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Guidelines for erosion and desertification control management

with particular reference to Mediterranean coastal areas

in co-operation with:

FAO
FIAT PANIS

Guidelines for erosion and desertification control management

Note:

This document has been prepared by the Priority Actions Programme Regional Activity Centre (PAP/RAC) of the Mediterranean Action Plan (MAP – UNEP), in co-operation with the Land and Water Development Division (AGL) of the United Nations Food and Agricultural Organisation (FAO), within the framework of the project "Capacity Building for Desertification and Erosion Control Management in the Mediterranean Region" financially supported by the European Commission.

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List of Acronyms

AGL	Land and Water Development Division (FAO)
BP/RAC	Blue Plan Regional Activity Centre
CAMP	Coastal Area Management Programme
CBD	United Nations Convention on the Protection of Biological Diversity
CCD	United Nations Convention to Combat Desertification
CORINE	Co-ordination of Information on the Environment
CSD	Commission on Sustainable Development
DGCONA	General Direction for the Conservation of Nature (Spanish Ministry for Environment)
EAP	Environmental Action Plan
EC	European Commission
EC DG XI	European Commission Directorate General XI
EIA	Environmental Impact Assessment
EU	European Union
FAO	The Food and Agriculture Organisation of the United Nations
FFS	Farmer Field School
GIS	Geographic Information System
GEF	Global Environment Facility
ICAM	Integrated Coastal Area Management
ICARM	Integrated Coastal Area and River Basin Management
ICONA	Institute for Nature Conservation, Madrid
ICZM	Integrated Coastal Zone Management
IPM	Integrated Pest Management
ISCRAL	International Scheme for Conservation and Rehabilitation of African Land
ISNM	Integrated Soil and Nutrient Management
LUCDEME	Mediterranean Project on Combating Desertification, Spain
MAP	Mediterranean Action Plan
MCSD	Mediterranean Commission on Sustainable Development
METAP	Mediterranean Technical Assistance Program
NGO	Non Governmental Organisation
PACD	Plan of Action to Combat Desertification
PAP/RAC	Priority Actions Programme Regional Activity Centre
SAP	Strategic Action Programme
SEA	Strategic Environmental Assessment
SOTER	Soil and Terrain Database
SWC	Soil and Water Conservation
TFAP	Tropical Forests Action Programme
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCOD	United Nations Conference on Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WB	The World Bank
WOCAT	World Overview of Conservation Approaches and Techniques

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Preface

These Guidelines were prepared by the Priority Actions Programme Regional Activity Centre (PAP/RAC) of the Mediterranean Action Plan (MAP) – UNEP, within the 1998-2000 Workplan of the priority action dedicated to soil protection. This priority action has been implemented by PAP/RAC since 1985, with the professional support and co-operation of the Food and Agriculture Organisation of the United Nations (FAO) Land and Water Development Division (AGL).

During the period preceding the preparation of the Guidelines, a Mediterranean Co-operative Project on "Mapping and measurements of rainfall induced erosion in Mediterranean coastal areas" was implemented by PAP/RAC, FAO and the Spanish General Directorate for the Conservation of Nature (DGCONA), Madrid. That project, *inter alia*, dealt with mapping and measurement of erosion processes in selected watersheds of Spain, Tunisia and Turkey, involving also the relevant national institutions and teams of experts. In addition to respective national reports published, during the implementation of the project, a consolidated mapping methodology, applicable in the region and presenting simultaneously erosion potential and dynamics, was developed and successfully applied in all three countries. Finally, the results of the Project, as well as of other recent similar initiatives, were used for the preparation of the Guidelines for Mapping and Measurement of Rainfall-induced Erosion Processes in Mediterranean Coastal Areas (PAP/RAC, 1997).

In 1998, PAP/RAC commissioned the preparation of updated national reports on current erosion and desertification related problems and practices in 6 selected Mediterranean countries. These reports were prepared and published in early 2000 (PAP/RAC, 2000). In addition, a synthesis report of the national reports was prepared and published as a separate document (PAP/RAC, 2000a).

Taking into account the extensive experience of FAO and of PAP/RAC, as well as the facts presented in the mentioned national reports, the present situation related to erosion and desertification in the region might be defined in general lines as follows:

- erosion and desertification processes, despite significant improvement within the EU countries, are still among major environmental and socio-economic problems in large parts of Mediterranean coastal areas;
- actual best practices related to specific protection and conservation technologies and control management are not widely disseminated or applied; and
- a comprehensive, updated and harmonised control management practice seems to be the weak point in a number of cases, in particular related to project management and integration in a wider management context, oriented at sustainable development.

Therefore, it has been decided to prepare specific guidelines for erosion and desertification control management in Mediterranean coastal areas, capitalising on the experience of PAP/RAC, and of recent actions within various EU programmes, applying the general principles of project management, the methodology and practice of Integrated Coastal Area Management (ICAM), and the UN Convention to Combat Desertification (CCD).

The objectives of the present Guidelines are related to mitigation of erosion and desertification processes in the region and preparation of a practical document to be used as tool when formulating and planning relevant control management programmes and projects. The Guidelines are intended for experts and professionals involved in the control management process, experts in relevant sectoral activities, and decision makers responsible for mitigation and control of erosion and desertification phenomena and processes.

The Guidelines describe and recommend: (i) an integrated approach to erosion and desertification phenomena in the region; (ii) the basic elements of an integrated erosion and desertification control management process; (iii) prerequisites for the implementation of the recommended process; and (iv) a detailed description of the main phases of the process. In addition, the Annexes enclosed present a glossary of terms, information and database, a list of relevant national authorities and institutions in the region, and the mapping legend with few examples of maps. Finally, reference bibliography is presented.

Since the Guidelines refer in particular to Mediterranean coastal areas, the recommended methodology and procedure were developed in accordance with the Integrated Coastal Area Management (ICAM) methodology, to be understood and applied as the broader conceptual framework. Due to the complexity of erosion and desertification phenomena, and to the specific national, local, and ecosystem conditions, the Guidelines should be used in a flexible and creative way, primarily as the basis for the formulation and implementation of relevant control management programmes and projects, together with the previously published Guidelines on mapping and measurement. In some cases, need may arise for consultation with FAO AGL or PAP/RAC.

It should be noted that the Guidelines were prepared as a part of the project “Capacity Building for Desertification and Erosion Control Management in the Mediterranean Region”, implemented by PAP/RAC with a grant awarded by the EU. The draft English version of the Guidelines was presented at a workshop held in 2000 in Malta for English speaking participants, and the respective French version at a workshop held in Tunisia the same year. The final version of the document has been prepared according to the comments and amendments proposed by the participants of the two workshops.

Finally, although the Guidelines were conceived on, and primarily targeted at the Mediterranean region, it is likely that they might be applied, with some adaptation if necessary, in other regions of the world.

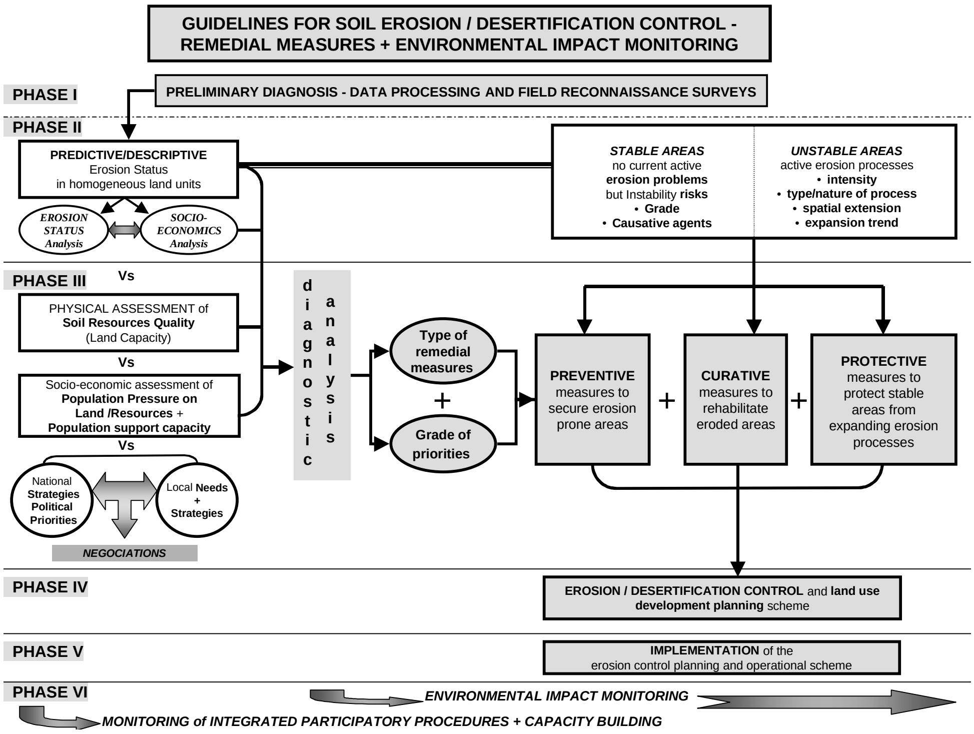
Executive Summary

This document has been prepared by the Priority Actions Programme Regional Activity Centre (PAP/RAC) of the Mediterranean Action Plan – UNEP, in co-operation with FAO AGL, as part of the 1988-2000 Workplan of the priority action on soil protection. The basic inputs used for the preparation of the document were the experience of FAO AGL and PAP/RAC, mostly resulting from joint actions in the region, in particular from the co-operative project on erosion mapping and measurement implemented during the 1989-96 period (with mapping and measurement in selected areas of Spain, Tunisia and Turkey). The results of the co-operative project were presented in respective national reports and in the Guidelines for Mapping and Measurement of Rainfall-induced Erosion Processes in Mediterranean Coastal Areas (PAP/RAC, 1997). One of major results of the co-operative project was the development and testing of a common consolidated mapping methodology, innovative in being capable to present simultaneously on a single map both erosion dynamics and potential, and in being applicable to desertification processes as well. Additional inputs used were the six national reports on erosion related problems and practices, commissioned in 1998, prepared in 1999 and published in 2000 (PAP/RAC, 2000), and their Synthesis (PAP/RAC, 2000a).

The present Guidelines, dealing with management related issues of erosion/ desertification control, are a logical and thematic follow up of the Guidelines on mapping and measurements, published in 1997. The geographical coverage of the Guidelines are the Mediterranean coastal areas and river basins. Nevertheless, it is assumed that the document is applicable in wider areas of Mediterranean coastal states, as well as in other regions, taking into account differences of relevant natural processes, management practices and other area-specific conditions. The document is targeted at: (i) professionals, experts and institutions dealing with erosion/desertification processes and control management; (ii) responsible authorities at local and national levels; and (iii) decision makers at various levels.

The broader thematic framework of the procedure described and recommended includes the principles and goals of sustainable development and the Integrated Coastal and Marine Areas Management (UNEP, 1995), and for river basins the Integrated River Basin Management (UNEP/MAP/PAP, 1999). The basic concepts and management procedures of ICAM and ICARM are briefly presented and references suggested. Furthermore, the FAO conceptual approach for improved land management, based on FAO experience on integrated planning for sustainable management of land resources (FAO/GTZ/UNEP, 1999) is applied. The recommended procedure for management of erosion/desertification control is presented in the figure below.

In accordance with the UN Convention for Combating Desertification, and with the MAP Phase II documents, adopted in 1995, as well as with the permanent orientation of FAO, the Guidelines, in addition to erosion, extend their thematic framework to desertification phenomena. Due to the fact that in Mediterranean coastal areas the erosion processes are prevailing, but potentially inducing desertification, interrelations and erosion/desertification interface are presented and illustrated.



Flowchart of the procedure

The recommended procedure envisages the following phases/activities:

- Phases I+II: Diagnostic analysis, erosion mapping, data processing, preparation of sectoral working documents;
- Phase III: Integration of mapping outputs with socio-economic and land-use features, identification of priority areas, formulation of remedial measures;
- Phase IV: Formulation of the strategy and of the programme for management of erosion/desertification control;
- Phase V: Implementation of the management programme; and
- Phase VI: Post implementation activities, environmental impact monitoring, evaluation, reporting, and readjusting, if needed.

The Guidelines are structured as follows:

I. Introductory part: background, objectives of the Guidelines, target audience, geographical context, instructions for use;
II. Global approach: overall context, basic facts, experience, justification, the 1997 Guidelines, erosion/desertification interface;
III. Prerequisites for implementation of management procedures: data management, institutional aspects, capacity building and participation, funding, integration/ ICAM/ICARM, international co-operation;
IV. Integrated management procedure: concept, principles, monitoring, scheme, main phases of procedure, integration within wider remedial programmes;
V. Detailed description of the procedure: diagnostic phases, identification of measures and technologies, formulation of management strategies and programmes, implementation of programmes, post implementation activities, monitoring and reporting.

In addition, a number of boxes present specific examples, experiences and information from the Mediterranean region, and in some cases from other regions, but of potential Mediterranean interest or applicability.

Finally, four annexes are included: glossary of terms, data and information, reference list of authorities and institutions, and the erosion mapping legend with examples of maps prepared (1997 Guidelines).

Part I: Introduction

1. Background Information

Since its inception in 1975, the Mediterranean Action Plan (MAP) has recognised soil conservation as an essential element of environment protection and sustainable development of Mediterranean coastal areas. Within MAP, the implementation of a priority action on soil protection has been entrusted to the Priority Actions Programme Regional Activity Centre (PAP/RAC), located in Split, Croatia.

PAP/RAC, as a component of MAP, is entrusted with the implementation of priority actions in the region related to Integrated Coastal and Marine Areas Management (ICAM) within the context of sustainable development of Mediterranean coastal areas. Within its mandate, PAP/RAC is acting as the MAP Centre responsible for the formulation and implementation of the MAP Coastal Area Management Programme (MAP CAMP) and its individual projects. Finally, the mandate of PAP/RAC encompasses actions related to: (i) major coastal resources: water resources management, soil protection, aquaculture; (ii) waste management; (iii) seismic risk; (iv) renewable energy sources; (v) sustainable tourism; and (vi) application of tools and techniques for ICAM.

From its beginning, the action dedicated to soil protection has been implemented with the co-operation of FAO, joined later by DGCONA (earlier ICONA) of the Spanish Ministry of Environment, and by a number of other interested Mediterranean national institutions. A large number of experts and scientists from all Mediterranean countries have been involved in the action.

PAP/RAC started the implementation of the action in 1984, its first phase being dedicated to fact finding and identification of major problems and best practices in the region. National reports from almost all Mediterranean countries were prepared, presented and discussed in a number of seminars during the 1985-86 period.

According to the major problems identified, the second phase of the action was dedicated to rainfall-induced erosion. After a preparatory period, a Mediterranean co-operative project on “Mapping and measurement of rainfall-induced erosion processes in Mediterranean coastal areas” was formulated, discussed in two workshops, and approved by MAP in 1989.

This co-operative project, dedicated to erosion mapping and measurement, was implemented in the 1990-94 period, with pilot mapping and measurements implemented in selected watersheds of Spain, Tunisia and Turkey. Additional mapping and measurements were implemented in the 1995-96 period. The results of the pilot projects were presented and approved in 1997. On the basis of the project results a consolidated mapping methodology has been developed, tested and found applicable, efficient and flexible. The results of the co-operative project were used for the preparation of the Guidelines for Mapping and Measurement of Rainfall-induced Erosion Processes in Mediterranean Coastal Areas, drafted during 1996, presented and discussed in workshops in 1996 and 1997, and published in 1997 (PAP/RAC, 1997).

The MAP Phase II started in 1995 with the revision of the Barcelona Convention, and adoption of the “MAP Phase II Action Plan” and the “Priority Fields of Action for the Environment and Development in the Mediterranean Basin (1996-2005)”. Both of these documents define as MAP priority, among others: *"...development of policies, strategies and programmes to prevent soil loss and desertification, to include mapping, monitoring and protection measures (in co-operation with FAO)*". Priority activities on soil management and combating erosion and desertification, and management of vegetation cover are included in the Action Plan and defined in its chapter IV "Integrated Management of Natural Resources". As in the MAP Phase I, the implementation of these activities has been entrusted to PAP/RAC.

With regard to the above, PAP/RAC envisaged the following actions to be implemented in the 1998-2000 period in co-operation with FAO:

a) updating National Reports on problems and practices of erosion and desertification control management, as well as of a Synthesis of these Reports, to be published and disseminated in the region, and used as one of inputs for the preparation of the present Guidelines; and
b) elaborating "Guidelines for Erosion and Desertification Control Management (with particular reference to Mediterranean coastal areas)", as a follow-up of issues dealt with by the 1997 Guidelines, covering thus the entire process of soil protection against erosion and desertification phenomena, including the control management process, project formulation/implementation, and integration within the Integrated Coastal and Marine Areas Management (ICAM) process.

In early 1999, PAP/RAC submitted a proposal of a project entitled "Capacity Building for Desertification and Erosion Control Management in Mediterranean Coastal Areas" to the EC DG XI '99 Grant programme. The proposed operation envisaged the implementation of following activities: a) preparation of Guidelines on erosion and desertification control management (English version); b) translation of the Guidelines into French; c) presentation of a number of reference documents, including the "Guidelines on mapping and measurement" and "Guidelines on erosion and desertification control management", at a workshop to be held in Malta for English speaking constituency; d) the organisation of the same workshop for the French speaking constituency, to be held in Tunisia; e) dissemination of Guidelines on erosion and desertification control management; and f) formulation of proposals for follow up, according to the recommendations of the two workshops. The Commission of the European Community has accepted the PAP/RAC proposal, and the project started in July 1999, to be completed by the end of the year 2000.

The major activities of FAO AGL in the region implemented in the same period consisted actually of adapted Soil and Water Conservation (SWC) programmes based upon erosion/desertification assessment or inventory, either through systematic mapping or local soil surveys. Development projects of the kind were implemented in Jordan, Morocco and Tunisia.

Currently, SWC expertise and indirect contribution to erosion/desertification physical assessment approaches and methods are provided to North African countries, such as Tunisia and Morocco, within the framework of the FAO International Scheme for Conservation and Rehabilitation of African Land (ISCRAL). The referred to assistance is now part of the new strategy of dryland management in Morocco (Stratégie "Bour"), and integrated in two UNDP and WB supported development projects in Tunisia.

2. Objectives

The objectives of the Guidelines are in full harmony with the MAP Phase II Action Plan and with the Priority Fields of Action for the Environment and Development in the

Mediterranean Basin (1996-2005), as well as with the UN Convention to Combat Desertification. Furthermore, they are in line with the FAO approach principles and regular programme.

a) The long-term objectives of Guidelines are to contribute to:
    - mitigation and better control of erosion and desertification processes;
    - better land use;
    - rational utilisation of land resources; and
    - improvement of living conditions and of food security of population.
b) The immediate objective is the production of a practical, updated and transparent document, to be used as a methodological tool and source of information for the formulation and implementation of erosion and desertification control management programmes and projects.

Special emphasis was placed on the standardisation and harmonisation of approaches, methods, scientific and technical terminology, criteria, concepts, and evaluation and monitoring indicators.

3. Target Audience

The document is intended for a target audience of three different groups:

- experts, professionals and institutions involved in erosion/desertification control management in the region and in land-use management, for direct professional use;
- soil management authorities and responsible decision makers, for a better understanding of the importance, role and benefits of the implementation of erosion control programmes, in particular of standardised mapping, based on the common consolidated methodology;
- experts, institutions and decision makers involved in Integrated Coastal Area Management (ICAM) in the region, for a better understanding of the impacts of erosion and desertification on the economy, social conditions and the environment, and of the role of erosion mapping, measurement and control management within ICAM.

4. Geographical Context

The geographical context of the Guidelines is defined by the Barcelona Convention as revised in 1995, encompassing the Mediterranean coastal areas and watersheds, including also impacts of erosion/desertification processes on adjacent marine areas. The concept of coastal area, broader than the coastal zone, understands a distinct transitional system between marine and terrestrial (continental) environments. Figure 1 below illustrates the Blue Plan – MAP definition of Mediterranean coastal areas, based on territorial/administrative coastal units (UNEP-BP/RAC, 1989). For a more detailed insight on definition(s) and practical understanding of the notion, references (UNEP, 1995) and (Vallega, 1999) might be consulted.

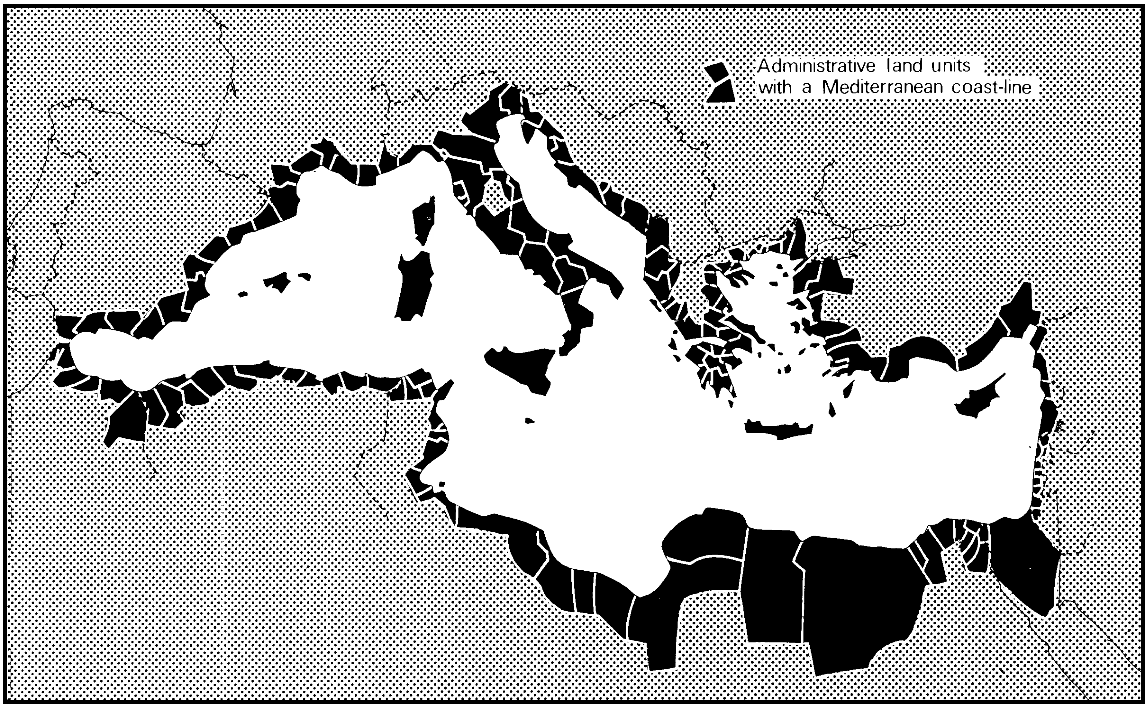


Figure 1: The Blue Plan – MAP definition of Mediterranean coastal areas

The geographical interpretation of Mediterranean watershed(s), however, must be approached in a more flexible way, in particular within the context of these Guidelines. Figure 2 (UNEP-BP/RAC, 1989) presents boundaries of the Mediterranean watershed, with boundaries in very arid areas to be understood as approximate ones. In practice, all relevant upstream processes and those parts of river basin areas under the influence of the Mediterranean climate and with Mediterranean specific biota should be considered as corresponding to the Convention definition. Faraway areas of large rivers, such as Ebro, Rhone, Po and Nile, are in practice excluded, but not the relevant impacts generated there.

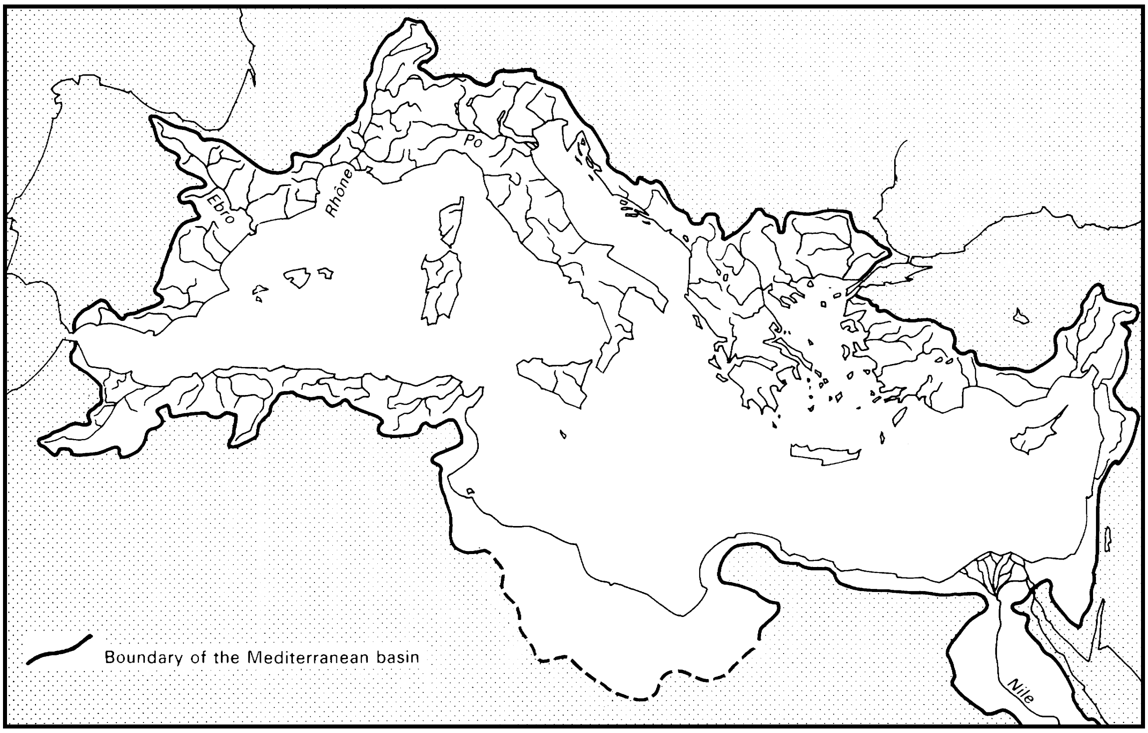


Figure 2: Boundaries of the Mediterranean watershed

Concerning erosion/desertification related phenomena the geographical context as defined above results with focus on land resources and management, including faraway upstream causes and respective impacts, as well as the adjacent marine environment affected by the resulting pollution, sediment transport and impacts on biodiversity.

5. How to Use these Guidelines

These Guidelines, due to the specific character of erosion/desertification phenomena, and the dependence of their manifestations and dynamics on local and other relevant conditions, should be used in a flexible and creative way. The recommended procedure should be used, and the available technologies selected, taking into account national and area specific conditions, on the basis of a carefully prepared Diagnostic Analysis.

Parts I and II of the Guidelines, mainly of an informative and descriptive character, should be consulted for general information and framework setting, with the exemption of the section related to the 1997 Guidelines (mapping), including Annex III, making integral part of the described procedure, and thereto to be applied within the recommended scheme. Part III, providing a review of basic prerequisites for implementation, in addition to its informative character, should be considered when formulating the programme and used as checklist prior to implementation. Finally, Parts IV and V, presenting the general and detailed description of the management procedure and programme formulation and implementation, should be considered as being of specific, strictly professional character, and used and applied by professionals. In case of teams lacking the needed professional guidance, training and capacity building is recommended as part of the preparatory phase of any relevant action. Assistance by and co-operation with FAO AGL and/or PAP/RAC in these cases is recommended.

With respect to major target groups, the use of the Guidelines is recommended as follows:

- for high and local level decision makers and authorities: consulting the Executive Summary, Part II and Part IV section 1 (the general concept);
- for executives of national and local institutions and authorities, responsible for management of erosion and desertification control: consulting Parts III and IV and Annex III;
- for experts and national teams responsible, or to be involved in programme formulation and implementation: using the document as a whole, in particular Parts III, IV, V, all Annexes and the 1997 Guidelines (the part related to mapping).

Finally, it should be noted that, while applying the Guidelines to coastal areas, the ICAM methodology should be understood as the wider reference framework.

Part II:
Global Approach to Erosion/Desertification Issues and Processes in Mediterranean Environments

1. Overall Context

All through its history, the Mediterranean region has suffered from the fragility of its eco-systems, and more specifically in the coastal areas where most of the population has always concentrated. Agricultural activities in particular are refrained by degradation and constant risk of depletion of soil and water resources in many sub-regions, and especially in the coastal areas.

In view of a general assessment of soil erosion and possible desertification problems at regional level, the Priority Actions Programme Regional Activity Centre (PAP/RAC) initiated investigations and surveys along three geographical transects oriented West-East: the first one from Spain to Turkey passing across Italy; the second and third North-South from Spain to Morocco, and from Italy to Tunisia including Malta. Each of these countries submitted a national report on the main issues related to soil erosion.

The data resulting from the six mentioned countries are complemented with some relevant information concerning other Mediterranean countries. Relevant references for the Mediterranean environment are: (PAP/RAC, 1997), (Rubio and Calvo, 1996), (ICONA, 1982, 1988), (Burke and Thornes, 1996), (Ennabli, 1993), (FAO, 1989), (FAO, 1983), (Giordano and Marchisio, 1991), (CIHEAM, 1993), (Commission of the European Community, 1992), (ESSC and CSEI, 1993), (Mainguet, 1991), and (Hill and Peter, 1996).

2. Basic Facts

2.1. The Facts

When discussing soil erosion or land degradation it is important to bear in mind the four main basic physical factors on which the rate of erosion depends: the erosivity/agressivity of climate and rainfall, the fragility/erodibility of the soil, the topography, and the amount and density of vegetation cover. In the Mediterranean region, which is a transition zone between the arid tropics and the temperate and more humid climates of the North, most of these factors are of particular relevance:

- the Mediterranean Basin includes an enormous variety of topographic, lithologic and edaphic (predominantly fragile red Mediterranean soils) conditions and landscapes;
- the so-called Mediterranean ecosystems have as major criterion the alternation of hot, dry summer and more humid winter periods thus generating a very typical climatic feature which consists of a marked deficit of precipitation as related to evapotranspiration during 3 to 6 months of summer period; this peculiarity is to be considered as a highly determinant parameter in the global resources degradation process and in some specific physical desertification mechanisms (see Part II, Chapter 5). Another characteristic is that most of the precipitation comes in violent downpours, which makes the erosivity of rainfall much higher than in temperate zones, when these violent rainstorms follow or coincide with the dry summer periods, thus generating severe erosion damages to the unprotected topsoil;

- the existing semi natural vegetation cover (i.e. vegetation associations such as garrigue, maquis) actually represents degraded forms of the genuine mixed Mediterranean forest. The natural vegetation had to adapt to growth conditions characterised by high summer temperatures that coincide with a severe shortage of water. During these same periods the remaining forest formations are periodically affected by bush fires. The remaining vegetation still establishes large wooded areas, but these appear rather vulnerable to further destruction by fire or illegal timber extraction.

Figures related to human induced soil degradation in five of the selected Mediterranean countries are presented in the Table 1.

2.2. The Causes

Currently, rainfall-induced erosion is the most serious physical form of soil degradation affecting the Mediterranean coastal zones. The main environmental impact results from interactions between the physical bio-climatic factors and ecologically unbalanced and inadequate human interventions. Due to these very long anthropogenic constraints, and in particular because of the removal of forest cover, and modification and/or degradation of vegetation after centuries of grazing by domestic animals and cultivation, a very large proportion of the soils of the region has been destroyed. The most severe erosion processes usually develop in areas where the vegetation cover has been destroyed, and cause average yearly soil losses exceeding 15 tons/ha in more than one third of the total land of the Mediterranean Basin.

Table 1: Human induced soil degradation
(surfaces expressed in percent of the total national territory)

Degradation type		Spain	Morocco	Italy	Tunisia	Turkey
Water erosion	extreme	3.0	6.0	0.5		22.3
	strong	49.0	12.2	35.0	37.0	36.4
	moderate	12.5	25.7	47.5		20.0
	light	25.5	9.0			7.2
Wind erosion	extreme					
	strong		1.0		35.0	0.65
	moderate		16.0			
	light					
Physical degradation	extreme					
	strong			14.0		2.0
	moderate					
	light					
Chemical degradation	extreme					
	strong	6.0			3.0	
	moderate		12.4*	3.0		
	light	1.0	13.5			
Stable terrain under natural conditions		3.0				
Lakes						0.5
Salt flats					6.0	
Dunes and or desert			4.2		19.0	

*The area belongs to the desert environment
Source: Data elaboration from (UNEP-ISRIC, 1992) and (Dogan, personal communication, 2000)

Amongst direct causes of soil erosion and desertification, deforestation should certainly be considered as the most predominant and ancient. The consequences of deforestation leading to soil erosion and desertification are described by Mabbutt and Floret (1980): "*if for any reason the plant cover is destroyed the soil surface layers are then exposed to wind and water erosion...*" which eventually generates the outcrop of stone pavements or soil "hard pans" thus reducing greatly the percolation of water into the soil. The remaining perennial plants can barely survive, and germination in general becomes difficult for both annuals and perennials. In the last twenty years there has been a significant increase in the frequency and magnitude of forest fires in the Mediterranean area. Various explanations have been proposed for the dramatic increase of bush fires in Spain and in Italy: (i) land abandonment and the subsequent vegetative cover changes; (ii) traditional agriculture and grazing practices which include burning to improve soil fertility; (iii) the increased change of forested land into tourist and recreational areas; and (iv) speculative initiatives to convert land for tourism, urbanisation and extensive ranging.

In Morocco, Tunisia and Turkey, where pastoralism is vital, the reduction of grazing areas due to soil erosion and land use change towards cropping activities initiated a depletion spiral: less total grazing space means higher animal pressure on land which, in turn, generates more intensive land degradation and the progressive shrinking of agricultural land. In North Africa, the evidence of determinant impact of overgrazing on desertification may be inferred from the great amount of shifting sand moving from the steppe areas toward the desert (Rognon, 1999). Turkey is also facing this problem of overgrazing; extension of the grazing period from early spring to late fall results in accelerated land degradation.

In the North African mountainous regions two apparently contradictory soil erosion parameters, namely human pressure on land and rural depopulation have to be considered: the former may produce deforestation and soil depletion, the latter is responsible for the lack of maintenance of most of erosion control installations and therefore responsible for the induced soil erosion. Some figures illustrating the main types of land use in the six selected countries are presented in the Table 2.

Table 2: Land use in six Mediterranean countries[1]

Countries	Cultivated land (%)	Forests (%)	Pasture and range (%)	Others (%)
Italy	36	29	21	14
Malta	41	-	-	59
Morocco	21	20	47	12
Spain	37	28	31	4
Tunisia	29	5	28	38
Turkey	36	30[2]	28	6

Sources: (MAPA, 1998), (MIMAM, 1998), (Ministero Ambiente, 1997), (Dogan, 1999), (MEAT, 1997) and (FAO, 1996)

[1] The presented figures are comparable for cultivated land and forests, but are less comparable for pasture and others. As a matter of fact some countries, like Italy, consider the item "others" comprehensive of the unproductive land that some countries, like Turkey and Spain, consider as a part of the rangeland. Tunisia is a separate case due to the huge desertic surfaces making up the item "others".

[2] In the 30% covered by forest are also included 3% of surface covered by degraded forest submitted to erosion control projects, and 1% covered by grassland.

Overexploitation of the water resources has been recognised as one of the causes of desertification (Puigdefábregas, 1995). The imbalance between water supply and demand makes Spain and Italy very vulnerable to drought periods and possible climatic changes. The imbalance leads to water quality degradation. In the Saharan area of Morocco and Tunisia the extraction of water from wells for agricultural and tourism purposes in certain cases is greater than the recharge possibility of the ground water table.

The growing demand for groundwater in Spain causes salt intrusion from the sea into coastal aquifers. Out of a total of 82 coastal aquifers, 15 present a generalised salt intrusion, while 40 show partial salt intrusion. In the desertic and steppic parts of Morocco salinisation is a considerable risk. Salinisation may occur also in the areas where modern irrigated agriculture is practised. Moderate soil salinisation occurs in the coastal plain of Italy, mainly due to the capillarity rising of the salty ground water table located in clayey marine sediments, the use of brackish water for irrigation, and excessive extraction of fresh water from wells which favours the intrusion of salty water from the sea. In the coastal plains of Tunisia, where many irrigation projects have been realised, the irrigated soils being protected against periodical flooding undergo a consistent salinisation, affecting the hydro-pedological systems.

In all the countries bordering the Mediterranean there is concentration of human activities in the coastal areas as a consequence of urbanisation, industrial activities and tourism. In some cases the human activities have not been evaluated in advance according to an EIA (Environmental Impact Assessment) procedure, and even more rarely according to an SEA (Strategic Environmental Assessment) procedure, which would provide the planners with the guarantee of land sustainability.

2.3. The Impacts/Significance

Figure 3 gives a general and schematic view of the impact and significance of various factors likely to intervene in the process of resource degradation if no environmental protection measures are taken.

In addition to the direct effects of land degradation there are also indirect ones: soil erosion is accompanied by increased irregularity in the flow of rivers, leading to both water shortages and floods, and generating increased siltation phenomena which are especially serious where they reduce the life of dams. In some particularly drought prone areas, where the low mean annual rainfall is combined with strong winds, there is also the risk of wind erosion.

Soil erosion and desertification processes may generate immediate and severe consequences such as:

- decreasing soil productivity with losses of nitrogen, phosphorus and potassium;
- depopulation of rural areas;
- increasing flood risks/reduction of dam storage capacity as a consequence of siltation; and
- loss of bio-diversity.

The decrease of soil productivity is not only due to soil loss but also to the fertility depletion (loss of nutrients). As an example Merzouk (Laouina *et al.*, 1993) has reported that in the Sidi Salah catchment (Rif, Morocco) soil erosion contributes to the soil fertility decrease with a yearly loss of 41 kg/ha of nitrogen, 16 kg/ha of phosphorous and 20 kg/ha of potassium. When the soil has lost its fertility the land is abandoned; sometimes there is a recovery of soil fertility but more often there is a worsening of the situation.

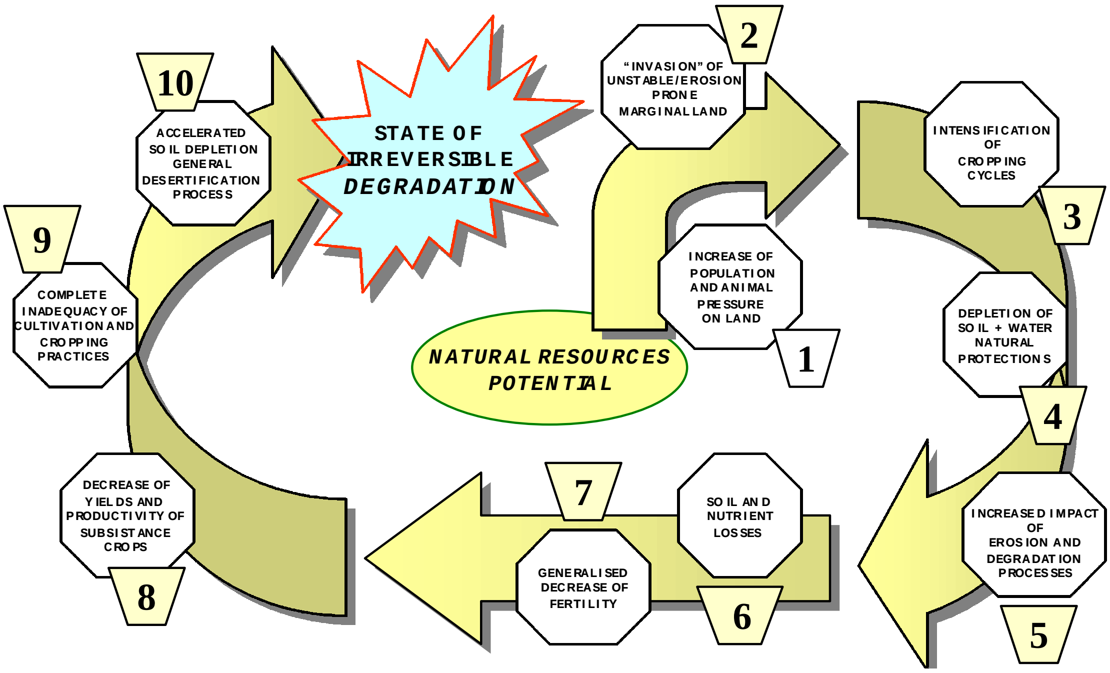


Figure 3: Resources degradation scheme – general scheme

Degradation is a self-reinforcing process: the more the land is degraded, the more intensive erosion becomes. Soils covered by forest or by rich and dense crops have a high water infiltration rate. On the contrary, soils with surface bare or partially covered by secondary shrubland or matorral allow an intense runoff. An interesting example concerning the Rif is reported by Laouina *et al.* (1993): when the original dense matorral is ploughed and cultivated to the point to deplete its soil fertility, then the land is abandoned and colonised by a clear matorral. If this clear matorral is protected it may evolve toward a dense matorral; if not protected its soil becomes highly erosion prone.

The effects of the land abandonment on soil erosion and land degradation depend very much on climatic conditions and subsequent land use. Garcia-Ruiz *et al.* (1996), for example, report a rapid recovery of vegetal cover in abandoned fields in the sub humid mountains in Aragon, Spain, provided overgrazing could be avoided. Martinez-Fernandez *et al.* (1996) report that moderate grazing on North-facing slopes has positive effects on soil protection after the land has been abandoned. In general terms, the recovery of vegetal cover protects soil against soil erosion and reduces runoff. On the contrary, in arid and semiarid areas, the water deficit and the soil crusting limit the recovery process. The slopes are left unprotected and become very susceptible to erosive rainstorms. Besides, land abandonment causes the deterioration and destruction of former soil and water conservation structures thus accelerating the erosion processes.

One of the most serious problems leading to land abandonment is land fragmentation that is a very consistent problem in most of Mediterranean countries. People leave inland regions to concentrate in coastal areas looking for better job opportunities. As a consequence, private plots not only become smaller but also scattered and more distant from each other, making farm work increasingly difficult and time costly. Furthermore, when land tenure becomes too fragmented, soil rehabilitation measures and structures meant to stabilise broader areas of a slope or a catchment lose efficiency because of their discontinuity in space, or uneven quality from one private plot to another.

A frequent off-site effect of precipitations and soil erosion is the flooding risk that can be quite high. The danger is particularly pronounced in the steppe regions where the soil surface, being compacted, produces a generalised runoff, thus generating sudden and violent floods (Hamza, 1995). The rivers being often unable to discharge the flows start to shift from one place to another eroding the banks which contributes to increase the volume of the flow and then determine an additional erosion. The consequence of this important solid charge transported by the river is the dam siltation. As an example, in Morocco a decrease of 50 Mm^3/year of water storage capacity occurs (Conseil supérieur de l'eau, 1991).

Introducing the subject of biodiversity loss related to soil erosion, it must be noted that in a majority of the Mediterranean areas, originally covered by natural vegetation, the biodiversity loss has started long time ago. Due to the conspicuous and current land use changes the loss of biodiversity is even more serious today.

Overgrazing is largely responsible for the reduction of the biodiversity. In Malta it has been reported that, due to the soil erosion occurring in the study area of Wield il-Qlejgha, most areas along the bed and sides of the valley are covered by opportunist plant species, such as *Aster squamatus* (Tanti, 1999). Sardinian pasture lands, when overgrazed, lose their biodiversity being invaded by *Cistus Monspeliensis*, which is eliminated by fire, which, in turn, speeds up the desertification. The most severe risk for the biodiversity comes from the modern farm management systems where monocultures and herbicides play a negative role. In Morocco the pistachio formations of the eastern semi-arid plateau have disappeared, as well as oleaster formations in the Atlantic plains (Laouina, 1998). The red juniper formation of the southern slopes of the Moroccan Atlas Range is in danger of disappearing. In Tunisia the surface covered by alfa (*Stipa tenacissima*) is continuously reduced. The excessive losses of soils, soil nutrients and seeds from the ecosystem are altering the regeneration capacity of the vegetation, and thus generate a process of sometimes irreversible environmental damage (Figure 3).

3. Experience in the Region

The experience relative to the management of erosion/desertification processes presented below refers to data and information provided by the six national reports prepared during the 1998/99 period. Nevertheless, with some reservations, these might be considered as instructive and illustrative for the region as a whole. For more details see Annex III.

3.1. Institutional Aspects

At the regional/sub-regional level most of the Mediterranean coastal states have had their erosion assessment and control policies implemented by authorities or institutions usually depending on the Ministries of Agriculture/Environment/Equipment or Land Planning. The following list includes some of the most representative organisations and agencies in the region:

Italy

Several Ministries have jurisdiction on aspects related to soil conservation, among them the most concerned are:

- Ministry of Environment;
- Ministry of Public Works; and
- Ministry of Agriculture, Food and Forest Resources.

The milestone of the recent Italian Soil Conservation Policy is the law n° 183 of May 18, 1989. ("*Norme per il riassetto organizzativo e funzionale della difesa del suolo*"). This law defines the planning of watershed by means of a Basin Plan and of the Basin Authority charged with planning and carrying out operations. The Basin Authority is a mixed agency constituted by State and Regions concerned, represented by interested Ministries and Regions or Provinces.

Malta

The following institutions are concerned with soil erosion and desertification:

- Environmental Protection Department;
- Agriculture Department;
- Water Services Corporation; and
- Planning Authority.

In the National legislation the most significant issues are:

- agriculture leases – act 1967;
- fertile soil preservation – act 1973 amended in 1983;
- environment protection – act 1991; and
- development planning – act 1992.

Morocco

Institutions taking care of soil conservation are:

- Ministry of Agriculture and Rural Development
- Ministry of Waters and Forests;
- Ministry of Equipment and the Ministry of Interior; and
- Ministry of Land-use Planning, Urbanism, Habitats and the Environment.

The following are important National Plans dealing with soil erosion and desertification:

- National Plan to Fight Desertification;
- National Watershed Management Plan;
- National Forests Programme; and
- Model Law on Development and Protection of Mountainous Areas.

Spain

The most significant institutions are:

- General Directorate for Nature Conservation (DGCONA) which has launched the LUCDEME (Lucha contra la Desertificación en el Mediterraneo) project that, having started in 1981, pioneered desertification control in the Mediterranean. DGCONA has also promoted the National Plan for Hydrological Forest Restoration and Erosion Control (Rojo, 1998);
- Ministry of Environment with the National Water Resources Plan; and
- Inter-ministerial Commission for Science and Technology which is responsible for the National Plan for Scientific Research and Technological Development (National R+D Plan).

Tunisia

Main institutions are:

- Ministry of Environment and Land Planning; and
- Ministry of Agriculture with two General Directorates (General Directorate of Forests, General Directorate of Soils).

In South Tunisia there is the Arid Zone Institute (IRA), depending on the Ministry of Agriculture, specialised in research targeted to combat and mitigate drought and desertification. The research activities of IRA are described by Akrimi (1998).

Turkey

Numerous Turkish institutions have responsibility for problems relevant to soil erosion and desertification:

- General Directorate of Rural Services;
- General Directorate of Erosion Control and Afforestation;
- General Directorate of Government Hydraulic Works;
- Ministry of Agriculture and Rural Affairs;
- Ministry of Environment; and
- State Planning Organisation.

3.2. Problems

In the Region as a whole there has always been a general consensus amongst bio-physicists on the fact that mapping and periodic monitoring of erosion processes constitute the basis for formulating and implementing sound degradation control management plans for a sustained use of Mediterranean land resources. A great amount of erosion mapping methodologies have been experimented so far to assess soil erosion and desertification processes in the Mediterranean environment. A complete review of the methods and cartography has been prepared by Giordano and Marchisio in 1991. More than ten years ago the very first global attempts to provide practical solutions at the Mediterranean regional scale have been made. Land cover was mapped at an original scale of 1:100,000 by visual interpretation of Earth Observation Satellite Images in the context of the European Commission's "CORINE Programme" (Co-ordination of Information on the Environment). However, the method was to some extent analyst-dependent. Additionally, "CORINE" did not provide very specific information on soil erosion processes, which are extremely important for overall land degradation monitoring.

Also, at the regional level there has always been a lack of soil surveys at suitable scales. The EC Commission was aware of this problem, and in the 4th Environmental Action Programme (1987-1992) recognised for the first time the need for a global approach to soil protection. Mapping efforts were being supported under the CORINE Programme. Thus the EC Soil Map of Europe at 1:1,000,000 scale has been digitised, and soil erosion risks have been assessed and mapped at the same scale across the Mediterranean region of the Community.

The CORINE map must be considered as a first important step towards erosion assessment at the regional level but, similar to the European Commission soil map itself, it mainly provides a general view of land degradation problems, indicating the prevailing environmental background and soil types or broad erosion risk classes but not the existing erosion hazards.

With regard to the above, the Mediterranean coastal states, in their role of Contracting Parties to the Barcelona Convention and participants in the Mediterranean Action Plan, entrusted the Priority Actions Programme of MAP with the implementation of a priority action dedicated to "*Soil Protection as an Essential Component of the Protection of the Mediterranean Environment*". After several years of implementation (1984-1988), that action was focused on rainfall-induced erosion processes. The fact-finding phase indicated that, unfortunately, the erosion control activities were based on a number of different mapping and measurement methodologies, most of which incompatible with the others. Therefore, the co-operative PAP-FAO-DGCONA project was formulated and implemented with the participation of Spain, Tunisia and Turkey. The mapping component was implemented in the 1990-1994 period, with some additional mapping performed in 1995. The measurement component was implemented in the 1993-1995 period. The main outputs of the project were 3 national reports and the 2nd part of the 1997 Guidelines.

An overall regional and/or sub-regional degradation assessment indicates that the southern and eastern margins of the Mediterranean are most affected by soil erosion processes:

- In the Moroccan Rif Range, 2,650,000 ha (6% of the country's arable land) undergo an extreme degradation due to soil erosion by water and to mass movements. In the Atlas Range 5,440,000 ha (12% of arable land) suffer strong degradation, and 7,115,000 (15%) moderate degradation. The Pre-Rif and Atlantic coast sub-regions (4,056,000 ha, 9%) show lighter forms of soil degradation. In the undulating plains bordering the western side of the Atlas, soil erosion is usually associated with salinisation risk (5,205,000 ha corresponding to close to 12%). The Saharan areas extend over more than 7,380,000 ha (16%).
- In Italy, water-induced erosion affects 28% of the territory, of which 20% are affected by mass movements, and 25% show physical degradation such as compaction and physical depletion. In the Po Valley, besides a moderate physical degradation, there is also some chemical degradation. Sicily suffers from an almost permanent but rather light wind erosion.
- The Malta National Report indicates severe to moderate erosion on most of its arable land having as determinant negative consequence the disruption of the terracing stone walls.
- In Tunisia there is a rather balanced state between land affected by water-induced erosion (37%) and areas stricken by wind erosion (35%). In many cases both of them are associated.
- In Turkey, strong to extreme rainfall-induced soil erosion affects the whole country. In addition, 22% of the territory show a moderate chemical degradation, while mass movements appear on 2.2%, and salinisation on 1.8% of the land. Half of the Turkish European territory has physical degradation (water logging and soil compaction); the other half presents water-induced erosion and chemical degradation.

4. Erosion Mapping and Measurement Guidelines (1997)

The joint PAP/RAC and FAO action concerning the soil protection (1989-1994) was dedicated to problems of and practices related to mapping and measurement of erosion processes in Mediterranean coastal areas. Case studies, reports and comparative analyses were prepared and presented in several workshops and seminars (PAP/RAC, 1988; PAP/RAC, 1989; PAP/RAC, 1992; PAP/RAC, 1996; PAP/RAC, 1997b). Practical mapping and measurements were implemented in Spain (in Adra and Valcebre areas), Tunisia (Oued Ermel, El Khairat), and Turkey (Essen, Caybogazi). The results of mapping and measurement exercises were presented by national teams in respective national reports.

The mapping process consists of three phases:

- <u>predictive mapping</u>, by identifying, assessing and integrating all basic parameters, such as hypsography (slopes), lithology and/or soils, land, vegetation cover, in view of determining preliminary assumptions on erosion risks (erodibility–potential erosion);
- <u>descriptive mapping</u>, when describing and assessing qualitatively current on-site and active erosion processes. This systematic mapping of qualitative and dynamic erosion features identifies two broad categories of geographic environments: geomorphologically stable, non-erosion-affected areas on the one hand, and unbalanced, erosion-affected areas on the other;

- <u>the consolidation and integration phase</u> which provides the final cartographic product identifying and assessing both the erosion potential (erosion status) and current erosion process, intensities and trends.

The process is described in detail, and maps relevant to each step are included (see Annex IV).

The 1997 Guidelines also contain a glossary of technical terms, and reference bibliography. Due to the importance of erosion control programmes for ICAM in the region, and to the need to adequately interpret the erosion-related results obtained, a special chapter is dedicated to the role of mapping and measurement of erosion processes within the ICAM process.

The methodology has been tested successfully under different sub-regional and national conditions. The prerequisites of its application can be met without special efforts in almost all of the Mediterranean countries. However, in any particular case, need may arise for consultation and/or initial training, in which case FAO AGL, DGCONA, or PAP/RAC may be contacted.

Compared to traditional mapping systems, such an output shows great advantages for erosion control processes and ICAM, while the funds and time required for the mapping exercise do not differ from those required by traditional methods.

5. Erosion and Desertification Interface

Recurrent and/or increasing soil erosion should be considered as a symptom, indicator and evident risk of the initiation of a desertification process, which is already known to be taking place in the Mediterranean Basin. As a consequence of permanent and excessive pressure on resources exploitation, the degradation phenomena can shift from recurrent but still reversible erosion processes, to a progressively uncontrolled desertification trend (see Figures 3 and 4).

As already emphasised in the Part I, the Mediterranean biome is recognised as a rather fragile transition zone, and is geographically best defined in Spain, the southern part of Italy, the Balkans, Asia Minor coastline, Near and Middle East, and the broad Maghreb region. Its most relevant bio-climatic feature is the critical summer period when a strong and sometimes prolonged precipitation deficit jeopardises the already fragile natural balance in terms of protective vegetation cover and biomass reserves. In this precarious context any other extra adverse event happening, such as lasting droughts, bush fires, exceptional overgrazing or deforestation, might locally generate some irreversible situation thus initiating the expansion of a degradation/desertification “hot spot”.

These “accidents” are likely to occur in very diversified landscape units (upstream watersheds affected by bush fires, access and surroundings of water ponds destroyed by cattle trampling, intensely cultivated sloping land, etc.). This will happen each time there are not enough regenerating resources and capability to revert the degradation process and restore the original equilibrium; the lack of regenerating resources is a direct consequence of plant cover degradation and deforestation. The problems arise when man alters a stable environment by a permanent overexploitation of land and water resources. When this happens in areas with lower rainfall rates, like the southern semi-arid Mediterranean region, the reduction of natural vegetation density in coincidence with the introduction of more animals, generates conditions very likely to lead to accelerated soil erosion, and further to incipient desertification.

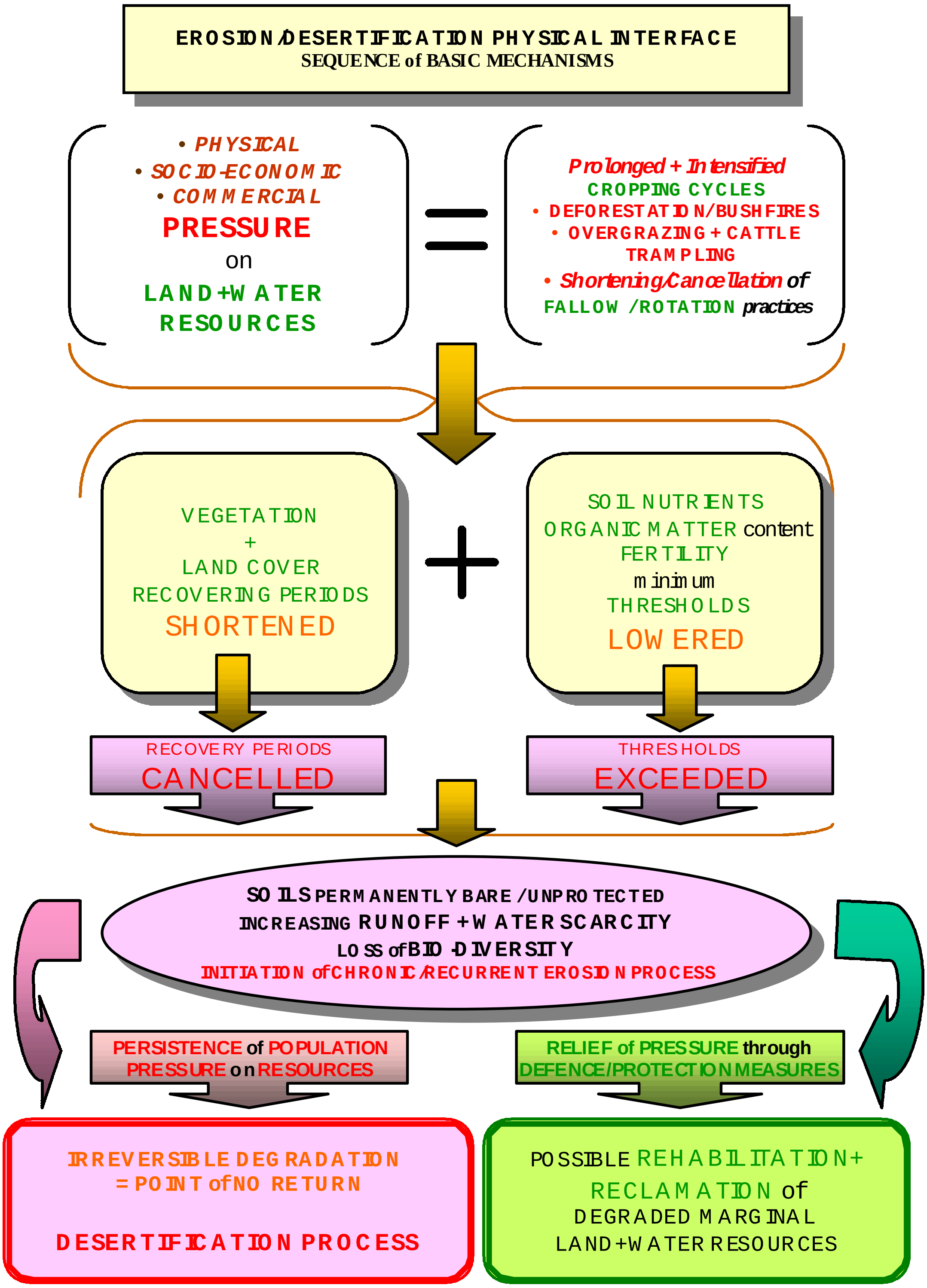


Figure 4: Erosion/desertification physical interface – sequence of basic mechanisms

Amongst human activities inducing most of degradation processes, overgrazing and the abusive consumption of trees and brushwood for fuel leading progressively to deforestation, are two of the main causes of desertification in the North African margins of the Mediterranean region. Generally speaking, the degradation of the vegetation cover aggravates the effects of droughts and dry season, and leaves the soil unprotected against other erosive processes which, in turn, destroy the soil structure and make it desertification prone.

Other forms of improper land-use and land management, such as inadequate cultivation practices, ill-adapted mechanisation and equipment, have very negative impacts on the biological features of soils. The most evident of these impacts are the reduction of soil organic matter and nutrient reserves as a consequence of the general shortage of vegetation, crop residues and/or animal manure not being returned to the soil; the fertility declines and soils become sensitive to desertification processes.

Desertification *per se* can be understood as a global degradation trend resulting from the interaction and the cumulative negative impact of various more specific erosion processes. Amongst these desertification generating mechanisms, the most active ones are identified as follows:

- runoff, surface water-induced erosion;
- physical soil degradation, such as mechanical compaction, crusting and sealing;
- wind erosion affecting mainly coastal areas and semi-desertic marginal land; and
- various types of pollution and contamination.

The main characteristics of the above activities are as follows:

1. Surface/runoff water-induced erosion is certainly one of the most visible and impacting forms of land degradation. Rainfall-induced erosion in densely occupied landscapes is more likely to occur on arable land as the soil remains unprotected by vegetation cover during certain periods of the year which usually coincide with intense rainfalls. Once the process of water erosion has started, runoff increases causing soil losses on one side and excessive sedimentation and silting one the other.
2. Physical soil degradation, such as crusting and compaction, favours the concentration of rainfall and runoff thus generating and increasing water-induced erosion. Moreover, these processes have been recognised as determinant desertification factors mainly because of their destructive effect on soil structure and aggregates. Cultivated soils can become compacted either through mechanical (heavy agricultural machines and equipment) or animal (trampling) actions. Soil crusting and compaction also decrease the infiltration of water, prevent or inhibit plant growth, and leave the soil surface bare and exposed to other forms of degradation.
3. Wind erosion occurs most frequently in the driest areas of the Mediterranean environment. It usually starts in flat and open coastal land, with up to 700-800 mm of average annual rainfall. Aeolian deflation is particularly active in areas where dryland agriculture is being practised with scarce or no vegetation cover, and where light-textured and destructured soils can easily be removed. The removal of the soil surface layers means a considerable loss of soil nutrients since they normally concentrate in the soils upper agric horizons. As far as shifting sands are concerned, the burying effects can affect both infrastructure (roads, irrigation systems) and arable land, thus triggering the desertification procedure.
4. Pollution and contamination problems may arise as consequence of excessive use of fertilisers, herbicides and insecticides or the release of airborne pollutants. The direct consequence is always a reduction of soil cover and a destruction of aggregates in the surface layers, again generating desertification prone conditions.

Desertification indicators and symptoms are well known and can actually be identified amongst the various erosion/degradation processes as listed and defined in most of erosion mapping methodologies and legends. Any of these processes can become “desertification sensitive” by increasing its intensity/frequency, and expanding in space. Within one same and rather homogeneous ecosystem, the interface between erosion and physical desertification mechanisms is obvious, and any remedial measure taken against erosion is one more tool to combat desertification.

The consolidated erosion mapping methodology, as proposed by UNEP/FAO/DGCONA in the 1997 Guidelines, as well as the management procedures recommended by the present Guidelines, can therefore be considered as basic contributory tools, not only for the diagnosis/assessment of erosion mechanisms, but also for the formulation, implementation and planning of physical degradation/desertification control management modalities. The referred to approach, as a new inventory and surveying methodology, might be a direct and concrete answer to the concerns, needs and priorities as identified by UNEP within the framework of the recently implemented United Nations Convention to Combat Desertification (CCD) (see Box 1).

6. Justification for the Guidelines

With regard to the growing impact of erosion processes and the risk of desertification, as well as the present experience and knowledge in the field of natural resources depletion, creating and developing new tools to combat erosion and land degradation as a whole becomes an obvious priority in the region. When developing appropriate site-specific erosion control strategies, to address physical processes only would be a partial solution. The physical context in which soil erosion and land degradation processes take place interacts with contexts related to other factors, such as socio-economic and environmental ones:

Box 1

The United Nations Convention to Combat Desertification (UNCCD)

The international community has long recognized that desertification is a major economic, social, and environmental problem of concern to many countries in all regions of the world. In 1977, the United Nations Conference on Desertification (UNCOD) adopted a Plan of Action to Combat Desertification (PACD). Unfortunately, despite this and other efforts, the United Nations Environment Programme (UNEP) concluded in 1991 that the problem of land degradation in arid, semi-arid, and dry sub-humid areas had intensified, although there were "local examples of success".

As a result, the question of how to tackle desertification was still a major concern for the 1992 United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro. The Conference supported a new, integrated approach to the problem emphasizing action to promote sustainable development at the community level. It also called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee to prepare, by June 1994, a Convention to Combat Desertification in those countries experiencing serious drought and/or desertification, particularly in Africa. In December 1992, the General Assembly agreed by adopting Resolution 47/188.

Working to a tight schedule, the Committee completed its negotiations in five sessions. The Convention was adopted in Paris on 17 June 1994 and opened for signature there on 14-15 October 1994. It entered into force on 26 December 1996, 90 days after the 50th ratification was received. Over 170 countries are now Parties. The Conference of the Parties, which is the Convention's supreme body, held its first session in October 1997 in Rome, Italy; the second in December 1998 in Dakar, Senegal; the third in November 1999 in Recife, Brazil. The fourth will take place in December 2000 in Bonn, Germany.

- In most Mediterranean countries there is an explicit need for upgrading of existing capacities, training of professionals and exchange of experience. The use of different mutually uncoordinated approaches in various countries, changing intensity and efficiency of control and remedial measures, as well as lack of experience in some countries call for assistance and provision of clear and applicable methodological and guiding instructions.
- The FAO-PAP/RAC-DGCONA experience and pilot projects resulted in accumulated knowledge, establishment of a competent network of institutions, experts and professionals, capable of providing further assistance and contribution. Guidelines for erosion mapping and measurement (1997) presented a consolidated and standardised mapping methodology, which has proved to be handy, cost effective and of high potential for assessment of erosion processes and trends, and for the identification of priority areas for control and application of remedial measures.
- The preparation of a second set of guidelines to deal with erosion and desertification control management process, integrated with the resource and socio-economic assessments, as well as with their implementation and monitoring, not only covers the remaining part of the control management modalities but also means capitalisation of former experiences and efforts.
- According to analyses made, reference bibliography indicates the absence of a practical standardised regional document providing guidance and examples. This confirms the need for the preparation of new guidelines introducing: a) methodologies for practical site-specific solutions; b) instructions for formulation and implementation of control management measures; and c) proposals for the formulation of large rehabilitation projects, also eligible for international funding, if needed and as appropriate.
- Bearing in mind the above, the preparation of such guidelines will contribute to the upgrading of both national and regional capacities for land degradation and erosion control management, and for the assessment of physical desertification symptoms and/or indicators. The organisation of workshops to present and discuss the Guidelines, the dissemination of the new Guidelines, and the formulation of a larger follow-up regional programme will provide complementary support.

Part III:
Prerequisites for Implementation of Control Management Programmes

The success of erosion and desertification control programmes depends on favourable framework conditions. These framework conditions comprise appropriate organisational, institutional, legal and political structures and processes as basis for programme planning and implementation. The management efficiency of the institutions involved is crucial in this respect. If the framework conditions are found to be insufficient, appropriate steps, such as capacity building efforts, have to be initiated in order to ensure sustainable programme implementation.

1. Data and Information Management

1.1. Data and Information Management as the Starting Point

The very first step of any surveying exercise requests a basic and updated inventory of relevant data and their processing. It concerns statistical data, cartographic and other geo-referenced data. The surveying team has to be provided with all available data, systematised so as to enable their correct and easy use. Therefore, the establishment of such a management system has to be understood as the very first prerequisite. The basic elements of the system are infrastructure, equipment and personnel. The system has to be designed and calibrated according to the technical requirements of the programme, and in particular regarding the time scale and level of accuracy. The basic principles of such a design for erosion/desertification control management are presented in the section 1.2 below, while details about tools are presented in Annex II.

1.2. Basic Principles

The availability of appropriately comprehensive, reliable data represents a prerequisite for successful implementation of erosion and desertification control programmes. However, data collection is not an end in itself but has to be designed to efficiently support decision-making, planning, implementation and evaluation of projects and programmes. Remote sensing and geographic information systems provide excellent tools for acquisition, processing and analysis of spatial and attribute data. In order to build an effective information system for erosion and desertification control, the available technology has to be adapted to the user requirements that should be explicitly defined in advance and that should aim for promotion of integrated solutions.

All necessary baseline information, that is needed to analyse and understand relationships between the key factors of erosion control management in order to identify and prioritise control management issues properly, should be included in the database. It should contain data on the problems and causes of erosion, as well as on biophysical, institutional and organisational characteristics of the area of interest. The relevant baseline data set can be grouped as being concerned with (FAO, 1998a modified):

- *biophysical characteristics of the area* that include, for instance, land cover (e.g. vertical and horizontal arrangements of plants, cover density, indicator species, cultivated areas, built-up areas, waterbodies, etc.), geomorphology (landform and nature of materials), climate (e.g. rainfall intensity and duration, wind velocity and direction), soils (e.g. soil loss and runoff measurements), hydrography (e.g. watershed delineation, data from stream gauging stations, reservoir profile surveys);

- *social issues and related economic linkages* that include human activities in terms of population (e.g. demography, occupation), infrastructure, historic and current land-use types (e.g. urban areas, industrial areas, mining, fisheries, forestry and agriculture), management types, land and sea tenure, actual or potential competition for resources, resource dependency, and relevant economic linkages (e.g. household income); and
- *the institutional characteristics and legal framework* that should address the components of the institutional structure and their mandates (e.g. line ministries, provincial and local administrations, statutory bodies, community organisations and non-governmental organisations), the financial and human resources of the relevant institutional bodies, legislation and regulations with their level of enforcement, management and development policies related to erosion control and desertification.

In data collection, there should be a balance between subjective sources of information (e.g. stakeholders' perceptions) and objective sources (e.g. primary and secondary data). Furthermore, data are always collected to meet a certain objective. Box 2 presents the justification and basic rules of data collection. Co-ordination between the different entities involved in data collection, compilation and data quality control will allow the location of different data sources, joining of forces to harmonise and standardise data formats and quality standards, thereby avoiding costly duplication of data and information management efforts.

Acquiring specific erosion, sediment and desertification related data is a crucial task for planning and implementation of erosion and desertification control programmes. Data have to be complete and sufficiently reliable. If data accuracy is not ensured, provisional data have to be further examined and screened for reliability. Comprehensive data are very important when off-site benefits are to be evaluated. Without them the overall impact of the programme will not be known.

The usual sources for acquiring such erosion and desertification data include the following:

- stream gauging stations and climatic stations of the same watershed;
- reservoir profile surveys downstream;
- specially established soil loss and runoff plots in the area;
- erosion observations and surveys in the field; and
- research results of agricultural experimental stations.

Box 2
Collecting data and information

Some basic principles:

- Data and information collection should be objective-oriented and meet users' demands.
- Data and information should be geared to gaining an understanding of how the land/land use ecosystem functions. Which are the processes involved, how do land properties affect land use, and what is the impact of changes in land use on the land resource?
- Data and information collection should be efficient, focusing on minimum data sets, and flexible, to allow collection of any additional data, which may be relevant.
- Physical data is needed in a spatial format, as maps or geo-referenced observations. The spatial variation in land resources is the main justification for land use planning.
- Data and information collection should be part of a continuous process. Rather than being seen as a one-time exercise needed to produce a rigid land-use plan, the initial data set should be used to formulate a flexible, rolling land-use plan, which can later be modified in light of future information, or according to changing circumstances.

(FAO/GTZ/UNEP, 1999)

Baseline data sets for erosion control management programmes and projects are:

- environmental data:
    - topography;
    - geology (including structure, stratigraphy, lithology);
    - landform;
    - hydrology and hydrography (including irrigation schemes and practices);
    - land cover;
    - land-use; and
    - soils.
- surface water data:
    - runoff distribution, reservoir capacities, inflow and outflow data;
    - sediment data;
    - return flows, section gain or loss; and
    - flood peaks, low flows, drought flows.
- climate data:
    - precipitation;
    - temperature;
    - evapotranspiration; and
    - wind velocities, directions and intensities.
- socio-economic data:
    - population density (human and animal populations);
    - social groups;
    - administrative and land property structures;
    - land tenure, agricultural structures and systems; and
    - economic data (agricultural input costs, agricultural product sale prices, transport costs, etc.).

All the data should be carefully collected, analysed, kept and compared over time to get meaningful results. The data collection should place emphasis on:

- site specific data needed for the design of the erosion and desertification control scheme; and
- continuation of the collection of data of broader nature needed to fill major information gaps in the general erosion and desertification assessment.

Data collection should not be considered as an end in itself but as means to efficiently implement erosion and desertification control projects and programmes. Therefore the following steps should be carefully considered:

1. Appraisal of the usefulness of available data;
2. Assessment of additional data required for achieving the objective;
3. Selection of methods, standards and schedules for acquiring additional data;
4. Organisation of acquisition of additional data and implementation of data collection;
5. Organisation and examination of data for efficient analysis of erosion and desertification processes;
6. Utilisation of the results for project implementation; and
7. Evaluation of data utilisation in project implementation and preparation of comprehensive long-term plans for integrated erosion and desertification control.

Some of these steps are further elaborated in the Annex II. An example of a framework for data collection and analysis is provided in Box 3.

2. Institutional and Organisational Aspects

Organisational aspects comprise the functional creation of both structure and processes, as well as formation of groups for representation of common interests and achievement of common goals, whereas the institutional aspects concentrate on the sustainable manifestation of structure and processes in order to ensure regular and objective responses to problems such as depletion of natural resources, erosion and desertification. The legal and political situation within a society has a major influence on the organisational and institutional aspects.

One key constraint for achieving successful erosion and desertification control is the lack of appropriate organisational and institutional arrangements. Diversification and complexity of the subject require a high level of integration within and among institutional structures. Existing institutional arrangements should be kept and appropriately strengthened. A high level of horizontal integration is particularly necessary among sectoral institutions at the planning stage, and a high level of vertical integration is necessary within institutions at the implementation stage (UNEP, 1995) of erosion and desertification control programmes.

Box 3
Framework for data collection and analyses

World Overview of Conservation Approaches and Technologies (WOCAT)

WOCAT is a comprehensive inventory of conservation approaches and technologies, accepted as a global programme by the 9th International Soil Conservation Organisation Conference in 1996. Its goal is to contribute to the sustainable use of soil and water through collection, analysis, presentation and dissemination of soil and water conservation technologies and applications world-wide.

The collaborating institutes of WOCAT have developed a methodology for collecting and storing information in accessible form about land management to counter degradation in a sustainable manner. This data includes mapping at country scale, geo-referencing land use technologies and describing the institutional support which is behind the spread of those technologies.

The exercise is not only useful to catalogue success stories in rural development and analyse the elements of success or constraints to further improvement, but also to give an overall evaluation of a country's soil and water conservation programme with current social and economic impacts. Highlights can be shared with global partners.

Guidelines are constantly being updated to assist in training of the technicians and decision-makers involved in WOCAT procedures.

Questionnaire on Maps **(QM)** records information on land use, degradation status and severity, area-based achievements in soil and water conservation and productivity. These are recorded on Soil and Terrain database units which are non-scale dependent, for insertion in a GIS as well as cross-linked to the QA and QT databases.

Questionnaire on Technologies **(QT)** gathers information on 4 categories of technologies (agronomic; vegetative; structural; management), their design, natural and human environment; land use and supporting technologies; analysis of the technology in strengths, weaknesses, cost and spontaneous adoption outside the demonstration area.

Questionnaire on Approaches **(QA)** records how the implementation was achieved, including area information, specific description, objectives, operations involved, funding. The analyses include methods for monitoring and evaluation, impact, documentation and overall conclusions. Internet: *www.wocat.org*

(World Association of Soil and Water Conservation, 1998)

2.1. Organisational aspects

The organisational context is crucial for the success of any national erosion and desertification control programme. The following organisational aspects are involved:

- adequate co-ordination mechanisms which ensure that management of erosion and desertification control is not isolated from agricultural development;
- availability of appropriate funds, vehicles and other equipment necessary to implement the programme;
- adequate capacities in planning, field supervision and extension;
- experienced, well-trained staff to implement the programme; and
- an institutional set-up, appropriate for the given task.

2.2. Institutional Aspects

As a principle, it should always be referred to the existing institutional structures. There are different institutional set-ups possible for erosion and desertification control management. Firstly, the responsibilities of long-established forest or agriculture departments are expanded to include an erosion and desertification control management section. Secondly, separate newly created organisations are responsible for the implementation of erosion and desertification control programmes. No matter which option is chosen, most crucial is the management efficiency of the respective organisation and its capability to carry out the necessary tasks (FAO, 1989).

Erosion and desertification control programmes demand a number of interventions to strengthen the performance of the institutional support services. Key institutional elements at national level are:

- Promotion of a sound institutional base for planning of national erosion and desertification control. Partnerships between different organisations concerned have to be developed and the role of NGO's in the process is to be recognised and promoted. Also, the participation of groups of land users in community-level operational planning, implementation and review of erosion and desertification control plans and activities has to be encouraged (see Part III, Chapter 3).
- Formulation and implementation of a demand driven national programme for erosion and desertification control. There are two different forces for determination of demand: national priorities ("top-down") and locally expressed needs ("bottom-up").
- Stimulation and support of bottom-up demand, especially by assisting the formation and operation of people-led organisations and initiatives (see Part II, chapters 3 and 4).
- Establishment of erosion and desertification control committees at different institutional levels.
- Nomination of a task force organisation primarily responsible for the successful implementation and co-ordination of erosion and desertification control programmes.
- Establishment of a national information system for erosion and desertification control management (see Annex II).
- Development of sustainable mechanisms for generating the funds required (see Chapter 5).
- Development of integrated extension programmes based on a competent and capable extension support service together with comprehensive training programmes for both basic extension staff and local land users. National strategic information, education and communication campaigns may play a fostering role in the extension efforts.
- Promotion of people-centred learning and research such as participatory technology development (see Part III, Chapter 4).

2.3. Legal Aspects

Clearly defined national policies on land use and soil and water conservation are a precondition for successful management of erosion and desertification control programmes. However, existing policies may not be closely or consistently followed. Legislation which lacks consistency or firm support may prove useless. Legislation has limited value unless the resources and manpower to enforce it are available.

Therefore, a brief statement of policy and intent (e.g. on the basis of the World Soil Charter, see Box 4, or Agenda 21, or CCD) may be sufficient at the start of a programme. Later, when experience has been accumulated and serious bottlenecks have been eliminated, enactment of appropriate legislation will really help the programme. It is not recommendable to put too much emphasis on early legislation, neglecting the need for prior field experience. With further experience this premature legislation may prove impractical (FAO, 1989). The following issues may play a major role in setting the legal framework:

- Regulation of land use within watershed areas on the basis of land suitability and soil erosion risk assessment, such as definition of areas for permanent agricultural use or delineation of the permanent forest areas. This should be achieved by legally defined land-use planning procedures.
- Granting of legal land user rights and responsibilities for specific areas in order to resolve the problems of using common property above its carrying capacity ("tragedy of the commons").
- Pricing of land and water resources which considers the full cost of protection of the respective resources.
- Restriction of direct incentives to cases where there is no other alternative. The consequences of cash payments, food for work, free inputs, and other direct incentives have to be assessed before their application in order to avoid negative side effects.

Box 4
World Soil Charter

Principles

1. Using resources should not cause their degradation.
2. Promote optimal land use to preserve resources as a high priority.
3. Partial or total loss of productivity from soil degradation is a threat to food security, as well as needs for fuelwood and fibres.
4. Soil degradation directly affects yields and water regimes, as well as causing downstream effects and damage.
5. Governments should ensure that stakeholders utilise land in the most rational way.
6. Appropriate incentives at farm level, and a sound technical, institutional and legal framework are vital to good land use.
7. Assistance to land users should be practical and encouraging to good land husbandry.
8. Negotiation should take place on land tenure with owners, tenants and land users to ensure this issue does not become an obstacle to sound management.
9. Education of land users and the public should highlight the need and means of improving soil productivity and conservation.
10. An assessment of a country's land resources should precede any proposed changes.
11. Good quality soils with a wide potential range of uses should be kept in a flexible form of use for a variety of future uses.
12. Land use management decisions should favour the long term advantage rather than the short term expedient.
13. Land conservation measures should be included in land development at the planning stage and costs included in the development planning budgets.

Based on the European Soil Charter adopted by Council of Europe 30 May 1972 (FAO, 1982)

2.4. Political Aspects

Political instability, frequent change in government and drastic reorganisation can create a feeling of insecurity and discouragement amongst government staff, and disrupt also erosion and desertification control programmes. Soil conservation programmes, because of their essentially long-term nature, are particularly sensitive to the disruption which these changes cause. Fluctuation in government support to conservation programmes may occur even in the absence of major government changes. However, negative effects on long-term programme planning have to be avoided or compensated. The situation can be improved by the activities of NGO's, such as soil conservation societies, and various interest groups. Public educational campaigns and the influence of the media may also help (see Part III, Chapter 3). Finally, whenever possible and as appropriate, programme proponents should strive at a political consensus about its approval.

3. Capacity Building

In the context of erosion and desertification control programmes the term capacity can be broadly defined as the ability of a country or a society to identify and solve erosion and desertification related problems. Capacity building is then the process by which this ability is developed. This process is "*determined to a large extent by the capacity of its people and its institutions as well as by its ecological and geographical conditions*" (Agenda 21, Chapter 37). Specifically, capacity building depends on organisational and institutional capabilities (see Part III, Chapter 2), as well as technological, scientific and human resources. People's participation and conflict resolution mechanisms play a key role in the capacity building process because of the complex human learning processes taking place, and its stimulating effects on institutional and social development (see Chapter 4).

3.1. Response to Capacity Building

Capacity building processes may be analysed by the application of a system approach which places emphasis on the different factors involved. Usually the perception of erosion and desertification problems leads actors to develop and implement strategies (typically against opposing target groups) under certain conditions. The outcome is then influenced mainly by the following factors (Jänicke and Weidner, 1997):

- a) actors;
- b) strategies;
- c) structural framework conditions;
- d) specific context of a single situation; and
- e) problems.

Both the structure of problems and the capacity to respond to them are strongly influenced by economic performance (Jänicke and Weidner, 1997).

a) Actors can be broadly classified into promoting or opposing ones, such as:
   - Governmental organisations and institutions, i.e. government ministries, state administration, state-owned extension services, etc.
   - Non-governmental organisations and institutions, i.e. NGO's, media, private extension services, private companies, etc.

   There are often coalitions of relevant outstanding personalities across organisations and institutions. These informal networks may have a strong influence on successful programme implementation.

b) A strategy is the general approach to a problem by the purposeful use of instruments, capacities and related opportunities to achieve long-term goals.

Strategies may be top-down or bottom-up-oriented, as well as sector-oriented or integrated. Successful erosion and desertification control management depends highly on appropriate strategies in order to compensate the generally weak promoting actors. In this context the intelligent use of time for the right timing of interventions is very important.

c) Structural framework conditions consist of several linked factors:
   - Knowledge as basis for problem perception, public awareness and subsequent policy generation.
   - Organisational, institutional and legal structures for institutionalisation and internalisation of rules and standards for effective erosion and desertification control management. Participation plays a key role in this respect.

d) The specific context of a single situation describes the variable short-term conditions of action such as urgent problems (land slides, draughts, etc.) which, for instant, cause direct public pressure. Also, the discovery of win-win situations may stimulate situation-specific changes.

e) The character of the problem influences considerably the capacity building process. The fact that erosion and desertification are causing direct impacts and are perceived as urgent problems will be decisive for the felt need to take actions and solve problems after their identification.

Capacity building efforts are needed at three different levels to enable taking specific responsibilities in the promotion of erosion and desertification control programmes at national, sub-national and local levels. It has to be ensured that all authorities, institutions and organisations involved integrate their activities within appropriate co-ordinating mechanisms in order to give consistent signals for the management of erosion and desertification control.

3.2. Capacity Building at National Level

Capacity building at national level has to build upon the existing institutional structures. It might be mainly concerned with development and promotion of institutions and organisations which deal with policy creation and legislation. The establishment of a multidisciplinary interdepartmental (inter-ministerial) committee for erosion and desertification control management and exchange of related expertise should be considered, preferably under the overall guidance of the Ministry of Agriculture at the ministerial level. The committee should consist of the major ministries concerned, such as Ministries of Agriculture, Environment, Forestry, Water Resources, and others, as appropriate. A comprehensive national planning is needed to inform sub-national and local authorities of the intentions of national development policies, and especially of the erosion and desertification control policies to be enforced. The implications of the usage of incentives and disincentives have to be considered carefully (see Part III Chapter 4), as in some cases those might be counterproductive.

3.3. Capacity Building at Sub-National Level

At the sub-national level, depending on the existence and power of sub-national authorities, more detailed integrated planning and management are required within the responsibilities of the respective authorities. The consistency with the activities at the local level and the compliance with the national planning and policies have to be ensured. Thus, capacity building at the sub-national level provides the link for the two-way feedback process between national and local level activities. The effectiveness of erosion and desertification control programmes depends largely on the quality of the sub-national agencies which support local level activities (FAO, 1989).

Related government agencies are often liable to be understaffed, poorly equipped or immobilised by lack of transport means and insufficient infrastructure. Under these circumstances it will be difficult to win the trust and support of the land users. The situation can be worsened when extension officers are charged with several duties of which conservation is only one and not necessarily seen to be the most important. Thus, to be effective in conservation, it is obligatory that extension staff receive additional training and resources for successful implementation of erosion and desertification control programmes.

Capacity building is a continuous process. But, in individual erosion and desertification control programmes, an implementation cycle with three stages can usually be recognised (FAO, 1989). The stages (which may overlap) are as follows:

a) Motivation stage: using normal mass education techniques to generate land users' awareness and interest in conservation issues, and to promote participation in the programme.

b) Technical assistance stage: actual planning, design, layout and installation of conservation measures. This is normally undertaken jointly by soil conservation and extension agencies in co-operation with the target groups.

c) Follow-up stage: assistance to selected target groups by the extension agency in obtaining loans for farming inputs and in marketing their produce; and by the responsible government institutions in the maintenance of conservation structures and practices.

Obviously the responsible government agencies (especially the extension services) have a very important role to play in the overall erosion and desertification control programme. Many programmes may fail because of poor extension work due to lack of motivation and/or lack of follow-up which led to poor maintenance.

3.4. Capacity Building at Local Level

Detailed planning, development and implementation take place at the local level. A necessary precondition for sustainable adoption of solutions is that the changes must be profitable and provide tangible benefits to the land users. Mechanisms need to be developed to influence the behaviour of land users in such a way as to motivate them to adopt the desired measures. In this respect, "*incentives and disincentives are policy instruments that change the comparative advantage of an economic activity and, thus, stimulate or deter specific behaviour*" (Sanders *et al.*, 1999). In order to guarantee sustainability of interventions, a long-term perspective with regard to utility optimisation (and not profit maximisation) has to be applied. Direct incentives, such as subsidies, should be broadly avoided.

However, a distinction should be made between areas where one local government authority or community can effectively manage the local erosion and desertification control activities and those areas where several local governments or communities need to co-operate for execution of activities. Conservation efforts at local level can be organised much more efficiently if target beneficiaries organise themselves into co-operatives or groups. In particular, group action can alleviate peak labour shortages by encouraging alternating work periods. In many countries, land users are found to be very independent, indeed individualistic. It is often difficult to promote (large) co-operatives (FAO, 1989). Therefore, it may be easier to promote small groups. Small groups are also easier to manage than co-operatives, especially so when a contact farmer or a farm leader can be identified within the group and is given proper training to serve as an effective link to the programme implementing institution.

Indicators for identification of the status of capacity development in erosion and desertification control management are the existence and performance of environmental government institutions, integrative capacities of government, performance of NGO's, participation by different stakeholders, performance of the business sector, activities of universities, available statistics and performance of the media (see Table 3).

Successful erosion and desertification control management is more than a single isolated treatment of problems but means a structural change of the societal importance of erosion and desertification control activities. The capacities for this kind of intervention are often very low. However, this is generally not an insoluble problem if programme implementation puts its emphasis on capacity building and, consequently, aims at increasing people's participation.

Successful long-term strategies of erosion and desertification control management depend on the strength, competence and organisation of governmental and non-governmental actors and related promoting framework conditions such as organisational, institutional and legal structures as well as economic-technological progress. The utilisation of the existing capacities depends on favourable strategies and the use of situation-specific opportunities in relation to the problems encountered.

Apart from the stimulation of participatory approaches (see Chapter 4), capacity building efforts for erosion and desertification control management will mainly involve generation of scientific, technological and administrative knowledge, policy integration, raising of public awareness and making available material and human resources, as well as promoting strong responsible organisations and institutions based upon the existing institutional set-up.

Table 3: Indicators for identification of the status of capacity development

	Positive characteristics	**Negative characteristics**
Government institutions responsible for environment	Institutions for integrated planning at all levels	No central institution
Integrative capacities of government	Long-term intersectoral planning on a broad societal basis	Only additive environmental institutions and fragmentation of jurisdiction
NGO's	Competent lobbies/organisations playing a consultative role in political decision making	Only local organisations with no clear autonomous national lobby or organisation
Participation by different stakeholders	Participation includes also ecologically relevant long-term planning (Agenda 21) which pays attention to the different stakeholders, including gender issues	Participation is restricted to general elections
Business sector	Pioneer enterprises have a strong impact on the economy	Related business interests are scarcely articulated
Universities, science and research	Relevant knowledge is actively generated	Only scattered or irrelevant data
Statistics	Solid data is available	Only scattered or irrelevant data
Media	Erosion and desertification problems are widely reported in all the media	Only few, largely official reports on the situation

Source: modified after (Jänicke and Weidner, 1997)

4. Participation

Participation is the key to the success in any erosion and desertification control programme. Regardless of how technically sound a plan is, it cannot be successfully implemented without the support and participation of the target groups (FAO, 1989). In the past, erosion and desertification control projects and programmes often failed because they were top-down, not oriented to the needs of the land users, and capital intensive, with little or no sense of ownership or participation by the target groups in project conception, implementation or maintenance. Therefore, an emphasis has to be placed on participatory approaches to design and implementation of erosion and desertification control activities. However, local extension and project staff often lack experience in participatory approaches to erosion and desertification control activities which are farmer initiated and managed for sustainability and replicability elsewhere in the intervention areas (Englisch, 1996; Englisch, 1997).

The aim should be an interactive participatory approach to erosion and desertification control management. The term "Interactive Participation" describes a process of communication among local people ("insiders") and development agents ("outsiders") during which insiders take the leading role to analyse their problems, for example erosion and desertification, and to plan, implement and evaluate solutions, such as erosion and desertification control activities. Interactive participation is understood as a two-way learning process of dialogue, negotiation and decision making between insiders and outsiders to elaborate a common agenda for future activities (Pretty *et al.*, 1995).

Interactive participation can be based on the use of different tools for initiating, maintaining and evaluating the two-way learning process:

- Transect walks mean that a group of insiders and outsiders conducts a walk along a predetermined route through the community. For example: From the top to the valley, or from the centre of the village to the outer side. During this walk the different features observed are discussed.
- Matrices serve to evaluate different factors at the same time. Insiders establish, with facilitation from outsiders criteria for problem assessment. The interrelations of the problems are discussed and rated using seeds, stones or other locally available materials to visualise the problems according to the established criteria.
- Ranking are methods to see the relative importance of different classes or factors. Pictures or photographs can be very helpful in such ranking exercises.
- Drawings, mapping, models are visualisations of the local situation. For instance, a drawing or map of the farm can give a lot of understanding of the household situation. They are very useful in discussing problems about land, water and crop management, especially with regard to landscape and time aspects.
- Time diagrams, such as seasonal calendars or daily activity clocks, are created by insiders (with facilitation from outsiders) in order to assess the distribution of certain parameters over time. For example: labour, rainfall, pests, food shortage, etc.
- Probing and semi-structured interviewing aim at learning about the local situation through informal and in-depth questioning by outsiders with insiders as resource persons.

These participatory tools may be applied in different overall approaches to interactive participation:

- Village workshops have been applied in additional training programmes for ongoing erosion and desertification control projects (for instance see Englisch, 1997) to help orient project activities towards an interactive participatory approach and support the project personnel in their participatory extension efforts in order to address the immediate needs of target groups.

- Farmer Field Schools (FFS) are an innovative participatory approach to farmer-centred learning which is currently promoted very successfully in many FAO projects throughout the world (see Box 5).
- Participatory Research and Technology Development aims at increasing involvement of target groups in the definition of research needs and the design, implementation and evaluation of research programmes in order to utilise their specialist knowledge (Werner, 1993).

A key to successful implementation of erosion and desertification control programmes consists in the implementation of participatory training which complements other programme activities. Sensitisation and training of local target groups should start without delay as soon as an area or watershed is chosen for erosion and desertification control management. Such training involves, apart from the above mentioned participatory tools, village meetings, exhibitions, field visits and installation of demonstration plots.

The first objective is to motivate and convince the target groups to participate in the programme. It has to be ensured that these activities are implemented efficiently. Whoever is responsible for this extension work should bear in mind that erosion and desertification control management may require a drastic change in land use – possibly a change in the terrain itself (e.g. by terracing). Land users will not take an active part in the programme if they are not convinced of the measures to be applied.

Box 5

Farmer Field Schools (FFS) in participatory training

FAO developed the FFS concept in the 1980s to provide farmer education on Community Integrated Production and Pest Management. Excessive spraying of pests and their predators alike is counter-productive and dangerous to health. FFS demonstrated a more enlightened approach with selected groups of farmers in their own fields. Trainers teach farmers to recognise the onset of problems and to devise ways to reduce or eliminate those effects by management, changes of variety, rotations in actual experiments during weekly training sessions which last for the entire growing season. Other soil and crop management on-farm trials have been introduced gradually. Many trainees eventually train other farmers in FFS and “Clubs” are organised to pass on the messages to the rest of the village and to provide support so farmers do not fall back into their old spraying routines. Extension workers and on-line technical officers assist in various ways as trainers of trainers and in curriculum development, after attending special courses.

Popularity for FFS rises with increasing yields and profits. In some cases, sub-regional or local authorities are taking up part or all of the costs of running schools and clubs. Researchers and seed companies are joining the effort. Networking is spreading the findings.

Australia, Netherlands and Norway are supporting the IPM and FFS initiative in several Asian countries.

Integrated Soil and Nutrient Management (ISNM) is also being promoted through the structure of Farmer Field Schools. The principles are:

- maximise ground cover;
- maximise input of organic matter;
- use of leguminous species;
- selective use of plant nutrients;
- land use promoted according to suitability for each purpose; and
- overcome the yield-limiting factors for crops.

See FAO’s website: http://www.communityipm.org/

The training in interactive participation and participatory tools lays the foundations for:

- changing extension practices to better serve effective erosion and desertification control management;
- participatory interaction between land users and development agents;
- self-help mobilisation and capacity building; and
- successful erosion and desertification control management by the land users themselves.

Special training is usually given to selected people, such as village group leaders, contact farmers, or active members of local organisations. Selection should be done carefully. Basic requirements for these key actors at local level are age, physically active disposition, attitude, adequate level of education, favourable position within the community, and confidence of target groups in the person.

An application ideally consists of training programmes for:

- Sensitisation: Interactive participation can be successful once all partners recognise the need to work at personal responsibilities, such as self-critical attitudes and gender-sensitivity. They will also need to seek feedback constantly, and to be clear and explicit about what was and was not achieved. The organisations involved need to recognise that interactive participatory learning and action represent a long-term commitment.
- Introduction of participatory tools and procedures for an interactive participatory problem analysis and solution identification: The implementation sequence is divided into three main phases and integrates activities of individual farmers, local communities, local organisations and development institutions:
    - <u>Preparatory phase – Team formation:</u>

      The team for promotion of interactive participation is formed by thoroughly assessing the experience, qualification and motivation of the future team members.
    - <u>Participatory training phase – Awareness creation and process initiation:</u>

      Training and planning workshops lead to a stakeholders' group exercise and the establishment of an action plan, documented in a workshop report, written together with the members of the group.
    - <u>Implementation phase – Participatory learning and action:</u>

      Erosion and desertification control activities are executed as evolved from the participatory learning process and outlined in the action plan.
- Assistance in the application of the method, and introduction of tools and procedures for participatory planning, monitoring and evaluation: Participatory planning, monitoring and evaluation enable the farmers to take the lead in the design and execution of successful erosion and desertification control activities which address their immediate and long-term needs.

Participatory approaches and methods support the creation of interest and commitment. They contribute to agreed courses of action at the different levels of intervention. Thus, the consideration of local conditions, i.e. of diversification and complexity of erosion and desertification problems, will be ensured. Participation also creates informal and formal linkages between different organisational and institutional levels.

5. Funding and Financial Aspects

Erosion/desertification control management programmes, same as any other programme, require expenditures, in most cases far above the amounts immediately and regularly available. Even securing matching funds for initial activities often represents a problem. The formulated programme must be "implementable", the criterion implying, among others, the availability of funds needed. Financial considerations have, therefore, to be taken into account from the very beginning of the initial phase of programme formulation, and the funding sources carefully analysed.

The level of programme expenditures and their dynamics are programme specific, depending on strategies selected and investments needed. Accordingly, a wishful workplan and timetable will be prepared initially. After comparing it with the availability of funds and the expected cash flow, a realistic work plan, timetable, cost sharing and cash flow analysis have to be elaborated. Programmes needing high investment expenditures and a longer implementation period have to be structured and implemented in a logical sequence of phases.

In general lines, the programme will imply different types of expenditures:

- increased expenditures of responsible administrative structures;
- investment and other costs related to programme implementation; and
- increased costs of the monitoring programme and of the initial and regular post implementation activities.

The potential sources of funding, to be usually taken into consideration, are:

- budgets at various levels;
- charges, taxes, fees;
- other, conventional and non-conventional sources; and
- external, international sources.

Budget funds are addressed in particular for matching funds and expenditures of responsible administrative structures. Budget funds and those of the responsible infrastructure services and public companies usually are the major source of funding for the needed investments. Within such a context, the programme must identify the institutions to be addressed. Due to the multisectoral character of programmes, several sources will usually have to be involved, the fact implying also the active involvement of future investors in programme formulation.

Taxes, user fees, charges, polluter charges, entrance fees, etc. might be a valuable source of funding, providing their approval through the relevant legal procedure. Other sources might be secured through donors’ contribution, public raising campaigns, support of indirectly involved or affected institutions or stakeholders, etc.

International sources are related to specific international funds and programmes: those of the EU, GEF, METAP and/or MAP-UNEP (should the programme make part of a larger ICAM project), bilateral or multilateral co-operation and assistance, international grants and international loans and credits (soft loans), etc. The international funding of such programmes presupposes a number of prerequisites:

- internationally accepted concepts and principles to be respected and applied;
- the nature of programme to comply with funding criteria;
- a proper programme design and format;
- in some cases, certain tools and techniques to be applied;
- declaration of priority to be provided by national authorities;
- partial funding, in some cases; and
- other specific requests, if required by the funding agency or institution.

Should international funding be envisaged, the potential donor(s) or partner(s) have to be informed and, if possible, involved from the early stage of programme formulation.

The present experience indicates automatic funding mechanisms as more efficient than the non-conventional ones. But, a successful application of non-conventional sources might provide significant contributions to the programme budget. Finally, for large programmes in particular, a mix of funding sources is recommendable to be secured.

6. Integrated Processes (ICAM and ICARM)

In coastal areas and river basins, erosion and desertification processes initiate and develop within a complex framework of interactions and interrelations between the coastal and marine environments, strongly influenced by human activities. Intensive physical, biological, socio-economic, cultural and other processes are present within multiple interacting marine, terrestrial and riverine systems. Causes and impacts generated at one end of the chain often result in consequences in faraway areas. Increase of coastal population and intensified economic and other activities result in pressures often beyond the carrying capacity of ecosystems affected, causing overexploitation and depletion of resources, degradation of ecosystems and, in extreme cases, their irreversible disruption. The usually limited coastline and coastal area on one hand, and many aspirations for its use on the other, result in user conflicts for siting of often mutually incompatible activities.

There is large evidence that the traditional sectoral approach to planning and management, in case of coastal areas and watersheds, results in mismanagement and uncontrolled development. The consequences are worsening of the quality of life and health conditions of the population, pollution, degradation and disruption of coastal and marine ecosystems, negative impacts on biodiversity, etc. These were the reasons for introducing the integrated approach in coastal management, and for the development and gradual implementation of the methodology of integrated coastal area management.

The integrated approach understands integration of all relevant elements of the process, as well as of all policy and management aspects.

Policy integration aims at:

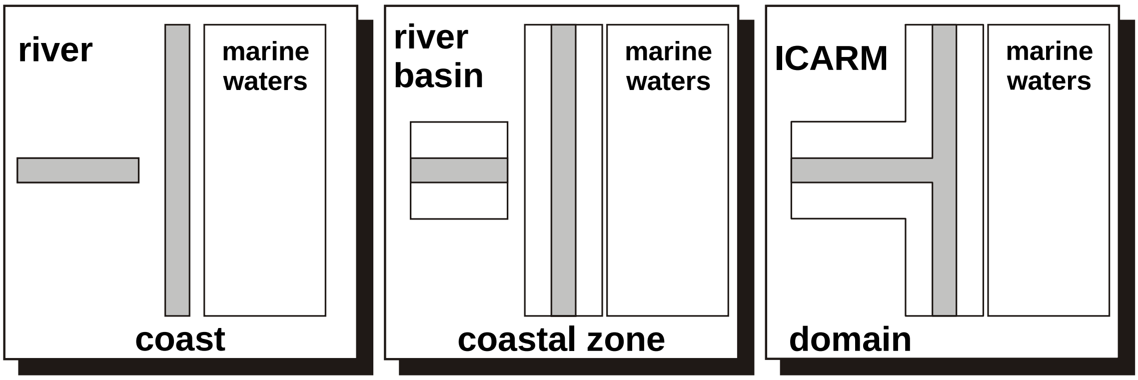
- securing comprehensiveness of inputs, with regard to time, space, actors and issues;
- processing of inputs into decisions, with selection of most appropriate strategies and actions, based on an aggregated evaluation of policies;
- production of consistent outputs, through harmonisation of all policies, integration among policy levels, and implementation of only one policy by all actors.

The concept of Integrated Coastal Zone Management (ICZM) was introduced officially in the USA in early 1970s by the adoption of the Coastal Zone Management Act. In the Mediterranean region the practice was introduced and applied during 1980s. UNEP/MAP developed the relevant methodology as Integrated Coastal and Marine Areas Management (ICAM). Among the numerous definitions of ICZM (ICAM), the one used by UNEP/MAP/PAP will be cited:

> ***"ICAM is a continuous, proactive and adaptive process of integrated resource management for sustainable development in coastal areas."***

ICAM is characterised by a system prospective and an integrating, multi-sectoral approach, being long-term oriented and open ended. It is an anticipatory and remedial process, suitable to respond to long-term and pluri-sectorally originated issues. Alternative strategies, selection criteria, and management-targeted solutions, within a broader context of national development policies, are among its major characteristics (UNEP, 1995).

In case of programmes related to large river basins in coastal areas, or associated with coastal areas, the Integrated Coastal Area and River Basin Management (ICARM) approach is recommended, similar to ICAM, but respecting different and specific environmental and other conditions and processes (UNEP/MAP/PAP, 1999). The ICARM approach, in most cases, is of fundamental importance for erosion related processes and programmes. For illustration, main spatial components of the ICARM domain are presented in Figure 5 (UNEP/MAP/PAP, 1999). The basic elements of an integrated watershed strategy are presented in Box 6.



a) domains of river and coastal management

b) river basin and coastal zone management

c) ICARM

Figure 5: Spatial components of ICARM

After years of testing and application, nowadays a majority of the coastal states' governments recognise the need for and benefits from application of an integrated approach when implementing large coastal and river basin related programmes and projects. For a more detailed insight into integrated coastal management, references (UNEP, 1995), (Clark, 1996), (Cicin-Sain and Knecht, 1998) and (Vallega, 1999) are recommended.

In case of Mediterranean coastal areas and river basins, processes of erosion and/or desertification are significant almost everywhere, resulting in impacts on other natural processes, state of coastal resources, economic activities (agriculture in particular), productivity, biodiversity, land use, and land management. These impacts might be systematised as follows:

- primary impacts: land degradation, loss of productive soil, landscape degradation, sediment transport;
- secondary impacts: loss of productivity, decline of land-dependent activities, change of agricultural practices and land use, deposition of eroded material in waterways and dams, change of the sediment flux and of the natural balance along the shoreline, pollution of freshwater and of the adjacent sea; and
- tertiary impacts: change in rainfall pattern, impacts on biodiversity, social impacts (poverty and migration), economic impacts (lifetime of dams, impacts on tourism, etc.).

The omnipresence and significance of the resulting impacts implies the inclusion of erosion and desertification related issues in the process of integrated coastal and river basin management as mandatory. Looking from the other side, the management of erosion/desertification control, if not analysed, formulated and implemented within a larger context and integrated with other interlinked processes, increases failure risk and/or results in transfer of problems, instead of their mitigation, curing and/or control.

7. International Co-operation and Support

In most cases of erosion/desertification control management programmes, international co-operation is a highly needed prerequisite, and in case of developing countries in particular. In cases of transboundary causes and impacts, international co-operation is mandatory due to the need for, and sometimes obligation of reporting to neighbouring state(s) the envisaged actions are likely to affect, other than the national areas.

Box 6
Watershed strategy

A number of issues have to be addressed:

water shortage risks; extremes of drought and flood from records; reliable water supply for priority needs; evaluation of water demand, distribution and management; local and extra-territorial effects of urban and industrial pollution; over-pumping ground water; ground water pollution; sea water intrusion in ground water; effects of pollution on land and water quality; degradation of coastal waters; inflationary urban growth; impacts of deforestation; desertification effects; impacts of hazardous waste disposal.

Recommendations include:

- The project become an integral part of the societal system with interaction between project, society and environment. A plan accounts for impacts on other users while integrating into the development strategy.
- Non-structural solutions should be promoted; where structures are unavoidable, they should be designed with local materials and to “work with nature”.
- Negative impacts on water quality should be avoided or taken care of in the plan.
- Physical, social and economic benefits as well as adverse environmental impacts should be assessed, with curative proposals included.
- Disaster mitigation strategies must account for natural events as well as introduced stresses.
- Resources supply and demand should be analysed for all user sectors for balanced use.
- Stakeholders should be involved from the beginning of the planning process to ensure “ownership” of solutions proposed.
- Conflict resolution procedures should be built into the process.
- A national awareness and education campaign will inevitably be needed.
- Research should be planned soonest to resolve unknown factors.

Management structure:

Sustainability can only be ensured by organising a competent team of managers, technicians and workers to operate within an appropriate infrastructure for start-up. Cost consciousness must extend to efficient maintenance aspects. A dedicated budget line is essential. Some generation of income is vital for the system to continue to function adequately. Continuous performance monitoring is also essential to catching problems before they develop. Data gathering and analysis is implied. Policies and legal instruments will need to be developed in thoughtful manner and supportive ways.

(PAP/RAC, 1997a)

In order to secure eligibility for international funding, programmes should comply with internationally accepted principles and conventions, as well as with specific requirements of the potential funding institution. Such programmes should be harmonised with, and whenever possible integrated within international/regional programmes aiming at sustainable development and environment protection, including soil protection programmes. In case of coastal areas, the programmes should be formulated within the ICAM framework. The most usual forms of assistance provided through international co-operation are: financial support, capacity building, strengthening of institutional mechanisms, provision of scientific support and know-how, and the exchange of experience.

The Mediterranean experience lists a number of projects, dealing with cases of erosion and desertification, conceived and implemented in co-operation with, or within relevant programmes of PAP/RAC – MAP/UNEP, FAO, DGCONA, METAP, GEF, and/or programmes sponsored by the EU. In addition, the Mediterranean Commission on Sustainable Development (MCSD), established in 1995 within the MAP framework, within a number of priority issues deals also with erosion/desertification problems. Involvement, as appropriate, of these institutions might greatly contribute to the formulation of sound, scientifically based, and professionally correct and updated measures and actions, securing thus the efficiency, cost effectiveness and proper results of the programme.

The co-operation with relevant international organisations should be established in the initial phase of programme formulation, in order to provide for a timely information, data, suggestions and assistance. Programmes internationally verified, or formulated with the participation of specialised international organisations and agencies, have an increased credibility and better chances for domestic and external fund raising. In most cases, the initiatives for international support have to be channelled through relevant national authorities/institutions, and addressed to the appropriate international institution, corresponding to the nature and significance of the programme.

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Photo 1: Irreversible state of generalised soil degradation (Province of Valencia, Spain)

Photo 2: Typical red Mediterranean soil under xerophilic scrub association – *garrigue/matorral* (Province of Valencia, Spain)

Photo 3: Intensively exploited and sheet erosion affected Mediterranean landscape (Province of Valencia, Spain)

Photo 4: Terraced cropping land (near Valencia, Spain)

Photos 5 and 6: Stabilised and cultivated river beds amongst heavily eroded sloping land (near Valencia, Spain)

Photo 7: Mountains completely deprived of vegetation and eroded to the parent material due to continuing overgrazing (Sardinia, Italy)

Photo 8: Geological erosion (Abruzzo, Italy)

Photo 9: Erosion in the foreground and mass movement in the background after a heavy rainstorm (Piedmont, Italy)

Photo 10: On steep slopes ploughing has to be discouraged (Marche, Italy)

Photo 11: Desertification as a consequence of land mismanagement in semi-arid climate (Sierra de los Filabres, Spain)

Photo 12: Flooding as a consequence of intensive and prolonged rain on erosion-prone soils (Piedmont, Italy)

Photo 13: Stone wall terraces in the prealpine region (Piedmont, Italy)

Photo 14: Traditional land management for soil and water conservation (South-eastern Spain)

Photo 15: Earth mounds to retain rainfall water and to prevent the erosive runoff (Sfax, Tunisia)

Photo 16: Sand dunes stabilisation (Zagora, Morocco)

Part IV:
Integrated Erosion/Desertification Control Management Procedure

1. General Concept

1.1. Why Map and Measure Erosion?

Awareness is the answer. Land users and politicians have to know the extent, volume and potential costs of rehabilitation and loss of production on eroded land, before they are obliged to act and remedy the situation.

The "invisible" production elements are the first to be eroded: nitrogen, phosphorous, potassium, organic matter, micro-elements. Their reduction quickly leads to diminished ground cover and loss of larger soil particles. Reduced harvests will inevitably follow as the moisture retentive capacity of the soil will also be lowered, due to structure deterioration, compaction, surface sealing (Box 7).

This sequence is a simplified description of what may happen. There are various ways to overcome the worst of the problems if land users are aware of the processes involved, and if simple timely remedies can be demonstrated to them.

Mapping can identify the hotspots or danger areas, so priorities for action can be planned and costed. Simple predictive mapping can identify future problem areas at low cost. Non-technicians can participate. Walking transects are a valuable mapping training exercise. Detailed mapping can give more information about the range of options which can be made available and the hazards involved.

Measuring can be used to verify which land-use practices are the most damaging to soil and productivity loss. Simple techniques can be used which non-technical people can readily understand and carry out without sophisticated equipment. Mechanical and electronic devices can be installed to carry out longer-term measuring, for a more scientific result. There are trade-offs to each of these extremes.

Measuring can be oriented to indicate options in technologies which use less energy and lower inputs for the same or even more sustainable results. Tillage practices are an example.

Box 7
Soil erosion and nutrient loss

FAO analysed data from tropical and sub-tropical environments to get an appreciation of the extent and cost of soil erosion and nutrient loss. The measure of how much more concentrated a nutrient is in the material removed by erosion (enrichment ratio) than in the original soil, averaged 2.5 which means that a considerable selective removal of nutrients has been due to the erosion process.

Nitrogen and phosphorus losses from the arable lands were about 3 times the level of total fertiliser applied in the growing season. Calculations made show the financial cost of erosion per hectare per year varied from US$20 to US$50 on arable land, and from US$10 to US$80 on grazing lands.

The implication of these figures is that erosion is a massive "hidden" cost on the economy of a country. The implications are far more serious if the country has to import nitrogen and phosphorus.

(Stocking, 1986)

It can be demonstrated that the more the target population is involved in their own mapping and measuring, the more likely they are to adopt, and act in consequence of the results. The stakeholders then have a better understanding of the dimensions of the problem to be addressed. It is often seen to be a problem which extends far beyond the farm boundaries, but until resolved, production will always be compromised. As a successful example of such an approach the Landcare Movement in Australia and New Zealand might be mentioned, as presented in Box 8.

1.2. How to Measure?

The 1997 Guidelines give a detailed description of an agreed protocol for mapping and measuring carried out by technicians. It must be remembered that various levels of intensity are desirable in order to involve the stakeholders and give “ownership” to the identified problems.

Partly due to research funds reductions in Australia, simple measuring kits were assembled and distributed to primary and secondary level schools across the continent. These kits included simple rain gauges, sampling bottles, thermometers, depth gauges, and so on. Teachers used the instruction leaflets to organise classes in natural sciences to measure and collect data on rainfall, river height, water purity, frost days, crop growth rates, “worm-watch” and various other activities. The students were very enthusiastic, producing mountains of data which were then centrally processed. Errors were quickly evident due to the mass of data collected in parallel. The teachers at last had meaningful practical lessons to deliver. The exercise is proving to be highly cost-effective, as well as renewing interest in the sciences.

This is not a complete substitute for scientific monitoring. But a combination of the two approaches can be meaningful and more economical. Catchment flow measuring devices in theory have to be “calibrated” during a period of 7 to 28 years for reliability of results, before any upper catchment works are imposed. As a consequence, very few governments agree to fund this intensive type of research.

2. Principles of Erosion/Desertification Control

Managers need accurate information on the state of the country’s resources in order to plan for spending to maintain those resources. There could be a proactive scenario. There is also the possibility of a “zero” scenario, where upstream degradation continues to affect delta infrastructure, water supply reservoirs, productive bottomlands, offshore fishing and coastal fringe tourism. It is often too easy for politicians to blame upstream land users for downstream degradation of resources, without adequate investigation. (Hofer & Messerli, 1997).

Neglect of the upstream population may have consequences at the polling booth if negligence is seen to be resulting in downstream pollution or destruction. But in every case, the facts have to be carefully investigated before conclusions can be reached or fault assigned. It may be that faulty policies are the driving force behind degradation. (FAO, 1998).

Erosion rehabilitation can be expensive in resources, so it is important to make sure the problems are correctly evaluated and mapped. Priorities should be given to specific works as it is not feasible to treat all problems; some problems resolve themselves over time. These priorities should be land user priorities, or the programme will not be effective in the long run.

Box 8
Landcare: Application of the participatory principle in Australia and New Zealand

Landcare is about education and action to achieve the vision of sustainable land use. It includes group and individual activities, many of which have been implemented since some years.

Landcare tries to encourage people to form new Landcare groups. It brings together people who share a concern for locally sustainable land use; by working together in groups, they can solve problems which are too big for individuals.

Landcare provides a way to co-ordinate activities which work towards achieving sustainable land use.

Some Landcare projects have addressed:

salinity assessment and control; conservation of groundwater and use of artesian bores; property planning; catchment planning; contour furrowing; gully erosion control; demonstrations of demonstration of contour bank systems; reduced tillage techniques; managing weed infestations; tree planting for erosion control and reclamation; rehabilitation of coastal wetlands; urban woodland regeneration; producing newsletters to promote Landcare education and awareness.

Landcare in participative planning and mapping

Issues and options

- water erosion
- wind erosion
- dryland salinity
- irrigation salinity
- soil structure decline
- induced water-logging
- flooding
- induced soil acidity
- water repellence
- weed invasion
- animal pest proliferation
- soil contamination
- range deterioration
- water quality decline
- riverbank erosion
- reduced biodiversity
- coastal dune erosion

Although control methods for these are available, the solutions must be based on an understanding of the whole management system required for each land use and land type, integrating economic and environmental objectives.

Priorities for Landcare must take into account the:

- current and potential environmental, social and economic impact of land degradation problems;
- net benefits of undertaking possible control measures;
- state of knowledge and technical soundness of proposed remedial measures;
- community support for and involvement in the programmes;
- required balance between research, resource assessment, information exchanges, planning, implementation and monitoring.

Implementation

Initial action will be taken by land users and managers of non-agricultural lands, acting through community groups or as individuals. This will require effective support from Government.

Responsibility for implementation of programmes will continue to be held within regions. Regional Landcare action plans will be developed based on priorities identified jointly by the community and the Government.

Government will manage public land including waterways, to avoid degradation and will provide consistent policy, planning and assistance to guide the transition towards sustainable land use.

National website: *http://www.affa.gov.au/agfor/lancare/nlp.html*

In order to estimate the cost of doing nothing, monitoring is again required. Most managers will be sufficiently shocked by these initial estimations to plan at least partial maintenance of upper watersheds. A list of options and their costs or constraints must be available to the planners. These may be area-based costs, population *per capita* costs, or other. Testing by stakeholders should follow. Geological erosion should be estimated and always indicated separately from man-induced erosion.

A few basic rules may be helpful, taking into account that exceptions will invariably occur:

- If changes to technologies are needed, work from the traditional systems to modified solutions, rather than introducing abrupt conversions and thus confusion.
- Policies and strategies should be targeted to satisfy the interests of the country. It is unreasonable to support bad managers of land through direct subsidies for an indefinite period. Subsistence agriculture used as a form of social security will not be sustainable. Diversity in processing, light industries and a range of non-agricultural activities, can be successfully promoted in some areas.
- Keep all stakeholders informed of the issues. Keep technicians and land users involved. Prepare an action plan and a database with monitoring and appropriate policy reform. One medium-term objective should be to raise land users to the status of taxpayers by strategic investment and encouragement of local responsibility for improvements by whatever means are reasonably possible: education and specific training, infrastructure in rural areas, market facilities and other interventions beyond the scope of this guide.

The 1997 Guidelines recognise several levels of activity concerning managers. The upper level is the international level where, by common agreement, issues from groups of countries are addressed by assessment and mapping at a reconnaissance scale to draw attention to the “hot-spots” and priority treatment zones. The result may be a regional action plan which co-ordinates a series of national actions.

National and local activities can be addressed by the creation of a high-level advisory commission which recommends the structure and working methods for the designated leading institute, and helps co-ordinate with existing initiatives at international or local levels (EAP, TFAP, CBD, CCD, CSD, Drought Strategy etc.). That leading institute would establish or strengthen government services and NGOs concerned with erosion control and soil and water conservation issues. The advisory commission would ensure that an appropriate legal framework is put in place to support the erosion identification and follow-up processes of rehabilitation and stabilisation. Ongoing monitoring and evaluation would become a standard procedure. Monitoring and evaluation will lead to policy development. Various mechanisms would need to be put in place to encourage participation of the various stakeholders in the follow-up period (see also Box 9).

Improvements to land use at the local level are to be investigated and refined by the land users in collaboration with the various focal point institutes. The evaluation of the resources and identification of the root causes make up an important participatory exercise with the stakeholders. Implementation of the remedies is the next step, followed by evaluation, and then ongoing monitoring by the target population. To initiate this part, a range of technical and managerial options will need to be put in front of the stakeholders.

Box 9

Land use and management policy – participatory issues identification

In November 1994, policy drafting began in a "pilot country" with field inspections of land management and specific degradation problems, followed by village meetings to draw out the local issues. A two-day Policy Development Workshop followed in the capital city, and representatives of a wide range of institutes raised those important issues to be addressed by the new Land Use and Management Policy. Issues and option papers were outlined. Individuals wrote basic drafts which were refined by a review team, in order to produce the initial policy document. This was referred back to village representatives and the provinces, and then presented to a National Land-Use Policy Seminar. Further refinements were later made, and an Action Plan was developed taking all of the sectoral issues into consideration, as well as allotting tasks and responsibility for implementation and follow-up to key institutes for each issue identified.

Key issues included:

land rehabilitation; public awareness of degradation; waste disposal; institutional co-ordination; cross-sectoral policy; smallholder farmers; sustainable agriculture; incentives for soil conservation; agricultural production and livestock; business and industry; land tenure and property rights; mining; natural resources; NGOs and local communities; physical planning and settlements; population; women involvement; legislation.

Countries of the Mediterranean basin agreed on the seriousness of land degradation/ erosion/desertification processes, and in the MAP Phase II document (1995) defined as priority the relevant activities. Now, the decision has to be taken to establish conditions necessary for systematically addressing the problems, with mapping and inauguration of measuring as early and vital steps in the process.

3. Monitoring of Processes

Monitoring of erosion and desertification control means regular assessment of activities, recording of impact, and periodical analysis of relevant information in order to determine whether:

- activities are implemented according to the plan;
- the available time is sufficient to complete the activities according to the plan;
- manpower and materials are being used efficiently;
- the quality of activity implementation is maintained; and
- the progress made is sufficient to achieve the envisaged objectives.

Thus, monitoring provides feedback information on programme implementation and results. Monitoring can be understood as an early-warning system which identifies problems at an early stage in order to make appropriate adjustments for achievement of the planned outputs.

Monitoring of erosion and desertification control is based on key indicators such as occurrence of specific erosion phenomena. These immediately visible erosion and desertification phenomena are mainly the following (PAP/RAC, 1997):

- sheet erosion;
- rill erosion;
- gully erosion;
- wind erosion;
- mass earth movements; and
- physical soil degradation processes (compacting; crusting; salinisation).

The indicators and the ways of information collection and analysis have to be determined already during programme planning. Indicators have to be appropriate and precise. They should reflect quality, quantity, and spatial and time dimension of information. Identification of indicators to be monitored is based on the following criteria:

- Relevance to the established objectives, i.e. does the indicator provide relevant information on the achievement of any of the objectives?
- Efficiency, i.e. does the indicator provide relevant information on the efficient use of resources?
- Spatial aspects, i.e. does the indicator provide relevant information on the spatial distribution of effects?
- Time aspects, i.e. is the indicator time-sensitive and does it reflect trends and fluctuation over time?
- Applicability, i.e. is the indicator easy to handle at reasonable expense within the given budget?

After the establishment of the indicators for monitoring, the next step is to determine how the identified indicators will be monitored and who will execute the monitoring activities. It is recommendable that an independent monitoring and evaluation body is established in order to undertake regular control. Furthermore, a monitoring unit should be established under the responsible agency for data collection and monitoring. Every potential for application of participatory approaches and methods (see Part IV, Chapter 3) should be used for monitoring of erosion and desertification control.

In addition to monitoring records and erosion data, specially designed surveys are needed for periodic evaluation purposes. Such periodic surveys may include the following (FAO, 1989):

- surveys of land-use changes and conservation progress in an area or watershed using remote sensing techniques every 5 to 10 years, as required;
- surveys on socio-economic conditions in the project area to compare with the baseline survey;
- surveys after major hydrologic events, such as floods and long droughts and damage estimates for comparison purposes;
- other single-purpose and brief surveys, such as on farm income, land productivity, conservation attitude, etc., when needed.

Evaluation should be made against the original objectives and expected benefits. Any major discrepancies or additional achievements and benefits should be explained. The results of evaluation should be presented to the users and the government so that experience can be gained and further used.

Erosion and desertification control is relatively difficult to monitor because the expected benefits are of a long-term character, because of the elements involved, and because of a dispersed and uneven distribution of the resulting benefits. However, monitoring is a mandatory tool in order to assess the results of the programme against the planned outputs, and to take the appropriate management steps for corrective actions. Thus, monitoring ensures successful programme implementation.

4. General Scheme: Definition, Role and Outputs of the Main Phases

4.1. Basic Approaches

The basic conceptual approach, as presented in Figure 6, is to be implemented in three main steps, and will consist of the following:

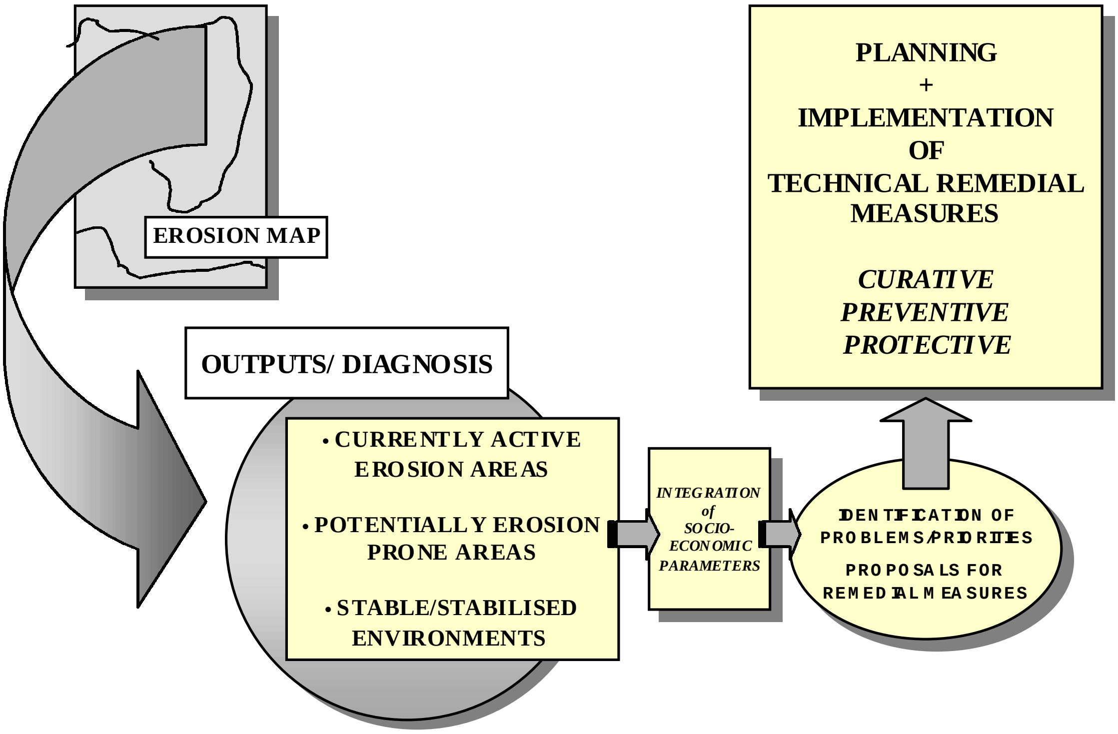

Figure 6: General methodological scheme

- systematic soil erosion and degradation surveying and mapping at different scales and grades of detail;
- preparation and formulation of integrated and sound, adapted conservation technological packages for site-specific remedial measures to be implemented; and
- elaboration and formulation of global strategies and relevant policies for erosion/desertification control management and planning programmes; preparation of more site-specific and detailed management plans by setting priorities, defining technical curative, preventive and protective measures.

a) Erosion mapping

This is an essential tool for the knowledge of the distribution and geographic extent of the phenomena, as well as for its qualitative characterisation. The common consolidated methodology of mapping of rainfall-induced erosion in the Mediterranean coastal areas (PAP/RAC, 1997) provides instructions for both predictive and descriptive mapping of the erosion phenomena (see legend presented in Annex IV).

The erosion map provides a synthetic, systematic information about the nature, intensity and distribution of the relevant phenomena. On this basis it is possible to identify the most severely affected areas and the dominant types of erosion phenomena. On a more detailed basis, the measurement in selected environments provides accurate qualitative and quantitative data necessary as detailed inputs to ICAM (FAO, 1998), as well as the reliable basis for the planning and design of the prescribed erosion control management activities.

Systematic mapping of qualitative and dynamic erosion features identifies two broad categories of geographic environments: morphologically stable, non-erosion-affected areas; and unstable, erosion-affected areas. As related to the first category, a qualitative assessment is provided for erosion risk or potential erosion, identifying, at field level, the various parameters considered for the basic predictive erosion status map, and assessing their comparative de-stabilising force. The latter should lead, in each specific case, to the identification of the main or most probable causative factors of medium- to high-erosion risks by means of codes and symbols. As far as erosion-affected areas are concerned, the descriptive and qualitative erosion mapping identifies the nature of specific erosion processes, their comparative importance expressed in terms of extent, size, depth or volume, and their expansion rate or trend based on field observations indicating either a recession or an increase of erosion activity.

b) Formulation of remedial measures

While the mapping survey procedures mainly identify and assess physical parameters and processes, the synthesis phase integrates socio-economic factors, such as cropping practices and land tenure patterns, trade and market perspectives. Within this process there will be a permanent concern for participatory approaches, sustainability assessment and monitoring, and integration of sectoral surveys and outputs as promoted in most FAO and UNEP projects and programmes.

Through erosion mapping it is possible to incorporate the erosion phenomena as a factor in the process of land-use planning and management, and particularly in the process of Integrated Coastal Areas Management (ICAM). The full capacity to integrate both methodologies, erosion mapping and ICAM, into geographical information systems (GIS), facilitates the integrated use of tools and approaches for decision making in land-use management of the Mediterranean coastal areas.

c) Formulation of strategies and policies

When reaching the stage of strategy and policies formulation, the present Guidelines should be used in a flexible and adapted way that takes into account both environmental and local socio-economic circumstances. Integrated planning formulation implies the introduction of several basic and common key factors and prerequisites as recommended by FAO (Box 10).

The formulation of national strategies and policies for improved resources management and production should be started by the co-operative preparation and adoption of sound Strategic Action Programmes (the so-called SAPs of some successful World Bank experiences) which are to be considered as key measure for implementing priority actions at a regional or national level. Objectives of SAPs are in full coincidence with those defined in the present Guidelines, namely:

- to evaluate both degradation and potential production trends;
- to assess their causative factors and implications;
- to identify priority actions,- both preventive and curative;
- to provide cost estimates for an improved evaluation of potential benefits and investments; and
- to design and install an adequate framework for monitoring and evaluation.

Within the specific context of erosion/desertification control management, the SAP should give priority to actions to control processes leading to irreversible physical and ecological damage while minimising economic losses. The strategic policy actions should include provisions for participation of regional experts, stakeholders and non-governmental organisations in their preparation. The formulation principles have then to be translated into actions by the means of broad-based participation including local authorities, academic and research institutions and NGOs.

Box 10
Formulating national strategies for production

Strategy: Identify and remove constraints to production and provide means and incentives encouraging increased degradation control and production

Initiating the approach to strategy formulation, a basic set of key factors is common to all cases of integrated planning for sustainable management of land resources. The factors are as follows:

- clearly formulated objective(s);
- identification of stakeholders and their differing objectives;
- policy and regulations that create an enabling environment;
- effective institutions at local, sub-national and national levels;
- an accessible knowledge base;
- a platform for negotiation; and
- a set of planning procedures.

It is the responsibility of the government to ensure that these prerequisites are out in place, or that the conditions are created for them to evolve. Partnership between government and people is key to the success of the programme. Because effective implementation is participatory and built upon local people's initiative, it should be recognised that time spent to engage and gain local support is of inestimable value and of greater importance than the speed of adoption of a plan.

(FAO/GTZ/UNEP, 1999)

4.2. Definition, Role and Outputs of Main Phases

The more detailed methodology sequence, as shown in the Guidelines chart (see Figure 6), is structured in 6 phases, namely:

i) Phases I and II: Preliminary inventories, information processing and diagnosis; interpretation and processing of erosion mapping outputs;
ii) Phase III: Diagnostic analysis + Identification of remedial measures and priorities; preliminary assessment of national/local planning policies;
iii) Phase IV: Preparation of erosion control and development planning schemes; planning proposals to be submitted to planning authorities;
iv) Phase V: Implementation of the erosion control planning scheme;
v) Phase VI: Implementation of monitoring (project activities and environment) and capacity building programmes.

The detailed descriptions of specific objectives, activities and outputs will be provided in Chapter 5. Special emphasis will be given to inter-sectoral links and relations, more particularly from Phase III onward when socio-economic and policy parameters need to be integrated. At all stages of the programme the sustainability of proposed schemes, as well as their "participatory" implementation, will be considered of main concern.

5. Remedial Processes: Context and Scheme

The traditional sectoral approach to mitigation and control management of erosion and desertification processes, predominantly applied in the past and still prevailing in the present practice, proved in many occasions to be counter productive, not efficient, and implying failure risk. Since one of the objectives of any erosion/desertification control management initiative, related to the follow up, is the provision of prerequisites for its implementation, such initiatives should, therefore, be formulated taking into account a broader environmental, socio-economic and development context.

In particular, this implies consideration of problems and issues related to: (i) status, planning and management of water resources, forestry, agriculture; (ii) urban and rural development; (iii) land use and sea use planning; (iv) environmental concerns; (v) socio-economic aspects; (vi) national and local planning and management regulations and practices; and last but not least, (vii) health aspects and dominating impacts on quality of life of the affected population.

In practice, in all cases, national and local authorities and the responsible institutions are simultaneously planning and/or implementing activities or programmes aiming at improvement of welfare and health conditions, and of the quality of life, and/or at the protection and enhancement of the environment, ecosystems and individual resources. All such activities make part of more or less structured and integrated remedial and development processes or programmes.

A structured remedial process or programme can be defined as a set of harmonised initiatives aiming at control, reduction or elimination of causes and consequences of non-compliance with health and environmental quality standards and criteria, and with development objectives.

Remedial programmes, in general, aim to:

a) identify causes of non-compliance and the resulting impacts, and evaluate their significance;
b) identify ecosystems/resources to be protected/restored;
c) identify, select, prioritise and elaborate remedial measures; and
d) implement selected remedial measures, according to priorities.

An erosion control management programme, harmonised, co-ordinated and, if possible, integrated in planned or on-going broader remedial/development programmes has better chances of success than if formulated outside such a context. Prior to its formulation the following elements of the enlarged context have to be considered:

- actual on-going and planned activities interrelated with, or influencing the erosion/desertification programme;
- characteristics and hierarchy of the decision making and management processes;
- degree of centralisation/decentralisation: competencies at various levels;
- degree of integration of the decision making and management processes (vertical and horizontal integration);
- time frame and procedure of the planning process;
- the relevant legal framework;
- actual level and forms of participation;
- identification of authorities responsible and of those likely to be involved; and
- identification of the most appropriate procedure to be followed for the formulation, approval and implementation of the erosion/desertification related programme.

Understanding and respecting the above is of particular importance for: (i) formulation and addressing of solutions and proposals; (ii) provisions for the implementation of the monitoring and evaluation processes; (iii) formulation, justification and addressing of proposals for follow up; and (iv) selection of techniques and methodologies, to be implemented as part of local/national practice in the future.

Box 11

The CAMP "Malta" Project – management of erosion/desertification control, integrated into a larger ICAM project

One of the activities of MAP is dedicated to Integrated Coastal and Marine Area Management (ICAM), within the component entitled Coastal Area Management Programme (CAMP). CAMP is performed through individual projects, being implemented in selected coastal areas of regional interest. In the 1989-2000 period, CAMP projects were implemented in Albania, Croatia, Egypt, Greece, Israel, Tunisia, Turkey and Syria. Presently (year 2000) CAMP projects are being implemented in Lebanon and Malta, while the projects for Slovenia and Algeria are in preparation.

The CAMP "Malta" project started in 1999 and is expected to be completed by mid 2002. The project is of a multidisciplinary character, dealing with priority issues as defined by a Diagnostic Analysis prepared by national authorities. The project area is defined at two levels: the island of Malta and the NW area of the island. Nine activities are being implemented: Co-ordination and Integration, Data Management, Participatory Programme, Systemic Sustainability Analysis, Sustainable Coastal Management, Marine Conservation Areas, Integrated Water Resource Management, Management of Erosion/Desertification Control, and Tourism and Health (PAP/RAC, 2000b).

The implementation of the project is harmonised, co-ordinated and integrated at the level of individual activities and at the project level, during the implementation process and in its final stage. Interim results of each individual activity are used as inputs for other interrelated or integrating activities, draft results at activities level are checked for consistency with other results, amended if needed, and integrated into a final integrated project document. The final project output is expected to provide a comprehensive, consistent and applicable programme for sustainable development of the island, and in particular of the NW area.

The activity related to management of erosion control is being implemented by a team of selected national experts, co-ordinated and assisted by PAP/RAC, through the participation of reputed international consultants, and with the professional support of FAO AGL.

The activity envisages the implementation of the following actions, defined in accordance with the procedure recommended by these Guidelines:

- collection of available data and information;
- preparation of a national report (sectoral diagnostic analysis);
- survey of the actual state of land resources and basic interrelated factors, identification of priority areas;
- field survey, reconnaissance, mapping of erosion status and potential;
- analyses: socio-economic, land use, land tenure, market;
- using of interim inputs related to data management, sustainability analysis, coastal management, water resource management, participatory programme;
- provision of interim outputs to interrelated activities: coastal management, marine conservation, water resource management;
- detailed analysis and integration, identification of priority actions and alternative remedial strategies and technologies available;
- formulation of general recommendations at island level, and presentation of a management control plan for the NW area; and
- presentation of a final activity document.

In coastal areas and associated river basins, erosion/desertification control management processes have to be implemented within actual coastal management systems and practices, based more or less on Integrated Coastal and Marine Area Management (ICAM), and adapted to specific requirements of remedial programme (UNEP, 1995; WB, 1993). One of ICAM programmes, being implemented in the Mediterranean since 1990, is the MAP Coastal Areas Management Programme (MAP CAMP) (UNEP/MAP/PAP, 1999). Among a number of CAMP projects implemented so far, three (the Albanian Coast, Fuka-Egypt, and Malta) were dealing with erosion related problems, integrating the respective activity with other project activities.

In practice, when implementing CAMP projects, outputs from individual project activities dealing with integrated data management, systemic sustainability analysis, participatory programme, integrated coastal management, and water resources management are used as inputs for the erosion related activity, while the outputs of that activity are used as inputs for activities related to integrated coastal management and water resources management. As a practical example of integration of the erosion/desertification control management activity in a CAMP project, the “Malta” project might be mentioned (PAP/RAC, 2000b) (see also Box 11).

Part V:
Procedure Description

The overall framework for the implementation procedures consists of a logical sequence of six phases of specific interconnected activities (see Table 4). The efficient application of the referred to methodological sequence has the following implications:

- Preliminary problem diagnosis is based upon the outputs and conclusions of systematic soil erosion surveying and mapping which provide, both in quantitative and qualitative terms, an assessment and interpretation of:
  - Physical land degradation (spatial extension of problems, their causes, intensity and expansion trends, actual and potential risks and impacts on the project area);
  - Socio-economic background and parameters referred to the rural communities' land husbandry features;
- The integration procedure of physical factors and processes with human and socio-economic parameters will be mandatory for the definition of sectoral alternative solutions;
- The identification and evaluation of sectoral alternative solutions at multi-sectoral and project levels will take place in a fully participatory way amongst technicians, stakeholders and planning authorities; similarly, priorities and needs at both national and local levels, will be analysed, discussed, approved and implemented by the means of fully participatory negotiations;
- General and specific environmental impact monitoring processes are to be considered and included in the general procedure sequence.

The general procedure has been introduced in Part IV, Chapter 4; detailed description of Phases and Activities are provided in Table 4, and the flowchart in Figure 7.

1. Preliminary Processing + Diagnostic Phases (Phases I + II)

The overall activity procedure should be undertaken as a logical continuing sequence of former surveying and mapping phases which provided a descriptive and cartographic inventory of global resource degradation factors and parameters.

These thematic working maps, technical documents and matrices identifying both natural and anthropogenic factors and parameters have been integrated through GIS procedures and overlays.

1.1. Assessment and Processing of Erosion Mapping Outputs (Physical Parameters)

The basic erosion mapping outputs consist of sets of erosion status and site-descriptive erosion maps providing graphic information at the level of homogeneous geographic units in terms of specific erosion processes, their nature, intensity, extension, and evolution trend, thus providing a clear cartographic statement /balance of global erosion status, plus site-specific actual erosion damages or potential risks. This preliminary physical diagnosis subdivides landscape units or overall geographical environments in two broad categories, i.e. stable non-erosion-affected areas, and unstable erosion affected areas.

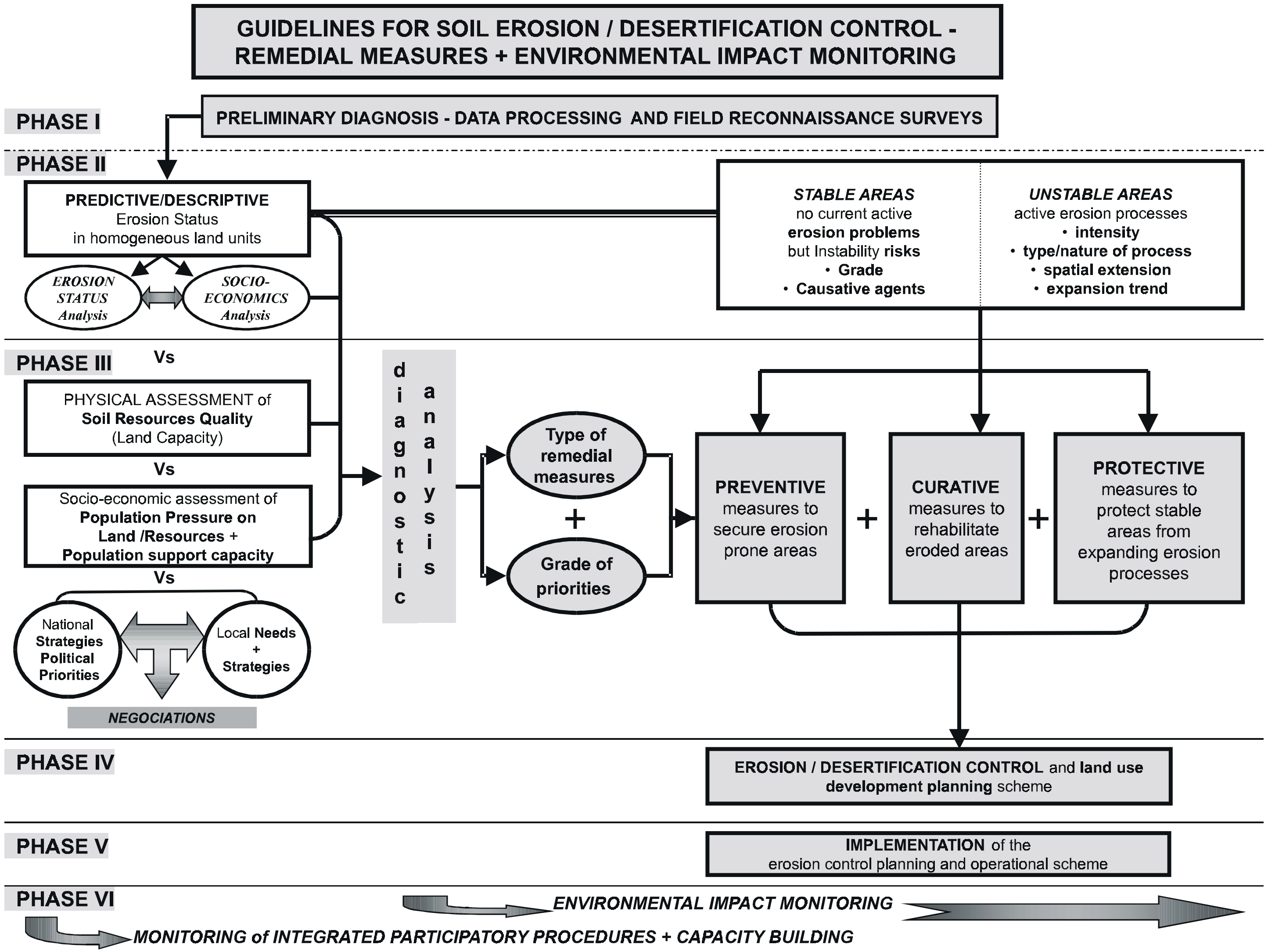

Figure 7: Flowchart of the procedure

Table 4: Procedure description – main activities and outputs

Phases/activities	Relevant documents/inputs	Outputs
Phases I + II		
Identification/inventory/assessment of basic technical data and information from erosion mapping	All basic information and data related to soil+water resources degradation issues	Erosion Status Map: Predictive/descriptive erosion status in homogeneous landscape units
Mapping outputs and complementary data processing Preparation/Elaboration of sectoral/ thematic working documents	• Maps/Data/tech.docs related to soil+water qualitative assessment (land suitability) • Population density; Population carrying capacity; land uses, land tenure	Site-specific descriptive erosion map: Spatial identification and distribution of stable + unstable areas • Nature/intensity of erosion problems • Evolutive trends+priorities
Phase III		
Integration of mapping outputs with socio-economic/land use features	Socio-economic statistics and data + outputs of other working groups: water resources/sustainability/ marine conservation/tourism	Intermediate working document: Preliminary results (draft maps + technical notes) of the diagnostic analysis
Identification of homogeneous priority management/ rehabilitation units/areas	Erosion status and site-specific descriptive maps	1st Draft of Synthesis map
Identification/Formulation of site specific remedial measures (curative/preventive/protective)	1st Draft of synthesis maps	Proposal for remedial measures: Technical notes + draft maps on adapted technological soil conservation packages
Phase IV		
Formulation/elaboration of a global synthesis framework as a contribution to an erosion control management strategy	Draft maps and proposals for the application of site-specific remedial measures	E/D Control Management Strategy: Final maps + Final recommendations + Control management schemes with implementation instructions
Phase V		
Implementation of erosion control planning + operational activities	All pertinent maps + tech. docs collected and prepared on the march of the project	Enforcement of Strategy: Problematic priority areas treated Remedial measures applied and implemented
Phase VI		
Monitoring + evaluation	List of field indicators + operating schedules and instructions for ongoing activities + environmental impact monitoring	Periodic Monitoring assessments and reporting (Project advance + short/mid-term environmental impacts)

As explained in the 1997 Guidelines for erosion mapping and measurement, the degradation/erosion assessment procedure consists of several distinct steps:

- Step 1: For stable/stabilised environments defining the grade of erosion risks/potentials;
- Step 2: For unstable environments defining the type of dominant erosion process, its relative intensity and evolution trend; and
- Step 3: Identifying and assessing specific local features, such as main erosion-prone areas or special causative agents.

This procedure, together with the integration of socio-economic (see section 1.3. below) and national or local policy priorities, might provide the reference canvas to map information and indicators allowing the identification and delineation of priority areas for preventive, curative and/or protective remedial measures to be applied.

1.2. Socio-Economic Parameters

1.2.1. Understanding of the socio-economic aspects

Socio-economic phenomena and trends, influencing the erosion/desertification processes and respective control management programmes/projects have to be dealt with as the indispensable wider framework, as well as crucial elements of these processes. When considering the socio-economic aspects within the erosion/ desertification context, the needed approach, among others, should take into consideration the principle No. 1 of the UNCED 1992 Declaration on Sustainable Development:

> *"Human beings are the centre of concern of sustainable development. They have the right for a healthy and productive work in harmony with the nature."*

Furthermore, interactive participation as part of the programmatic concept, and the cost-efficiency of programmes/projects as the needed prerequisite for their successful implementation are interrelated and interdependent with the socio-economic factors, both at the wider and strictly erosion/desertification levels.

As mentioned in Part II of the Guidelines and presented in detail in the relevant national reports (PAP/RAC, 2000) and in their respective synthesis (PAP/RAC, 2000a), the impacts of socio-economic factors on erosion/desertification processes are multiple and related to development level, quality of life achieved, technologies available, water availability, infrastructure, population pressure, market elements, land tenure, ownership and property issues, migration caused by processes not related to land use and erosion/desertification phenomena, etc. All these and other project area specific elements have to be taken into account as appropriate, and their impacts on and significance for erosion/desertification processes identified and interpreted.

On the other hand, the most frequent and significant impacts of erosion/ desertification processes on human activities might be listed s follows:

- poverty increase in affected rural communities, leading to marginalisation and migration, resulting in land and settlement abandonment, in many cases intensifying the erosion /desertification processes;
- change of agricultural practices and land use;
- unemployment, social instability resulting with decline of productivity, reduced competitivity, loss of traditional markets for agricultural products;
- negative impacts on other industrial activities (tourism f. ex.);
- pollution induced by erosion/desertification;
- loss of property, economic losses;
- loss of amenities;
- reduced development options, etc.

Having the above in mind, the socio-economic aspects make part of the concept, methodology and procedures recommended by the Guidelines. In particular, this is related to procedures, defined in point 2.1 below, as well as to those presented in Figure 6, Table 4, Figure 7, Box 11, and Annex II, dedicated to data management.

In order to provide for a sound interpretation of socio-economic aspects, a competent expert should be fully involved in the programme/project implementation activities from the early stage of work dealing with data collection and preparation of the Diagnostic analysis. Impacts on erosion desertification phenomena of the broader socio-economic situation and trends, as well as of the specific local and process related aspects have to be identified and duly interpreted. Furthermore, when elaborating and evaluating available alternative strategies, the potential impact of these strategies on the socio-economic context have to be identified and evaluated.

In case of larger programmes/projects, and in case of insufficient and or outdated data and information a separate socio-economic analysis should be prepared by a group of socio-economic experts, assisted by members of the implementation team. In such a case, the market analysis, recommended in Box 13, might make part of the broader socio-economic analysis.

1.2.2. Identification of Stakeholders, their Status, Objectives and Needs

Before any changes to existing systems can be proposed, it is very important to understand the social groupings as well as the market forces and the effects on households. The techniques indicated in Pretty *et al.* (1995) (see Part IV) give many options to interact with community groups in order to better understand, map and plan appropriate actions for rehabilitation, conservation or improving production. The possibility of negotiating with the rural population has been used on many occasions to introduce new concepts.

A notable example from late 1950s through to 1975 was demonstrated in the field preparation and implementation phases of the Eppalock watershed project in Australia (Department of Environment, Research Directorate, 1978). Earlier research had identified technology improvements but the poorer sections of the population needed encouragement and a subsidy, as well as a push (deadline when the subsidy would expire) and some peer pressure to adopt the technologies. Government was seen to be “generous” on conditions for disbursement due to their own stated deadline, so appeared to be more flexible. The principles were incorporated later into the Landcare strategy. Groups formed into “do-it-yourself” rehabilitation action teams with minimal government support, except for some supervision and small subsidies for uncommon inputs (see also Boxes 8 and 9).

Concerning the socio-economic assessment, WOCAT Approaches and WOCAT Technologies questionnaires can be useful in systematically gathering detail on actual technologies, costs and benefits, social and cultural factors, successes, strengths and weaknesses (see Box 12).

1.3. Integration of Physical Erosion Mapping Outputs and Socio-economic Factors

The draft thematic/sectoral working maps, analytical outputs and data (site-descriptive erosion maps/land suitability) are to be confronted to the socio-economic background and realities (population density/land tenure and land use) by the means of GIS overlays operated in various steps (see Figure 8):

- assessment of land/water resource quality: on the basis of soil maps/surveys, water resources inventory and assessment;
- preparation of population and land carrying capacity maps and statistics;
- integration of land tenure and cropping patterns;
- zoning of peri-urban lands may be needed to limit the spread of construction and industry onto valuable food production areas;
- an important tool is a market study of intended innovations, to determine the conditions for introducing a new crop, new procedures; and
- adjustments to national and local priorities/strategies.

2. Identification and Screening of Options (Phase III)

This phase consists of: (i) an in-depth analysis to be prepared on the basis of the results of two previous phases; (ii) the identification of priority areas; and (iii) identification and screening of options, based on interpretation of previous results and available remedial measures and strategies. The output of the first action is presented as Diagnostic Analysis, of the second one as Identification of Priority Units and Areas, including the first draft of Synthesis Map, and of the third one as Preliminary Proposals of Priorities and Measures.

2.1. Diagnostic Analysis

In general, a Diagnostic Analysis is the essential input document for the formulation and implementation of studies, research or remedial programmes or projects. Such a document usually contains: (i) description of the project (study) area; (ii) identification of problems, their causes, resulting impacts and significance; (iii) description of the broader context, including the socio-economic factors, previous relevant activities, the legal and institutional framework, data available; (iv) a preliminary identification of priorities and priority areas; (v) results of reconnaissance and field work activities, if any, including the processed data and information collected; and (vi) interpretation of results and preliminary identification of available strategies.

Within the context of this document, Diagnostic Analysis is the initial output of Phase III, prepared according to the results of Phases I and II. Its objective is to provide and in-depth insight into relevant problems, their causes, consequences and significance, as well as to present the resulting professional interpretation necessary for the formulation of preliminary proposals for remedial measures.

Box 12

<u>Outline of the socio-economic assessment: the WOCAT example</u>

The WOCAT Questionnaire on soil and water conservation approaches (institutional implementation of a programme of SWC technologies) asks in the final conclusion:

"Can the land users continue the approach without support?"
"If the Approach was being started anew, would you propose major changes?"

In order to fill in the Approaches strengths and weaknesses which then follow, it is recommended to use a standard format at national level and reply to the whole range of related questions. The proposed standard is the WOCAT Approaches Questionnaire (QA).

The chapter and section headings are:

1. general information and background, area information;
2. specification of the Approach, objectives, operation; participation; finance; subsidies.
3. analysis; methods used for monitoring and evaluation; impact analysis.

Engineering designs, photos of actual implementation are attached and supporting documentation is abstracted.

Once the WOCAT methodology is adopted, the next stage is to detail the diverse SWC technologies which make up each Approach as described.

1. general description and area information;
2. purpose of the technology; status; design and management specification; natural environment; human environment and land use; costs; supportive technologies;
3. analysis; benefits, advantages, disadvantages; economic analysis; adaptation; acceptance or adoption.

Engineering designs, photos of actual implementation and supporting documentation is again attached or abstracted.

(World Association of Soil and Water Conservation, 1998)

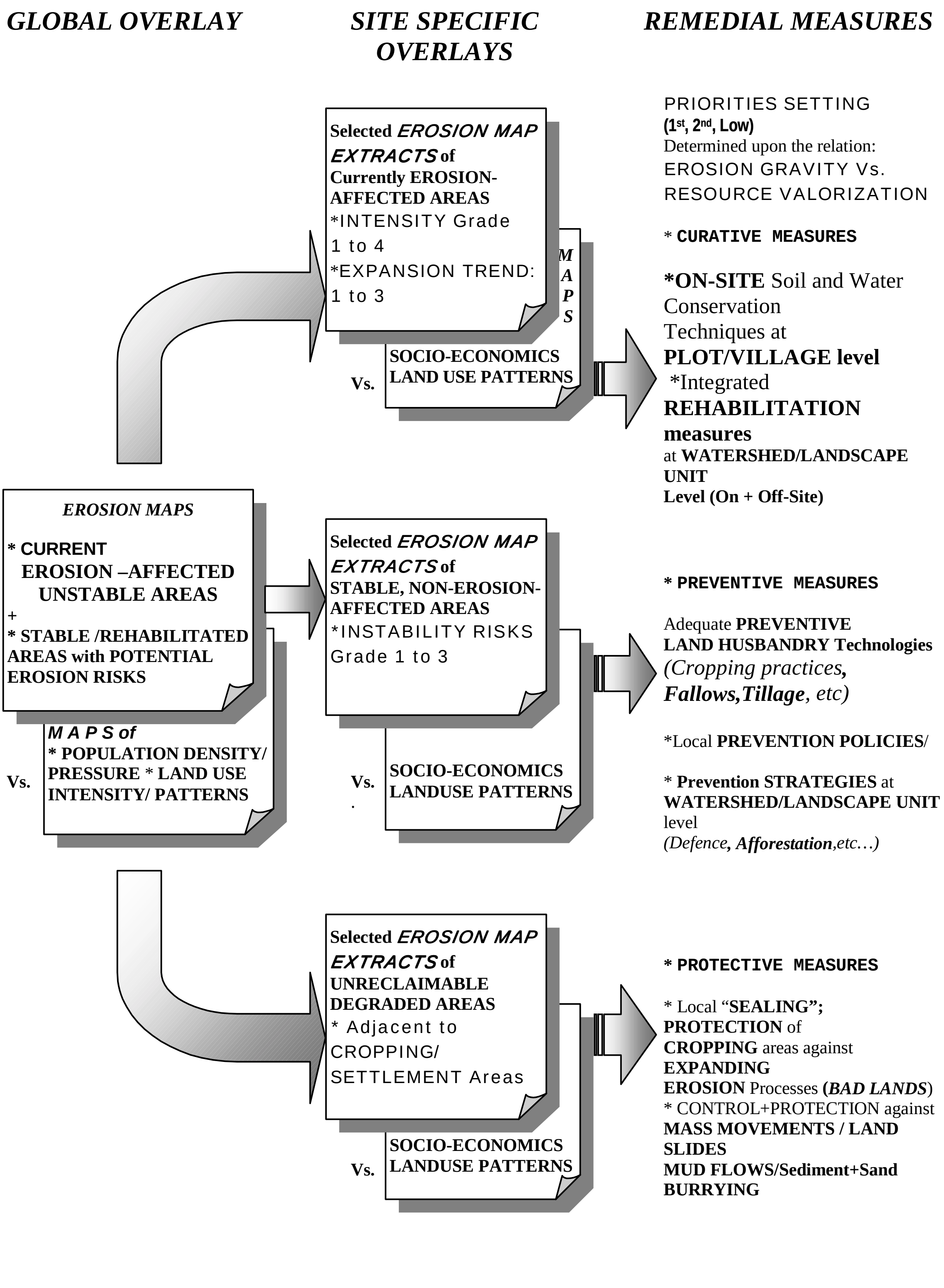

Figure 8: Integrated erosion/desertification control management procedure

The document should present: (i) available primary data; (ii) data collected during Phases I and II, related in particular to soil and water resource assessment, land use, land tenure, and the prepared erosion maps; and (iii) the relevant socio-economic analysis and the market analysis (see Box 13), integrated with mapping results, duly processed, and interpreted. Finally, the document might include preliminary considerations related to possible strategies to be adopted, based on mapping, reconnaissance and field survey.

The Diagnostic Analysis is an intermediate step, resulting form the overlay and integration of the physical assessment of resources (land suitability/state of conservation), and of relevant socio-economic parameters, including population pressure on land and current land use practices, integrating also strategic parameters and policy options and/or priorities. Conclusions and lessons brought forward by the Diagnostic Analysis should be decisive for the identification of options, their selection and prioritisation, in particular related to:

- nature of problems and the type of related adequate remedial measures;
- urgency of actions and their grade of priority; and
- alternative strategies to be taken into account when formulating Preliminary Proposals.

Box 13
Marketing aspects and factors

Diversity leads to better food security. However, planners should understand there is no point in proposing alternative crops if the infrastructure and market setup for those are inadequate.

Growers have to face many decisions through the year. Sometimes options are severely limited. Market liberalisation has created many uncertainties.

The planners should consider additionally recording:

- What is grown (and what are alternatives not yet grown); what is current demand; what are average production costs and marketing costs; what are storage and processing facilities (and future requirements)?
- Input suppliers; when and how do farmers buy inputs and at what prices; is delivery on-farm included in prices; is credit available through outgrower schemes, or from other crop type dealers or local banks; is group purchase and transport feasible?
- Are prices information for decisions on buying inputs and selling produce readily accessible?
- Is produce to be sold immediately, with full payment or by instalments; does the buying price vary in other parts of the country; are there alternative buyers; is storage an option; do traders collect at the farm gate; compare costs and benefits from storage on-farm; costs and benefits from pre-processing?
- What is the commission taken by traders; is it better to sell direct to processing plant or sell and transport as part of a group?
- Are bags included in the price paid; what are quality requirements; what are minimum quantities for collection?
- Is seed kept from harvest for home consumption or next season sowing?

Replies to these questions can be captured in the WOCAT Approaches plus Technologies questionnaires and database.

Everyone in the rural community has interest to see maximised farm income, reduced storage losses and quick compensation for produce.

(Shepherd, 1999)

2.2. Identification of Priority Areas and the Draft Synthesis Map

This action relates to the formulation of remedial measures, based upon a final cartographic and statistic documentation and interpretation on the global state of erosion /degradation/desertification (actual and potential). The main output of integrated diagnostic procedures is a draft synthesis map providing a preliminary planning framework. It is the result of the diagnostic analysis as described in section 2.1. and of the complementary map-interpretation exercises:

- A preliminary step consists of identifying, delineating and categorising areas of homogeneous erosion status (erosive processes of similar nature, intensity and expansion trend, or similar conditions of stability and/or erosion risks) independently of resource quality and/or land-use patterns;
- The second step is the overlay and confrontation of the basic physical erosion diagnosis with the soil quality/suitability maps of similar scale, together with the distribution of population, land use patterns and other relevant socio-economic parameters;
- A third step integrates local, sub-national or national policy or strategy decisions which might confirm or occasionally modify and re-orient the technicians' diagnosis.

Derived from these data, draft designs and proposals can then be formulated for preventive, curative and protective remedial measures, as well as related priorities for their application. It would be very helpful to prepare a systematic inventory of soil and water conservation technologies applied, subdivided in agronomic, vegetative, structural and management, following the questionnaires of WOCAT (World overview of conservation approaches and technologies, World Association of Soil and Water Conservation, 1998) – see Annex IV.

The available physical measures (either mechanical or biological), most commonly applied are briefly presented and commented below.

<u>2.2.1. Preventive Measures</u>

a) Agronomic measures

Crop rotations should alternate with soil regenerating leguminous plants. At farm level, the decrease of organic matter in the soil, can be reduced by the means of some simple measures:

- incorporating green manure;
- applying improved fallow periods;
- returning crop residues into the soil; and
- improving cropping practices.

Arboriculture should be encouraged on selected, soil suitable areas. Conservation tillage is increasingly used in very diverse agricultural systems. The conservation tillage technique might be applied in various ways, as reduced tillage, no tillage, or direct drilling. It is characterised by surface cover of stubble, herbicide application to control weed competition for water and light, and less tilling. Conservation tillage increases both the soil organic matter content and the infiltration rate, and reduces evaporation losses, which, in turn, lead to a higher soil water content and mitigate soil erosion. It also protects the topsoil against raindrop impact (splash effect) and reduces the shear stress of runoff (Giraldez, 1996). The main disadvantages of this cropping system are the need for nitrogen fertilisation, an increase in pests due to the greater amount of vegetal residues, the need for an integrated weed control, and time for the training of farmers. Grass soil cover in specific crops (vineyards, orchards) to prevent excessive growth and protect the soil surface from splash erosion.

Pastoralism and associated sylvo-pastoral management is to be considered as a particularly sensitive agronomic practice in the Mediterranean regions due to marked traditional features sometimes conflicting with other cropping activities (plantations, wood and timber extraction). Special aspects to be considered are as follows:

- rangeland protection;
- co-operative development;
- new techniques of cattle breeding; and
- management of steppe rangeland.

New policies have been introduced in some North African countries limiting the free access of animals in some areas sensitive to droughts and overgrazing. Pastoral co-operatives take care of the implementation of these new policies.

b) Biological and ecological measures

All advanced land planning schemes now recognise forested areas as integrated part of the rural space. At regional level (Mediterranean Biome) two basic aspects are to be taken into consideration:

- the urgent need for the protection and improvement of the locally adapted bushy/shrubby formations (maquis, matorral, macchia, garrigue, phrigana,...);
- the simultaneous implantation of both productive and anti-erosive forest plantations (most of existing forests are coniferous and provide poor soil protection) for fuel wood thus reducing the human pressure on natural forests.

Environmental Impact Assessment and the Strategic Environmental Assessment will be relevant and particularly important to protect agriculture in peri-urban and industrialised areas.

2.2.2. Curative Measures

a) Reforestation and watershed planning projects

As far as marginal land or less agriculture suitable areas are concerned, reforestation is by far the best ecologically adapted and most efficient soil erosion control technique. In these marginal areas less suitable for crops, shifting to range activities might restore a natural ecological balance.

This type of projects are based upon the combination and integration of several actions:

i) Reforestation of degraded forest and range land as well as marginal agricultural lands. The reforestation consists of mechanical soil preparation techniques including bench terracing, sub-soiling and the introduction of drought resistant species (almost exclusively coniferous). These methods have been widely criticised and now there is a strong emphasis on increasing species diversity and the use of bushes (Castillo, 1997);

ii) Grazing land management. This implies an estimate of the stocking rate according to pasture carrying capacity to avoid overgrazing. Additionally, the improvement of natural pasture by sowing grass or woody species, and fertilisation may be considered;

iii) Installation of anti-erosive structures, mainly check dams, for gully erosion control and stabilisation of gully heads; and

iv) Forest management and forestry treatments to improve the extension and density of soil coverage by the means of natural vegetation.

b) Land rehabilitation in arid and semi-arid Mediterranean areas

Some locally adapted technologies for rehabilitating degraded soil in arid and semiarid Mediterranean areas are based on soil quality improvement by organic fertiliser and use of plant species improved by the addition of symbionts (partner organisms within a symbiosis). Both urban wastes and sewage sludge are being used as organic sources for improving the soil quality of agricultural land, and restoring marginal degraded land (Albaladejo *et al.*, 1996).

2.2.3. Protective Measures

In sloping areas, where erosion problem are most severe, the general basic measures to be applied are as follows:

- to secure a minimum disturbance of local physiographic features with special emphasis on the natural drainage network;
- to preserve the balance of naturally or artificially stabilised degradation processes;
- to apply drainage control and land consolidation measures on active erosion processes; and
- to implement adequate combinations of natural vegetation cover and adapted cropping patterns.

a) Physical measures

Physical measures usually imply the construction of specific protection structures. The function of these structures is to intercept surface runoff and convey it out of the field. Furthermore, concentration of runoff water through the hillside ditches increases gully development since farmers do not take any specific conservation measures (e.g. mulching or live crops) inside the channel. In some rather limited areas of semi-arid or semi-desertic fringes of the Southern Mediterranean region, dune fields or shifting sand stretches inland or in coastal areas are usually stabilised and controlled by the means of, either mechanical or live plant material.

b) Socio-economic measures

Whatever the measures being selected and adopted, their assessment implies the integration of the erosion risk concept expressed in terms of social and/or economic benefits or losses; some specific decisions and measures might be envisaged:

- opening remote and marginal rural areas, thus favouring new markets and commercial exchanges;
- providing training and extension facilities to rural population for improved agriculture by the means of participatory approaches and actions;
- preparing sets of sound adequate soil and water conservation technologies; and
- promoting improved and mutual confidence-based planning and working relationships between rural communities and government authorities.

Locally adapted development programmes based upon land degradation control management plans should also consider, and possibly integrate, some broader complementary criteria, such as:

- improvement and strengthening of local policies;
- creation and promotion of extra-agriculture activities, such as tourism and handicrafts; and
- installation and implementation of special funds and/or co-operative facilities to attend local emergencies and priorities.

3. Identification and Formulation of Control Management Plan (Phase IV)

3.1. General planning approach

The general planning concepts and procedures should follow the sequence and steps as proposed and introduced by agricultural land-use planning experts in a recent UNEP/FAO publication (FAO/GTZ/UNEP, 1999) on sustainable agriculture development programmes (see Figure 9).

3.2. Identification of the Erosion/Desertification Control Management Plan

The erosion/desertification control management plan consists of site-specific rehabilitation and remedial measures pattern to be formulated and described in the final synthesis document. The final sets of data and maps will include technically annotated legends, technical notes and all working documents relevant to the selection of geo-referenced and locally adapted soil conservation and erosion control technological packages. The overall action plan will identify and co-ordinate all actions, measures or decisions generated either by the direct initiative of the stakeholders undertaking on-site works, or through more indirect outside help and support such as subsidies, institutional decisions or professional and financial contributions. Figure 10 provides a scheme of this kind of operational procedure.

The identification and description of the erosion control planning model comprises the following steps and decisions:

- identification and precise delineation of specific intervention areas or landscape units, their type of problems and grade of priority, and the selection of remedial measures to be applied;
- setting and description of technical specifications, preparation and final adoption of the working programme, related time-table and description of activities, as well as their assessment in terms of cost/sustainability;
- specification of institutional and administrative arrangements, identification of local contributions, description and preparation of participation modalities at both decisional and implementation levels; and
- identification and preparation of a set of monitoring indicators and procedures for on-going activities and potential environment impacts.

Whenever possible and as appropriate, it is recommended to use sustainability indicators (see Box 14 and Table 5). Larger projects, such as those formulated within the MAP programme, might also apply the Systemic Sustainability Analysis (BP/RAC 2000), identifying, defining and interpreting sustainability indicators at project and erosion/desertification levels (see Box 16). Both technical and administrative issues should be thoroughly assessed and agreed upon by multidisciplinary teams and responsible authorities and institutions on the occasion of inception meetings or workshops.

3.3. Appraisal and Set-up of the Plan

The preparation of an integrated document, containing Erosion/Desertification Control and Land-Use Development Plan, related maps and planning graphs and flowcharts, should foresee the following steps:

- preparation and proposal of a draft erosion/desertification control management plan;

- testing consistency of the draft plan with the national planning perspectives and priorities; and
- formulation of the final plan (operational erosion control and management plan).

1) Formulation

The control management strategies and the programme formulated as described in the preceding chapters have to be presented in the form of a comprehensive document, containing:

a) the recommended preventive, curative and protection measures and technologies to be applied, and the respective actions to be implemented;

b) the monitoring, evaluation and reporting procedure, related to the: (i) actual erosion /desertification processes; (ii) implementation of the programme; and (iii) post implementation phase; and

c) identified prerequisites for implementation: (i) the institutional arrangements; (ii) design of the participatory programme; (iii) professional and/or scientific support, if needed; (iv) capacity building; (v) the evaluation and verification procedure, as appropriate; (vi) adoption/approval procedure; and (vii) funding.

2) Evaluation and verification

The document, once formulated should be subject to evaluation/verification or revision. Such verification is made: (i) at professional or scientific level, as appropriate; (ii) by public consultation, through a public participation programme; and (iii) by the responsible authorities. The procedure is country specific.

3) Detailed programme elaboration

After verification, the programme needs a detailed elaboration of the prerequisites, listed under c) above. This might require the preparation of a feasibility study, or of an Inception Report, containing details of: the institutional arrangements; the needed capacity building programme; Workplan and Timetable; the costs calculated, budget proposal, funding sources and cost sharing.

4) Approval

The elaborated document is submitted to the authority(ies), entitled to approve the programme/project (local authority, local assembly, ministry, government, national assembly). The approval procedure is highly country and project specific.

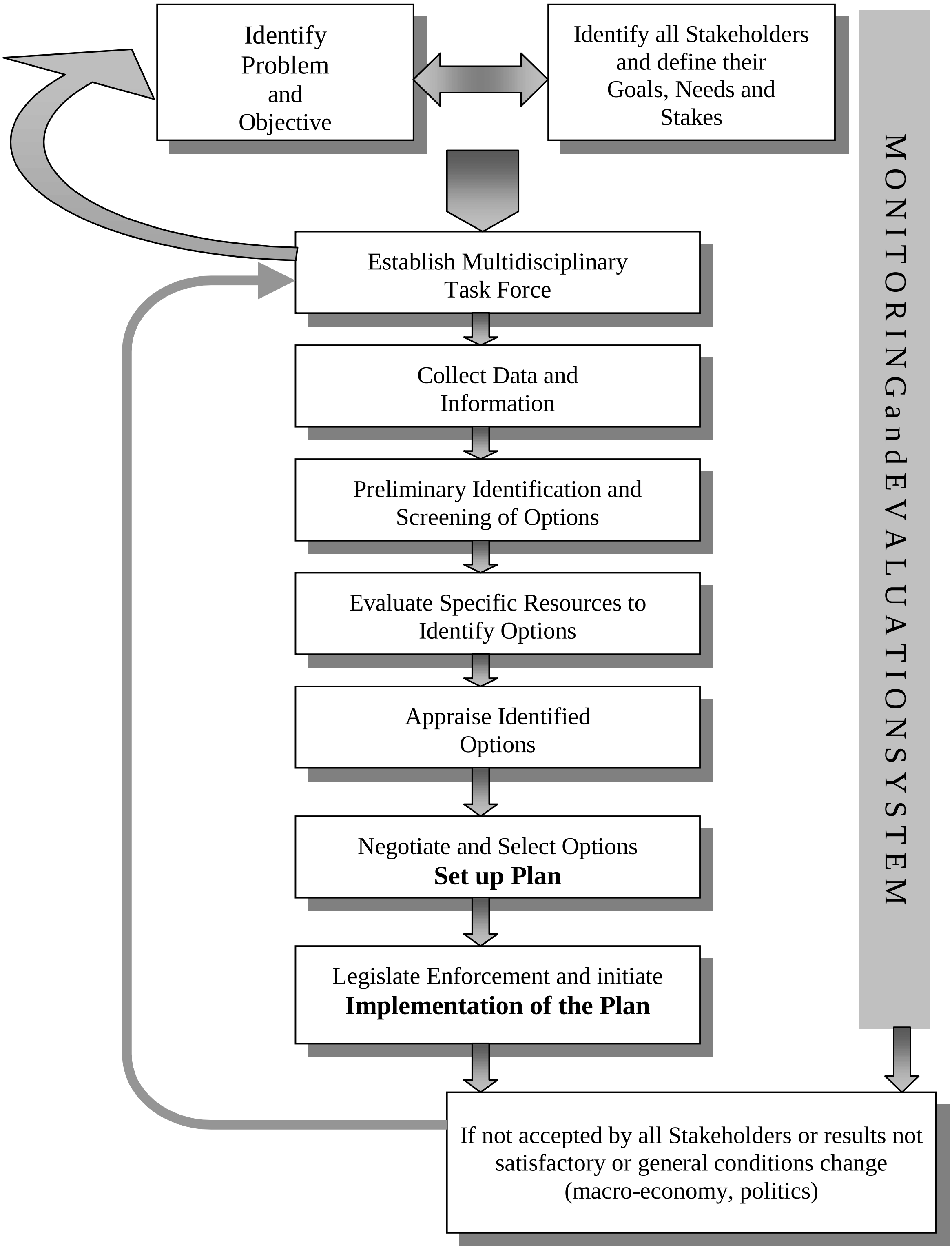

Figure 9: The planning methodology

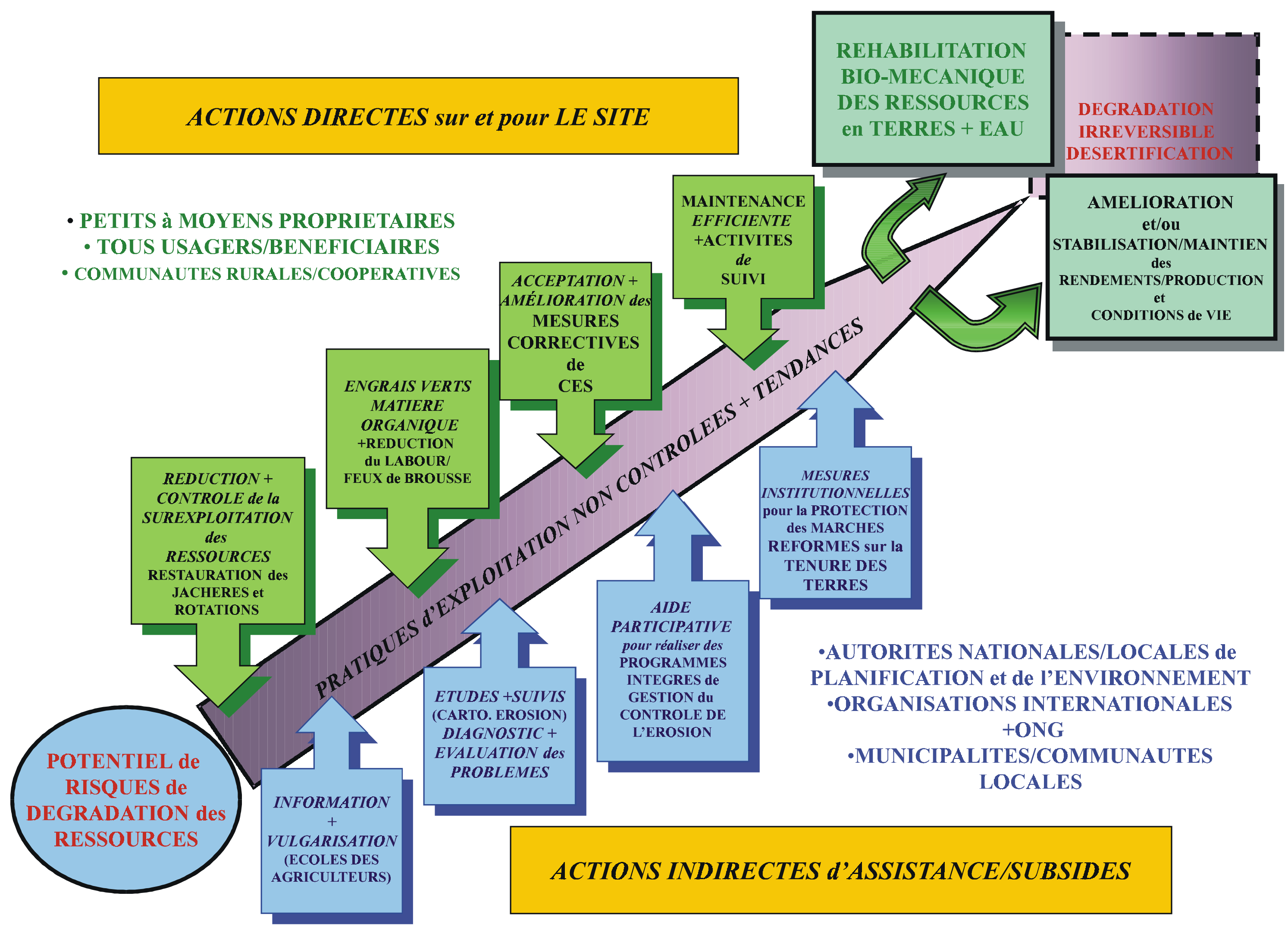

Figure 10: Proposed scheme for integrated approach and planning of measures

Box 14
Sustainability indicators

Agenda 21, Chapter 40

"Indicators of sustainable development need to be developed to provide solid basis for decision makers at all levels and to contribute to the self regulating sustainability of integrating environment and development systems."

Sustainability indicators represent a source of information on performance and trends of change and should be used as a practical tool for formulating sustainable development policies. Their basic functions are:

- to simplify the description of a system;
- to quantify basic development aspects; and
- to communicate information on sustainability issues, in a transparent way, to decision makers. stakeholders and affected/involved population.

According to the purpose and use, indicators are identified and defined at the national, sub national, and local or project area levels

The following might be listed as standard selection criteria for sustainable indicators

- transparency;
- availability of data at appropriate level;
- cost effectiveness, comparability; and
- public sensitivity.

In case of erosion/desertification control management programmes or projects, sustainability indicators and their general interpretation should be focused on:

- development trends and their sustainability at national, and if specific at sub national levels;
- same for the project area level;
- implications of sustainability level and trends on erosion/desertification control management strategies;and
- impacts of alternative strategies on specific erosion/desertification related indicators and on the whole set.

The following is a list of potential indicators, related to erosion/desertification control management programmes/projects:

- population growth;
- employment rate, unemployment rate;
- land cover classification, land use, landscape;
- treatment of vacant and derelict land;
- abandoned agricultural land;
- reuse of land by sectors;
- % of land under active conservation management;
- % of built up and of non-built land;
- areas under irrigation and type;
- afforested areas, surface, %;
- rebuilding of terraces, rubber walls;
- soil quality: nutrient loss;
- pollution: heavy metals in topsoil; and
- habitats indicators, biodiversity indicators.

Table 5:
Some examples of monitoring indicators on sustainability of agricultural land

Issues	Pressure	State	Response
Bio-diversity/ landscape	• Land use changes **from natural state;** • **Overexploitation of land + water resources.**	• Extinction threat **on species;** • Break of **ecological balance.**	• Total expenses incurred in **protected areas management;** • Percentage of **protected areas** as related to the national territory.
Water resources (fresh water and waste water)	• **Intensity** of use of **surface + underground water** as related to the total renewable water resources available **(Exploitation rate)**; • **Contamination/ pollution**; • **Non-sustainable water** production rate: proportion of **fossil resources** and/or **over-exploitation**.	• Frequency, duration and extent of **water shortages;** • Share of provided **potable water** not conform to **quality standards;** • General **water quality rate.**	• **Water Authorities/ IWRM** (Integrated Water Resources Management)**;** • **Waste water treatments:** ▪ Share of **waste water actually collected and treated;** ▪ Share of treated **industrial waste water;** • **Potable water consumption** efficiency; • Existence of **economic tools** for **water costs** assessments.
Land/soil degradation/erosion/ desertification	• **Intensity**/rate of **land exploitation;** • Increasing occupation of **marginal land** (mainly mountainous **sloping land)** .	• Changes in **land use** and **cropping patterns**; • **Abandonment of land** and their **conservation infrastructures;** • Constructions on agricultural land **(impermeabilisation)**; • Rate of **topsoil losses**; • Soil **fertility/nutrients loss**.	• Existence of **national environment management/ protection authorities**; • **LUP** (Land Use Planning); • **ICAM** (Integrated Coastal Areas Management); • Adoption/ implementation of **erosion/desertification control management programmes**; • **Rehabilitation** of degraded areas.

After (OECD, 1994) and (PLAN BLEU – CMDD, 1999)

4. Implementation of the Management Programme (Phase V)

When approaching the programme implementation, distinction should be made regarding the type of remedial measures envisaged. Should the programme include civil engineering works, that part of programme has to be implemented according to the actual national legislation and procedure. Programmes envisaging non-structural activities only (legal, institutional, capacity building, changes in land-use and of agricultural practices, market instruments applied, regular or special monitoring, etc.) will follow the standard project management procedure. In case of the Mediterranean coastal areas, the ICAM procedure is recommended, in particular if the programme makes part of a larger integrated project. Finally, in case of the programme implemented within MAP CAMP, it has to follow the respective MAP procedure (UNEP/MAP, 1999).

The main phases of a standard implementation procedure are as follows:

a) Initial phase, focused at implementation of activities defined as prerequisites: approvals, permits, property issues, training, establishment of institutional arrangements, securing availability of funds, adjusting workplan and timetable with expected cash flow, preparation of the technical specification, contracts. If construction works make part of the programme, technical documentation, project design, other accompanying activities (EIA, permits for construction, etc.) make part of this phase.

b) Implementation phase: the programme is executed according to the technical specification and design, workplan and timetable.

c) Monitoring of implementation, evaluation and reporting. This phase is implemented simultaneously with b) above. The procedure has to be defined by the technical specification and design, and is programme and area specific. In general lines the monitoring process is following the procedure defined for post project activities in section 5.

d) Technical revision and permits for use: the civil engineering works, if any, when completed, are submitted to the procedure of technical revision, approval and obtaining of permits for use. The procedure follows the national regulations and practice.

e) The participatory programme. Applying the participatory principle, during the entire implementation stage, i.e. the above phases a) – d), a participatory programme should be implemented, addressed at the resident/affected population and major stakeholders (see Part III, Chapter 4). Box 15 illustrates some aspects of the participatory approach during the implementation process.

5. Post-Implementation Activities (Phase VI)

5.1. General Approach to Monitoring Activities

At national level, the general post-implementation monitoring activity should be assigned preferably to a body with inter-ministerial powers. If such an institute already exists, it may only be necessary to slightly adapt the terms of reference, which is preferable to creating a new body.

Within such a body, an expert group or committee, which might be formed from various agencies, should be established to collect a comprehensive list of monitoring issues concerning the land resource management. An initial brainstorming would focus on points to be clarified with land users in selected areas. The WOCAT Map Questionnaire might be used as a tool for collecting the appropriate estimations and evaluation; information is layered in a GIS. SOTER is currently used as the reporting tool.

Box 15
Monitoring and evaluation of the implementation phase

When stakeholders are designing the monitoring and evaluation plan, they should ask themselves the following:

- If the implementation is going according to plan and meeting the objectives, how will we know?
- What will be the key indicators that it is working as desired?
- How will the key indicators tell us whether it is working or not?
- Are the assumptions realistic?

Typically, monitoring and evaluation should be done throughout the implementation process and stakeholders should review and retest the indicators they have already identified and ask:

- Is the implementation keeping to the time schedule? Do adjustments have to be made?
- Are the activities proceeding successfully (criteria for success)?
- What is proving to be less than successful?
- Is there new information or are there influencing factors (threats, opportunities) that need to be taken into account?
- What actions and strategies need to be taken to address the new conditions and reform unsuccessful aspects?

(FAO/GTZ/UNEP, 1999)

A market investigation can be introduced at this point. As part of the essential information gathering and measuring, it is important to know what main upstream land uses are prevalent, what range of crops and cropping practices are used, how these crops are related to soil management, what the economics are in terms of cost/benefits and if there is room for improvement at points in the production, harvesting, storage, transport and marketing operations.

This study will draw attention to the necessary arrangements to be put in place before new introductions or modifications to systems are proposed. Diversification to new enterprises can only be effective when the basic infrastructure, inputs supply lines, transport and storage facilities are in place and assured buying arrangements are present.

The collected issues are distributed back to the relevant institutions for further analyses. Logically, a consolidated monitoring programme is then devised. There are of course other participative ways of addressing these questions. From government point of view, the assumption is that local communities often have a better understanding of the problem and the solutions, so it would be cost-effective to give subsidies in order that local groups carry the process to a logical conclusion.

Agro-meteorology has important application in all dryland planning schemes. A serious effort has been engaged through the technique known as “Response Farming” where rainfall records are analysed and decisions are taken at onset of rains, depending whether these come early, late or mid-period. The principles should be studied.

5.2. Specific Erosion/Desertification Control Monitoring

Monitoring of processes within the post-implementation phase has to be applied according to specific criteria as described in part IV, chapter 3.

5.3. Environmental Impact Monitoring

The common methods of environmental impact monitoring for erosion/desertification control activities seem to be primarily focusing towards the monitoring of direct project performances, i.e. number of hectares and kind of landscape treated, but little or no attention is paid to the monitoring of their short or long-term environmental impacts, such as ground water recharge and bio-diversity balance. The creation of indicator-database can facilitate the selection of indicators adapted to specific geomorphic situations (up-stream – down-stream interactions and connections), and provide standardised methods. The storage of data is important, but their accessibility should also be guaranteed.

Environmental impact assessment and monitoring should ideally be applied on natural landscape features easily identifiable along transects, longitudinal from catchment headings to the river mouth, and/or valley cross-sections from hill tops to the valley bottom, all along the various slope sections (upper, middle, low). In most Mediterranean environments these physiographic features are clearly visible due to the rather scarce vegetation cover and usually well defined and contrasted geologic structure.

On each of these landscape reference hints environmental monitoring exercises should focus on a set of basic indicators, such as:

- run-off, spring and surface waters on slopes and valleys;
- soil/sediment removals/transfer and/or deposits;
- natural vegetation cover; and
- biological indicators (fauna + flora).

Some examples are worth to be mentioned as fairly representative of Mediterranean environments:

- On highlands, plateaux, divide lines:
  - state/improvement or degradation of reforested or bush-fire recovering areas (garrigue, maquis or matorral); changes in protected defence areas;
  - state of wildlife (birds, small animals).
- On sloping land:
  - stabilisation or expansion of rill and gully networks or systems (trend/amount of natural/spontaneous revegetation);
  - soil/sediment transfer reduced/stopped/increased;
  - occurrence of landslide/mass movements;
  - importance of sediment deposits on the hill foot;
  - changes in springs regime and/or yield.
- In the valleys:
  - changes in the amount of rivers bed load and suspended sediment load;
  - indications on silting-up in dams and river-connected irrigation networks;
  - river banks stability;
  - changes in frequency and regime of flooding.
- In coastal areas and river mouths:
  - suspended river load/presence of polluting elements;
  - state of coastal erosion dynamics;
  - grade of stabilisation of dune fields and systems.

Periodic controls and assessment of these sets of key indicators should be performed following a specific and permanent agenda, considering extreme seasonal climatic features, as well as exceptional events, such as floods, droughts, important bush fires or major mass movements on sloping land.

Box 16
Programme/project evaluation criteria

The evaluation of the programme/project implementation should be done by applying evaluation criteria, to be defined in the initial phase of project formulation.

The evaluation criteria should be set up according to:

- programme/project objectives;
- workplan, timetable, budget; and
- outputs and results envisaged by the end of the implementation phase.

The following evaluation criteria might be considered when formulating a programme/project (*):

Quantitative evaluation criteria:

- timely implementation, % of time of extended project duration, in comparison with the original timetable;
- % of workplan implemented;
- overrunning of budget, if any, % of overrun;
- number of experts involved in the project;
- number of participatory actions implemented;
- number of stakeholders involved;
- number of persons trained, number of capacity building activities;
- equipment supplied; structures, constructions built up;
- database established;
- catalytic effects, if any, in value; etc.

Qualitative evaluation criteria:

- professional evaluation of results achieved by the completion of the project, vs. those envisaged by the project document;
- benefits identified vs. those expected, impacts on sustainable use of land resources;
- evaluation of professional capacity of involved institutions and authorities achieved by programme implementation;
- stakeholders response and participation;
- intellectual catalytic effect/impact on decision making process and decision makers at various levels;
- replicability of the programme/project in other areas in the country and outside;
- increased public awareness; etc.

Other programme/project specific evaluation criteria:

Other criteria might be identified, according to the conditions, nature and other specific characteristics of the programme/project. Whenever possible, it is highly recommended to identify and formulate them, as appropriate.

Final Sustainability Assessment:

Following the programme/project commitment for a sustainable land use and the recommendations to develop and apply sustainability indicators, inclusion of a final sustainability assessment in the evaluation process is recommended.

(*) The criteria listed should be taken into account with a flexible and creative approach, understanding them as a check list.

5.4. Evaluation of Monitoring Results

On the basis of regular monitoring during the post implementation phase, evaluation should be made related to monitoring indicators and evaluation criteria presented in part IV, chapter 3, and part V, chapter 5.3, and in particular:

- whether the prescribed remedial measures and practices are being implemented correctly;
- functioning and maintenance of structural elements and equipment, if any;
- direct impact of applied measures on processes, resources, and land management;

- contribution to improved sustainability of land management;
- wider impacts of applied measures: direct and indirect benefits, social aspects, development implications, etc.

In addition, evaluation criteria, as defined by the programme, have to be compared with the actual results identified through the monitoring process (see Box 16). Finally, a critical assessment of prescribed measures has to be made, describing the problems met and corrective actions undertaken. Proposals for minor adaptations and/or changes should be formulated, if needed and as appropriate. In the case of the need for reconsideration of basic elements of the programme, the report should propose the initiation of the reconsideration procedure. Due to its highly professional and multisectoral character, the evaluation should be made by an interdisciplinary team of experienced experts.

5.5. Reporting

The results of the monitoring process and evaluation should be regularly reported at periodic intervals (usually half-yearly or yearly), or on an *ad hoc* basis in case of need or if requested. Each report should include elements mentioned in section 5.4. Summarising the results achieved, the reports should present the problems met, lessons learned, and, most importantly, the proposals for the follow up. Should the evaluation procedure indicate the need for an in-depth reconsideration of the programme, the report should formally request the start of the reconsideration procedure, the professional justification and interpretation for the request included.

Usually, reporting is the obligation of the lower (local, area) level responsible institution or authority, to be addressed to responsible national authorities, with copies to the relevant local administrative authority. In all cases, regular information, properly formulated, should be presented to major stakeholders, and the involved/resident population and target groups.

5.6. Reformulating of the Programme

Should the need arise, based on evaluation and reports presented, and verified by competent authorities, the process of reconsideration/reformulating of the programme should be initiated. Depending on the nature of reasons for reformulating, the process will start either from the beginning of the procedure described by the Guidelines or from one specific Phase, as appropriate. Accordingly, relevant decisions will have to be made and prerequisites created for the start of the procedure.

Annex I:
Glossary of Terms

Agro-Ecological Zone *(F.: Zone agro-écologique; S.: Zona agro-ecológica)***:** A land resource mapping unit, defined in terms of climate, land form and soils, and/or land cover, and having a specific range of potentials and constraints for land use.

Aridity *(F.: Aridité; S.: Arido)*: Bio-climatic feature of environments with extremely dry climate as a consequence of insufficient precipitations; the aridity rate is expressed in relation to total rainfall, average temperature and evaporation.

Biome *(F.: Biome; S.: Bioma)*: The largest recognised ecological region as a result of complex interactions of climate, geology, soil type, water resources and latitude. These components together determine what types of plant and animal life exist in different place.

Biodiversity *(F.: Biodiversité; S.: Biodiversidad)*: The variety and variability among living organisms and the environment in which they occur. The richness of the mix of elements and the connections between those elements that sustain the system as a whole**.**

Carrying Capacity *(F.: Capacité de charge; S.: Capacidad de carga)*: A relative concept, largely dependent on value judgement; a frequently used definition refers to the maximum pressure, rate of exploitation, number of users which can be sustained by a number of man-made resources without endangering its future productivity, character and qualities (UNEP, 1995)**.**

Catchment, see Watershed.

Desertification *(F.: Désertification; S.: Desertificación)*: Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNEP, 1995).

Drainage Area, see Watershed**.**

Drainage Basin/Network, see Watershed**.**

Erodibility *(F.: Erodibilité; S.: Erodibilidad)*: Susceptibility to erosion, erosion proneness. Sands are generally more erodible than silts, and silts more than clays; no fully satisfactory soil erodibility assessment method has yet been found. Soil erodibility might change according to the soils' physical conditions (soil wetness, frost, recent tillage or compaction). Angular soil particles are more interlocking than rounded particles; soil colloids cement particles together; compaction increases total surface contact among particles.

> **Erodibility Map**, from the current elaborated Mediterranean common mapping methodology, expresses the same practical concept by crossing the soil's qualitative erodibility with the slope factor to assess the overall land erosion susceptibility.

Erosion *(F.: Erosion; S.: Erosión)*: The wearing away of the land by running water, rainfall, wind, ice or other external agents, including such processes as detachment, entrainment, suspension, transportation and mass earth movement.

Erosion Risk *(F.: Erosion Potentielle; S.: Riesgo de Erosión)*: Probability rate for an erosion process to start and develop as a result of changes of one or several erosion inducing or controlling factors. While climate, soil and topography are fairly stable, vegetation cover, land use and management are more liable to modifications. The concept of risk is equivalent to that of potential erosion.

Erosivity *(F.: Erosivité; S.: Erosividad)*: Potential ability of physical dynamic agents such as water, wind or ice to cause erosion. Falling rain is more erosive than water moving over the surface of the ground. Drop size, falling velocity and intensity are rain features related among themselves which determine rainfall erosivity.

Erosion Status. *(F.: Etat érosif; S.: Estado Erosivo)*: Actual and/or Potential Erosion assessment as related to the local environmental features such as topography, geology and soils, vegetation cover and land use. Rainfall and other climatic features are not taken into account**.**

Erosion Trend *(F.: Tendance évolutive de l'érosion; S.: Tendencia de Erosión)*: The predictable tendency of an erosion process to develop or to stabilize in terms of nature, intensity and/or area expansion.

Evapotranspiration *(F.: Evapotranspiration; S.: Evapotranspiración)*: Amount of water transferred into the atmosphere by evaporation from the soil surface and by plant transpiration.

GIS (Geographical Information System) - *(F.: SIG; S.: GIS)*: A system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which is spatially referenced to the earth.

Gully Erosion *(F.: Erosion concentrée, Ravinement; S.: Erosión en Cárcavas)*: The removal of soil by the formation of relatively large channels or gullies cut into the soil by concentrated surface runoff. In contrast to rills, gullies are too deep to be obliterated by ordinary tillage practices.

Landslide *(F.: Glissement de terrain; S.: Deslizamiento de terreno)*: A slope mass earth movement where a soil or substrata mass slides over a contact surface called sliding surface.

Land Tenure *(F.: Tenure des terres; S.: Tenencia de la tierra)*: Land tenure refers to the arrangements or rights under which a person or a community are allowed to use specific pieces of land and associated resources (e.g. water, trees, etc.)**.**

Lithofacies *(F.: Lithofaciès; S.: Litofácies)*: A term used to describe the physical mechanic and organic features of local soil and subsoil conditions.

Marginal (Land/Environment) *(F.: Marginal; S.: Marginal)*: Land which is not suitable, economical or productive in most circumstances for a generalised type of land use (agriculture, forestry, grazing) due to the presence of climatic, soil-associated or geographic constraints.

Mass Earth Movements *(F.: Mouvements de masse; S.: Movimientos en masa)*: Erosion where main causative agents are water-logging and gravity. Heavy and/or prolonged rains are usually the triggering factors. Landslides, mudflows, rock falls and soil creep are mass movements.

Mudflow *(F.: Lave torrentielle; S.: Lava torrencial)*: Viscous muddy fluid composed of water and a very high concentration of sediments and solid weathering debris and which has been generally originated by mass earth movements such as landslides in the catchments' upstream sections**.**

Rill Erosion *(F.: Erosion en rigoles; S.: Erosión en Regueros)*: The removal of soil by the cutting of numerous small, but conspicuous water channels or tiny rivulets by concentrated surface runoff. The marks of rill erosion may be obliterated by ordinary tillage practices.

Runoff *(F.: Ruissellement; S.: Escurrimiento/Escorrentia)*: Portion of total precipitation from a given area that appears in natural or artificial surface streams.

Sediment Delivery Ratio *(F.: Pourcentage de sédiments transportés; S.: Porcentaje de acarreo)*: A measure of the sediment actually reaching a stream or any water body expressed as the quantity of material of material reaching a specific point in a drainage system divided by the quantity actually eroded in the catchment above the same point.

Sedimentation *(F.: Sédimentation; S.: Sedimentación)*: The process of deposition of solid material by water.

Sheet Erosion *(F.: Erosion en nappe/laminaire; S.: Erosión Laminar)*: The removal of a fairly uniform layer of soil from the land surface by runoff, water or wind.

Soil Crusting *(F.: Encroûtement; S.: Sellado del Suelo)*: Process of compaction and cementing of fine soil surface particles removed and accumulated by splash and sheet erosion processes which can lead to a complete sealing of soils pores.

Splash/Raindrop Erosion *(F.: Erosion pluviale/aréolaire; S.: Erosión Pluvial)*: The spattering of soil particles caused by the impact of raindrops on the soil. The loosened particles may or may not be subsequently removed by runoff; splash erosion is an important component of sheet erosion.

Steppe *(F.: Steppe; S.: Estepa)*: Term usually applied to environments with less than 500 to 600 mm rainfall per year and a dry season of 8-9 months, and with open, widely spaced herbaceous formations containing perennial and xerophitic graminae.

Suspension/Suspended Sediments *(F.: Sédiments en suspension; S.: Sedimentos en suspensión)*: State of floating and dispersed eroded sediment particles in water, especially for the smaller and lighter particles such as fine sand or clay.

Sustainable Agriculture and Rural Development (SARD) *(F.: Agriculture et développement rural durables; S.: Agricultura y desarrollo rural sostenible)*: The management and conservation of the natural resource base, and the orientation of the technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development in the agriculture, forestry and fishery sectors concerns land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically and socially viable.

Sustainable Development *(F.: Developpement durable; S.: Desarrollo sostenible)*: Development which respects the environment, is technically appropriate, economically viable and socially acceptable, which allows the need of present day generations to be met without undermining the possibility of future generations to satisfy theirs. (MAP).

Meeting the needs of the present, without undermining the possibility of satisfying those of future generations (The Bruntland Commission).

Terracetting *(F.: "Pieds-de-vaches"; S.: Pisoteo)*: The characteristic pattern formed by numerous gently inclined steps or ledges traversing a hill slope; It is most probably caused by the combined action of soil creep and the tread and trampling of animals.

Thalweg *(F.: Thalweg; S.: Talweg/Vahuada)*: A term frequently used to designate the longitudinal profile of a river, i.e. from source to mouth following the line of the lowest points of a valley.

Vegetation Cover *(F.: Couvert végétal; S.: Cobertura vegetal)*: Proportion of a particular area of the ground, substrate or water surface covered by a layer of plants considered at the greatest horizontal perimeter level of each plant in the layer**.**

Water Divide Line *(F.: Ligne de partage des eaux; S.: Divisoria de aguas)*: Dividing ridge between two neighbouring catchments.

Watershed = Catchment, Catchment Area, Drainage Area, Drainage Basin, River Basin. The area which supplies water by surface and subsurface flow from rain to a given point in the **drainage system/network/pattern.**

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Annex II:
Data and Information Management

The main tools for data and information management are remote sensing, GIS, and statistic processing systems.

1. Remote Sensing

People have always used lookout points high above the landscape to view the surrounding terrain. These lookouts provided a so-called “bird’s eye view” of the surroundings, and the people could examine and interpret what they observed (Aronoff, 1989). A similar way of collecting information on the landscape is used in the technique termed “*remote sensing*”. Data thus collected are called “*remotely sensed*” data. These techniques are used extensively to interpret landscape features that may change over time and comprise large, often inaccessible areas, because the technique has proven to be a cost-effective means of acquiring information.

To date, most natural resource mapping is carried out using remote sensing. Aerial photographs have been used to produce thematic maps, such as topographic, geologic, forestry, soil and vegetation maps. More recently, space and airborne satellite imagery are being used for mapping applications. Weather satellites provide temperature measurements at different altitudes, patterns of sea surface temperatures show the position of currents and areas of upwelling that are important for fisheries. Satellite-based systems measure chlorophyll levels near the sea surface, which are an indicator of food availability to fish stocks, crop condition can be measured at regular intervals to produce yield estimates and to identify problems. Satellite imagery can be applied to a much wider range of applications than commonly thought.

A major advantage of remotely sensed data in digital format is that computer techniques can be used, where appropriate, to automate the information extraction process and to directly input the derived information into a geographic information system. Visual interpretation of imagery remains, however, the most valuable information extraction technique that cannot be matched by automated techniques as the human eye can take into account the surrounding characteristics of the object being identified. Remote sensing systems provide the capability to collect uniform measurements in digital form over vast areas at a very high speed (e.g. near real time) in order to analyse phenomena that could not be monitored in any other way (Aronoff, 1989). The following paragraphs provide the basic information on remote sensing in order to produce useful geographic, i.e. spatial, information that may form the inputs to the Geographical Information System (GIS), discussed in the following section. It will not address the technical details of the satellite instruments and imagery.

With the use of remote sensing, the spatial resolution of the image or photo is important as this will determine the:

- smallest object that can be detected;
- recognition level of the object; and
- identification of the object.

To generate information secondary indicators are also being used, i.e. indicators other than direct observation (e.g. cultivated fields that are bare in a certain season and that may be identified as “fields” without a standing crop). Information requires a certain level of accuracy, i.e. the degree of likelihood that the derived information is correct and that is often expressed in percentages of the level of confidence. Definition of the accuracy depends on the type of application, the critical factor being to make correct decisions (e.g. what would it cost if the wrong decisions were taken based on the information).

The costs of satellite data are often mentioned as being a limiting factor. However, what are the alternative sources of information and their costs? Where satellite data can provide the requested information, they offer a number of advantages over aerial photography:

- a satellite scene covers a large area, greatly reducing the time needed for interpretation and comparison and matching of separate interpretations;
- a satellite scene is taken at the same time, providing an internal consistency that is difficult or impossible to achieve with aerial photography; and
- flying aerial photography is expensive and depends on favourable weather conditions.

The principal steps taken to analyse remotely sensed data are identical to those at the lookout points where people interpret the landscape (Aronoff, 1989):

1.1. Defining the Information Needs

The objective of using remotely sensed data is generation of information. The information needs have to be defined before any data acquisition or analysis starts. The definition of this information needs supports the identification of available suitable technique(s) that best satisfy the defined requirements. Such an assessment should take into account: (1) data accuracy; (2) what time period the data need to be collected; (3) the costs involved; and (4) the form (e.g. digital, paper map, tabular statistics and/or report).

1.2. Data Collection

Field observations, measurements, existing maps and reports are used together with remotely sensed data. The definition of data requirements and the analysis of existing materials support the definition of new, i.e. missing, data to be collected. Remote sensing devices detect energy reflected or emitted from objects. Commonly known is the photographic camera that records reflected light energy, multi-spectral scanners can detect visible and non-visible energy (e.g. emitted thermal infrared to detect heat), radar systems use microwave energy and generate images from the reflected signals. The remote sensing data specifications should be prepared and integrated with the other data collection activities. Field collection procedures may be modified in order to properly integrate expensive field sampling into the remote sensing analysis. Groundthruthing is an indispensable element in the use of remote sensing techniques.

1.3. Data Analysis

Three types of analysis can be distinguished when remotely sensed data are being applied:

- *Measurement*: consists of values measured by the sensor to calculate environmental conditions (e.g. surface temperature, soil moisture content, quantity of plant material, and crop condition).
- *Classification*: regions are being defined that have the same characteristics. The results are commonly provided in the form of a delineated area (e.g. mapping unit). Ranges of similar features may also be grouped as areas, i.e. measurements may be grouped according to an adopted classification.

- *Estimation*: is commonly applied to classification results. Objective is the estimation of the quantity of material (e.g. standing biomass) in order to divide the area into regions that have statistically the same characteristics. The advantage of the use of remote sensing is that a stratification of the region can be made and that estimates can be obtained with the same, or better, accuracy with fewer field samples and, therefore, at lower costs (e.g. land cover/land-use area frame data collection).

1.4. Verification of Analysis Results

To use information effectively one needs to know about its accuracy. The expected level of information should be known and taken into account when using the information. Results of remote sensing analyses, and any other type of spatial information, should be accompanied by a report on the quality of the data. This step involves the verification of the results produced in the previous step. A formal accuracy test, in which sample points are selected, measured on the remotely sensed data product, and compared with independent field survey data. The amount of error is then calculated for each sample point, and if the overall error is too great, the product is rejected. The costs involved in verification must be weighted against the use of incorrect information. Verification is essential for any data type.

1.5. Reporting the Results

If the quality of the derived remotely sensed data is considered to be acceptable, the derived information can be assembled into a suitable reporting format and presented to the organisation or institute that requested the information.

1.6. Taking Action

The overall objective of producing remotely sensed data derived information is to produce inputs for decision-making, planning, implementation and/or evaluation of programmes and projects. Even a decision not to take any action is a decision.

The above paragraphs have provided a general overview of how remotely sensed data can be used rather than discussing the technology itself. Remote sensing provides much of the input to a GIS. Prerequisites for the effective use of remote sensing are technically skilled personnel, as well as appropriate technology. Remote sensing and GIS are complementary technologies. Their integrated use will not only improve the quality of spatial information, but also enable information previously unavailable to be more economically produced.

2. Geographic Information System (GIS)

From the earliest civilisations maps have been used to portray information about the earth's surface (e.g. land surveying and map making were an integral part of the Roman Empire) (Aronoff, 1989). Mapping is a valuable instrument of recording and planning the use of the land. With the science and technology developments, the demands for growing volumes of environmental data increased. The increase in spatial data production did not necessarily result in a wider use of these data or in more sophisticated analyses. Effective use of large volumes of geographic data depends on the existence of efficient systems that can transform these data into usable information (Marble and Peuquet, 1983).

Not only the amount of data to be handled changed, the organisation of these data became important as well. A *database system* provides for the input, storage and retrieval of data. The *database* is the set of data being stored (Aronoff, 1989). A database system should provide the user with the necessary data, i.e. a selection of information about the real world appropriately organised so that plans and decisions can be made. The data in a GIS represent an abstraction of the reality because it contains only those bits of information about the real world that are considered to be useful. Every data effort without contribution to the final objective undermines because it represents time, effort, human and financial resources that could have been used elsewhere to improve the analysis. The same argument holds true for the data quality.

The most important aspects of data quality are (Aronoff, 1989):

- *accuracy* measures how often, by how much, and how predictably the data will be correct (often such a statement is lacking);
- *precision* measures the resolution of the scale used to describe the data (e.g. a scale of 1:1,000 versus 1:1,000,000);
- *time* indicates at what point, or over which period of time the data were collected;
- *currency* measures how recently the data were collected, and thus how appropriate the data set is for current use (e.g. soil data will remain valid over a much longer period than land cover data); and
- *completeness* refers to the portion of the area of interest for which data are available (the term is also used with reference to the classification system used to represent the data).

Data are of no value unless the right data can be in the right place at the right time (Aronoff, 1989), and thus the database is critical. In a computer-based GIS the quantity of data is large enough that the form and performance of the database are critical to the overall usefulness of the system. Furthermore, the decision model represents an object (e.g. land cover) or phenomena (e.g. erosion) that exist in the real world. The model should correctly and consistently predict the behaviour of the real world for the phenomena of interest. A major factor in successful GIS applications is the degree to which the criteria used to evaluate the decision model truly reflect the values of the people involved (e.g. stakeholders and decision-makers). Essential to the action to be taken, decided by weighting the various alternatives as predicted by the model, are the decision-makers because they have the mandate and the responsibility for the consequences of the action to be taken. No matter how high the data quality and how appropriate the model used, if the wrong criteria are used to evaluate the information produced by the GIS, the results will be unlikely to be satisfactory. It is very easy to train someone in operating a GIS, but it remains hard to instruct someone in how to apply GIS technology effectively in order to satisfy information needs. The danger of GIS is that it always produces a result! It is therefore important that the GIS resides within a suitable institutional framework that will be able to effectively use this type of technology.

A pre-assessment should be undertaken to review existing operations within an agency for the distinct purpose of identifying issues and concerns related to the cost effective implementation of GIS technology. Because of the high cost in implementing GIS technology it is imperative that all operational and technical issues be identified prior to a committed investment. The situational assessment summarises the existing operational environment, evaluates the potential opportunities for implementation, and identifies critical success factors.

GIS is often confused with cartographic systems that store maps in automated form. However, the ability to integrate data is what sets GIS apart from these mapping systems. The main function of the GIS is to *create information by integrating data layers to show the original data in different ways and from different perspectives*.

A GIS is a "*powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes*" (Burrough, 1986). Spatial data comprise: (1) the object or phenomenon being reported; and (2) its spatial location. A third component is time, which is often not explicitly stated though often crucial (e.g. the change in vegetation cover over the seasons). A GIS provides capabilities to input, manage, manipulate and output data. These capabilities are described in more detail below.

2.1. Data Input

The data input concerns conversions from the original data format (e.g. paper map, table, aerial photograph, and satellite image) into a digital format supported by the GIS. The construction of the database is time-consuming and should therefore be carefully considered in advance. An evaluation in terms of processing, accuracy standards to be met, and the form of the output to be produced should be carefully considered. The data input should be carefully scrutinised before any analyses are carried out.

2.2. Data Management

This component deals with the GIS functions to store and retrieve data from the database. The methods used to implement these two functions affect the efficiency of the data operations. The manner in which the data are structured and how files relate to one another limit data retrieval and speed. The GIS data architecture will provide the foundation for future capabilities, application development and generation of information products. A person who is expert in database design and analysis procedures can evaluate the type of system needed for the specific application.

2.3. Data Handling

The handling and analysis function of the GIS determines the type of information that can be generated by the system. A list of required capacities should be made as part of the system requirements. The key element of the user needs analysis is the translation of user needs into GIS functional capabilities. The introduction of tools like GIS does not only automate certain activities, it will also change the manner in which an organisation or institute works. With the GIS one can generate faster a set of alternatives, and these in turn may be refined successively. The decision-making process may not lead to the selection of a single option but several alternatives may be closely studied, and an alternative may be evaluated and further improved in the decision-making process.

2.4. Data Output

The reporting or output functions of the GIS vary a lot in quality, accuracy and ease of use of the available capabilities. The functions needed are determined by the users' needs, thus their involvement is critical when specifying the output requirements.

A GIS is a powerful tool for handling digital spatial data. The digital format is a format that is more compact than paper maps or tabulations. The ability to manipulate large volumes of geographic data and corresponding attribute data, and to integrate different types of data in a single analysis at high speed are unmatched by manual methods. The ability to perform complex analyses provides a quantitative as well as qualitative advantage. Planning scenarios, decision models, change detection and analyses can be developed by making refinements to successive analyses. This iterative process only becomes practical when each computer run can be carried out at high speed and at relatively low cost. Not only are different data types integrated in a GIS, but also various procedures can be integrated, such as data collection, verification and updating.

An information system evolves over time. At first, it is used to perform the tasks habitually carried out while using the new technology. At a later stage, new ways of providing the same functions are developed that take more fully advantage of the technology. This will be followed by the development of new approaches that take full advantage of the technology potential.

A GIS is expensive to implement, it includes overhead costs to maintain the system, and requires a considerable level of expertise to operate it. Costs are more easily justified when the data volumes to be handled are large, frequently accessed and updated, and the information is used for a wide range of applications. If these conditions do not apply, a GIS may not be the solution. The implementation of a GIS is a long-term undertaking. The acquisition of GIS hard- and software, functional requirements and performance standards are important but they are not the issues that determine the success of GIS implementation. GIS implementation is where people and technology meet. An implementation plan includes a strategy to address critical issues, such as database design, data conversion, and the definition of realistic milestones and schedules. The implementation plan is essential for the successful operation of GIS technology.

Annex III:
List of Authorities and Institutions

This list of national authorities and institutions involved in erosion/desertification control management issues is not exhaustive, and was prepared according to information provided by nominated national experts and or respective National Focal Points for PAP/RAC.

For more details concerning Spain, Italy, Malta, Tunisia, Morocco and Turkey, see the national reports (PAP/RAC, 2000).

Albania

Responsible authorities:

- National Agency for Environment Protection;
- Ministry of Agriculture and Food.

Institutions involved:

- Soils Sciences Institute, Tirana.

Algeria

Responsible authorities:

- Ministry of Territorial Planning and Environment (MATE);
- Ministry of Agriculture;
- Ministry of Water Resources – National Agency for Water resources (ANRH);
- National Agency for Nature Conservation (ANN);
- Ministry of High Education and Scientific Research.

Institutions involved:

- Research Unit for Terrestrial Biology (URBT);
- National Centre for Remote Sensing (CNTS);
- University of Sciences and Techniques Huari Boumedienne (USTHB) – Centre of Scientific Research and Techniques for Arid Zones (CRSTRA).

Bosnia and Herzegovina

Responsible authorities:

- Environmental Steering Committee of B&H, Sarajevo, Banja Luka;
- Federal Ministry of Agriculture, Forestry and Water Management, Sarajevo.

Institutions involved:

- Water Steering Committee, Sarajevo, Trebinje;
- Hydro-Engineering Institute, Sarajevo;
- Institute for Water Management, Sarajevo;
- Institute for Agropedology, Sarajevo.

Croatia

Responsible authorities:

- Ministry of Environment protection and Physical Planning, Zagreb; Directorate for the Adriatic, Rijeka; Directorate for soil protection, Osijek;
- Ministry of Agriculture and Forestry, Zagreb;
- Ministry of Science and Technology, Zagreb;
- State Water Directorate, Zagreb.

Institutions involved:

- University of Zagreb, Faculties of: Agriculture, of Civil Engineering, of Mining, Geology and Petroleum Engineering, of Geodesy;
- Croatian Waters, Zagreb;
- Institute of Agriculture and Tourism, Porec;
- Institute for Mediterranean Agriculture, Split.

Cyprus

Responsible authorities:

- Ministry of Agriculture, Natural Resources and Environment;
- Ministry of Interior.

Egypt

Responsible authorities: n/a.
Institutions involved: n/a.

France

Responsible authorities: n/a.
Institutions involved: n/a.

Greece

Responsible authorities: n/a.
Institutions involved: n/a.

Israel

Responsible authorities: n/a.
Institutions involved: n/a.

Italy

Responsible authorities:

- Ministry of Environment;
- Ministry of Cultural and Environmental Heritage;
- Ministry of Health;
- Ministry of Public Works;
- Ministry of Merchant Marine;
- Ministry of Agricultural, Food and Forest Resources (MiRAAF);
- Ministry of the Interior;
- Ministry of University and Scientific Research;
- At regional (sub national) level, Regional Services for:
  - soil and soil mapping;
  - land use planning;
  - agriculture and forests;
  - environment; and
  - nature conservation.

Institutions involved:

- Research Institute for Hydrogeological Protection – National Research Centre (CNR);
- National Company for Alternative Energies (ENEA);
- National Agency for the Protection of the Environment (ANPA);
- Research Institute for Soil Studies and Conservation (MiRAAF);
- Experimental Institute for Plant Nutrition (MiRAAF);
- Forestry Academy;
- Geological Service;

- Georgofili Academy;
- National Institute for Agricultural Economics (INEA);
- Mediterranean Agricultural Institute (IAM);
- Agricultural Institute for Overseas (IAO);
- a number of Universities and relevant Faculties (Turin, Basilicata, Florence, Cagliari, Viterbo, Bari, Palermo,...).

Lebanon

Responsible authorities:
- Ministry of Agriculture;
- The Green Plan;
- Ministry for Environment;
- Ministry for Electro- and hydric Resources.

Institutions involved:
- National Centre for Scientific Research;
- Lebanese Environmental Forum (NGO);
- The Green Forum (NGO);
- the Universities of Beyrouth.

Libya:

Responsible authorities: n/a.
Institutions involved: n/a.

Malta

Responsible authorities:
- Environment Protection Department, Ministry of Environment;
- Department of Agriculture, Land and Water Division;
- Planning Authority;
- Water Service Corporation.

Institutions involved:
- University of Malta, Department of Geography and the Institute for Agriculture.

Monaco

Responsible authorities: n/a.
Institutions involved: n/a.

Morocco

Responsible authorities:
- Ministry of Agriculture, and Rural Development (MAMVA);
- Ministry of Water and Forests (MEF);
- Ministry of Land-use planning, Urbanism, Habitat and Environment;
- Ministry of Equipment (ME);
- Ministry of Interior;
- Administration of Water, Forests and Soil Conservation (AEFCS);
- at sub national level, AEFCS has nine Regional Research and Management Services (SREA) and the Division for Watershed Management and Combating Desertification.

Institutions involved:
- Superior Water Council;
- National Forestry Council;
- National Forestry Programme;
- Project on National Law on Development and Protection of Mountainous Areas;
- University Mohamed V.

Slovenia

Responsible authorities:

- Ministry of Environment and Physical Planning;
- Ministry of Science and Technology.

Institutions involved:

- University of Ljubljana, Faculties: of Civil Engineering and Geodesy, of Arts – Department of Geography, Biotechnical Faculty;
- Water Management Institute;
- Enterprise for runoff infrastrucures.

Spain

Responsible authorities:

- General Directorate for Conservation of Nature (DGCONA), Ministry of Environment, Madrid;
- In each Autonomous Region: General Directorates for Natural Environment.

Institutions involved:

- High Council for Scientific Research (CSIC);
- A large number of Universities and respective Faculties.

Syria:

Responsible authorities:

- Ministry for Environment;
- Ministry for Agriculture;
- Ministry for Water Resources and Irrigation.

Institutions involved:

- University of Damascus;
- University of Lattakia;
- The Remote sensing institute (GORS), Damascus.

Tunisia

Responsible authorities:

- Ministry of Agriculture, General Directorates of Soil and of Forests and for Soil and Water Conservation (CES);
- Ministry of Environment and Land use Planning (MEAT);
- National Agency for Environment Protection (ANPE);
- Directorate of natural Environment;
- Agency for Protection and Management of Coastal Areas (APAL);
- Tunisian Observatory for Environment and Development (OTED);
- Tunisian International Centre for Environmental Technologies (CITET);
- Ministry for Economic Development;
- National Commission for Sustainable Development (CNDD);
- Regional (sub national) Councils for Rural Development.

Institutions involved:

- Institute of Research and Agriculture Graduate Education (IRESA);
- The Arid Zone Institute (IRA);
- Tunisian National Institute for Agricultural Research (INRAT);
- National Institute of Rural Engineering, Water and Forests (INGREF);
- Tunisian National Institute for Agriculture (INAT);
- High Engineering School for Rural Services (ESIER);
- Tabarka Sylvo-pastural Institute (ISPT).

Turkey

<u>Responsible authorities:</u>

- Ministry of Agriculture and Rural Services;
- General Directorate of Rural Services;
- General Directorate of Erosion Control and Afforestation;
- General Directorate of Government Hydraulic Works;
- Ministry of Environment;
- State Planning Organization;
- National Water Organization;
- Ministry of Administration of Collective Habitat.

<u>Institutions involved:</u>

- Middle East Technical University, Ankara;
- Egean University, Izmir;
- Dokuz Eylul University, Izmir;
- A number of other universities;
- MEDCOAST (NGO).

Annex IV:
Erosion Mapping Legend and Examples of Maps Prepared

The erosion mapping legend, presented below, provides a methodological basis for erosion/desertification mapping, as described in detail in the 1997 Guidelines. Examples of maps prepared according to the legend are presented after the legend.

A. PREDICTIVE MAPPING: INFERRED GLOBAL EROSION HAZARDS

Symbols

(0)	**none** (Equivalent to **stable non-used wasteland** in **descriptive mapping: 010**)
(1)	**very slight**
(2)	**slight**
(3)	**moderate**
(4)	**severe**
(5)	**very severe**

B. SITE-DESCRIPTIVE MAPPING:GRADE OF STABILITY/EROSION PROCESSES[3]

I. Stable, non-erosion-affected areas (*)

00	**stable, non-used wasteland** (rock outcrops, cliffs, stony or sandy areas)
01	**stable, unmanaged areas with potential for forestry use only**
02	**stable, unmanaged areas with agricultural potential** (crops and pasture)
03	**stable, managed areas with forestry use only**
04	**stable, managed areas with agricutural use** (crops and pasture)

• **Rehabilitated areas by means of:**

05	**natural or artificial re-vegetation**
06	**physical infrastructures** (terraces, check dams, etc.)

*__Grade of instability risk__

Assessment of **instability risk** for all **stable** environments (00 to 04) and of risk for **rehabilitated** environments, i.e. 05+06 (i.e. a risk in the first years of rehabilitation;) to be expressed by a complementary digit (0 to 3) to the original **stable units'** code:

0: No risk (= highest grade of **stability**)
1: Low to moderate
2: High
3: Areas in hazardous/precarious/critical state (Stability threshold = highest grade of **instability risk**)

Example : 03 = **stable** managed areas
: 032 = **stable** managed areas with a high **erosion risk**

*__Identification of main causative agents__

Instability risk assessment may be reinforced by the identification of its most probable/ prevailing **causative agents** inherent in the **landscapes'** main basic components, i.e.:

t: Topography
g: Geology
v: Vegetation
h: Human activities
a: Animal activities (trampling, terracing, etc.)

Extra codes might be freely added according to local specific contexts and situations.

Example: 023 **g** = stable managed areas with erosion risk mainly due to geologic factors.

II. Unstable areas (**)

• ***Splash erosion***

A1	**localized** (<30% of the area is affected)
A2	**dominant** (30-60%)
A3	**generalized** (>60%)

• ***Sheet erosion***

L1	**localized**
L2	**dominant**
L3	**generalized with soil profile removal**
Lx	**= unreclaimable areas due to total soil removal**

• ***Rill erosion***

D1	**localized**
D2	**dominant**
D3	**generalized**

• ***Gully erosion***

C1	**individual gullies**
C2	**localized gully networks**
C3	**dominant**
C4	**generalized**
Cx	**= unreclaimable areas due to generalized bad lands**

[3] Refer to the glossary for the definition of terms.

- ***Wind erosion***

E1	**localized loss of topsoil/overblowing/deflection**
E2	**dominant**
E3	**generalized**
Ex	**= unreclaimable areas due to total sand or sediment burying or topsoil removal**

- ***Mass earth movements***

M1	**local gravitational soil creep/solifluction**
M2	**localized land slides/mudflows**
M3	**dominant**
M4	**generalized**
MX	**= unreclaimable areas due to total slope slides**

Symbols

- ***Water or sediment excess***

W1	**areas periodically flooded and/or sediment buried**
W2	**areas permanently flooded and/or sediment buried/waterlogged areas**

- ***Degradation induced by land management***

S1	**soil compacting**
K1	**soil crusting**
Z1	**cattle trampling/terraceting**
H1	**salinisation**

- ***Associated processes***

See "Note" in para (**)

Multiple processes

P1 P2 P3 etc.(for description of different closely interacting erosion processes)

****Erosion expansion trend (rate)**

Assessment of erosion rate/trend for all **unstable** erosion-affected areas to be expressed by a complementary digit (0 to 3) to the original **unstable units'** code:

0: Trend to **stabilization, recession** or limitation of spatial **expansion**

1: Trend to local **expansion** or **intensification**

2: Trend to widespread **expansion** or **intensification**

3: Trend to increase **generalized degradation** towards an **irreversible state**

Example:

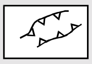
L2 = dominant sheet erosion

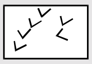
L23 = dominant sheet erosion with a trend towards generalization and an irreversible state (Lx type units)

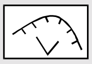
Note: All multiple or mixed but clearly identifiable erosion processes can be mapped by associating or combining the corresponding codes (the sequence of the codes should be established according to the relative importance of the processes: first code = the most important process):

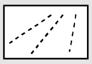
Example: L_{11}/C_{12} = Localized sheet erosion combined with dominant gully networks with a trend to widespread expansion or intensification.

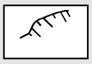
- ***Point/line erosion data (Individual erosion processes)***

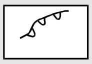

rocky canyon

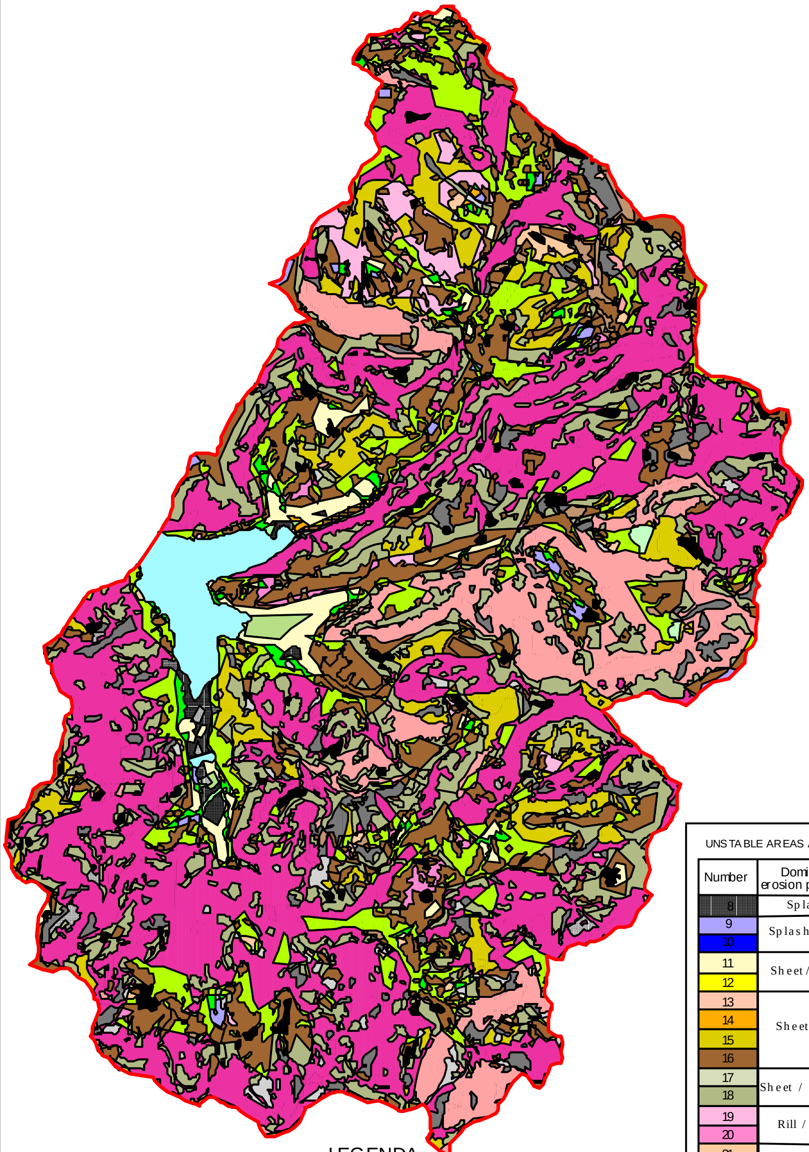

individual gully and/or gully head


individual landslide/mudflow


gravitational stone fan


waterways bank erosion


coastal erosion line



LEGENDA

STABLE, NON-EROSION-AFFECTED AREAS

Number	Grade of stability	Grade of risk of erosion	Dominant causative agents	Area ha
1	01	3	TH	10.18
2	03	0	HL	55.03
3	03	1	HL	38.00
4	03	1	HT	75.00
5	03	1	TH	112.00
6	03	2	TH	429.83
7	04	1	HL	16.84

UNSTABLE AREAS AFFECTED BY EROSION PROCESSES

Number	Dominant erosion processes	Class of erosion status	Area ha
8	Splash	3	14.50
9	Splash / sheet	4	30.00
10		5	0.13
11	Sheet/ splash	4	137.43
12		5	2.60
13	Sheet / Rill	2	1.01
14		3	3.70
15		4	388.60
16		5	1 048.86
17	Sheet / Rill / Gully	4	8.40
18		5	1 255.43
19	Rill / sheet	4	110.84
20		5	29.59
21	Rill/sheet/Gully	4	19.42
22		5	45.92
23	Rill/gully/sheet	4	66.51
24		5	288.96
25	Rill / gully	2	600.93
26		3	1.49
27		4	2 180.98
28		5	14.07
29	Areas periodically flooded	2	3.68
30		3	18.50
31		4	3.50
	Settlements		
	Water area		

Figure 11: Consolidated erosion map – Butoniga area (Croatia)

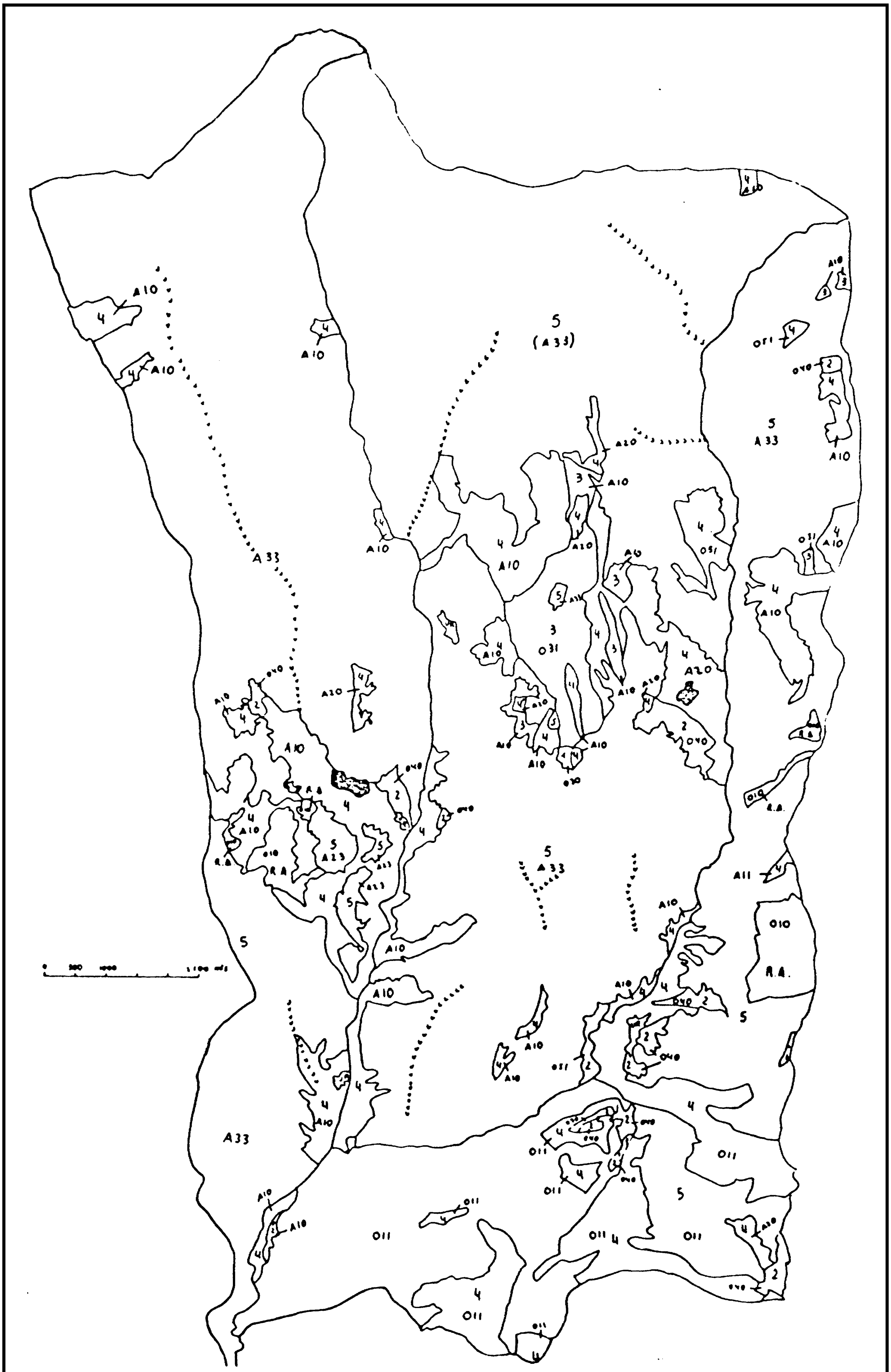


Figure 12: Consolidated erosion map – Adra area (Spain)

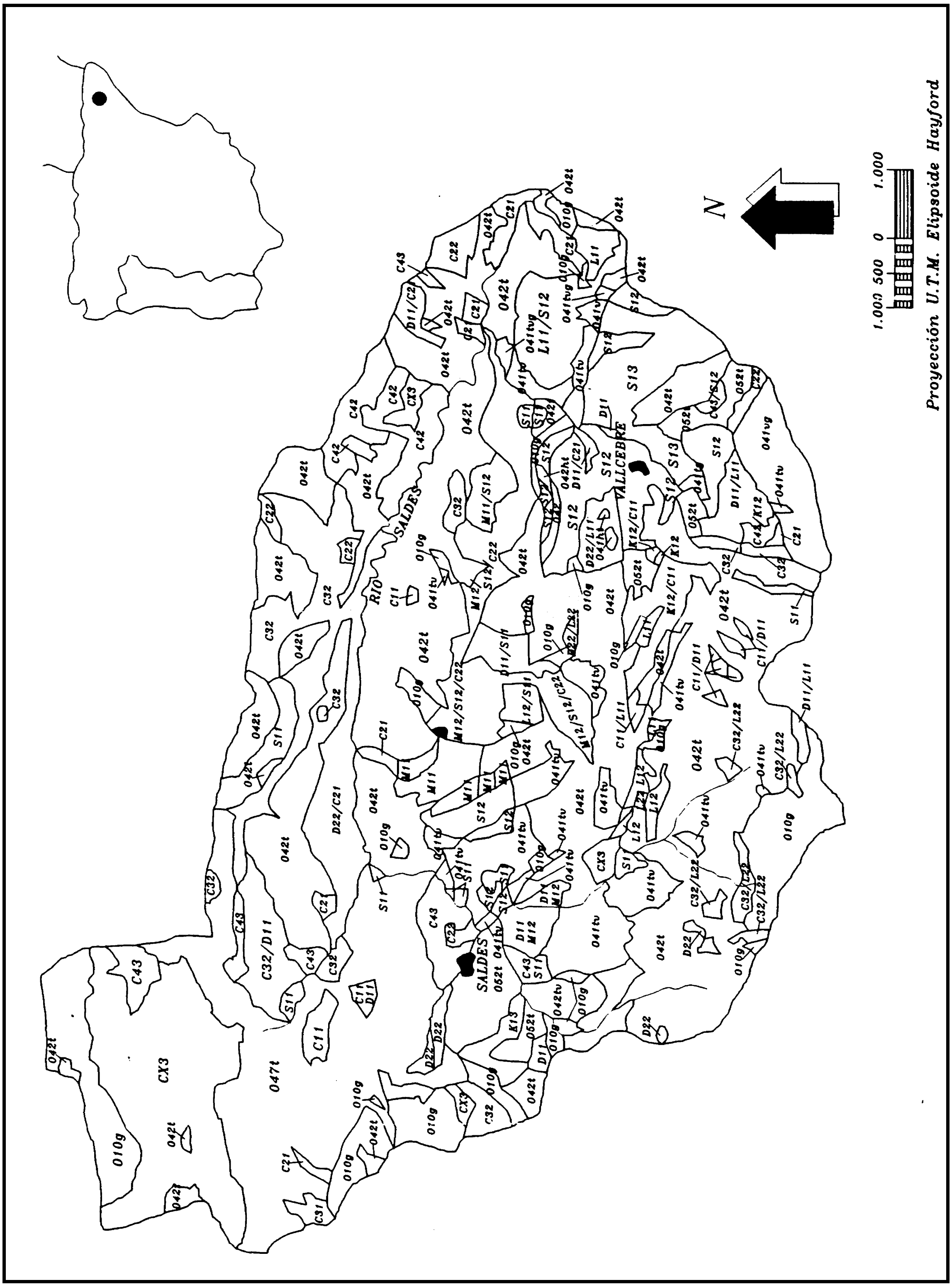


Figure 13: Consolidated erosion map – Valcebre area (Spain)

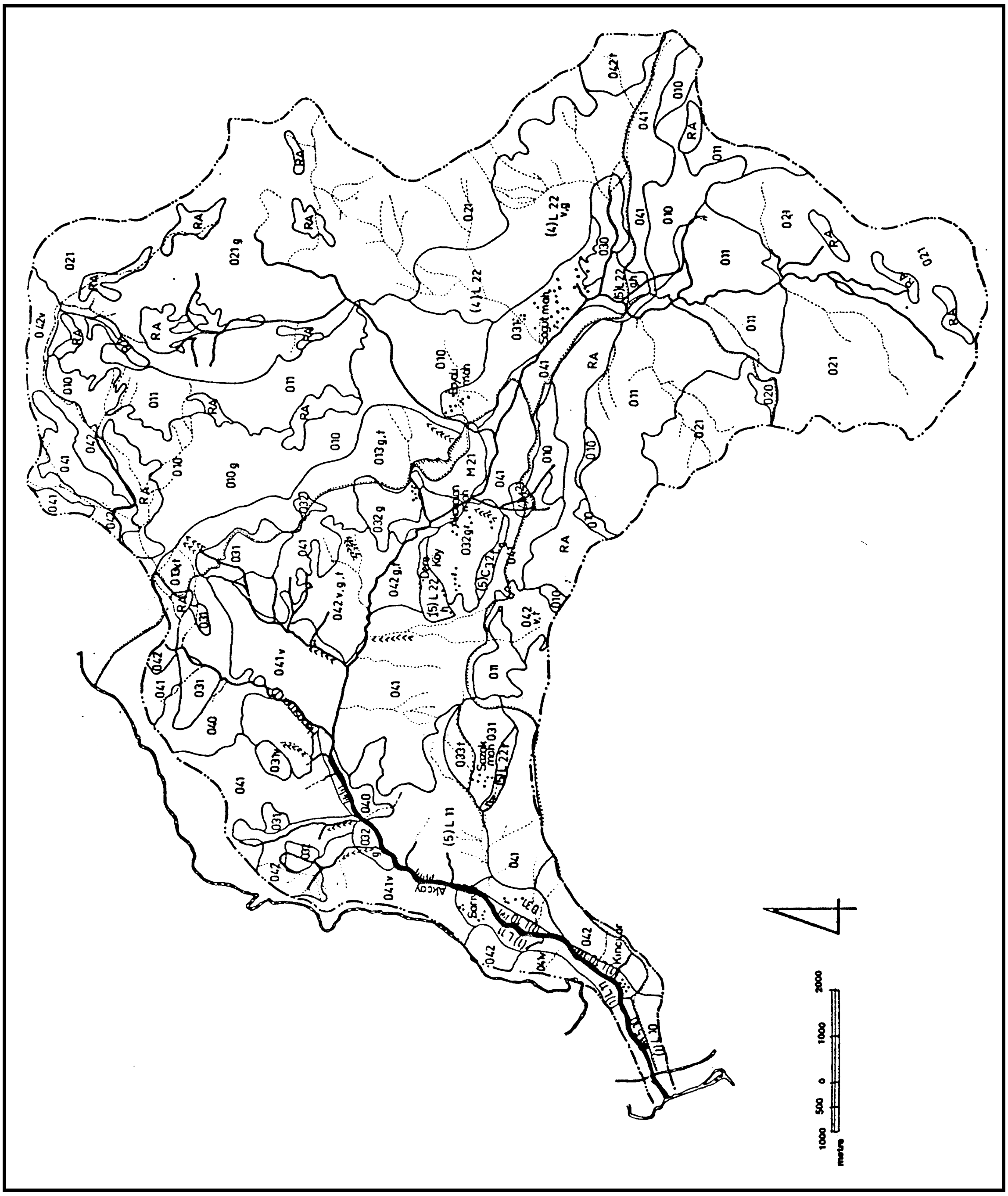


Figure 14: Consolidated erosion map – Akçay sub-catchment area (Turkey)

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