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MAIN POINTS OF THE ADVICE

The Ecuadorian organisation Centro de Reconversión Económica del Azuay, Cañar y Morona Santiago (CREA), requested support of the Netherlands Government in preparing a Strategic Environmental Impact Assessment (EIA) for the Río Paute catchment in Ecuador. The Netherlands Minister for Development Cooperation thereupon requested assistance of the Netherlands independent Commission for Environmental Impact Assessment to advise on Terms of Reference for the preparation of a Strategic Environmental Impact Statement (EIS) for the region involved.
The advice is prepared by a working group of the Commission for EIA, consisting of independent experts of Ecuadorian, Colombian and Dutch nationality.
During the preparation of the advice, the working group visited the Río Paute area as well as several governmental and non-governmental agencies in Quito and Cuenca in the period 12-26 March 1994.

The direct motive for considering a Strategic EIA for the Río Paute catchment is the disaster of the La Josefina landslide, which took place on 29 March 1993. This landslide should be considered in the first place as a symptom of the environmental problems in the area. The primary objectives of the Strategic EIA are:
- describe and analyse the environmental problems in the study area;
- assess environmental effects of ongoing and proposed projects and plans;
- set priorities for mitigation measures;
- develop alternative strategies to alleviate the environmental problems and to enhance sustainable development.

These objectives fit within the approach chosen for this advice: the Strategic EIA should aim to be an instrument for achieving sustainability in the Río Paute catchment.

The Commission concluded that especially the following subjects require major attention in the Strategic EIS:
- ! The geological instability should be the point of departure for the problem analysis. The effects of this instability may be aggravated by disturbances caused by human activities (such as the construction of roads and other infrastructural works or the degradation and disappearance of protective vegetation due to deforestation, grazing and overgrazing of fragile range and forest land and extension of agricultural frontiers, unsuitable types of landuse).
- ! Other environmental problems, which are not directly linked with the occurrence of natural hazards, but which prominently feature in the Río Paute catchment should be taken into account as well. These are for instance the effects of industrial development, exploitation of mines and urban development (including disposal of solid waste and waste water).

- ! Finally, socio-economic issues (like population growth pressure, migration and poverty) and institutional issues (like policy distortions, legal and institutional bottleneck's and other constraints to effective natural resource planning and environmental management) have to be described.

In chapter 8 the advice finally provides suggestions for the strategic approach: examples of alternative strategies are given to enhance sustainable development for the Río Paute catchment.
The methodological approach of the Commission for preparing the advice is shown schematically in the diagram below.

Structure of the Strategic EIS

General overview / Points of departure

1. Introduction	
2. Background and problem analysis	* the motive for undertaking a Strategic EIS * general analysis and first attempt of identification of problem areas
3. Objectives	
4. Legislation and policies	* assessment of the legal issues associated with planning and management (policies and practices) of the environment

In depth analysis
Existing situation and trends

5. Descriptive analysis of the environment * abiotic and biotic * socio-economic * institutional	* a general environmental survey of the area * a statement of specific environmental impacts * trends in the quality of the environment
Evaluation of impacts and trends in the current situation, independently from the reality of ongoing and proposed projects and plans Description of impacts from the existing and planned interventions	
6. Assessment of ongoing and	* impacts of interventions as fas as they have a

Salient problem categories

7. Priority setting and mitigation measures	* integrated analysis of environment-related problems and ranking of the main problems * need for mitigation of the most important adverse envi-

Development of strategies
Weighing of alternatives to overcome the problems

8. Formulation of alternative strategies and policy responses	* objectives, criteria, principles for enhancement of sustainable regional development * development of alternatives to fulfil the objectives * assessment of alternatives in terms of environmental impacts, socio-economic and institutional impacts

Final Part

9. Remaining gaps in knowledge	

1. INTRODUCTION

The Ecuadorian organisation Centro de Reconversión Económica del Azuay, Cañar y Morona Santiago (CREA), has requested support of the Netherlands Government in preparing a Strategic Environmental Impact Assessment (EIA). The study area is located in the Río Paute catchment, with the direct surroundings of La Josefina as the focal area. La Josefina is the area where the massive landslide took place on March 29, 1993.
The purpose of the Strategic EIA is to obtain insight in the major environmental problems in the study area, to identify possible activities to overcome the problems and to define a priority setting for these activities.
In a letter dated 28 December 1993 (see Appendix 1), the Netherlands Minister for Development Co-operation has requested the Commission for EIA in The Netherlands to advise on Terms of Reference for the preparation of a Strategic Environmental Impact Statement (Strategic EIS) for the region involved. The intention of the advice is to specify the contents of the Strategic EIS. The strategic character of the advice is reflected in the final chapter, which provides a methodology for the development and weighing of alternative strategies to enhance sustainable development.
The Commission, having taken notice of the wide spectrum of natural and man-induced hazards (processes and activities which affect the environment in terms of degradation, exhaustion and pollution) in the area, deems it necessary to place the Strategic EIS in a framework of regional knowledge of factors inducing specific impacts. Therefore a mid- and longterm development strategy must necessarily be based on detailed understanding of natural abiotic, biotic and artificial man-induced environmental factors and processes. Only then the likely environmental impacts of the planning and implementation of development projects can be predicted.

The advice has been prepared by a working group of the Commission for EIA, consisting of independent experts of Ecuadorian, Colombian and Dutch nationality. The composition of this working group is presented in Appendix 2 together with general information on the Strategic EIA.
The advice is prepared and submitted to the Netherlands Minister for Development Cooperation by the working group on behalf of the Commission for EIA in The Netherlands.
During the preparation of the advice, the working group of the Commission visited the Río Paute area as well as several governmental and non-governmental agencies in Quito and Cuenca in the period 12-26 March 1994. The programme of the field visit is presented in Appendix 3. During the field visit, the Commission has noted as far as possible the opinions of all parties involved.
Appendix 4 and 5 contain lists of Key Institutions and Key References, which might be of help in preparing the Strategic EIS.
Appendix 6 contains a checklist for the descriptive analysis of the current situation and impacts, belonging to chapter 5 of this advice.
Finally, Appendix 7 and 8 give specific information on institutions in environmental administration in Ecuador on definitions used by the Commission.

Herewith the Commission wishes to express its gratitude for the excellent support and courtesy extended to the Commission by the various Ministries of the Government of the Republic of Ecuador in Quito and all Regional and Municipal organisations in the area during this visit.
The Commission would like to express its special thanks to CREA, especially to Mr. O. Washima in Cuenca and to Mrs. B. Coolman of the Netherlands Technical Mission in Quito.

2. BACKGROUND AND PROBLEM ANALYSIS

2.1 The La Josefina landslide

Since the La Josefina landslide is the direct motive for undertaking the Strategic EIA, special attention is given to the causes of the landslide and to its consequences.

On March, 29th 1993 a vast landslide occurred, affecting the area of the Paute valley, in the sector known as La Josefina, situated at the confluence of the Paute and Jadán rivers, roughly 25 km

downstream of the city of Cuenca. The volume of material dislodged, formed a natural dam in both rivers.
By obstructing the course of the river Paute, the landslide had three direct effects:

- Two pools of water formed very rapidly upstream from the landslide, one in the bed of the river Jadán and the other in the bed of the river Paute, inundating the natural vegetation and valuable arable land and destroying many dwellings, bridges, irrigation facilities and industrial plants. The Pan-American Highway and the railway from Quito to Cuenca were initially completely submerged, as was the El Descanso Thermal Power Station. Fuel oil escaping from the stock of the plant heavily polluted a large area. The untreated sewage of some 300.000 people as well as industrial waste water accumulated in the remaining reservoir and hygienic problems are to be expected in the short- and medium term.

- On the 1st of May 1993 the waters of the La Josefina Reservoir flowed over the dam produced by the landslide. The outpouring of the dammed-up water, and the subsequent rapid erosion of the material of the upper part of the dam, caused flooding in the town of Paute and in all surrounding settlements. Large amounts of debris and sand were deposited in parts of the valley.

- In the sector of the Paute/Amaluza Hydroelectric Reservoir (50 km downstream of Paute) there was also considerable damage caused by strong erosion along the river bed. An estimated 10 million m^3 of sediment were deposited close to the Power House, posing a potential threat to the hydroelectric plant's water intakes. This Station exploits the waters of the river Paute and supplies 70-90 percent of the country's electric needs. Downstream from the small town of Amaluza the water destroyed some 300 m of the access road to the machine hall.

At the present moment, one year after the disaster has taken place, the damage caused to the main road upstream of the natural reservoir has been partly restored. The main problems now can be summarized as follows:

- inundation, pollution and contamination primarily upstream of the dam;
- isolation, distorted communication and loss of market connections of the area cut off by the inundation;
- institutional constraints and the absence of policies, mechanisms and instruments for effective planning towards rehabilitation of the area.

Approx. 2000 hectares of cultivated land have been destroyed. This land was cultivated by peasants largely for domestic consumption (cereals, maize, fruits and vegetables) and used for dairy cattle rearing. The bottling plants (production of alcoholic drinks) in Zhumir as well as the flower plantations of Malima and El Cenaculo (cultivation of flowers for export) were seriously damaged.
The outflow of the accumulated water also destroyed 10 km of asphalted road that connects Paute, Pan, Sevilla de Oro and Gualaceo with Cuenca, 5 km of the main irrigation canal and a significant part of the electric transmission masts and water supply in the urban areas. Five traffic bridges and many pedestrian bridges were destroyed completely and about 750 houses were washed away or seriously damaged.
Although some restoration works have been executed, the most important problem is the lack of communication, which has the effect that this area now can be regarded as economically distressed. The marketing of local goods has met with great difficulties and higher costs. The availibility of medical services and educational facilities has been greatly reduced.

2.2 Problem analysis

The La Josefina landslide is the lead motive for undertaking the proposed Strategic EIA. In addition to La Josefina the study area contains various other sites where landslides are taking place or where the soil conditions are such that landslides may develop in the future. Examples are Paccha, Cumbe, Tomebamba and Tahual. The analysis of these sites and the detection of other slide-prone areas is one of the key subjects of the Strategic EIA.
The geological instability should be the point of departure for the problem analysis. The effects of this instability may be aggravated by disturbances caused by human activities (such as the construction of roads and other infrastructural works or the degradation and disappearance of protective vegetation

due to deforestation, grazing and overgrazing of fragile range and forest land and extension of agricultural frontiers, unsuitable types of landuse).
The problem analysis to be presented in the Strategic EIS should include a clear description of the aspects mentioned above. Other environmental problems, which are not directly linked with the occurrence of natural hazards, but which prominently feature in the Río Paute catchment should be taken into account as well. These are for instance the effects of industrial development, exploitation of mines and urban development (including disposal of solid waste and waste water).

Finally, socio-economic issues (like population growth pressure, migration and poverty) and institutional issues (like policy distortions, legal and institutional bottlenecks and other constraints to effective natural resource planning and environmental management) have to be described, because of their direct influence in the degradation of natural resources.
The most important problems will be described into more detail in chapter 5.

3. OBJECTIVES

The purpose of the Strategic EIA is to obtain insight in the major environmental problems in the study area, their underlying causes, to define alternative strategies to overcome the main environmental problems and to set priorities.
A statement of the overall objectives of the Strategic EIS and its relationship to decision points concerning project planning, design and implementation should be defined.

Essential activities are:
- analysis of the actual quality of life and the environment and the actual use of natural resources;
- assessment of the environmental sustainability of resource use in the Río Paute catchment;
- analysis of the trends in the environment and the use of natural resources;
- assessment of the importance and relevance of the natural resource base for the population, specified for gender and indicating the relationship between poverty and the environmental situation;
- identification of policy distortions, institutional bottlenecks and other constraints to effective natural resource planning and environmental management.
- assessment of development plans and programmes with regard to their environmental effects.

As such, the strategic EIS provides a baseline for the formulation of alternative strategies and policy responses to overcome the main environmental problems.
Based on the above mentioned strategies and policies the most feasible plan or scenario for sustainable regional development and environmental management may then be selected.

4. LEGISLATION AND POLICIES

Apart from fulfilling the objectives, there is a need to place the Strategic EIS in a broader planning and management context in the region. The Strategic EIS must indicate how (inter)national laws, rules and regulations and policies once adopted, will affect the Río Paute catchment. These may include the following:

- policies, legislation, regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, siting, land use control etc. (at international, national, regional and local levels);
- EIA laws and regulations of the Ecuadorian government;
- policies and legislation concerning (environmental) planning and management (at national and regional level);
- institutional strength of competent authorities;
- decentralization regulations and policies, consistency of new regional regulations;
- control of execution of existing regulations and law-enforcement.

5. DESCRIPTION AND ANALYSIS OF THE ENVIRONMENT AND TRENDS

5.1 Study area

The area of the Río Paute catchment corresponds with the Provinces of Cañar (cantons Biblián, Deleg and Azogues) and Azuay (cantons Cuenca, Chordeleg, Gualaceo, Sigsig, Paute, El Pan and Sevilla de Oro) in the central-southern part of Ecuador. The catchment covers an area of 4530 km2, and the altitude varies between 4000 meters above sea level (páramos de Cajas) and 1960 meters above sea level (Presa Amaluza).
The study area of the Strategic EIA basically covers (i) the area of the Río Paute catchment, where the effects of the disaster are felt, directly and indirectly, and (ii) the area, where the sources of pollution and causes of environmental degradation (current and future) are located. In short, the study area should include the La Josefina reservoir area, the upstream source area and the downstream riverine zone, as far as significant beneficial or adverse effects can be expected. The study area includes the higher parts of the eastern and western Cordillera, the slopes and the valleys of Azogues, Cuenca, Paute and Gualaceo, including areas used for agricultural production, for abstraction of drinking water, for disposal of liquid and solid waste etc.. Special emphasis, however, is dedicated to the midstream section in connection with the La Josefina landslide. The indicative study area is shown in Figure 1. However, it should be emphasized that accurate boundaries of the study area can only be determined after evaluation of all available information on the causes and the effects of the disaster and the sources of pollution. In the Strategic EIS, the study area should be indicated on a series of maps at a scale of 1:100.000.

These maps should present essential background information on the abiotic and biotic environment and infrastructural situation, including topography, rivers, irrigation/drainage, road network, industries, residential areas, land use, forestry areas and protection zones.

5.2 Descriptive analysis of the current situation and impacts

The Strategic EIS must present a descriptive analysis of the present natural environmental conditions in the study area, of socio-economic and of institutional issues, with an analysis of the interrelationships between these three elements of society. That is, the most important activties and phenomena affecting the environment have to be described, as well as impacts resulting from the actual environmental situation, influencing e.g. socio-economic conditions.
Trends have to be described for the same issues as described in the current situation.

Point of departure for the descriptive analysis of the environment must be paragraph 2.2 'Problem analysis', where the most important problems are briefly indicated. In this chapter, the problems have to be thoroughly analysed.
Appendix 6 provides an extensive checklist to be used. This checklist may also serve as background knowledge or theoretical luggage for the description and analysis of problems, impacts and trends. The Commission recommends strongly to make use of this checklist.

Some elements, mentioned in this checklist may be described in general terms of in a later phase.
However, a detailed description or thorough analysis is required for;

- geology / geomorphology in terms of landscape instability;
- (un-)suitability of the soils for different forms of land-use like cropland, forest or rangeland and erodibility (i.e. the vulnerability of the soil for water or wind erosion);
- pollution of especially water and soil (urban/industrial, waste waters, solid wastes, run off, agrochemicals and pesticides);
- socio-economic issues especially population (growth)pressure, poverty and consequent migration with special emphasis on the relationship between poverty and environmental degradation;
- institutional issues, like capacities, coordination and management.

The checklist indicates the level of detail which is required for the above mentioned elements (indicated with an asterix (*)). The importance and motive for a detailed description is given as well in this checklist.
This analysis is necessary in order to be able to develop environmentally sound plans, like the construction of roads, a waterplan or an industrial site plan.

6. ASSESSMENT OF ONGOING AND PROPOSED PROJECTS AND PLANS

6.1 Assessment of existing projects and plans

Existing projects and plans directed to environmental improvement, disaster prevention and emergency response, and their projected impacts have to be described and assessed. These impacts may concern environmental issues as well as impacts on e.g. production and poverty (socio-economic issues).

- The Strategic EIS has to assess in the first place the environmental, socio-economic and institutional effects and impacts of the emergency activities realized in Paute and the surrounding area through the Consejo de Programación. These activities are e.g. road (re)construction ('anillo vial'), regulation of the river course, complementary overflow of the La Josefina reservoir, reconstruction of houses, reconstruction of communal services, health etcetera. Concerning these activities a determination of the efficiency, effectiveness, relevancy and significance for the mitigation of the effects of the disaster is executed. Likewise an analysis of environmental, socio-economic and institutional impacts of the new activities has to be done ('anillo vial' above all).

- Secondly an assessment has to be made of water and soil management activities (irrigation canals, reservoirs, soil rehabilitation and conservation, UMACPA and actions of NGO's). This assessment will determine the effects and impacts (both foreseen and potential) of the institutional actions concerning the environment. Likewise the evidence of a new conscience towards the requirement for an adequate management of natural resources will be verified.

- The assessment also has to provide criteria concerning the executive capacity of Governmental organizations, NGOs and local governments. Information has to be provided as well about the existence of other professional skills in the area concerning the Strategic EIS: local consultants with special expertise and/or experience, universities, documentation centres, monitoring equipment (for toxic materials or other contagion etcetera).

- Finally the assessment has to contain relevant information about the professional capacity in matters of planning, monitoring and evaluation and administration control of each institution involved in environmental management of protection.

6.2 Assessment of proposed projects and plans

Proposed projects and plans, which are significant for improvement/deterioration of the environmental quality and quality of life and for protection/misuse of the ecological resources, are evaluated with respect to their significance for reversing or accelerating the trends towards further deterioration of the environment and the ecological resources. The assessment may include projects and plans of public institutes, NGO's or private enterprises.
Examples of proposed plans are 'Plan de Desarrollo Integral de la Provincia del Azuay' by the Consejo Provincial del Azuay and 'Plan de Desarrollo del Austro" by CREA.

7. PRIORITY SETTING AND MITIGATION MEASURES

7.1 Priority setting

The Strategic EIS will provide and integrated analysis of the environment-related problems in the study area, on the basis of the results from the activities described in the chapters 5 and 6 above. Subsequently the Strategic EIS provides a ranking of the most salient categories of problems, which ultimately will lead to a setting of priority problems, which have to be mitigated urgently. As salient problem categories may be considered:

- geological dynamics and instability;
- erosion and degradation, caused by land-use practices, irrigation and deforestation;
- lack of sewage treatment and pollution control;
- population growth pressure, migration, poverty;
- institutional constraints, e.g. structure, capacity, management, coordination.

In order to reach more into depth, a subdivision of the catchment into sub- areas with specific types of problems is made. The table below gives a first indication of key problems. In the Strategic EIS the priority problems have to be identified and a selection plus ranking has to be made.
An important criterium for this selection is the importance and relevance of the environmental problems for the population. They might have tried already to identify these problems and seek solutions. Endorsing and joining these problems would be preferable.

Area	Key problems
Cuenca and surroundings	Urbanization, industry, pollution of surface- and groundwater, sewerage, solid waste, public health, minifundism, migration, employment, lack of family planning and environmental education.
Azogues, Burgay watershed	Transport, infrastructure, sewerage, solid waste, public health, land-use, erosion, employment, minifundism, migration, lack of family planning and environmental education.
La Josefina and surroundings	Slope stability, rock strength, transport, roads, water quality, flood control, sedimentation, poor soils, poverty.
Paute, Gualaceo, Chordeleg	Roads, transport, irrigation, agriculture, horticulture, tourism, mineral exploitation, river training, drinking water, rehabilitation of agricultural land, deforestation, low productivity, migration, poverty, malnutrition.
Sevilla de Oro, El Pan	Natural forest, reforestation, preservation, land tenure, land use, mineral development, (re)migration, poverty, lack of family planning.
Since it is difficult to specify institutional issues per area, the key problems are mentioned in general:	- lack of an legal framework for the planning of measures concerning environmental management - absence of a governmental institute or agency with leading capacity to conduct the planning and execution of regional programmes for conservation of natural resources and the envi-

7.2 Mitigation measures

Considering the above mentioned priorities, feasible and cost-effective measures which may prevent or reduce significant negative impacts must be indicated in the Strategic EIS. These impacts can result from the current situation (as described in chapter 5) as well as from ongoing and proposed projects and plans (as described in chapter 6). The various measures are then compared, trade-offs between alternative measures are weighed, and different options proposed. The alternative options can be divided in short term measures (most urgent), mostly targeting at natural disaster prevention and emergency response, mid term and long term measures, focusing on sustainable regional development and prevention or abatement of environmental degradation.

The mitigation measures may be described in terms of:

- direct priority measures to alleviate the current problems in the study area and to restore the economic and natural resources to a level as considered feasible (the already proposed mitigation measures are also described and evaluated);
- measures for reduction of pollution loads, introducing pollution controls, waste treatment, environmental parameter monitoring (e.g. water quality);

- measures for disaster prevention and response;
- changing project sites, routes, processes, operating methods, disposal routes or locations etcetera;
- institutional strengthening and capability building to improve environmental planning and management of natural resources;
- offering compensation to affected parties for impacts which cannot be mitigated.

8. FORMULATION OF ALTERNATIVE STRATEGIES AND POLICY RESPONSES

The inputs for this chapter are:
Chapter 5, in which the impacts and trends in the current situation are evaluated, independently from the reality of ongoing and proposed projects and plans.
Chapter 6, in which impacts from the existing and planned interventions are presented.
Chapter 7, which gives an overview of key problems and alternative packages for mitigating the most important negative impacts.

This chapter describes the process of formulation of alternative environmental strategies, followed by evaluation of the alternatives and subsequent selection of the most suitable or feasible strategy. The process of developing and evaluating strategic alternatives is summarized in the table below:

I.	Overall objective	Sustainable regional development
II.	Priority problems	1 2 3 4 5
III.	Aims and criteria	Formulation of criteria
IV.	Strategies policies	alt. 1 alt. 5 alt. 7 alt. 10 alt. 13 alt. 2 alt. 6 alt. 8 alt. 11 alt. 14 alt. 3 alt. 9 alt. 12 alt. 4
V.	Assessment	alt. 2, 6 and 12 (by way of illustration)

I.
In this part of the Strategic EIS sustainable regional development and effective environmental management have to be defined. In appendix 8 the Commission already gives some guidelines for these definitions.

II. The most important problems that hamper sustainable regional development and effective environmental management have to be identified.

III. Formulation of aims and criteria have to be elaborated into more detail to define strategies.

IV. Alternative strategies and policies to solve each of the selected problems have to be formulated and may include:
   - mitigation measures to **prevent or reduce** negative impacts (effect-di -rected)
   - measures to **improve** the environmental situation (source directed), e.g. the evaluation of ongoing and proposed plans and projects and formulation of new ones
   - EIA for project development (preliminary design)
   - EIA for project implementation (detailed design)

V. Weighing of alternatives: the effects of various alternatives are assessed and their feasibility be analyzed. A comparison is made, priorities are identified and a selection is made.

Below three examples are given to provide an idea for the functioning of the above mentioned approach: example 1 concerns a physical problem, example 2 treats a socio-economic problem and

example 3 describes institutional issues. To identify physical problems, the methodology of hazard analysis, described in appendix 9, might be of help.
The Commission wants to emphasize that these examples are not thoroughly analysed as far as their completeness and correctness is concerned. The definitive alternatives should be the result of an accurate strategic EIS.
Similar strategies can be formulated for equally important problems, as mentioned in chapter 7.1.

Example 1:

II. Problem: Erosion and degradation may be considered as salient problem categories that hamper sustainable development.

IV. Strategy: Based on a thorough analysis of the erosion hazard in the area, priorities can be given to soil conservation projects and types of measures to be taken. Alternatives might be:

Alternative 1: Formation of an organization specifically orientated to soil and water conservation, which develops standard criteria for erosion surveys, planning, design, execution and evaluation of erosion prevention or control measures;

Alternative 2: EIA for the Unidad de Manejo de la Cuenca del Río Paute (UMACPA)-project. This project elaborated plans and projects in the field of soil conservation, reforestation and forest protection. Actually the continuation of the project is under study, the results being expected in November 1994; the first phase of the project ends in 1995;

Alternative 3: Training and coordination of NGO's in the Río Paute catchment in soil conservation and erosion control measures;

Alternative 4: Investigation of methods, efficiencies and preferences for soil conservation, erosion control and irrigation practices of peasants in the Río Paute catchment;

Alternative 5: Analysis of alternative soil conservation and erosion control methods in the area.

V. Assessment and selection: A careful weighing of alternatives is required, according to the following criteria:

. technical efficiency;
. economical feasibility;

Example 2:

II. Problem: Institutional issues are considered as one of the main constraints to sustainable regional development and effective management of natural resources in the catchment.

IV. Strategy: Significant and sustainable decrease in environmental deterioration only will arise if a coordinated action will be undertaken in the short term, decentralized in the medium term and an action completely incorporated in the population in the long term. A number of alternative scenarios for institutional actions can be considered:

Alternative 1: leading agency (CREA), that coordinates actions of Governmental Organizations, NGO's and local agencies;

Alternative 2: consortium of Governmental organizations, NGO's and local agencies in which each one contributes with finances and agrees on common actions;

Alternative 3: strategy centralized in local agencies, acting as leading and ordering units of institutional action;

Alternative 4: a combination of the former.

V. Assessment and selection: advantages, disadvantages, risks of each alternative have to be considered, as well as minimal conditions, to achieve that these are able to function (technical and economical feasibility), such as:

. staff requirements (of local, regional and international level: number, profiles, duration);
. equipment requirements;
. needs, possibilities and mechanisms for (financial) compensation;
. eventual needs for legal mechanisms in case of creation of interinstitutional executing units;
. requirements for training of staff;
. need for technical assistance (local, regional, international);
. need for finances (additional to the yet existing);
. mechanisms for obtaining funding (local contribution, national contributions, bilateral funding, repurchase debt, debt for nature swaps, donor contributions

Example 3:

II. Problem: Poverty is cause and effect of degradation of natural resources.

IV. Strategy: To contribute to poverty alleviation the above mentioned vicious circle has to be broken. Various alternatives could be considered:

Alternative 1: Improving or upgrading of knowledge and practices concerning the management of natural resources, related to agricultural production;

Alternative 2: Introduction of environmental education in formal educational programmes;

Alternative 3: Non-formal education on environmental issues, especially on the subject of the interrelations between poverty and degradation of natural resources. Popular and peasant organizations may serve as a distribution channel of knowledge. Women groups also might offer a suitable entrance for two reasons: women form the majority of the population in the Río Paute catchment (because of migration of men) and because of their essential role in the management of natural resources.

V. Assessment and selection: A comparison of alternatives is made, taking into account:

. effects on income of the local population (introduction of conservation practices in agricultural production often requires investments in the short term to achieve results in the long term);
. access and permanent presence of educational facilities;
. (trained) staff and equipment requirements in formal education;
. coordination and responsibilities for non-formal environmental education.

9. REMAINING GAPS IN KNOWLEDGE

The Strategic EIS must include a list of the remaining gaps in knowledge and data. Any uncertainties in predicting the environmental impacts must also be included. The significance and implications of these gaps in knowledge and uncertainties for the assessment must also be specified.
In view of the uncertainties, it is recommended that the Strategic EIS will include a monitoring programme. This programme could as well monitor the implementation of mitigation measures and of impacts which are irreversible or unavoidable. Monitoring on sustainable development could be part of this programme.

The Strategic EIS has to indicate as well in what way and through what means lacking experience and knowledge gaps can be developed or upgraded. An example for geology/geomorphology is given below:

- natural hazard evaluation has to be given priority, especially using GIS (see UNESCO-ITC report 1992, Bogota workshop). In this context a good relation with the starting Swiss project (ETAPA) is important, regional planning is to incorporate this hazard evaluation;
- sponsoring of a small geotechnical unit to be initiated in the Technical University with direct links to Ministerio de Obras Públicas and CREA. Training on the job, geotechnical facilities and GIS;
- connection with the volcanologic/seismic observatory and installation of a possible substation in the Cuenca region. The technical university as seat of the civil engineering discipline should be strengthened with geological/geotechnical expertise. These disasters are partly due to lack of contact c.q. understanding between the civil engineering profession and the geological profession;
- promotion of the initiation of technical, financial sponsorships at regional, university and international levels, with direct links to project evaluation and educational upgrading;
- monitoring by means of an early warning system in locations with high geomorhpological risks;
- improvement of basic knowledge of geological/geomorphological inventory systems;
- organization of workshops/meeting of geologists (hard rock educated) and geomorphologists (non-lithified material) together with civil engineers and irrigation/land-use specialists;

10. SUMMARY OF THE STRATEGIC EIS

The summary must present the most important elements of each of the chapters of the Strategic EIS, preferable in the form of maps, figures, tables and diagrams.