, LU
	HEA LMO	Change in vector abundance, contact, and immunity	Increased health risks (water related diseases)					PH, AQ, SW
	IRM ?	Land allocation; irrigation organisation	Land tenure problems; inequities in land/water supply					SE, LU
		Cropping & irrigation systems	Accelerated use of fossil energies					

III. Matrix for Initial Environmental Scoping (cont.)

		Interventions Affecting Environmental Components and Categories	Potential Environmental Impacts	Initial Environmental Appraisal				Kind of Information required
				Signif. Score 1-8	No info avail.	Key Impact	Sign. User Competition	Envir. Evaluation Categories
During Construction	LMO LMA	Land clearing, land modification	Erosion, local wetness, soil degradation					SO; AE; TFL, TFA, SW
	LMO IRS	Land modification, irrigation & drainage system	Noise, air pollution and other construction hazards					SW, AQ, NO
	SWA GWA	Water abstraction, drainage system; water storage	River morphology, channel degradation					SW, GW, AFL, AFA
	IRS DRS	Irrigation and drainage system	Erosion, soil degradation, water pollution					SO, GW, SW
		Infrastructure	"					
During Operation	SWA	Excessive, uncontrolled surface water abstraction	Water user conflicts, river system degradation					SW, AFA, AFL
	GWA	Groundwater overdraft	Water user conflicts, gw-quality changes					GWA, TFL, AFL, SW
	TIL CRO	Inadequate soil tillage and cropping systems	Soil degradation; excessive water demand, erosion					SO, GW, SW
	IRM TIL	Inadequate water management	Soil erosion & degradation					SO, GW, SW
	IRS IRM	Inadequate water management	Excessive water demand, water pollution problems					SW
	FER PES	Inadequate use of agro-chemicals	Soil contamination, water pollution, health risks					SO, SW, GW
	TIL LMA	Inadequate soil amelioration, land manipulation	Soil fertility degradation; water pollution; health risks					SO, SW, TFL
	SEW	Use of sewage water; polluted water	Soil contamination; groundwater pollution; health risks					PH, SO, GW, SW
	DRW	Use of saline water	Soil salinity; soil fertility decline; excessive water use					SO, GW, SW
	WMM	Water management monitoring system	if not provided, inefficiency is likely					
	MON	Environmental monitoring & evaluation system	if not provided, sustainability is unlikely, conflicts are likely					
other								
	ENE	Excessive use of non-renewale energy -	contribution to exploitation of energy resources					
	FOS	Use of fossil groundwater rreserves	Irreversible loss of water for future generations					

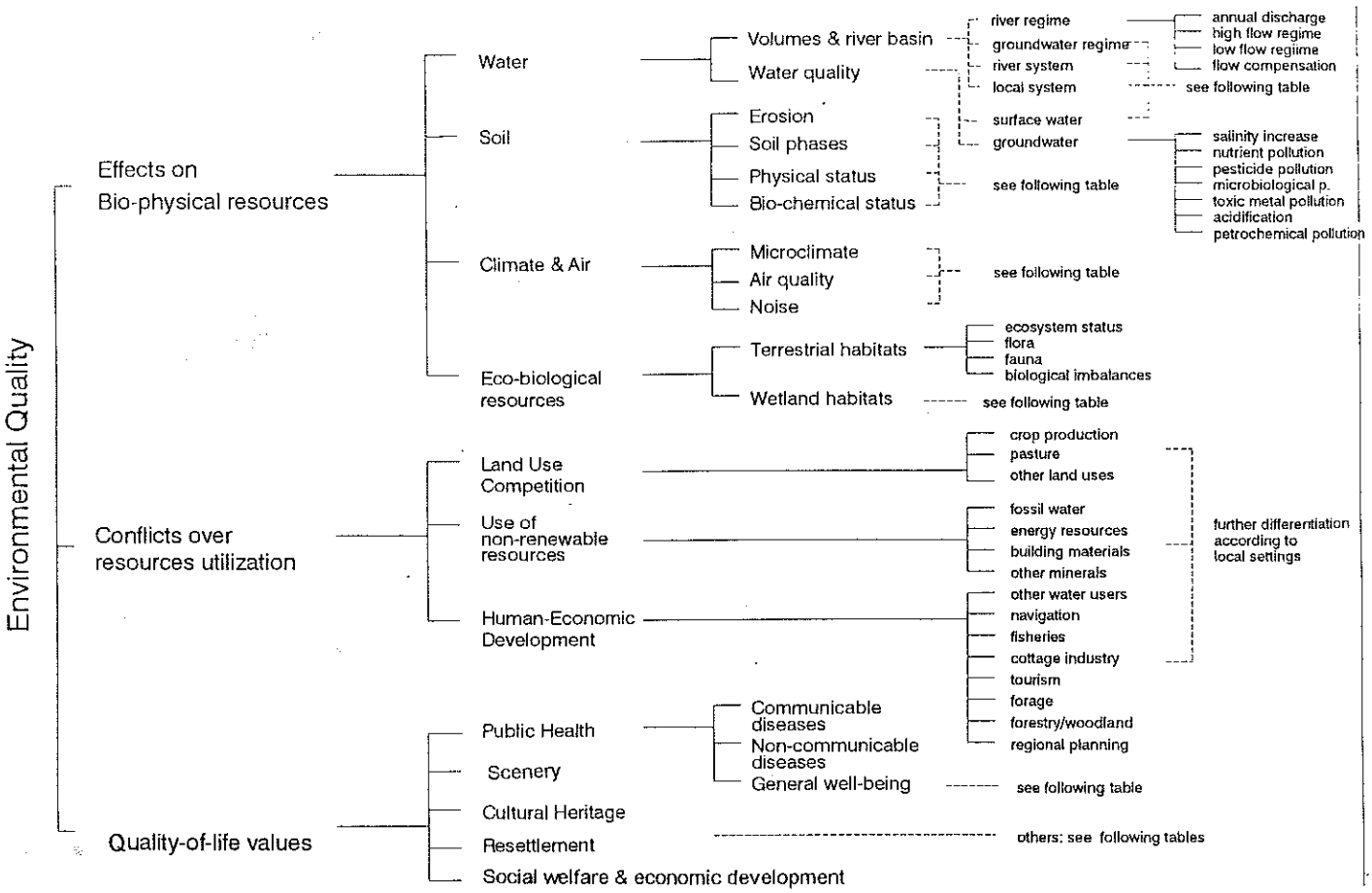
ANNEX 4 ENVIRONMENTAL QUALITY ACCOUNT SYSTEM

The assets of the natural environmental are

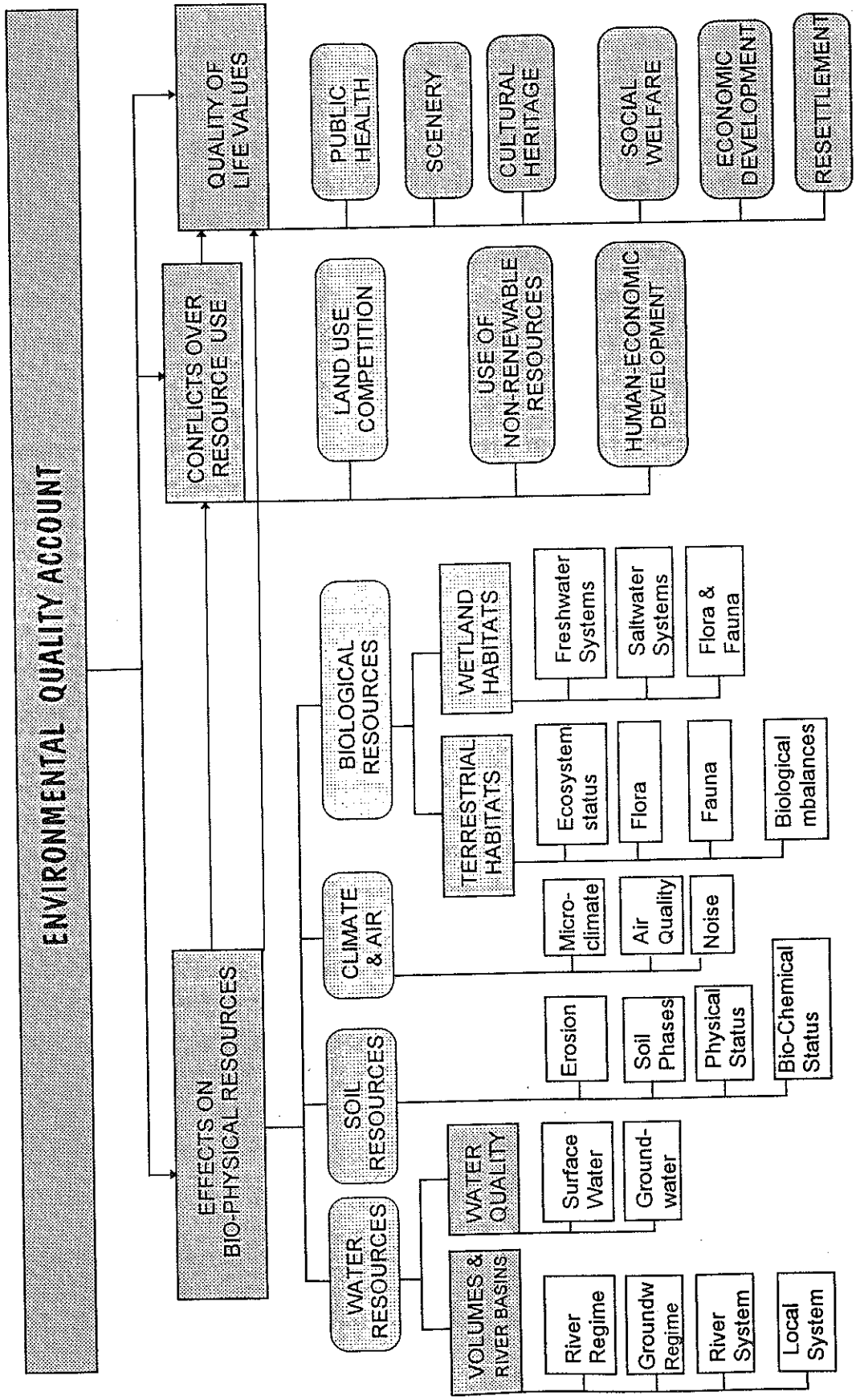
- water, soil, climate and air, fauna and flora, and their interrelations in ecosystems (habitats);
- resources opportunities to use such as land, water and mineral resources;
- quality-of-life values, such as public health, scenery and landscape beauty, cultural heritage, social welfare and economic development (if directly related to natural resource uses; otherwise, social and economic impacts are subject to separate impact studies).

Environmental analysis requires both inventory and evaluation of the state-of-environmental components at four levels:

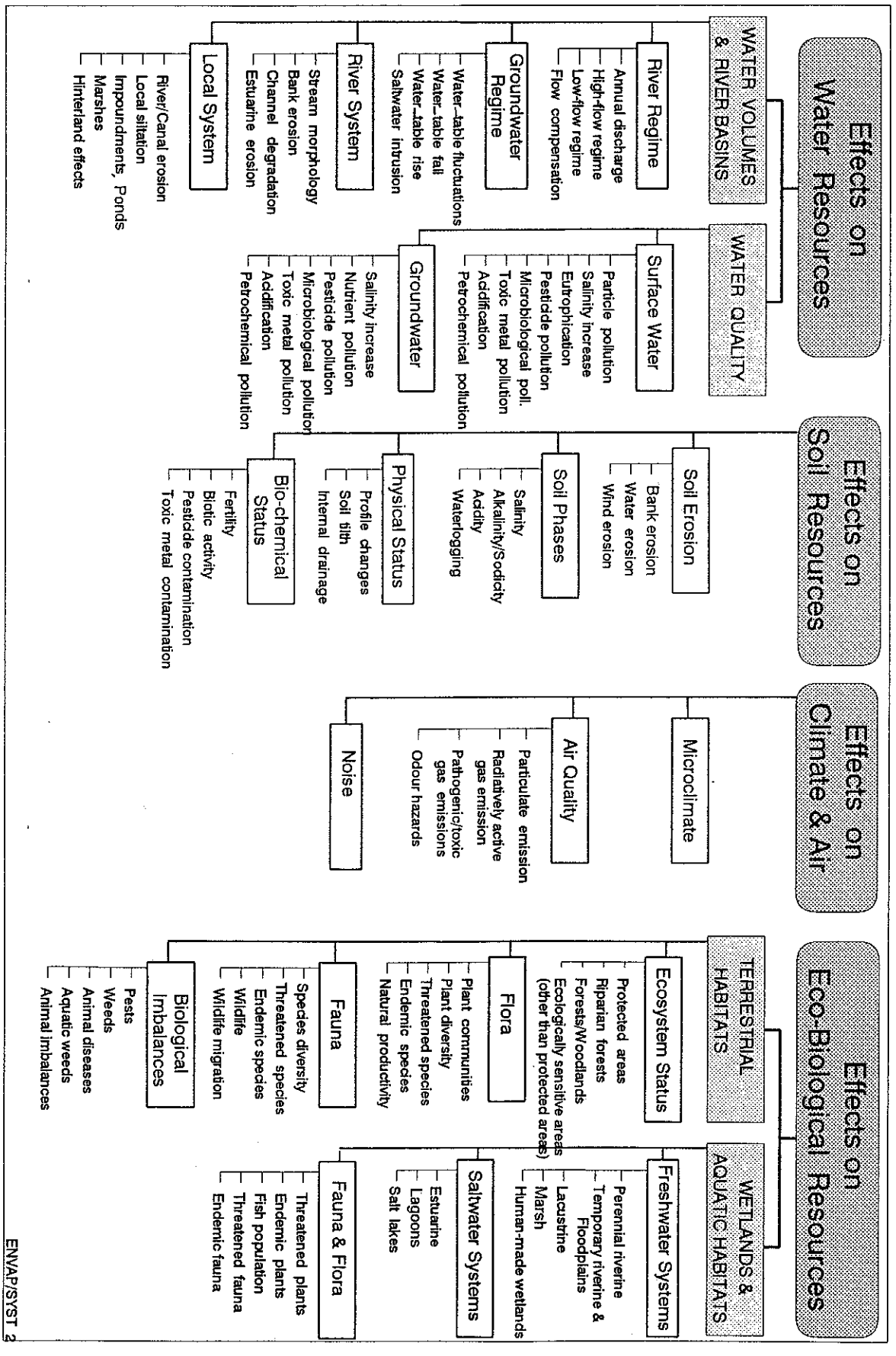
- The uppermost level defines the environmental quality as aggregated natural goods and services and their human uses;
- Level 2 defines environmental components/sub-components, such as the component water and its subcomponents water volumes and water quality;
- Level 3 defines environmental categories as specifications of the components, such as river regime and groundwater regime;
- Level 4 specifies the categories in terms of elements and their respective parameters (for quantification) such as annual discharge and low-flow regime in m^3/s.



Upper levels: qualities and components/sub-components



Lower levels: environmental sub-components and categories



Lower levels cont.: environmental sub-components and categories