AIDCCD

European Commission

AIDCCD - Active exchange of experience on indicators and development of perspectives in the context of UNCCD

Report on the state of the art on existing indicators and CCD implementation in the UNCCD Annexes

Edited by
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Preface

Desertification, land degradation processes and the unsustainable use of non-renewable natural resources, cause severe environmental damage worldwide.
The European Commission has been funding research on desertification since 1984.
AIDCCD project (Active Exchange of Experience on Indicators and Development of Perspectives in the Context of UNCCD) is an Accompanying Measure funded by the European Commission, Research Directorate General.

Its main goal is to favour the exchange of information and experiences among the main institutions involved in the implementation of the UN Convention to Combat Desertification (UNCCD) in all the regional Annexes, with specific reference to the desertification Benchmarks and Indicators (B&I) and the Information Circulation Systems.
Such issues have in fact been recognised as priority issues in the fight against desertification and much work has been carried out in parallel in all Regional Annexes. This had generated a significant quantity of data and information that has never been organised before systematically.
AIDCCD involves the realisation of two international thematic seminars on "Local and Regional Desertification Indicators in a Global Perspective" (held in Beijing, China, from 16 to 18 May 2005) and "Role of the Information Circulation Systems in the scientific and practical approach to combat desertification" (to be held in Namibia in 2006).
In preparation of the seminars, a review on the use of B & I in the different UNCCD Annexes was carried out, with specific reference to the response and impact indicators adopted in the National Action Plans (NAPs).
The review began with the dissemination of a questionnaire to the UNCCD Focal Points, and to stakeholders at various levels, in order to collect information about their experiences in the utilisation of B&I. In particular, information was requested about projects and/or actions through which B&I were developed in their own Country as well as a critical opinion about the utilisation of B&I. On the basis of the information collected, six regional reports have been elaborated for Annex I (Northern Africa; Southern Africa), Annex II (Western & Middle Asia; East & Southern Asia), Annex III (Latin America and the Caribbean) and Annex IV (Mediterranean Europe).

A think-tank was held to discuss the results achieved with a small group of selected experts and the AIDCCD Coordinating Board Members. The aim of the meeting was to highlight the relevance of the studies. A number of important conclusions emerged which provide Focal Points for common future issues which require attention. The conclusions of the think- tank are reported in the final chapter of this volume.

This volume contains reports which undoubtedly constitute the first attempt to provide a global overview on the utilisation of desertification B&I and on some of the activities that have been carried out so far. They also provide an excellent basis to compare the level of implementation of the UNCCD in the different Annexes and the different approaches used.
We are confident that the results achieved will contribute to the implementation of the UNCCD at the global level.

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STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR THE DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN NORTH AFRICA

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Executive summary

The objective of the present preparatory study is to take stock of the available indicators used for the monitoring of desertification and the implementation of the CCD in the countries of North Africa. It is intended as preparatory work for an international workshop on indicators organised in the framework of the AID-CCD project financed by the European Commission (EC).

For purposes of the present study, North Africa shall be defined as comprising the following countries: Mauritania, Morocco, Algeria, Tunisia, Libya and Egypt.

For several years now, OSS has been conducting a sustained sensitisation campaign among decision makers on the importance of having a monitoring-evaluation system for national action programmes to combat desertification. The most tangible result is that the first Maghrebi countries to adopt their NAPs have benefited from OSS support in matter of implementation of their national monitoring-evaluation systems. Two projects, dedicated in particular to monitoring-evaluation of the NAPs, have been initiated by OSS:

- with Morocco, Tunisia and the Arab Maghreb Union (AMU), under the European programme SMAP;
- with Tunisia, within the framework of Tunisian-Italian cooperation.

Besides these programmes that are focused on the monitoring-evaluation of NAPs, it is worth mentioning other regional projects and programmes which also aim at the development of products that are useful to decision making, such as thematic maps, insofar as they serve as indicators for combating desertification. Of these projects and programmes, the following may be mentioned in particular:

- the ROSELT/OSS network (Long term Ecological Monitoring Observatories Network);
- the project of « Monitoring Desertification in the Countries of the Southern Shore of the Mediterranean » ; « Set up of a Pilot System in Morocco and Tunisia/ Study of Extension to Algeria », financed under the LIFE Pays Tiers programme of the European Commission (EC) ;
- the regional programme DISMED (Desertification Information System for the Mediterranean Basin), which aims at developing the regional desertification sensitivity map for Mediterranean countries.

Finally, in view of the data, which we have been able to collect, it has seemed to us useful to present the Lebanese experience in matter of monitoring-evaluation of desertification within the framework of its NAP/CCD.

1. Sub-regional context

While all the North African countries have ratified the United Nations Convention on Combating Desertification (CCD), they are not at the same level of implementation of the said convention. Libya and Egypt, for instance, are in process of developing their National Action Programme (NAP), with Egypt having for several months now a draft version of its NAP.

Country	Date of validation of the NAP
Mauritania	2002
Morocco	June 2001
Algeria	December 2003
Tunisia	1998
Libya	Not yet
Egypt	Not yet

Table 1: Validation of the NAPs by the North African countries

The level of implementation of the NAP also varies from one country to another. Thus, Morocco and Tunisia have already started the implementation process of their NAPs, while Algeria adopted, in December 2003, its NAP/CCD (National Action Programme for Combating Desertification) and is in process of developing its operational programme.
It is quite obvious that the issue of CCD indicators is closely connected with the process of implementation of this convention. Accordingly, it may be noted that Morocco and Tunisia are engaged in the identification and use of desertification indicators, as well as CCD implementation indicators, in the framework of an operational project whose results will be described later in the present document.
Algeria refers, in its NAP document, to the set up of a monitoring-evaluation system for its NAP, mentioning explicitly the works conducted by the OSS, and by its neighbouring countries (Morocco, Tunisia).
In its latest version of its NAP project, Egypt does not present a dedicated mechanism with regard to the monitoring of desertification or to follow-up of the implementation of CCD. However, the Desert Research Centre of Cairo, which serves as a CCD National Focal Point, cooperates with OSS within the framework of the ROSELT/OSS programme (Long Term Ecological Monitoring Observatories Network) and it hosted in September 2003 a training session conducted by OSS on the monitoring-evaluation of action programmes to combat desertification. Current work is focused on setting up a national long term ecological monitoring network, designed in accordance with the methodology developed by the ROSELT programme, and which would bring together other observatories and monitoring mechanisms relating to environment currently prevailing in Egypt[1]. The establishment of such a mechanism will be integrated within the NAP/CCD (National Action Programme for Combating Desertification) of Egypt.
Algeria, too, participates in the ROSELT/OSS programme and shares, particularly in this regard, a common methodology for the development of desertification indicators with the other countries of the region (Cf. infra presentation of the ROSELT/OSS programme).
To our knowledge, Libya and Mauritania have not yet taken any particular measures relating to the development and use of desertification monitoring indicators.

[1] Cf. M Abderrazik, 2003: " Desertification Monitoring at the National Level of Egypt".

2. State of art on Benchmarks and Indicators

Work methodology

This has involved conducting an analysis of the national reports submitted by the countries to the CoP (Conference of the Parties), as well as an analysis of the relevant provisions of the NAPs (National Action Programmes) where such programmes were adopted. A questionnaire, designed under the AID-CCD project, was also circulated to all the National Focal Points of the countries of the region. Other information was taken from the various programmes on indicators conducted by OSS at the level of the region.

The OSS did not receive any reply to the questionnaire. Two types of reasons are likely to justify this absence of reply:

- For countries such as Morocco and Tunisia, OSS already has the main information on the indicators used for desertification monitoring insofar as the national monitoring-evaluation systems are currently being set up within the framework of the OSS programmes;
- For the other countries, in view of the state of implementation of the CCD, no indicator is explicitly used for the monitoring of desertification, except perhaps within the framework of such programmes as ROSELT/OSS, a programme, which is equally managed by OSS.

In view of the data available and those which were collected from the countries, the document is structured into the national, sub-regional and regional levels:

National Level:

- Experience in the implementation of sustainable development indicators in North African countries (Morocco, Algeria, Tunisia, Egypt);
- Morocco : presentation of the results of the SMAP/EC/OSS project and of water indicators ;
- Tunisia : presentation of the indicators obtained by the Tunisian-Italian Project (PTI)/OSS ;
- The “desertification prone areas” model in the Lebanon

Sub-Regional Level:

- DISMED Programme (Morocco, Algeria, Tunisia, Egypt);
- LIFE/OSS Programme (Morocco, Tunisia, together with study of extension to Algeria);
- SMAP Programme;
- Water resources indicators developed by OSS.

Regional Level:

- ROSELT/OSS Programme (Morocco, Algeria, Tunisia, Egypt);

2.1. Benchmarks and indicators at National level

2.1.1. Experience in the implementation of sustainable development indicators in the countries of North Africa (Morocco, Algeria, Tunisia, Egypt)

Testing sustainable development indicators

The countries of North Africa, similarly to the countries of other regions, regularly draft reports on development with regard to its demographic, social, economic and environmental aspects. The assessment of the use of sustainable development indicators by the countries of the region reveals that they “do not have yet an adequate data system to describe the natural environment and its interaction with economy. In other words, they do not use appropriate indicators to assess the implementation of sustainable development programmes, and this for various reasons. Insufficient know-how and lack of human and material means are invoked in particular as major constraints."[2] The information collected on sustainable development indicators within the framework of the present study relates only to Algeria, Tunisia and Egypt.

Three North African countries (Morocco, Algeria, and Tunisia) have set up a coordination institution for sustainable development and have tested the relevance of the sustainable development indicators as established and proposed by the United Nations Sustainable Development Commission (SDC).

In Morocco, the study on the national strategy for the protection of the environment and sustainable development has led, based on the existing and available data on the state of the environment, to establish a set of indicators for water, air, solid wastes, urban environment, soil and natural environment, as well as the coastline.

Tunisia issues reports on the state of the environment on a regular basis. The sustainability indicators which are proposed in a non exhaustive manner at the present stage are intended to assess the overall evolution noted on the human, economic, social and environmental levels. These indicators are inspired by the general spirit of National Agenda 21. OTED (Tunisian Observatory on Sustainable Development) has been assigned the task of testing the SDC indicators. Among the 121 indicators subjected to testing, 48 are calculated in Tunisia according to the United Nations method (of which 18 social, 12 economic, 10 environmental and 8 institutional indicators). There are, in addition, other indicators that are not calculated but for which data are available.

In total, 63 indicators out of the 121 are either calculated or calculable on the short term in Tunisia, according to the UN method. In matter of capacity of the Tunisian statistical system to produce the selected indicators, data are available for 83 indicators out of 121 and partially available for 16 other indicators. Social and economic indicators are the most commonly used and form the subject of regular publications. As for environmental indicators, they are the least developed in Tunisia.

Algeria, too, has issued a report on the state of the environment and has, in addition, set up a National Environmental Action Plan (PANE), which fits entirely under sustainable development and provides for the use of sustainable development indicators for purposes of reporting, in particular, on the state of the environment.

Quality of the available data and information

As regards the nature and quality of the available data and information relevant to decision making, the Inter-governmental Experts Committee of the Centre for Sub-Regional Development of North Africa (CDSR) of CEA[3] has drawn up the following table which presents the quality and availability of information on sustainable development at national level[4] for three countries: Algeria, Tunisia, Egypt.

It emerges from the table that the situation differs considerably from one country to another in matter of availability and quality of data on the various aspects of sustainable development, such as presented in Agenda 21.

2 CEA/TNG/CDSR/CIE/XVI/8, March 2001: Mise au point et utilisation d'indicateurs applicables en ce qui concerne la sécurité alimentaire et le développement durable (Finalisation and Use of Applicable Indicators in Matter of Food Security and Sustainable Development).

3 CEA/TNG/CDSR/CIE/XVI/8

4 Information supplied by the governments to the United Nations Sustainable Development Commission.

Country	Good	A few good quality data, but many gaps	Poor
Algeria	- Elimination of poverty - Changes in consumption modes - Human settlements - Integrated planning and management of land resources; - Combating deforestation; - Combating desertification and drought - Sustainable development of mountains - Promotion of a sustainable agricultural and rural development; - Bio-technology; - Oceans, seas, coastal areas and their biological resources; - Dangerous wastes; - Solid wastes; - Education, sensitisation of the public and training.	- Integration of the environmental issue - Development in decision making - Protection of the atmosphere - Safeguard of biological diversity - Water resources - Toxic chemical substances - Farmers - Financial resources and mechanisms - Technology, cooperation and capacity building - Science in the service of sustainable development - International cooperation for capacity building - International legal instruments - Information for decision making	-International cooperation and trade -Safeguard of biological diversity -Farmers -International institutional provisions
Egypt	. International cooperation and trade . Elimination of poverty . Health care . Human settlements . Integrated planning and management of land resources . Combating deforestation . Combating desertification and drought . Promotion of a sustainable agricultural and rural development . Safeguard of biological diversity . Water resources . Solid wastes . NGOs . Local government . Workers and their trade unions . Trade and industry . Scientific and technical community . Farmers . Education and sensitisation of the public, and training . International cooperation and capacity building	. Change in consumption modes . Oceans, seas, coastal areas and their biological resources . Toxic chemical substances . Radioactive wastes . Woman and sustainable development . Children and youth . Aboriginal populations . Financial resources and mechanisms . Technology, cooperation and capacity building . Science in the service of sustainable development . International institutional provisions . Information for decision making	. Integration of the environmental issue - Development in decision making . Protection of the atmosphere . Sustainable development of mountains . Bio-technology . Dangerous wastes
Tunisia	. Elimination of poverty . Demographic dynamic and sustainability . Health care . Integration of the environmental issue in decision making . Integrated planning and	. International cooperation and trade . Changes in consumption modes . Human settlements . Protection of the atmosphere . Sustainable development of	. Toxic chemical substances . Dangerous wastes

	management of land resources . Combating deforestation . Combating desertification and drought . Promotion of a sustainable agricultural and rural development . Water resources . Woman and sustainable development . Children and youth . Financial resources and mechanisms . Technology, cooperation and capacity building . Education and sensitisation of the public, and training . International cooperation for capacity building . International institutional provisions . International legal instruments	mountains . Safeguard of biological diversity . Bio-technology . Oceans, seas, coastal areas and their biological resources . Solid wastes . Information for decision making	

Table 2. Quality of the available data and information

2.1.2. Morocco – experience of setting up the national monitoring-evaluation system Taking into consideration the desertification indicators within the NAP/CCD (National Action Programme for Combating Desertification)

Morocco validated its National Action Programme for Combating Desertification (NAP/CCD) in June 2001. Several provisions of the NAP refer explicitly to the need to set up a national system for monitoring-evaluation of the NAP/CCD. Accordingly, the Moroccan NAP/CCD provides the following arrangements:

a) Enhancing basic knowledge and development of natural resources monitoring systems, comprising the following components:
   - Inventory of soil and vegetation resources: According to the NAP, Morocco has experienced considerable delay in matter of inventory of its renewable resources: the soil resources cartography is incomplete in other than irrigated areas; the inventory of floristic resources on national level is available only on the scale 1/2.000.000th.
   - Setting up a drought and desertification observatory: Drought is now considered as a structural element of the climate in Morocco. The adoption of objective criteria for a characterisation of the extent of seriousness of drought in the various regions of the Kingdom will also allow an identification of drought-stricken areas, as well as of the most vulnerable population groups which need to benefit as a matter of priority of State support actions.

b) Strengthening the ecological monitoring network: Combating desertification needs to be based on both a short term and long term monitoring mechanism aiming at:
   - a better understanding of desertification inducing mechanisms;
   - establishing objective indicators that would allow an appropriate characterisation of the causes and impacts of desertification;
   - identifying methods and techniques favouring a rational management of natural resources and the protection of the environment.

   The Long Term Ecological Monitoring Observatories Network (ROSELT/OSS), which has been developed by OSS, is considered by the NAP (National Action Programme) as an operational framework for such a mechanism (Cf. infra the presentation of the ROSELT/OSS programme). Eleven (11) potential sites have been identified, of which precisely 3 (Issougui - Fezouata and wadi Mird) have been certified by the ROSELT/OSS programme:

Name of the observatory of the 11 identified ecosystems	Province	Bioclimate
Issougui	Ouarzazate	Hyper-arid
Oued Mird	Zagora	Hyper-arid
Fezouata	Zagora	Hyper-arid
Ait oumribt	Tata	Hyper-arid
Mezguitem	Taza	Arid
Tebndrara	Figuig	Arid
Tafingouet	Taroudant	Semi-arid
Haut atlas oriental	Errachidia	Semi-arid
Souss Massa	Agadir	Semi-arid
Grouz Bouarfa	Figuig	Arid
Canal Lahmida	Errachidia	Hyper-arid

Table 3. List of sites selected in Morocco within the framework of the ROSELT network

c) Monitoring-evaluation of the impacts of the programmes for combating desertification

The monitoring of the impact of the actions to combat desertification should hold a key position within the national monitoring-evaluation system of the NAP; it should also serve as information support to the ONC (National Coordination Institution) service, which will find in it the relevant information in order to assess the performance of the programmes and to take informed decisions as to any adjustments to introduce in these programmes.

d) Set up of a NAP monitoring-evaluation system

The information support to the monitoring-evaluation function will be provided by the SCID (Information Sharing System on Desertification), which will make it possible to:

- gather information on the profitability of the investments made ;
- measure the impact of the actions undertaken on the environmental level and with regard to improving the life conditions of the populations ;
- identify the constraints in a timely manner and promptly decide on the necessary corrective measures ;
- promote dialogue and favour decisions based on objective information and jointly accepted as such.

Set up of national monitoring-evaluation system of the NAP/CCD (National Action Programme for Combating Desertification) under the SMAP/EC programme.
Presentation of the project
Entitled « Setting up Monitoring-Evaluation Systems of the Action Programmes of Maghrebi Countries », this project was designed by OSS and the National Coordination Institutions (ONC) of the Action Programmes for Combating Desertification of Morocco and Tunisia, together with the UMA (Union of the Arab Maghreb) Secretariat as a focal point of the Sub-Regional Action Programme (SRAP) for North Africa.
The overall objective of the project is to assist the North African countries in setting up an operational system for the monitoring-evaluation of the impact of the Action Programmes for Combating Desertification, which are instruments of implementation of

the UNCCD (United Nations Convention to Combat Desertification) on national and regional levels.

Based on a participatory, iterative and incremental approach, the project should allow national capacity building such as to set up a impact monitoring-evaluation system in the first countries to have a National Action Programme (NAP) for Combating Desertification (CD), that is Tunisia and Morocco, with the possibility of extension to the other countries of the region that are eligible for financing under the SMAP of the European Commission (EC). At the sub-regional level, the project will set up an information sharing system on desertification and the environment as a tool for strengthening the national mechanisms of information sharing on desertification, and as a component of the Sub-Regional Action Programme (SRAP) for Combating Desertification.

The specific objectives of the project are: The reference situation in matter of monitoring-evaluation of impact is established and analysed;

- The indicators of impact of the action programmes are identified, developed and usable;

The results expected are:

- A system of information sharing on desertification on the national and regional levels is set up and used;
- The products for each group of users, or « customer », are defined and disseminated;
- The operational modes of the permanent monitoring-evaluation systems, including the SCIDE component within the framework of the Action Programme, are established;
- The project results are capitalised from a regional and international perspective.

Initiated in Morocco and Tunisia late in 2002, the project has already given certain results. It was structured as follows at the regional level and at the national levels: The OSS acts as an assembler and as a scientific coordinator of the project, providing support to UMA (Union of the Arab Maghreb) in preparing and organising a project launch workshop on regional level, while ensuring a circulation of the results to the other countries member of UMA which are not directly involved in the project, as well as to Egypt. The Moroccan and Tunisian partners undertake the implementation of the NAP for combating desertification.

The indicators identified in Morocco

The inventory of the data and indicators available in Morocco has allowed a listing of the indicators related to the issue of desertification[5]. These indicators are proposed in the Pressure – State - Response matrix of table 2 below, organized according to the natural resources concerned:

A – Resource: Water
B – Resource: Forests
C - Resource: Rangelands
D - Resource: Crops lands.

[5] Mise en place de systèmes de suivi-évaluation des programmes d'action dans les pays maghrébins ; SMAP/CE/OSS ; Rapport 2 : Evaluation et analyse des dispositifs existants et proposition d'une liste d'indicateurs ; Rapport provisoire en instance d'examen par l'ONC, Rabat, juillet 2003 (*Set up of monitoring- evaluation systems for the Action Programmes in Maghrebi countries : SMAP/EC/OSS ; Report 2 : Assessment and analysis of the existing mechanisms and proposal of a list of indicators ; Draft report under examination by ONC, Rabat, July 2003*).

A particular effort was thus made to identify the various indicators in view of the logical framework Pressure – State – Response. This table is the outcome of an in-depth bibliographic work undertaken by the Moroccan team in charge of the project.
Many of these indicators are available and have already been calculated. For instance, Table 4 presents certain indicators relating to water which are regularly produced by the Moroccan statistical services
Subsequent work consisted in identifying the indicators that are most representative of the desertification issue, which could be monitored within the framework of the implementation of the NAP/CCD (National Action Programme for Combating Desertification). This work led to proposing a non exhaustive grid of indicators presented in the following table 4.

A – Resource: Water

Pressures/Factors	State/Impacts	Response
SURFACE WATER A1: Permanent climatic constraints A2: Recurrent drought A3: Rapid growth of population and increase of its needs A4: Withdrawal of the State, causing a vacancy in exercising responsibility in matter of water management A5: Deficient maintenance of canals A6: Wastage and poor management A7: Irrigation types and modes causing losses and wastages (water free of charge, prevalence of gravity irrigation, poor control of consumption by users, inadequacy of amount of water fee and/or of its recovery system A8: Crop choices non adapted to little water resources: large water consuming plants A9: Water consumption in cities (wastage, outdated water distribution networks, sale price too low for cost price) A10: Water needs of polluting industries	A101: Increasing mismatch between water demand and available water resources A102: Poor capitalisation of irrigation water A103: Little diversity of the crops practiced A104: High cost of water tapping A105: Small size of developed irrigated areas A106: Salinity problems A107: Wind erosion and sanding up (sand encroachment)	A201: Survey and control studies of the various links in the water use chain A202: Water master plan A203: Other water resources tapping structures (intake structures, pumping stations, irrigation networks, recharge dams) A204: Better agricultural capitalisation A205: Water tax at an opportunity price reflecting scarcity of the resource A206: Rehabilitation and maintenance programmes for the networks A207: Water efficiency/ saving programmes
GROUND WATER A11: Abstractions higher than renewable resources (Extreme case : mining exploitation of fossil resources) A12: Insufficient knowledge about the conditions of renewal of the resource and/ r of the needs A2: Recurrent drought	A108: Gradual decrease of exploitation flow A109: Gradual decline of the resource leading to abandonment (depletion and drying up of aquifers) A110: Cracking and crumbling of ground surface (damage to constructions, pollution of aquifers by surface water)	A201: Survey studies of potential and renewal of resources A202: Evaluation of demand A201: Establishment of piezometric and soil quality maps A207: Establishment of a programme for well drilling, tapping of springs, drinking water supply network,

	A111: Intrusion of salty marine water A108: Reduction of irrigated areas, if not abandonment of land A103: Little diversity of the crops practiced A107: Wind erosion and sanding up (sand encroachment) A111: Salinity problems	installation of equipment . . .) A222: Control of abstraction authorisations A208: Establishment of a policy of rational water pricing A204: Set up of villagers' committees for management of the resource and training of the members
OASES A2: Prolonged drought A13: Reservoir dams constructed mainly upstream of the oases A14: Replacement of traditional structures by modern ones (flood water spreading dams, earth dykes, . . .) A15: Replacement of traditional dewatering means (Delou, . . .) by motorpumps, besides their multiplication A16: Mining exploitation and/or at great depth of ground water A11: Abstractions higher than renewable resources A12: Insufficient knowledge about the conditions of renewal of the resource	A112: Elimination of floods A113: Elimination of permanent flow in minor beds, thus resulting in the disappearance of perennial vegetation (Tamarisk, Rose Laurel, . . .) A109: Drying up of the aquifer A107: Sand encroachment by wind A106: Increase in salinity A114: Decrease in crop intensification, in yields and in incomes A115: Reduction in the value of the plant heritage and elimination of vegetable crop growing, fodder crops, . . . A115: De-population of the oases zones: rural exodus, particularly among the youth	A201: Survey studies of potential and renewal of resources A202: Evaluation of demand A201: Establishment of piezometric and soil quality maps A207: Establishment of a programme for well drilling, tapping of springs, drinking water supply network, installation of equipment . . .) A222: Control of abstraction authorisations A208: Establishment of a policy of rational water pricing A204: Set up of villagers' committees for management of the resource and training of the members
DEVELOPMENT OF IRRIGATION A17: High crop intensification A11: Proliferation of private pumping	A117: Loss of fertility (quasi-exclusive resorting to mineral fertilisers and reduction of the humus capital of the soils) A118: Wind erosion A125: Asphyxiation of surface horizons of the soils due to loss of structure A119: Decrease in perviousness (permeability) A106: Salinity A120: Alkalinity A114: Decrease in yields A114: Reduced diversity of crops A121: Formation of a harrowing slab: difficulty of seed germination A122: Degradation of the vegetation: drastic reduction of biological diversity (disappearance of spontaneous vegetation) A123: Disappearance of the fauna and appearance of parasitic fauna (pests,..)	A209: Rationalisation of the use of fertilisers A210: Supply of organic fertilisers A211: Resorting to leguminous plants A212: Choice of soil work techniques (to avoid soil asphyxiation) A212: Drainage A214: Training and counselling of farmers A215: Applying a water policy

Pressures/Factors	State/Impacts	Response
RURAL AND PASTORAL HYDRAULICS (1)		
A18: Overexploitation of the resource A19: Deficient management of the equipment A20: Deficient water policy A21: Little sensitisation of the users A22: Absence of tax collection A26: Recurrent drought	A101: Increasing mismatch between demand and available resources (human/ animal) A116: Rural exodus	A216: Organisation and sensitisation programmes A217: Drinking Water Supply/ Tanks A218: Limiting animal load A219: Enlarging the water points grid
DEVELOPMENT AND WATER POLLUTION		
A17: High crop intensification A23: Densification of housing A24: Use of unregulated wastewater A25: Industrial installations	A124: Excessive concentration of nitrates and nitrites	A220: Control and measurement of pollution A221: Programmes intended to mitigate pollution

B – Resource: Forests

Pressures/Factors	State/Impacts	Response
NATURAL FORESTS		
B1: Land clearance B2: Abusive cutting of firewood B3: Overgrazing B4: Forest fire B5: Recurrent drought B6: Epidemics B7: Poorly controlled forest exploitation (wood trade, laying of tracks and roads)	B101: Reduction of woody areas B102: Soil erosion B103: Reduction of water balance (budget) B104: Affected biological diversity	B201: Demarcation of the forestry domain B202: Finalising the land tenure situation B203: Reforestation B204: Legislation control B205: Protection against fires B206: Phytosanitary treatment B207: Involving the neighbouring population in the income generated by the forest B208: Development of agriculture in peripheral forestry areas B209: Development of alternative energy
CATCHMENT BASINS		
B8: Water erosion	B105: Soil losses B106: Silting up of dams	A210: Reforestation of catchment basins A211: Protection and restoration of soils

C – Resource: Rangelands

Pressures/Factors	State/Impacts	Response
C1: Proliferation of water points C2: Water Erosion C3: Wind erosion C4: Land clearing C5: Unregulated collection of aromatic plants C6: Overgrazing (cattle load) C7: Forsaking of traditional organisation	C1O1: Disappearance of most productive species C102: Reduction of the tree layer and related fodder resources C103: Reduction of biomass C104: Soil degradation C105: Rural exodus	C201: Analytical study of fodder and water resources, as well as of the stock-breeding system practiced A202: Development of a pastoral management plan A203: Measures and works of restoration of rangelands: • *Planting of fodder shrubs* • *Re-sowing of rangelands*

		• *Temporary grazing restrictions ("no grazing" areas)* • *Monitoring the evolution of pastoral resources* A204: Organising farmers in farmers' groups and provision of training A205: Rational management of rangelands: • *Intra-annual momentary "no grazing" programme* • *Reduction of livestock load*

D – Resource: Farmland

Pressures/Factors	State/Impacts	Response
RAINFED FARMLAND D1: Recurrent drought D2: Water erosion D3: Wind erosion D4: Land intensification D5: Improper use of soils D6 : Soil pollution D7 : Human pressure (urbanisation) D8: Sand quarrying	D101: Soil losses D102: Sand encroachment D103: Reduction of land productivity D104: Limited diversity of the crops practiced D105: Loss of organic matter D106: Rural exodus	D201: Social conservation budget programme D202: Fruit tree growing budget D203: Agricultural development programmes budget
IRRIGATED FARMLAND D9: Land intensification	D107: Salinisation and/ or sodification of soils D108: Decline in the physical-chemical fertility of the soils D109: Reduction of land productivity D110: Reduction of crop diversity D111: Abandonment of land D112: Wind erosion/ sand encroachment	D204: MRT project

Table 4. Matrix of Pressures-States-Responses, according to the sectors

	Indicator	Value
PRESSURE	Intensity of use of water resources per sector (1998/99)	- 1.850 Billion m3 of downstream abstractions - 9.516 Billion M" intended for irrigation -2.269 Billion m3 intended for drinking and industrial water supply
	Surface water quantity tapped per year with respect to total water available (1998/1999)	- 10.950 Billion m3 regulated/ 16 Billion m" may be tapped - 1.850 Billion m3 of downstream abstractions - 7.516 Billion M" intended for irrigation -1.584 Billion m3 intended for drinking and industrial water supply

	Ground water quantity tapped per year with respect to total water available	- 2.685 Billion m3 regulated/ 16 Billion m” may be tapped - 2 Billion m3 of downstream abstractions - 7.516 Billion M” intended for irrigation - 685 Million m3 intended for drinking and industrial water supply
	Water consumption at national level (1998/99)	13.635 Billion m”
	Domestic water consumption	- 100 l/inh/day as average national allotment for the connected population - 20 l/inh/day for the non connected population
	Drinking water production at national level (1998)	800 Million m”
	Water quantity used in the industrial sector (1996)	1.088 Billion m3 of water (81% sea water, 14% surface water, 4% drinking water and 1% ground water)
	Quantity of hydro-electrical energy produced	In the order of 1 600 GWH, in average year, that is 15% of the total energy consumption, representing to a fuel saving in the order of 660 000 tons of fuel per year
	Portion of flow of wastewater in rivers (1994)	30% of the total pollution disposed of, that is 150 Million m3
	Use of chemical fertilisers in agriculture (1994)	About 8 500 tons of nitrogen pollution generated
	Use of pesticides in agriculture (1994)	About 15 tons of pesticide pollution generated
STATE	Quality conditions of water resources	- Ground water: The poor quality of the water is due to 2 factors: (1) Mineralisation of the water due to marine water intrusion which, in its turn, is a consequence of the overexploitation of the aquifers of Martil, Gharb, Bou Areg and Triffa, (2) A high concentration of nitrates in the aquifers of Beni Amir, Beni Moussa west and of central Bahira which constitute the seat of an intensive agriculture. - Surface water: It is mainly the sections of rivers (wadis) located downstream of the disposal zones of major towns which present poor quality
	Pollution flow disposed of in the water network (1993/94)	- Urban pollution: 131 443 tons of oxidizable matter; 25 881 tons of total nitrogen; 3 847 tons of total phosphor; - Industrial pollution: 26 640 tons of oxidizable matter; 2 770 tons of total nitrogen; 60 tons of total Phosphor; 70 tons of chromium
RESPONSE	Cost of wastewater treatment	9 810 Million DH 1994 (Net of Taxes): amount of investment to be made up to 2020
	Total rate of connection to the sanitation network (1996)	70% for the whole urban centres (76% for the major towns, 67% for medium-sized towns, 40% for small-sized urban centres)

	% of population connected to a wastewater treatment plant (population 1994)	Less than 8% of all the urban population of the country (whatever the state of the wastewater treatment plant),
	Rate of wastewater treatment in urban environment (1999)	23 wastewater treatment plants in operating order, out of the 63 existing wastewater treatment plants
	Fees for wastewater treatment	Provided by the Water Law, but not yet applied

Table 5. Summary of main “Pressure – State – Response” indicators

Pr. Jamel ALIBOU, Studies and Research Centre on Hydraulic and Environmental Systems, EHTP (October 2002)

Topic	Indicator	Type
Elimination of poverty		
	Growth rate of total population	P
	Growth rate of rural population	P
	Rural population/ Total population Ratio	E
	Agricultural GDP/ inh.	E
	GDP/ inh.	E
	Illiteracy rate	E
	Active pop. In the agricultural sector/ Active rural population ratio	E
	Rural exodus flow	R
	Schooling rate (primary education)	R
	Rate of rural households with access to electricity	R
	Rate of rural households with access to drinking water	I
	Rate of rural population in Poor population.	I
	Rate of population below poverty threshold	I
	Rate of rural unemployment.	
Water resources		
	Tapped surface water volume	R
	Tapped ground water volume	R
	Rate of silting up of dams	P
	Rainfall variance with respect to normal (mean value)	E
	Climatic aggressiveness (erosion factor)	E
	Rate of rural drinking water supply	R
	Drinking water consumption/ inh.	I
	Irrigation water consumption/ hectare	I
	Efficiency of irrigation networks	R
	Rate of recovery of irrigation water fees	R
	Water volume available per inhabitant	I
	General water quality index	R
	Portion of irrigated areas using water saving (efficiency) techniques	R
	Rate of filling of dams (September)	I
Forests		
	Cleared land area/ year	P

	Area affected by parasite waves	P
	Decay/ year	P
	Area affected by fire/ year	P
	Total forestry area (Mha)	E
	Area of degraded forestry (ha)	P
	Water erosion prone area (ha)	P
	Area definitely delimited/ year	R
	Area reforested/ year	R
	Area of protected zones	R
	Area treated against diseases/ year	R
	Area regenerated/ year	R
	Area treated against water erosion/ year (in the major catchment basins)	R
	Forest area/ 10 year	I
	Ratio of reforested area/ deforested area/ year	R
Rainfed land		
	Rate of farms of less than 5 ha in area	P
	UFS (Useful Farm Space) per rural inh.	P
	Portion of grain crops in USF	E
	Portion of fallow land in UFS	E
	Portion of cover crop area/ Total mechanised area	R
	Crop rotation structure (UFS structure)	R
	Plantation area	R
	Agricultural development budget allotted to the rainfed land zone	R
	Area grown in the framework of the national olive growing plan	R
	Area grown under the fruit tree DRS (soil protection and restoration) scheme	R
	Evolution of the yields of the main crops and tree plantations	E
	Average annual rainfall	E
Irrigated land		
	Rate of exploitation of available water resources	P
	Sale price of water/ Cost price of water	P
	Portion of areas of high water consuming crops	P
	Quantity of fertilisers and pesticides used	P
	Number of dried up wells	E
	Area affected by salinity	I
	Crop rotation structure	E
	Portion of area of irrigated zones	R
	Developed areas	R
	Number of AUEA	R
	Portion of the area affected by salinity/ Total irrigated area	I
	Evolution of yield of the major irrigated crops	I
	Water volume consumed by irrigation	P
	Production value of agricultural land/ PIBA	E
	Portion of areas of little water consuming crops (drought-resistant)	R
Rangelands		
	Population of small ruminants	P
	Land area cleared	P
	Livestock load per available fodder unit	P

	Area of degraded land	P
	Vegetation Index (NDVI)	E
	Portion of developed rangeland	R
	Number of equipped water points	R
	Number of operating pastoral organisations	R
Oases		
	Area affected by sand encroachment	E
	Area affected by salinity	E
	Number of desiccated palm trees	E
	Number of seedlings distributed in the framework of the oases restructuring plan	R
	Area of stabilised dunes	R
	Portion of the area affected by the degradation factors	E

Table 6. Draft list of indicators selected by the project SMAP/OSS/Morocco

2.1.3. Tunisia – Experience of setting up a performance chart for desertification

Tunisia is engaged in several programmes related to the monitoring-evaluation of desertification, namely ROSELT/OSS, LIFE/OSS, DISMED, and SMAP/EC/OSS. The issues addressed and the results reached by the ROSELT, LIFE/OSS and DISMED projects and programmes are proposed in a separate presentation. With regard to the SMAP/EC/OSS project, its approach is proposed in the case of Morocco where it represents the main project in terms of production of indicators for the NAP/CCD. Tunisia, too, is a partner in the SMAP/EC/OSS project, but has benefited in addition from Italian support toward the development of the general framework of monitoring-evaluation of the Tunisian NAP. This is the reason why this project, which has already given tangible results, is presented further down. The SMAP/EC/OSS project in Tunisia will ensure continuity of the work undertaken under the Tunisian-Italian project by focusing mainly on the regional and local levels.

The Tunisian-Italian Project (PTI) for setting up a monitoring-evaluation system for the NAP/CCD in Tunisia. Overview

As part of the work of the UN Commission on Sustainable Development aimed at designing sustainable development indicators, Tunisia started as early as 1997 to test the 134 SDIs (Sustainable Development Indicators) established in this regard.

In this same context, other initiatives started to develop in Tunisia, involving a set of well defined topics of which desertification. Thus, Tunisia set out a "Project for the Establishment of a System of Monitoring-Evaluation of NAP/CCD" (Tunisian-Italian Project – PTI), supported by Italy and coordinated by the OSS.

The project started in 2002 with a view to achieving the objectives set for it based on identifying, analysing and assessing the available data and information, as part of a first phase.

In accordance with the concept developed by OSS and its partners, the components of the monitoring-evaluation system and the typology of the monitoring-evaluation indicators of NAP/CCD Tunisia are set in the following three classes:

- Indicators of the process of implementation of the NAP;
- Desertification indicators;
- Indicators of impact of the NAP.

The approach selected by the project consisted in identifying the three key phases in establishing a performance chart for the monitoring of desertification:

- To draw up an issues table, i.e. a table where the major desertification-related issues are grouped;
- To identify indicators that inform about these various issues;
- To establish a performance chart on desertification monitoring.

Identification of relevant issues. Identification of the causes of desertification
This causality field related to desertification is defined by the framework and determinants of the regressive dynamics of the ecosystems/ agrosystems:
- The framework is defined by the natural conditions of the ecosystems/ agrosystems (which cause them to be vulnerable, resilient, etc . . .), on the one hand, and the socio-economic conditions of the population concerned, on the other hand;
- The determinants of the regressive dynamics are manifested by the human pressures induced and worsened by poverty and by drought under the form of practices of exploitation of natural resources and of survivalist conduct by the populations concerned. Such practices thus constitute causes of desertification. Each cause induces a negative impact or a set of negative impacts on one or more resources (soil, vegetation, population…). Often, the causes combine and generate one or several more or less complex impact(s).

The issues table
This is a simplified and synthetic formulation, in a specific table, of the desertification issue. Each level of analysis of the situation of a territory under desertification requires the development of a specific table for setting the issues related to this plague. This operation comprises various stages, which follow from one another according to a given logic:
- The identification of the decision maker(s) and of their expectations with regard to the monitoring-evaluation system. These expectations depend on the subject of interest and the priorities of the decision maker(s) in matter of combating desertification;
- The choice of the appropriate logical framework (or model) related to indicators. This choice follows from the results of the first stage;
- Identification of the reference document recognized by the decision-making centre and the other actors of the CD (programme for Combating Desertification) as being the main source of information relating to the framework, the approach and the objectives and means of CD;
- Identification of the components of the desertification issue likely to be considered as the best descriptors of the evolution trend of the situation under consideration;
- Development of the desertification issues table.

In the Tunisian case, it is the Driving Force – Pressure – State – Impact - Response) model which has been adopted.
For most levels of analysis/ decision, two types of components are to be taken into consideration:
- The natural resources/ spaces subject to desertification;
- The data relating to the issues pertaining in the desertification/ degradation of these resources/ spaces.

The issues table reports the results of the analysis of the field of causality of the desertification phenomenon, and allows the identification of the appropriate CD (combating desertification) actions, on the one hand, and guides the choice of the relevant indicators to be adopted for monitoring-evaluation of the CD. It constitutes, accordingly, a transition to the logical framework selected, namely FPERI, where the rationality of the choices of the responses made, on the one hand, and that of the performance of their impacts, on the other hand, are tested. The table below presents the desertification-related issues in Tunisia.

SPACE/ RESOURCE SUBJECT TO DÉSERTIFICATION AND M-E	AREAS ENDANGERED	GEOGRAPHIC LOCATION	DESERTIFICATION CAUSES	DESERTIFICATION PHENOMENA	LAND DEGRADATION PROCESSES	DESERTIFICATION IMPACTS	QUANTIFICATION OF DEGRADATION
AREAS GROWN	5 M ha*	Tunisia Rainfed and irrigated farming	Crop growing techniques Mismatch soil/ crop Irrigation by salty water Drought	Loss of fertility Water erosion Wind erosion Salt accumulation	Impoverishment in organic matter + nutrients Loss of land fertility Salinisation Sodisation Physical, chemical, biological degradation	Loss of fertility and production Overrun cost of agricultural productions Farmer poverty, exodus . . . Negative environmental impacts	Areas affected : Olive tree crops Grain crops ha salinised/ year
FORESTS	0.97 M ha	Tell zones Ridge Matmata mountain chains	Disruption of ecosystem Forest fires Improper exploitation of resources and crop growing practices Land clearing Extension of farming in mountainous zone Overgrazing	Recession of forest cover Reduction of biological diversity Disappearance of the plant cover Destabilising of soil functions	Loss of biological component of the soil/ Ground surface vulnerability Loss of organic matter Loss of nutrients Reduction of soil depth Soil dysfunction	Decrease in fertility Decrease in productivity Disruption of water system Poverty of population, rural exodus …	Nb. ha/ year affected by forest fire Nb. ha/ year cleared - Clearing - Peripheral - Size of livestock in forest

STEPPIC LANDS	4,5 M ha	North Centre South	Disruption of ecosystem Improper exploitation	Degradation of quality of the rangelands Lack of regeneration of plant cover Destabilising of soil functions Degradation of soil quality	Rarefaction of productive species Decrease in production/ ha Vulnerability of the ecosystem Salinisation, Physical, chemical and biological degradation	Reduction of rangeland area, loss of biological diversity Destabilising of the ecosystem Exposure to erosion Loss of fertility and cattle feed deficit Disruption of structure of ovine stock-breeding, impoverishment	Degraded flora area
WATER RESOURCES	Surface water resources	Northern regions dams	Drought	Reduction in volume of tapped water	Salt concentration	Degradation of soil quality	Deficit of water that may be tapped
	Ground water resources + wastewater	Ground aquifers	Overexploitation of ground water	Degradation of water quality	Marine edge effect Drop in piezometric level	Decrease in land productivity Decrease in irrigation profitability	Increase in average salinity
WETLANDS	1,5 M ha	North Centre South	Land use planning	Drying up/ Salinisation/ Pollution	Degradation of ecosystem	Loss of economic and environmental functions	Area affected

Table 7. Desertification Issues Table on National Level

*M ha : Million hectares

The Tunisian CCD indicators grid

The grid of the indicators for Combating Desertification (CCD) is the list of the main relevant indicators established in a given logical framework (model) and describing for a given period the territory under desertification in terms of its natural and socio-economic components. The indicators of the process of implementation of the NAP are not taken into account in what follows. The relevance of the indicator is defined by:

- The quality of the information brought with respect to a given aspect of the desertification issue;
- Its suitability for analysis/ decision centre in charge of the planning and the management of the territory under consideration.

For pragmatic reasons, it has been deemed useful, at the inception of the process of Monitoring-Evaluation, to adopt simple indicators on which consensus may be easily achieved. The analysis of the information and the data available in Tunisia led to the establishment of grids:

- A grid of indicators on the implementation of the CCD and of the NAP. This grid is not proposed here as it is in process of validation by the ONC (National Coordination Institution);
- Two grids having the same structure, but a different number of indicators:
  - A broad grid, comprising 62 indicators of Pressure, State, Response and Impact, taking into consideration the strategies and objectives of the various actors. The grid represents in fact a rich set of data which are all available, regularly produced and usable for justifying and supporting the assessment that will be made subsequently, and based on which the most significant simple and aggregate indicators have been selected in order to make the second grid;
  - A synthetic grid, comprising 22 indicators, in line with that proposed by the OSS to the countries of the region, and comprising:
    - 4 indicators relating to sustainable economic development of the populations, with 1 Pressure indicator, 2 State indicators and 1 Impact indicator;
    - 18 indicators relating to the management of natural resources, distributed into 9 State indicators, 4 Pressure indicators and 5 Response indicators.

This synthetic grid will serve, inter alia, for comparing the performance of the country with that of the other countries of the region.

Finally, the draft performance chart on desertification, which groups the whole set of the indicators and issues concerned, is currently in process of validation by the National Coordination Body (NCB) of the NAP/CCD.

CCD Objectives	**NAP Objectives**	**Problematics**	**Indicators**			
			Pressure	**State**	**Response**	**Impact**
Elimination of poverty	Improvement of the socio-economic conditions of the population	Poverty	Rural exodus *Source:INS*	Percentage of population living below the poverty threshold *Source:INS*	Number of projects for the promotion of rural woman and of community development *Source:INS*	Rate of household connection to drinking water network *Source:INS*
			Total rural population *Source:INS*	Annual expenditure per person on health and hygiene *Source:INS*	Number and budget of "promotion of rural woman and of community development" projects *Source:INS*	Total annual expenditure per person according to environment *Source:INS*
			Population according to the uses of natural resources per natural space *Source:INS*	Rate of contraceptive prevalence in rural and urban environment *Source:CREDIF*		Rate of electrification of households *Source:INS*
			Illiteracy rate in rural environment *Source:INS*			Number of precarious housing *Source:INS*
			Population with part of its income generated by the rangelands and forests *Source:INS*			Economic values profiting to the local populations *Source:INS*
						Evolution of the expenditure of the populations according to the natural spaces *Source:INS*
Management of natural resources	Forestry space	Forest fires	Forest fires (area, number, A/N ratio) *Source:DG/F*	Rate of recovery of forest formations *Source:DG/F*	Budgets allocated to actions in the forestry sector *Source:DG/F*	Number of work days in the forests and rangelands *Source:DG/F*

	Steppe Space	Ecosystem degradation and Soil degradation	Number of reported forestry offences *Source:DG/F*	Volume of tree wood/ ha *Source:DG/F*	Number of AFIC, GFIC and GDA operating in the forests and rangelands Source:DG/F	Contribution of income generated by forestry activities in the household income *Source:INS*
			Total forestry population *Source:IN*	Rate of recovery of forest formations *Source:DG/F*	Ratio of protected forestry and steppes areas/ Total forestry and steppes areas *Source:DG/F*	Amount of conventions made by Groups/ Total budget allocated to the forestry sector *Source:DG/F*
			Rate of coverage of the needs of the livestock of the Governorates (Provinces) of the North by the production of the forestry spaces *Source:DG/F*	Albedo *Source:CNT*	Area of forest and pastoral plantations *Source:DG/F*	
			Rate of coverage of firewood needs by the Governorates of the North *Source:DG/F*	Total area of forestry formations Source:DG/F		
				Rate of native forestry species produced in nurseries *Source:DG/F*		
		Sand encroachment	Rate of recovery of steppes formations *Source:DG/F*	Annual areas of steppes formation restricted to grazing *Source:DG/F*		
				Length of tabias (conventional fences) for sand stabilisation *Source:DG/F*		
		Degradation of Ecosystems	Supplement feed given to the livestock in the Governorates of the	Area of steppes formations *Source:DG/F*		

			Centre and of the South *Source:OEP*			
			Area of collective rangelands allotted to private developers *Source:OEP*			
			Infrastructure (water point, shade areas, roads, . . .) *Source:OEP*			
			Tenure status of rangelands *Source:OEP*			
		Agriculture	Grain crop areas / Steppes rangeland area in the Governorates of the Centre and of the South *Source:DG/EDA*	Biomass / Vegetation index / Albédo *Source:CNT*	Size of researchers teams acting under the R-D programmes listed in the NAP (National Action Programme for Combating Desertification) *Source:IRESA (INRGREF)*	
				Animal and plant biodiversity trends *Source:DG/EQV*	Number of Master Studies Graduates in Combating Desertification per year *Source:IRA*	
	Farmlands	Rainfed crops	Total area of grain crops in Tunisia *Source:DG/EDA*	Average national yield of grain crops *Source:DG/EDA*	Budgets allocated to Water & Soil Conservation works *Source:DG/ACTA*	
			Total quantity of fertilisers used per year	Grain crop sown area/ Area fit for grain crop growing in	Area of catchment basins developments	

			Source:DG/EDA	the Governorates of the North *Source:DG/ACTA*	*Source:DG/ACTA*	
			Rainfed crops area in the Governorates of the South *Source:DG/EDA*	Farmland cover (occupancy) in Tunisia *Source:DG/EDA*	Area of reinforced Water & Soil Conservation developments *Source:DG/ACTA*	
			Farmland area/ inhabitant *Source:DG/EDA*	National olive crop production *Source:DG/EDA*	Area of land developed based on soft techniques *Source:DG/ACTA*	
			Grain crop area in mountainous zones North of the Ridge *Source:DG/EDA*		Number of flood water spreading structures *Source:DG/ACTA*	
			Grain crop area + Tree plantation area/ Steppes rangelands + Rainfed farmland in the Centre and the South *Source:DG/EDA*			
		Irrigated agriculture	Quality of irrigation water : surface and ground water *Source:DG/EDA*		Irrigated area equipped with water saving (efficiency) techniques *Source:DG/EDA*	
	Water resources	Water quality			Percentage of treated wastewater volume/ Total wastewater volume *Source:DG/GREE*	
					Area of land irrigated by treated wastewater *Source:DG/GREE*	
		Water volume		Water storage in dams as of 31 August / Total storage	Number and capacity of hillside dams	

				capacity *Source:DG/BGTH*	*Source:DG/EDA*	
					Number of hillside lakes *Source:DG/ACTA*	
					Number of manmade recharge sites of groundwater aquifers, and volumes injected *Source:DG/RE*	
	Wetlands	Dysfunction		Number, Area and Distribution of wetlands *Source:DG/F*	Number of protected wetlands *Source:DG/F*	

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Legend:
AFIC : Community Interest Forestry Association;
GFIC : Community Interest Forestry Group;
GDA : Agricultural Development Association

Table 8. List of the 62 indicators of desertification selected in Tunisia

CCD Objectives	Specific Objectives of the Tunisian NAP	Indicators	Type of Indicator P-S-R-I*
Elimination of poverty	Sustainable rural development	Percentage of population living below the poverty threshold	**S**
		Total annual expenditure per person according to the environment (rural/ urban)	**I**
		Rural exodus situation	**P**
		Rate of contraceptive prevalence in rural and urban environment	**S**
Management of natural resources	Control over degradation of soils and of ecosystems	Farmland cover (occupancy) in Tunisia	**S**
		Farmland area/ Inhabitant	**P**
		Grain crop sown area / Steppes rangeland area in the Governorates of the Centre and of the South	**P**
		Grain crop sown area + tree plantations area/ Steppes rangeland area + rainfed farmland in the Governorates of the Centre and of the South	**P**
		Rate of steppes formations cover	**S**
		Biomass/ Vegetation index/ Albédo	**S**
		Rate of forestry formations cover	**S**
		Forest fires (area, number, A/N ratio)	**P**
		Rate of forest cover	**S**
		Budgets allocated to actions in the forestry sector and of Water & Soil Conservation	**R**
	Sustainable management of water and control over drought impacts	Rainfall map for crop year	**S**
		Rainfall for the months of September, October and November	**S**
		Water storage in dams as of 31 August/ Total storage capacity	**S**
		Index of exploitation of deep aquifers	**R**
		Rate of irrigated land equipped with water saving (efficiency) techniques with respect to total irrigated land	**R**
		Ratio of wastewater volume treated/ wastewater volume used	**R**
	Optimal functioning of wetlands	Area and distribution of wetlands	**S**
		Number and area of protected wetlands/ Number and area of total wetlands	**R**

** * P = Pressure; S = State; R = Response; I = Impact*

Table 9. Synthetic list of the 22 indicators selected for monitoring-evaluation of desertification

- The sources, periodicity of production, reference state and other information relating to the indicators are available in their respective files.
- The classification of the indicators into P-S-R-I (Pressure – State – Response – Impact) is in process of approval by the ONC (National Coordination Institution).
- The indicators of the process of implementation of the NAP are not included in the above table.

An example of co-operation with the sectors concerned in matter of indicators

The Directorate-General of Forestry (DGF) is member of the technical group in charge of the identification of desertification indicators set up by the Permanent Secretariat of the ONC (National Coordination Institution). It has made available to this working group its experience in matter of sustainable management of the forest and steppes formations of Tunisia.

Indeed, within the framework of the sustainable development of the forest and steppes formations, considerable work has been done by the forestry sector and has led to the identification and calculation of indicators relating to the various criteria of sustainable management of forest and steppes formations. In this precise case, data are available and are regularly collected. The following table presents the whole set of the indicators calculated and available at the Directorate-General of Forestry (DGF).

Criterion 1	**Extent of forest spaces**
Indicator 1.1	Area of forest formations
Indicator 1.2	Area of steppes formations
Indicator 1.3	Structure of forestry stocks
Indicator 1.4	Development stage of forestry stocks
Indicator 1.5	Land tenure situation
Indicator 1.6	Rate of forestry cover
Indicator 1.7	Area reforested
Indicator 1.8	Area grown in multipurpose species
Indicator 1.9	Area of recreational forests
Indicator 1.10	Area of forestry clearing
Criterion 2	**Conservation of biodiversity**
Indicator 2.1	Percentage of total area of protected zones with respect to the country's forestry area
Indicator 2.2	Area and number of national parks
Indicator 2.3	Area and number of natural reserves
Indicator 2.4	Area and number of wetlands
Indicator 2.5	Percentage of endangered species
Indicator 2.6	Species and population of migratory birds
Indicator 2.7	Population of main re-introduced animal species
Indicator 2.8	Number of tree and shrub species produced in nurseries
Indicator 2.9	Percentage of native shrub and tree species
Indicator 2.10	Percentage of sapling per species
Criterion 3	**Prevention of and combating forest degradation**
Indicator 3.1	Fire damaged forest area
Indicator 3.2	Number of forest fires
Indicator 3.3	Size of forest tracks network
Indicator 3.4	Size of fire-break network
Indicator 3.5	Number of fire-watch points
Indicator 3.6	Percentage of area treated against pests with respect to affected area
Indicator 3.7	Percentage of temporary "No grazing" forest area with respect to total area other than protected areas
Indicator 3.8	Percentage of temporary "No grazing" steppes formations other than protected areas
Indicator 3.9	Total number of forest offences
Indicator 3.10	Nature and extent of offences
Indicator 3.11	Preservation of young plantations
Indicator 3.12	Area of stabilised continental dunes
Criterion 4	**Production and protection aspects**
Indicator 4.1	Intensity of forestry exploitation of main products (wood, cork, esparto, rosemary) with respect to potential
Indicator 4.2	Percentage of production of timber with respect to total volume
Indicator 4.3	Percentage of trituration (ground) wood with respect to total volume

Indicator 4.4	Number of Non Woody Forestry products having been sold by auction
Indicator 4.5	Forestry area having formed the subject of a development plan
Indicator 4.6	Fodder production of the forest rangelands
Indicator 4.7	Hunting production
Indicator 4.8	Apparent consumption of wood and derivatives
Indicator 4.9	Coverage rate of needs in wood and derivatives
Indicator 4.10	Contribution of the forestry sector in GDP
Indicator 4.11	Area of restored forestry rangeland
Indicator 4.12	Expenses allocated to rangeland works (DGF, OEP, CES, ODESYPANO)
Indicator 4.13	Percentage of investments allocated to the forestry sector with respect to the budget of the Ministry of Agriculture
Indicators 4.14	Extent of windbreak and roadside plantations
Indicators 4.15	Area of coastal dune stabilisation works
Criterion 5	**Socio-economic role of forests**
Indicator 5.1	Value of woody products
Indicator 5.2	Value of non woody forestry products
Indicator 5.3	Number of hunters
Indicator 5.4	Sale of sundry products (value)
Indicator 5.5	Size of labourforce employed in the sector
Indicator 5.6	Number of visitors to national parks
Indicator 5.7	Average annual production of firewood per household
Indicator 5.8	Contribution of forest rangelands in the feed of the national livestock
Indicator 5.9	Number of operating community groups (authorised)
Indicator 5.10	Number of forest exploitation units (micro-enterprises)
Indicator 5.11	Percentage of forestry contracts awarded to the Community Groups
Indicator 5.12	Number and extent of temporary occupancies
Indicator 5.13	Contribution of the income generated by forestry activities in household income
Criterion 6	**Institutional and legal aspects**
Indicator 6.1.1	Number of forestry technicians and engineers having received promotion
Indicator 6.1.2	Number of forestry technicians and engineers having taking part in missions, study stays abroad or training sessions
Indicator 6.1.3	Percentage of research subjects related to the forestry sector with respect to agricultural research
Indicator 6.1.4	Percentage of funds allocated to forestry research with respect to the national objective (1 % of GDP)
Indicator 6.1.5	Number of research bulletins and annals issued
Indicator 6.1.6	Participation of forestry executives in radio and TV programmes
Indicator 6.1.7	Extension/ Outreach folders, brochures and documents issued and distributed
Indicator 6.1.8	Number of TV spots broadcast on the various forestry topics
Indicator 6.1.9	Development and equipment of eco-museums
Indicator 6.2.1	Percentage of vacant sorting
Indicator 6.2.2	Set up and monitoring of the implementation of a framework law
Indicator 6.2.3	Evolution of the funds allocated to the forestry sector
Indicator 6.2.4	Settling the situation of forestry assistants and of the workers on national projects
Indicator 6.2.5	Percentage of intervention by private developers in the execution of forestry works and in the exploitation of forestry products
Indicator 6.2.6	Number of NGOs involved in forestry projects
Indicator 6.3.1	Number of issued decrees and enforcement texts of forestry code
Indicator 6.3.2	Amendment of certain regulatory articles and/ or texts with a view to promoting sustainable management of forestry resources
Indicator 6.3.3	Development and updating of the PAFN (National Forestry Action Plan)

Table 10: Criteria and indicators of sustainable management of the forest and steppes formations of Tunisia[6]

[6] Source : Ministry of Agriculture, the Environment and Water Resources, General Directorate of Forestry

Following discussions on the need to select a minimum set of desertification indicators; the indicators below were finally proposed for the monitoring of desertification and relating to the « Forests and steppes » sector:

Criterion 1: Extent of forest space
Indicator 1.1: Area of forest formations
Indicator 1.2: Area of steppes formations
Indicator 1.3: Area reforested
Indicator 1.4: Area grown in fodder shrubs
Indicator 1.5: Area grown in spineless cactus
Criterion 2: Conservation of biodiversity
Indicator 2.1: Percentage of total area of protected zones with respect to the total area of the country
Indicator 2.2: Percentage of endangered species
Indicator 2.3: Size of main re-introduced animal species
Indicator 2.4: Percentage of saplings produced in nurseries per species
Criterion 3: Prevention of and combating forest degradation
Indicator 3.1: Fire damaged forest area
Indicator 3.2: Percentage area treated against pests with respect to affected area
Indicator 3.3: Total number of forestry offences
Indicator 3.4: Nature and extent of offences
Indicator 3.5: Preservation of young plantations
Criterion 4: Production and protection aspects
Indicator 4.1: Intensity of forestry exploitation of main products (wood, cork, esparto, rosemary) with respect to potential
Indicator 4.2: Forestry area having formed the subject of a development plan
Indicator 4.3: Fodder production of forest rangelands
Indicator 4.4: Hunting production
Indicator 4.6: Contribution of the forestry sector to GDP
Criterion 5: Socio-economic role of forests
Indicator 5.1: Value of woody products
Indicator 5.2: Values of non woody forestry products
Indicator 5.3: Number of hunters
Indicator 5.4: Sale of sundry products (value)
Indicator 5.5: Size of labourforce employed in the sector
Indicator 5.6: Number of visitors of the national parks
Indicator 5.7: Average annual consumption of firewood per household
Indicator 5.8: Number of operational (authorised) community groups
Indicator 5.9: Number of forestry exploitation plants (micro-enterprises)
Criterion 6: Institutional and legal aspects
Indicator 6.1: Number of man/ month of training done in Tunisia and overseas
Indicator 6.2: Number of issued research bulletins and annals
Indicator 6.3: Extension/ Outreach folders, brochures and documents issued and circulate
Indicator 6.4: Evolution of funds allocated to the forestry sector
Indicator 6.5: Number of NGOs involved in the forestry projects

Table 11. Indicators selected for monitoring the Tunisian NAP/CCD with regard to the Forests/ Pastoral Areas component

As has already been noted, all these indicators are calculated.

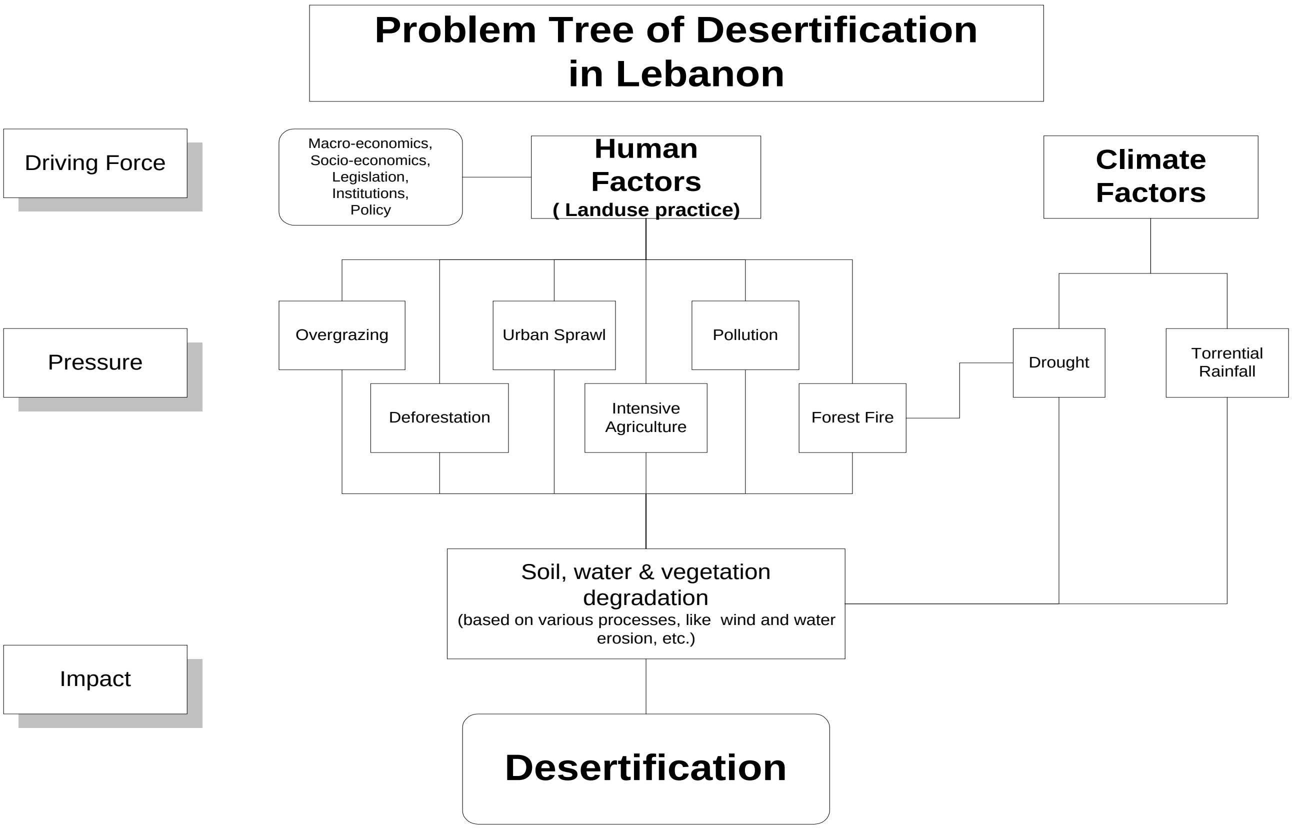
2.1.4. The "Desertification Prone Areas" Model in the Lebanon

The choice of indicators

The following guiding principles have been followed in the choice of indicators adopted in the approach:

- Their relative importance in contributing to degradation phenomena
- Data availability

Taking into consideration the local context, the limited resources available and experience from previous attempts at monitoring at the national level, MoDeL attempts a methodological integration and proposes "a basic approach", a pragmatic comprehensive approach based on data which is regularly collected by the various institutions.



Index	Layers
Climate	Precipitation, Evapo-transpiration
Soil	Soil textural class, Soil structural stability, Soil organic matter, Soil Depth, Slope gradient
Vegetation	Fire risk, Erosion protection, Drought resistance
Land use intensity	Land use, grazing intensity
Demographic pressure	Population density, Household satisfaction index

Table 12: Information layers used in evaluating DPA and related sources

A qualitative classification scheme with values ranging from 1 to 21 has been applied throughout the model for individual indices as well as the final classification of Desertification Prone Areas. The value “1” is assigned to areas least prone to desertification while “2” is assigned to areas which are most prone. The range between 1 and 2 reflects relative vulnerability. The individual indices are described below:

Climate
In particular the selected information layers are:

- Annual precipitation
- Annual potential evapotranspiration

The climate index is the ratio of the yearly precipitation over yearly potential evapotranspiration (P/ETP).

Soil Index
S are important properties, which influence soil degradation phenomena. Therefore, the model incorporates soil water retention capacity and erodability as part of the soil index, which is based on the following characteristics

- Slope gradient
- Soil texture in relation to both erosion and salinization
- Soil structure in relation to erosion
- Soil depth in relation to erosion and biomass production
- Organic matter in relation to erosion and biomass production.

The soil index was calculated using information layers describing the above characteristics.

Vegetation Index
The vegetation index is calculated based on the various functions and roles played by the vegetative cover with regard to degradation processes:

- Fire risk and regenerative ability
- Soil erosion protection
- Drought resistance

These functions were translated into information layers (based on the Lebanese land cover map, FAO 1990), which were used in the calculation of the vegetation index.

Land use intensity

The “Derived Land Use Map of Lebanon” (1997) was used to describe land use intensity. It is based on the following legend:

1. Horticulture
2. Irrigated temporary cropping,
3. Non irrigated temporary cropping
4. Permanent cropping, which is subdivided into olive, grape, fruit trees and citrus and banana cultivation
5. Pastures
6. Forests for re- and afforestation
7. Recreational forests
8. Forest for pine kernel production
9. Non used forests
10. Non usage
11. Residential, industrial, mining, …

The grazing intensity on pastures was calculated separately and added to the land use index. Table 6.5 shows the different land uses and their respective relative scores:

Demographic pressure Index

The demographic index has been calculated on the basis of:

- Population pressure, assessed by means of population density;
- Poverty, assessed using household satisfaction index as published by UNDP.

The assessment of the demographic index was done at the Caza (district) level because of data availability. The value “2” has been assigned to areas with the highest density and highest rate of dissatisfaction, and “1” to areas with the lowest. Intermediate areas were assigned values between 1 and 2.

Combining indices

The integration of the various indices was made by using GIS technology. The various information layers for each index were prepared in a suitable format and then overlaid in order to calculate the index as described below:

Index_x = (layer_1 x * layer_2 x * layer_3 x * ...... * layer_n x) (1/n)

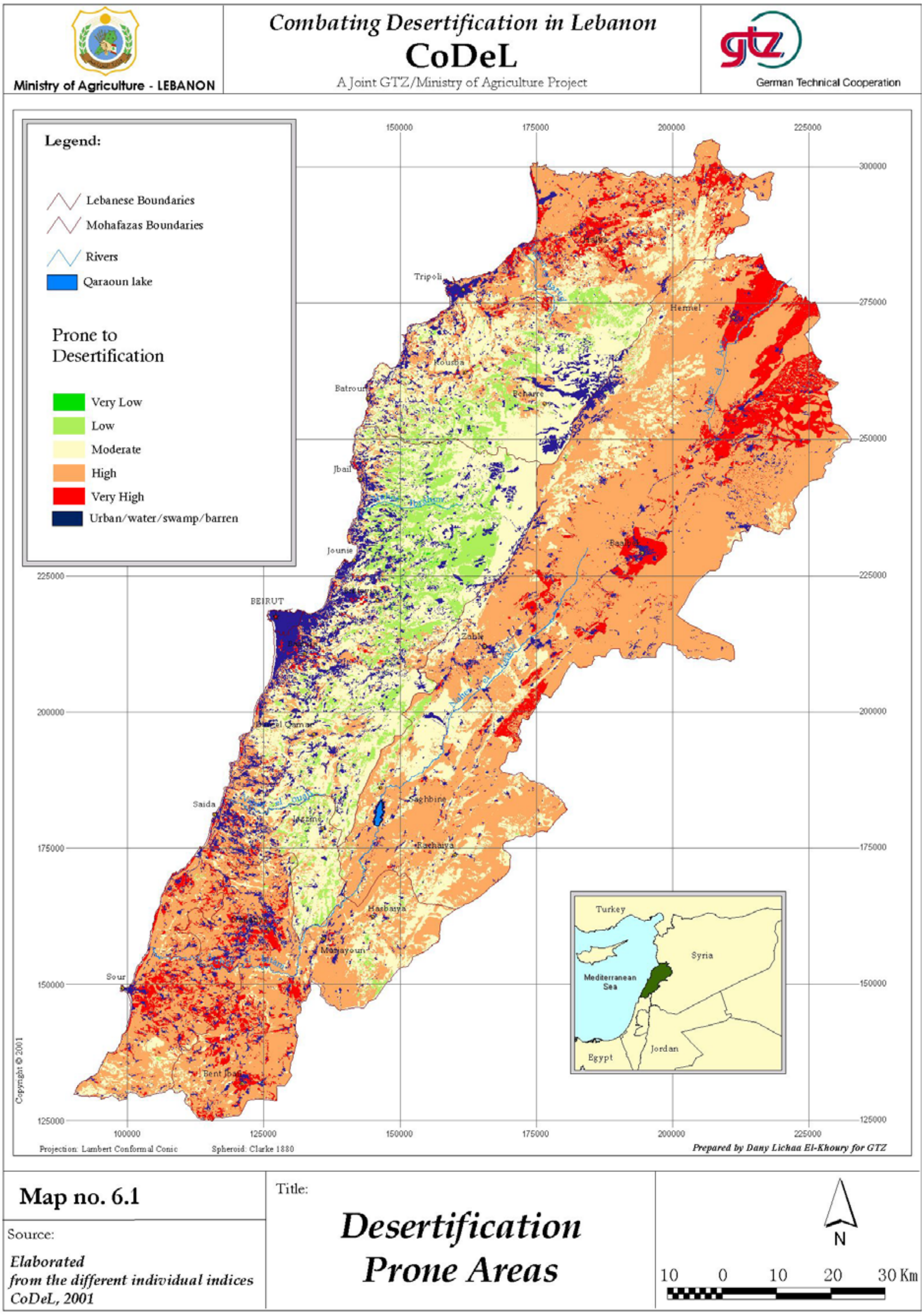
Where x is the index in consideration and n is the number of layers used for a specific index. The various indices were combined to derive Desertification Prone Areas (DPAs) according to the formula below:

DPA = (CI * SI * VI * LUII * DPI) (1/5)

Where:

- DPA is Desertification Prone Areas
- CI is the Climatic Index
- SI is the Soil Index
- VI is the Vegetation Index
- LUII is the Land Use Intensity Index
- DPI is the Demographic Pressure Index

Desertification Prone Areas in Lebanon



2.2. Benchmarks and indicators at sub-regional level

2.2.1. DISMED project

Objectives and expected results of the project

This project aims more particularly at strengthening co-operation between the member states of Annexes 1 and 4 of the CCD (Convention to Combat Desertification) by means of harmonized information systems. The partners are: Morocco, Algeria, Tunisia, Italy, Spain, Portugal, Greece, Turkey, Libya, Egypt, the European Environment Agency, the OSS, the CCD Secretariat.

The main results expected from the project, in terms of products (deliverables), consist in making a desertification sensitivity map for the Mediterranean Basin.

Adopted methodology

Following several technical meetings, the project member states agreed to develop a common cartography on sensitivity to desertification on scale 1: 1.000.000th, based on the following major layers:

- climate;
- soil;
- vegetation;
- land management (including the socio-economic indicators).

The adopted methodology draws upon the Medalus approach, which takes into account four indices:

- IQS: soil quality index;
- IQC: climate quality index;
- IQV: vegetation quality index;
- IQAH: land management quality index.

These indices constitute the 4 cartographic layers and make it possible to generate the Desertification Sensitivity Index (DSI) which is calculated according to the following formula:

$$\mathbf{DSI = (IQS \times IQV \times IQC \times IQAH)^{1/4}}$$

First results

The climate layer – The climate layer was prepared by the FMA and made available to the group. The countries contributed by supplying additional climatic data to refine the model used.

The soil and vegetation layer – The OSS prepared the methodology for the soil layer. This document is in line with the methodology already adopted in Italy; its feasibility was evaluated and the working group adopted it.

The methodology for the soil layer is based on the use of the following four sub-layers:

- Soil textural class
- Soil depth
- Bed materials
- Slope gradient

The methodology for the vegetation layer is based on the following parameters:

- fire risk of vegetation (FR);
- erosion protection (EP);
- drought resistance of plants (DR);
- Plant cover (PC).

The land management layer – The making of this layer is the most complex task as there is not yet any commonly agreed methodology (not even among the scientific community). Moreover, it is often difficult to represent geographically the social and economic indicators relating to the land management, particularly because of the data acquisition methods.

Production of the synthesis map – As agreed, the end product (deliverable) will be a desertification sensitivity map at inter-regional level.

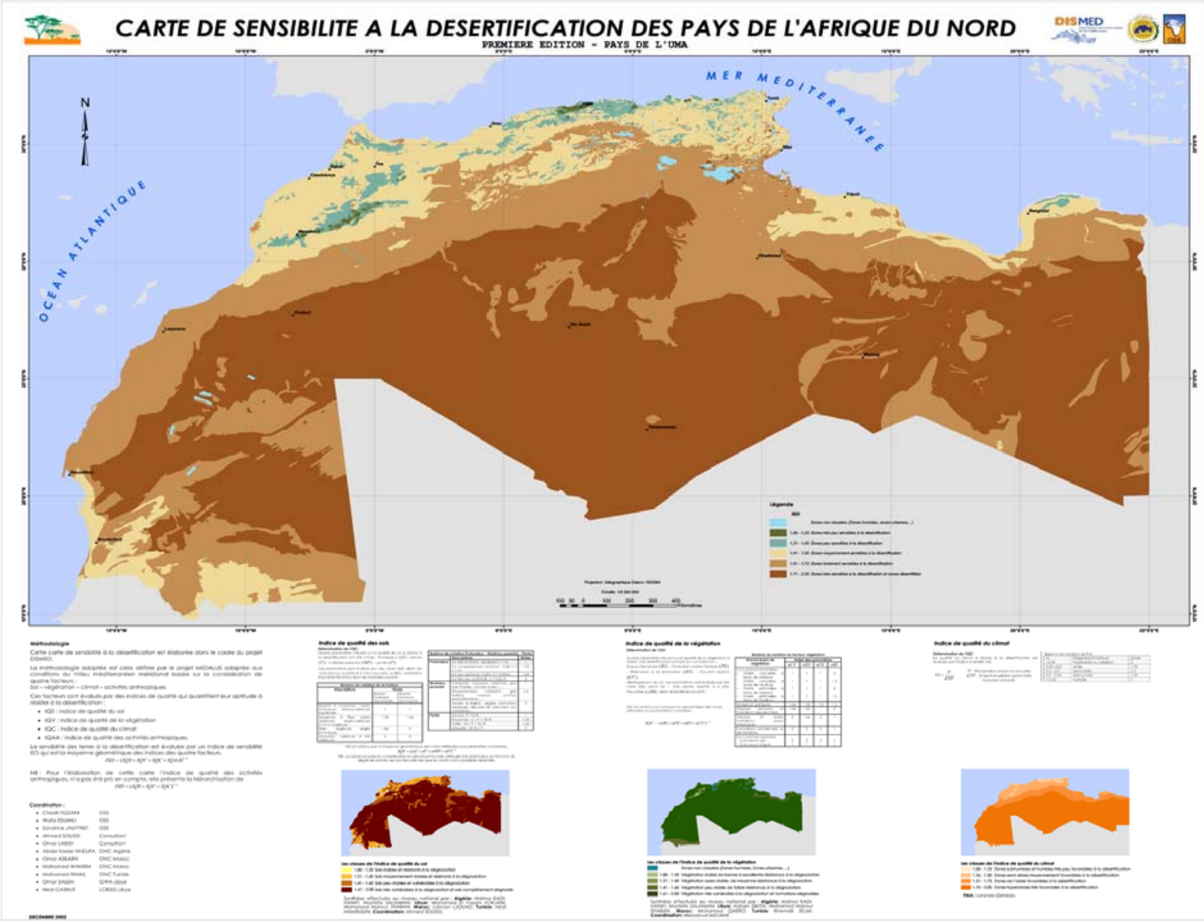


Figure 1. Preliminary contours: Soil layer for Algeria – Tunisia – Libya

2.2.2. The desertification monitoring project in the countries of the southern shore of the Mediterranean: "Setting up a pilot system in morocco and in Tunisia/ study of extension to Algeria"

Objectives of the project

This project is financed by the European Commission within the framework of the financial instrument LIFE Pays Tiers. The partners of the project are Morocco, Tunisia, France and the OSS, together with the consultants "SCOT Conseil", as a service provider contributing external assistance. The general objective of the project is to contribute in the prevention of environmental degradation, with regard in particular to the prevention of desertification risks, and this by improving environmental information in Tunisia and Morocco. The project proposes to extend the benefit of some of its actions (training, sensitisation), as well as to consider the methods of its extension to Algeria. It is expected that the project would contribute in building the capacity of Tunisia and Morocco, initially, and subsequently that of Algeria, in matter of production, management, exploitation, exchange and dissemination of environmental indicators, through the set up of pilot systems within the ministerial departments in charge of the environment and of combating desertification, or of institutions assigned by them to undertake such missions. This will make it possible to capitalize the existing acquired knowledge and experience of Tunisia and Morocco in matter of monitoring of desertification, as well as to examine the technical and financial feasibility conditions of fully operational future Desertification Monitoring Systems in the Mediterranean sub-region covered by OSS action (Morocco, Algeria, Tunisia, Libya, Egypt).

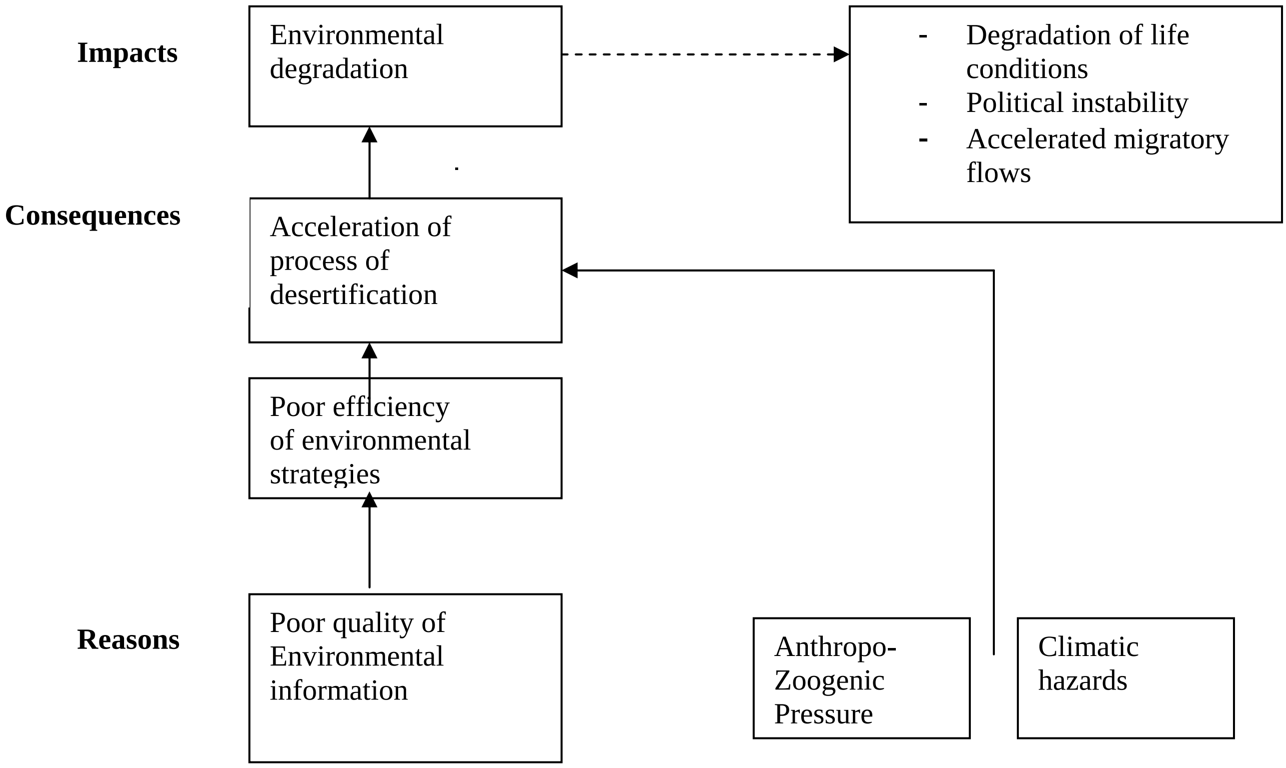


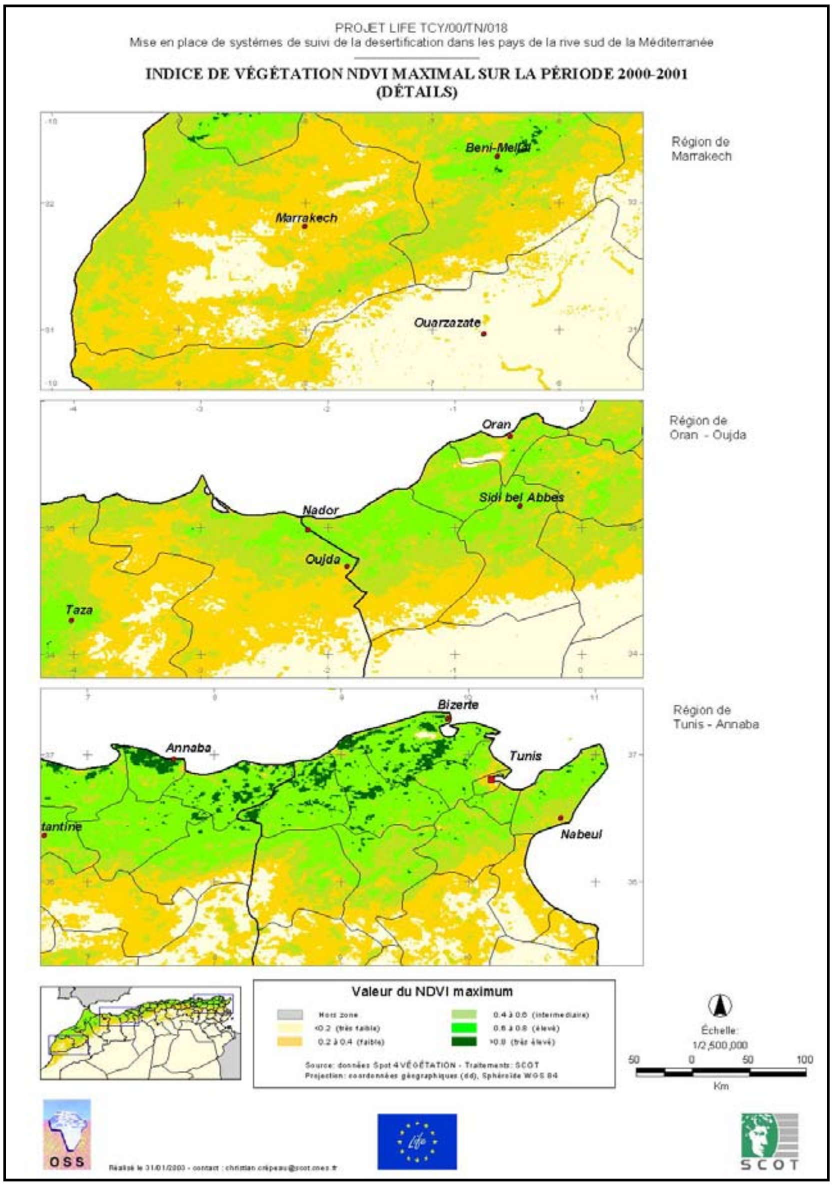
Figure 2. Problems Diagram

Expected results
The expected results are:
- Development and validation of macro-geographical indicators
- Development and validation of meso-geographical indicators
- Analysis of specific vulnerability
- Integration of the results in the SSE of the NAP/CCD (National Action Plan for Combating Desertification)
- Organization of regional technical meetings
- Dissemination of methodological results

For the macro-geographical indicators**,** the choice was made on the following items:
At CRTS: Choice of the NDVI, Surface Temperature and Albedo
- Use of NOAA/AVHRR data
- Establishment of a 5 year record (1998 – 2002)
- Development of vegetation indices NDVI on a decade-based time span, surface temperature and ALBEDO
- Setting these indicators on line on the cartographic server.

At CNT: Choice of the NDVI and ALBEDO
- Use of SPOT4/VGT data
- Establishment of the record available since 1998
- Development of the NDVI-S1O (decade-based synthesis)
- Setting on line of these indicators on the cartographic server.

For the meso-geographical indicators**,** it was decided to produce indicators of land use on the scale 1/50 000th and to interpret these changes with exogenous data. These maps are being made on 2 sites per country in close consultation with the ONC (National Coordination Institution) in the two countries. The methodology of development of these maps was discussed at a regional workshop of consultation and harmonization of the methods. A Metadata base and cartographic server has also been established at OSS, at CNT and at CRTS.



Region of Marrakech

Region of Oran – Oujda

Region of Tunis – Annaba

Figure 3. Set up of desertification monitoring systems in the countries of the Southern shore of the Mediterranean Maximum Vegetation Index NDVI for the period 2000-2001 (Detailed)

2.3. Benchmarks and indicators at regional level .The "ROSELT/OSS"[7][8] network

2.3.1. The Long term Ecological Monitoring Observatories Network (ROSELT/OSS)

The ROSELT/OSS programme aims at meeting the need to have reliable data on the state of the environment and, more particularly, in the circum-Saharan arid or semi-arid zones which are highly affected and/or endangered by desertification.

The key objectives of ROSELT/OSS in the field of environmental monitoring and research relate to :

- enhancing the state of knowledge of the mechanisms, causes and consequences of desertification;
- monitoring of the state and long term evolution of the ecological systems and of the resources that they contain;
- understanding the functioning of these systems and the interactive effects between the populations and their environment at local level, particularly with a view to identifying the respective and/or synergetic part of the climatic causes (climate change) and human causes of land degradation.

Ecological monitoring is understood in its broadest sense, that is as the study of the dynamics of the natural, physical and biological milieu of the human environment, including social organisation and land use systems, as well as the systems governing the interactions which exist between these various sets or compartments. The ultimate objective is not only to analyse and to appreciate the functioning of these systems and their various interactions, but also, and above all, to seek to identify optimal solutions both with regard to the use of the natural resources and to meet the needs of the populations, as well as the prevention and compensation of environmental damages. It is also worth pointing out that the ROSELT/OSS programme has considerably drawn upon the recommendations of the meeting organised jointly by IGBP, MAB/UNESCO and OSS in July 1992 in Fontainebleau (France) and which has, in addition, served to give birth to the GTOS[9] programme. Such convergences are likely to firmly establish the ROSELT/OSS programme from a scientific point of view, though the latter remains specific in view of its practical and operational calling, as well as by virtue of its mandate which is confined to a well defined geographic area, i.e. the circum-Saharan zone. This has led the programme to focus, as much as possible, on development support actions in the areas affected or endangered by desertification, as well as on the interactions existing between development and the protection of the environment in these areas. Indeed, does not the key objective of OSS consist in providing help towards decision making for the development actors entrusted with implementing the solutions intended to break the « desertification/poverty » vicious circle which traps the needy populations and leads them to overexploit the natural resources to which they have access?

2.3.2. General Principles of organisation and operating of ROSELT/OSS

Twenty-five observatories or clusters of observatories, labelled ROSELT/OSS, distributed over 11 countries out of which 12 were selected as pilot – observatories.

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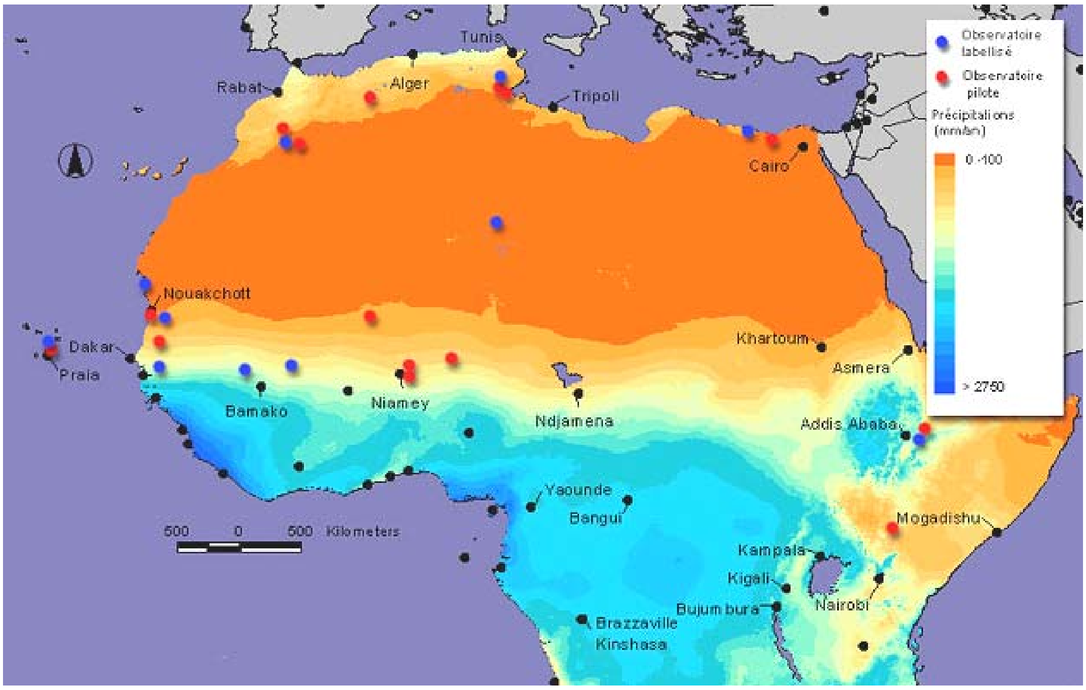
[7] Réseau d'Observatoires de Surveillance Ecologique à Long Terme (Long Term Ecological Monitoring Observatories Network)

[8] Extract of the report « ROSELT/OSS : A common device for the monitoring of desertification in Circum-Saharan Africa. Achievements and retrospective overview», OSS, March 2004

[9] Global Terrestrial Observing System, founding document ROSELT/OSS, 1995.



Map 1. Location of the ROSELT/OSS Observatories in Africa

	Denomination of the ROSELT/OSS Observatories	Land area of the Observatory	Bioclimate	Type of prevailing ecosystem	Prevailing uses
			NORTH AFRICA		
ALGERIA	Steppes of the Upper Plains of Southern Oran	4 x 100 000 ha	Mediterranean : from lower semi-arid to per-arid	Steppic ecosystems Agrosystems	Rain-fed cereal cropping, pastoral systems
EGYPT	El Omayed	100 000 ha	Mediterranean arid	Steppic ecosystems	Dryland farming, orchards, irrigated cropping and pastoral systems
MOROCCO	Oued Mird Issougui	60 000 ha 123 000 ha	Mediterranean lower arid	Steppic ecosystems Sparse *Acacia raddiana* dominated Savannah ecosystems	Rain-fed cereal cropping, irrigated cropping in the wadis, pastoral systems
TUNISIA	Haddej – Bou Hedma Menzel Habib	16 488 ha 190 000 ha	Mediterranean arid	Steppic ecosystems Sparse *Acacia raddiana* dominated Savannah ecosystems Agrosystems	Rain-fed cropping, Dryland farming, pastoral systems
			WEST AFRICA		
CAPE VERDE	Ribeira Seca	22 000 ha	Tropical, semi-arid to arid, monomodal with a coastal oceanic variant	Agro-forestry systems	Rain-fed cropping, irrigated cropping
MALI	Cercle de Bourem : Test – zone of Bamba	50 000 ha	Tropical, arid monomodal	Very sparse Savannah ecosystems and	Pastoral systems, flood recession crops, irrigated cropping,

				Sahel agrosystems	fishery
MAURITANIA	Nouakchott	40 000 ha	Tropical, arid monomodal with a coastal oceanic variant	Degraded sub-urban ecosystems Coastal ecosystems	Pastoral systems
NIGER	Torodi – Tondikandia – Dandiantou Keita	69 800 ha 40 000 ha 486 000 ha	Tropical, semi-arid monomodal	Sparse Savannah ecosystems and Sahel agrosystems	Rain-fed cropping, irrigated cropping, pastoral systems
SENEGAL	Ferlo Cluster, 3 sites : Souilène, Widou, Linguère	2 600 000 ha	Tropical, semi-arid monomodal	Sparse Savannah ecosystems and Sahel agrosystems	Rain-fed cropping, pastoral systems
EAST AFRICA					
ETHIOPIA	Melka Werer	67 000 ha	Tropical, semi-arid, bimodal	Savannah ecosystems and agrosystems	Irrigated cropping, pastoral systems
KENYA	Kibwesi – Kiboko : 4 stations	250 000 ha 800 000 ha 300 000 ha 30 000 ha	Tropical, semi-arid, bimodal	Savannah ecosystem and agrosystems	Pastoral systems, Rain-fed cropping

Table 13. Features of the twelve Pilot - Observatories ROSELT/OSS

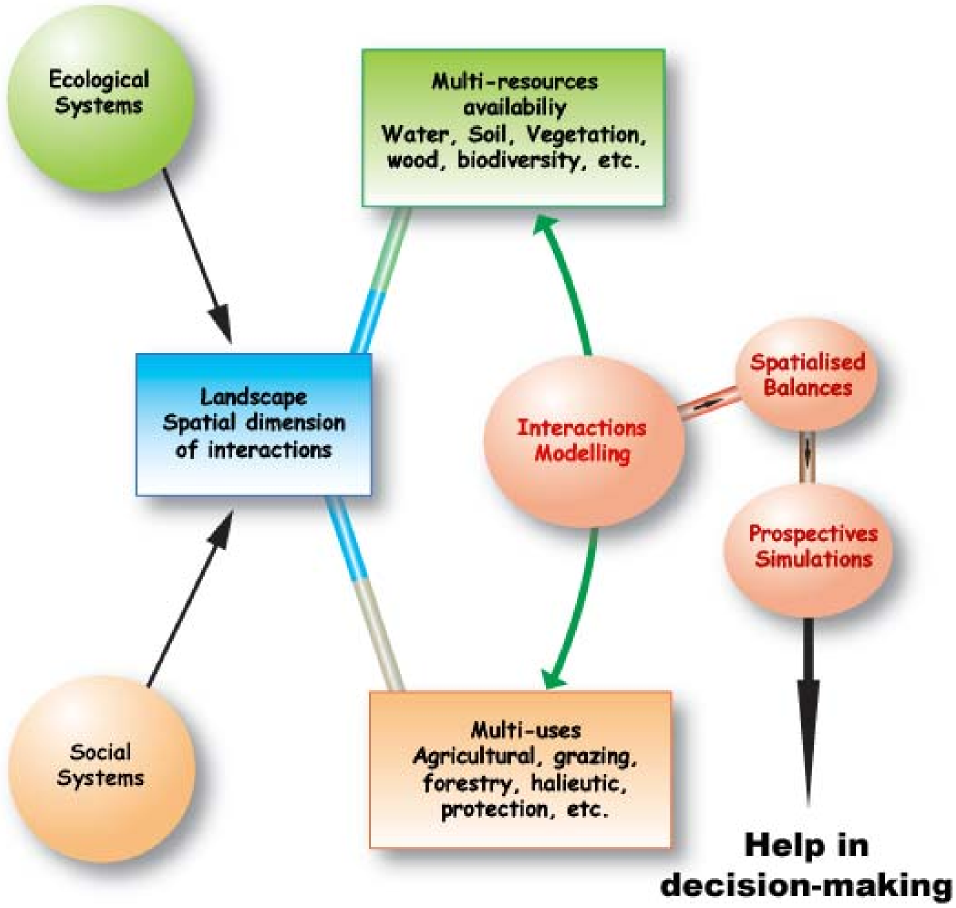
Soon upon starting the operating programme in 1998 in the ROSELT/OSS Pilot-Observatories in North Africa (Egypt, Morocco, Tunisia), a model activities programme was proposed by OSS based on the founding document (ROSELT/OSS 1995) for purposes of defining the implementation of the diagnosis and monitoring activities :

- long term environmental monitoring activities;
- analysis, interpretation and synthesis of information, including the study of mechanisms;
- development of tools for assistance in decision making and for development backup.

In 2000, the concepts used within the network have been up dated and a global conceptual framework (Figure 4) has been developed by the Regional Operator, together with OSS, for the study of environmental changes within ROSELT/OSS with a particular focus on a conceptual development of the «landscape » approach. This spatial approach allows to include the set of biophysical and socio-economic data, as well as to study the impact of uses on natural resources, with a view to developing the decision making aids expected : reliable data on land degradation in arid zones, relevant biophysical and socio-economic indicators on desertification, a state of the environment of the OSS zone, space-related uses/ resources balance, prospective scenarios, etc…

The monitoring activities are implemented in the following conceptual framework:

Local Environment Information System



Figure°4. : Conceptual model for understanding the mechanisms, causes and impacts of desertification and for assistance in decision making

Special effort has been made with a view to defining a minimum data set, to be collected at lower cost, which would allow for a spatialisation of the data, their possible extrapolation to larger zones and their integration within models of space and resources use. The final objective of such operations was in fact to :

- provide a characterisation of the state of the environment at the various stages of its evolution;
- offer the possibility of conducting prospective studies on the dynamics of the environments based on simulations and modelling techniques;
- undertake an in-depth analysis of specific topics (desertification, biodiversity, sand encroachment, pastoralism, farming activities, etc . . .).

Within the framework of the ROSELT/OSS programme, the "data sets" thus defined correspond to the following set up :

- Bio-physical data set :
  - climate : rainfalls (quantity and spatial and temporal distribution), meteorological data;
  - soil and water : quality and spatial distribution (soil surface conditions, pedology, surface hydrology and hydro-geology);
  - vegetation : production, structure, quality, spatial distribution and floral diversity;
  - fauna : structure and spatial distribution of livestock and wild fauna;

- Socio-economic data set **:**
  - human population : number and location;
  - micro-economic parameters : households micro-economy;
- Interface data set :
  - land tenure rules for access to resources;
  - production/ exploitation systems for a characterisation of uses/ activities;
  - production and extraction of resources (agricultural, pastoral and forestry).

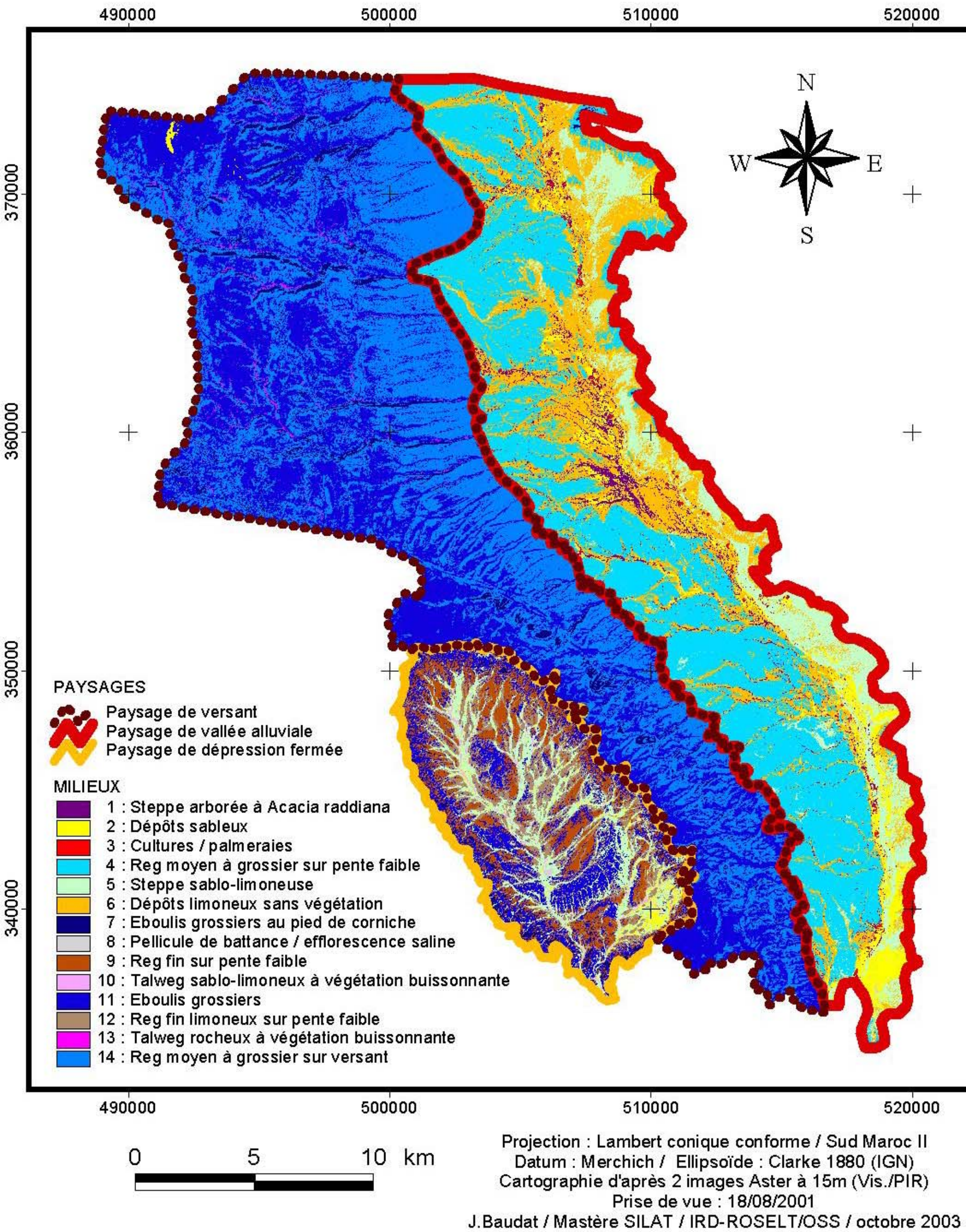
At present, the ROSELT/OSS programme is in full operational phase. It has just been launched in East Africa, while several countries that have not yet been provided with ROSELT/OSS labelled observatories have expressed their interest in joining the network (Uganda, Djibouti…).

2.3.3. Results and products

Based on the preliminary diagnosis activities, the overview of the state of knowledge relating to the whole set of observatories at the time of inception of the ROSELT/OSS activities have been realised. They involve, on the whole, two main fields : the biophysical data (climate, soil and water, vegetation and fauna) and the socio-economic data (socio-economic features, uses and practices). The volume and quality of the data collected vary from one observatory to the other.

The reference state (zero state) of an observatory is represented by :

- the land cover maps (COT) which give the features and location of the vegetation units (physionomic units defined by dominant species, their stratum, their cover and their density), as well as the vegetation forms that translate the uses;
- the maps related to the physical features of the territory concerned and which inform on the major topographic, pedological and geomorphological sets.



Map°2. Land Cover map of the ROSELT/OSS Observatory of Oued Mird, MOROCCO (ROSELT/OSS Morocco, 2003; ROSELT/OSS Technical Contribution n°10, 2004)

The harmonisation of the data collection and processing methods was made possible thanks to the set up of inter-observatory topic-focused working groups, composed of experts from the various countries. These works allowed the elaboration of a ROSELT/OSS Methodological Guidebook for North Africa.
The main objective of the methodological Guidebook for North Africa is to define the minimum data set to be collected for purposes of long term monitoring using commun sampling principles (Figure 3). The ROSELT/OSS Methodological Guidebook for West Africa will be gradually drafted in 2004.

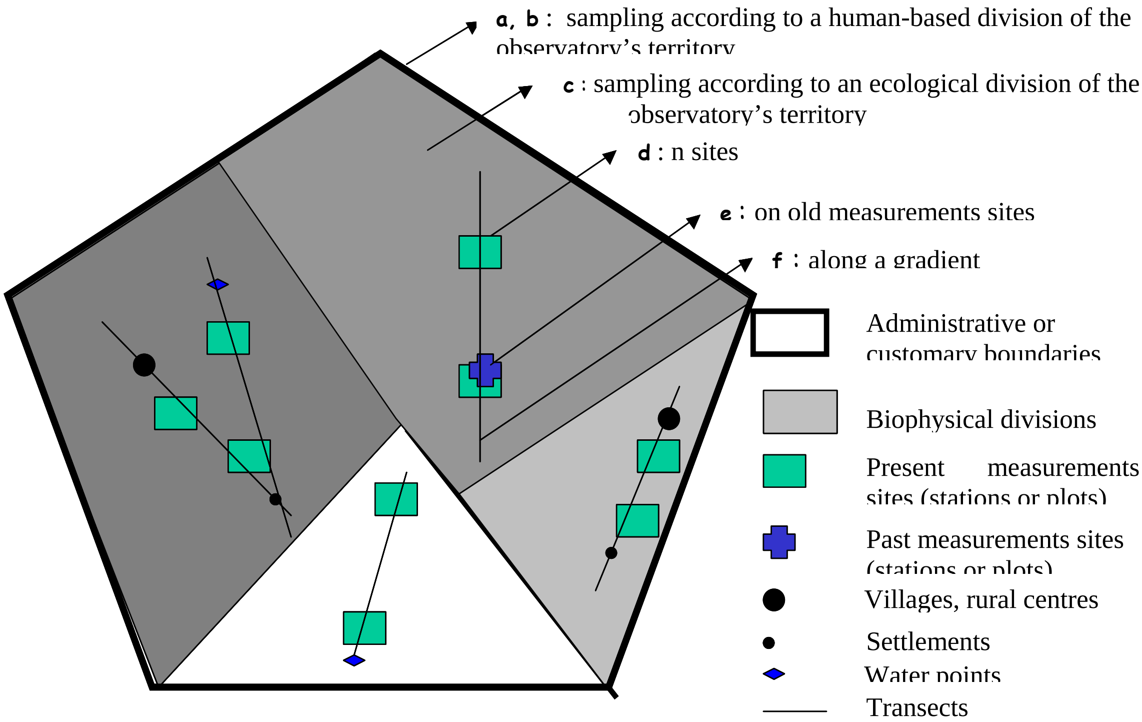


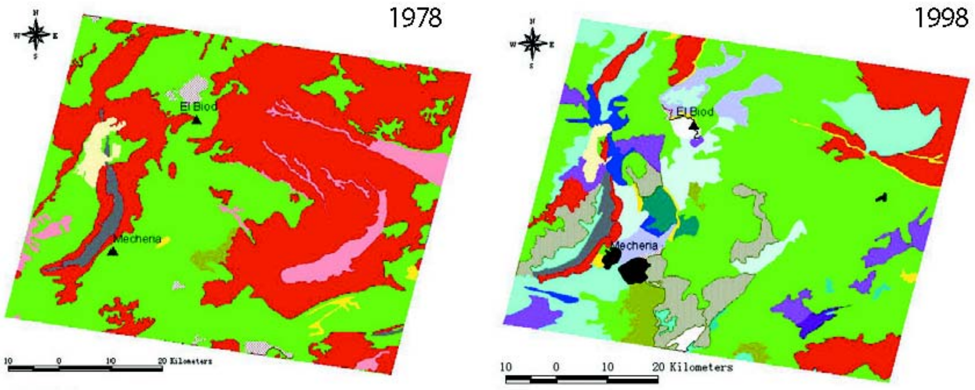
Figure 4. Principles of common sampling of the long term monitoring mechanism (ROSELT/OSS Scientific Document 2, 2004)

The produced indicators within ROSELT/OSS
The definition of ROSELT/OSS indicators of long term ecological changes requires the implementation of a methodology that is tailored to long term monitoring of the biophysical systems and their interaction with the socio-economic systems.
Two types of studies were conducted :
- diachronic studies;
- synchronic studies.

2.3.3.1. Diachronic studies and valuation of the achievements
In a diachronic study, the key variable to be considered is time. This approach applies to identified and validated series of historical data (time-series) relating to a well-defined space or to an environmental parameter .Data identification constitutes the first phase of this work : the task is to gather the whole body of data of any type having been collected in the past (untreated or developed data, documents, studies) in order to lay down the foundations for a comparison with identical data collected at a more recent time (ROSELT/OSS 2003 b). The "past" diachronic approach makes it possible to

rapidly identify relevant indicators and to define the series of data to be measured in the framework of the long term ROSELT/OSS monitoring (ROSELT/OSS 2001 a).
In the framework of implementation of the ROSELT/OSS programme in the observatories, the past data, as well as the data collected since 1998, are gradually collected within data bases and described in the metadata bases. The cartographic data are geo-referenced and integrated within Geographical Information Systems (GIS) . . . The building of such data bases and the establishment of reference states « $\mathbf{t_0}$ » allow for comparisons in time and in space. Thus, the preliminary works related to a comparison of the thematic maps (past and/ or present) have already led to the identification of indicators at local level (posters presented at the 4th session of the Executive Board, Bonn 2003) :

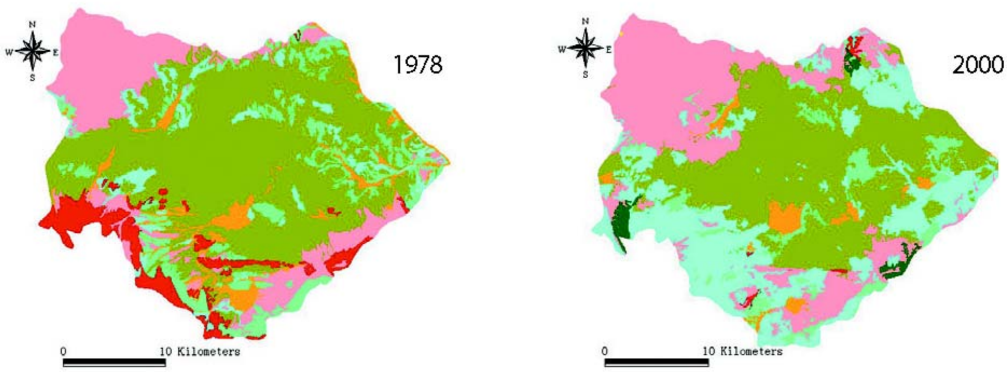
ROSELT/OSS Observatory of the Steppes of the Upper Plains of the Oran South-West (Sud-ouest oranais), Algeria



Disappearance of the *Artemisia herba alba* steppes
Important decrease of the *Stipa tenacissima* steppes (Reference :URBT/CRSTRA, Algiers)

Figure 5. Evolution of land cover - Evolution of the plant cover between 1978 and 1998

ROSELT/OSS Observatory of Menzel Habib, Tunisia



Reduction of *Rhanterium suaveolens* dominated rangelands
Quasi-disappearance of *Stipa tenacissima* steppes

Figure. 6. Evolution of the plant cover between 1978 and 2000

(Reference : IRA, Tunisia)

The comparison of the evolution of land cover in Algeria and in Tunisia reveals the same phenomena, namely :

- a degradation of pastoral areas (*Stipa tenacissima* or « Alfa » dominated steppes in Algeria, and *Rhanterium suaveolens* dominated steppes in Tunisia) whose area has been receding in the two observatories ;
- the change in physiognomy of the steppes and the decrease in their pastoral quality : modification of the flora composition (in particular, by species replacement) ; disappearance (or extreme rarefaction) of high grazing value species (perennial grasses) or high-economic value species (Alfa in plains, in the Algerian observatory, and in mountains, in the Tunisian observatory, used for the production of paper); replacement by species of lower grazing value (e. g. : *Lygeum spartum* in Algeria, and *Astragalus armatus* in Tunisia).

The far-reaching changes, which, today, affect the two observatories, are mainly due to overgrazing. The indicators identified on the local scale allow for better highlighting similar trends of the evolution of the plant cover at the level of the North-African steppes.

2.3.3.2. Synchronic studies

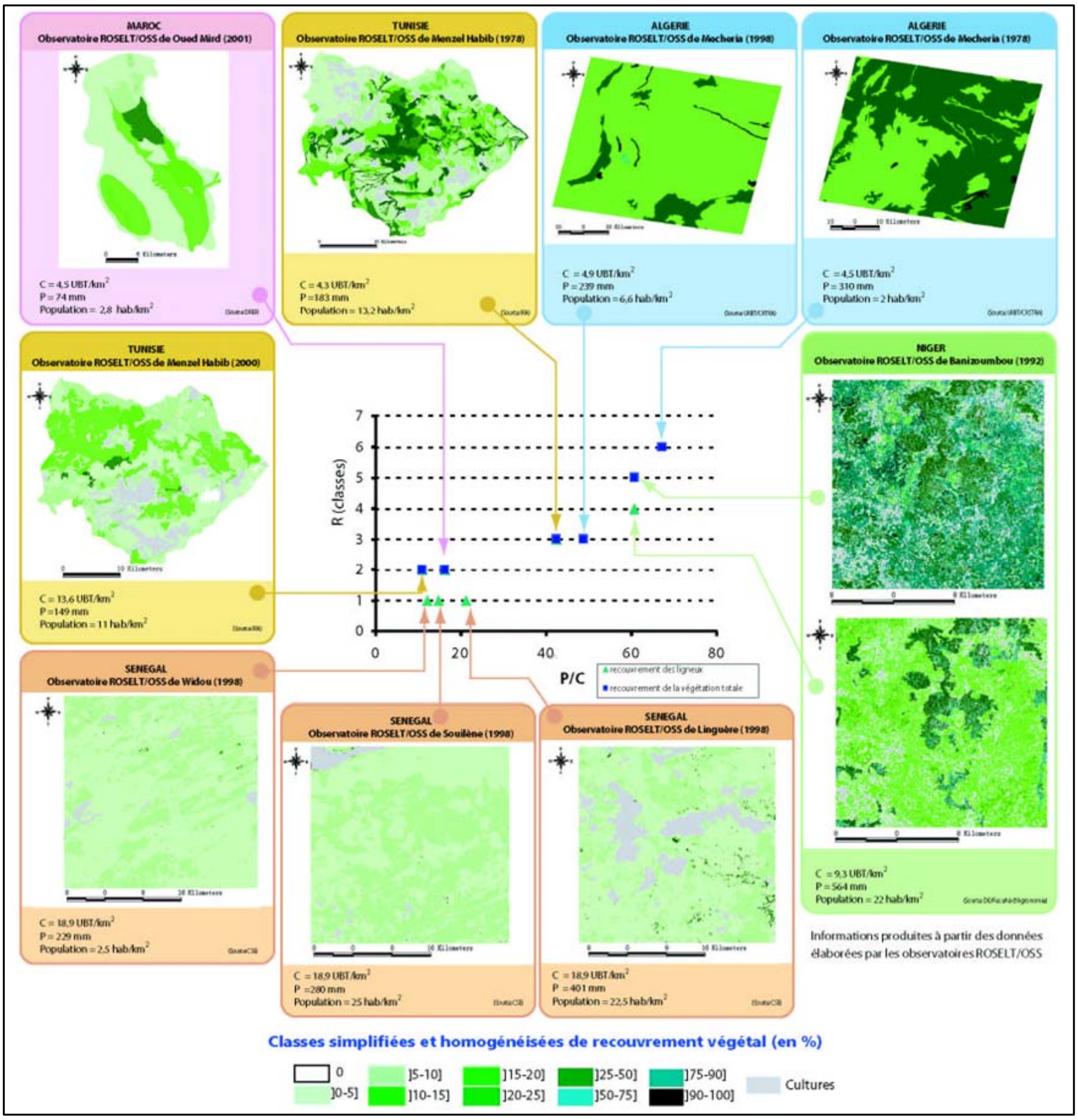
Synchronic studies aim at comparing, at a given time, certain spaces selected according to the variation of a well identified desertification factor, while making sure that most of the other factors remain comparable. These studies allow a comparison of one parameter (plant cover, or sand rate, for instance) along an environmental gradient (rainfall gradient, uses gradient, edaphic gradient indicating erosion or sand encroachment phenomena . . .).

The harmonisation of data processing based on the vegetation maps of certain observatories has made it possible to identify a first indicator at regional level : an indicator of relative degradation related to the total plant cover or woody cover according to rainfall and to pastoral load (or stocking rate). The network structure of ROSELT/OSS and the synchronic and diachronic approaches that it allows lead to the development of synthetic indicators based on simple data (ROSELT/OSS, 2004 – Technical Contribution n°9).

This study has evolved according to two phases :

- the first phase has led to a characterisation of the vegetation based on the use of Land Cover Maps (“Cartes d’Occupation des Terres” (COT));
- the second phase consists in comparing the previously defined state indicators (mean covers) with the climatic data (rainfall) and with the parameters relating to human activities (for instance, the pastoral load).

Thus, one can notice a positive correlation between rainfall and the plant cover which is weighted by the pastoral load. This means that the less the rainfall, the more the plant cover decreases. The plant cover decreases all the more as the pastoral load increases.



R = f (P / C)

N.B : Cover classes (R) which appear in the graph correspond to simplified and homogenised plant cover classes (in %) as follows :
Class 0 = 0%, Class 2 = 5-10 %, Class 4 = 15-20 %, Class 6 = 25-50 %, Class 8 = 75-90%
Class 1 = 0-5%, Class 3 = 10-15%, Class 5 = 20-25%, Class 7 = 50-75%, Class 9 = 90-100%

Figure 7. Indicator of relative degradation. Total plant cover (R) depending on Rainfall (P) and Pastoral load (or Stocking rate) (C)

2.3.3.3. Prospective simulations and desertification risk index

An approach by module of space and resources use and balances of resources/spatialised uses has been developed under the LEIS-ROSELT/OSS.A varied use of the space and of the resources is the rule in most circum-Saharan arid and semi-arid zones. In order to analyse the state and the evolution of the Reference Spatial Units according to the various modes of use, themselves associated with as many management modes, an analytic approach, by module, has been favoured prior to establishing a balance that makes up the synthesis of the interventions and of the extractions. Each use is related to resources, while considering their relations in time and in space which are specific to them (Loireau, 1998).

For the time being, the LEIS-ROSELT/OSS has been developed for the ROSELT/OSS Observatory of Torodi –Tondikandia – Dandiantou « Banizoumbou ») in Niger. A desertification risk index map has been made according to the following methodology :

- for each type of use identified, a model of use of space and resources is developed, but only the model on the human activity that is considered as the key activity from which the ”landscape” derives its structure is used for identifying homogeneous practice units. The other models are related to the reference spatial units;
- the spatialisation of the models of use of space and resources, based on the reference spatial units, makes it possible to establish, on the one hand, a resources availability map and, on the other hand, an extraction map for each type of use;
- the comparison of the two variables, based on the reference spatial units, allows for the establishment of a spatialised balance (detailed with regard to space and time) for each type of use. The latter balances, called « modular », allow the locating of zones of balance or misbalance between extractions and resources, and this by going back the construction chain, and identifying the causes of the case of balance or misbalance;
- The comparison of the spatialised balances (modular balances) (annual fodder balance, annual wood-energy balance and sensitivity index of soils to degradation), based on the spatial reference units, allows the establishment of a global multi-use balance for the whole observatory’s territory. This balance makes it possible, not only to report on the state of the landscape at a given time, but also to appreciate, by going up the whole construction chain, the respective part of the biophysical and the socio-economic factors, and hence to interpret this state. This leads us also to develop a map of desertification risk index for the whole observatory.

The LEIS-ROSELT/OSS is in process of development in the other ROSELT/OSS observatories of the network, and the early results on Tunisia and on Senegal are due to be available during the first quarter of 2004.

PASTORAL RESOURCES		
Fodder availability map	**Fodder extraction map**	**Spatialised annual fodder balance**
		

Figure 8: Development of a spatialised annual fodder balance based on the fodder availability and the fodder extraction maps (Loireau 1998, ROSELT/OSS Niger 2003)

WOOD-ENERGY RESOURCES		
Wood-energy availability map	**Wood-energy extraction map**	**Spatialised annual wood-energy balance**
		

Figure 9: Development of a spatialised annual wood-energy balance based on the wood-energy availability and the wood-energy extraction maps (Loireau 1998, ROSELT/OSS Niger 2003)

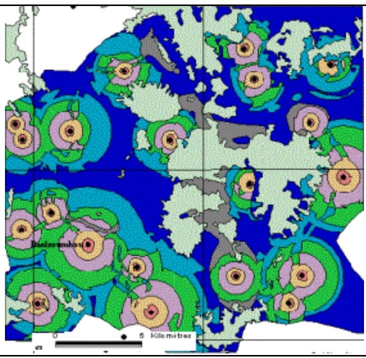
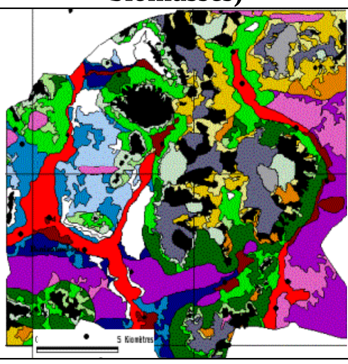
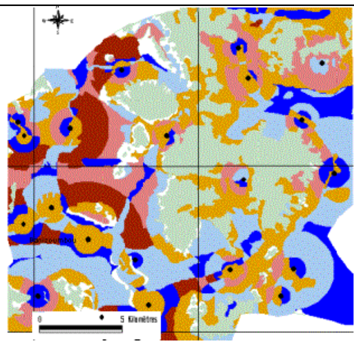
BALANCE OF FARMING ACTIVITY IN TERMS OF SOIL DEGRADATION		
Map of homogeneous practices units (agricultural map)	**Map of « landscape » units (+ herbaceous and ligneous biomasses)**	**Sensitivity index map of soils to degradation**
		

Figure 10: Development of a sensitivity index map of soils to degradation, based on homogeneous practices units maps and landscape units maps (Loireau 1998, ROSELT/OSS Niger 2003)

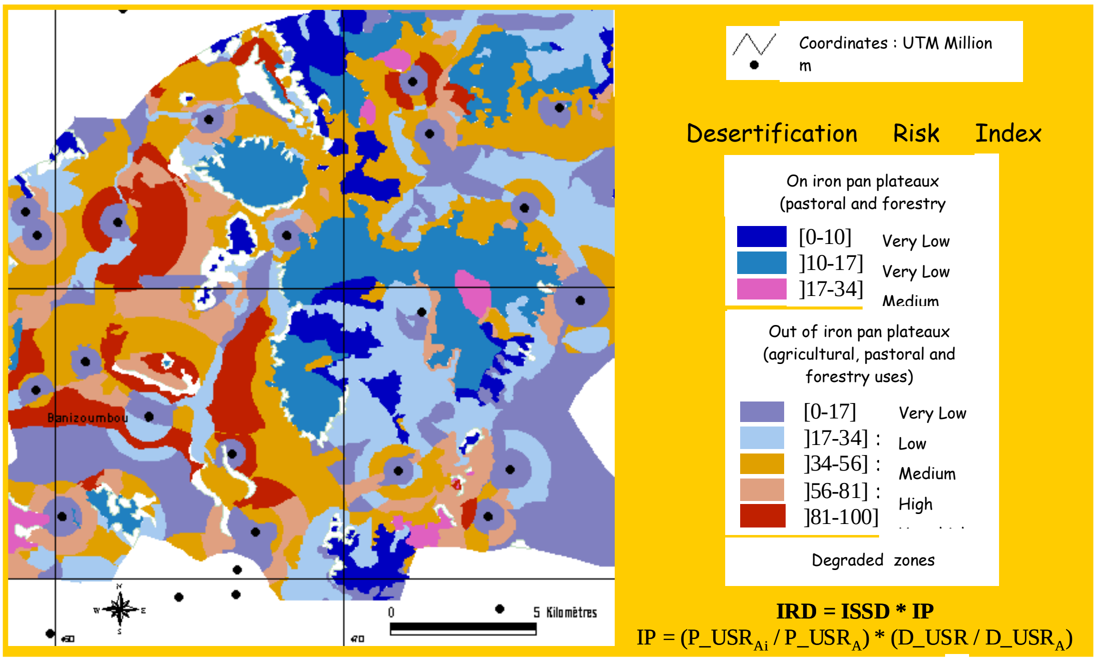


Figure11: Desertification risk index for the ROSELT/OSS Observatory of Torodi – Tondikandia – Dandiantou « Banizoumbou ») – Niger (Loireau 1998, ROSELT/OSS Niger 2003)

2.3.3.4. ROSELT/OSS products

The ROSELT/OSS products may be distributed as follows:

- Maps, such as « land use » maps, and « physical features » maps;
- The scientific documents which are gradually issued as part of the « ROSELT/OSS Scientific and Technical Collection », such as :
  - the methodological guidebook and its thematic leaflets (such as flora and vegetation, socio-economic features, fauna, . . .);
  - technical and concept-related documents;
  - national scientific and technical reports;
- Local Environment Information System LEIS - ROSELT/OSS;
- The metadata base;
- The Charter on the management and dissemination of data and products within ROSELT/OSS;
- Indicators at local and regional levels;
- Prospective simulations and desertification risk index maps.

3. Recent projects undertaken on development of B&I

The state of desertification in the Maghreb has been addressed in a certain number of recent synthesis studies conducted by OSS in Morocco, Algeria and Tunisia. More precisely, the objective was to take stock of the impact of the natural factors (bio-climatic factors) and of the human factors (development, land tenure) on the state of the natural resources in the steppe zones of North Africa.

3.1. Algeria

Demarcation of the steppe zones

On the administrative level, the steppe territory comprises 8 pastoral Wilayas (84 *daïras* (districts) and 223 communes), together with 13 sub-steppe Wilayas (174 *daïras* and 517 communes). The steppe and sub-steppe Wilayas total 258 *daïras* and

740 communes. "Steppe" refers to a geographical set whose boundaries are defined based on a bio-climatic criterion since it is estimated that the northern limit of this space corresponds to the isohyet 400 mm, while its southern limit coincides with the isohyet 100 mm. The total area of the steppe is about 13.6 million hectares, for a useful farm space (UFS) of 12.5 million hectares (or 80 %), that is to say the whole land area with a slope less than 12.5 %. The climate of the steppe is arid and is marked by low, variable rainfall ranging, according to the regions, between 100 and 400 mm of rain per year with severe and prolonged drought periods and violent rains. Rainfall reaches 300 mm on a narrow strip along the southern flank of the Tellian Atlas, a marginal grain-crop zone. The High plateaus themselves, stretching from the Hodna to the Moroccan border, receive only 200 to 300 mm of rain per year. The Saharan Atlas receives 400 mm of rain. Further south, rainfall drops to 200 mm, then to 100 mm and less. The annual average temperature is comprised between 13°C and 15.5°C. The mean temperature of the minimum values of the coldest month varies between –1.8°C and +1.9°C; while the mean temperature of the maximum values of the hottest month ranges between 37.6° C and 33.1° C. The absolute minimum reaches – 12°C.
Finally, these zones are characterized, on the one hand, by the nearness of the desert whose influence increases degradation and, on the other hand, by an exclusively steppe environment marked by a low rainfall; these two combined actions tend to reduce the plant cover and to exacerbate the rigors of the climate.

Vegetation
The steppe may be considered as an immense area of spontaneous vegetation adapted to the xerophytism and the quite peculiar soils of the arid or semi-arid plateaus.

Land cover		Area
Steppe vegetation		15.000.000 ha
Other types of land cover distributed as follows		5.000.000 ha
Crops		1.100.000 ha
of which:	High plains of the Saharan Atlas	900.000 ha
	Southern piedmonts	200.000 ha
Forests		1.400.000 ha
Unproductive zones: (made up mainly of bare rocks, sandy areas and salty lakes)		2.500.000 ha
of which:	High plains of the Saharan Atlas	700.000 ha
	Southern piedmonts	1.800.000 ha
TOTAL		20.000.000 ha

Table 14. Distribution by major vegetation sets

Botanical name	Arabic name	Location	Value	Area (ha)
- 1 - *Stipa tenacissima* (esparto)	Halfa	Dry and sandy plateaus, arid mountains	Industrial plant Poor fodder	3.000.000
- 2 - *Artemisia herba alba* (white armoise)	Chih	Wet bottoms on loose and slimy (alluvial) ground; slimy plateaus	Good fodder	4.000.000
- 3 - *Lygeum spartum* (" false esparto ")	Sennagh	Edge of bottoms and wetter plateaus soils	Fiber and good fodder plant	2.000.000
- 4 -	Guettaf	Salty lands; halophile plants	Variable quality;	1.000.000

Atriplex halimus and salsolaceous plants			Quite dense fodder, much prized at clump base	
- 5 - Plant clusters (1+2+3) and other plants	These are link areas where clear settlements intermingle and highlight very diverse situations due to: • the state of evolution of the soils and the very advanced degradation; • the extreme diversity of local conditions, where relief, atmospheric humidity and exposure to the wind account for the somewhat differentiated ecologies		Variable and complementary quality	5.000.000
TOTAL				**15.00.000**

Table 15. Diagrammatic distribution of the steppe vegetation

Water resources in steppe zones

The water resources in the steppe zones are characterized by their scarcity and their uncertainty which are connected with the nature of the rainfall, as well as of the soils and the relief. The irrigation of the lands is made based on the resources obtained not only from small and medium-sized structures but also from major structures. The distribution of the areas of small-scale and medium-scale irrigation, according to the nature of the mobilization structure, and based on major water structures, is as follows:

Wilaya	Irrigated area according to type of water resource												
	Small dam		Hillside lake		Borehole		Well		Downstream		Springs		Total
	Nb	Area	Nbr	Area	Nbr	Area	Nbr	Area	Nbr	Area	Nbr	Area	
Laghouat	1	150	5	172	213	3195	2807	11703	214	80	131	308	15608
Biskra		1250			7175	51991	4544	13700					66941
Tebéssa					692	6695	1589	1673					8368
Djelfa					885	6929	4253	4200	5	1270	126	673	13072
M'Sila					1262	9330	7364	7600	234	960	61	820	18710
El Bayadh	2	1165	7	225	236	2888	72	90			137	191	4559
Khenchela	1	727	1	27	1301	8500	3944	3208		2159	212	542	15163
Naama			2	25	173	360	1632	3213					3598
Total	4	3292	15	449	11937	89888	26205	45387	453	4469	667	2534	146019

Source: MRE/CNES Report/04.

Table 16. Irrigated area according to type of water resource

Degradation of the physical environment

The degradation of the natural environment as affecting its essential components—namely the flora, fauna, soil and water—by natural agents and by man, on the one hand, and by population growth in the steppe zones, on the other hand, increases in a very significant way the pressure and competition on the natural resources, thus inducing negative impacts not only on the natural balances but also on the economic and social balances. The phenomenon of desertification and wind and water erosion may be considered as affecting some 600.000 ha which have already fallen to desertification and a further 6.000.000 ha likely to become desertified soon.

Besides, rainfall plays—according to its volume and its temporal distribution—a decisive role in the process of degradation or preservation of the rangelands. It is estimated that between 50 and 250 t/ha/year of soil are swept away by water runoff on stripped, highly sloping land. The total area endangered by water erosion is estimated at nearly 10 million hectares.

The evaluation of the phenomenon of desertification of the steppe zones derives from the study conducted by the National Center for Space Technologies (CNTS Arzew) based on satellite imagery, on behalf of the Ministry of Agriculture, over an area of more than 13 million hectares (about 70 % of the entire steppe zone).

Five (5) classes of sensitivity to desertification have been defined. The zones are classified as follows:

Sensivity		
High	**Medium**	**Low**
Tiaret (98 %)		
El-Aricha (95 %)		
M'Sila (90 %)		
El-Bayadh (87 %)	Batna (68 %)	Khenchela (32%)
Djelfa (84 %)	Tebessa (75 %)	
Naama (82 %)		
Biskra (81 %)		
Laghouat (79 %)		

Table 17. Classification of the steppe-dominated Wilayas with respect to the extent of the rangelands subjected to desertification

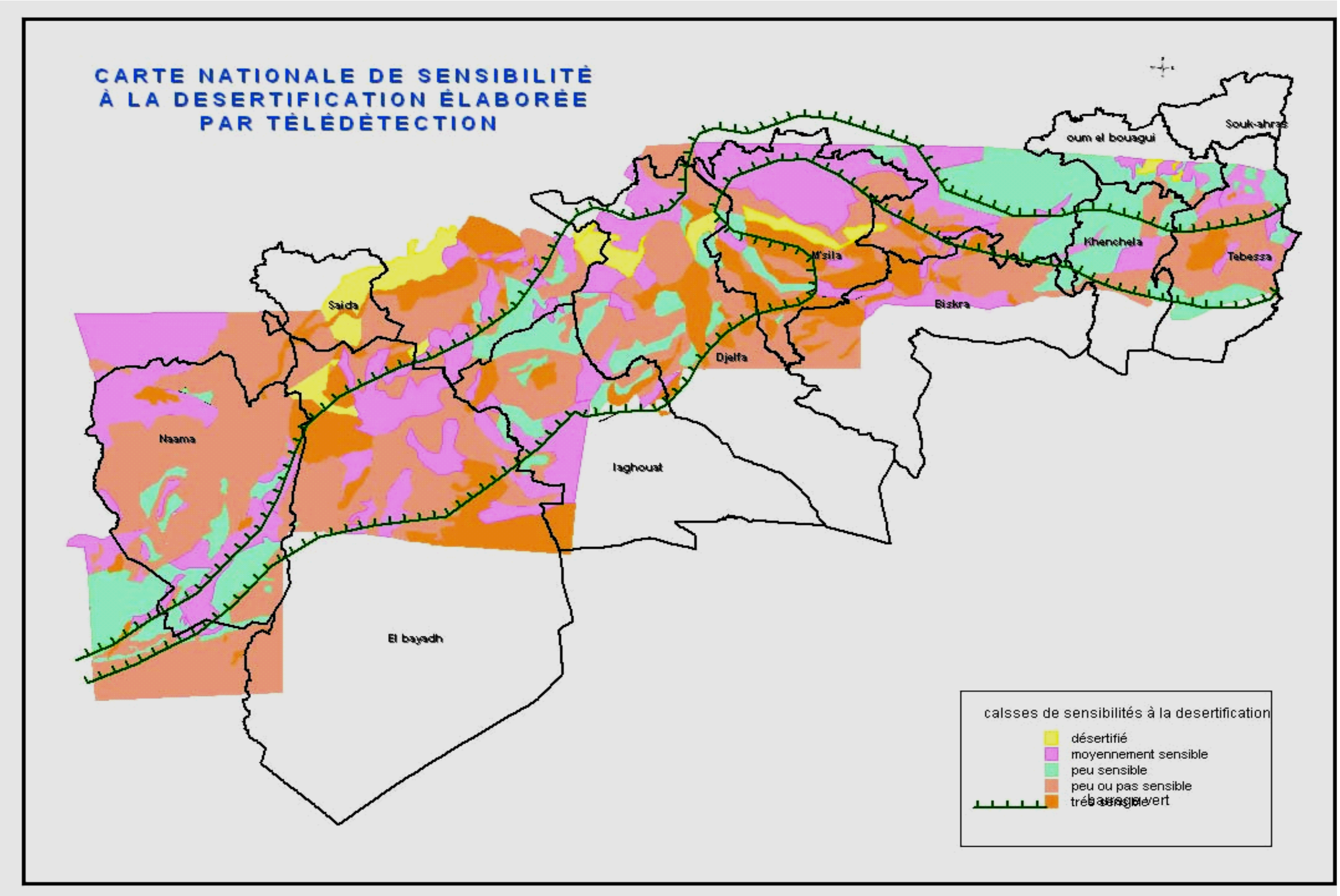
In terms of regions, the zones most endangered by the phenomenon of desertification are as follows:

- Central region: 40.423.074 ha, that is 86 % of the area of this regional set;
- Western region: 4.410.926 ha, that is 85 % of the area of this regional set;
- Eastern region: 2.119.826 ha, that is 61 % of the area of this regional set.

Steppe-dominated Wilaya	Degree of sensitivity										
	LNS		FS		S		HS		D		Total
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)
Tebessa	182.265.01	24.96	312.650.63	42.82	191116.78	26.17	44089.83	6.03	-	-	730.122.25
Khenchela	692.901.44	67.66	191.228.57	18.67	96.426.18	9.41	-	-	43.443.	4.24	1.024.000
Batna	280.493.04	27.39	369.792.99	36.11	185.896.23	18.15	143.392.6	14.0	44.425.14	4.33	1.024.000
Biskra	132.514.88	18.46	146.737.14	20.44	384.047..04	53.5	54.448.65	7.58	-	-	7.17.747.71
S/Tot East	**1.288.174.4**	**36.84**	**1.020.409.33**	**29.18**	**857.486.23**	**24.52**	**241.931.08**	**6.92**	**87.868.95**	**251**	**3.495.869.96**
Djelfa	151.518.27	13.5	406.186.91	36.19	393.515.6	35.06	137.347.39	12.23	33.561	299	1.122.129.17
Laghouat	128.919.84	20.48	98.256.21	15.61	224.618.3	35.68	177.631.32	28.22	-	-	629.425.67
Tiaret	20.736.57	1.53	378.136.27	27.92	580.667.42	42.88	304.224.57	22.46	70.283.19	519	1.354.048..0
Me Sila	199.913.58	9.76	258.066.76	12.60	882.914.71	43.11	581.508.87	28.39	125.596.06	613	2.047.999.98
S/Tot Center	**501.088.26**	**9.72**	**1.140.646.15**	**22.13**	**2.081.716.03**	**40.39**	**1.200.712.15**	**23.29**	**229.440.25**	**445**	**5.153.602.84**
El Bayadh	92.833.26	6.03	3.59.884.84	23.41	461.033.91	29.99	524.250.24	34.10	99.086.40	644	1.537.088.99
Naama	464.651.92	17.86	586.663.82	22.55	1.242.756.8	47.77	235.805.58	9.06	71.507.1	274	2.601.385.22
Tlemcen	9.960.79	1.73	507.470.94	88.36	50.152.78	8.73	6.711.71	1.16	-	-	574.296.22
Dj. Arar	22.461.73	4.89	62.328.7	13.58	368.242.35	80.28	5.624.4	1.22	-	-	458.657.18
S/Tot West	**589.908.04**	**11.4**	**1.516.348.3**	**29.32**	**2.122.185.84**	**41.03**	**772.391.93**	**14.93**	**170.593.5**	**329**	**5.171.427.61**
Total	**2.379.170.67**	**17.21**	**3.677.403.78**	**26.60**	**5.061.388.1**	**36.62**	**2.215.035.16**	**16.02**	**487.902.7**	**353**	**13.820.900.4**

LNS: Little or Not Sensitive *FS: Fairly Sensitive* *S: Sensitive* *HS: Highly Sensitive* Source: CNTS – 1996.

Table 5. Classification of the steppe-dominated Wilayas according to the degree of sensitivity to desertification



Desertification sensitivity classes

- Desertified
- Fairly sensitive
- Little sensitive
- Little or non sensitive
- Highly sensitive

Figure 12. National desertification sensitivity map developed by remote sensing

3.2.5. Desertification and shrinkage of the fodder offer

The exploitation of natural resources continues to be practiced according to unsuited conducting of the herds and anarchic land cover likely to generate social conflicts. A gradual and large-scale disappearance of the plant cover and, hence, of the pastoral potential of the rangelands, characterizes the process of degradation of the steppes with, as a consequence, the creation of dune formations and sandy pastures.

The size of the livestock, whose main component is the ovine species with over 80 %, has been constantly on the increase at a rate of 2 to 3 % since independence and ranges between 14 and 18 million head of cattle.

The estimates give the following distribution:

- Ovine livestock : 15.000.000;
- Caprine livestock : 1.200.000;
- Bovine livestock : 250.000;
- Cameline livestock : 100.000.

The analysis of the results of the General Agricultural Census gives the number of head of cattle as 13.6 million sheep and 1.7 million goats distributed as per pastoral and agro-pastoral Wilaya as follows:

Wilaya	Sheep (population)	Goats (population)
Laghouat	1 749 954	241 021
Biskra	330 162	77 712
Tébessa	503 134	142 335
Djelfa	3 486 221	372 782
Msila	1 222 108	70 743
El-Bayadh	491 499	64 083
Khenchela	175 800	47 386
Naama	582 558	57 232
S/TOTAL	8 541436	1 073294

Table 18. Distribution of ovine and caprine population as per steppe-dominated Wilaya

Wilaya	Sheep (population)	Goats (population)
Oum-El-Bouaghi	354 594	44 553
Batna	312 014	74 160
Bouira	284 441	34 813
Tlemcen	290 208	34 694
Tiaret	1 109 873	108 994
Sétif	861 454	109 995
Saida	496 404	44 947
Sidi-Bel-Abbès	256 463	22 947
Médéa	334 952	48 669
Bordj-Bou-Arréridj	425 906	69 427
Souk-Ahras	421 487	89 556
S/total	5.459 810	756 915
GRAND TOTAL	14.001 246	1.830 209

Table 19. Distribution of ovine and caprine population as per agro-pastoral Wilaya

Species	1888	1946	1952	1965	1970	1978	1980	1965	1969
Ovine	11.000	2.800	6.000	5.726	7.786	9.773	13.370	15.660	17.316
Caprine	-	-	-	1.762	2.581	2.269	2.723	2.688	2.404
Bovine	-	-	848	602	885	1.002	1.363	1.416	1.405
Cameline	-	-		176	143	155	149	133	122
Equidae	-	-	218	114	184	154	175	91	86

Table 20. Evolution of the livestock (U: 1.000)

According to the High Commissionership for Development of the Steppe (HCDS), and under such conditions, the fodder offer can meet only 20 % of the feed needs of the ovine livestock. The fodder deficit is estimated at about 3 billion Feed Units (FU).
The degradation of the rangelands is such that, currently, out of the 20 million steppe hectares of rangeland, only 15 million are palatable.
The rangelands still in good palatability condition, which cover hardly some 3 million ha (20 %), produce annually about 120 FUs. Most alarming is the fact that the

vegetation is poorly drought-resistant and does not seem to preserve its capacity of spontaneous recovery upon return of more abundant rain.

3.2. Morocco

Presentation of the arid and steppe zones

The arid, semi-arid and semi-desert regions in Morocco account for more than 80 % of the total area of the country. Grain crops occupy 60 % of the UFS (useful farm space) there and account for 55 % of the national production. These zones are characterized by water deficits due to low and irregular rainfall. These water deficits are made even worse by the temperature systems, the eroded soils, the farming of marginal lands and the intra- and inter-annual droughts.

The climate of the steppe zones is of the Mediterranean type, with rain concentrated over the six-month winter period; the total annual average ranges from 100 to 500 mm in the arid steppes and from 50 to 100 mm in the diffuse psamophile steppes of the northern Sahara.

type of climate or zone	Annual rainfall (R) (in mm)	Inter-annual variability of the rains	Corresponding area	
			Km^2	Percentage
Desert or hyper-arid	R<100 highly irregular rainfalls	Up to 100 %	434 600	61,2
Arid	100 < R < 250 mm	from 50 to 100 %	117 200	16,5
Semi-arid	250 < P < 500 mm	from 25 to 50 %	106 000	15.0
Sub-humid and humid	P > 500 mm	from 10 to 25 %	51 000	7,2
High in the mountains	P > 500 mm winter snow fall		1 000	0,1
Total area of Morocco			710 800	100

Table 21. Bio-climatic zones and their relative size

Zones	Total area (ha) *	Forest area	Steppes area	% steppes	Grass area
Saharan	49 000 000	0		100	
Pre-Saharan (Saharan steppes)	5 675 000	5 700	5 643 000	99	
Oriental (Arid steppes)	5 000 000	300 000	4 700 000	94	
Northern Atlas plains	1 300 000	286 000	1 014 000	78	
Souss (Arganeraie)	1 500 000	705 000	795 000	53	
Middle Atlas	1 200 000	984 000	216 000	14	48 000
Upper Atlas	2 200 000	2 024 000	176 000	4	88 000
Rif	900 000	900 000	0	0	
Central plateau	800 000	800 000	0	0	
Central Atlantic coastline	175 000		175 000	100	
Total	**67 750 000**	**6 209 000**	**61 430 000**	**90,2**	**136 000**

* exclusive of irrigated UFS area and favorable fallow land

Table 22. Areas of rangelands as per region

State of the natural and water resources in the steppe zones

Flora

The flora is richer than is commonly thought; it comprises about 2 630 species between the annual isohyetal curves of 100 and 500 mm from the Red Sea to the Atlantic Ocean, which is about the double of the Sahelian flora over a territory that is four times less. The species rates are as follows for the whole of the arid zones:

- 600 species present in five countries, that is 22.7 % (in % of the steppe flora set);
- 900 species present from Libya to Morocco, that is 34.1 %;
- 1 160 species present from Tunisia to Morocco, that is 43.9 %
- 1 826 species present in Algeria and in Morocco, that is 69.1 %.

A	B	C	D	E	F	G
Country/ Zone	Number of species	Area (103 km^2)	Density B/C	Number of arid species	Arid area (103 km^2)	Arid density E/F
Egypt	2100	100	2,1	1160	30	39
Libya	1920	1764	1,1	1520	193	8
Tunisia	2250	164	13,7	1630	69	24
Algeria	3200	2376	1,3	1890	216	9
Morocco	4200	720	5,8	2210	120	18
North Africa	6000	4924	1,2	2630	628	4

Table 23. Density of the flora of the arid steppes of North Africa

Country/Zone	Number of endemic arid species	% of the flora of the country or zone	% of arid flora
Egypt	38	1,8	3,3
Egypt/Libya	8	0,4	0,5
Libya	56	2,9	3,7
Libyae/Tunisia	17	0,7	0,9
Egypt/Libya/Tunisia	3	0,2	0,3
Tunisia	5	0,2	0,3
Tunisia/Algeria	20	0,6	0,8
Algeria/Morocco	95	4,1	3,6
Morocco	270	6,4	10,2
Maghreb zones	165	6,3	6,3
Iberian-Maghreb zones	10	0,3	0,3
Total	687	11,5	26,1

Table 24. Endemic profile of the steppe flora of North Africa

Fauna

The fauna of the arid regions of North Africa comprises 83 mammals, 133 resident birds and 55 reptiles. There are zonal distributions according to aridity which are comparable to those observed for the flora. The characteristic species of the bio-climatic sub-zones within the arid regions are distributed as follows:

- The upper arid zone between the annual isohyetal curves 300 and 500 mm comprises:
  21 species of mammals, 82 of birds and 3 of characteristic reptiles;
- The middle arid zone (200 - 300 mm) represents a habitat for 27 species of mammals, 28 of resident birds and 20 of reptiles;
- The lower arid zone (100 - 200 mm) comprises 7 species of mammals, 3 of resident birds and no characteristic resident reptiles;

- The northern Sahara comprises 28 species of characteristic mammals, 20 of resident birds and 32 of reptiles.

Vegetation
The correspondence between bio-climate and vegetation can be synthesized as follows:
Saharan bio-climate : Saharan vegetation: *Calligonum* (*C.comosum*, *C.azel*), *Anabasis aretioides*, *Gymnocarpos decander*, *Oudneya*; *Zilla*, *Zygophyllum*, *Acacia raddiana*, *A.seyal*, *Balanites aegyptiaca*, *Tamarix* (*T.africana*, *T.speciosa*);
Arid bio-climate : possibilities of forest, pre-forest and steppe vegetation : *Arganier spinosa*, *Acacia gummifera*, *Pistacia atlantica*, *Zizyphus lotus*, steppe : *stipa tenacissima*, *Artemisia herba alba*.
Semi-arid bio-climate with prevailing Mediterranean conifers: *Pinus halepensis*, *Tetraclinis articulata*, *Juniperus phoenicea*, *Cupressus semperviriens*, *Essences sclerophylles* (*Quercus rotundifolia*, *Quercus suber*).

Causes of soil degradation in Morocco
Among the factors of degradation, it is worth mentioning in particular:
Water erosion: Water erosion is a threat to almost the entire Moroccan territory with specific degradations exceeding 2 000 t/km2/year in the Rif slopes. Out of the area studied, which covers 22 million hectares of northern Morocco, nearly 12.7 million hectares of farm land and rangeland are subjected to more or less significant water erosion risks.
Wind erosion: Wind is one of the major factors that have shaped the landscapes of the arid zones. This type of erosion is especially active in the south-eastern, south-western and eastern zones where it represents a threat to the rural centers, the palm-tree groves, the roads, as well as certain irrigated areas.
Irregular rain: The rains received by the arid and semi-arid zones are unevenly distributed over time. This concentration in time and space causes the disintegration of the soil constitutive elements.
Crop-growing practices: Farmer crop-growing practices, especially in sloping areas, are hardly convenient for the situation: absence of deep harrowing and soil conservation techniques. The mechanization of farming in these zones has on the whole been limited to the passage of the cover crop, which induces pulverization of the surface soil and, hence, erosion under all its forms.
Salinisation: The problem of salinisation and the rise of the aquifer affects almost all major irrigated areas; an area of 37 000 ha is affected by either salinisation or alkalinisation. In the only provinces of Ouarzazate and Errachidia, it is estimated that 22 000 ha of irrigated land and 5 million hectares of rangeland are affected by salinisation.

Indicators of pressure on the natural resources
Water is essential to the sustaining of life. The exploitation of water resources around human settlements increases the pressure on the environment and the risks of desertification. Several phenomena cause desertification, among which frequent droughts, deforestation, intensive crop-growing and overgrazing.
Among the key factors and major actors having also contributed in a "regressive" evolution (shrinkage) of the rangelands, it is worth mentioning the following:

- Population : because of its agro-pastoral practices closely connected with the rangeland areas;
- Natural conditions : particularly chronic droughts;

- Actions of the various actors : mainly the administration services in connection with the various projects geared to various objectives.

The interaction of the various factors and their impacts on the rangeland zones help to distinguish four major sets of indicators which govern the inception and evolution of the desertification process :

- physical indicators (water resources, soil erosion);
- vegetation indicators (composition, cover, etc.) ;
- socio-demographic indicators (human density, incomes);
- socio-economic indicators (livestock population, UFS/yields).

The major causes of the degradation of the water resources are:

- drought;
- extensive farming;
- overexploitation of plant resources;
- soil properties.

Animal pressure in the steppe zones

The livestock, which constitutes a significant asset not only in terms of size but also in view of its economic and social role, accounts for about 40% of rural employment. It is composed of:

sheep:	15.6 million head,
cattle:	2.4 million head,
goats:	4.4 million head.

The stock-breeding system practiced in the steppe zones is of the extensive type on vast degraded or poor rangelands. These movements are necessary in search for water and pasture for the maintenance of the livestock.

Two main systems of exploitation of the space in the arid zones may be found: the pastoral system and the agro-pastoral system.

The pastoral system: This system is based on the use of the spontaneous vegetation of the rangelands. Balance had been maintained between the natural resources and livestock size until it was disrupted under the combined effect of population growth and the increase in the needs of the animals. The phenomenon of settlement aggravates the feed deficit since the fodder resources produced by the spontaneous vegetation cannot ensure the subsistence of the herds throughout the year.

The agro-pastoral system: The agro-pastoral stock-breeding system remains of family type. Several factors have largely contributed in the development of the phenomenon of settlement. This is especially due to the development of means of communication, in particular following the construction of a major highway and roads network, as well as a network of souks (village markets) and commercialization centers.

3.3. Tunisia

Presentation of the steppe zones

Almost the entire steppe zone is an arid zone with a moderate winter. The rains are irregular and stormy, with a rainy autumn season (accounting for over 30 % of the rains). On average, the zone gets about 25 days of rain per year. The autumn rains are very aggressive for the dry soil.

As regards the temperatures, the steppe zones are characterized by a significant variability between winter and summer (ranging from 3 to 40° C). Most characteristic of the climate are sirocco winds in the summer and hail and frost in the winter. These thermal amplitudes thus make the soils quite vulnerable to the autumn rains.

Three bio-climatic regions or stages may be distinguished:

- The northern region of the country or the wet zone (also known as the Tellian Tunisia), with a thick, predominantly shrubby, plant cover; it extends over an area of 9 272 km^2, that is 5.6 % of the national territory;
- The central region, a semi-arid or steppe zone, dominated by the upper and lower steppes; it covers an area of 29 118 km2, that is 17.8 % of the territory. The Tunisian steppes (such as defined in the IFPN (National Forestry and Pastoral Inventory, 1995) thus cover the Governorates (regional administrative departments) of Kairouan, Kasserine and Sidi Bouzid, as well as part of the Governorates of Gafsa, Sfax, Mahdia and Sousse;
- The southern region, or again southern Tunisia, is characterized by the existence of vast desert spaces and Chotts strewn by oases; it covers an area of 49 225 km^2, that is 40 % of the territory.

The remainder of the area, extending over 65 209 km^2 (that is 42.7 % of the territory), constitutes the Saharan zone. The steppes are the whole of the vast plains and the mountains which, from the north of Gafsa and the south of the Dorsal, form central Tunisia. The upper and the lower steppes may be distinguished there. The upper steppes are a zone of vast elevated plains (over 400 m) partitioned by secondary mountain chains of variable directions and heights: the sub-meridian, or else meridian, Atlas mounts in contact with the lower steppes. The drainage of the high steppes is made by three major networks of wadis: that of Sidi Aich which flows towards the region of Gafsa, and those of Marguellil and Zeroud which flow in the plain of Kairouan. As to the lower steppes, they extend over vast, uneven coastal plains cut through by loose hills surrounding closed basins where a number of wadis with endoreic flow stream. According to their quality, the soils of the upper steppe may be classified as follows:

	(in ha)	**(in %)**
Good quality soils for tree-plantations	211 000	24.8
Lesser quality soils for tree-plantations	100 000	11.7
Good quality soils for annual crops	80 000	9.4
Lesser quality soils for annual crops	82 000	9.6
Soils reserved for rangeland	135 000	15.8
Forestry soils	40 000	4.7
Soils unfit for cultivation	203 000	23.8

Table 25. Classification of the quality of the soils

As regards the lower steppe, the soils may be classified, according to fertility and suitability, as follows:

Nature of the soils	Area (1000 ha)	Fertility	State of degradation
Isohumic soils	297	Fertile, suited for tree-plantations and irrigation	Endangered by wind erosion and impoverishment in humus
Encrusted isohumic soils	89	Fairly fertile, suited for tree-plantations (after necessary development)	Water and wind erosion. Deflation and removal of surface horizons
Sound, little developed soils	132	Fertile, suited for all crops, though much more fit for	Alluvial deposits

		annual crops	Enrichment by supply of silts, though having ceased since construction of dams
Salty, alluvial, little developed soils	102	Fairly fertile, suited for grain crops and pasture	Salinisation due to stagnant water
Salty and alkaline soil	66	Barren; useful as rangeland for camels	
Calci-magnetic, encrusted soils and litho-soils	147	Not very fertile, suited for rangelands and tree-plantations after scarification	Water erosion, Removal of surface horizon
Sebkhas and other	67		

Table 26: Classification of the soils according to their fertility

Water resources

The total potential of water resources in the steppe zones is about 500 Mm3/ year, that is about 10% of the total resources of the country.

Surface water has a mobilizable potential of about 220 Mm3/ year, but the inter-annual variability of the supply is quite significant (one year out of four).

Groundwater resources (about 60 % of the resources) are much in demand in the steppe zone, which has induced overexploitation phenomena in certain aquifers (mainly in Sidi Bouzid, North of Gafsa, etc . . .).

The water resources potential of the upper steppes is about 150 Mm3/ year, of which 120 Mm3/ year of groundwater resources. The exploitation of these resources generates certain problems for both surface water and deep water.

For the management of the runoff waters, which are mobilized only at the time of major floods, the most common technique is that of flood-water spreading. This very old technique is perfectly mastered and accepted by the population.

The water resources potential of the lower steppes is estimated at 332 Mm3, distributed as follows:

	Potential (Mm3)
Surface water	190
Groundwater	142
Total	332

Table 27. Water resources potential of the lower steppes

As regards the esparto steppe, the exploitable water resources are practically limited to the groundwater whose potential is about 17 Mm3. The main aquifers which characterize the steppe are as follows:

Aquifers	**Nbr. of wells**	**Salinity (in g/l)**	**Exploitable resources (in Mm3)**	**Exploitation**
Thelepte	145	0.5 to 2.0	0.70	0.75
Feriana	219	0.5 to 3.5	1.60	1.04
Hassi El Frid	110	1.0 to 5.0	0.30	0.32
Wadi El H' Chim	120	1 to 1.5	0.40	0.37
Oum Laksab	146	1 to 1.5	4.10	3.80

Table 28. Major aquifers

As to the deep aquifers, their potential is limited to about 7.1 Mm3. These resources are exploited partly by means of boreholes.

Aquifers	**Exploitable Resources**	**Exploitation in 2000 (in Mm3)**
Wadi H' Chim	1.50	0.01
Ouled Foamed	0.50	0.09
Sfisifa	0.30	0.20
Oum Ali Thelepte	7.30	3.94
Skhirat Feriana	0.30	0.15
Oum laksab	0.30	0.1
Beautiful Majel Abbès	0.60	0.42

Table 29. Exploitation of the deep aquifers

As regards the southern lower steppe, the surface water resources are limited; the major wadis flow intermittently (with floods occurring once in every 4 to 5 years), the most important ones being wadi Leben and wadi Doura.
The groundwater resources consist of two major aquifers: Bir Ali Ouadrane and Skhira whose resources are estimated at 9 Mm3, while their exploitation is of 9.3 mm3 / year. This overexploitation has generated a decrease in piezometry and an increase in salinity from 1 to 8 g/l.

Pastoral resources of the Tunisian steppes
The National Forestry and Pastoral Inventory (IFPN, 1995) gives a total area of esparto cover of 743 306 ha. Today, the esparto cover represents only 16% of the national pastoral resources (4 706 Million ha); they are, however, essential for the two Governorates of Kasserine and Sidi Bouzid, where they represent 71 and 60 %, respectively, of the total pastoral resources of the said Governorates.

The value of esparto derives from the various opportunities and advantages which it offers directly or indirectly to the populations living in the natural environment and its vicinity:

- On the industrial level, esparto constitutes a raw material appreciable for wood pulp;
- On the level of the stock-breeding sector, esparto continues to account for a significant part of the fodder resources balance;
- On the economic level, it offers non negligible employment opportunities, since it constitutes a raw material for the manufacture of handicrafts for domestic use;
- On the environmental level, certain ecologists believe that esparto plays a key role in soil stabilization (cleared land plots degrade and are stripped very rapidly).

Shrinkage and degradation of rangelands

Evolution of the livestock population and fodder balance
Until the 1960s, the Tunisian livestock population was quite sensitive to climatic risks. The cyclic drought periods thus claimed a heavy toll (25 % of total losses in 1937-38; 50 % in 1946-1949). The stockbreeders had to increasingly resort to various storable fodder supplements: chaff, hay, secondary grains and agri-food industrial by-products.
In 2002, the national livestock population counted 753.000 head of cattle, 6.833.000 sheep and 1.449.000 goats. The ovine population has almost tripled since 1962 (2.349.000 head). Moreover, 40 % of the cattle stockbreeders are small farmers (less than 10 ha) and hold less than 10 females.

In spite of the increase in the livestock population, and a reduction by about 40% of the fodder supply provided by the rangelands between 1964 and 1990 (IBRD, 1995), Tunisia can meet, during favorable rainfall years, the needs of the livestock thanks to the improvement of the rangelands, the development of rain-fed or irrigated fodder plots, the extension of barley crop-growing, as well as a better integration of farming and stock-breeding (valorization of by-products)
The areas of barley crops passed from 350.000 ha in 1971 to 522.000 ha in 1995 (+ 49 %). However, they remain quite fluctuating, according to the yearly rainfall (311.000 ha in 1977, as against 642.000 ha in 1979). Forty one per cent (41%) of the areas of barley crops are located in the steppe zones. The starting of production of the olive-tree groves planted in the 1970s and 1980s has made it possible to provide significant quantities of cattle feed (olive residue, leaves of olive-trees), thus incepting a certain integration between stock-breeding and farming.

Shrinkage of natural resources

The impacts of agricultural development on the natural resources of the steppe zones are obvious: such as a reduction of the plant cover and an invasion of the medium by species of limited, if not nil, pastoral value. Gradually, the erosive factors have increased, as induced by climatic and edaphic aridity, which causes a drop in the productivity of the soils and a loss of biodiversity.
One of the manifestations of the degradation of the rangelands is the change affecting the floristic diversity. In a study relating to the colonization of the *Rhanterium suaveolens*-dominated steppe by degradation-inducing species, certain research studies (Cf. Chaieb, 1997) have revealed a significant development of *Astragalus armatus subsp. Tragacanthoides* on this vulnerable formation.
The privatization of the land and the settlement of herdsmen do not allow a regeneration of the plant species and cause further degradation, if not utter disappearance, of the more palatable species, as well as the vulnerability of the pastoral ecosystems.

Changes of zone (in %)	Quality of the biodiversity of the residual vegetation	Production (phytomass m3 and/or kg SM/ha/year)	National classification of vegetation types
40 to 50	degraded	300 to 650 kg SM	Esparto steppe
20 to 35	degraded	100 to 1100 Kg SM	*R. suaveolens*-dominated steppe
42	degraded	480 to 1300 Kg SM	*Artemisia herba alba* dominated steppe
15	degraded	180 to 1300 Kg SM	*Arthrophytum scoparium*-dominated steppe
15	degraded	200 to 400 Kg SM	*Arthrophytum schmittianum*-dominated steppe
5 to 10	disrupted	700 to 1200 Kg SM	Halophyte-dominated steppe

Source: National Strategy for Biological Diversity, Ministry of the Environment and Land Use Planning (MEAT), April 1998

Table 30. Characteristics and areas of the main vegetation clusters of the steppes

In a more recent study (Mhiri et al., 1998), the annual land losses due to the various processes of soil degradation (erosion and desertification) are estimated at 37.000 ha, of which 13.000 ha where degradation has reached an irreversible stage. Based on the erosion map (1980), it is estimated that 900.000 ha in the steppe zones are affected by erosion. A study on the evaluation of sedimentation in 6 major dams (Ministry of

Agriculture, 1990) revealed that the volumes of sediments had reached 28 Mm2/year, that is the equivalent of 10.000 ha/an.

Classes	Area (ha)	% of the total area
Little affected zones	1.820.000	17.2
Fairly affected zones	4.220.000	39.7
Highly affected zones	1.250.000	11.7
Desert zones	3.330.000	31.4
Total	10.620.000	

Floret et al., 1976

Table 31. Zones affected by desertification in the Center and the South

4. Suggestions to support the UNCCD implementation

The different national reports to be submitted at the COP7 (October 2005), based on the experience in implementing the Convention during these three last years, point out the following key aspects for a better implementation of the National Action Programmes to Combat desertification. They were analysed by 3 Regional workshops held in Ouagadougou; Cotonou and Addis Ababa in February 2005.

Regarding participation of the civil society it is recommended to:

- fully involve the civil society including NGOs networks in the UNCCD implementation as true partners in development;
- intensify environmental education and awareness creation activities on issues related to combating desertification and to land degradation through focussed campaigns using civil institutions;
- build capacities and enhance exchange of good practices and experiences among communities, NGOs and CBOs in the preparation and management of small scale community based projects while enhancing their organizational capacity;
- empower communities through effective decentralization and allocation of funds to local authorities and communities to enable them to manage their resources;
- evaluate the effective participation of civil society in the UNCCD implementation process on the basis of qualitative indicators

Regarding mainstreaming all the countries call to:

- integrate sustainable land management issues into school curricula in close collaboration with the ministries of education;
- build capacities of local governments and communities for better integration of sustainable land management issues into their district development plans as well as resources mobilisation, conflict resolution and group organisation and management in the context of the NAPs;
- expand further the National Coordinating Bodies (NCBs) by including representatives from various key stakeholders ensuring gender balance and enhance their capacities through trainings on environmental laws, policies analysis, development of environmental planning tools, development and provision of appropriate equipment for communication and networking;
- strengthen institutional arrangements for coordination and implementation of the UNCCD to take into account local communities that are implementing programmes, particularly in view of the importance of synergies which need to be established.
- pursue the sensitisation of policy and decision makers to support integration of land management issues into national planning and budgeting processes and ensure

integration of the NAP into public investment programmes to subsequently increase allocation to environmental programmes in the national budget, while also promoting the private sector participation and investment in drylands development;

- strengthen in-country capacity to effectively coordinate mainstreaming of UNCCD/NAP into national development planning frameworks such as Poverty

Reduction Strategy Papers (PRSPs), in order to ensure the effective mobilization of resources for UNCCD/NAP implementation;

- identify innovative and successful interventions targeting sustainable land management, the protection of fertile land and the rehabilitation of degraded land at national and sub regional levels for wider dissemination;
- promote a holistic approach and improved coordination in the implementation of projects and programmes at the local level;
- develop set of appropriate indicators to be integrated in the national poverty alleviation indicators grid and devoted to measuring impact of action programmes to combat desertification.

Regarding desertification M&E issues there is a need for:

- reinforcing South-South cooperation for building capacities to enhance data collection, collation and analysis (human resources and equipment) while making use of subregional and regional institutions such as ICPAC (formerly Drought Monitoring Center (DMC) Nairobi), DMC Harare, Remote Sensing Unit of SADC, Regional Center for Mapping Resources for Development, Observatoire du Sahara et du Sahel (OSS) etc…
- identifying a regional/sub regional team of experts on drought and desertification monitoring and assessment to exchange lessons learnt and deal with transboundary issues that cause drought or desertification, leading among others to sustainable land management information exchange networks in close collaboration with the CST and the thematic programme network on monitoring and assessment (TPN4);
- strengthening national and sub regional monitoring facilities and early warning systems, taking into account the participation of local communities in local level monitoring for enhanced decision making;
- completing and refining the baseline data contained in the country profiles on which future monitoring can be based as well as elaboration of a desertification map based on all indicators (identification of “hot spots” that require close monitoring).

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Annex I: List of people/institutions to whom the questionnaire was sent (and rate of response)

Country	Gender	First name	Sure name	e-mail	Organisation	Position
Algeria	Male	Abdelghani	Belouad	-	Division des Forêts Ministère de l'Agriculture Chemin Doudou Mokhtar-Ben-Aknoun 16000 ALGER	General Director
Algeria	Female	Farida	Khammar	-	Centre de Recherche Scientifique et Techique des Régions Arides Front de l'oued BP 1682 R.P 07000 BISKRA	Director
Egypt	Male	Ismaill	Abdel Gilil	ismaill@bramyl.ie-eg.com	Desert Research Center Ministry of Agriculture and Land Reclamation 1 Mathaf El Mataray P.O. Box 11753 11728 CAIRO	Director
Maroc	Male	Omar	Askarn	ces@athena.online.co.ma	Conservation des Eaux et du Sol Ministère Délégué chargé des Eaux et Forêts RABAT-CHELLAH	Inspecteur Général
Maroc				-	Institut Agronomique et Vétérinaire Hassan II BP 6202-Instituts, 10101-RABAT	General Director
Tunisia	Male	Mohamed	Ismail	pan.onc@gnet.tn	Ministère de l'Environnement et de l'Aménagement du Territoire TUNIS	UNCCD Focal Point
Tunisia	Male	Houcine	Khathelli	-	Institut des Régions Arides Route de Djorf km 22,2 4119 Médenine	General Director

Annex II: list of indicators

Country	Cathegory	Indicator	Benchmark	Level	Type
Algeria, Egypt, Libya, Mauritania, Morocco, Tunisia	Biophysical	Desertification sensitivity index	None	Sub-Regional/National	**S**
Morocco, Tunisia, Algeria	Biophysical (remote sensed data)	Macro-geographic indicator : NDVI	None	Sub-regional/National	**S**
	Biophysical (remote sensed data)	Macro-geographic indicator : MSAVI2	None		**S**
	Biophysical (remote sensed data)	Meso-geographic indicator : land use changes	None	Sub-national/Local	
	Biophysical (remote sensed data)	Meso-geographic indicator : biomass	None	Sub-National/Local	
Morrocco (monitoring-evaluation system of NAP/CD)					
	Elimination of poverty				
	Socio-economic	Growth rate of rural population	None	National	**P**
	Socio-economic	Rural population/ Total population Ratio	None	National	**P**
	Socio-economic	Agricultural GDP/ inh.	None	National	**S**
	Socio-economic	GDP/ inh.	None	National	**S**
	Socio-economic	Illiteracy rate	None	National	**S**
	Socio-economic	Active pop. In the agricultural sector/ Active rural population ratio	None	National	**S**
	Socio-economic	Rural exodus flow	None	National	**S**
	Socio-economic	Schooling rate (primary education)	None	National	**R**
	Socio-economic	Rate of rural households with access to electricity	None	National	**R**
	Socio-economic	Rate of rural households with access to drinking water	None	National	**R**
	Socio-economic	Rate of rural population in Poor population.	None	National	**I**
	Socio-economic	Rate of population below poverty threshold	None	National	**I**
	Socio-economic	Rate of rural unemployment.	None	National	**I**

	Water resources				
	Biophysical	Tapped surface water volume	None	National	**R**
	Biophysical	Tapped ground water volume	None	National	**R**
	Biophysical	Rate of silting up of dams	None	National	**P**
	Biophysical	Rainfall variance with respect to normal (mean value)	None	National	**S**
	Biophysical	Climatic aggressiveness (erosion factor)	None	National	**S**
	Socio-economic	Rate of rural drinking water supply	None	National	**R**
	Socio-economic	Drinking water consumption/ inh.	None	National	**I**
	Socio-economic	Irrigation water consumption/ hectare	None	National	**I**
	Socio-economic	Efficiency of irrigation networks	None	National	**R**
	Socio-economic	Rate of recovery of irrigation water fees	None	National	**R**
	Socio-economic	Water volume available per inhabitant	None	National	**I**
	Biophysical	General water quality index	None	National	**R**
	Socio-economic	Portion of irrigated areas using water saving (efficiency) techniques	None	National	**R**
	Socio-economic	Rate of filling of dams (September)	None	National	**I**
	Forests				
	Biophysical	Cleared land area/ year	None	National	**P**
	Biophysical	Area affected by parasite waves	None	National	**P**
	Biophysical	Decay/ year	None	National	**P**
	Biophysical	Area affected by fire/ year	None	National	**P**
	Biophysical	Total forestry area (Mha)	None	National	**S**
	Biophysical	Area of degraded forestry (ha)	None	National	**P**
	Biophysical	Water erosion prone area (ha)	None	National	**P**
	Biophysical	Area definitely delimited/ year	None	National	**R**
	Biophysical	Area reforested/ year	None	National	**R**
	Biophysical	Area of protected zones	None	National	**R**
	Biophysical	Area treated against diseases/ year	None	National	**R**
	Biophysical	Area regenerated/ year	None	National	**R**
	Biophysical	Area treated against water erosion/ year (in the major catchment basins)	None	National	**R**
	Biophysical	Forest area/ 10 year	None	National	**I**
	Biophysical	Ratio of reforested area/ deforested area/ year	None	National	**R**

	Rainfed land				
	Biophysical	Rate of farms of less than 5 ha in area	None	National	**P**
	Socio-economic	UFS (Useful Farm Space) per rural inh.	None	National	**P**
	Socio-economic	Portion of grain crops in USF	None	National	**S**
	Socio-economic	Portion of fallow land in UFS	None	National	**S**
	Socio-economic	Portion of cover crop area/ Total mechanised area	None	National	**R**
	Socio-economic	Crop rotation structure (UFS structure)	None	National	**R**
	Biophysical	Plantation area	None	National	**R**
	Socio-economic	Agricultural development budget allotted to the rainfed land zone	None	National	**R**
	Socio-economic	Area grown in the framework of the national olive growing plan	None	National	**R**
	Socio-economic	Area grown under the fruit tree DRS (soil protection and restoration) scheme	None	National	**R**
	Biophysical	Evolution of the yields of the main crops and tree plantations	None	National	**S**
	Biophysical	Average annual rainfall	None	National	**S**
	Irrigated land				
	Biophysical	Rate of exploitation of available water resources	None	National	**P**
	Socio-economic	Sale price of water/ Cost price of water	None	National	**P**
	Socio-economic	Portion of areas of high water consuming crops	None	National	**P**
	Socio-economic	Quantity of fertilisers and pesticides used	None	National	**P**
	Socio-economic	Number of dried up wells	None	National	**S**
	Biophysical	Area affected by salinity	None	National	**I**
	Socio-economic	Crop rotation structure	None	National	**S**
	Biophysical	Portion of area of irrigated zones	None	National	**R**
	Socio-economic	Developed areas	None	National	**R**
	Socio-economic	Number of AUEA	None	National	**R**
	Biophysical	Portion of the area affected by salinity/ Total irrigated area	None	National	**I**
	Biophysical	Evolution of yield of the major irrigated crops	None	National	**I**
	Biophysical	Water volume consumed by irrigation	None	National	**P**
	Socio-economic	Production value of agricultural land/ PIBA	None	National	**S**
	Biophysical	Portion of areas of little water consuming crops (drought-resistant)	None	National	**R**
	Rangelands				

	Biophysical	Population of small ruminants	None	National	**P**
	Biophysical	Land area cleared	None	National	**P**
	Socio-economic	Livestock load per available fodder unit	None	National	**P**
	Biophysical	Area of degraded land	None	National	**P**
	Biophysical	Vegetation Index (NDVI)	None	National	**S**
	Biophysical	Portion of developed rangeland	None	National	**R**
	Socio-economic	Number of equipped water points	None	National	**R**
	Socio-economic	Number of operating pastoral organisations	None	National	**R**
			None	National	
	Oases				
	Biophysical	Area affected by sand encroachment	None	National	**S**
	Biophysical	Area affected by salinity	None	National	**S**
	Biophysical	Number of desiccated palm trees	None	National	**S**
	Biophysical	Number of seedlings distributed in the framework of the oases restructuring plan	None	National	**R**
	Biophysical	Area of stabilised dunes	None	National	**R**
	Biophysical	Portion of the area affected by the degradation factors	None	National	**S**
Tunisia (monitoring-evaluation system of NAP/CD)					
	Elimination of poverty				
	Socio-economic	Rural exodus situation	None	National	**P**
	Socio-economic	Total rural population	None	National	**P**
	Socio-economic	Population according to the uses of natural resources per natural space	None	National	**P**
	Socio-economic	Illiteracy rate in rural environment	None	National	**P**
	Socio-economic	Population with part of its income generated by the rangelands and forests	None	National	**P**
	Socio-economic	Percentage of population living below the poverty threshold	None	National	**S**

	Socio-economic	Annual expenditure per person on health and hygiene	None	National	**S**
	Socio-economic	Rate of contraceptive prevalence in rural and urban environment	None	National	**S**
	Socio-economic	Number of projects for the promotion of rural woman and of community development	None	National	**R**
	Socio-economic	Number and budget of “promotion of rural woman and of community development” projects	None	National	**R**
	Socio-economic	Rate of household connection to drinking water network	None	National	**I**
	Socio-economic	Total annual expenditure per person according to the environment (rural/ urban)	None	National	**I**
	Socio-economic	Rate of electrification of households	None	National	**I**
	Socio-economic	Number of precarious housing	None	National	**I**
	Socio-economic	Economic values profiting to the local populations	None	National	**I**
	Socio-economic	Evolution of the expenditure of the populations according to the natural spaces	None	National	**I**
	Forestry space				
	Biophysical	Forest fires (area, number, A/N ratio)	None	National	**P**
	Biophysical	Rate of recovery of forest formations	None	National	**S**
	Socio-economic	Budgets allocated to actions in the forestry sector	None	National	**R**
	Socio-economic	Number of work days in the forests and rangelands	None	National	**I**
	Biophysical	Number of forestry offences	None	National	**P**
	Socio-economic	Total forestry population	None	National	**P**
	Socio-economic	Rate of coverage of the needs of the livestock of the governorates (provinces) of the North by the production of the forestry spaces	None	National	**P**
	Socio-economic	Rate of coverage of firewood needs by the Governorates of the North	None	National	**P**
	Biophysical	Volume of tree wood/ha	None	National	**S**
	Biophysical	Rate of forest cover	None	National	**S**
	Biophysical	Albedo	None	National	**S**

	Biophysical	Total area of forestry formations	None	National	**S**
	Socio-economic	Rate of native forestry species produced by nurseries	None	National	**S**
	Socio-economic	Number of AFIC, GFIC and GDA operating in the forests and rangelands	None	National	**R**
	Biophysical	Ratio of protected forestry and steppes areas / total forestry and steppes areas	None	National	**R**
	Biophysical	Area of forest and pastoral plantations	None	National	**R**
	Socio-economic	Contribution of income generated by forestry activities in the household income	None	National	**I**
	Socio-economic	Amount of conventions made by groups / total budget allocated to the forestry sector	None	National	**I**
	Steppe space				
	Socio-economic	Rate of coverage of the needs of the livestock of the Governorates of the Centre and of the South by the production of the steppes spaces	None	National	**P**
	Socio-economic	Supplement feed given to the livestock in the Governorates of the Centre and of the South	None	National	**P**
	Socio-economic	Area of collective rangelands allotted to private developers	None	National	**P**
	Socio-economic	Infrastructure (water point, shade areas, roads, . . .)	None	National	**P**
	Socio-economic	Tenure status of rangelands	None	National	**P**
	Biophysical	Grain crop areas / Steppes rangeland area in the Governorates of the Centre and of the South	None	National	**P**
	Biophysical	Rate of recovery of steppes formations	None	National	**S**
	Biophysical	Reference list of the species indicative of irreversibility for the various types of steppes	None	National	**S**
	Biophysical	Area of steppes formations	None	National	**S**
	Biophysical	Biomass / Vegetation index / Albédo	None	National	**S**
	Biophysical	Animal and plant biodiversity trends	None	National	**S**
	Biophysical	Annual areas of steppes formation restricted to grazing)	None	National	**R**
	Biophysical	Length of tabias (conventional fences) for sand stabilisation	None	National	**R**

	Socio-economic	Budget allocated to Research-Development in the area of combating desertification	None	National	**R**
	Socio-economic	Size of researchers teams acting under the R-D programmes listed in the NAP (National Action Programme for Combating Desertification)	None	National	**R**
	Socio-economic	Number of Master Studies Graduates in Combating Desertification per year	None	National	**R**
	Farmlands/ Rainfed crops				
	Biophysical	Total area of grain crops in Tunisia	None	National	**P**
	Biophysical	Total quantity of fertilisers used per year	None	National	**P**
	Biophysical	Rainfed crops area in the Governorates of the South	None	National	**P**
	Socio-economic	Farmland area/ Inhabitant	None	National	**P**
	Biophysical	Grain crop area in mountainous zones North of the Ridge	None	National	**P**
	Biophysical	Grain crop sown area + tree plantations area/ Steppes rangeland area + rainfed farmland in the Governorates of the Centre and of the South	None	National	**P**
	Biophysical	Average national yield of grain crops	None	National	**S**
	Biophysical	Grain crop sown area/area fit for grain crop growing in the Governorates of the North	None	National	**S**
	Biophysical	Farmland cover (occupancy) in Tunisia	None	National	**S**
	Socio-economic	National olive crop production	None	National	**S**
	Socio-economic	Budgets allocated to water & soil conservation works	None	National	**R**
	Biophysical	Area of catchment basins developments	None	National	**R**
	Biophysical	Area of reinforced water & soil conservation developments	None	National	**R**
	Socio-economic	Area of land developed based on soft techniques	None	National	**R**
	Socio-economic	Number of flood water spreading structures	None	National	**R**
	Farmland/irrigated agriculture				
	Biophysical	Percentage of land degradation in irrigated areas	None	National	**P**

	Biophysical	Quality of irrigation water : surface and ground water	None	National	**P**
	Biophysical	Total irrigated area	None	National	**R**
	Socio-economic	Irrigated area equipped with water saving (efficiency) techniques	None	National	**R**
	Water resources				
	Biophysical	Rainfall map for crop year	None	National	**S**
	Biophysical	Rainfall for the months of September, October and November	None	National	**S**
	Biophysical	Water storage in dams as of 31 August/ Total storage capacity	None	National	**S**
	Biophysical	Exploitation index of deep aquifers	None	National	**R**
	Socio-economic	Number of Community Interest Groups (GIC) in the water sector in rural environment	None	National	**R**
	Biophysical	Number and capacity of hillside dams	None	National	**R**
	Biophysical	Number of hillside lakes	None	National	**R**
	Biophysical	Number of manmade recharge sites of groundwater aquifers, and volume injected	None	National	**R**
	Biophysical	Rate of irrigated land equipped with water saving (efficiency) techniques with respect to total irrigated land	None	National	**R**
	Biophysical	Ratio of wastewater volume treated/ wastewater volume used	None	National	**R**
	Wetlands				
	Biophysical	Number, area and distribution of wetlands	None	National	**S**
	Biophysical	Number and area of protected wetlands/ Number and area of total wetlands	None	National	**R**
			None	National	
ROSELT/OSS Network					
	Remote Sensing	Evolution de l’indice de végétation (NDVI) au cours du temps	None	Regional/Local	**S**
	Remote Sensing	Evolution de l’indice de brillance au cours du temps	None	Regional/Local	**S**
	Biophysical	Evolution de l’occupation des terres (land cover) au cours du temps	None	Regional/Local	**S**
	Biophysical	Evolution de l’occupation des sols (land use) au cours du temps	None	Regional/Local	**S**

	Biophysical	Evolution du recouvrement états de surface du sol au cours du temps	None	Regional/Local	**S**
	Biophysical	Evolution du recouvrement de la végétation	None	Regional/Local	**S**
	Biophysical	Evolution du phytovolume	None	Regional/Local	**S**
	Biophysical	Evolution de la richesse spécifique	None	Regional/Local	**S**
	Biophysical	Evolution du nombre d'individus pérennes (densité)	None	Regional/Local	**S**
	Biophysical	Evolution de la valeur pastorale (qualité) des zones de parcours	None	Regional/Local	**S**
	Biophysical	Evolution de la germination des espèces annuelles	None	Regional/Local	**S**
	Biophysical	Evolution de l'épaisseur des sols	None	Regional/Local	**S**
	Biophysical	Evolution de la disponibilité en eau du sol	None	Regional/Local	**S**
	Socio-economic	Demography	None	Regional/Local	**P**
	Socio-economic	Number of human population	None	Regional/Local	**P**
	Socio-economic	Location of human population	None	Regional/Local	**P**
	Socio-economic	Households micro-economy	None	Regional/Local	**P**
	Socio-economic	Land tenure rules for access to resources	None	Regional/Local	**P**
	Socio-economic	Production/ exploitation systems	None	Regional/Local	**P**
	Socio-economic	Production and extraction of resources (agricultural, pastoral and forestry)	None	Regional/Local	**P**
	Socio-economic	Stocking rate and spatial distribution	None	Regional/Local	**P**
	Socio-economic	Number and locationof water points	None	Regional/Local	**P**

Annex III: list of Acronyms

AID	Available Indicators of Desertification
CCD	Convention to Combat Desertification.
CDSR	Centre for Sub-regional Development of North Africa
CILSS	The interstate committee to combat drought in the Sahel, (Comité Inter-Etats de Lutte contre la Sécheresse au Sahel, Ouagadougou), Burkina Faso
CNT	Centre National de la Télédétection (*National Centre of Remote Sensing*), Tunisie
CoP	Conference of the Parties
CRTS	Centre Royal de Télédétection Spatiale (Royal Centre of Spatial Remote Sensing)
DGF	Directorate General of Forestry
DISMED	Desertification Information System for the Mediterranean Basin
DPA	Desertification Prone Areas
EC	European Commission
FAO	Food and Agriculture Organization.
FMA	Fondation pour la Météorologie Appliquée
GIS	Geographic Information System
GRN	Gestion des Ressources Naturelles (Natural Resources Management)
IGAD	Inter-Governmental Authority on Development
MRT	Mauritania
NAP	National Action Programme
NAP/CCD	National Action Programme / Convention to Combat Desertification
NDVI	Normalized Difference Vegetation Index
NOAA	National Oceanic & Atmospheric Administration, USA
NGO	Non Governmental Organisation
ONC	Organe National de Coordination *(National Co-ordination Institution*)
OSS	Observatoire du Sahara et du Sahel, (*Sahara and Sahel Observatory*), Tunisia
OTED	Observatoire tunisien de l'Environnement et du Développement *(Tunisian Observatory of Environment and Development*)
PAFN	National Forestry Action Plan
PTI	Projet Tuniso-Italien (Tuniso-Italian Project)
RAP	Regional Action programme
ROSELT/OSS	*Long Term Ecological Monitoring Observatories Network*/OSS, (Réseau d'Observatoires de Surveillance Ecologique à Long Terme)
SCID	Information Sharing System on Desertification
SDC	Sustainable Development Commission
SDI	Sustainable Development Indicators
SMAP	Small and Medium Action Plan
SSE	Système de Suivi-Evaluation
SRAP	Sub-regional Action Programme
UMA	Union du Maghreb Arabe (*Union of Arabic Maghreb*)
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nation Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNSO	The United Nations Office to Combat Desertification and Drought

STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN SOUTHERN AFRICA

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Executive summary

This study has reviewed the state of art on existing indicators and their use for desertification monitoring and CCD implementation in the Southern African region. However, the information provided in the reviewed reports and in the few questionnaires received is very limited, in most cases just a name of an indicator is provided. Only a few of the indicators have any form of description and even fewer have defined benchmarks. An in depth analysis of the state of art of benchmarks and indicators in the SADC region, based on these results, is therefore not possible. Nevertheless, some of the questions suggested can be discussed based on these findings.

This study has shown that many of the SADC countries have defined indicators under the framework of UNCCD. The review identified a total of approximately 225 unique indicators related to desertification monitoring or to NAP implementation. However, only 34 of these indicators had some kind of benchmarks defined. The diversity of indicators proposed by the different countries is striking. Seldom is an indicator used in more than one country. Monitoring of various aspects of rainfall and soil properties are the most commonly suggested indicators. This illustrates that issues related to desertification that are found to be important in the different countries varies widely, which makes it difficult, if not impossible to develop one "universal" core set of desertification indicators.

South Africa and Namibia (monitoring of desertification) and Zambia and Tanzania (monitoring of the NAP process) stand out as the countries in the SADC region that have actually implemented some of the suggested indicators. The fact that so few results of monitoring are actually made available is alarming.

The review of the NAPs and country reports shows that when developing national indicators, most countries establish some kind of forum or national group of experts that develop a list of potential indicators. However, the only clear example of real participation found in this review is the approach taken by Napcod in Namibia where the development of local level indicators was based on the information needs expressed by the local resource users, resulting in local level monitoring systems being developed by local resource users for local resource users.

Only 34 of the suggested indicators presented here had any kind of benchmarks defined. There seems to be confusion about what a benchmark is. The lack of defined benchmarks for the indicators identified in this study suggests that very few of these indicators actually have been implemented, and that the indicators presented are only a wish list of what might be interesting to monitor.

Very few examples of implementation were given. Tanzania and Zambia gave comprehensive lists of indicators to be used for monitoring and evaluation of the NAP process. Both the Tanzanian and the Zambian country reports based their reporting of the status of their NAP implementations based on the suggested indicators. Zambia also presents an extensive report on the state of the environment based on both biophysical and socio-economic indicators. However, the frequency of the monitoring is not

indicated. The South African SOER indicators are being used and so are the Namibian land degradation and bush encroachment indicators. Malawi is producing SOERs every two years. Lesotho has defined a list of indicators but according to the country report of 2002 (Government of Lesotho, 2002) no monitoring of land degradation or ground assessment of resource degradation is taking place.
This study has shown that most countries in the SADC region have not operationalised their suggested benchmarks and indicators for desertification monitoring. The few questionnaires received from the region indicate that either the questionnaire was too complicated or that the actual knowledge amongst national focal points and other stakeholders regarding the state of the art of benchmarks and indicators is almost non-existing. For the sake of the success of the United Nation's Convention to Combat Desertification in southern Africa, let's hope the reason for the meagre result is not due to the latter.

1. The sub-regional context

Most countries in the SADC region have at least started their process to develop and implement National Action Plans. However, only a few have actually initiated the implementation process (UNSO, 1998). This is an important point as the lack of implementation also indicates that little effort has been put towards defining and testing benchmarks and indicators for desertification monitoring. According to UNSO's report "A preliminary overview of national action programme processes of the United Nations Convention to Combat Desertification and Drought" (UNSO, 1998), one of the concerns expressed in many countries is that producing visible results can often take long, leading to discouragement and uncertainty about the relevance and effectiveness of the NAP. Therefore, in order to maintain momentum and credibility, especially with local-level land users, priority programmes and projects should be implemented in response to the needs of the affected populations. At this stage, the development of methodological approaches to the design of these innovative programmes has not received sufficient attention. The few countries, which have identified NAP programme areas, have yet to demonstrate viable partnership arrangements to support implementation, posing a major obstacle and suggesting an urgent need to develop arrangements to synchronise priority programme identification and the effort to build partnerships. Based on agreements reached with the local communities, countries need to develop and implement quality programs for combating desertification at the grassroots level. Further, it will be important that countries ensure that projects emerging from the NAP are realistic and that adequate capacity exists or can be found to fund and implement them. This has been done in some countries through embarking on feasibility studies (e.g. Bolivia and Argentina). Another challenge, which arises when seeking to identify activities that address the needs of all affected populations, is the implicit assumption that the affected population is a homogenous group. In fact, within the affected population there are many conflicting interests. Therefore some time needs to be spent deciding how to most effectively address these needs and who should set the priorities in order to achieve real consensus building (UNSO, 1998).
To date, there are no clear evaluation or assessment mechanisms in place addressing specifically where desertification occurs, and who is most affected by this phenomenon. Furthermore, as many countries are currently in the first phase of the NAP process, many have yet to assemble national indicators useful for review and evaluation
exercises of the NAP process. However, as will be shown in this report, several countries in the SADC region have recognized the urgency of using national indicators both for monitoring the extent and rate of desertification as well as for the evaluation of

the implementation of NAPs, and have accordingly initiated the process of doing so. The development of benchmarks and indicators at the global level can be useful for comparative purposes, particularly across national and regional levels. However, the main challenge remains at the national level where countries should aim to develop their own indicators. In view of the nature of the CCD as a development and an environment framework, it is critical that the indicators account for the socio-economic dimensions used to monitor national and global development (UNSO, 1998).

The CCD calls for parties to work closely together in the elaboration and implementation of Sub-regional Action Programmes (SRAP) as the key operational tools for implementing the Convention at the sub-regional level. The responsibility for coordinating the preparation and implementation of a SRAP falls upon an appropriate intergovernmental organisation, which becomes the focal point for the programme. For Southern Africa, the relevant intergovernmental organisation is the Southern African Development Community (SADC), a legal entity committed to equitable regional economic integration. As the overall SADC coordinator of environment issues, the SADC Environment and Land Management Sector (ELMS) Coordination Unit is mandated to oversee the implementation of the CCD in the sub-region. SADC-ELMS has coordinated various activities in respect of the UNCED and CCD preparatory processes (SADC, 1997). According to the regional action programme for the SADC countries, monitoring and evaluating of the SRAP process will be an essential function of its management and coordination. While paying due attention to administrative targets, the overall purpose of monitoring and evaluation will be to assess the long-term impact of the SRAP on the size and rate of land degradation and on the socio-economic conditions of the affected communities. Benchmarks and indicators will be carefully selected to gauge progress in implementation, and baseline information compiled as a basic framework for comparison of important trends. Both “high-tech” and low-cost, participatory monitoring and evaluation techniques will be used.

SADC-ELMS together with its sub-region partners World Conservation Union (IUCN) and Southern African Research and Documentation Centre (SARDC) produced the 2000 State of Environment Report for the Zambezi River Basin and is in the process of finalizing the Second State of Environment Report for Southern Africa (SADC, 2002).

The SADC Environmental Information Systems (EIS) Programme was elaborated by SADC-ELMS in 1995. The objectives of the programme are (i) to improve the collection, storage, exchange and management of environmental data; (ii) to assist in the production of State of the Environment reports; and (iii) to strengthen the EIS capacity in the SADC member States. The main components of the programme are the establishment of a sub-regional environmental database and the strengthening of existing networks for data harmonisation and exchange. The SADC Food Security Sector coordinates the development of an Early Warning System for the SADC region. The project’s primary objective is to provide advance information on food crop production and food supplies in the sub-region and alert SADC member states of impending food shortages or surpluses in sufficient time for appropriate action to be taken (SADC, 1997). A network of national early warning units (NEWUs) has been established in all SADC countries, which regularly feed data to the Regional Early Warning Unit (REWU). The regular production of national food security and meteorological data through national bulletins now make it possible to produce a monthly regional early warning bulletin. Through the same system, information about the outbreak of migratory pests within the sub-region is communicated. A major service provided by the programme has been to communicate advance warning of food shortage levels during the recent drought years experienced in the sub-region (SADC, 1997).

According to the provisions of the CCD, SADC-ELMS will establish a Multidisciplinary Scientific and Technical Consultative Committee (MSTCC), which will be expected to articulate the role of science and technology in the SRAP process and provide SADC-ELMS with guidance and advice on scientific and technical aspects of programme execution. The MSTCC will assist SADC-ELMS in the elaboration of benchmarks and indicators for monitoring and evaluating the SRAP; and in its actual evaluation (SADC, 1997).
As part of its on-going training and capacity building activities, SADC-ELMS has been developing guidelines and techniques for environmental monitoring in the sub-region. The general objective of this activity is "to achieve permanent monitoring of the environment, with the aim of collecting background data for the evaluation of short- and long-term environmental changes". Further, the initiative aims to promote standardised assessment and monitoring systems. Of particular relevance to the SRAP and NAP implementation processes are the guidelines currently being developed on Vegetation Monitoring and on Soil Erosion and Degradation Monitoring. Other monitoring guidelines produced cover; Satellite Image and Air Photo Analysis, and Pesticide Residues (SADC, 1997).

2. State of art on Benchmarks and Indicators

Here follows a detailed reporting on the state of art on benchmarks and indicators developed by each country in southern Africa. This chapter was intended to be based on information received from responses to the questionnaire that was sent to all focal points and selected stakeholders in the region. However, just a few responses were received and therefore this section reports on information collected from country reports submitted to CRIC and COP meetings and other relevant documents.

2.1 State of the Art in Different Countries

2.1.1 Angola country report to CRIC 1, 2002

Angola's NAP is not yet finalised and therefore still not implemented. A National Coordinating Body NCB has been established. The Information Technology (IT) system of the NCB is still poor. In the country, different entities have their own database, such as, on Water (National Directorate of Water), Meteorology (INAMET), Population (National Institute of Statistic), Food Security (Agriculture, MINARS and TRADE) and others are available. There has been exchange of information between the national cooperating partners mainly to broadcast documentation on the Convention. However, no attempts to establish benchmarks or indicators for monitoring of desertification in Angola have yet been made. Information dissemination outside the country is also still poor, done through the UNDP, UNEP, SADC, CCD Secretariat and others (Government of Angola, 2002).

2.1.2 Botswana NAP and country report to CRIC 1, 2002

Botswana is in the process of developing its National Action Programme and thus has not started the implementation process. However, the development of the National Action Programme took cognisance of the recommendations of the Committee on Science and Technology particularly the establishment of benchmarks and indicators, promotion, use and enhancement of traditional knowledge and the use and need for early warning systems for drought management (Government of Botswana, 2002a).
The draft National Action Programme of Botswana outlines 9 activities and 19 expected results but none of these activities involve the development and implementation of benchmarks or indicators for monitoring of desertification. However, the NAP focuses

on local participation and empowerment of the stakeholders especially communities to plan, manage and implement development endeavours in order to improve the standard of living. According to the NAP stakeholders would have specific roles to determine their own development efforts, government would encourage participating stakeholders to monitor and evaluate their programmes. Government and participating stakeholders will monitor and evaluate the outputs and activities of the NAP strategy through performance indicators. Stakeholders including government will develop and agree on these indicators. Monitoring would be carried out throughout the implementation period while evaluation would be done annually. Government will encourage communities and institutions implementing projects to combat desertification and drought to develop monitoring and evaluation plans for those projects. The NAP Secretariat will continue to support Project management committees to plan, monitor and evaluate their projects. Government would set up a Multidisciplinary team comprised of representative stakeholders to advise and supervise the monitoring and evaluation of all projects to combat desertification, mitigate effects of drought and alleviate poverty (Government of Botswana, 2002b).
According to the Botswana Rangelands Inventory and Management Project[1] about 17% of the rangeland is degraded. This information was derived from satellite imagery data reflecting the seasonal status of vegetation. This information says very little about changes in vegetation species composition and thus may have under-estimated the extent of range degradation in Botswana. There is therefore need to monitor the state of rangelands not only through remote sensing but also through observation at various sites (Government of Botswana, 2002a).

2.1.3 Lesotho NAP and country report to CRIC 1, 2002
The NAP of Lesotho states that a set of carefully selected and predetermined indicators will be developed to assist to gauge the progress and impacts of programmes throughout their respective stages of implementation. Further, the NAP identifies the need to determine a set of indicators from which baseline information can be collected and from which further evaluation of the process can be done as an initial step in the implementation of the NAP. It is suggested that baseline information on the status of the land in Lesotho be collected using modern technologies. Monitoring of land degradation and the gains made to reverse land degradation using a set of predetermined indicators .can be monitored using remote sensing and Geographic Information Systems (GIS). Baseline data is needed to help accommodate comparison of important trends and to help in the improvement of programme implementation (Pomela, 1999). A set of indicators and the methods to measure them are indicated in table 1. The NAP suggests that a number of monitoring and assessment indicators be used at the beginning of the programme implementation to enable acquisition of the baseline data. These indicators can be categorized as 1) ecological, 2) climatic, 3) economic and 4) socio-cultural indicators (Pomela, 1999). The report ‘Desertification in Lesotho’ (Chakela & Seithleko, 1995) which was prepared at the start of the NAP preparations provides more suggestions for specific indicators. Ridgway in Chakela and Seitlheko (1995) has suggested the following criteria to select desertification indicators at field level:

- They should relate closely to the land use and management practices being applied by the land users, who are able to draw on well founded indigenous knowledge base when monitoring the state of the environment;

[1] See questionnaire received from Botswana

- They should be able to demonstrate changes over relatively short time periods, 5-10 years, in terms of productivity, environmental degradation and its abatement (Pomela, 1999).
- They should be able to distinguish short-term phenomena of degradation from longer term processes of desertification, i.e. sensitive to resilience;
- They should be able to be applied in standard format over different locations that are used by different people.

In addition to the use of indicators, the NAP will also seek other ways of monitoring the process of land rehabilitation or land degradation. Through the participatory approach advocated in the NAP, agreements will be reached with stakeholders on the nature of the desertification problem, its trends, and the common goal of environmental rehabilitation and the respective responsibilities and commitments of the parties involved. Monitoring of the NAP process shall then also be facilitated by a system of frequent reporting, from local level upwards, of responses, lessons learned and other unplanned events resulting from the process. Such a kind of monitoring system, though often qualitative and subjective, may provide valuable inputs on responses, behaviour, demands, initiatives and/or failures, which monitoring systems with sets of indicators may fail to detect.

Desertification in Lesotho is an anthropogenic problem. Putting people at the hearth of a monitoring system may reveal more effectively the potential and limitations of mobilizing social dynamics for the healing of the land than the use of formal indicators would be able to do.

The NAP of Lesotho has three specific objectives dealing with indicators and monitoring, i.e. 1) Establish a permanent system for monitoring desertification and land degradation to provide up to date information, 2) Long term relay process for development, implementation and monitoring strategies related to resource management, and 3) Process monitoring system based on agreed principles of interaction (Pomela, 1999).

Indicator category	**Methods of measurement**
Ecological indicators	Water status: 1. Amount of annual and seasonal water deficits 2. Annual, seasonal and inter-seasonal rainfall amounts, distribution and intensity 3. Ground water depth in wells and aquifers Soil properties: 1. Depth of soil over root inhibition zone 2. Siol fertility in N.P.K amounts, organic carbon content 3. Presence of soil crusts causing surface sealing and development of small areas with swept appearance to large bare areas swept and packed 4. Dust and dust storms and wind erosion status, rate and hazard Soil water relations: 1. Water erosion status, rate and hazard as measured by density of rills and gullies, rate of mass movement, thickness o top soil, organic matter content, quality and type of sediment deposits downstream and in dams, slope angle, presence of vegetation cover, soil texture, permeability and erodibility Vegetation: 1. Vegetation characteristics as measured by its quality, growth form, rate of regeneration and succession in formerly cultivated and disturbed fields or grazing lands, change in perennial and annual composition, woody and herbaceous litter, prevalence of key species and vegetational yield and productivity
Climatic indicators	Rainfall patterns: 1. Decrease in rainfall as measured by daily, monthly and annual rainfall totals

	2. Cloud types 3. Rainfall variability during the wet season Wind patterns: 1. Wind direction and speed
Economic indicators	Cash income: 1. Rate and degree of fluctuations of cash incomes available to meet felt needs and financial obligations 2. Redistribution of wealth: 3. Social mechanisms for wealth distribution and their effectiveness, lobola, mafisa, feasts, festivals, funerals etc. Production systems: 1. Diversity of production systems as measured by the degree of diversity of array of production systems and resource availability to community
Socio cultural indicators	Population density: 1. Population estimates and fertility rates Social processes: 1. Extent of conflicts and marginalisation 2. Breakdown of patterns of redistribution and forced out migration 3. Discontinuities between subsistence and cash income economies Raising Awareness: 1. Rate and formation of effective farmer conservation groups and of farmer to farmer training programmes 2. Extent of local NGOs training schemes 3. Local incentive programmes for abatement of desertification Tree planting: 1. Rate of uptake of farmers in the planting and care of trees Conservation work: 1. Rate of adoption of soil conservation technologies 2. Length and number of physical binds and terraces constructed and buffer strips laid out 3. Improvement of soil fertility and structure Agroforestry: 1. Rate of incorporation of agroforestry into existing cultivation practices in dryland farming

Table 1. Indicators presented in Lesotho’s National Action Programme (Pomela, 1999)

At present various Government institutions such as Soil and Water Conservation Division, Range Management Division and Department of Water Affairs have established their own benchmarks to observe various attributes such as rate of soil erosion, range condition trend and sediment flow respectively. A concerted effort has not yet been made to determine standard benchmarks. This is due to be considered under the National Action Plan.

The Department of Water Affairs (DWA) has been monitoring the amount of rainfall and the information was used to design optimum water collecting tanks for assisting villagers. DWA has also been involved in reconnaissance studies for the construction of small and medium size dams at the constituency level; and for monitoring, construction and operation of water resources investment projects. Thirdly, DWA has formulated a National Action Plan and investment programme based on interactive database, forecasting models and environmental consideration. The data are collected by the Divisions of Meteorology and Hydrology on a real time basis and used for real time forecasting models development.

The establishment of the Early Warning System Unit and Disaster Management Authority (DMA) are new measures taken to help protect areas, including mountain ecosystems, against erosion, floods, landslides, snow avalanches and other natural hazards. Based on the information provided by the Early Warning System, the DMA

has been enabled to be in a state of preparedness to assist vulnerable groups in times of snow, drought and early frost disasters. Material assistance has included fuel, medical and food supplies, and agricultural inputs; and has contributed to building capacity for sustainable agriculture and conservation practices (Government of Lesotho, 2002).
To date the field level indicators of desertification for use in Lesotho have been suggested as indicated in the National Action Programme, see table 1 above. The aspects of monitoring and evaluation of the different initiatives related to the NAP implementation are not coordinated in any formal way. This constraint is real and serious. It would require some support initiatives to set up formal monitoring and evaluation mechanisms in place. As discussed earlier, there is limited data collection within the NES in terms of land issues, chemical management, and persistent organic pollutants. The process of reviewing the state of the environment report, for example, requires dedicated monitoring and evaluation systems throughout and these are not in place. The result is that the dynamics of land degradation, and ground assessment of resource degradation are not monitored (Government of Lesotho, 2002).

2.1.4 Malawi NAP and country report to CRIC 1, 2002

The NAP of Malawi only briefly mentions indicators and benchmarks in association to local knowledge serving as a basis for environmental monitoring and as an early warning system of ecological changes, e.g. through knowledge of indicator species. The NAP states that local observers can act as monitors of faunal and floral growth, distribution, and change. However, the document gives a comprehensive report on the state of the environment in Malawi using indicators as, e.g. length of growth period, annual rainfall, illiteracy levels, infant mortality, access to basic social services, population densities, population growth rate, dependency on natural resources, crop production versus requirement, and soil erosion rates. No strategies or plans towards incorporating these measures into a national monitoring/ early warning system are presented in the NAP (Government of Malawi, 2001).
In the country report presented at CRIC 1 it is stated that Malawi has established a system for generating data for the state of the environment report (SOER). The Malawian SOER identifies state, pressure and response indicators in agriculture, forestry, fisheries, water, biological diversity, and climate change, see table 2. These indicators match with guidelines on benchmark and indicators recommended by the Committee on Science and Technology of the Convention. The Malawian NAP has adopted these indicators, which are assessed every two years in order to produce the SOER (Government of Malawi, 2002). For social and institutional indicators, formation and training if village natural resources management provide a measure of changes towards empowerment of village communities in natural resource management.

Indicator	**Level/Benchmark**
Soil loss (tones/ha)	20.0
Nutrient loss (tones/ha)	160,000
Nutrient replenishment (fertilizers manure)(tones/ha)	90,000
Crop yield for hybrid maize (kg/ha)	2500
Land hold size (ha/household)	0.2-0.5
Food deficits (months)	3-5
Forest cover (% o total land area)	28
Deforestation rate (% of total land area)	2.8
Afforestation rate (% of total land area)	1.0
Demand for fuel wood (% o National Energy Budget)	93

Fish catchments (tones/year)	60,000
Aqua culture production (tones/year)	550
Value of ornamental fish trade (US$/year)	300,000
Assess to safe drinking water (% of population)	52
Feacal pollution (75% of rivers have coliform)	500/100 ml
Base flows	Diminishing in Bua and Linthipe
Diversity of fauna (species)	4,000 of which 1.500 are vertebrates
Diversity of flora (species)	5,500
Precipitation (mm/year)	600-800 mm (30% of the country); 800-1200 mm (60% of the country)
Drought occurrence	1992, 1995
Flood occurrence	2000
Population growth (%)	1.9
Population of children (%)	50.0
Population of female (%)	52
Life expectancy (years)	39

Table 2. Indicators and benchmarks defined for the Malawian State of the Environment reporting (Government of Malawi, 2002).

According to the country report early warning systems are in place, one national and one regional (based in Harare). The national system warns for floods and has so far aided the Government of Malawi to identify a flood situation in the 2000/2001 season, allowing them to timely approach donors for support in order to minimize human suffering (Government of Malawi, 2002).

2.1.5 Mozambique country report to CRIC 1, 2002

According to the report that was presented at the CRIC 1, year 2002 (Republic of Mozambique, 2002), the process of drawing benchmarks and indicators being carried out in the NAP formulation is still far from being completed. Progress in this area has been limited by the lack of expertise in the subject and the heterogeneity of circumstances where these indicators have to be applied. For monitoring and evaluation purposes, the institutions responsible for data collection are making considerable progress. Recent efforts have been made towards the establishment of databases in digital format that can be accessed through the Internet and in a paper format for those who do not have access to the Internet.

2.1.6 Namibia country report for CRIC 1, 2002

Namibia's Programme to Combat Desertification (NAPCOD) is regarded as the National Action Programme by the UNCCD. It is administered by the Ministry of Environment and Tourism (MET) and the Ministry of Agriculture, Water and Rural Development (MAWRD), and jointly implemented by Government and NGOs. Napcod's main achievements in monitoring desertification are the development of the national and local level indicators to monitor desertification and land degradation. Two NGOs, the Desert Research Foundation of Namibia (DRFN) and the Namibia Economic Policy Research Unit (Nepru) are developing and implementing the national and local-level monitoring for the national programme, see Appendix 3.

A national level monitoring system is operational and being improved with the active involvement of national remote sensing and climate monitoring experts on the National Overview Technical Working Group. The current desertification risk assessments are based on four key indicators: population pressure, livestock pressure, rainfall, and soil erosion hazard. The indices were developed through a participatory process involving stakeholders on national and local levels. Land degradation risk assessments have been done annually for the period 1971 – 1997 (Klintenberg & Seely, 2004), and the results can be retrieved via the Internet. The accuracy of the monitoring system is being evaluated on the ground at two of the Napcod pilot areas, and so as to integrate the local-level monitoring system with the national level indices (Klintenberg et al., 2003). The definitions of these national indicators and the resulting land degradation risk assessment are presented in Appendix 4.

Indicators for local level monitoring have been defined in close co-operation with local communities in pilot areas. This process has resulted in a set of indicators being developed, which now are being routinely used for local environmental monitoring by local land users. The local monitoring programmes developed focus on the regular and continued observation and assessment of conditions of a variety of relevant factors identified by the local land users, e.g. livestock and rangeland condition, carrying capacity and rainfall over time. The objective of the local level monitoring is to provide the resource user with relevant information that he/she requires to make informed management decisions and give early warning about the natural resource base. Four specific indicators have been developed together with local farmers at Napcod's pilot sites, these are: 1) Livestock condition, 2) rainfall monitoring 3) Vegetation and bush density and 4) Carrying capacity. The definitions of these indicators are presented in Appendix 5.

Nationally the Directorate of Forestry in MET has three projects monitoring woody vegetation north of the 20th latitude, i.e. the region that receives sufficient rain to support woodlands (Bethune & Pallett, 2002). The Directorate of Forestry (DoF) within the Ministry of Environment and Tourism (MET) is the main government body concerned with remote sensing of environmental characteristics in the northern, highly populated, higher rainfall parts of the country. Currently there are three projects that are monitoring the extent of land degradation. Although the monitoring system is in place, interpretation has yet to be done. These projects fall under the National Forest Inventory in the Directorate of Forestry, as part of the Namibia Finland Forestry Programme (NFFP). 1) Monitoring of woody cover north of 20º latitude. Landsat images are correlated with field-collected data to estimate the extent/density of woody vegetation. The project is comparing data sets from 1990 and 2000 to detect overall change in the amount of woody vegetation (trees). 2) Monitoring of extent of land clearance in the northern regions of the country. Landsat images are being compared from 1990 and 2000. 3) Monitoring of fires using Landsat images. Although frequent, uncontrolled burning is deleterious to the environment, fire can be used as an important management tool, provided it is controlled and is integrated with spatial and temporal data. Fire scar mapping, giving the total coverage of fires in northern Namibia, helps to assess the effectiveness of firebreaks that are being established (Bethune & Pallett, 2002).

The bush encroachment project, falling under the umbrella of Napcod has developed a set of indicators for monitoring of bush encroachment.[2]

2.1.7 South Africa country report for CRIC 1, 2002

South Africa has not yet developed a National Action Programme. However, South Africa has been approached by the Observatoire du Sahara et du Sahel (OSS), to develop a Desertification Information System (DIS) under the framework of the CCD. This process was scheduled to begin year 1999 (Government of South Africa, 1999). The DIS/EISI concept is based on the combination of a participative institutional approach and a technical process involving the development of information and

[2] See the questionnaire received from the Namibian Bush Encroachment Project

communication technologies (ICTs). It responds to the needs expressed by a large number of decision-makers responsible for environmental matters in developing countries. As well as being a technological tool, it also seeks to encourage the various players involved in the management of natural resources and the environment to communicate better with one another and to share their experiences and information heritage in the interests of establishing a genuine partnership. At the institutional level, the concept seeks to bring about a participative approach through partnership, coordination through consultation and decision-making through negotiated consensus. At the technical level, an environmental information and monitoring system on the Internet depends on the integration and networking of existing databases and geographic information systems, using Internet services to circulate information relating to the management of natural resources and the environment (documents and various types of product such as maps, data, indicators and metadata).

The DIS/EISI is intended to serve the various partners concerned with environmental issues, i.e. the authorities (coordination bodies, ministries and their respective technical services, the scientific and technological community, research and training institutions, etc.), civil society (NGOs, associations, etc.) and partners in cooperation (multilateral and bilateral development agencies, etc.).

The users in question are thus:

- national bodies responsible for coordinating the United Nations conventions;
- national, sub-regional and international institutions;
- technical directors and other technical officials;
- programme and project managers;
- the scientific and technological community;
- the media;
- the general public.

The implementation and success of a DIS/EISI involves three major phases comprising successive stages: An institutional preparatory phase comprising:

- an awareness-building mission and feasibility study;
- an institutional profile of the environment based on inventories;
- a consultative forum for the players concerned, for the purpose, among other things, of drawing up an information charter to serve as a genuine draft agreement.

An equipment and training phase designed to strengthen the technical capabilities of the institutions concerned and to train technicians with a view to the creation of a network of harmonized Web pages.

An evaluation, restitution and extension phase comprising:

- internal and external evaluations aimed at improving the DIS/EISI and adapting it to the evolving needs of its users;
- restitution in the form of a national forum or workshop;
- drawing up of arrangements for extending the project to other national partners;
- ideas for maintaining the project in operation.

Synthesis and evaluation of activities undertaken in the field of combating desertification include a study on *Land Degradation in South Africa* by Timm Hoffman and Associates (Government of South Africa, 1999).

South Africa is planning a study into the present situation in South Africa in terms of sustainable development benchmarks and indicators at all levels. These results will form the basis for the development of a system that can monitor and evaluate measures for the effects of desertification in South Africa. The first step to be taken is to pull together and review what has happened and what is happening in South Africa and to develop a proposal to suggest a way forward to develop a benchmark and indicators system for

South Africa. In Phase 2 a suitable system will be developed (Government of South Africa, 1999). According to the South African country report the study on benchmarks and indicators will be finalised in June 2002 (Government of South Africa, 2002). This will provide a core set of environmental indicators, including desertification indicators.
The State of the Environment Report of South Africa is a tool to monitor and evaluate the status of the environment. The National South African State of the Environment report is currently being updated. Seven of the nine provinces of South Africa are in the process of developing State of the Environment reports. A State of the Rivers report has also been finalised by the National Water Research Commission in co-operation with the CSIR. The Department of Environmental Affairs and Tourism are compiling an inventory of wetlands. A National Land Cover Data Base is in process, on a scale of 1:50 000 (Government of South Africa, 2002). So far a total of 8 specialist State of the Environment reports have been compiled as outputs of Phase 3 of the National Environmental Indicators Programme for State of the Environment reporting in South Africa. These reports present a number of indicators of relevance to monitoring and assessment of desertification in South Africa. A list of indicators developed in these reports that were considered to be relevant for desertification monitoring is presented in table 3.

Indicator	**Type**	**Comment**
Land use	Land cover	State indicator
Land productivity versus potential	Land cover	State indicator
Desertification	Land condition	State indicator
Soil loss	Land condition	State indicator
Soil acidification	Land condition	Impact indicator
Soil salinisation	Land condition	Impact indicator
Land degradation	Land condition	Pressure indicator
Persistent organic pollutants	Land condition	Pressure indicator
Wasted and degraded land in mining zones	Dormant indicators	State indicator
Quality of mining operations	Dormant indicators	Response indicator
Enforcement of the Conservation of Agricultural Resources Act	Dormant indicators	Response indicator
Permanent loss of agriculturally productive land	Dormant indicators	State indicator
Land degradation per GDP in the agricultural sector	Dormant indicators	Pressure indicator
Wasted and degraded land in mining zones per GDP in the mining sector	Dormant indicators	State indicator
Conversion of natural vegetation to agricultural crops	Climatic and atmospheric change	Presents time series of area under cultivation per year for the period 1930-1993
Annual rainfall deviations	Climate and atmospheric change	Annual rainfall deviations data during the 1990s relative to the mean annual rainfall for the period 1960-1989
Annual temperature deviations	Climate and atmospheric change	Temperature deviations during the 1990s relative to the 1960-1989
Annual precipitation and evaporation	Sustainability of water resources	Mean annual precipitation and annual evaporation for the catchments of South Africa major rivers
Extent of urbanisation in South	Social	Urban and Population

Africa		Distributions in South Africa
Population growth rate 1980-1991	Social	Percentage growth per annum
Movement from rural to urban areas	Social	Movement from rural to urban areas 1904-1996
Poverty Rate by Population Group	Social	Percentage of poor population per population group
Percentage of households using different fuels in five rural areas	Social	
Income distribution	Economic	Income distribution in South Africa for all households (the Lorenz curve): 1985
Sectoral composition of the South African economy	Economic	Percentage of economy contributed from primary, secondary and tertiary sectors
Budget allocation, Department of Environmental Affairs and Tourism	Political	

Table 3. Indicators selected from the South African State of the Environment Reports, considered being relevant for desertification monitoring (Arendse & Wilkinson, 2002). For a complete description of these indicators, see (Arendse & Wilkinson, 2002) and South Africa's national state of the environment report on the web, http://www.ngo.grida.no/soesa/ (visited February 2004).

2.1.8 Swaziland NAP and country report for CRIC 2002

Swaziland has developed a NAP (Government of Swaziland, 1999), but nowhere in the document does the text refer to monitoring of desertification or benchmarks and indicators. According to the country report given by Swaziland at CRIC 1 (Government of Swaziland, 2002) very little has been made on the development and adaptation of implementation of benchmarks and indicators. This is mainly due to the fact that no concrete programmes or projects have been implemented that are strictly addressing NAP elements. This subject will hopefully be worked on with the implementation of the prepared programme support document.

2.1.9 Tanzania NAP and country report for CRIC 2002

The NAP of Tanzania states that methods to measure and monitor the effects of drought and desertification will be developed (Government of Tanzania, 1999). In the country report given by Tanzania 2002 (Government of Tanzania, 2002) no progress towards establishment of environmental monitoring was reported. However, a framework of indicators and benchmarks to measure the progress of the implementation of the National Action Programme, adopted by the SADC member states, was presented, see table 4.

N.	Indicators	Evaluation parameters	Remarks
1	Effective participation of actors in defining national priorities	1. Methods of participation of various actors 2. Representativeness of various actors in the national priorities identification process. 3. Involving stakeholders in the implementation of the NAP activities.	1. Through representation in the NCB 2. Attendance in meetings and workshops/seminars 3. Broader representations during the consultative process Catalytic support has been extended to NGOs/CBOs in various parts of the country.
2	Effective Support from	1. Degree of participation from international partners	1. Degree of participation has been positive. ACP-EU

	international partners for cooperation		Partnership through Cotonou Agreement has been effected
3	Institutional framework for coherent and functional desertification control	1. Measures identified or adopted to adjust or strengthen the institutional framework	1. Institutional framework already proposed and it is waiting Government approval.
4	NAP as part of national economic and social development and environment protection plans	1. Making the NAP coherent with other environmental strategic frameworks and vice-versa	1. Integration of NAP into the national economic and social development planning is regularly being undertaken. This involves integration in the PRSP, ADS and ASDS.
5	Harmonized legal and regulatory framework impacting on the environment	1. Analysis of the legislation and enforcement of laws on the environment 2. Measures to adapt current legislation or introduce new ones Policies piloted for the implementation of the NAP	1. Analysis done but adaptation of laws and their enforcement skill underway. 2. Under review 3. Review of policies
6	Adopted financial mechanisms	1. Measures to facilitate the access of local actors to existing sources of funds 2. Working out new, adapted methods to mobilize internal and external resources	1. Assisting local level actors with the preparation of project proposals Making financial requests for the implementation of projects at local level is being prepared
7	Established technical programmes and functional integrated projects to combat desertification	1. Inventory, adaptation and integration of projects underway within the NAP process 2. Identification of new actions 3. Actions to strengthen national and local capacity to combat desertification	1. Continuing 2. Done 3. Identified and proposed on NAP
8	Operational mechanisms for monitoring and evaluation	Establishment and/or strengthening of environmental monitoring and observation Capacities Established mechanism and criteria for monitoring the impacts of NAP formulation Established unit to undertake the monitoring and evaluation Established norms and standards	Not yet fully established Not yet fully established Not yet fully established
9	Review of NAP and commitment by partners	Approval and acceptance of the NAP by actors involved Adequate resources committed Partnership agreement adopted	NAP accepted by actors Resources still inadequate Agreement still underway

Table 4. Benchmarks and Indicators for measurement of progress of the implementation of the Tanzanian NAP presented in the country report given in Rome 2002 (Government of Tanzania, 2002)

2.1.10 Zambia NAP and country report for CRIC 2002

In the Zambian NAP it is stated that monitoring systems for the effective management of the national action programme will be developed and implemented. However, according to UNCCD (2003) Zambia has not yet developed benchmarks and indicators for the implementation of the UNCCD. This is because the country has put a lot of emphasis on the preparation and modalities of the implementation of the NAP. The NAP has expressed the importance of undertaking this exercise and after this preparatory stage Zambia will go ahead in setting benchmarks and indicators (UNCCD, 2003). The Zambian NAP highlights a number of priority areas that would involve the development and use of benchmarks and indicators and monitoring, e.g. 1) early warning and preparedness, 2) land degradation assessments, monitoring and reporting and, 3) easy to use environmentally friendly technologies including indigenous knowledge (Government of Zambia, 2002b). The NAP states that a strengthening of the early warning and preparedness systems, which is also emphasised in the CCD, shall be achieved through the following interventions:

- Assess the current early warning and preparedness systems,
- Improve the early warning and response capacities,
- Evaluate current strategies and methodologies (for example Vulnerability Assessment Mapping) for assessing the impacts of climate variability on natural resources and humans in terms of easy-to-use, accurate information collected and quick production of results,
- Utilise predictions of climatic variability in an effort to mitigate the effects of drought by ensuring that information reaches decision makers, planners and affected populations in good time,
- Develop sustainable and appropriate programmes for both crops and livestock, and
- Support national centres/ institutions by providing them with adequate financial resources, better equipment for the enhancement of procurement, processing and dissemination of information about natural disasters, such as drought and floods.

The NAP suggests a framework for land degradation assessments and monitoring of desertification. The system should:

- Provide benchmarks for assessing land degradation,
- Assess the extent and status of land degradation,
- Ensure that environmental impact assessments for all major proposed interventions are conducted,
- Put in place monitoring and reporting mechanisms, particularly through monthly, quarterly, and annual reporting on desertification.
- Put in place mechanisms for annual, mid-term and end of phase reviews.
- Promote the participation of all stakeholders in land degradation assessments, monitoring and reporting

The use of environmentally friendly technologies including indigenous knowledge aimed at:

- Undertake an inventory to take stock of existing knowledge and technologies;
- Use identified indigenous knowledge systems in combating land degradation and mitigating the effects of drought;
- Emphasise on increased awareness and incentive scheme support to increase farmers' adoption rates;
- Promote technological transfer through conventional management and conservation technologies. The technologies being promoted include contour ridging grass strips, use of green manure, improved fallow, rain water harvesting, deep rip ploughing, farm forestry, intensification, are aspects in the right direction; and

- Use of traditional rulers and their administrative structures to spread knowledge and energy conservation practices.

Even though no specific benchmarks or indicators are presented in the NAP, an extensive report on the State of the Environment in Zambia is given. The status of biophysical factors as; estimates of erosion hazard, identification of vulnerable soils, annual rainfall and number of rainfall days per year, drought occurrence, start and length of rainfall season, variations in temperature are presented. Further, some figures and/or estimates of a number of socio-economic factors as; poverty, land tenure and property rights, extent of various land use practices, use of wood and charcoal, occurrence and frequency of man-made bush fires, occurrence of overgrazing, and establishment of new settlements are also presented.

The NAP also gives figures of annual rate of deforestation. Variation in maize production for the period 1987-1999 is presented as an indicator of desertification, i.e. decreasing productivity due to decreasing soil quality/soil erosion (Government of Zambia, 2002b).

In the Zambian country report of 2002 it is stated that a proposal for a case study on “Identification and Use of Indigenous Knowledge and Technologies in Combating Desertification and Mitigating the Effects of Drought. The Case of Central, Eastern, Lusaka, Southern and Western Provinces of Zambia” has been prepared, but not yet funded (Government of Zambia, 2002a).

An Environmental Information Network and Monitoring System (EINMS) is being established. Its main purpose is to provide information services to improve the availability and accessibility of environment information to support planning, monitoring, evaluation and decision-making at all levels. The program is designed to develop 5 specific EIS sub-systems to address 5 priority environmental issues: a) deforestation, b) soil degradation, c) wildlife depletion d) water pollution and e) industrial air pollution. The EIS would provide information to support the preparation of the State of Environment (SOE) report by the Environmental Council of Zambia. The EIS would also develop a national database on environmental projects/programs: lessons and best practices and develop Environmental Assessment (EA) source Books. Further, a register of environmental capacity of the private sector and NGO’s will be established and an ESP database that will consolidate the results of the Monitoring and Evaluation system will be built (Government of Zambia, 2002a).

On the issue of benchmark and indicators the country report states that an institution responsible for the observation and monitoring of the environment exists. However this institution, the Environment Council of Zambia (ECZ) has not been able to put in place a monitoring mechanism. Currently standards are being developed for monitoring forest depletion (Government of Zambia, 2002a). The Ministry of Tourism, Environment and Natural Resources is also working on the development of indicators for monitoring progress of the different programmes under the ministry of which desertification is one of them. For the purpose of assessing progress on the NAP process benchmarks and indicators adopted by SADC member states have been used, see table 5.

No.	Benchmarks	Indicators	Remarks
1	Institutions in place a. National Co-ordinating Unit b. Focal Point c. Implementing institutions	• Legal status • Resources • Intersectoral and multidisciplinary character • Composition and mode of operation • Terms of References	• Established by the MTENR • Not enough resources available • NSC is intersectoral and multidisciplinary • Focal point is responsible for the day to day operations. • Has TORs

		• Senior experts representing various institutions • Continuity of NFP • Established time frame	• NSC is composed of senior experts representing various departments. • Changed once within same ministry. • Plan of action with time frame
2	Effective participation of actors involved in identifying national priorities	• Methods of participation of various actors • Representativeness of various actors in the national priorities identification process • Nature and scope of information, education and communications action • Extent of uptake of Local concerns at the national level • Extent of uptake of Results of national consultations at the local level • Inventory of key stakeholders	• Through representation in the NSC • Attendance in meetings and workshops • All identified stakeholders invited to meetings and workshops during the consultative process • Special consultations with specialised groups • Through workshops, meetings, distribution of translated and other documents and use of the media. • Through the consultation process at the grassroots level • Not yet implemented • There is an inventory of stakeholders
3	Support from international partners	• Degree of participation of international partners • Establishment of an informal consultation and harmonization process for actions between partner countries	• Degree of participation has been positive • Informal bilateral consultations
4	Institutional framework for coherent and functional desertification control	• Measures identified or adopted to adjust or strengthen the institutional framework • Measure adopted to strengthen existing institutions at the local levels	• Being done through the ESP and CBENRMP • Being done through the ESP and CBENRMP
5	NAPs as part of national economic and social development planning	• Making the NAP coherent with other environmental strategic frameworks and vice-versa • Inter-linking of NAP with national, regional and local approaches • Inter-linkages of NAP with subregional action programme • Agreement by the government • Integration of NAP into national development plans and taking account of existing programmes • Specific programmes emerging from policy statements	• Review of ongoing programmes and integration of relevant ones. • Done during the NAP process. • Done • NAP not yet adopted by government • Not yet undertaken • Yes a number of programmes are in place e.g. Poverty reduction.
6	Harmonised legal and regulatory framework impacting on the environment	• Analysis of the legislation and enforcement of laws on the environment • Measures to adapt current legislation or introduce new ones • Policies piloted for the	• Analysis done but adaptation of laws and their enforcement still to be implemented. • In progress. • Not yet

		implementation of the NAP	
7	Adopted financial mechanisms	• Measures to facilitate the access of local actors to existing sources of funds • Working out new, adapted methods to mobilise internal and external resources • Facilitation funds established	• Assisting local level actors with the preparation of project proposals • Making requests for the implementation of projects at local level • Consultations in progress • Pilot Environment Fund is operational
8	Established (technical) programmes to combat desertification	• Inventory, adaptation and integration of projects underway within the NAP process • Identification of new actions • Actions to strengthen national and local capacity to combat desertification	• An analysis of on going projects was done and relevant ones were integrated. • Done • Identified and proposed by the • Forum to strengthen current efforts.
9	Established mechanisms and norms and standards for monitoring and evaluation	• Establishment and/or strengthening of environmental monitoring and observation capacities • Established mechanism and criteria for monitoring the impacts of NAP formulation • Established unit to undertake the monitoring and evaluation • Established norms and standards	• On going • Established • Established • In progress
10	Review of NAPs and commitment by partners	• Approval and acceptance of the NAP actors involved • Adequate resources committed	• NAP has been adopted by all stakeholders but is in the process of adoption by the Government. • Not yet • Still being pursued

Table 5. The table below shows the state of affairs in the development of the NAP in Zambia

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2.1.11 Zimbabwe NAP and country report for CRIC 2002

The NAP states that Zimbabwe has realised the need to establish an Environmental Information System for the NAP process. The objective being the development of a common information base and an operational framework that will allow the NAP process to effectively achieve its responsibilities on combating desertification and mitigating the effects of drought in Zimbabwe (Government of Zimbabwe, 1999). About monitoring of the implementation of the NAP it is stated that Monitoring and evaluation of the NAP process will be done at national, provincial, district and community levels. Communities themselves will make their own monitoring and evaluation of the programme. Community based indicators will be developed for purposes of monitoring and evaluating progress towards sustainable utilisation of land resources as well as towards finding and adopting sustainable alternative livelihoods. The Secretariat to the programme will undertake a critical self-evaluation of the whole programme development and its impact on local ecosystems and on all its beneficiaries (Government of Zimbabwe, 1999). No benchmarks or indicators have yet been developed. However, the issue of development of benchmarks and indicators to measure progress in the formulation and implementation of the NAP programme has been a subject of discussion by the national taskforce on desertification. During the production of the first Nation Report it was the view of the majority of the members that the issue be put on hold until there was consensus among members of the Taskforce on what the NAP process is, and issues to be addressed are clearly defined (Government of Zimbabwe, 2002).

2.2 Conclusions

This study has reviewed the state of art on existing indicators and their use for desertification monitoring and CCD implementation in the Southern African region. In the terms of reference for this study a thorough analysis of the identified indicators is required. However, the information provided in the reviewed reports and in the few questionnaires received is very limited, in most cases just a name of an indicator is provided. Only a few of the indicators have any form of description and even fewer have defined benchmarks. An in depth analysis of the state of art of benchmarks and indicators in the SADC region, based on these results, is therefore not possible. Nevertheless, some of the questions suggested can be discussed based on these findings.

Practical ways and tools; how indicators are derived and what are the problems faced

South Africa is one of the few countries in the SADC region that has actually implemented some of their suggested indicators. The country has gone through a rigorous process of developing indicators for their national state of the environment reporting. Many of the suggested indicators are applicable to desertification monitoring. The strength of the South African SOER indicators is that they all have been thoroughly defined, e.g. underlying theory has been referred to, benchmarks and/or threshold values have been defined where possible and the indicators have been implemented and the results have been published. The same applies for the indicators developed by Napcod in Namibia. The process of defining desertification indicators in Namibia involved stakeholders on all levels. The four national indicators used for the land degradation risk assessments evolved from a process of workshops, where potential indicators were discussed, the development of criteria for selection of operational indicators and the final implementation of selected indicators, involving major stakeholders throughout. The local level indicators used by the local land users in Namibia where developed together with the farmers based on their information needs. Both national and local indicators are presently being used. The national results forms part of a combined national SOE report, which will be published early 2004. Local resource users at Napcod's pilot sites routinely use the local level indicators to collect information to support their decision-making. Agricultural extension services have recently adopted the Napcod approach and have started to train extension staff in how to establish local level monitoring systems together with local farmers. This will hopefully lead to a rapid expansion of this tool throughout Namibia.

Apart from the relatively successful implementations of benchmarks and indicators in South Africa and Namibia, not much has been done at the national level in the SADC region, according to the findings of this study. The fact that so few results of monitoring are actually made available is alarming.

Is there a real implementation of participatory approach to derive indicators?

On the regional level a number of initiatives were referred to in the beginning of this report, e.g. monitoring and evaluation of the SRAP process, to assess the long-term impact of the SRAP on the size and rate of land degradation and on the socio-economic conditions of the affected communities, a SOER for the Zambezi River Basin was done year 2000 and the second SOER for southern Africa was about to be finalised.

However, an Internet search for any reference to the Zambezi basin report or the SOER for southern Africa only generated one hit, i.e. the SADC-SRAP presented at the CRIC 1 meeting in Rome 2002 (SADC, 2002). Does this mean that the studies never took place, or just that the reports never reached a broader public?
The review of the NAPs and country reports shows that when developing national indicators, most countries establish some kind of forum or national group of experts that develop a list of potential indicators. However, the only clear example of real participation found in this review is the approach taken by Napcod in Namibia. The development of local level indicators was based on the information needs expressed by the local resource users. This resulted in local level monitoring systems being developed by local resource users for local resource users, and not just a system developed together with the community but then when in place only to become a tool for the researchers to collect information, something that often is the result of a participatory process involving local communities.

Have the indicators got defined benchmarks (baseline data / reference sites)?
Only 34 of the suggested indicators presented here had any kind of benchmarks defined. There seems to be confusion about what a benchmark is. For instance the response given in the questionnaire from Directorate of Environmental Affairs in Namibia states that benchmarks as e.g. total canopy cover by points, total canopy cover by Bitterlich gauge, percentage of encroacher species among live canopy, mean distance from point to bush were proposed. These are not benchmarks but indicators. A comparison of the indicators and benchmarks used by Tanzania and Zambia reveals that what is referred to as an indicator in Tanzania is referred to as a benchmark in Zambia. Napcod used the term benchmarks to mean a threshold value to which the outputs from an indicator is compared in order to identify change and/or to identify if the system is in a desirable state or not. These benchmarks are either defined as physical reference sites or as a specific value, e.g. 150mm/annum, 1000/km^2 etc. An indicator without defined benchmarks is still useful as it can show change if repeatedly monitored, however without benchmarks it is difficult to interpret what this change actually means to the system being monitored. The lack of defined benchmarks for the indicators identified in this study suggests that very few of these indicators actually have been implemented, and that the indicators presented are only a wish list of what might be interesting to monitor.

Are desertification indicators really used? What kind of indicators?
Very few examples of implementation were given. Tanzania and Zambia gave comprehensive lists of indicators to be used for monitoring and evaluation of the NAP process. Both the Tanzanian and the Zambian country reports based their reporting of the status of their NAP implementations based on the suggested indicators. Zambia also presents an extensive report on the state of the environment based on both biophysical and socio-economic indicators. However, the frequency of the monitoring is not indicated. The South African SOER indicators are being used and so are the Namibian land degradation and bush encroachment indicators. Malawi is producing SOERs every two years. Lesotho has defined a list of indicators but according to the country report of 2002 (Government of Lesotho, 2002) no monitoring of land degradation or ground assessment of resource degradation is taking place.

Existence of early warning systems

On continental and regional levels the African early warning system developed by FEWS NET "Monitoring impacts of desertification and climate change in Africa" provides early warning information based on NDVI, rainfall estimates and water requirement satisfaction index. The system can be accessed via the Internet (http://www.fews.net/).

The SADC Regional Early Warning Unit situated in Harare, Zimbabwe produces quarterly and monthly bulletins reporting on food security in the SADC region, and an agro-meteorological update that is published two times per month.

On national level Malawi reports that they have an operational early warning system that monitors the flood levels. Lesotho also reports that they have a system that can warn for snow, drought and early frost disasters.

Another initiative providing early warning information for southern Africa (and the rest of Africa) is FEWS NET, which is a program funded by the U.S. Agency for International Development (USAID) that seeks to establish more effective and sustainable food security information networks in Africa that reduce the vulnerability of groups at risk (Gonzalez, 2002). The monitoring program capitalizes on the fact that FEWS NET uses the same remote sensing and field methods to track short-term environmental conditions that scientists use to monitor long-term environmental phenomena. Therefore, the monitoring program constitutes a logical extension of FEWS NET capabilities. FEWS NET has launched a programme titled "Monitoring impacts of desertification and climate change in Africa", which has the objectives to:

- analyse original and secondary scientific data on desertification and climate in Africa.
- help FEWS NET staff to integrate this information on desertification and climate change into existing activities.

The project has the following components:

1. Ecological base maps of Africa
2. Analyses of Normalized Difference Vegetation Index (NDVI) time series
3. Field surveys of trends in forest species distributions
4. Analyses of chronic vulnerability

Results since the start of the program in October 1999:

1. Maps of aridity zones, ecological zones, and forest cover in Africa, in English
2. Forest species surveys in Burkina Faso, Chad, Mali, Mauritania, and Niger
3. Map of forest species loss in the Sahel 1960-2000
4. Technical assistance to FEWS NET staff in West Africa, through field trips, distribution of technical reports, and e-mail exchanges
5. Technical presentations on desertification and climate change in Africa to FEWS NET staff (May 2000, June 2000), Peace Corps (May 2001), UNCCD (June 2001), USGS (June 2001, Sept. 2001), USAID (August 2001), Canadian International Development Agency (Dec. 2001)
6. Technical report "Advances in desertification monitoring and drought early warning" for the UNCCD Ad Hoc Panel on Early Warning Systems
7. Two scientific publications (Desanker *et al.* 2001, Gonzalez 2001)

Activities in progress for completion in 2002:

1. Collaboration with NASA on the NDVI analyses and on a scientific publication
2. Analyses of chronic vulnerability

3. Summary of desertification and climate change issues in Southern Africa for the FEWS NET Regional representative
4. Collaboration with NASA on use of IKONOS and other high-resolution imagery to examine environmental change in the Sahel
5. Collaboration with WRI on analysis of drylands goods and services
6. Posting of information on the FEWS NET, NASA, and USGS web sites
7. Full technical report of all results

The indicators used by FEWS NET are Normalized Difference Vegetation Index (NDVI) time series analyses, Field surveys of forest species trends, Vulnerability analyses. The vulnerability analysis, combined with the NDVI and forest species analyses and with a U.S. Department of Agriculture Natural Resources Conservation Service analysis of the vulnerability of soils to desertification, will provide information to map out areas of chronic vulnerability. FEWS NET conducted annual food security vulnerability assessments for Burkina Faso, Chad, Mali, Mauritania, and Niger but no assessments have been done for southern Africa. For an in depth description of the indicators used for the project, see (Gonzalez, 2002).

3. Recent Projects undertaken on development of B&I

The findings presented in this report reveals that just a limited number of national and regional projects have undertaken any development of benchmarks and indicators for desertification monitoring. In this report the initiatives of developing and implementing indicators for monitoring of the NAP implementation are worthwhile to mention. State of the environment reports based on socio-economic and biophysical indicators are produced by Malawi, Namibia, South Africa and Zambia. Furthermore, Malawi has an operational early warning system that monitors flood levels. Lesotho also reports that they have a monitoring system that can warn for snow, drought and early frost disasters.

On continental and regional levels two monitoring initiatives have been identified, the African early warning system developed by FEWS NET "Monitoring impacts of desertification and climate change in Africa" and the SADC Regional Early Warning Unit situated in Harare, Zimbabwe.

4. Suggestions to support the UNCCD implementation

The various attempts to establish benchmarks and indicators for desertification monitoring in southern Africa have illustrated a number of experiences relevant to other developing countries as well as international agencies attempting to contribute to understanding and monitoring of land degradation.

According to Klintenberg and Seely (2004), presenting Namibia's approach of developing and implementing benchmarks and indicators, several key steps for development of relevant desertification indicators, applicable for national level monitoring, have been identified. First, it is important that those involved in identification of indicators have an overall understanding of key elements of land degradation impacts, both socio-economic and biophysical. Secondly, a set of well-defined criteria is required to ensure relevance and usefulness of indicators being developed. Based on the Namibian experience it was suggested that development of criteria be done on an international level to ensure that a globally accepted set of criteria will be made available. Thirdly, accessibility of data is fundamental for the function of any monitoring system. Many indicators proposed by Namibian stakeholders were inappropriate as data were not being collected or could not be collected for various reasons involving funding, manpower and inflexible sectoral programmes.

A major thrust on the international level is development of a set of core desertification indicators that would be universally applicable. The Namibian experience instead underlines the importance of developing specific indicators applicable on a national level. There are many benefits of this. First, there are no universal causes or effects of land degradation. Secondly, involvement of all stakeholders is required to develop these specific indicators, which gives stakeholders ownership of the process and the resulting indicators, and leads to an increased understanding of the concept of environmental monitoring. Furthermore, involvement of stakeholders from various sectors, gives opportunities for an increased interaction between sectors, an important aspect in most developing countries where sectoral approaches predominate.

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Annex I: List of people/institutions to whom the questionnaire was sent (and rate of response)

Country	Gender	First name	Sure name	e-mail	Organisation	Position
Angola	Male	Isidro	Pinheiro	ipinheiro49@yahoo.com.br	Ministry of Planning/OKACOM	
Botswana	Female	D.	Khagite-Titte	khabekgathi@hotmail.com	Botswana Wildlife Training Centre	Trainer
Botswana	Female	P.	Huntsman-Mapila	pmapila@orc.ub.bw	University of Botswana	Professor
Botswana	Female	Sue	Ringrose	sringrose@orc.ub.bw	Harry Oppenheimer Okavango Research Centre	Associate professor
Botswana	Male	K	Mosepele	bmosepele@conservation.org	University of Botswana	Professor
Botswana	Male	Segoa	Motsumi	cranegroup@dynabyte.bw	Birdlife Botswana	Researcher
Botswana	Male	K.	Mosepele	kmosepele@orc.ub.bw	University of Botswana	Professor
Botswana	Male	L	Sola	l.sola@conservation.org	Conservation International	Researcher
Botswana	Male	L.B	Ramberg	lramberg@orc.ub.bw	University of Botswana	Professor
Botswana	Male	V.	Goitsione Masedi	masedi_vg@yahoo.co.uk	Water Resources Consultants	Consultant
Botswana	Male	Mushanana	Nchunga	mchunga@gov.bw	Ministry of Environment, Wildlife and Tourism	Executive Secretary
Botswana	Male		Lenkopane	mlenkopane@hotmail.com	National Environmental Laboratory	Researcher
Botswana	Male	P.	Wolski	pwolski@orc.ub.bw	University of Botswana	Professor
Botswana	Male	T.E	Bernard	tbernard@orc.ub.bw	University of Botswana	Professor
Botswana	Male	R.M	Kwerepe	rkwerepe@gov.bw	Ministry of Agriculture	Researcher
Lesotho	Female	Nkhothatseng	Malephane	natenv@ilesotho.com, lea@lea.org.ls	Ministry of Tourism, Culture and Environment	Director
Lesotho	Female	Vuyani	Shabalala	wpc@ilesotho.com	Department of Water Affairs	
Lesotho	Male	Jabo	Molapo	jmolapo@elms.org.ls	SADC/ELMS	Director
Lesotho	Female	Botle	Mapeshoane	bottemapes@yahoo.co.ur	University of Lesotho	Lecturer
Madagaskar	Female	Herivololona	Ralalarimanana	minenv@dts.mg	Ministère des transports, de l'environnement et de la météorologie	
Malawi	N/A	Noname	Noname	fstw@unima.wn.apc.org, sadcfstcu@malawi.net	Department of Forestry	Deputy Director of Forestry
Malawi	Female	Margret	Kawalewale	maggiekawalewale@yahoo.com	Department of Forestry	Forester
Mauritius	Male	S.A.	Paupiah	forest@intmet.mu	Ministry of Agriculture, Food Technology and Natural	Conservator of forests

					Resources	
Mozambique	Female	Ms. Lolita Hilário	Fondo	micoa@ambinet.uem.mz, lolitahilario@hotmail.com	Ministry for Coordination of Environmental Affairs	
Namibia	Female	Herta	Kolling	kollingh@mawrd.gov.na	Ministry of Agriculture, Water and Rural Development	Government Official
Namibia	Female	J.P.	Msangi	jpmsangi@unam.na	University of Namibia	Professor
Namibia	Male	Leon	Lubbe	llubbe@unam.na	Neudamm Agricultural College	Lecturer
Namibia	Male	Axel	Rothauge	arothauge@unam.na	University of Namibia	Lecturer
Namibia	Male	Ibo	Zimmerman	ibozim@polytechnic.edu.na	Polytechnic of Namibia	Lecturer
Namibia	Male	Nico	de Klerk	ndk@dea.met.gov.na	Bush encroachment project, Directorate of Env. Affairs	Project co-ordinator
Seyshelles	Male	Didier	Dogley	didier2@hotmail.com, boga@seychelles.net	Ministry of Environment	Director General for Nature Conservation
South Africa	Female	Kate	Rowntree	k.rowntree@ru.ac.za	Rhodes University	Professor
South Africa	Female	Karen	Esler	kje@sun.ac.za	University of Stellenbosch	Professor
South Africa	Female	Lorene	Breedbaart	lorene@lantic.net	Working for Water wetlands	
South Africa	Female	Natasha	Gabriels	ngabriels@uwc.ac.za	University of Western Cape	Professor
South Africa	Female	Anuschka	Barac	plbasb@puknet.puk.ac.za	Potchefstroom University	Professor
South Africa	Female	Nicky	Allsopp	nallsopp@uwc.ac.za	University of Western Cape	Researcher
South Africa	Female	Pippin	Anderson	panderso@botzoo.uct.ac.za	University of Cape Town	PhD candidate
South Africa	Female	Zuziwe	Jonas	zjonas@botzoo.uct.ac.za	University of Cape Town	MSc student
South Africa	Male	Noel	Oettle	dryland@global.co.za	Environmental Monitoring Group	Director
South Africa	Male	Johan	Pauw	johan@nrf.ac.za	South African Environemntal Observation	
South Africa	Male	Llewellyn	Foxcroft	llewellynf@parks-sa.co.za	Kruger National Parks	Researcher
South Africa	Male	M	Lupankwa	lupankwa@hotmail.com	Wits University	Professor
South Africa	Male	Moshibudi	Rampedi	mrampedi@ozone.pwv.gov.za	Department of Environmental Affairs and Tourism	Director
South Africa	Male	Norman	Rethmann	nrethman@postino.up.ac.za	University of Pretoria	Professor
South Africa	Male	Klaus	Kellner	plbkk@puknet.puk.ac.za	University of Potchefstroom	Professor
South Africa	Male	Ngcali	Nomtshongwana	pmphati@ozone.pwv.gov.za	Department of Environment and Tourism	Government Official
South Africa	Male	Mike	Rutherford	rutherford@nbict.nbi.ac.za	National Botanic Institute	Researcher
South Africa	Male	Stuart	Mangold	smangold@nwpg.org.za	Ministry of Agriculture	
South Africa	Male	Anthony	Palmer	t.palmer@ru.ac.za	ARC-Range and Forest Institute	Researcher

South Africa	Male	Tony	P.	tonyp@dwaf.gov.za	Working for Water wetlands	
South Africa	Male	Timm	Hoffman	thoffman@botzoo.uct.ac.za	University of Cape Town	Associate professor
Swaziland	Male	Bongani Simon	Masuku	moaclds@realnet.co.sz	Ministry of Agriculture and Cooperatives	Soil Scientist
Tanzania	Male	Richard S.	Muyungi	rmuyungi@vpdoe.go.tz	Vice President's Office	Assistant Director of Environment
Tanzania	Male	Feefham	Banyikwa	feeban@africaonline.co.tz	University of Dar Es Salaam	Professor
Zimbabwe	Female	Mutsa	Chasi	zpn143@mweb.co.zw, chasidnr@africaonline.co.zw	Ministry of Mines, Environment and Tourism	Director
Zimbabwe	Male	Daudi	Sumba	dsumba@awfzw.org	African Wildlife Foundation	
Zimbabwe	Male	P.	Sithole	psithole@cass.org.zw	Centre for Applied Social Sciences	Professor

Table A.I 1 Detailed list of contacts that received the AID-CCD questionnaire

Country	Total	Male	Female	Reply
Angola	1	1	0	0
Botswana	14	11	3	1
Lesotho	4	1	3	0
Madagascar	1	0	1	0
Malawi	2	1	1	0
Mauritius	1	1	0	0
Mozambique	1	0	1	0
Namibia	6	4	2	4
Seychelles	1	1	0	0
South Africa	21	13	8	3
Swaziland	1	1	0	0
Tanzania	2	2	0	0
Zimbabwe	3	2	1	0
TOTAL	**58**	**38**	**20**	**8**

Table AI 2. Summary of stakeholders that received questionnaires

Annex II: list of indicators

Country	Cathegory	Indicator	Benchmark	Level	Type
Botswana	Biophysical	Change detection by analysis of NDVI images generated by Landsat TM and NOAA AVHRR	none	National	S
Botswana	Biophysical	Field surveys to detect environmental change.	none	Local	S
Lesotho	Biophysical	Amount of annual and seasonal water deficits	none	National	S
Lesotho	Biophysical	Annual, seasonal and inter-seasonal rainfall amounts, distribution and intensity	none	National	S
Lesotho	Biophysical	Cloud types	none	National	S
Lesotho	Biophysical	Decrease in rainfall as measured by daily, monthly and annual rainfall totals	none	National	S
Lesotho	Biophysical	Depth of soil over root inhibition zone	none	Local	S
Lesotho	Biophysical	Dust and dust storms and wind erosion status, rate and hazard	none	National	S
Lesotho	Biophysical	Ground water depth in wells and aquifers	none	National	S
Lesotho	Biophysical	Presence of soil crusts causing surface sealing and development of small areas with swept appearance to large bare areas swept and packed	none	Local	S
Lesotho	Biophysical	Rainfall variability during the wet season	none	National	S
Lesotho	Biophysical	Soil fertility in N.P.K amounts, organic carbon content	none	Local	S
Lesotho	Biophysical	Vegetation characteristics as measured by its quality, growth form, rate of regeneration and succession in formerly cultivated and disturbed fields or grazing lands, change in perennial and annual composition, woody and herbaceous litter, prevalence of key species and vegetation yield and productivity	none	Local	S
Lesotho	Biophysical	Water erosion status, rate and hazard as measured by density of rills and gullies, rate of mass movement, thickness o top soil, organic matter content, quality and type of sediment deposits downstream and in dams, slope angle, presence of vegetation cover, soil texture, permeability and erodibility	none	Local	S
Lesotho	Biophysical	Wind direction and speed	none	National	S
Lesotho	Socio-economic	Breakdown of patterns of redistribution and forced out migration	none	National	
Lesotho	Socio-economic	Discontinuities between subsistence and cash income economies	none	National	
Lesotho	Socio-economic	Diversity of production systems as measured by the degree of diversity of array of production systems and resource availability to community	none	Local	S
Lesotho	Socio-economic	Extent of conflicts and marginalisation	none	National	S
Lesotho	Socio-economic	Extent of local NGOs training schemes	none	Local	
Lesotho	Socio-economic	Improvement of soil fertility and structure	none	Local	

Lesotho	Socio-economic	Length and number of physical binds and terraces constructed and buffer strips laid out	none	Local	
Lesotho	Socio-economic	Local incentive programmes for abatement of desertification	none	Local	
Lesotho	Socio-economic	Population estimates and fertility rates	none	National	S
Lesotho	Socio-economic	Rate and degree of fluctuations of cash incomes available to meet felt needs and financial obligations	none	National	S
Lesotho	Socio-economic	Rate and formation of effective farmer conservation groups and of farmer to farmer training programmes	none	National	
Lesotho	Socio-economic	Rate of adoption of soil conservation technologies	none	National	
Lesotho	Socio-economic	Rate of incorporation of agroforestry into existing cultivation practices in dryland farming	none	National	
Lesotho	Socio-economic	Rate of uptake of farmers in the planting and care of trees	none	Local	
Lesotho	Socio-economic	Redistribution of wealth:	none	National	S
Lesotho	Socio-economic	Social mechanisms for wealth distribution and their effectiveness, lobola, mafisa, feasts, festivals, funerals etc.	none	National	S
Malawi	Biophysical	Annual rainfall	none	National	
Malawi	Biophysical	Aqua culture production (tones/year)	550	National	
Malawi	Biophysical	Base flows	Diminishing in Bua and Linthipe	National	
Malawi	Biophysical	Crop production versus requirement	none	Local	
Malawi	Biophysical	Crop yield for hybrid maize (kg/ha)	2500	National	
Malawi	Biophysical	Diversity of fauna (species)	4,000 of which 1.500 are vertebrates	National	
Malawi	Biophysical	Diversity of flora (species)	5,500	National	
Malawi	Biophysical	Drought occurrence	1992, 1995	National	
Malawi	Biophysical	Fish catchments (tones/year)	60,000	National	
Malawi	Biophysical	Flood occurrence	2000	National	
Malawi	Biophysical	Forest cover (% o total land area)	28	National	
Malawi	Biophysical	Length of growth period	none	National	
Malawi	Biophysical	Nutrient loss (tones/ha)	160,000	National	
Malawi	Biophysical	Nutrient replenishment (fertilizers manure)(tones/ha)	90,000	National	
Malawi	Biophysical	Precipitation (mm/year)	600-800 mm (30% of the country); 800-1200 mm (60% of the country)	National	

Malawi	Biophysical	Soil erosion rates	none	Local	
Malawi	Biophysical	Soil loss (tones/ha)	20	National	
Malawi	Socio-economic	Access to basic social services	none	National	
Malawi	Socio-economic	Afforestation rate (% of total land area)	1	National	
Malawi	Socio-economic	Assess to safe drinking water (% of population)	52	National	
Malawi	Socio-economic	Deforestation rate (% of total land area)	2.8	National	
Malawi	Socio-economic	Demand for fuel wood (% o National Energy Budget)	93	National	
Malawi	Socio-economic	Dependency on natural resources	none	National	
Malawi	Socio-economic	Feacal pollution (75% of rivers have coliform)	500/100 ml	National	
Malawi	Socio-economic	Food deficits (months)	03-May	National	
Malawi	Socio-economic	Illiteracy levels	none	National	
Malawi	Socio-economic	Infant mortality	none	National	
Malawi	Socio-economic	Land hold size (ha/household)	0.2-0.5	National	
Malawi	Socio-economic	Life expectancy (years)	39	National	
Malawi	Socio-economic	Population densities	none	National	
Malawi	Socio-economic	Population growth (%)	1.9	National	
Malawi	Socio-economic	Population growth rate	none	National	
Malawi	Socio-economic	Population of children (%)	50	National	
Malawi	Socio-economic	Population of female (%)	52	National	
Malawi	Socio-economic	Value of ornamental fish trade (US$/year)	300,000	National	
Namibia	Biophysical	Amount of bushes	none	Local	S
Namibia	Biophysical	Biodiversity	none	National	S
Namibia	Biophysical	Bush height classes, all bushes, per species	none	Local	S
Namibia	Biophysical	Carrying capacity	See appendix 5	Local	S
Namibia	Biophysical	Density of bushes, all bushes, per species	none	Local	S
Namibia	Biophysical	Density of grass	none	Local	S
Namibia	Biophysical	Density of seedlings	none	Local	S
Namibia	Biophysical	Fires	none	National	Pressure
Namibia	Biophysical	Frost	none	National	Pressure
Namibia	Biophysical	Fruit production on encroacher species	none	National	Pressure
Namibia	Biophysical	Land degradation risk assessment	See appendix 4	National	S
Namibia	Biophysical	Livestock (per species and type)	none	National	Pressure
Namibia	Biophysical	Livestock condition	See appendix 5	Local	S

Namibia	Biophysical	Perennial grass species composition	none	Local	S
Namibia	Biophysical	Rainfall	See appendix 4	National	Pressure
Namibia	Biophysical	Rainfall monitoring	See appendix 5	Local	Pressure
Namibia	Biophysical	Soil cover	none	Local	S
Namibia	Biophysical	Soil erosion hazard	See appendix 4	National	S
Namibia	Biophysical	Vegetation/bush density	See appendix 5	Local	S
Namibia	Biophysical	Wild herbivores (per species)	none	National	Pressure
Namibia	Biophysical	Woody canopy cover, all bushes, per species	none	Local	S
Namibia	Socio-economic	Animal production	none	Local	Response
Namibia	Socio-economic	Control methods applied by land users	none	Local	Response
Namibia	Socio-economic	Livestock pressure	See appendix 4	National	Pressure
Namibia	Socio-economic	Population pressure	See appendix 4	National	Pressure
Namibia	Socio-economic	Type of management	none	National	Pressure
Namibia	Socio-economic	Wood production	none	Local	Response
South Africa	Biophysical	Annual precipitation and evaporation	none	National	S
South Africa	Biophysical	Annual temperature deviations	none	National	S
South Africa	Biophysical	Aridity index	none	National	
South Africa	Biophysical	Biological crusts are present but broken	none	Local	
South Africa	Biophysical	Change in soil temperature	none	Local	
South Africa	Biophysical	Change in soil texture	none	Local	
South Africa	Biophysical	Changes in flow rates	none	Local	
South Africa	Biophysical	Changes in infiltration rates	none	Local	
South Africa	Biophysical	Changes in quantity of ground water	none	Local	
South Africa	Biophysical	Changes in quantity of surface water	none	Local	
South Africa	Biophysical	Changes in river channel depth	none	Local	
South Africa	Biophysical	Changes in river channel pattern	none	Local	
South Africa	Biophysical	Changes in sediment load and turbidity	none	Local	
South Africa	Biophysical	Changes in soil depth	none	Local	
South Africa	Biophysical	Changes in wind speed	none	National	
South Africa	Biophysical	Decline in quality of ground water	none	Local	
South Africa	Biophysical	Decline in quality of surface water	none	Local	
South Africa	Biophysical	Decrease in soil organic matter and fertility	none	Local	
South Africa	Biophysical	Decrease in the type, number or frequency of resource-rich soil zones	none	Local	

South Africa	Biophysical	Decreased soil moisture	none	Local	
South Africa	Biophysical	Degree of stoniness	none	Local	
South Africa	Biophysical	Desertification	none	National	S
South Africa	Biophysical	Dung lies on soil surface and is not decomposed	none	Local	
South Africa	Biophysical	Higher or raised land looses productivity first	none	Local	
South Africa	Biophysical	Increase in frequency of dust and sand storms	none	National	
South Africa	Biophysical	Increase in intensity of dust and sand storms	none	National	
South Africa	Biophysical	Increased dune movement	none	Local	
South Africa	Biophysical	Increased run-off rate	none	Local	
South Africa	Biophysical	Increased seasonality of springs and small streams	none	Local	
South Africa	Biophysical	Land degradation	none	National	S
South Africa	Biophysical	Land productivity versus potential	none	National	S
South Africa	Biophysical	More dunes form around bushes (nebkha dunes)	none	Local	
South Africa	Biophysical	More dunes without vegetation	none	Local	
South Africa	Biophysical	Permanent loss of agriculturally productive land	none	National	S
South Africa	Biophysical	Persistent organic pollutants	none	Local	Pressure indicator
South Africa	Biophysical	Potential evapo-transpiration	none	National	
South Africa	Biophysical	Rainfall amount	none	National	
South Africa	Biophysical	Rainfall duration	none	National	
South Africa	Biophysical	Rainfall frequency	none	National	
South Africa	Biophysical	Rainfall intensity	none	National	
South Africa	Biophysical	Rainfall season	none	National	
South Africa	Biophysical	Rainfall variability	none	National	
South Africa	Biophysical	Reduced biological crust	none	Local	
South Africa	Biophysical	Reduced resource trapping capacity	none	Local	
South Africa	Biophysical	Reduction in carbon sequestration rates and storage rates	none	Local	
South Africa	Biophysical	Soil acidification	none	Local	Impact indicator
South Africa	Biophysical	Soil compaction	none	Local	
South Africa	Biophysical	Soil loss	none	Local	S
South Africa	Biophysical	Soil salinisation	none	Local	Impact indicator

South Africa	Biophysical	Soil salinization or alkalinization	none	Local	Impact indicator
South Africa	Biophysical	The amount of exposed rock	none	Local	
South Africa	Biophysical	The number of erosion gullies	none	Local	
South Africa	Biophysical	Wasted and degraded land in mining zones	none	National	S
South Africa	Biophysical	Wind-blown sand covers fields and roads and enters settlements	none	Local	
South Africa	Socio-economic	Abandonment of land	none	Local	
South Africa	Socio-economic	Amount of dung used for fuel	none	Local	
South Africa	Socio-economic	Amount of government support	none	National	
South Africa	Socio-economic	Amount of land required supporting one family	none	National	
South Africa	Socio-economic	Budget allocation, Department of Environmental Affairs and Tourism	none	National	
South Africa	Socio-economic	Cattle holdings per family	none	National	
South Africa	Socio-economic	Change in land use	none	Local	
South Africa	Socio-economic	Changes in gender roles	none	Local	
South Africa	Socio-economic	Conflict around resources	none	National	
South Africa	Socio-economic	Conversion of natural vegetation to agricultural crops	none	National	Response indicator
South Africa	Socio-economic	Decrease in assets	none	National	
South Africa	Socio-economic	Decrease in incomes	none	National	
South Africa	Socio-economic	Distances to fuel and water resources	none	Local	
South Africa	Socio-economic	Economic diversification	none	Local	
South Africa	Socio-economic	Enforcement of the Conservation of Agricultural Resources Act	none	National	Response indicator
South Africa	Socio-economic	Extent of urbanisation in South Africa	none	National	S
South Africa	Socio-economic	Historical documents, aerial photos	none	Local	
South Africa	Socio-economic	Income distribution	none	National	S
South Africa	Socio-economic	Land degradation per GDP in the agricultural sector	none	National	Pressure indicator
South Africa	Socio-economic	Lower farm profits	none	Local	
South Africa	Socio-economic	Money spent collecting fuel and water	none	Local	
South Africa	Socio-economic	More bankruptcy	none	National	
South Africa	Socio-economic	More malnutrition	none	National	
South Africa	Socio-economic	Movement from rural to urban areas	none	National	Pressure indicator

South Africa	Socio-economic	People migrate out of the area	none	Local	
South Africa	Socio-economic	People's perceptions of changes in natural resource availability and condition	none	National	
South Africa	Socio-economic	Per capita income	none	National	
South Africa	Socio-economic	Percentage of households using different fuels in five rural areas	none	Local	S
South Africa	Socio-economic	Perceptions based on local knowledge / grassroots indicators	none	Local	
South Africa	Socio-economic	Population density	none	National	
South Africa	Socio-economic	Population feeding habits	none	National	
South Africa	Socio-economic	Population growth rate 1980-1991	none	National	S
South Africa	Socio-economic	Population structure	none	National	
South Africa	Socio-economic	Poverty Rate by Population Group	none	National	S
South Africa	Socio-economic	Quality of mining operations	none	National	Response indicator
South Africa	Socio-economic	Relative dependence on cash crops / subsistence crops	none	National	
South Africa	Socio-economic	Require increased inputs (supplementary feeding)	none	Local	
South Africa	Socio-economic	Sectoral composition of the South African economy	none	National	S
South Africa	Socio-economic	Subdivision of land (landlord to tenant ratio)	none	Local	
South Africa	Socio-economic	Time spent collecting fuel and water	none	Local	
South Africa	Socio-economic	Unsuitable land uses (amount of fertilizer, irrigation water quality)	none	Local	
South Africa	Socio-economic	Wasted and degraded land in mining zones per GDP in the mining sector	none	National	S
Tanzania	Implementation of NAP	Actions to strengthen national and local capacity to combat desertification	none	National	
Tanzania	Implementation of NAP	Analysis of the legislation and enforcement of laws on the environment	none	National	
Tanzania	Implementation of NAP	Degree of participation from international partners	none	National	
Tanzania	Implementation of NAP	Established mechanism and criteria for monitoring the impacts of NAP formulation	none	National	
Tanzania	Implementation of NAP	Established norms and standards	none	National	
Tanzania	Implementation of NAP	Established unit to undertake the monitoring and evaluation	none	National	
Tanzania	Implementation of NAP	Establishment and/or strengthening of environmental monitoring and observation capacities	none	National	
Tanzania	Implementation of NAP	Identification of new actions	none	National	
Tanzania	Implementation of NAP	Inventory, adaptation and integration of projects underway within the NAP process	none	National	
Tanzania	Implementation of NAP	Involving stakeholders in the implementation of the NAP activities.	none	National	
Tanzania	Implementation of NAP	Making the NAP coherent with other environmental strategic frameworks and vice-versa	none	National	

Tanzania	Implementation of NAP	Measures identified or adopted to adjust or strengthen the institutional framework	none	National	
Tanzania	Implementation of NAP	Measures to adapt current legislation or introduce new ones	none	National	
Tanzania	Implementation of NAP	Measures to facilitate the access of local actors to existing sources of funds	none	National	
Tanzania	Implementation of NAP	Methods of participation of various actors	none	National	
Tanzania	Implementation of NAP	Policies piloted for the implementation of the NAP	none	National	
Tanzania	Implementation of NAP	Representativeness of various actors in the national priorities identification process.	none	National	
Tanzania	Implementation of NAP	Working out new, adapted methods to mobilize internal and external resources	none	National	
Zambia	Biophysical	Annual rainfall and number of rainfall days per year	none	National	
Zambia	Biophysical	Drought occurrence	none	National	
Zambia	Biophysical	Estimates of erosion hazard	none	National	
Zambia	Biophysical	Identification of vulnerable soils	none	National	
Zambia	Biophysical	Start and length of rainfall season	none	National	
Zambia	Biophysical	Variation in maize production	none	National	
Zambia	Biophysical	Variations in temperature	none	National	
Zambia	Implementation of NAP	Actions to strengthen national and local capacity to combat desertification	none	National	
Zambia	Implementation of NAP	Adequate resources committed	none	National	
Zambia	Implementation of NAP	Agreement by the government	none	National	
Zambia	Implementation of NAP	Analysis of the legislation and enforcement of laws on the environment	none	National	
Zambia	Implementation of NAP	Approval and acceptance of the NAP actors involved	none	National	
Zambia	Implementation of NAP	Composition and mode of operation	none	National	
Zambia	Implementation of NAP	Continuity of NFP	none	National	
Zambia	Implementation of NAP	Degree of participation of international partners	none	National	
Zambia	Implementation of NAP	Established mechanism and criteria for monitoring the impacts of NAP formulation	none	National	
Zambia	Implementation of NAP	Established norms and standards	none	National	
Zambia	Implementation of NAP	Established time frame	none	National	
Zambia	Implementation of NAP	Established unit to undertake the monitoring and evaluation	none	National	
Zambia	Implementation of NAP	Establishment and/or strengthening of environmental monitoring and observation capacities	none	National	
Zambia	Implementation of NAP	Establishment of an informal consultation and harmonization process for actions between partner countries	none	National	

Zambia	Implementation of NAP	Extent of uptake of local concerns at the national level	none	National	
Zambia	Implementation of NAP	Extent of uptake of results of national consultations at the local level	none	National	
Zambia	Implementation of NAP	Facilitation funds established	none	National	
Zambia	Implementation of NAP	Identification of new actions	none	National	
Zambia	Implementation of NAP	Integration of NAP into national development plans and taking account of existing programmes	none	National	
Zambia	Implementation of NAP	Inter-linkages of NAP with subregional action programme	none	National	
Zambia	Implementation of NAP	Inter-linking of NAP with national, regional and local approaches	none	National	
Zambia	Implementation of NAP	Intersectoral and multidisciplinary character	none	National	
Zambia	Implementation of NAP	Inventory of key stakeholders	none	National	
Zambia	Implementation of NAP	Inventory, adaptation and integration of projects underway within the NAP process	none	National	
Zambia	Implementation of NAP	Legal status	none	National	
Zambia	Implementation of NAP	Making the NAP coherent with other environmental strategic frameworks and vice-versa	none	National	
Zambia	Implementation of NAP	Measure adopted to strengthen existing institutions at the local levels	none	Local	
Zambia	Implementation of NAP	Measures identified or adopted to adjust or strengthen the institutional framework	none	National	
Zambia	Implementation of NAP	Measures to adapt current legislation or introduce new ones	none	National	
Zambia	Implementation of NAP	Measures to facilitate the access of local actors to existing sources of funds	none	Local	
Zambia	Implementation of NAP	Methods of participation of various actors	none	National	
Zambia	Implementation of NAP	Nature and scope of information, education and communications action	none	National	
Zambia	Implementation of NAP	Policies piloted for the implementation of the NAP	none	National	
Zambia	Implementation of NAP	Representativeness of various actors in the national priorities identification process	none	National	
Zambia	Implementation of NAP	Resources	none	National	
Zambia	Implementation of NAP	Senior experts representing various institutions	none	National	
Zambia	Implementation of NAP	Specific programmes emerging from policy statements	none	National	
Zambia	Implementation of NAP	Terms of References	none	National	
Zambia	Implementation of NAP	Working out new, adapted methods to mobilise internal and external resources	none	National	
Zambia	Socio-economic	Annual rate of deforestation	none	National	
Zambia	Socio-economic	Establishment of new settlements	none	National	
Zambia	Socio-economic	Extent of various land use practices	none	National	
Zambia	Socio-economic	Land tenure and property rights	none	National	

Zambia	Socio-economic	Occurrence and frequency of man-made bush fires	none	National	
Zambia	Socio-economic	Occurrence of overgrazing	none	National	
Zambia	Socio-economic	Poverty	none	National	
Zambia	Socio-economic	Use of wood and charcoal	none	National	

Table AII 1. Suggested indicators. Note that not all indicators have been classified according to type (state, pressure, impact and response) as this was not done by all countries and adding that information here would be impossible given the lack of comprehensive definitions of most of these indicators.

Country	**Biophysical**	**Socio-economic**	**NAP implementation**	**NAP**	**Country report CRIC 1**	**Questionnaires**
Angola	0	0	0		x	0
Botswana	2	0	0	x	x	1
Lesotho	13	16	0	x	x	0
Malawi	17	18	0	x	x	0
Mozambique	0	0	0		x	0
Namibia	21	6	0		x	4
South Africa	54	42	0		x	3
Swaziland	0	0	0	x	x	0
Tanzania	0	0	18	x	x	0
Zambia	7	8	39	x	x	0
Zimbabwe	0	0	0	x	x	0
TOTAL	**114**	**90**	**57**	**7**	**11**	**8**

Table AII 2. The number of biophysical, socio-economic and NAP implementation indicators proposed/used by the SADC countries.

Country	**Local**	**National**
Botswana	1	1
Lesotho	11	18
Malawi	2	33
Namibia	15	12
South Africa	52	44
Tanzania	0	18
Zambia	2	52
TOTAL	**83**	**178**

Table AII 3. The distribution of national and local level indicators per country

Annex III: Responses to the AID-CCD questionnaire

The questionnaire was sent to a total of 58 stakeholders (20 female and 38 male) in the SADC region. Only five questionnaires were received, see table 6 for a summary and Appendix 2 for a complete list of contacts.

Altogether 5 questionnaires were returned by a total of 8 respondents, i.e. approximately 14 % of the total number of stakeholders contacted. One respondent from Botswana returned one questionnaire, three respondents from South Africa returned one questionnaire, and four respondents from Namibia returned three questionnaires. Three stakeholders responded that they had no relevant information to contribute. The questionnaire was sent twice to each respondent, as there were no replies after the first time.

Botswana

The questionnaire replied from Botswana reports on a project named "Mapping of degraded areas in Botswana". The objective of the project is to define areas through satellite imagery and fieldwork. Contact persons for the project are: Raymond Kwerepe and Sue Ringrose. The geographic area of the project is entire country of Botswana. This research project came to an end 1996 and was implemented by Ministry of Agriculture in Botswana. The spatial scale of the indicators that were used is approximately 360m^2, i.e. equal to the resolution of a Landsat TM pixel. The methodology used is satellite image analysis over time for change detection.

The respondent from Botswana didn't contribute with any information about the use of benchmark and indicators of desertification and/or drought in Botswana.

Regarding the state of the art with respect to benchmarks and indicators the Botswana Ministry of Agriculture (Range ecology) was indicated to use:

- NOAA data for environmental monitoring
- Conduct ground based environmental monitoring

None of the specific questions about indicators were answered. Further, no questions about methodology or use of indicators were answered.

South Africa

The questionnaire from South Africa was jointly submitted by three researchers at the Lesley Hill Institute for Plant Conservation (LHIPC). The Mission of the Leslie Hill Institute for Plant Conservation is to develop human and institutional capacity through the pursuit of scientific knowledge about the biological functioning of and pressures facing the vegetation of the Succulent Karoo and Fynbos biomes of South Africa so that people are able to make sound management decisions for the sustainable use, conservation and restoration of this unique asset. The level of the research carried out by this Governmental institution (higher education) is mainly on a local level. Three different projects are being reported on:

- Environmental history of the Succulent Karoo
- The impact of land use and cover changes on plant communities of the Succulent Karoo at multiple scales
- Land use and its impact on the Succulent Karoo

Environmental history of the Succulent Karoo

The objective of this project is to document landscape level changes in the Succulent Karoo Biome over the last 100 years. The geographic area of the project is the Succulent Karoo Biome, especially Namaqualand, The project is a research project implemented by the LHIPC. The start date of the project was 2001 and it will be running for four years, until 2005. The Director and contact person of the project is

Professor Timm Hoffman. Two institutions participate in the project, the LHIPC and the Programme for Land and Agrarian Studies (PLAAS). The spatial scale of the project is on a landscape level, i.e. km^2. The methodology used is based on repeat photography.

The impact of land use and cover changes on plant communities of the Succulent Karoo at multiple scales

This project is implemented by the LHIPC. The objective of this project is to understand the effect of variable stocking rates on plant communities of the Succulent Karoo Biome. The geographic area of this research project is Leliefontein communal area and immediate surrounds in Namaqualand, Succulent Karoo. The project started year 2002 and will end 2006. Professor Timm Hoffman is the director and Pippin Anderson is the contact person of the project. Multiple scales are considered for proposed indicators. The methodology used is ground truthed data (plant community composition, cover and biomass used in conjunction with satellite imagery to explore grazing impacts on plant communities at multiple scales.

Land use and its impact on the Succulent Karoo

The objective of this research and conservation-planning project is to map the extent of current land use practices and to create future land use scenarios for the Succulent Karoo. The geographic area of the project is the Succulent Karoo biome and extending through the northwest areas of South Africa and into Namibia. The implementing institution is LHIPC, Professor Timm Hoffman is the Director and Zuziwe Jonas is the contact person of the project. The spatial scale of the suggested indicators is local through to biome level. The methodology used is mapping and classification of current land use practices using GIS. By relating land use activities i.e. cropping, grazing, etc., to environmental drivers, potential areas where these activities might expand are identified and future potential scenarios explored.

Critical vision about the application of benchmarks and indicators

No information was provided about the use of benchmark and indicators on desertification and/or drought in South Africa.

State of the art of indicators and benchmarks

It was stated that indicators and benchmarks are widely used throughout South Africa at a range of different levels and by many institutions. The respondent felt that this question would take considerable research and several hours to answer properly.

Specific questions

Are indicators used at different levels?

Yes

What type of indicators is considered?

See Appendix 6 for suggested indicators identified from the broader literature.

*Are indicators used in the framework of NAP activitie*s?

No, the South African NAP is still being developed.

Are you using project cycle indicators?

No

Report on your experience with the practical use of benchmarks if available

Have used fence line contrast and gradient analysis (e.g. away from water points / stock posts) to good effect.

Methodology

Give an overview on methodology of Benchmark and Indicators in each project/related activity in your country

The respondents felt that this is a too vast topic to comment on thoroughly here.

Specific questions
Are participatory approaches used to generate indicators?
Sometimes
Is the approach theoretical? Empirical? Other?
Scientific
Are there available case study areas for use and evaluation of benchmark and indicators? What are the issues concerned?
Paulshoek and Leliefontein area may provide sound case study area in due course.
Geographic location of the case study sites?
Namaqualand, Northern Cape Province, South Africa
The extent of the area?
Variable as project dependent
The data that are being collected/monitored?
Photographic data, plant community composition, land use change.
Starting date of data collection/monitoring?
Variable as project dependent
Are there benchmarks in the areas? If not, are people working to define benchmarks?
Not in existence, but being worked on.

Use of indicators
Give some examples on practical use of Benchmarks and Indicators in each project/related activity in your country
To assess the impact of stocking rates, for exploring land use and climatic change through time.
Specific questions
No answers were given to these specific questions as the respondents stated that they do not feel able to answer these detailed questions about benchmarks and indicators used at the national level.

Namibia
Three questionnaires were returned from Namibia, one from Neudamm Agricultural College, one from Directorate of Environmental Affairs within the Ministry of Environment and Tourism and one from University of Namibia.
Questionnaire 1 (Neudamm Agricultural College)
The objective of the Governmental institution Neudamm Agricultural College is to provide Diploma level training. The level of operation is national. Two different projects are presented:
1) Diet selection of livestock
2) Long-term rangeland monitoring

Diet selection of livestock
The objective of this project is to find out what free-ranging livestock are eating and how choice is affected by season, stocking rate and type of breed. The geographic area of this project is in the highland savanna and camel thorn savanna. The project is a research project and started year 1997 and does not have any defined end date. The Director and contact person of the project is Axel Rothauge. The spatial scale of the proposed indicators range from farm scale to landscape scale.
The methodology used is to determine diet selection by direct observation. The quality of the diet is determined by nutrient analysis. Range condition is determined by systematically randomised sampling of botanical composition, ground cover and herbaceous yield.

Long term rangeland monitoring
The objective of this project is to determine what is the condition of the rangeland and how is it affected by rainfall and stocking rate. The geographic location of this research project is the highland savanna. The project is implemented by Neudamm Agricultural College and Directed by Axel Rothauge. Polytechnic of Namibia is a participating institution. The project started 1997 and has no defined end date. The spatial scale range from farm level to landscape level.
The methodology used for determining rangeland condition is the same as in the project above, i.e. by systematically randomised sampling of botanical composition, ground cover and herbaceous yield. Soil erosion is monitored by using erosion bridges.
Critical vision about the application of benchmarks and indicators
No information was given about the use of benchmark and indicators of desertification and/or drought in Namibia or on the state of the art of indicators and benchmarks.
Specific questions
Are indicators considered at different levels?
No, only on at farm level. However, results can be extrapolated to regional level but that has not yet been verified.
What types of indicators are being considered?
Grass species (especially abundance of *Schmidtia pappophorides*)
Woody species (especially invasive species)
Livestock condition and mass
Are indicators used in the framework of NAP activities?
Don't know
Are you using project cycle indicators?
What is this?
Report on your experience with the practical use of benchmarks if available
Too few benchmarks in this country. Could be very useful because we cannot believe that rangelands can be in the condition as indicated by benchmarks.

Methodology
No information was provided regarding the methodology of benchmarks and indicators in the projects. However, some of the specific questions were answered.
Are participatory approaches used to generate indicators?
No. only eco-physical
Is the approach theoretical? Empirical? Other?
Scientific (deductive but measured).
Are there available permanent monitoring sites for use and evaluation of Benchmarks and indicators?
Yes for project 2 above. There are no issues associated to these sites as the availability of long term monitoring is guaranteed.
Geographic location of sites
The location of the permanent sites is at Neudamm Agricultural College just outside Windhoek.
Extent of area
The extent of the permanent sites is line transects at nine different locations with an average length of 1 km.
Are there benchmarks (baseline data/reference sites) in these areas?
No

Use of indicators
No examples on practical use of benchmarks and indicators were given.
Specific questions
How are desertification and/or drought benchmarks and indicators being used?
The more sensitive ones give early warning of degradation, e.g. loss of specific grass species, loss of productivity as seen in decreasing body condition of livestock.
Who are using the indicators?
I am, farmers could also use them.
What are the problems or difficulties encountered?
The research is not yet completed.
Are there indicators used under other conventions in Namibia?
I don't know
Do information circulation systems or early warning systems exist at different levels?
I suppose so.

Questionnaire 2 (Directorate of Environmental Affairs within the Ministry of Environment and Tourism)
The institutional objectives of the Directorate of Environmental Affairs are presently under revision. The level of this Governmental institution is national. One project, the bush encroachment research, monitoring and management is presented.
The objective of this project is to:
1. Improve the understanding of the causes and impacts of the species-specific bush encroachment process
2. Improve the understanding of land capability
3. Up-dated and time-sequenced, historical information in map and GIS database form available for researchers, planners and general public
4. Improved monitoring systems and methodologies for vegetation change and land capability assessments purposes
5. Sustained and functional mechanisms and capacity to operate and manage the bush monitoring and management project is being developed and operational for phase 2 of the project
6. Compiled policy analysis of bush encroachment related issues foe policy reform
7. Increased awareness of bush encroachment dynamics and operational networks for information and experience sharing

The geographic area of the project is between 18.6° and 23° south and 14° and 21° east. The area includes Grootfontein, Tsumeb, Outjo, Otjiwarongo, Okahandja, Windhoek, Omaruru, Karibib and Gobabis districts as well as the western communal areas with Okombahe, Omatjette, and Grootberg as the focal points. The eastern communal areas include Epukiro, Otjinene, Okakarara, Okamatapati and Otjituuo. The project is a research project run by the Directorate of Environmental Affairs. The starting date of the project was 1st September 2000 and it ended 31st December 2003. The Director of the project was Mr. Teo Nghitila. Contact person is Nico de Klerk. The following institutions also took part in this project:
- Ministry of Agriculture, Water and Rural Development,
- Namibia National Farmers Union
- Namibia Agricultural Union
- Desert Research Foundation of Namibia
- Polytechnic of Namibia
- Individual farmers

Critical vision about the application of benchmarks and indicators
No information about use of benchmarks and indicators of desertification was given.
Special questions
Are indicators considered at different levels?
Local and regional (regional in a national sense)
What type of indicators are considered?
Same as under Napcod, see appendix 3-5 for descriptions of the Napcod indicators developed for national and local level land degradation monitoring.
Are indicators used in the framework of NAP activities?
See Appendix 3-5 where the indicators and the monitoring developed by Namibia's Programme to Combat Desertification (Napcod) are presented.
Report on your experience with the practical use of benchmarks if available.
They are relevant but will be very time consuming and costly to implement.

Methodology
No overview on the methodology of benchmarks and indicators was provided.
Specific questions
Are participatory approaches used to generate indicators?
Yes
Is the approach theoretical? Empirical? Other?
Both scientific and practical. As far as possible, empirical norms are proposed.
Are there available case study areas for use and evaluation of benchmarks and indicators?
One study to test methods and to propose indicators was carried out in Okakarara communal area and on an adjacent commercial farm in Otjozondjupa region, which is regarded as representative of other ecological zones in Namibia.
The extent of the area?
+/- 2000 ha
The data that are being collected/monitored?
Testing methodology: Monitoring vegetation change by using indicators of pressure, state and response.
The start date of data collection/monitoring?
2001
Are there benchmarks in these areas?
The following benchmarks were proposed for monitoring of bush encroachment:

- total canopy cover by points
- total canopy cover by Bitterlich gauge
- percentage of encroacher species among live canopy
- mean distance from point to bush
- mean distance to perennial grass
- soil cover by litter or bases
- rangeland condition score

Use of indicators
Specific questions
How are desertification and/or drought benchmarks and indicators being used?
See table 7 below.

Type of indicator	**Indicator**	**Units of measure**	**Proposed method**

Pressure	Livestock (per species and type	Kilogram live weight per hectare	Records kept by farmer
	Wild herbivores (per species)	Subjective rank	Records kept by land users
	Type of management	Descriptions and some quantities	Records kept by land user
	Fires	Areas marked on map	Analysis of records and maps kept by land user
	Fruit production on encroacher species	Subjective rank	Records kept by land user
	Rainfall	Millimetres per annum	Rain gauge
	Frost	Occurrence of top-kill in bushes	Records kept by land user
State	Amount of bushes	Comparison with previous photos	Records kept by land user
	Density of grass	Plants per hectare	Plot count
	Density of seedlings	Seedlings per hectare	Plot count
	Woody canopy cover, all bushes, per species	Percentage	Bitterlich gauge
	Bush height classes, all bushes, per species	Percentage	Point sampling
	Density of bushes, all bushes, per species	Plants per hectare	Distance measurements from point
	Perennial grass species composition	Percentage cover and range condition score	Distance measurements from point
	Biodiversity	Index	Measures of variables
	Soil cover	Percentage	Point sampling
Response	Control methods applied by land users	Area marked on map	Analysis of records and maps kept by land users
	Animal production	Kilogram live weight per hectare per annum	Analysis of records kept by farmers
	Wood production	Kilogram per hectare per annum (local and national levels)	Analysis of records and maps kept by land users

Table 7. Indicators suggested by the Namibian Bush Encroachment project

Problems and difficulties encountered?
The indicators outlined in table 7 above still need to be implemented. Pilot tests show that they are possible to implement. Most of them will require physical surveys and research. In this sense it will be time consuming and expensive. At this stage no information circulation system or early warning system exists that is using the indicators presented above.

Questionnaire 3 (University of Namibia)
The third questionnaire received from University of Namibia did not contain any information. The sender just confirmed that he had no knowledge about the topic.

STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN EAST AND SOUTHERN ASIA

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Executive Summary

Desertification has resulted in deteriorating environment and poor economy. It has been listed as the first of first in the ten environment and development problems of concern to human race. Desertification has not only imposed threat to the surviving environment of the overall mankind, but also become an important factor in hindering global economy development and has adverse impact on social security.

The benchmarks and indicators related to the implementation of the NAPs, SRAPs and RAPs for desertification monitoring, assessment and combating at local, national, regional or international levels has been a very important issue and concerned by many scientists, officials in the national and international organisations. For the new efforts in this domain the China National Desertification Monitoring Centre, State Forestry Administration of China (CNDMC) had joint the EC Project "Active exchange of Experience on Indicators and Development of Perspectives in the Context of the UNCCD", (Commission of the European Communities- AID-CCD-EVK2-2002-00609) and used a questionnaire entitled Enquiry: benchmarks and indicators of desertification processes designed by a scientists group of this project. The questionnaire was sent by e-mail to the Focal Points and scientists of the relevant eastern and south-eastern Asian countries listed below:

- Countries of Eastern Asia: China, Mongolia, Japan
- Countries of South and South-Eastern Asia: India, Pakistan, Thailand, Vietnam

By the time of the deadline, replies had been received only from India, Thailand. In order to compile this report, information for the other countries was extracted from the following sources:

- From reports available from the UNCCD website.
- From some international workshops such as:
  - International Symposium on Space Technology Application for Sustainable Dry-land Development and Desertification Monitoring, October 2003, Beijing, China. A sub-meeting of the Symposium is called by The Thematic Programme Network on Desertification Monitoring and Assessment (TPN1);
  - International Symposium: Evaluation and Monitoring of Desertification, February 2004, Tsukuba, Japan;
- Information about China is form CNDMC itself;
- From recent reports and papers of relevant desertification combating projects such as Dust and sandstorm monitoring and preventing by northeastern Asian countries.

The countries of eastern and south-eastern Asia vary in their approach to combating and monitoring desertification. Many of them have joint the TPN1 of Asia for drawing up a common set of desertification indicators at the first stage with the aim of UNCCD Secretariat.

- The TPN1 of Asia supported by countries of Annex II has compiled common sets of benchmarks and indicators (B&I) system for desertification monitoring and assessment (DMA) in the Asian region. As a result, a regional desertification mapping at 4 million scale has been tried for the first time.

- For the need of evaluating the dynamic of desertification, formulating NAP of China and planning for main ecological construction programs, up to now China has carried out the nation-wide desertification survey and monitoring for three times in the interval of 4-5 years according to a bio-physical indicator set developed by CNDMC. In the procedure of desertification assessment of the indicator system, the first stage is climatic zoning using climatic moisture index as the indicator according to UNCCD definition, second stage is land use types, third stage is desertification types and the fourth will be the severity degree.
- Natural resources and socio-economic surveys have been done and still underway in many countries. Just like India which has made a lot of efforts for developing desertification indicators and successfully tested. In India soil/land use survey was started as early as 1950s. Now India has made national level programme on desertrification monitoring and assessment using satellite data. Recently the benchmarks and indicators have been standardized for the country and methodology for the desertification status mapping has been evolved and standardized as part of TPN-1 UNCCD. But we don't have detail on this report yet.
- As one of the efforts for supporting the NAP implementation, Mongolia scientists have cooperated with Israel expert Dr. A. Karnieli who developed The NDVI-LST space based drought indicators for Drought and Vegetation Monitoring in the Arid and Semi-Arid Regions of the Mongolia using Remote Sensing and Ground Data.
- From assessment and evaluation of scientific information of soil and climate, Thailand can be categorized as affected country by desertification because the ratio of precipitation over evapotranspiration in some parts of the country falls within 0.05-0.65. Soil erosion and soil salinity are two main types of desertification in Thailand. Land degradation has been arisen from processes deriving from human activities and habitation patterns. Land degradation was analyzed relating to poverty incidence. It has supported the desertification combating and related NAP of Thailand.
- Efforts also made by Japan and Republic of Korea in Cooperation of Indicator development and Application with others. Even they are not considered as the countries having desertification land but still suffered by desertification impact such as sandstorm. Many experts have paid their attention on the development of indicators and benchmark related to desertification monitoring. Many related international forums and workshops have been held. For example, International Symposium of Evaluation and Monitoring of Desertification Synthetic Activities for the Contribution to UNCCD has held in 2004 Feb. at Tsukuba, Japan and International Forum/Workshop on Combating Desertification and Controlling Dust and Sand Storms has held in October 2003 at Seoul, Republic of Korea.

In spite of the report provided here, we still feel not gathering enough information to cover the rather complete efforts for this domain by the countries in the reported region.

1. The sub-regional context

Asia is a vast continent with serious desertification & drought problem with a largest population in the world. Even some countries in Asia are developed and rich like Japan, South Korea, Kingdom of Saudi Arabia, The United Arab Emirates, Israel etc. most Asian countries are developing countries with quite amount of poverty people. The governments, relevant Institutes, Stakeholders and Scientists of Asian countries have been making great efforts to solve these problems. UNCCD have been paying high attention to Asia too. There is a UNCCD Asia Office settled at United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) to organize and coordinate the cooperating activities of combating desertification in Asia region, also consider the World. Not only the Asian countries who have desertification land in its territory and fight to the problem hardly such as China, Mongolia, India etc. but also countries who haven't desertification land in its own territory also actively join their effort too for example Japan, South Korea for they have suffered and affected by desertification like sandstorm and dust dropping. There are financial support donated by their governments, societies and folks. For the normal knowledge the climate in northeast Asia is drier so most desertified lands are concentrated in the countries of this region. The countries of southeast Asia like Thailand, Viet Nam which should in the humid climatic environment but still very active in cooperating with UNCCD and other countries on the effort to combating desertification since they have had critical seasonal drought as well.

Many regional, interregional, sub-regional conferences, meetings and workshops have been held In Asia for making effective Regional, Sub-regional, national Action Plans and cooperation of combating desertification. The first Regional Conference on the Implementation of the United Nations Convention to Combat Desertification, held at New Dehli, August, 1996, prepared the ground for the preparation of the Convention Regional Action Programme for Asia. Guided by the principles and provisions of the Convention, especially those in its Annex II, the Regional Implementation Annex for Asia, Asian country Parties, with continued assistance from the UNCCD Secretariat, have taken initiatives aimed at achieving the objectives of the Convention. As a follow-up to the New Delhi meeting, two other important meetings were held: the Ministerial Conference on Regional Cooperation to Implement the United Nations Convention to Combat Desertification in Asia, held in Beijing in1997, and the International Expert Group Meeting on the Preparation of the Regional Action Programme for Combating Desertification and Mitigating the Effects of Drought in Asia, held at Bangkok in 1998. Those meetings carried the Asian region through a process of mobilizing political commitment to regional and subregional collaboration. They also paved the way for the formulation of a framework for the Regional Action Programme (RAP) and the development of National Action Programmes (NAPs). Furthermore, the meetings established thematic programme networks (TPNs) that provide structural support to RAP and NAPs which, essentially, are at the core of action for combating desertification in the region.

Some relevant meetings are listed below:

Regional Meetings:

- August 1996, Regional Conference on the Implementation of the UNCCD in Asia (1st regional conference), New Delhi, India.
- May 1997, Beijing Ministerial Conference on Regional Cooperation to Implement the CCD in Asia (2nd regional conference), Beijing, China.
- May 1998, 1st Asian Meeting of the CCD National Focal Points, Ohtsu, Shiga, Japan.
- November 1998, The International Experts Group Meeting on the Preparation of the Regional Action Program (RAP) fo Combating Desertification and Drought in Asia, Bangkok, Thailand.
- November 2000, Third Regional Meeting of the UNCCD National Focal Points in Asia, Bangkok, Thailand
- June 2001, Fourth Regional Meeting of CCD Focal Points in Asia, Ulan Bator, Mongolia.

- December 2001, First TPN2 Workshop (Asian regional thematic programme network on agroforestry and soil conservation in arid, semi-arid and dry sub-humid areas), Hyderabad, India.
- June 2002, National Stakeholders Consultation Meeting on the TPN5 (Asian Regional Thematic Programme Network on Strengthening Capacities for Combating Desertification and Mitigating the Effects of Drought), Ulan Bator, Mongolia.
- June 2003, Second Asian Ministerial Conference on UNCCD Implementation in Preparation for the Sixth Session of the Conference of the Parties to UNCCD and The Sixth Regional Meeting of Asian Focal Points in preparation for the Ministerial Conference and the Sixth Session of the COP, Abu Dhabi, United Arab Emirates.

Subregional Meetings:
- May 2001, Pacific Island Sub-Regional Workshop on Mitigating Drought and Combating Land Degradation, Apia, Samoa;
- July 2003, South East Asia Sub-Regional Workshop on the Development of the SRAP, Bali, Indonesia;
- October 2003, International Forum/Workshop on Combating Desertification and Controlling Dust and Sand Storms, Seoul, Republic of Korea;

National Meetings:
- June 1999, National Workshop to Review the National Action Plan to Combat Desertification and Land Resource Degradation, Sana'a, Yemen;
- September 1999, National Awareness Raising Seminar on Combatting Desertification in Indonesia, Jakarta, Indonesia;
- June 2001, Coordination Meeting for Partnership Building and Resources Mobilization for UNCCD Implementation in China, Particularly in the Western Region, Beijing and Ningxia, China;
- August 2003, National Workshop on UNCCD Implementation in Sri Lanka and Identification of Synergies of Environmental Conventions, Colombo, Sri Lanka;
- September 2003, The National Workshop on Combating Desertification and Promoting Synergistic Implementation of Inter-linked Multilateral Environmental Conventions, Islamabad, Pakistan;

Interregional Meetings:
- August 1996, First Asia-Africa Forum on Combating Desertification, Beijing, China.
- September 1997, Second Asia-Africa Forum on Combating Desertification, Niamey, Niger.
- July 1999, Asia - Africa Technical Workshop on Early Warning Systems, Beijing, China.
- February 2000, Workshop on national reporting for countries in Central Asia and Eastern Europe, Almaty, Kazakhstan
- June 2001, Third Asia - Africa Forum on Combating Desertification and Mitigating Drought, Mongolia, Ulanbator.
- June 2003, 4th Africa-Asia Forum on Combatting Desertification, Theme: Agroforestry and Soil Conservation, Cotonou, Benin.

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2. State of art on Benchmarks and Indicators

2.1 Development Indicators and Application in Different Countries

In fact, many countries in Asia have done national and key areas desertification monitoring which were separated activities from the TPN1. Many countries have established national monitoring, observation and information systems to appraise the status and trend of desertification. Apart from some ground observation stations, the nationwide information were obtained from satellites images with ground truth checking for desertification monitoring. It is noted that the satellites are equipped with instruments for surveying in the visible, infrared and microwave ranges of the spectrum, which makes the information obtained particularly varied and valuable. The operational mechanism for monitoring and assessing the environment, including environmental impact auditing, not only at the national level, but also at the provincial and local levels. However, in many other countries such a mechanism hasn't been established due to the lack of financial resources and the lack of or limited capacity.

Selected indicators should have baseline data to indicate the benchmark, so that it can be used to measure change for evaluating future trends. Baseline monitoring of desertification and land degradation, however, is a difficult and complex task. This kind benchmark could be a researching goal. But for an operational work the present situation and dynamic change of land desertification should be considered first. For example, in China's first national desertification survey task, the technical team used 1990's satellite images as a basis. In china's first desertification monitoring task, the technical team used satellite images of 2000' compare with 1990's. In this task 1990's satellite images worked as a baseline for monitoring and assessment of desertification. In those work some thousands field sampling plots were measured to provide adequate spatial coverage of the vulnerable areas, while remote sensing imagery with proper ground truth for assessing plant cover and biomass.

Many countries recognized the importance of sub-regional and regional cooperation in the areas of monitoring and assessment of the environment (including desertification), and sharing experiences and information. The importance of technical assistance shared between Asia developed and developing countries.

2.1.1 Development Indicators and Application in China

The Desertification Problem and Scope of China

China is one of the countries which is affected by desertification with vast area, wide distribution and serious adverse impact. The usable land resources in China is very limited. However, the land area encroached by desertification every year reaches 10400 km^2, within this only the sandy desertification increased 3436 km^2 for each year. The socio-economic development in the desertification area as well as in other parts of China is closely related to the base status, dynamic changes and future development of desertification affected land. It is extremely important and urgency to undertake desertification monitoring in China. The Objectives of Monitoring are :

- To provide evidence for executives and planning sectors; to assist them in making macro-decisions for combating desertification. The evidence specifically refers to existing desertification affected land area, dynamic change and future development prediction data in the whole country as well as concerned provinces/municipalities /autonomous regions.
- To carry out evaluation on losses from desertification damage; resource and environment evaluation for combating desertification and sustainable development.
- To provide monitoring data in desertified areas for UNCCD; to promote exchange of domestic and international data; to share cooperation channel; All these efforts aim

to make the Chinese desertification monitoring system one of the important members in Asian as well as the global desertification data network.

First of all was to determine the desertfication affecting zones. Five climatic zones are classified in accordance with moisture index recommended by UNCCD:

Climatic Zone	Moisture Index
extreme arid area	<0.05
arid area	0.05-0.20
semi-arid area	0.21-0.50
dry sub-humid area	0.51-0.65
humid area	>0.65

It was found that, by using the moisture index derived through the calculation of meteorological data in the period of 1981-1990, the desertification affecting scope (the arid, semi-arid and dry sub-humid areas) in China was distributed in 18 provinces/municipalities/autonomous regions and 471 counties with a total affected area of 3,317,000 km^2.

Review the development on Benchmark and Indicators of desertification Monitoring and Assessment in China

Benchmark and indicators are an effective tool for nationwide or regional desertification monitoring, providing a channel for description, monitoring and assessment of desertification. According to the informal process initiated by the INCD on the basis of the decision of 9/12 and 10/9, international, regional, sub-regional, NGOs and the interested members of INCD will discuss benchmark and indicators relating to the UNCCD.

Chinese government has attached great importance to the establishment of desertification benchmark and indicators of desertification monitoring and assessment. As early as 1995, the Former State Commission of Science and Technology initiated the research project of “Indicators for Desertification Monitoring and Assessment System and Evaluation Method”. The Commission, in 1996, Listed a topic of “Indicators System for Sandy desertification and Dynamic Evaluation” at the Ninth Five-year Plan (1996-2000) key project of “Desertification Combating Technology Study and Demonstration”. In 1997, the UNDP assisted project of CPR/96/111-Capacity Building for the Implementation of UNCCD (1997-2000) also includes the work of desertification monitoring and assessment. In 1998, the Nation Natural Resources Committee approved and funded a research project of “Desertification Occurrence Mechanism and Optimistic Model for Combating Desertification”(1999-2002) that again includes the topic of “Indicators System of Desertification Classification and Expert System”. In the meantime, China Desertification Monitoring Center Drafted “the Master Plan of China Desertification Monitoring Technology” and “the Regulations of the Fixed Location Monitoring Technology in Typical Desertified Areas of China” and both of them were revised three times. During the National Desertification Inventory in 1994-1996, a pilot demonstration of provincial desertification monitoring was carried out and it was the first time in our country. Based on the pilot demonstration, a initial classification criteria of desertification was created and used to analyze the data collected through inventory and make the national land desertification distribution map. It was also based on the pilot demonstration, a standard series of indicator and index were developed and applied on the first National Desertification Monitoring Mission.

Up to now we have mainly adopted the Status Indicators in desertification monitoring. The status indicators are used to describe and interpret the status and trend of desertification. For instance, the work through remote sensing and mapping means will produce the information on the dynamic status of desertification occurrence and expansion, and predict and forecast the future trend of desertification so as to provide basic data for establishing early warning system on desertification combating. Of course we have still paid great attention at the Indicators to Implement the UNCCD and the Impact Indicators. When we assessed the data collected by The National Desertification Inventory as well as The Monitoring that we do analysed many social economic data as well but only in common way. We didn't applied them as some indicators for the assessment of implementing the UNCCD, the NAP and impacting indicators as well.
So the establishment and application of the benchmark and indicators for desertification monitoring and assessment is still in the initial stage and it will take somewhat years to provide more precise information to assess the situation of desertification combating. Meanwhile, it has to be recognized that establishment of desertification benchmark and indicators also related to the increase of information and experience, enhancement of capacity, advancement of technologies, social demand and changes of priorities.

Technical Framework of China National Desertification Monitoring System

- Satellite Remote Sensing Based Spatial technology Application
  Desertification monitoring combines resources and ecological environment. It contains complex elements and is undertaken in a vast area and featured by continuity in time and comparability in evaluated index. It is impossible to accomplish such work which has a high-level technology and sophisticated starting point by only using traditional methods. Modern high-tech support is of extremely necessity. Remote sensing, GIS and GPS are three indispensable tools to accomplish desertification monitoring.
  The technical methods mainly used for national and provincial monitoring of desertification in China are through such technical system: Advanced aerospace remote sensing technology is applied for obtaining data; GPS is used for on-the-site positioning, position rectification and supplementation of data; GIS technology is used simultaneously with math technical processing models and remote sensing which is good at data analysis; computer-based information management is also applied.
- Spatial Levels and Cycle of Monitoring
  Three spatial levels for China national desertification monitoring system is classified into: national, provincial levels and key & typical localities. The provincial monitoring and the national monitoring which adds up results from the provinces are undertaken every five years, mainly focusing on dynamic monitoring and assessment. But monitoring desertification in key & typical localities are carried out every year in accordance of specific requirements to serve combating desertification.
  Based on the main natural factors, land desertification is divided into: desertification of Wind-erosion type, desertification of Water erosion type ; soil Salinization of secondary type due to chemical process; Soil hardening is resulted by physical reason and vegetation degradation results in drought etc.. Land desertification could be also classified by the degradation of arable land, grassland ,forest land and so on.
- Types and Indicators for Classification and Assessment of Desertification
  Double entry nomenclature is applied in the classification of desertification types:
  - Land Use Type + Desertification Type + Extent of Desertification For example: Desertified grassland of medium wind erosion ;

- Desertified arable land of slight water erosion, etc..

Land use type is classified in accordance with national land use status classification criteria.

Based on the quantified extent of target indicators and Index, land desertification degree is classified into different degrees: not desertified, slight desertification, medium desertification, serious desertification, extreme serious desertification. The indicators used in desertification monitoring and assessment are such as ground forms, ground texture, vegetation coverage & species, coverage of bared area and soil types etc. which could reflect different desertification types and degree. The target indicators to be selected should be of representative, practical, scientific and applicable (see annex1 in detail as a case study).

Practice of China National Desertification Monitoring

China National Desertification Monitoring has been technically designed, organized and carried out by the China National Desertification Monitoring Center (CNDMC) of the State Forestry Administration supervised by the Secretariat of CCICCD. The Center has over 60 experienced scientific staff including some remote sensing application experts. The Center is in charge of the following work: the establishment and operation of the national desertification monitoring system, formulation of the relevant technical methods and organization of the implementation of the system; management of the collected information in combating desertification, information analysis and forecasting of the desertification trend; provision of guidelines and assistance to the establishment of local level desertification monitoring; study on the basic technologies and their dissemination in regard to desertification; working out the operational plan for the national and regional desertification combating projects, monitoring and evaluating the progress. Since its establishment, the Center has fulfilled the nationwide inventory on the desertified land, worked out “The General Plan for Desertification Monitoring in China” and “The Main Technical Regulations for National Desertification Monitoring” and so forth. These documents contain a detailed table of indicator and index for operational application. At the same time, CNDMC took part in the preparation of some chapters which are related to desertification monitoring, treatment and integrated development for the Forestry Action Plan for China’s Agenda 21; the Ninth Five-Year Implementation Plan for National Sandy Desert Control Program; National Planning Outline for the Construction of Ecological Environment Dynamic Monitoring, Prediction, and Early-warning System of Desertification, Serving as Scientific Evidences for Decision-Making.

A nationwide inventory on desertified land was carried out in China from 1994 to 1996. In accordance with the spirits of the UNCCD, the China Country Paper to Combating Desertification was compiled and China’s desertification map with a scale of 1:2.5 million was made. The report and the map systematically unveiled the desertified land area, distribution and causes and analyzed the desertification expansion trend. Starting from 1999, the National Desertification Monitoring with thousands of sampling plots has been carried out, aiming at collection of information, being aware of the dynamic status of desertification, periodical announcement of the results of monitoring so as to provide scientific evidences for decision making. The results has been reported.

From 2004 the second National Desertification Monitoring has been prepared and will start soon.

Both the National Desertification Inventory and the Monitoring had been through the application of modern spatial technology Landsat TM in collaboration with ground inventory. Both the tasks had used more than 200 scenes of TM satellite images with

newest time concept, artificial color image map composed of three bands at 4,5, 3 with a scale of 1:100,000.
As the outputs of the National Inventory the China Land Desertification Distribution Map and China Country Paper to Combating Desertification had been published and the desertification attributes database and spatial information database also be established. The China country paper have adopted the result got from introduced national monitoring above. Several large ecological development programmes have been set up such as "National Sandy Desert Control Program", "Harness Project at Sandy Wind Source Area Surrounding Beijing and Tianjin Cities" etc..

Building capacity of desertification monitoring is one of the priority areas of China's NAP
In accordance with the needs of combating desertification, National desertification monitoring is carried out at intervals to gain timely and accurate understanding of the national trend of desertification and provide professional information for macro decision-making in combating desertification.
The national desertification monitoring is designed at three levels, i.e.: national macro-monitoring, typical monitoring in sensitive areas and special monitoring in selected position.provincial monitoring mainly employs sampling techniques that obtains the overall and general data on national desertified land and sandy land through sampling survey methods which takes province as a unit. One cycle is 5 years.
Typical monitoring in sensitive areas primarily indicates special monitoring on actively expanding areas of desertification, controlled areas with remarkable success and emergent events such as sand and dust storms, flood and mining. The scope and interval of monitoring are determined to meet practical needs.
Special monitoring in selected positions of different zones indicates establishment of fixed positioning and monitoring stations or plots in different affected zones to undertake long-term and systematic monitoring on the relevant factors related to the formation of desertification aiming to provide the causes and process of formation and development of desertification, countermeasures and results.
These activities are materialized through development of the monitoring stations/plots, use of modern equipment, introduction of advanced techniques, training of monitoring personnel and establishment of national network system.

International Cooperation
China has built up a good cooperation relationship with international organizations and foreign countries such as UNCCD, UNDP, FAO, EC, OSS, and Germany, Japan, Brazil, Israel, France, Netherlands, etc. through various means of bilateral and multilateral channels in the field of combating desertification including desertification monitoring and assessment. Since 1998 the CNDMC had been cooperated with SCOT Conseil of CNES, France in the joint project "Vegetation Data Testing in China's Desertification Monitoring" and "3S and Internet Technologies Application in Desertification Monitoring of China". NDVI (Normalized Difference Vegetation Index) derived from satellite remote sensed data was served as the indicator for assessing the monitoring result. In addition there is another joint project "Establishment of a Chinese Energy and Water Balance Monitoring System for Desertification and Food Security Applications" cooperated by the CNDMC with EARS (the Environment Analysis and Remote Sensing), Netherlands. In this project the CMI (Climate Moisture Index = Precipitation / Potential evapotranspiration) is an indicator for determining and

classifying climate zones. The result (map and value of local CMI) derived from data collection and processing of a geo-stationary meteorological satellite.
Desertification is still a very serious problem in China, which is challenged by heavy pressure of large population and limited land resources. The national economy is still in a developing course. China wishes and is willing to carry out cooperation with UN organs and its member States so as to make due contribution to the common course of combating desertification. During the prolonged process of combating desertification, China hopes to gain concrete support and assistance from international organizations, developed and developing countries. The human society is facing many great challenges in combating desertification and realization of the goal of sustainable development. The Chinese government and its people will, as always, work together with people of other countries to take appropriate actions and strive for the global course of combating desertification, protection of the human dependant environment and development of a beautiful homeland for the mankind.

2.1.2 Development Indicators and Application in India

General Condition

In India about 320,000 sq. km is hot desert while 84,080 sq. Km is cold desert. There are 12 per cent of total geographical area of the country fell under arid category. Besides cold desert is uninhabited, uncultivated and capable of supporting only a few forms of life the Thar Desert in west India is the main hot desert with thickest population density in the world. Desertification is mainly a man-made problem which leads to the environmental degradation of fertile lands. The basic cause of desertification is the inter-relationship between the physic-environment system and the various human activities. This is because the environment are under stress of human needs which are governed by the socio-economic conditions of the people.
Many agencies are involved in study various aspects related to desertification and drought including monitoring method in India. Remote sensing has been successfully used to monitor, assess and suggest mitigation measures for desertification problem.

Indicators and Benchmarks of Desertification

One of important elements of Desertification Monitoring and Assessment (DMA) is to identify/define the indicators/parameters and the frequency interval at which these needs to be recorded/monitored. Sometimes the choice of indicators is limited by the constraints in terms of the available technology and infrastructure for collection/ measurement and processing of data needed to generated a particular indicator. Many of the indicators are amenable to remote sensing and thus are depicted on satellite imageries. In the context of desertification monitoring and assessment (DMA), Benchmarks are the baselines that serve as the starting point for evaluation, monitoring and assessment and thus provides a point of reference from which the land starts to degrade/ improve. Benchmarks are standards or baseline against which any piece of land can be compared in order to determine if the land is undergoing the process of degradation and also to quantify the severity of degradation. Different benchmarks are to be established for different processes of degradation and also for different agro-climatic regions as well as for different land use classes.

Indicators and Benchmarks Amenable to Satellite Remote Sensing

Repetitive and synoptic coverage by the remote sensing satellites make them ideally suited for monitoring and assessment of natural resources as well as monitoring and assessment of drought and desertification.

Remote sensing satellites are characterized by the following parameters which are important in the context of the extraction of spatial data (thematic), its scale & level of information content to meet the requirement of the desertification monitoring and assessment system: Resolution (Spatial Resolution, Spectral Resolution, Radiometric Resolution), Swath Coverage and Repetivity).
The Indicators system for desertification monitoring and assessment consists of both: indicators amenable to remote sensing and indicators possible with field measurements and survey only. Most of the physical indicators under the category of "state indicator" are amenable to remote sensing and can be extracted from satellite data. Whereas, a few of the biological and hydrological indicators aan be extracted from satellite data. Socio-economic indicators are normally obtained from field surveys. Climatic indicators are mostly obtained from ground based weather stations.
Indicators amenable to Satellite Remote Sensing for desertification monitoring and assessment are for example change in vegetation coverage and condition, change in land use and productivity, lowering of ground water table, change in spread and number of surface water bodies, soil moisture, salinity/alkalinity, soil erosion status, shift sand sheet/sand dune area, Mass movement/land slides, water logging, manmade change of land (mining, quarrying…) etc..

Desertification Mapping
Preparing desertification status map is an important component of implementation of NAP. To prepare a desertification status map on scientific basis it is necessary to study present land use, criterion for assessment of degradation and various agents of erosion (water and wind) which are action on the ecosystem directly or indirectly. Preparation of desertification combating action plan require data on climate and socio-economic profiles in addition to the thematic data base. Operational methodology has not been available in India for preparation of desertification status map. In order to evolve and standardize procedure for desertification status mapping using satellite data a pilot project has been taken up at the behest of Ministry of Environment and Forests, Govt. of India with the following objectives:

a. To evolve and standardize the procedure for desertification status mapping in arid, semi-arid and dry sub-humid zones for both cold and hot deserts of the country and ultimately to harmonize the approach, including the database with the one being adopted at regional node.
b. To study the temporal behavior of the land undergoing desertification with respect to the indicators vis-a-vis the severity of desertification.
c. To suggest action plan for combating the desertification and monitoring its impact.

Other relevant efforts
Work done by Central Arid Zone Research Institute

- Desertification indicators have been developed and successfully tested.
- Waste/Degraded land survey has been done in arid ecosystem of India and benchmarks established. Arid zone of India Atlas has been developed based on integrated natural resource and socio-economic survey being conducted since 1960s.

Work done by National Bureau of Soil Survey and Land Use Planning.

- Soil/land use survey was initiated in late 1950s. Benchmark soil profiles have been established throughout the country.
- Soil/land use maps at different scales and for different levels, watershed to national, have been developed and published .

2.1.3 Development Indicators and Application in Mongolia

Mongolia scientists have cooperated with Israel expert Dr. A. Karnieli who developed The NDVI-LST space based drought indicators for Drought and Vegetation Monitoring in the Arid and Semi-Arid Regions of the Mongolia using Remote Sensing and Ground Data.

1. Mongolia is a land-locked country which covers an area of 1.5 million square kilometers on the southernmost fringe of the Great Siberian boreal forest and the northernmost Central Asian deserts and vast steppes. The main characteristics of the climate of Mongolia are sunny days, long and cold winters. The average mean air temperature in the warmest month is 15-20□ in the north, and 20-25□ in the south of Mongolia. In the Gobi Desert and Steppe zones, the summer continues over 3 months. The maximum summer air temperature can reach anywhere 35-39□ in the north and 38-41□ in the south. The total annual precipitation in mountainous regions averages to about 400 mm, in the steppe 150-250 mm and in the desert-steppe less than 100 mm. About 85 to 90 per cent of the precipitation falls during the three summer months. The number of rainy days decreases from north to south. The temporal and spatial distribution of precipitation in Mongolia is variable. There is very little precipitation at the beginning of the growing season but much more in the second half of the season when cool air starts to spread around the country. This variation has considerable effects on the growth of several spring plants. Summer, autumn and winter precipitation is a source of soil moisture but it is insufficient for vegetation to thrive in this country. Mongolia has expansive areas (almost 90%) of natural grasslands and current dominant industry in the agricultural sector of the country is the nomadic livestock husbandry which is highly dependent upon the conditions and changes in nature and the environment during the four seasons of a year. Almost 99% of the Gobi Desert and Desert Steppe - arid and semi-arid zone are used as natural pasture. In the above-mentioned vast Gobi Desert and Desert Steppe area are often occur the natural disasters such as drought and heavy snowfall states. Over this regions drought occurs on an average of once every two or three years and the heavy snowfalls occurs every 5 to 6 years and once every 2 to 3 years covering half and quarter of country's territory, respectively. The summer frequent droughts and severe winter's forces are intensifying desertification in arid, semi-arid and sub-humid areas of Mongolia. Coarse spatial resolution, high temporal frequency satellite data from the Advanced High Resolution Radiometer (AVHRR) operated by the National Oceanic Atmospheric Administration (NOAA) based technology and methods are widely used to monitor vegetation cover and drought events throughout the world). In Mongolia, several studies involving the use of the NOAA/AVHRR data have been published. Most of them had concerned with determining vegetation cover study mapped drought conditions of the Central Asian zone based on the multi-temporal Global Vegetation Index data from 1982-1987 and noticed that when a drought events occur in the Mongolian Gobi Desert zone, the Normalized Difference Vegetation Index (NDVI) values became to a low values, 0.0-0.05 units, same as value of the extra-arid land - Taklimakan Desert. As mentioned, previous works have introduced that the AVHRR derived NDVI images are useful for analyzing spatial vegetation pattern and for assessing vegetation dynamics. However, from a synoptic point of view is required to improve the vegetation cover and dynamic estimation technology as well as to assess the impact of natural drought and its overall extent in space and time, especially in the Gobi Desert and the Steppe area of the Mongolia.
2. Mongolia territory can be classified into four dryness zones such as the humid, the sub-humid, the semi-arid and the arid zone, by NDVI data, vegetation types and as

well as according with desertification and geo-botanic maps. The NDVI data calculated from AVHRR channel-1 and channel-2 reflectance and the NDVI is has been shown to be highly correlated with vegetation parameters such as green-leaf biomass and green-leaf area and, hence, is of considerable value for vegetation discrimination. The NDVI defined mathematically as NDVI=[NIR-R]/[NIR+R], where R and NIR are the radiance or reflectance in the red and the near-infrared spectral channels, respectively. The Land Surface Temperature (LST) computed from AVHRR channel-4 and channel-5 brightness temperatures through the split window methods for land surfaces. The LST is correlative to evapotranspiration since it is highly controlled by the radiation received at the surface and the latent heat flux from the surface to atmosphere. The NDVI-LST space based drought indicators are developed by Karnieli (1999) and also are developed the drought monitoring indicators based on normalization method for a local area.

Conditions		Dryness zone			
		Arid	Semi-Arid	Sub-Humid	Humid
Wet years (1993, 1994)	NDVI and LST	-0.10	0.35	0.36	0.50
	NDVI and Rainfall	-0.20	0.36	0.54	0.76
	LST and Rainfall	0.75	0.61	0.51	0.59
Drought years (1992, 1995)	NDVI and LST	-0.35	0.14	0.44	0.56
	NDVI and Rainfall	-0.27	0.17	0.57	0.73
	LST and Rainfall	0.69	0.69	0.66	0.74

Table 1. Correlation coefficients between the NDVI, LST and the total Rainfall on the different dryness zones in the warm (April to September) seasons.

Most suitable method for estimate local a condition in any case is establishing a "normal" value as a benchmark.

3. Several previous investigations have shown that the multi-temporal NOAA-AVHRR based NDVI and LST are suitable study for land cover classification in Africa, climate variability in southern Sahel, deforestation of Central African evergreen forest, and for quantify droughts in sparse vegetated area of the Negev Desert. All of those area located in relatively low latitude when there were drastic negative relations between those two parameters. We get such kind of relations in the middle latitude area, such as in the Gobi Desert arid area. But in the semi-arid area in the middle latitude we could discover positive relations between those two parameters. Based on differenced method we found a drought indicator - well suitable in the arid and semi-arid area of Mongolia. Due to moisture stress on the vegetation, NDVI (LST) value recorded in the dry years should be lower (higher) than those values recorded in a "normal" year; therefore in drought occurred areas, drought indicator – NDVI differenced (LST differenced) values will be high (low) than normal and wet years. It is concluded that the AVHRR based NDVI and LST can provide valuable information for drought detecting and monitoring by operationally.

2.1.4 Desertification and the Needs of Monitoring Indicators in Thailand

General Situation Improvement of environmental conditions

From assessment and evaluation of scientific information of soil and climate, Thailand can be categorized as affected country by desertification because the ratio of precipitation over evapotranspiration in some parts of the country falls within 0.05-0.65.Evaluation of land use activities has shown a close relationship with two different forms of land resources deterioration. Soil erosion is one that is obvious on steep-slope

cropping land. The other can be found in form of expansion of the areas of saline soil especially in the North-East.
Economic and social development with export oriented agriculture influences a large expansion of cash crop production and a consequence of land degradation. Deforestation for dry land cropping causes a considerable lost of forest area and fertility. Ignorance of proper conservation practices leads to an alarming soil erosion problem and lowering of soil fertility. It is apparently that production efficiency of agricultural sector is reported low. Widespread of saline soil becomes more evident in the Northeast because of deforestation, inappropriate irrigation development and land-use activities. In fact, agriculture supports a majority of employment , however, sharing of GDP of the country by this sector is the lowest comparing to manufacturing and services. These are why most farmers are poor, Land is one among many other identified factors contributing to poverty. Several efforts have been tried and adapted to suit specific social and economic conditions of different environment to deal with land degradation and poverty. Some policies and modalities have shown successful stories and ready for up-scaling or aggregating to form bundles of project and program of implementation as parts of national action program for combating desertification and poverty eradication of the country.

Land Degradation
In Thailand, land degradation has been arisen from processes deriving from human activities and habitation patterns in three different aspects :

- Long – term loss of natural forest:
  Natural forest has been observed decreasing continuously from 27,362,850 hectares in 1961 to 12,972,200 hectares in 1998 .
- Soil erosion caused by water: on lowland where slopes are less than 35 percent, areas of 66.4, 3.0, 0.2 and 0.7 percent were characterized as low, moderate, severe and very severe eroded categories respectively, and on highland where slopes are greater than 35 percent, areas of 21, 4.4, 0.8 and 3.3 percent were categorized in low to very severe eroded in the same manner as on the lowland.
- Deterioration of the physical, chemical and biological or economic properties of soils The Assessment of Human–induced Soil Degradation in South and Southeast Asia (ASSOD) project recognizes that fertility decline, which is one of chemical deterioration, is the most significant among others.
- Soil salinization was reported spreading over 2.89 million hectare in the Northeast due to land uses and development activities. Damming up reservoir raised water table of downstream of existing underlined saline layer and flushed up salt to surface soil. Deforestation on upper watershed led to leaching of salt from upland deposit to lowland. Extent of soil – salinity levels are:
  - extreme salinity = 0.28 mil. ha.
  - moderate salinity = 0.59 mil. Ha
  - low salinity = 2.02 mil. ha.

Poverty incidence
The rapid economic growth between 1965 – 1995, ranging between 7.3% to 7.8% per annum, effectively raised country's income and improved the proportion of Thai people below the poverty threshold. Initially between 1962-1963, about 57% of Thai population were categorized as 'poor'. In period before economic crisis in 1997, a successful socio-economic development remarkably contributed to decreasing the

percentage of the poor to a considerable level. In 1988, the figure was down to 32.6% and continued with this trend until it reached the lowest figure of 13.8 in 1996.
While overall indicators suggested progress in terms of poverty reduction both in proportional and absolute terms, the economic crisis that surfaced in the middle of 1997, however, more or less, reversed this positive trend. The “poor” increased by 12.9% between 1996 – 1999.
Causing problems in relation to land were identified in different aspects e.g. Lacking of land for livelihood, erosion and productivity decline, soil salinization and etc.
Due to apparent deterioration in natural resources base as well as in persistence of poverty and widening income gap, there has been a general recognition over the need, not only to shift the focus from economic growth, but at the same time to launch target group-specific and area-specific poverty alleviation programs.
Review of the Country Efforts to Combat Land Degradation and mitigating poverty;
Strategy areas relevant to combating desertification target to achieve the following:

- Conservation and restoration of natural resources as well as utilization with the aim to have no less than 25 percent of conserved forest and 0.2 million hectare of mangrove forest.
- Soil erosion protection should not less than 0.8 million hectare and
- 1.6 million hectare of problem soils will be developed

Desertification Combating and Related Action Plan

A number of strategic projects have been implemented to suit specific physical and social environment. Vetiver Grass has been introduced for most soil conservation purposes because it is low cost technology. Tree plantation project on the highland for ground water reduction has been implemented in the North-East to mitigate the increased areas under soil salinity problem in the lowland etc.
Proposed scopes of action to be undertaken are the following:

- Identifying challenges facing the sub-region e.g.
  - population pressure
  - increasing demand of urbanization
  - increasing demand of areas for agriculture
  - inappropriate land resources management
- widespread of land resources degradation
- existent of poverty incidence
- limited stakeholder participation
- ineffective policy implementation
- capacity building for dry-land soil conservation
- Reviewing the status of land degradation and implementation:
  - seasonally arid and drought conditions
  - soil erosion
  - soil salinization
  - drought warning system
  - saline soil development programs
  - soil conservation programs
- implementation of dry-land soil conservation
- designing of the monitoring and evaluation system

2.1.5 Efforts made by Japan and Republic of Korea in Cooperation of Indicator development and Application with others

The desertification has not a local environmental problem but also a climatical problem which has been impacting much bigger closed to the original desertified areas. So countries like Japan and Republic of Korea have made great efforts on the cooperation on combating desertification with other Asian countries as well as UNCCD. Many friendly people and companies have paid a lot of efforts on plantation activities in China's desert areas. Many experts also paid their attention on the development of indicators and benchmark related to desertification monitoring. Many international forums and workshops have been held. Recently several international meetings and projects worked very actively. There are two of them being introduced below.

International Symposium Programme of Evaluation and Monitoring of Desertification Synthetic Activities for the Contribution to UNCCD

This activity has held in 2004 Feb. at Tsukuba, Japan, Organized by: National Institute for Environmental Studies (NIES), Japan

Background and Objectives of the International Symposium: "Desertification" is a serious environmental problem mainly caused by human activities combined with environmental changes. Progressing desertification in extensive region on our planet has been affecting and will continue to impact human society including global environment and food security at present and in future. The United Nations adopted the Convention to Combat Desertification (UNCCD) in 1994, and the necessity of positive promotion to combat desertification was confirmed in the world.

Although desertification was estimated to affect one forth of all land area and one sixth of all populations, their exact values have not been clarified until now. Therefore, the Conference of the Parties (COP) of UNCCD has repeatedly required the establishment of scientific methods on evaluation and monitoring of desertification. The Group of Expert was installed under the Committee on Science and Technology (CST) of UNCCD in 2002 for improving the efficiency and effectiveness of CST activities including the examination and discussion on Desertification Monitoring and Assessment (DMA). In Asia, the "Thematic Program Network 1 (TPN1)", the first activity in Asian region to combat desertification under UNCCD, is concentrating to examine the DMA. In Japan, it has been recognized that the related researches for contributing and supporting to these international activities should be promoted from the scientific standpoint. "Desertification" is closely related to natural and socioeconomic conditions in each local area, while in the meantime, there should be some universal processes. It is necessary to develop the systematic methods for evaluating desertification by comparison of individual activities in each desertificated region, even at the viewpoints of evaluating countermeasures. Therefore, the synthetic activities must be important by sharing the knowledge/information in different desertificated regions on the evaluation/monitoring of the present state in order to find out the effective direction for combating desertification. In this symposium, we try to compare the present state of desertification and desertification researches in the representative Asian region, to clarify the characteristics and problems of desertification in common and in each unique local region, and also to examine the direction of desertification research to be advanced in near future.

International Forum/Workshop on Combating Desertification and Controlling Dust and Sand Storms

This activity has held in October 2003 at Seoul, Republic of Korea.

The objective of the Forum is to stress the increasing importance of accelerating concerted efforts to combat desertification and control dust and sand storms in Northeast Asia. Some scientists recommend the annual frequency of dust and sand storms could be a useful indicator for desertification assessment.

Large-scale Desert and Sandstorms (DSS) has significant environment effects that cause enormous economic losses, present serious public health concerns over a wide geographic area, and, sometimes take human life. For instance, the DSS on 5 May 1993 directly affected 1.1 million square kilometers in the PRC, which resulted in 85 dead, 246 injured, 4,412 houses destroyed, 120,000 livestock dead or lost, and 373,000 hectares of crop land damaged. The direct economic cost of this DSS within the PRC alone was more than CNY550 million (about $66 million at the current exchange rate). The two most severe DSSs in decades took place in March and April 2002. They swept across Mongolia and hit 18 provinces in PRC, the Korean Peninsular, and a large area of Japan. Total suspended particulate levels in these affected areas were recorded from tens to hundreds of times higher than the national standards in these countries.

The DSS in early April was so severe that Mongolia had to close its international airport in Ulaanbaatar for 3 days, and the Republic of Korea had to close primary schools and cancel more than 40 flights departing from Kimpo Airport in Seoul. Satellite images of DSSs and analysis of the dust samples collected on the ground have revealed that impacts of strong DSSs are not limited to the region, but reach as far as North America across the Pacific Ocean. A preliminary study indicates that:

- 18 of the 32 DSSs in 2001 originated from the deserts of Mongolia
- the remaining 14 originated from the desert or semidesert areas of Inner Mongolia Autonomous Region, the PRC.

Factors that contribute to DSS are:

- natural elements
- large desert and semi desert areas
- strong winds from Siberia sweeping these DSS originating source areas
- lasting drought
- natural disasters, etc

Their effects have been strengthened and intensified significantly, however, by human interventions over the last few decades, particularly through overgrazing, over reclamation, deforestation, and overexploitation of water resources in the DSS originating source areas, which lead to rapid land degradation and desertification. Although all the countries in the region are affected by DSS, effective actions are urgently needed in the DSS originating source areas in PRC and Mongolia to arrest deterioration of the land, before the situation becomes irreversible.

The governments of PRC and Mongolia have formulated comprehensive programs to combat land degradation and desertification, which serve as their main thrust to alleviate DSS. With support from ESCAP, UNCCD, and UNEP, PRC and Mongolia have developed their national action programs to combat desertification. In early 2002, the PRC Government announced a 10 year program with a total investment of CNY54 billion (about $6.5 billion) to address the DSS concern in the northern PRC. With support of ADB, the PRC Government has also established a partnership with GEF for an overall program on land degradation in dryland ecosystems. However, the linkage of these national initiatives to the regions concern of transboundary DSS is yet to be established through cooperation beyond national borders. Without an effective policy and coordination at a regional level, the effectiveness of the national initiatives will be limited. The intensified transboundary DSS has mobilized very strong public will for regional cooperation on combating DSS, particularly in the DSS-affected areas, where hundreds of millions of people have been exposed to the impacts of DSS on living standards, public health, and economic wealth. In addition to various initiatives of the governments, nongovernmental organizations and volunteers from the DSS-affected countries have been actively undertaking cross-border activities to mitigate DSSs (e.g., planting trees in the DSS originating source areas), but in a sporadic and uncoordinated manner. Regional cooperation will maximize the effects of the initiatives from the private sector and civil societies in the affected countries.

3. Recent Projects undertaken on development of B&I.

The launching of the Asian Thematic Programme Networks spearheaded by the host country focal points was a milestone in the region. The launching reflected the common interest of countries in the region to formulate a coherent approach to combating desertification. Through the identified programme areas, TPNs focused efforts to key problem issues and offered an approach that avoided duplication. In many ways TPNs have made countries realize the potential of collaboration and at the same time highlighted the importance of maximizing merge resources to attain the set objectives.

Total six Asian Thematic Programme Networks (TPNs) now have been set up since 1999. Each TPN programme has been dealing with a specific desertification problem in Asia. They are:

- TPN1: Benchmarks and Indicators Development and Mapping for Desertification Monitoring and Assessment, host country: China. The Launching Meeting for the Thematic Programme Network on Desertification Monitoring and Assessment (TPN1) was held in July 1999 at Beijing China.
- TPN2: Agroforestry and Soil Conservation in Arid, Semi-Arid and Dry Sub-Humid
- Areas, host country: India. The Launching Meeting on Asian Regional Thematic Programme Network on Agro-forestry and Soil conservation in Arid, Semi-arid and Dry Sub-humid Areas (TPN2) in March 2000 at New Delhi, India.
- TPN3: Rangeland Management in Arid Areas including the Fixation of Sand Dunes, host country: Iran. The Launching Meeting on Thematic Programme Network on Rangeland Management and Sand Dune Fixation (TPN 3) in May 2001at Yazd, Iran..
- TPN4: Water Resources Management for Agriculture in Arid, Semi-Arid and Sub-Humid Lands, host country: Syria. The Launching Meeting of TPN 4 (the Regional Thematic Network on water resources management for agriculture in arid, semi-arid and dry sub-humid areas) in July 2002 at Damascus, Syria.
- TPN5: Strengthening Capacities for Drought Impact Management and Desertification Control, host country: Mongolia. Launch Meeting of the TPN5 (Asia Regional Thematic Programme Network on Strengthening Capacities for Combating Desertification and Mitigating Drought Impacts) in July 2003 at Ulan Bator, Mongolia.
- TPN6: Assistance for the Implementation of Integrated Local Area Development Programmes (LADPs), host country: Pakistan (Network not yet launched).

The Progress of TPN1

Dealing with desertification and understanding the dynamics of drought involve a high degree of uncertainty with complex technical, socio-economic and political variables. For this reason the role of science and technology cannot be over emphasized. Agenda

21 recognized the important contribution of science and technology to environmental monitoring, particularly in the optimum use of satellites for communications, navigation and positioning and meteorology. The overall objective of this thematic programme area is to enhance the desertification monitoring and assessment capacities of countries in the region through the establishment of a network and the harmonization of approaches for its conduct in the region. There were several relevant meetings of TPN1 for fulfill its task hold since 1998 listed below:

- November 1998, The International Experts Group Meeting on the Preparation of the Regional Action Program (RAP) for Combating Desertification and Drought in Asia, Bangkok, Thailand.
- July 1999, Launching Meeting for the Thematic Programme Network on Desertification Monitoring and Assessment (TPN1), Beijing, China
- June 2000, Workshop of the Asian Regional Thematic Programme Network on Desertification Monitoring and Assessment (TPN1 Workshop), Tokyo, Japan.
- November, 2001, Task Group Meeting on Benchmarks and Indicators, Asian Regional Thematic Programme Network on Desertification Monitoring and Assessment (TPN1), Beijing China.
- October 2003, The Workshop on Benchmarks and Indicators Development and Mapping for Desertification Monitoring and Assessment (TPN1), Beijing, China

But it seems that up to now no substantial agreement has been made on which indicator should be introduced to the decision makers and stakeholders at different level to implementing CCD. However the TPN1 came to a agreement for a final list of proposed indicators now. Also with the recent support of UNCCD and ESA in the Workshop on Benchmarks and Indicators Development and Mapping for Desertification Monitoring and Assessment (Beijing, Oct. 2003) TPN1 intends to create Asia desertification distribution map in the near future. Some detail were discussed in the workshop.
"A Proposal of B & I System for Desertification Monitoring and Assessment in Asian Region"by the TPN1 Group (see Annex II)

Objectives of the document
The general objective of this proposal is to put forth to TPN1 member countries a common set of benchmarks and indicators (B&I) system for desertification monitoring and assessment (DMA) in Asian region for comments and suggestions.
The B & I system, once finalized based on the comments and suggestions from the member countries, could be used for DMA for the Asian region.

Benchmarks
According to the opinion from General Assembly of the Intergovernmental Negotiating Committee for the Elaboration of UNCCD, Tenth Session, New York, 6-17 January 1997: "Benchmarks are used to develop correlations between various parameters and to provide a baseline for monitoring at the local, national and regional levels." Benchmarks are the baselines that serve as the starting point for evaluation and monitoring and thus provides a point of reference from which the land starts to degrade/improve. Benchmarks are standards against which desertified land can be compared in order to determine degradation trends. The benchmarks are also used to quantify the severity/degree of degradation. Different benchmarks are to be established for different agro climatic regions and different land uses. Benchmarks can be determined by identifying non-degraded land ecosystems (representative sites) under the same agro climatic zone and natural conditions. The benchmarks can also be established based on existing researches, historical data and field investigation.

Indicator system
The proposed indicator system includes four aspects: pressure, state, desertification impact and implementation (see Annex II).
Pressure indicators characterize driving forces both natural and man-made, affecting the status of natural resources and leading to desertification. Pressure indicators are used to assess desertification trends and make an early warning for desertification. Natural indicators describe natural factors, mainly climatic conditions, natural disasters, which promote the occurrence and development of desertification. Non-natural indicators describe the pressure on land leading to land degradation from human activities.
State indicators characterize the status of natural resources including land. The physical and biological features of desertified land ecosystem are the main factors to be considered. Physical indicators describe the land characteristics, physical and chemical properties of soil and hydrological features of the land ecosystem. Biological indicators are used to describe biological characteristics of the land ecosystem.
Desertification impact indicators are used to evaluate the effects of desertification on human beings and environment.
Implementation indicators are used to assess the actions taken for combating desertification and to assess its impacts on natural resources and human beings. Such impacts refer to improvements of socio-economic and natural conditions.
The framework of the state indicator system is based on three aspects, namely agro climatic region, land use and degradation process (table 1). For the pressure, desertification impact and implementation indicators, the framework of the proposed indicator system is in reference to agro climatic regions (table 2).

4. Suggestions to support the UNCCD implementation

- UNCCD secretariat, FAO and UNEP through LADA program and the EC project DESERTLINKS, AID-CCD have done and tried great efforts for developing a standard indicators sets that could be excepted by all the users in the world. It should be reached as soon as possible. International bodies should join their efforts together to solve this problem. So international organizations and countries could use the same or similar standard and scale to measure desertification and always give clear picture for each other.
- For the purpose above UNCCD should invite and organize experts of with richest experiences in B&I of desertification to develop a consensus on the definition and use of standard headline indicators. The experts come from different countries as well as some well done project like DESERTLINKS, TPN1 of Asia, LADA and AID-CCD maybe next year.
- The state indicators are very common used in monitoring and evaluating desertification for national desertification report and NAP. But the pressure indicators, desertification impact and implementation indicators were not very practical in data collection by the desertification monitoring system of countries. Some experiences of model countries should be introduced.
- The social and economic indicators of desertification are not common used related to state (bio-physical) indicators of desertification. Such methodologies should be introduced for practise in national and international levels.

5. References

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Yu. Bayarjargal, Adyasuren, Munkhtuya,(2002) Drought and Vegetataion Monitoring in the Arid and Semi-Arid Regions of the Mongolia using Remote Sensing and Ground Data.

Annex I: List of people/institutions to whom the questionnaire was sent (and rate of response)

Pratap@cazri.raj.nic.in, (Dr. Pratap Narain) Central Arid Zone Research Institute, Jodhpur, Rajasthan, India
Drajai_in@yahoo.com, (Dr.Ajai) Space Application Centre, India
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About 20% of response.

Annex II: list of indicators

China Desertification Classification System And Its Assessment Methodology of Quantification introduced below

Division of Desertified Land Type

In view of the geographic location and unique climatic features of China, the type of desertification in this country is varied. Based on the definition for desertification of the "United Nations Convention to Combat Desertification", and the features of desertification, the division of desertified land type should include the following three components: the type of desertification, type of land utilization and the degree of desertification. For nomenclature, the methodolgy of three-tiered compound is adopted, and each type has its respective code accordingly, so as to facilitate statistic works for monitored data, and collection of information. In accordance with the results of nation-wide desertification survey, the type of desertified land to be monitored in China may be divided into 4 major categories, 15 sub-categories and 52 types.

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100 non-desertified land

110 arable land

111 paddy field; 112 irrigated field; 113 dry field; 114 vegetable plot

120 forest land

121 arborous site; 122 shrubbery site; 123 nursery land

130 grassland

131 natural grassland; 132 artificial grassland

140 waters

141 river; 142 lake

150 land used for towns, transportation and mining sites

151 residential area; 152 land for highways and railroads; 153 land for mining sites

160 unused land

200 desertified land by wind erosion

210 wind-erosion cropland

211 light deflation cropland; 212 medium deflation cropland; 213 heavy deflation cropland; 214 extremely heavy deflation cropland

220 wind-erosion forest land

221 light deflation forest land; 222 medium deflation forest land; 223 heavy deflation forest land; 224 extremely heavy deflation forest land

230 wind-erosion grassland

231 light deflation grassland; 232 medium deflation grassland; 233 heavy deflation grassland; 234 extremely heavy deflation grassland

300 desertified land by water erosion

310 water-erosion arable land

311 light water-erosion arable land; 312 medium water-erosion arable land; 313 heavy water-erosion arable land; 314 extremely heavy water arable land

320 water-erosion forest land

321 light water-erosion forest land; 322 medium water-erosion forest land; 3323 heavy water-erosion forest land; 324 extremely heavy water-erosion forest land

330 water-erosion grassland

331 light water-erosion grassland; 332 medium water-erosion grassland; 333 heavy water-erosion grassland; 334 extremely heavy water-erosion grassland

400 saline desertified land
410 saline cropland

411 light saline cropland; 412 medium saline cropland; 413 heavy saline cropland; 414 extremely heavy saline cropland
420 salt-affected forest land

421 lightly salt-affected forest land; 422 medium salt-affected forest land; 423 heavily salt-affected forest land; 424 extremely heavily salt-affected forest land;
430 salt-affected grassland

431 lightly salt-affected grassland; 432 medium salt-affected grassland; 433 heavily salt-affected grassland; 434 extremely heavily salt-affected grassland;

Table 1 Land Classification System for Desertification Assessment

Assessment Indicators and Methodology for Desertified Land
Selection of Assessment Indicators

The selection of assessment indicators for desertification should be strictly adhered to the principle of scientific matters, application and systematization. The indicators selected should reflected the actual degree of various desertified land on the one hand, and also would help to the collection of remote sensing information, especially for high spectrum remote sensing information on the other hand. In determination of the degree of desertified land, owing to the situation of vegetation, soil and ground surface, it can from different aspects reflects the conditions of land desertification, thus, the selection of indicators should be based in the above three aspects, and the degree of desertified land is expressed as:

$$D=G+T+B$$

D: indicates the degree of certain type of desertification
G: indicates the situation of vegetation
T: indicates the situation of soil
B: indicates the situation of ground surface

In summing up previous lessons learned and in combination of the results monitored from Naiman Banner (county), and further based on the alikeness of various type of desertification in degree assessment, the same category indicator which is used to assess any type of desertification can be integrated into the same category. The selected indicators for each type of desertification see table 2.

No.	Type of Desertification	Assessment Indicator
1	wind-erosion forest land, wind-erosion grassland	vegetation coverage, vegetation biomass, water content of soil, soil texture, condition of ground surface crust, form of sand dune
2	wind-erosion cropland	crop performance, soil nutrient grade, soil texture
3	water-erosion forest land, water-erosion grassland	vegetation coverage, vegetation biomass, slope, erosion pattern, % of erosion gully area in the total land area
4	water-erosion cropland	crop performance, slope, soil nutrient grade, engineering measure
5	salt-affected forest land, salt-affected grassland	vegetation coverage, vegetation biomass, salt content of soil
6	saline cropland	crop performance, salt content of soil

Table 2 Desertification Assessment Indicators

Assessment Methodology

In the process of assessment of the degree of desertified land, for avoiding any determination confusion derived from the crisscross of the multiple assessment factors, the quantitative methodology of assessment should be adopted, i.e by the Dephi method to identify the weight (Xi) of each indicators; then, each indicator should be further divided into grade criteria and endowed with a grade value(Yij), thus the formula is used to evaluate the degree of the desertified land:

$$D= \Sigma XiYij$$

D: indicates the degree index of certain desertified land unit (massif)
n: indicates the factor number of assessment indicator
Xi: indicates the weight of the assessment factor numbered i
Yij indicates the grade value of the assessment factor numbered i, under the grade criteria numbered j

In order to obtain the indicative information in a simple and convenient way from remote sensing, and use easily the data previously gained, each indicator is therefore divided into 5 grade criteria and endowed with a grade value of 1.2.3.4.5 while the totality of weight for various indicative factors is 10. Thus, the assessment indicative system (Table 3) for the degree of desertified land is established.

Type of Desertification	Assessment Indicator	Weight Xi	Class Criteria	Equivalent Value Yij
wind-erosion forest land wind-erosion grassland	vegetation coverage (%)	3	> 60	1
			60-41	2
			40-26	3
			25-10	4
			≤10	5
	vegetation biomass g/m2)	2	>500	1
			500-300	2
			300-150	3
			150-50	4
			< 50	5
	water content of soil		> 3	1
		1	3-2.3	2
			2.2-1.5	3
			1.4-0.7	4
			<0.7	5
	soil texture	1.5	clay loam	1
			soil	2
			sandy loam	3
			loamy soil	4
			sand	5
	ground surface crust condition	1.5	extreme crust	1
			medium crust	3
			non-crust	5
	form of sand dune	1	flat sandy field	1
			lower sand dune	2
			medium-height sand dune	3
			high sand dune	4
			extremely high sand dune	5

sandy arable land	Crop performance (kg)	4	excellent	1
			average	2
			poor	3
			poorer	4
			poorest	5
	soil nutrient grade	4	<1.7	1
			1.8-2.5	2
			2.6-3.3	3
			3.4-4.1	4
	soil texture		> 4.1	5
			clay loam	1
			soil	2
			sandy loam	3
			loamy soil	4
			sand	5
water-erosion forest land water-erosion grass land	vegetation coverage	3	> 60	1
			60-41	2
			40-26	3
			25-10	4
			≤10	5
	vegetation biomass	1.5	>500	1
			500-300	2
			300-150	3
			150-50	4
			<50	5
	slope	1	<3	1
			3-8	2
			9-14	3
			15-20	4
			>20	5
	erosion pattern	2	surface erosion	1
			rill erosion	2
			corrugation erosion	3
			dissected ditch erosion	4
			gully erosion	5
	% of erosion gully area in the total land area	2.5	<=5	1
			6-10	2
			11-15	3
			16-20	4
			>20	5
water-erosion arable land	crop performance	3	excellent	1
			average	2
			poor	3
			poorer	4
			poorest	5
	soil nutrient grade	2	<1.7	1
			1.8-2.5	2
			2.6-3.3	3

			3.4-4.1	4
			>4.1	5
	slope	2	<3	1
			3-8	2
			9-14	3
			15-20	4
			>20	5
	control measure	3	afforestation by every slope in level	1
			and/or adverse slope terrace;	2
			level and adverse slope terrace;	3
			hasty terrace;	4
			other biological methods;	2
			no engineering measures to be taken	1
salt-affected forest land salt-affected grassland	vegetation coverage	3	> 60	1
			60-41	2
			40-26	3
			25-10	4
			<=10	5
	vegetation biomass		> 500	1
		2	500-300	2
			300-150	3
			150-50	4
			<50	5
	salt content of soil		<0.2	1
			0.2-1.0	2
			1.1-2.0	3
			2.1-3.0	4
			> 3.1	5
salt-affected cropland	crop performance	4	excellent	1
			average	2
			poor	3
			poorer	4
			poorest	5
	salt content of soil	6	<0.2	1
			0.2-1.0	2
			1.1-2.0	3
			2.1-3.0	4
			>3.1	5

Table 3 Assessment System for Degree of Desertified Land

In determination of the degree of desertified land, by use of the formula (2) and based on the values obtained from the remote sensing information, the index of the desertification degree of certain land block could be required. In accordance with the international practice, the degree of desertified land could be divided into 4 grades of light, medium, high and extremely high.

Degree	Non-Desertiified	Light	Medium	High	Extremely High
Index Value	≤15	16-23	24-31	32-40	> 40

Table 4 Grade of Degree of Desertified Land

Indian Classification System of Desertification Assessment and Mapping System

A three level hierarchical system of classification has been followed for the desertification status mapping. This is explained as bellows :

LEVEL 1 : Land Use/ Land cover –

The following categories have been identified as below –

Dryland Agriculture
Irrigated Agriculture
Forest
Land with Scrub
Barren / Rocky land
Dunal/ Sandy Area
Drainage / Water body
Grassland

LEVEL 2 : Processes of Degradation

This level deals with the type of morphological processes resulting in degradation.

Vegetation Degradation
Water Erosion
Wind Erosion
Water Logging
Salinity
Mining/ Quarrying

LEVEL 3 : Severity of Degradation

This level represents the degree and severity of the degradation.

Slight
Moderate
Severe

The details on the severity classes for different desertification process are given as under:

a) Vegetative Degradation

Status criteria	Desertification classes		
	Slight	Moderate	Severe
Plant community	Climax or slightly changed	Long lasting secondary	Ephemeral secondary
Percentage of climax species	> 75	75-25	< 25
Decrease of total plant cover,%	< 25	25-75	> 75
Loss of forage ,%	< 25	25-75	> 75
Loss of current increment of wood, %	< 25	25-75	> 75

b) Water Erosion

Status criteria	Desertification classes		
	Slight	Moderate	Severe
Non-arable land			
Type of erosion(Depth and Width is in Meters)	Sheet erosion, single rills- Depth- upto 0.5m and Width- 0.4-0.9m	Sheet & rill erosion, rills, formation of gullies-Depth- 0.6-1.2 and Width-1.0-1.7 m	Sheet erosion, rills, network of gullies- Depth-6-10m and Width-7-25m Closely spaced 10-15 m, 20-40 m wide deep gullies- Very Severe
Density of channels, linear km per sq. km	< 0.5	0.5-1.5	1.5-3.0
Removal of top soil horizon, %	< 25	25-50	> 50
Arable land			
Removal of top soil horizon	< 25	25-50	> 50
Loss of yield of main crop, %	< 25	25-50	> 50

c) Wind Erosion

Status criteria	Desertification classes		
	Slight	Moderate	Severe
Non-arable land			
Sand Sheet in Cms	<30 cm per hummock Upto 100 cm over plains	< 50-150 cm/ stable dune and sandy hummock (East of 300mm Isohyet) <90-300 cm/ reactivated sand/ plant roots upto 40-100 cm (West of 300mm Isohyet)	<1-4 m dunes/ 100-300 interdunal sand/ Barchans 2-4 cm (mostly west of 300 mm Isohyte) 2-5 m active/ drifting dunes- Very Severe
Percentage of area covered with sand dunes	< 30	30- 70	> 70
Percentage of area covered with sod forming plants	50-30	30-10	< 10
Arable land			
Removal of top horizon, %	< 25	25-50	> 50
Blow-outs, percentage of area	< 5	5- 10	> 10
Loss of yield of main crops, %	< 25	25-50	> 50

d) Salinity/ Alkalinity

Status criteria	Desertification classes		
	Slight	Moderate	Severe
Water logging			In pockets with alarming rise in ground water table Standing deep water
Soil salinity and alkanity	>4ds/m (saline)	4-8ds/m (saline-alkaline), ground water fluctuations, 2-3 m depth	6-12ds/m (alkaline) groundwater rise upto 1 m
Soil salinization, solid residue, %	0.20- 0.40	0.40- 0.60	> 0.60
Salinity of ground water, g/litre	3-6	6-10	10-30
Salinity of irrigation water, g/litre	0.5- 1.0	1.0- 1.5	> 1.5
Seasonal salt accumulation, ton/ha	16- 30	30-45	45-90
Loss of yield of main crop, %	< 15	15-40	> 40

e) Water logging

Status criteria	Desertification classes		
	Slight	Moderate	Severe
Water logging	Wherever the Water table is near surface or Seasonal	Wherever the Water table is at the ground level but not submerging	Wherever the Water table is above the ground and it is submerging habitation / vegetation Perennial

B&I proposed by TPN1 Group

State indicators	Agro climatic region	Land use	Degradation process	Indicator
	Arid Semi-arid Dry sub-humid	Farmland Pasture Forestland ---	Physical process: Wind erosion/ Water erosion/ Freeze-thaw/ Water logging /Soil hardening/Landslide/Mudflow --- Chemical process: Salinization /alkalization / Loss of Soil organic materials --- Biological process: Vegetative degradation/ Loss of biodiversity ---	See table 4

Table 1 Proposed structure for the state indicators

Pressure indicators	Agro climatic region	Indicator
	Arid Semi-arid Dry sub-humid	See table 3
Desertification impact indicators	Agro climatic region	Indicator
	Arid Semi-arid Dry sub-humid	See table 5
Implementation indicators	Agro climatic region	Indicator
	Arid Semi-arid Dry sub-humid	See table 6

Table 2 Proposed structure for the pressure, desertification impact and implementation indicators

Pressure indicators	Natural indicators: Climate Natural disasters	Rainfall Temperature Wind Humidity Potential evapotranspiration Solar radiation Cloud cover Surface reflectivity Occurrence of dust storm and sandstorm Flood Drought Frost (in early spring and late summer) Landslide/mud-rock flow Plague of locusts Plague of rats in pasture/grassland ---
	Non-natural indicators: Socio-economic	Population density Education status Major source of livelihood/income Livestock density/composition Pasture management practices (artificial grassland) Forest felling and encroachment Miniing Fuel and fodder consumption/supply Collection of NTFPs Shifting cultivation Diminishing of water resources Land management practices Use of water resources ---

Table 3 Proposed pressure indicators

	Indicators for physical process	Erosion status of the land Shifting in sand sheet/sand dunes Water logging Soil moisture Soil texture Soil structure Soil types and properties Stone coverage/barren rocky area Surface water status Number and spread of water bodies Groundwater status Turbidity of water bodies ---
	Indicators for chemical process	Salinity/alkalinity Soil types and properties ---
	Indicators for biological process	Types of vegetation Species composition of vegetation Condition and coverage of vegetation Biomass and productivity of vegetation Crop area and yield Species composition of animals Soil microorganism ---

Table 4 Proposed state indicators

Desertification Impact indicators		Land use pattern
	Socio-economic indicators	Land productivity Income Migration Mortality rate Health conditions Unemployment Illiteracy Food security and malnutrition Prices of food grain Energy consumption by source Infrastructure security and development Gender specific issues Living standard ---
	Eco-environmental indicators	Air and water quality Occurrence of dust storm and sandstorm Land pollution Landscape pattern ---

Table 5 Proposed impact indicators

Implementation indicators	Action indicators	Economic input for combating desertification Investment level State of the development and implementation of action plan to combat desertification State of the legislation and execution related to combating desertification Capacity building Institutional support Intersectoral coordination and cooperation Incentive measures People participation NGO involvement ---
	Effect indicators	Proportion of desertified land rehabilitated Socio-economic standard of the people Improvement of environmental conditions ---

Table 6 Proposed implementation indicators

STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN WESTERN AND MIDDLE ASIA

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Executive Summary

The benchmarks and indicators related to the implementation of the NAPs, SRAPs and RAPs for desertification monitoring, assessment and combating at local, national, regional or international levels has been a very important issue and concerned by many scientists, officials in the national and international organisations. For the new efforts in this domain the China National Desertification Monitoring Centre, State Forestry Administration of China (CNDMC) had joint the EC Project "Active exchange of Experience on Indicators and Development of Perspectives in the Context of the UNCCD", (Commission of the European Communities- AID-CCD-EVK2-2002-00609) and used a questionnaire entitled *Enquiry: benchmarks and indicators of desertification processes* designed by a scientists group of this project. The questionnaire was sent by e-mail to the Focal Points and scientists of the relevant western Asian countries listed below:

- Countries of Central Asia: Kazakhstan, Kyrgyzstan, Turkmenistan;
- Countries of middle east: Iran, Turkey, Syria, Israel;
- Regional or sub-regional organizations: such as The Arab Center for the Studies of ARID Zones and Dry Lands (ACSAD), International Center for Biosaline Agriculture (ICBA) etc..

By the time of the deadline, replies had been received only from Israel. In order to compile this report, information for the other countries was extracted from the following sources:

From reports available from the UNCCD website;

- From relevant NAPs and SRAPs;
- From the Assessment and Mapping of Desertification Processes—A Methodological Guide edited by ESCAP/UNEP Research and Training Center on Desertification Control which was located at the Desert Research Institute, Academy of Sciences of Turkmenistan in 1993. From recent reports and papers of relevant desertification combating projects;
- From related study papers;

The countries of western Asian have paid attention and joint efforts in combating and monitoring desertification.

- The countries in this area have developed two Thematic Networks with some desertification M&E elements in The Sub-Regional Action Programme 2000 (SRAP) of western Asia. Capacity building, technical assistance, and training for the thematic network members and stakeholders have been paid attention; Geographic Information Systems (GIS) and Remote Sensing (RS) have been mentioned as tools in desertification M&E;
- Turkmenistan is a special country who had done a lot of work on developing a complete B&I system including physical, biological and socio-economic benchmarks and indicators to assess the impact of desertification and land degradation and carried

out many international training courses of desertification M&E indicators with UNEP in 1980's. Integrated estimation of the current state of desertification on the territory of Turkmenistan was carried out in 1998 by the Institute of Deserts based on space images, observations at stations, subject maps and statistic materials. A map of desertification was made on a scale 1:2,500,000;

- In a Case Study of Iran, three broad systems of indicators: Ground Water Indicators (Water Table, Cl, Ec, Sar), Land use indicator and Soil quality indicators (Ec , Sar, Organic Mater, Texture). Each indicator was weighted in relation to its influences on desertification process.
- In Israel, a case study "Remote-sensing monitoring of desertification, phenology, and droughts" has been carried out. It is concluded that the AVHRR imagery can provide valuable information for drought monitoring and characterization. Time series presentation of NDVI and LST reveals that the NDVI values correspond to the reaction of the vegetation to rainfall and that LST values represent seasonal climatic.
- There was a study of "Land degradation and desertification in desert margins" reported by Turkey experts. They recognized that Monitoring the extent, severity, and expansion of desertification with ground cover, storm intensities etc. as indicators is the most urgent and most difficult task. This requires large investments.
- There was a study of "Monitoring and Combating Desertification Project in the Syrian Steppe at Jabal AL-Bishri". The remote sensing and the GIS techniques were used in an intensive way to study the desertification phenomenon and its development in the monitoring area. The project activities included carrying out socioeconomic surveys of the population in the pilot area during the grazing season. It also included organizing field days for decision-makers and farmers in order to acquaint them with the results of the proper use of the lands of the steppe and the measures taken to rehabilitate the degraded areas.

In spite of the report provided here, we still feel not gathering enough information to cover the rather complete efforts for this domain by the countries in the reported region.

1. The sub-regional context

The countries of Western Asia are facing considerable economic, social and environmental challenges, which pose formidable threats to their future sustainable development. For the sake of brevity, only a selection of challenges directly related to desertification are highlighted here:

Population Pressure

A demographic explosion has been in the making for several decades in the sub-region. Some countries have had an annual growth rate of around3%. It is estimated that the overall population in West Asia increased by a factor of 2.5 between 1960 and 1995. Although some countries are reported to have experienced a reduction in their growth rate in recent years, the population increase will remain high over the next two decades. Thus, the pressure on natural resources will continue, and will lead to a higher risk of exposure to desertification in the sub-region.

Rapid Urbanisation

A high rate of migration from rural areas to the urban centres is being increasingly felt in the region. This process of migration has been most significant from impoverished low rainfall rural areas where poverty is more acute, to informal urban settlements in most cities. Moreover, migration to other countries from Egypt, Syria, and Palestine, for example, has provided a major source of family income in the rural areas. The agricultural population in many countries of the region has declined dramatically over the last three and a half decades, with respect to the total population, dropping from 58.5 % in 1960 to only 24.9 % in 1995. This said, in absolute terms, the size of the agricultural population has not fallen. Indeed, it has increased by approximately two million over the same period. This has led to increasing poverty in the sub-region as a growing population exploits a declining natural resource base. A case in point are the expanding urban centres on the best agricultural lands, which has driven farmers to poorer quality lands generating lower incomes. Thus, the growing incidence of rural poverty has been one of the leading factors driving desertification processes in the sub-region.

The Declining Nature Resource Base

The sub-region is endowed with a wealth of natural resources. However, due to the population increase, the *per capita* share is constantly declining. With limited water resources, the *per capita* share is projected to fall below the minimum requirement in almost all the countries of the sub-region.

Water scarcity is central to future development policies, since it is likely to limit economic growth in the sub-region. In addition, water-scarce conditions are often temporarily worsened by drought. In many countries, the resulting water deficit is compensated by overdrawing or by mining groundwater beyond sustainable limits. This results in declining water levels and increased salinity, particularly in the coastal areas, where seawater intrusion into freshwater aquifers has been reported.

Land resources and vegetative cover are similarly under serious stress, since more natural grazing land has been converted to permanent agriculture, forcing herders to graze their animals on declining rangeland, which, in turn, fuels the desertification process. Likewise, irrigation with low quality water, and poor irrigation management practices is leading to large-scale salinisation and loss of productivity. Inadequate fertilisation has lead to impaired nutritive status and structure of soils.

Overgrazing, and the declining quality of fallow land and contributing to the long-term decline in soil fertility, which impairs the biological productivity of the land. Pricing policies and incentives also play an important role in shaping producers' decisions, which, in turn, affect the long-term sustainability of the land quality and vegetative cover.

Slow Economic Growth and the Increasing Incidence of Poverty

The broad-based economic recovery of recent years has yet to resolve the major challenges facing the sub-region, including high unemployment and an increasing incidence of poverty. Nevertheless, these countries still suffer from persistently high levels of unemployment, and sharp disparities between rural and urban incomes and social and physical infrastructure. Meeting these challenges entails maximizing the potential of the sub-regional economies, in order to secure the rapid, equitable, and sustainable type of economic growth on which their future prosperity and socio-economic cohesion depend. Support for human development, socio-economic inclusion, and targeted poverty reduction initiative will also be crucial, as will continuing efforts to preserve the fragile or limited natural resources of the sub-region.

Limited Civil Society Participation

Article 5 of the UN Convention to Combat Desertification contains the definition of the obligations of affected country Parties implementing the Convention. These include the promotion of awareness on issues pertaining to the Convention and facilitating the

participation of the local population, particularly women and youth, resource users (including farmers, pastoralists and their representative organizations), in policy planning, decision making, implementation and reviewing National, as well as sub-regional and regional Action Programmes (NAPs) with the support of non-governmental organizations (NGO) and the civil society as a whole.
The strategic challenges faced by the sub-region include its capacity to institutionalize effective mechanisms to promote the participation of natural resource users in the definition of policies, and in the design and implementation of actions to combat desertification. Moreover, the development of clear environmental standards and indicators is crucial for increasing the awareness, commitment, and participation of the natural resource users in the process of promoting sustainability of natural resources.
In strategic terms, water resources and their sustainable management are a key issue for the future development of the sub-region. Similarly, vegetative cover and its sustainable management is a key concern for policy makers and development practitioners.
The components of the vegetative cover in the sub-region may be summarised as follows:

- Rangeland;
- Forestland;
- Mountainous areas;
- Cropped land area; and
- Oasis areas.

Like in the Eastern Asia there were many sub-regional meetings, workshops holding in western Asia. There were some of them:

- February 2000, Meeting on the endorsement of the sub-regional action programme to combat desertification in West Asia (GM), Dubai, United Arab Emirates;
- March 2000, Western Asia Focal Point Meeting on CCD National Report Preparation for COP4, Beirut, Lebanon;
- July 2000, Meeting on the Preparation of a Sub-Regional Action Programme to Combat Desertification in the Aral Sea Basin in the Context of the UNCCD, Bishkek and Issyk-Kul, Kyrgyzstan;
- April, 2001, Second Meeting of the Working Group of National Focal Points on preparation of the Sub-regional Action Programme to Combat Desertification in the Aral Sea basin (SRAP/CD), Almaty, Kazakhstan;

In order to solve the desertification causing problems mentioned above desertification monitoring has been a very strong requirement among the western countries and expressed in the Sub-regional Action Program in 1996 and Sub-regional Action Programme in 2000.
In the Sub-regional Action Program in 1996, Sub-regional Environmental Monitoring had been considered as fllowing: Environmental monitoring is essential to identify long term environmental trends, to provide early drought warning (in accordance with Article 10.3.a of the CCD), to discern human impacts and climatic trends that are expressed in desertification (in accordance with Article 17.a of the CCD), and to evaluate impacts of various development projects on the environment. Project #15,
Desertification Watch in Wadi Araba Using Remote Sensing and Geographic Information System proposes to develop a joint, Jordanian-Israeli, cost effective digital data base of environmental parameters related to desertification, to be distributed among government organizations, NGO's, planners and developers. A joint Jordanian-Israeli environmental monitoring system will be developed for Wadi Araba/Arava, and its implementation will include technology transfer and capacity building. Geographical Information Systems (GIS) together with remote sensing technology are the leading

methodologies used for monitoring and assessing environmental data and for the presentation and management of natural resources. Remote sensing sources use multispectral sensors mounted on satellites and on airplanes. These sensors provide cost effective digital data that is used after processing, calibration and analysis to create maps and monitor changes of the environment. Desertification processes that occurred in the last decade will be analyzed and mapped using historical satellite images together with existing data base, and field calibration and validation. This information will then be used to establish a long term environmental monitoring system for discerning the effects of climate andof human activities and development in the future, and for drought preparedness.

Also in The Sub-Regional Action Programme 2000 (SRAP) of western Asia has developed two Thematic Networks with some desertification M&E elements:

- TN 1 – Sustainable Water Management (SWM)
- TN 2: Sustainable Management of Vegetative Cover (SMVC)

TN 1/TN 2 Cross-Cutting Activities:

- Capacity building, technical assistance, and training for the thematic network members and stakeholders;
- Promotion of effective application of the tools of Geographic Information Systems (GIS) and Remote Sensing (RS) in support of relevant activities of the thematic networks;
- Development of Monitoring and Evaluation systems (M&E) for TN 1 & TN 2, to assist efficient management of the SRAP; and
- Provision of incremental support to member countries in their efforts to prepare environmental guidelines and standards, including the application of Environmental Impact Assessment (EIA) procedures, in their national development plans in areas affected by desertification.

The Monitoring and Evaluating Process

The local and sub-regional benefits of desertification projects must be demonstrated, documented, and shared. The SRAP will have to systematically document progress achieved under each Thematic Network. This will provide the basis for subsequent assessment, transfer and promotion of the approaches and techniques developed and tested over the SRAP implementation period.

As a first step to assess the progress made under the Programme, a unified monitoring and evaluation (M&E) system must be developed to draw on the various experiences of the participating countries.

The system will enable the MC and the RC to chart and report programme progress. At participating country level, the M&E system will be able to introduce modifications into the project plans and the overall programme of work and budget, on the basis of the progress achieved by each project, measured using the respective indicators and expected results. This will allow for the pruning out of non-performing projects from the SRAP Portfolio, while maintaining high quality performing projects.

Besides the SRAP some sub-regional cooperation research units related to desertification combating have been developed as well, such as The Arab Center for the Studies of ARID Zones and Dry Lands (ACSAD), International Center for Biosaline Agriculture (ICBA) etc.

2. State of art on Benchmarks and Indicators

2.1 Development Indicators and Application in Different Countries

2.1.1 Development Indicators and Application in Turkmenistan

General Situation of Turkmenistan

Like most countries in central Asia Turkmenistan had the pre-independence period, which was generally characterized by inadequate attention to the protection of the environment and by over-exploitation of land and water resources without due regard to ecological consequences, such as desertification and other forms of land degradation.

Turkmenistan is situated in the western part of Central Asia. The territory of Turkmenistan fully lies in the zone of Central Asian deserts and its nature conditions are characterized with extreme climate with rather fragile ecosystem, where every unreasonable step in land management could cause irreversible catastrophic consequences. Therefore, after gaining independence Turkmenistan is interested in conservation of nature integrity and environmental stability of the country. Negative natural phenomena control in Turkmenistan has been performed for a long time and significant experience has been gained on the governmental and local level. On the other hand, this problem attracts attention of scientists and specialists of Turkmenistan, mainly, because of global importance for the whole mankind.

In 1995 Turkmenistan, attaching specific importance to environmental-economic problems and expressing its determination to participate in developing environmental security in interests of present and future generation, joined the UN Convention to Combat Desertification, and in 1996 the Parliament of the country ratified it.

Practices of Desertification Monitoring and Assessment in Turkmenistan

Monitoring studies in Turkmenistan have a long history and started in 1912 when the Repetek sand-desert station was established. Later on the monitoring of environment was regularly performed in all eight reserves located in different landscapes of the country. Monitoring data allow scientists and specialists to determine the beginning and duration of desertification processes, to estimate their space-time dynamics and prove predicted conclusions on further development of environmental components. In the monitoring of desertification processes, in addition to the ground images, images obtained from satellites are widely used.

Turkmenistan has developed rather complete various physical, biological and socio-economic benchmarks and indicators to assess the impact of desertification and land degradation in 1980’s. This work had been done by the Desert Research Institute, Academy of Sciences of Turkmenistan.

Integrated estimation of the current state of desertification on the territory of Turkmenistan was carried out in 1998 by the Institute of Deserts based on space images, observations at stations, subject maps and statistic materials. A map of desertification was made on a scale 1:2,500,000 based on parameters, as follows:

- Plant cover degradation,
- Sand surface deflation,
- Erosion of irrigated and pasture land in piedmont regions,
- Salinization of irrigated soils,
- Salinization and dust-salt removal from the dried seabed of the Aral Sea,
- Swamping of pasture land with overflow collector-drainage water,
- Technogenic desertification in regions of new buildings.

On the map three classes of desertification are singled out: weak, moderate and heavy. One of the main indices of desertification processes development is the degradation of the plant cover. Vegetation of Turkmenistan plays a protective environmental role. In extreme conditions of deserts forests and forest plantations protect soil from deflation and erosion, serve as a fodder and fuel, biological drainage, protect populated areas and fields from hot wind and dust storms.

In the National Action Program to Combat Desertification of Turkmenistan, the monitoring and desertification database have been planned. Monitoring allowed scientists and specialists to determine duration period of desertification processes, to evaluate their spatial-time dynamics and validate prognosis of further development. Such work is one of important section of the National Action Program to Combat Desertification of Turkmenistan. Data gained with monitoring underlay theoretical and methodological recommendations, which were elaborated at the Institute of Deserts. Images gained from the artificial satellites “Meteor-Priroda”, equipped with survey facilities for visible, infrared and microwave spectrum, were widely used in the monitoring of desertification processes. The database on desertification control comprises information as follows:

- On topographical maps;
- On thematic maps;
- On aerial images;
- On space images;
- On desertification processes analysis;
- On bibliography;
- On implementation of projects to combat desertification.

Ground-based monitoring is conducted at research stations and reserves. For instance, such a work has been conducted for more than 25 years by the Repetek biosphere reserve. For summarizing and evaluation of desertification processes a database has been created, representing information-reference system. It contains cumulative and maintained in working conditions aggregate information and software necessary for achieving set objects. Database provides information to user groups or material for environmental expertise, for solving problem-oriented, or prediction and managerial tasks.

Sub-regional Cooperation on Desertification and Assessment

The Desert Institute of Turkmenistan has carried out an inventory of Central Asia's desertified lands, developed criteria of desertification assessment, and prepared a desertification map (scale 1:2 500 000). Almost all of Central Asia belongs to the Aral Sea basin. The Aral Basin has become an ecological disaster area giving way to saline land. The concept was developed of an Arid Land Centre for monitoring desertification, including a data bank based on space monitoring. This Centre was established two years ago in Ashkhabad. We have also offered to the Government of Mali and the Ministry of Forests of Iran, as well as to UNEP and ESCAP, our proposals to establish another centre. The creation of a network of such centres would promote the development of a single standardised monitoring network. Finally, we have developed a methodology on assessment and mapping of desertification.

In 1993, in view of the unprecedented development of desertification processes in the region, Presidents of states of Central Asia established an International Fund for the Aral Sea Rescue.

Turkmenistan pays great attention to the protection of environment for the purpose of reservation of health and prosperity of people. Turkmenistan deeply realizes its role as a keeper of those environmental resources, unique in the world.

International Cooperation and the Courses of The Assessment and Mapping of Desertification Processes

Before 1977 when a «World Plan to Combat Desertification» was passed at the international conference in Nairobi. Therefore, Turkmenistan joined in implementation of the Plan as an active member on its every stage. As early as in 1978 till 1991 International Scientific Training Courses were organized and functioned in Turkmenistan for improvement knowledge in the sphere of desertification control for representatives of developing countries of Asia, Africa and Latin America. During 12 years (before collapse of the USSR) 600 scientists and specialists from 62 countries had studied at the courses. In 1995 Turkmenistan joined the UN Convention to Combat Desertification and Drought Mitigation, and in 1966 the Parliament of the country ratified it. In the same year a Governmental Commission for preparing the National Program to Combat Desertification in Turkmenistan was established. On the whole, appropriate ministerial structures, departments, scientific institutions, institutes, NGO's and rural communes were involved into the successful implementation of the Convention on the national level.

Representatives of Turkmenistan took an active part in the work of the International Conference on Desertification Control Problems in Nairobi in 1977. Special training courses for interested countries of Asia, Africa and Latin America were organized on the basis of the Institute of Deserts of the Academy of Sciences of Turkmenistan as a first step in implementation of adopted Action Plan to Combat Desertification. In 1985 on the basis of the Institute of Deserts the National Center for Research and Training in Desertification Control for countries of Asian-Pacific Region was established Currently the Institute of Deserts is an organizer of a network of research and training centers of the CIS to combat desertification. There were some training courses such as "Pasture Land Reclamation and Desertification Control" and "Evaluation, Mapping and Monitoring of Desertification". A specific attention was paid to the criteria and indices of desertification and interdependence and interaction of natural and anthropogenic factors. In 1995 a concept of evaluation and technique of mapping of desertification processes with regard to the world-round experience was elaborated at the Institute of Deserts of Turkmenistan. In 1994 scientists of the Institute of Deserts prepared a proposal on making up "Atlas of desertification of arid land of Asia" in which scientists and experts of Kazakhstan, Uzbekistan, China, India, Pakistan, Mongolia, Iran and other countries of the region will take part.

The Assessment and Mapping of Desertification Processes—A Methodological Guide edited by ESCAP/UNEP Research and Training Center on Desertification Control which was located at the Desert Research Institute, Academy of Sciences of Turkmenistan in 1993.

In this book the concept of desertification assessment is discussed. The criteria for degradation of arid ecosystems (degradation of vegetation cover, soil erosion, soil salinization, soil compacting, technogenic desertification) is presented. The methodology of desertification mapping on the basis of space photos is considered. Desertification maps of the CIS arid zone and that the African Sahel Zone are presented as examples.

2.1.2 Development Indicators and Application in Iran

General Situation

The Islamic Republic of Iran (I.R. Iran) is located in South West of Asia with a land area of nearly 1650000 km2 . The country's population is about 65 million, of which more than 35.4 (about 23 million) live in rural areas where agriculture and animal husbandry is the main source of subsistence.

Eighty percent of total land area, where half of population resides, has arid and semi-arid climate. Rapid growth of population , inappropriate techniques in exploitation of water and soil resources, sensitivity of new geological formations to erosion, low average precipitation (less than 250 mm), spatiotemporal irregular distribution of precipitation, high evaporation rate (more than rainfall rate) and low biomass distribution all have caused severe erosion and high potentiality of land degradation.

The particular climatic conditions of Iran has contributed to the formation of indigenous knowledge with 3000 years of historical background. Iran is considered as one the most active countries in combating desertification.

Benchmark and Indicators Utilized to Measure Progress and Assessment Thereof

The indicators and benchmarks varies in different organizations including Dept. of Environment (DOE). In order to coordinate desertification indicators and benchmarks, FRO in consultation with the Natural Resources Faculty of Tehran University has prepared the draft proposal of a project. According to this project the criteria and indicators of desert, desertification, potential and velocity of desertification are determined on the basis of results obtained from domestic and foreign sources, taking into account the economic, social, biological and physical indicators.

Sustainable development, prevention of land degradation, and soil erosion as well as combating desertification have been dealt with as priority areas in the Third Five-Year Socio-Economic Development Plan, parallel to conservation and expansion of vegetation which is emphasized in our cultural and religious teachings. The strategies related to sectors of desertification has been prepared in accordance of principles of the NAP and designed to promote human indicators.

Measures have been taken or planned with the framework of national action programmes, including measures to improve the economic environment, to conserve natural resources and promote their sustainable use, to improve institutional organization, to enhance knowledge on desertification and its control and to monitor and assess desertification and drought.

As mentioned, immediately after ratification of the Convention in I.R. Iran, the principles of the Convention were incorporated in the Third Five-Year Socio-Economic Development Plan. Likewise, all provincial programming committees and relevant ministries in the field of water resource management, vegetation and environment, were instructed to coordinate their policies and activities through NSC.

Activities undertaken to integrate ongoing projects with the NAP are as follows:

- Identification of dry and semi-dry areas in the country;
- Determination of desertification factors and their role in this process;
- Expansion of Applied Sciences University;
- Expansion of public awareness;
- Promotion of local community organization in afforestation, water exploitation,
- watershed management and cottage industry;
- Transfer of lands tenure to local people and nomads in form of long-term lease
- Collection of indigenous knowledge in the field of combating desertification for
- applied and participatory plans;
- Identification of hotspots vulnerable to wind and water erosion ;
- Pest control and fire prevention;
- Participatory monitoring and assessment;
- Expansion of research in the field of combating desertification, and

- Promotion of early warning systems.

Technical Cooperation Developed

The I.R. of Iran has announced her readiness to exchange experiences with other countries. In the last two year, technical cooperation has mainly revolved around executing joint projects and workshops with specialized organizations .

The I.R. of Iran is interested to utilize experiences of other countries in the following areas including Determination of indicators and benchmarks of desertification:

- Formulation of indigenous knowledge and policies related to combating desertification;
- Mobilization of financial resources;
- Determination of indicators and benchmarks of desertification;
- Creation and promotion of early warning systems;
- Promotion of NGOs and community organizations; and
- Preparation and implementation of joint technical projects.

It is noteworthy that the Islamic Republic of Iran has found new opportunities to expand its regional cooperation after launching TPN3 in Yazd in 2001 .

A Case Study: Desertification vulnerability in Varamin Plain, Central of Iran

The vulnerability of land to desertification is mainly due to Overgrazing and woodcutting, over cultivation practices, and improper water management leading to salinization is the cause of the deterioration of irrigated lands. In addition to vegetation deterioration, erosion, and salinization, desertification effects can be seen in loss of soil fertility, soil compaction, and soil crusting. Urbanization, mining, and recreation are having adverse effects on the land of the same kind as is seen on range, dry farming, and irrigated lands. Land degradation involves as complex set of processes of factors, which interact in space and time leading to a decrease in land productivity. Thus, it is necessary to identify the various indicators, which will provide the relevant information to define the desertification prone areas. To this aim, the MEDALUS (Mediterranean Desertification And Land Use: European Commission, 1999) methodology was modified and adopted, and the risk of desertification was evaluated on a regional level by defined the ESA (Environmental Sensitive Area) Index. ESA's method takes into consideration three broad systems of indicators:

- Ground Water Indicators (Water Table, Cl, Ec, Sar)
- Land use indicator
- Soil quality indicators (Ec , Sar, Organic Mater ,Texture)

Each indicator was weighted in relation to its influences on desertification process. Each of indicators is assigned a score ranging from 100 (best) to 200 (worst). Value zero is assigned to the areas where the measure is not appropriate and /or those which are not classified (e.g. water bodies, urban areas, etc.). The function representing the variation of the indicators (scores) is liner ranging between the extreme values (100 - 200).

The integration was done using GIS technology and with help of ArcView 3.1 Software, the various information layers for each index were collected, prepared in a suitable format then overlaid in order to calculate the index as the geometric mean of the parameters related to each singe index.

The map of ESA index shows that in the central part of plain and along the northeastern it, there isn't any risk of desertification. But in the south western and in the limited area in southeastern the risk of desertification is high. And the others part of plain the risk of desertification is low to high.

2.1.3 Development Indicators and Application in Israel

In Israel, the Negev desert, comprising over half of the country's land area, is inhabited by only seven percent of the population. Israel is extensively involved in afforestation activities in desert areas, utilizing existing landscape and geographical resources to ameliorate conditions around Negev townships and intensive savannization programs and research.

The high priority accorded by Israel to combating desertification led to the establishment, in January 1994, of the Center for Desert Research and Restoration Ecology on Sede Boker, a joint project of the Jewish National Fund and the Ben-Gurion University's Desert research Institute.

Study on: "Remote-sensing monitoring of desertification, phenology, and droughts"

Several drought assessment studies have been made by experts of the Institute under investigation to demonstrate the annual dynamics. One of them used remote sensing method.

Results from the current study show that desertification, phenology, and droughts processes can be detected and characterized by using four out of five NOAA/AVHRR spectral bands. The NDVI is derived from the red and the NIR bands and the LST from the two thermal bands. Combined use of these two products provides more information than any product alone. Time series presentation of NDVI and LST reveals that the NDVI values correspond to the reaction of the vegetation to rainfall and that LST values represent seasonal climatic.

Drought indicators were derived in terms of three geometrical expressions based on the two extreme points of the NDVI-LST scatter plots. Evaluation of the suggested indicator shows only one that can successfully separate between the drought and the wet years. It is concluded that the AVHRR imagery can provide valuable information for drought monitoring and characterization.

The study areas for one case in the Sinai, little difference can be seen between the wet and the dry years and in the Negev, however, there is a considerable difference between the wet and dry years. During the wet years the shape of the graphs is stretched towards the high NDVI values and the phonological cycle is much more pronounced, whereas during droughts the NDVI component is much less remarkable.

1. the maximum LST 2 minimum NDVI; and
2. minimum LST 2 maximum LST.

It may be seen that the Sinai lines are very similar in terms of position and length; however, two groups can be distinguished between the Negev lines. The lines of the wet years are longer and with gentler slopes, whereas the dry years lines are shorter and steeper.

The objective of this function is to discriminate the drought years from the wet years on both sides of the border.

Study on: "Inter-linkages between Climate Change and Soil Conservation"

To focus on inter-linkages between climate change and soils that are relevant for soil conservation. The impact of Climate Change on the soil has recently been examined. The subject of the study was to look at the impacts of climate on soil functions. For Soil Conservation, the soil performs a soil and water conservation function (SWCf). This performance is totally different for cultivated and non-cultivated soils.

Research on relationships between climate and soil-water-vegetation interactions has been studied in relation to climate change and these are central to the interactions with climate.

These include those that influence the dynamics of the soil structure and mechanisms of crust formation. Soil temperature and moisture strongly influence water-stable aggregation, through soil biological processes. Soil aggregation is a good indicator of these affects as found from Israel.

2.1.4 Development Indicators and Application in Turkey

There was a study of “Land degradation and desertification in desert margins” reported by Turkey experts which was more or less related to the theme. 3.1 Development Indicators and Application in Turkmenistan

The term 'desert margin' as used here is the transition zone between the typical deserts and regions where there is an adequate supply of moisture for plant growth during the warm season.

Desert margins occupy about 54.4% of the land area of Turkey. According to the definitions, the desert margins occupy much of the Anatolian Plateau, the Mediterranean coast and the GAP area extending into Iran on the east and Syria in the south. The Black Sea coastal zone has high rainfall and is also excluded from the region considered as desert margins. Estimation made that about 83% of the whole country suffer from wind or water erosion problems. In addition, there are other soil-related constraints, such as salinity/alkalinity and hydromorphism that reduce the agricultural producing capacity. Most of these constraints are in the desert margin zones. Productivity is further hampered by the fact that the rural poor do not have the means or the technology to appropriately manage such systems in a sustainable manner.

Desert margins, from a biophysical and a socioeconomic point of view, form an unique ecosystem which has not been the subject of detailed studies largely because they occur in the developing countries of the world. However, due to population increases and demands for agricultural land, this last frontier of land is invaded and currently being stressed. This is the ecosystem within the zone of susceptible dry lands that is most prone to desertification. The ecosystems that are most prone to desertification largely due to high population density. Most of the tension zones occur in the desert margins. Identification and location of desert margins in countries, if followed-up with appropriate policy decisions and action plans.

There are processes and causes of desertification in the desert margins. The country of Turkey is used as a case study. There is sufficient information to demonstrate that this is the ecosystem within the zone of susceptible dry lands that is most prone to desertification. Assessment and monitoring of such systems, understanding of the socioeconomic and environmental context of land management and development of national to local policies to facilitate their use are the ingredients for reducing desertification.

The true deserts described as being 'hyper-arid' are excluded in the definition and further, CCD also refers to the arid, semi-arid and sub-humid zones collectively as 'susceptible drylands'. An Aridity Index (ratio of precipitation to evapotranspiration) is employed and drylands have a ratio between 0.05-0.65. Despite these politically correct definitions, there is still much divergence in the use of the terms. 3.1 Development Indicators and Application in Turkmenistan

Land degradation, being the loss in land quality or the reduced ability of the land for biomass production, results from a number of processes:

Anthropogenic pressures result from overgrazing, over-cultivation of marginal land, removal of biomass for fuel, and mismanagement of irrigated land. Collectively these processes strip the land of the protective vegetative cover that protects the land from wind and water erosion and crusting. A major characteristic of the desert margin is its inability to recover from such shocks in a short time frame; its resilience or the ability to restore the original biomass when conditions revert to the normal is low.

Loss of vegetation, which results in reduced evapotranspiration and an increase in albedo or the amount of radiation reflected back to the atmosphere, accelerates land surface-atmosphere feedback. Absence of cloud formation and thus rain causes a positive feedback further reducing the ability to regenerate vegetation. Progressive decline in land cover (banded, patchy, stippled patterns) is an indicator of desertification.

Hydrological feedback occurs when the reduced ground cover results in greater runoff and decreased soil storage of moisture. Rainfall efficiency in terms of fostering vegetation production, which is typically low in these areas, is further hampered.

Climate variations, caused by large scale deforestation at distant sites or by surface temperature anomalies, also affect the above processes. A characteristic feature of rain in desert margins is that it comes in a few storms of high intensity and regional climatic variations accentuate storm intensities. In the absence of adequate ground cover, high storm intensities are very erosive. Monitoring the extent, severity, and expansion of desertification is the most urgent and most difficult area of degradation research. This requires large investments that would be rewarded by our ability to predict and control desertification processes.
In the lands bordering actual deserts, such as the Sahel or the periphery of the Central Asian Deserts, the fluctuation of the climate is from arid to less arid conditions. The flux appears to have no predictable periodicity. Conditions of aridity are determined by global climate patterns. In such situations, land degradation results from humans attempting to utilize the small amounts of biomass available and from a point of view of intensity of land degradation processes, rates are low. This is in contrast with the Mediterranean or more humid semi-arid regions, where the iterative processes of land degradation contribute to aridity. In the lands bordering actual deserts, when more favourable moisture conditions prevail, vegetation re-establishes quickly or the resilience is high. In contrast, the land degradation induced conditions in the semi-arid parts of the world are different. The resilience of both the soils and vegetation is low and thus recovery is poor.

2.1.5 Development Indicators and Application in Syria
There was a study of “Monitoring and Combating Desertification Project in the Syrian Steppe at Jabal AL-Bishri” reported by Syria experts which was more or less related to the theme.
Within the framework of the cooperation between ACSAD and the international organizations, the Government of Germany provided ACSAD with modern techniques required for the study of the desertification phenomenon. The implementation of the Project started in the Syria steppe in late 1993 at a pilot area at Jabal AL-Bishri in collaboration with the Ministry of Agriculture and Agrarian Reform, the General Organization for Remote Sensing and the Peasants’ General Union in the Syrian Arab Republic.
The Objective of the project is Selecting and using the best techniques in the monitoring and analysis of the desertification phenomenon and the rehabilitation of the degraded steppes under different environmental conditions.

The remote sensing and the GIS techniques were used in an intensive way to study the desertification phenomenon and its development in the monitoring area (one million ha) within the Syrian steppe. The digital processing of the satellite images has been used since the middle of 1970s at regular periods. The most important achievements of the laboratory are:

- The map of the variables: this map shows the areas covered with sand in the monitoring area. It shows also the effect of banning cultivation in the Syrian steppe, which was put into force in 1995, on the retreat of the sand.
- The grazing intensity and watersheds maps.

Several methods were used in order to prepare this map:

- The digital interpretation of satellite images. This map played the most important role in identifying the sites of the surface water harvesting in the Project area.
- Detailed field surveys of the pilot area were made by the Project task force with the use of the remote sensing techniques and the topographic maps. According to these surveys the pilot area was divided into nine local environments and the type and degree of each degradation was identified in each environment.

The project activities included carrying out socioeconomic surveys of the population in the pilot area during the grazing season. It also included organizing field days for decision-makers and farmers in order to acquaint them with the results of the proper use of the lands of the steppe and the measures taken to rehabilitate the degraded areas. The project made surveys of the animal wealth in the monitoring area and carried out studies to assist in drawing up the proper plans for grazing management. Some studies were also carried out about the loss of the soil either by wind erosion or by water erosion at several sites representing different environments within the pilot area and the monitoring area.

3. Recent projects undertaken on development of B&I.

There is a relevant study: On Public Participation in Combating Desertification.

Currently, the world is in the state of change. The main factor of the global change is the excessive, and yet, increasing load that the human activities exert on the sphere where the humans live (the ecosphere). The global change has put on the world's agenda a number of major problems threatening the stability of the ecosphere, and, hence, the survival of mankind. Among these major problems are the ones associated with the deterioration of the biosphere as the area where the living organisms exist. Human activities have deeply changed the Earth's face. openness serves as an indicator of its man-made transformation The main features of the man-made transformation of landscapes and ecosystems are as follows:

- The fluxes of matters within a primary natural system are almost balanced, so that a system is almost closed. A system becomes ever more open due to the human activities such as the removal of harvest from a field. The same is correct for the energy fluxes in a natural system. One can say that the degree of the system's openness serves as an indicator of its man-made transformation.
- The homogeneity of the landscapes increases. It can also be an indicator of the antropogenic transformation of the territory.
- The ecosystem's productivity decreases in proportion to the value of the man-made load integrated over certain time.

The indicators of the desertification include the following: reduction of areas covered with vegetation; increase of the land surface's albedo; considerable loss of the perennial plants, in particular trees and bushes; degradation and erosion of soils; advancement of sand masses; salinisation and water logging of soils; etc. These processes are natural and they are typical of the arid systems. They are naturally controlled. But if the changes are triggered by man's actions, the consequences might increase above the usual ones and become irreversible.

4. Suggestions to support the UNCCD implementation

- A unified monitoring and evaluation (M&E) system must be developed to draw on the various experiences of the participating countries as soon as possible.
- For the purpose above UNCCD should invite and organize experts of with richest experiences in B&I of desertification to develop a consensus on the definition and use of standard headline indicators. The experts come from different countries as well as some well done project like DESERTLINKS, TPN1 of Asia, LADA and AID-CCD maybe next year.

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Karnieli A. and Giorgio Dall’Olmo (2003) Remote-sensing monitoring of desertification, phenology, and droughts

Monitoring and Combating Desertification Project in the Syrian Steppe Jabal AL-Bishri;

Sub-Regional Action Program for Combating Desertification, September 1996;

Sub-Regional Action Programme (SRAP) to Combat Desetification and drought in West Asia, 2000

Annex I: List of people/institutions to whom the questionnaire was sent (and rate of response)

erian@acsad.org, (Prof. Wadid F.Erian) ACSAD (Arab Center for Studying Arid Zone and Dry Lands)
karnieli@bgumail.bgu.ac.il, (Dr. Arnon Karnieli) Remote Sensing Lab., J. Blaustein Institute for Desert Research, Ben Gurion University; Israel
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academy@science.tajik.net, (Dr.Muhabatsho Hikmatov) Academy of Sciences,Tajikistan
rmorabbi@iran-irsc.com (Mr.Mohammad Morabbi) Iranian Remote Sensing Center, Iran
About 20% of response.

Annex II: list of indicators

Not available

STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN LATIN AMERICAN AND THE CARIBBEAN

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Executive summary

It is particularly clear in Annex III how burdensome issues related to desertification are and to what extent they affect a high percentage of land and population. Nevertheless, it is necessary to highlight how thoughtless the national and local governments turn on this issue, and how it taints at international levels for the seriousness of desertification in other annexes. Meanwhile, poverty and desertification clasp together at the most in areas where poor people are so dependant on limited and severly degraded resources.
As for the implementation of indicators and points of reference, B&I methodology is unanimous within the annex, what becomes obvious since almost all countries support this pattern. However, implementing B&I and setting to work " Desertification Monitoring and Assessment of Integral Systems" are deeply unequal from one member country to the other. Hence, while some countries have advanced on identifying and/or developing indicators systems and points of reference to further combat desertification, others are still initiating and concentrated on creating and consolidating institutional / organizing structures and capacities in order to design and contain combat actions (PAN). Within this framework, no countries have been found to add B&I to design and implementation, nor to measuring impact of each PAN.
The participation of international cooperation projects has been an outstanding contribution to consolidate and hasten the B&I definition process. As countries become more involved in international exchanges, likewise enhance the results on measuring and combating desertification.
On account of the topics dealing with indicators and points of reference available in the annex at the present time, B&Is command physical – biological support (land, vegetation, fauna, climate, water resources). Antropic scale indicators have grown in less, even when socio-economic aspects show a wider growth when compared with insititutional ones. The latter have not developed these days whilst impact indicators of actions carried out lag behind.
As regards the working scales prevailing in identified and developed B&Is, national scales dominate in detriment to local ones. Nevertheless, it is comprehensible for the scope of experiences carried out in the annex which, as mentioned, have headed firstly towards the organization and consolidation of National Action programs to later proceed with minor working scales (local).
Even when national working scales are predominant in the annex, it has done its best at designing participatory indicators on the initial actions carried out with local

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inhabitants. Meanwhile,working alliances have been consolidated among scientific, governmental and non-governmental sectors.

1. The regional context

In regard to the achievements in the Annex, the efforts of scientists coincide with governmental and non governmental organizations, evolving a vigorous promotion for the participation of local communities. Despite the strong contrasts among countries and sub regions, strategies to combat desertification are concentrated in the planning stage at national levels, to later decentralize and centre upcountry in the execution stage.

1.1 Desertification in Annex III

In Latin America and the Caribbean (Annex III) the effects of desertification are notorious and, though the degree of severity is not as manifest as it is in other regions, there is imperative need to use corrective measures now, so that the current trends do not become increasingly worse in the mid and long term.

According to PNUMA data (1991), in South American dryads desertification problems reach alarming figures: from the total of 420.67 million ha of agricultural lands, 305.81 million are degraded, representing 72.7%. Among these, the grasslands dedicated to animal production (390.90 mil. ha) are those that present the greatest affected surface: 297.75 mil. ha (76% of the total). About 31% of the lands without irrigation (6.64 mil. ha / 21.35 mil. ha) is degraded. Finally, of the 8.42 mil. ha of irrigated lands there are 1.42 mil. ha degraded (17%). It is evident that changing this situation will be not only very difficult but also very expensive.

There are severe problems of desertification in the Region, and they affect productive bases and society in practically all the countries involved -with specific socioeconomic, natural and political implications, that tend to worsen its effects thus spreading degradation. Among them we could cite the effects of natural catastrophes: hurricanes (the most critical of which was “Mitch”), sustained and recurrent droughts, earthquakes and destructive volcanic eruptions, floods and landslides, sandstorms, pronounced climatic oscillations in the semiarid and dry sub-humid zones with strong influence on the displacement of agricultural and husbandry related regions; "El Niño" and "La Niña" phenomena that influence coastal and interior areas, possible glacier retraction with consequences on water supplies and water logging, mainly in piedmont settlements of the great Andean range and their area of influence.

In addition to these natural risks – critical for drylands (arid, semiarid and dry sub-humid) – there is also human pressure on the environment as a consequence of the social, economical and political situations affecting the countries of the Region and provoking some of the major desertification problems:

- Massive deforestation, from the Amazonian and the Mesoamerican forests to the xeric "Monte" woods and the cold forest of the south end.
- Accelerated loss of biodiversity.
- Overgrazing and loss of productivity of savannahs, grasslands and shrubs.
- Accelerated rural-urban migration, abandonment of productive lands and increase in the rural, urban and suburban levels of poverty.
- Salinization / alkalinization and cave-in of the water table in irrigated cultivated lands.
- Critical effects on the quality and quantity of the surface and underground hydric resources.
- Degradation and destruction of soils.

- Extraction of non-renewable resources without previous planning (mining, petroleum).
- An increasing loss of values and traditional knowledge; undesirable changes in the use of land, worsening quality of life for rural and urban populations (violence, new survival strategies related to the urban explosion of outlying areas).
- Accelerated urbanization carried out without proper planning.
- The foreign debts of the countries that break the processes of growth and local development in the affected countries, and therefore work against the development of the national capacities in the fight against desertification.
- Underdevelopment of scientific and technological processes guided to control and revert the problems of desertification.
- Damage and infrastructure loss (reservoir filling, port dredging, destruction of roads, railways and bridges).

1.2 Benchmarks and Indicators in LAC. State of the Art

Yet, in spite of the fact that these shared problems can be detected, further inside the region the great diversity of situations is notorious. And if the seriousness of desertification problems is diverse, just as diverse are the levels of organization that each of the countries have consolidated. Some work experiences are previous to the convention, whereas in other cases the convention is the one to start synergizing efforts in this direction.

Likewise, and attending to the particularities assumed by desertification in relation to the geographical, social, economic, cultural and political characteristics of each country and region, the need for tools allowing to manage this information, and serving as a guide for the parties that participate in the implementation of corrective and preventive measures, stands out in the process of development of the Convention. It is therefore attempted to count on tools enabling to implement selection processes for critical areas, and to determine which actions should be taken in each particular and concrete case.

The need to count on permanent systems for monitoring and assessing both the processes generating desertification and the effects of drought is imperative, because such systems could result in sound and opportune decisions for decision makers.

In agreement with the fundamental role of information expressed in the context of the UNCCD, and in order to reach a better understanding of desertification processes, it becomes a priority to know what kind of information is required, and which will be its final use.

One of the assessment and action strategies recommended by the UNCCD to approach desertification issues is the use of benchmarks and indicators (B&I).

Indicators, as describers of the status and trend of the desertification process, constitute highly valuable tools to represent the complexity of the problem, and also document the history of projects in a transparent manner, contribute to and facilitate the process of decision making and the convincing of financial institutions, given that:

- They are tools for observing and assessing sustainability and for predicting tendencies
- They are a means to activate communication and participation.
- They are components and processes interrelated in an integral system of desertification assessment, planning and administration.

It is therefore inferred that adopting B&I in the region will allow to:

- Assess, in all their complexity, the desertification processes in the countries involved, particularly the processes of social, economic and environmental impoverishment.

- Strengthen the formulation and implementation of NAPs, SAPs and RAPs, to optimize their administration, to obtain more efficient and easily assessable results, both in the formulation and execution and in the follow-up of the generated impact.
- Help decision makers to analyze, predict, assess and modify the actions tending to favor sustainable development and formulation of proactive policies and their control in the fight against desertification.

The design of integral assessment systems based on the use of B&I is expected to enable mutual nourishment of international experiences, comparison of processes and problems of each region and country, and to obtain better results in the mid and long term in relation to the process of combating desertification. Thus it is recommended that the countries should adopt B&I systems, at national and local level, that will allow them to evaluate the status of resources and their tendency toward use and degradation, and assess their possibilities of introducing corrective measures and monitoring all actions undertaken.

Latin America and the Caribbean subscribe to this work dynamics and, together with the UNCCD, recognize that the use of indicators could synergize all efforts made. However, the possibilities of implementing integral assessment systems are different for each member country. While some have been working for several decades, others have just started to adopt the strategies suggested by the former.

Attentive to this disparity among situations, the countries integrating the annex have requested support and cooperation for an integral implementation of their NAPs through the establishment of Systems for the Follow-up of Desertification and Drought. Several of these countries have already developed capacities for the obtainment and assessment of transferable indicators. And, finally, all countries are interested in developing these capacities, acknowledging the importance of the use of indicators in the fight against desertification.

Evidently there is need to implement a mechanism of horizontal cooperation and technical training that facilitates data organization and human resource training by means of comparable methodologies capable of extrapolation.

There exist specific projects, finished or underway, involving groups of countries. These projects need to share and compare their results, and widen their scope of influence towards the countries that have not received cooperation as yet. Sums invested, though having allowed for the accumulation of important experiences, have generated only partial results. Existing initiatives have not yet generated the practical results necessary for their being adopted by the different countries.

It is necessary to capitalize on, and expand, the diverse initiatives existing in the Region. A key element for this purpose is the establishment of a Regional Program on Indicators of Desertification and Drought, an initiative that is currently taking shape under the TPN (Technical Program Network).

Great possibilities appear for the Region as respects international cooperation, especially South-South, and regarding project synergy inside and outside the Region associated with Desertification Indicators and Benchmarks.

2. State of art on Benchmarks and Indicators

2.1 Methodology used to obtain information on B&I in LAC

The present report attempts to provide an account of the diversity that characterizes the Region, and of gathered experiences in this issue. Thus it is intended to reflect the way in which each of the LAC countries and sub regions are currently working, and which is the degree of progress in building integral assessment systems based on indicators and benchmarks.

Within the framework of the project "Active Exchange of Experiences in Indicators and Development of Perspectives in the Context of the UNCCD", the objective of which is *to obtain the state of the art in Latin America and the Caribbean in relation to the use of indicators in the integral assessment of desertification processes*, a work methodology was designed to allow each of the countries involved to take part in the initiative. A general enquiry was carried out; the original version is included in annex 1. This first report, recalling the Annex, is the result of a critical analysis of the responses to the enquiry, and intends to integrate the State of the Art of the entirety based on a thorough assessment of each of the parties.
We must point out that the survey was carried out, issued to the key informants and processed in the year 2003 and beginning of 2004. This leads to the data reflected in this report, except for some actions already informed, which have been updated and refer specifically to the information provided by focal points and key informants. To this extent, definite information may have been ommited for having been worked out after that date, because the country did not provide for this type of facts or, in the last resort, for the reason that the survey was not made. We have tried to save this misstatement having recourse to the knowlegde of the authors and the information contained in substitute resources. We will appreciate the reception of all information not contained in this report, which will be duly included in future versions. In order to organize this study, we follow the sub regional organization promoted by UNCCD for Appendix III: South America Sub region, Mesoamerica Sub region, and Caribbean Sub region. The inquiry was conducted at each of the focal points in the countries of the region, including all key informants (non-governmental organizations, scientific institutions, etc.) identified along the joint work performed.

2.2 Report on South America subregion[5] - Experiences at national level

2.2.1. Argentina

One of the first antecedents of the use of indicators in LAC is the work carried out by IADIZA (Instituto Argentino de Investigaciones de las Zonas Áridas), which between 1987 and 1993 (even before the UNCCD establishment) elaborated a provisional methodology to obtain desertification indicators. At that time, the principal objectives were:

- To obtain a local and provincial set of desertification indicators, easy to identify, measure and represent, aimed at the formation of human resources in Argentina and Latin America and capable to lead training programs in the fight against desertification, and financed by PNUMA and FAO.
- To apply this methodology to the knowledge of the state and trends of desertification in degraded areas in order to design corrective actions and a legal frame.

Thus a practical and applicable methodology was reached. The selected indicators proved useful, not only for establishing desertification degrees, but also for helping awareness of the local population as well as of the decision-makers in the combat against desertification (Roig, F., Ed, 1989, and Abraham et al., 1994).
These works are complementary to the determination of desertification indicators at provincial level for the World Atlas of Desertification (UNEP, 1991). Leader indicators were identified per ecosystem, and maps of fragility, human pressure and state of desertification were drawn (Roig, F. et al., 1991). Both at local and provincial levels, the methodology include the temporal scale within the spatial scale (diachronic studies) for the analysis of process evolution, starting from the contributions of Environmental

[5] This study was made by Elena M. Abraham & Laura Torres (CONICET - LADYOT / IADIZA), Argentina

History. This methodology has been used in several case studies in order to understand the causes and evolution of desertification processes (Abraham and Prieto, 1991; Kharin and Abraham, 1992; Abraham, 1995).
Towards the early 90s a study on distribution and cartography of desertification in Patagonia was carried out (Del Valle et al., 1993) within the frame of the project for prevention and control of desertification for the sustainable development of Patagonia (PRODESER), Argentina-Germany Agreement (INTA-GTZ), now PRODESAR. The objectives focused on evaluation, classification, and interpretation of spectral signatures based on biophysical indicators for the drawing of desertification states. The resulting products were spectral charts for each Patagonian province, with a spatial resolution of 1,000 m x 1,000 m. of the total study area (78.5 million ha), 93.6% (73.5 million ha) shows different desertification degrees. The report also makes recommendations for a more sustainable management of the zone.
Once the agreement was settled, the activities and experiences held within the National Program for Combating Desertification remained as a useful knowledge. The numerous local, provincial, regional and national workshops stressed upon the necessity of working with indicators in order to develop a unique methodology in the fight against desertification. This methodology would permit to extrapolate and compare results among the different regions of the country, and facilitate decisions. These recommendations from the preliminary workshops were followed for the definition of thematic areas in the national program, in which a whole module deals with the strategies for obtaining indicators at national level. At that time the activities and experiences of the Argentinean Group for Obtaining and Evaluating Desertification Indicators, called by the National Focal Point, were extremely important.
Following the NAP's strategies and commands, the National Direction for the Conservation of the Soil, National Focal Point of the UNCCD, called specialists from all the regions of the country to form the "Argentinean Group for the Identification and Evaluation of Desertification Indicators". The work carried out was the preliminary identification of desertification indicators at national level for monitoring the desertification state and interrelations. This was performed according to a schedule of six workshops starting at the beginning of 1997 and ending by September 1998. The main governmental and scientific institutions of Argentina involved in desertification issues took part in this process. The result was the identification of indicators for thematic areas (biophysical, social, economical, management), analyzed according to state (vulnerability, anthropic pressure), dynamics and response. The preliminary results are published in the SDSyPA site (http://www.mediomabiente.gov.ar/areas/direcs/default.htm).
At sub regional levels, Argentina has been working on the "Construction of a desertification index in rural populations of the Arid Chaco". The purpose of this project was to build a desertification index in order to provide information to the national, provincial and regional users and to orient policies toward a reduction of desertification processes and the improvement of life quality in rural populations. The information obtained can be extrapolated to the 8 million hectares of the region. On the other hand, and considering that the production systems are similar to those of the Semiarid Chaco (24 million ha), results can be used for this region as well.
Argentina has also developed another approach: "Indicators at the request of decision-makers", and under this frame it is designing a B&I system directed to the decision-makers' necessities in the fight against desertification.
Another task now being tackled in Argentina is the development of indicators and benchmarks at local level. In this regard, the contributions of two groups can be pointed

out: IADIZA-LaDyOT, working in the desert of Mendoza, and UBA, Faculty of Agronomy, working in the Catamarca, Tucumán, and Salta valleys. For both regions integral desertification assessment systems are being settled. These systems are supported by the use of indicators and benchmarks, determined through case studies that involve local communities. Also, IADIZA-LaDyOT is working on several theoretical-methodological proposals related to indicators.[6]

According to the information provided by the Focal Point in Argentina, as an answer to the enquiry, the following projects should also be highlighted:

- Desertification diagnosis and control in the NOA valleys using indicators. Its main purpose is to characterize, according to indicators, the state and risk of desertification in the arid and semiarid valleys of northwestern Argentina (1,480,000 ha) and Puna (600,000 ha); also, to reach possible solutions to the problems using the right adaptable technology. Buenos Aires University, Faculty of Agronomy.
- Desertification spectral and landscape indicators in southern San Luis province. Its purpose is to observe by teledetection one space at different times and to check the spectral or geometric changes in the region between dates. INTA.
- Socioeconomic desertification indicators in the valleys of Catamarca, Tucumán and Salta. Its purpose is to identify some socioeconomic factors, and to quantify, evaluate and relate them to desertification. Faculty of Agronomy, Buenos Aires University.
- Monitoring and assessment of plant cover in relation to the processes leading to desertification. Its purpose is to identify variability and trends of vegetation in different ecological situations and assess which are prone to desertification. This project is underway at the Center for Survey and Evaluation of Agricultural and Natural Resources (CREAM), Córdoba University.

Another project now underway is the Argentina Pilot Country - LADA Project "Evaluation of Land Degradation in Arid Zones". It started in December 2001, through the association of UN organisms with international centres for agricultural research, agricultural organizations, universities and other civilian associates, as well as with the 170 countries that signed the Convention. The FAO is one the financing organisms and is in charge of carrying out the project. It will collect the available information and cooperate with experts from all over the world. Another major associate is the Environment Protection Fund (GEF). The Global Mechanism and the UNEP also participate by providing financial support, the latter being also in charge of carrying out the project.

Participant institutions will determine together an adequate evaluation method that will be fit for application at international level. During the first year of application of the project, four countries have been chosen for the pilot experience: Argentina, China, Senegal and Tunisia. It should be noted that this project has developed a seven-step methodology for evaluating degraded soils using indicators. Each one of the pilot countries will verify this methodology and contribute to its improvement by checking it with its own experiences. The first results for Argentina indicate that even though there are a good data base and a natural resource diagnosis, these have not been accompanied by a proper evaluation of social and economic effects. This is a tendency that has reverted over the last years, but an unbalanced situation persists between the volume of physical-biological information and economy. There is no evaluation of physical losses due to degradation of natural resources, decrease of productive potential, or recovery

[6] Torres, L.; ABRAHAM, E.; MONTAÑA, E.; TORRES, E. and Pastor, G.(2003) "La utilización de indicadores socio-económicos en el ESTUDIO y la lucha contra la desertificación: acuerdos, discrepancias y problemas conceptuales subyacentes", CEPAL, in press.

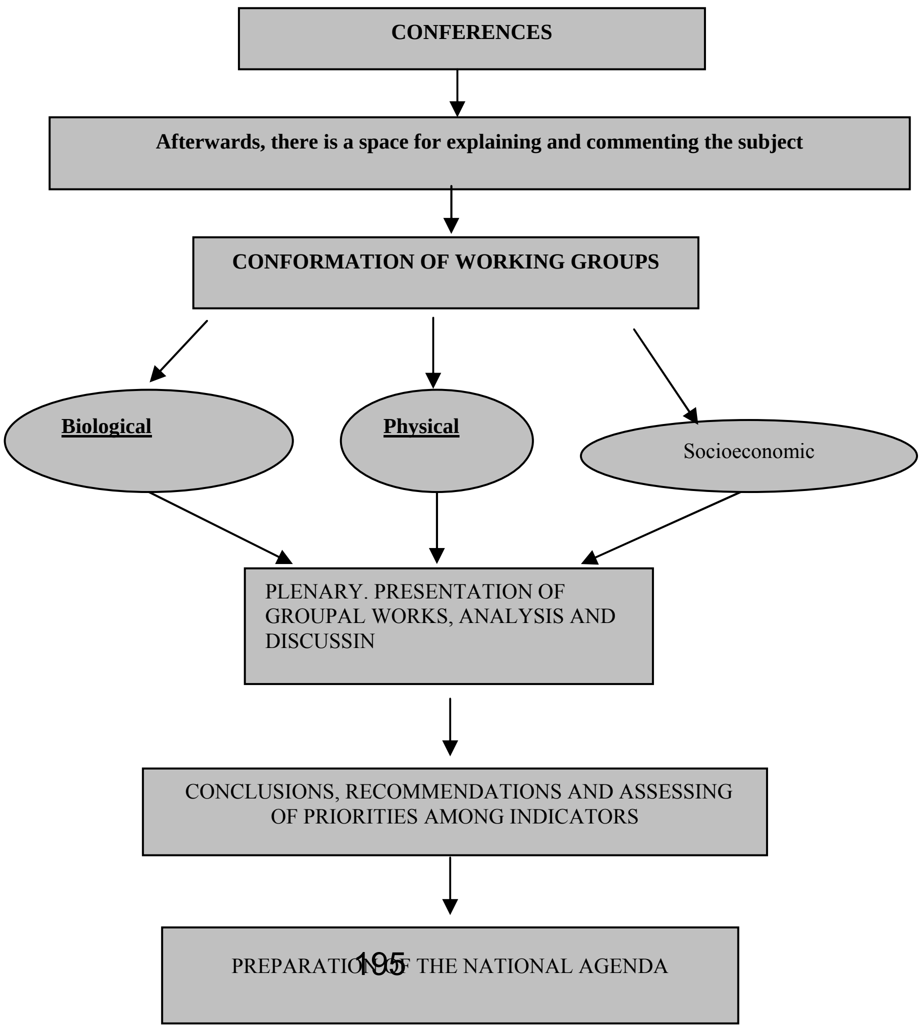
costs. Nonetheless, and in spite of their scarce diffusion, there have been methods and technologies generated in Argentina and validated at local and regional levels.

It should also be pointed out that the German Agency for Technical Cooperation (GTZ) has developed several actions as a support to NAP. Through an INTA – SRNyDS and GTZ agreement several supporting actions against desertification have been started at all levels, from national to local, thus cooperating with all NAP's partners, especially GOs and NGOs. The "Argentine Sustainable Development of Arid and Semiarid Lands" Project has devoted a special chapter to the development of Impact Indicators using a participative methodology and enabling the final users (doers, technicians, and inhabitants) to obtain and evaluate indicators. Results are available in CDs and can be ordered from the Argentina-Germany Cooperation. At the same time, supporting systems for making decisions in the combat against desertification have been developed by GTZ and INTA, especially for Patagonia and San Luis. These are also available in CDs and from catalogues.Argentina participates also in the Program to Combat Desertification en South America (IICA – BID) together with Bolivia, Peru, Chile, Brazil and Ecuador. The national focal point contributes with the set of indicators that have been agreed upon by the experts at national and local levels (Appendix 2). Likewise, it takes part in the project "Assessment of desertification indicators and of the socioeconomic impact of soil degradation" (ECLAC), together with Chile and Brazil.

Argentina has made the UNCCD a proposal for Technical Network Program (TNP) in order to articulate all B&I efforts in the region.

2.2.2 Bolivia

In 2003, this county carried out a workshop on desertification indicators socialization and validation, in the frame of the Program for the Fight Against Desertification in South America (IICA - BID). The methodology used is summarized as follow:



Indicators agreed upon at national level are in Appendix 3

2.2.3 Brazil

In the frame of the Program for the Fight Against Desertification in South America (IICA - BID), this country has developed a national workshop in 2003, which preliminary results are included in Appendix 4.
Besides, the Brazilian Focal Point, the Environment Ministry, Coordinator for the Fight against Desertification stand out among enquiries.
According to the data provided, Brazil has been working on the subject even before the UNCCD was created.
At present Brazil is carrying on several projects directly related to B&I. Some of them call international organizations, others NGOs, GOs and research institutions. This provides a wide approach and interesting analysis levels.
The main projects are: one of application in the Pernambuco State, depending on the Desert Institute; one dealing with indicators developed by this country together with Chile and Mexico and under the supervision of the Esquel Foundation; the already mentioned Program for the Fight Against Desertification in South America (IICA - BID) among Brazil, Ecuador, Peru, Bolivia, Chile, and Argentina, and finally the CEPAL Project that deals specifically with socioeconomic indicators at national level.
Lately, there has been and initiative from the Federated Universities of Pernambuco State channeled into the research project "Desertification; concepts, causes, consequences, and evaluation".

2.2.4 Colombia

Colombia ratifies the International Convention to combat Desertification in 1998.
In this country, the IDEAM has developed a model for the assessment of areas under desertification processes and the seriousness of this situation. These areas have been selected based on the climatic indicators proposed by UNCCD, together with other desertification indicators such as biotic component, xerophytic vegetation cover, edaphic component, degree of soil erosion, and salinization or alkalinization.
After applying this model to the whole country it was found that the lands under desertification processes reached 4.1% of the entire territory. Even though this does not seem to be a worrying figure, the affected territories belong to the productive area and this is an alarming sign.
As inferred from the enquiry analysis, Colombia is now developing the project “Diagnosis elements and recommendations of actions to be included in Colombia’s NAP (Stage I)”. Its purpose is to “reach a diagnosis of the present desertification state and to recommend actions to be included in the National Action Plan in the combat against desertification and management of dryland ecosystems (PAN).”
This is a research project at national level, conducted by the Environmental Studies Institute (IDEAM) together with the Ministry of Environment, Housing and Territorial Development.
Also, in the frame of the work “Diagnosis elements and recommendations of actions to be included in Colombia’s NAP (Stage I)” carried out by the consultant hired by MAVD with the IDEAM, the construction of a base line and environmental indicators of desertification in Colombia was started. It will alert on the natural resources and dryland ecosystems endangered by desertification and droughts. It will also help to make decisions on economic, political, social and ecological matters, as well as to design plans, programs and projects, to establish environmental priorities, and to become aware of what exists, its amount and fluctuation in time.

2.2.5 Chile[7]

This country ratified the 1997 UN Agreement, creating further on the National Action Program to Combat Desertification and Drought (PANCD-Chile).

Within this context, several desertification indicators have been developed to assess state and trends of these processes, following an interdisciplinary and interactive methodology.

The most significant indicators have been related to a higher objective, which is the creation of an environmental information system for the sustainable development of the arid and semiarid zones of the country.

A significant set of elements that take part in desertification have been assessed, as well as the relations and interactions that evidence this phenomenon.

Afterwards a model was defined for the interpretation of these phenomena and processes. The most conspicuous of these are:

- Land use and desertification multiscale model (GEM; MODAP)
- Model of climatic variation and productivity in arid regions (SIMPROC)
- Model of spatial distribution of plant communities in arid ecosystems (COBER)
- Model of carrying capacity in meadows from arid zones (CAPAS)
- Physically-based environmental model, spatially distributed (SHETRAN)
- Model of desertification dynamics (EIMS)
- System for monitoring desertification by teledetection (SIM-SIP-MULTIR)

List of regional indicators proposed by this country in Appendix 5

Since 1994 to date Chile has made progress in the development of indicators, from the Latin American regional scale approach to the local scale approach.

Chile has created an information system that permits to monitor desertification processes. Its main achievement is the MONITOR system developed by the Agriculture and Environment Centre, of the University of Chile, supported by GEF/UNDP and the organizations within PANCD-Chile.

Communities, institutions and authorities are participating in training programs on the use of the MONITOR System.

The country takes part in several projects in LAC: GTZ/ECLAC, together with Argentina and Brazil. It also participates in BID projects with Argentina, Brazil, Peru, Ecuador, and Bolivia.

In addition, as inferred from the submitted enquiries, in the country there is permanent concern for defining sustainable development indicators for each region. These efforts are harboured within the National Environment Commission (CONAMA).

The country has deepened the work with national and regional indicators, while local indicators have only been tackled within the context of specific projects, such as the already mentioned ECLAC and GEF-Monitor in which Chile participates.

Chile also provides a group of suggested indicators for evaluating the state of physical, biological, and social components, and the pressures on these resources. These indicators have been successfully tested in Brazil, Chile and Mexico through the GEF-Monitor Project. The list of indicators is in the Appendix 6.

As for participation in the frame of the use of B&I, some approaches in this regard have been applied, but participation level is still low. In this direction, some communities are getting involved in the definition of indicators and are learning how to use them. The

[7] The report on the progress of this country is based on Enquiry and two works presented at the International Seminar on Desertification Indicators for LAC, held in Mendoza, Argentina, in 2002. The first one, by Wilfredo Alfaro, is "Desertification Indicators Development in Chile", and the second one, by Fernando Santibañez, is "Developing an Indicator Model and Monitoring Tools for Assessing Desertification and Biodiversity Protection in Latin America".

selected approach is originally scientific, but its application is strongly based on experience, especially when evaluating indicators in the field.
With regard to the existence of case studies, pilot areas, or permanent stations for measuring and assessing B&I, there are several sites where information is permanently being evaluated which are the base for indicator assessment. In this sense there are rain gauge and other climatic data, water, air and littoral pollution. Socioeconomic data are monitored with CASEN polls every two years.

2.2.6 Ecuador
This country takes part in the Program for the Fight Against Desertification in South America (IICA - BID). The program proposes a workshop to be held in this country in order to discuss the indicators that will be adjusted with the other countries. Thus, Ecuador is now preparing its national workshop, which will contribute in turn to the creation of the NAP.

2.2.7 Paraguay
In 2003, the DESDELCHACO Foundation developed in this country a training course for the use of indicators and benchmarks in the fight against desertification. In that opportunity, governmental and non-governmental representatives were trained.
This experience meant that a great number of NAP's partners were trained in indicators. All of them are now working using this methodology and will consequently nourish the country's NAP.
Another initiative of Paraguay is to favour actions in the frame of the PAS Gran Chaco Americano thus promoting the systematic inclusion of B&I in the sub regional level.

2.2.8 Peru
In the frame of the Program for the Fight Against Desertification in South America (IICA - BID) among Brazil, Ecuador, Peru, Bolivia, Chile, and Argentina, this country has carried out its workshop in 2003. It provides important information rendered by two pilot experiences regarding indicators at national level. These contributions can be checked in Appendix 7.

2.2.9 Uruguay
The information about this country comes from the enquiries opportunely designed. According to data provided by the General Direction of Renewable Natural Resources, of the Livestock, Agriculture, and Fishing Ministry, among the projects or actions dealing with desertification and drought B&I, this country has developed a National Plan for Monitoring Soils Quality, starting in 2002.
Among its objectives, there can be mentioned:

- To obtain data and evolutionary trends of soils quality indicators in order to: a) decide on strategies for the use and management of soils in the middle and short term, and b) gather bases and criteria for future policies on the use of lands, in general, and soils, in particular. These tendencies should be detected in order to prevent and avoid problems before important quality losses (erosion, degradation, and desertification) occur.
- To move forward toward the promotion and certification of important agriculture and forest productive processes sustainability.
- To obtain information for the better understanding of soils diversity and quality and their evolution.

This project belongs to the research, planning and management area. It is geographically applied at national level, and is within the sphere of the Department of Soil Conservation, Soils and Water Division, DGRNR, MGAP.
Under this frame, indicators are proposed for the whole country. The principal methodological aspects are:

- Indicator selection criteria
  - It should be credible and easy to measure
  - It should be sensitive to changes in soil management
  - Its use and interpretation should be feasible
  - It should use soil
- Site selection criteria
- Condition (agricultural practices)
  - Conventional farming
  - Direct sowing
  - Open field irrigation
  - Greenhouse irrigation
  - Natural or recovered land
- Uses of the land
  - Agriculture with conventional farming
  - Agriculture with direct sowing
  - Agriculture-cattle rotation with conventional farming
  - Agriculture-cattle rotation with direct sowing
  - Forestation
  - Horticulture and fruit cultivation
  - Control (natural or recovered land)

According to the mentioned enquiry, the information about the properties and state of soils, as well as the plant cover, has been registered and is being used for production purposes (agriculture and forestation).
Differentiated indicators for the national or local levels have not been developed in the frame of this project. Nevertheless, there is a set of indicators that are being used.
They are:

- Physical indicators
  - Apparent density
  - Structure stability
  - Resistance to penetration
  - Infiltration
  - Texture
- Chemical indicators
  - pH
  - Fertility (interchangeable bases)
  - Organic matter
  - CIC
- Biological indicators
  - Nitrogen associated to total biomass
- Visual indicators
  - A-horizon depth

This project will contribute to the formulation and putting in operation of the NAP.
In spite of the short experience in carrying on the project, there is a wide experience in the use of information about soils, use/state/productivity relations, evolution of physical, chemical and biological properties, etc. This knowledge has permitted to make

recommendations on the use of land, especially regarding soils, water and pasture conservation (sustainable use).

2.2.10 Venezuela[8]

In 1993 the Ministry of Environment and Natural Resources (MARN) held a workshop on environmental indicators which served as a starting point for the creation of a National Centre for Environmental Statistics. One of its goals was to collect information about different environmental problems in the country and thereafter know their evolution in time.

In 1997, in the frame of the General Direction of Forest Resources, there was a national poll about criteria to define sustainability indicators for the Amazonian forest.

In 1998 the country ratifies the UN Convention against Desertification. After this, a series of meetings between NGOs and State authorities took place. As a result a list of indicators and variables relative to the soil resource was prepared. Within this frame the indicator is given a name, then it is defined, and finally the sources or institutions capable of producing the information are specified. (See list in Appendix 8)

In the present time, this country is devoted to the formulation of its National Action Program. For this purpose, the country is now trying to reach a diagnosis based on a technical document, which will permit to collect information from different States in the country. It conveys questions about specific topics for each State, but comprises variables of environmental, socioeconomic, and anthropic activities. The document develops indicators that could be considered as the starting point for the development of desertification indicators in Venezuela. (See list of indicators in Appendix 9).

Based on the enquiry, especially the one originated in the Ministry of Environment and Natural Resources, General Direction of Hydrographic Basins, it can be inferred that the country has not worked on desertification indicators as such. The publication of the NAP though permits to foresee a progress on the subject, since it deals specifically with desertification in some of its projects. Nevertheless, there are valuable experiences that are directly or indirectly related to the subject though not shaped as desertification indicators. According to the enquiry, the first antecedents in the region date back to the 90s. The first works are dated in 1994. They are the 1994-95 Venezuela's Environmental Balance and Venezuela's Environmental Balance Appendix 1996, whose objectives were to provide reliable information on the degree of environmental problems and to generate, collect, systematize, analyze, and spread this basic information regarding environment and natural resources. This is an interesting antecedent though the objectives could not be reached. After this project, there are other three that evidence the use of indicators in the country, but they do not focus particularly on soils or their use in connection with desertification or unsustainable practices. As for the use of indicators, the institutions that answered the enquiry state that the methodology used is based on the generation of a wide base of information on the physical, chemical and biological characteristics of the soil; quality of irrigation water; climatic factors; natural vegetation (its cover and degradation level); soil management practices, and socioeconomic conditions.

Afterwards, the relevant indicators for the case under study are selected. At the same time they are integrated, when possible, to desertification or sustainability indexes. These indicators are then recommended for the desertification process follow-up in the

[8] This report has been prepared based on the enquiry and the work "Application of desertification indicators in Venezuela. State or the art and considerations", presented at the International Seminar in Desertification Indicators for LAC, held in Mendoza, Argentina, in 2002.

zone. Regarding the selected approach, it is oriented toward participation, though only of experts and specialists at present.

2.3 Report on Mesoamerica subregion[9]

On account of the need to obtain information on the state of the knowledge and the use of benchmarks and indicators (B&I) of desertification and drought, at international level, the need emerged to make a brief diagnosis of the application of B&I in relation to the implementation of NAPs, SRAPs and RAPs, within the framework of the application of the UNCCD. For this purpose, identification of key informants and organisms was required (see *annex 10, List of Focal Points*), in order to request of them the information needed.

Concerning the enquire made to assess the performance in the use of benchmarks and indicators of desertification in Latin America and the Caribbean, responses were obtained from only two countries of the Isthmus (Costa Rica and Panamá), which reflects the low utilization of B&I. However, it is of utmost importance to point out that the responses obtained reveal a notable interest in implementing methodologies that may contribute to the generation of B&I, and for this reason the mentioned countries are developing some projects that will help generate these indicators. These projects are underway, and this report compiles all the information supplied during the research process from which the following was attempted to be accomplished:

1. Knowledge of the state of the art in relation to the use of benchmarks and indicators of desertification, on the part of different actors, at all levels (local, sub national, national , sub regional and regional) in relation to the implementation of the UNCCD.
2. Information on identified indicators for all thematic areas: especially biophysical and socioeconomic indicators.
3. Development of practical methodologies for the obtention of B&I:
   - How have these indicators been generated?
   - Which problems had to be solved in order to obtain them?
   - How are these selected indicators being used by decision makers and other users at the different levels of implementation of the UNCCD?

2.3.1 Panama

Institutional information

Complete name of the Institution:	ENVIRONMENT NATIONAL AUTHORITY
Address (postal, e-mail, telefax):	Albrok edificio 804; Apartado C-Zona 0843, Balboa Ancón; fax 315-0573; www.anam.gob.pa
Level (national, state, local):	National
Person (contact):	Ing. Ricardo Anguizola (General Administrator of ANAM), Lic. Abril Méndez, Ing. Yamil Sanchez, Lic. José Rincón C.
Institutional Objectives:	Protection, conservation and recovery of the environment, promoting the sustainable use of natural resources. In addition, to put in order environmental administration and integrate it with the social and economic goals, so as to achieve sustainable human development in the country.

[9] Study and compilation by Dr. Edgar E. Gutiérrez Espeleta and Bach. Humberto Jiménez Villanueva. Observatorio del Desarrollo, Costa Rica.

Governmental, non-governmental:	Governmental

Projects or actions in relation to the generation of B&I of desertification or drought

Project title:	Methodological guidelines for the Design of a Basic System of e Desertification and Drought Indicators in Mesoamerica
Objectives:	Design and implement a sub regional monitoring system based on indicators of drought, land degradation and desertification, that promotes the follow-up and assessment of participative actions for the prevention and correction of such processes and of what was proposed and validated in the Programs of National Action, and that at the same time contributes to the building of national capacities through the participation and sensibility of all actors involved.
Geographical area:	Mesoamerica (South of Mexico up to Panama)
Type of project (research, planning/administration, training, others)	Planning/administration, training.
Institution in charge of implementing the project:	President of the Central American Group (GRUCA), focal point presiding the Convención Centroamericana de Ambiente y Desarrollo (CCAD)
Start/end date of the project:	This is a proposal in search of financing.
Director:	Mesoamerican Group of experts on Drought and Desertification indicators.
Participating Institutions:	Ministries of the Environment or similar institutions of Central America-Mexico, and the CCAD
Contact persons (name and e-mail address):	Ing. Ricardo Anguizola (General Administrador of ANAM), ranguizola@anam.gob.pa Licda. Abril Méndez, senaarhi@hotmail.com Yamil Sánchez, senaarhi@hotmail.com José Rincón, senaarhi@hotmail.com
Other information:	Support of 4 experts from the region on the topic of benchmarks and indicators in Panama, Mexico, Costa Rica and Honduras to elaborate the technical part of the project.
Spatial scale of the indicators proposed:	Not defined as yet.
Methodology:	The methodology includes several stages: Stage1. Participative processes to define the users' needs; Stage 2. Definition of the objectives and capacities of the DMS; Stage 3. Establishment of work scales and geographical units of system analysis; Stage 4. Selection of Indicators; Stage 5. Establishment of biophysical and socioeconomic baselines for the selected indicators; Stage 6. Implementation of a protocol for data collection and assessment of indicators; Stage 7. Building an institutional network; Stage 8. Implementation of a National Desertification Monitoring System (DMS).

Opinion on the use of B&I (brief diagnosis)

According to the responses provided by Ricardo Anguizola Morales regarding the use of B&I in Panama, data related to this topic are currently being used in environmental administration. Moreover, proposals of desertification indicators have arisen in the national reports submitted to the CCD, still none of them has been implemented. Support has been given to the holding of workshops at regional level in order to sensitize on the importance of implementing these indicators in the National Action Programs of the countries, and to generate projects using desertification and drought indicators, worldwide and at the Mesoamerican level.

A proposal for the design of a basic system of indicators of desertification and drought in Mesoamerica has recently been developed, submitted by the Environment National Authority of Panama. Only indicators at the national level have been taken into account because the regional project's financing is underway, and the experts have not yet been able to hold a meeting to define the possible regional indicators.

It is worth pointing out that, at the national level, the following indicators are mentioned as an example:

Physical indicators

Deforestation, land movement, salinity, erosion, fertility, soil compaction and contamination, agricultural yield, forest and/or woodland cover, and increase in wild fauna.

Socioeconomic indicators

Increase in minimum wages, migration rate, mortality rate, unemployment rate, malnutrition and illiteracy rates.

Indicators are being used in activities for formulating the National Action Program and in the project life cycle. On the other hand the country's experience in the practical use of indicators is theoretical only, depending on the response obtained, as work is being carried out in relation to the formulation of the NAP and indicators have not been put into practice as yet.

Methodology used in Panamá in relation to B&I

The generation of indicators is achieved through a participative approach and by applying the scientific method, thus attempting an approximation to the reality shown by areas having problems of soil degradation and drought.

The methodology includes several stages:

Stage 1: Participative processes to define the users' needs.

Stage 2: Definition of the goals and capacities of the National Desertification Monitoring System (DMS)

Stage 3: Establishment of work scales and of geographical units of system analysis.

Stage 4: Selection of indicators.

Stage 5: Establishment of biophysical and socioeconomic baselines for the selected indicators.

Stage 6: Implementation of a protocol for data collection and assessment of indicators.

Stage 7: Building an institutional network.

Stage 8: Implementation of the DMS.

At present there are no study cases, pilot areas or permanent measuring stations for the use and assessment of B&I, nevertheless benchmarks do exist and can be used as a basis for measuring processes in the affected areas. They are also useful for generating indicators able to assess the behavior of areas subjected to degradation and drought.

Practical use of B&I in some of the identified projects

According to the results of the enquire, and relative to the question asked to the focal points of the UNCCD in Panama, at the moment B&I are not being used because the formulation process is in progress. Users are intended to be decision makers, and people devoted to generate research products for decision making.

The difficulties found in the country are mostly associated with financing the formulation and implementation of indicators. Besides, it must be noted that indicators generated in the frame of other Conventions are not being used. One more important aspect that should be remarked upon is that in the country there already exist information circulation systems and/or early alert systems at different levels.

2.3.3.1. Costa Rica

Institutional information

Complete Name of the Institution:	National System of Conservation Areas of the Ministry of the Environment and Energy
Address (postal, e- mail, telefax)	300 m sur Casa Italia, Barrio Francisco Peralta San José Costa Rica, fax 506 283-71-18
Level (national, state, local):	National.
Person (contact):	Mariano Espinoza Camacho
Institutional Objectives:	Administering and promoting the sustainable use of Natural Resources in accordance with the economic and social development of the country, with high participation of the civil society.
Governmental, non-governmental:	Governmental.

Projects or actions related to the generation of B&I of desertification or drought

According to the information provided by Mariano Espinoza, Focal Point of the UNCCD, thus far there is no project in the country for the development of B&I of desertification and drought. However, he highlights the participation that the Observatory of Development of the University of Costa Rica has, and has had, through the Advisory Committee on Land Degradation, in the generation of some projects which, though not directly developing this type of indicators, will contribute to the identification of degraded areas under the country's guidelines and responsibilities, in the frame of the Convention of the United Nations to Combat Desertification and Drought, and at the same time will help generate such indicators.

Opinion on the use of B&I (brief diagnosis)

Concerning the information or knowledge the country has about the B&I, the response was positive in spite of the fact that currently there are no projects in execution, Mariano Espinoza's answer in this respect is the following:

To date, in Costa Rica, no project developing B&I of Desertification or Drought has been generated. Currently, as respects fulfilling the country's commitments to the UNCCD to elaborate the NAP, a methodology has been developed for the priorship of hydrographic basins according to their level of land degradation, that will enable us to attend to the most critical points in the country. This methodology was presented at the workshop in Tegucigalpa-Honduras on this issue. Also the System on Land Degradation that CADETI is developing attempts to generate information closely related to B&I.

Indicators on different levels have been considered. The Observatory of Development of the University of Costa Rica, jointly with the Advisory Committee on Land Degradation (CADETI), is working on the development of a methodology for building indicators of land degradation in Costa Rica, which is intended to be likely of adoption by any UNCCD member country. This methodology is being developed under the criterion of hydrographic basins, and under social, environmental, economic and institutional criteria, in order to homogenize the effort with that of other institutions that are working on indicator building. The methodology comprises the generation of indicators at national level (local), but it is attempted to be used region wide, respecting the Convention’s criteria. Some indicators are included, such as land use, plant cover, production, employment, educational level, conservation practices, soils, pollution, among others.

Indicators currently being built up, both for the methodology for prioritizing hydrographic basins and for the Information System on Land Degradation (SIDETI), are being used in the formulation and implementation of the National Action Program (NAP) and for its assessment over its life cycle. The idea is that, once the methodology is applied and the problems are identified, pertinent measures may be implemented and the methodology may be periodically applied, and that the latter helps to assess whether corrective progress has been made.

Development of the methodology

Taking into account that there exist many limitations of information, in the first place the basin was determined as the geographical unit for the combat against land degradation. As a result of the country’s experience in agricultural development over the last 50 years, where numerous soil abuses were committed, the construction of a model was put forth for prioritizing the degraded basins, based on the following criteria:

- *Climate. Strong water deficits in basins*
- *Degradation level*
- *Concentration of the affected area*
- *Social development index*
- *Accessibility*
- *Fragility of land resources*
- *Capacity of recovery of plant cover*

It is also important to mention that, owing to the efforts made by CADETI and by institutions like the Observatory of Development of the University of Costa Rica, an Information System on Land Degradation is being implemented, that intends to generate a series of land degradation indicators useful to the decision-making process related to this issue, this task is currently in progress.

Methodology used in relation to B&I in Costa Rica

Here there is a brief comment based only on the enquire results, further on there is a more detailed explanation of the process of development of methodologies related to the generation of B&I, currently underway in Costa Rica, which are:

- *Information System on Land Degradation (SIDETI)*
- *Methodology for Prioritizing Interventions in Basins*

In general, in the development of these methodologies, it is attempted that there exists a true implementation of the participative approach in generating indicators. The approach used is theoretical-practical, developed under the scientific method and respecting the guidelines that must be considered in doing a research. It is intended to

be participative, since the opinions of experts on the topic and of people related to it are being considered.
CADETI has been working under the criterion of basin, doing the research on land degradation in the Jesús María pilot basin (center west of the country), including general aspects focused on land definition, according to the Organic Environment Law, and principally on soil use and conservation. Some data on the geographical area under study are provided below:

- Geographical position: Costa Rica, Central Pacific.
- Area extent: 358 Km^2
- Data obtained/measured: by monitoring stations.
- Starting date for data collection: in process.

The pilot basin will serve as a benchmark, and consequently as baseline, for the measuring processes in degraded areas and in areas susceptible of degradation. The basin and some of its areas showing a high degree of deterioration have been defined, and development of pilot projects will be focused on rehabilitation of these areas. These will be included in the elaboration of the NAP.

Practical use of B&I in some of the identified projects
The Observatory of Development of the University of Costa Rica has focused on the generation of information for decision making ever since its creation in 1997. In 1998 it started to pay more attention to environment-related problems, particularly the problem of land in its wider sense. The Observatory established the necessary contacts with state institutions, and promoted the creation of the Advisory Committee on Land Degradation (CADETI), of which it forms part and over which it presides at present. CADETI is the Inter Institutional Committee responsible for monitoring the fulfillment of the country's commitments after having ratified the UNCCD. This alliance has led to the development of several joint projects, as the one on "Development of a methodology of priorities of basin interventions". Besides, the methodology for the creation of indicators of land degradation is being developed, for their follow-up and to define the strategic work areas and the scope of the SIDETI Information System. It is attempted that users belong to the productive and academic fields, governmental and non governmental, so that decision makers and persons concerned may have the necessary inputs. The primary difficulty found is that there is no information system in the country that keeps record of statistical variables specifically related to land degradation. There is the intention to create the methodology required to develop and apply variables and indicators to the hydrographic basin geographical unit. Indicators generated within the frame of other Conventions are being used in the country and, moreover, there already exists a circulation or early alert system.

Some data on the methodologies implemented in Costa Rica
Information System on Land Degradation (SIDETI):
The Pressure-State-Response methodology (PSR) is being used to define its scope of action as regards the generation of indicators and the definition of the geographical unit.
Methodology for defining SIDET' s taxonomy: the methodology for defining the system's taxonomy will include the following elements.

- Delimitation of the scope of the information system
  The system will be directed towards providing information related to the land degradation issue.
- Delimitation of the Geographical Unit

All information is collected in accordance with the hydrographic basin unit determined and with the geographical area that comprises this unit.

- Integrating Framework for environmental monitoring: Application of the Pressure-State-Response (PSR) framework

  Originally designed by Statistics Canada in 1979, the Pressure-State-Response (PSR) conceptual model was resumed and adapted by the United Nations for elaborating several manuals on environmental statistics, conceived for its integration to physical and economic accounting systems. At the same time, this framework was adopted and modified by the Conservation and Economic Development Organization (OCED), that in 1991 developed the PSR framework, and in 1993 defined a key group of indicators in the European countries. The PSR will be used to guarantee an integral approach, but in addition the possible impacts caused from the activities generating degrading processes will be resumed, so the framework is called PRSI.

  The PRSI facilitates complete identification of relevant issues and sub issues to determine a proper delimitation of the system scope.

  Making the best use of this system depends on the success in defining an appropriate tool that allows to understand the issue of land degradation. In the first place, the huge dimensions associated with this issue should be put forth, and all truly relevant issues and sub issues must be identified for each dimension in particular in order to approach or measure the topic in question.

- Identification of dimensions

  The purpose of this exercise is to identify and propose a set of dimensions capable of being disaggregated logically, and allowing to have a comprehensive view of land degradation issues in Costa Rica.

  Four dimensions have been considered in order to achieve harmony in the System: Economic, Social, Environmental and Institutional dimensions, so that the System may be in harmony with other systems generated for the proper fulfillment of the environmental commitments of both the country and the region. Likewise, each dimension will be disaggregated into quantitative variables and sub issues in order to generate data allowing for the assessment of conditions in the different study areas.

- Definition of concepts

  These dimensions will be disaggregated into issues and sub issues, which is expected to enable identification of quantitative and qualitative variables that lead to the analysis of the situation.

Methodology for prioritizing basin interventions

The advantage of a procedure as the one abovementioned is that it is a simple, transparent and objective method, orientated towards the definition of the priorities of remedial actions for degraded basins.

Methodological development

The productive structure resulting from the development pattern of the last 50 years has been one of the triggers of soil abuse. This has provoked impediment to, and even destruction of, the capacity of recovery of plant cover, causing, in turn, an overall change in the mechanisms of soil surface runoff and retention, thus bringing about accelerated erosion processes having strong implications in the balance of ecosystems.

For the above reason, and with the aim of analyzing and quantifying these processes, and to eventually accomplish the elaboration of viable policies and remedial measures, a methodology of analysis is put forward that aims at including a wider combination of factors. In this exercise, the building of a model was attempted considering information limitations for the proper development of this methodology.

Establishment of intervention priorities

a. According to the distribution of hydrographic basins in the country, those showing an important dry period, that is, dry sub humid areas, were selected. The map of Life Zones of Costa Rica, published by the Tropical Scientific Center (1992) was used for this determination.
b. By contrasting the capacity of use with the current use it was determined that the basins more strongly affected by soil overuse correspond mostly to those of the Pacific margin, particularly the northern and central sectors.
c. Once the group of basins had been thus selected, intervention priorities were set by using the combined analysis of seven biophysical and socioeconomic criteria (indicators) that integrate the current degradation of each area with both their socioeconomic characteristics and their likelihood of restoration.

Degradation level

It refers to the % of basin affectation, which corresponds to the sum of the divergence categories Ot + O + Wt. As a measuring procedure, the most highly affected basin is assigned the highest score, that is 10, and then the values corresponding to each basin are established proportionately.
Where:
W: well used lands
Wt: lands used within their use capacity, but requiring special conservation treatments
U: underused lands
O: overused lands
Ot: severely overused lands

Concentration of the affected area

It is considered that the higher the concentration of the area affected, the more severe the problem tends to be, and vice versa. As a measuring procedure, a graphical analysis of the map of divergences in land use caused by hydrographic basins was made to compare and determine the degree of dispersal of the affected area among the pre selected basins, in order from higher to lower concentration, and to set the corresponding score points.

Index of Social Development (ISD) (MIDEPLAN, 2002)

These values were taken from the data published by IFAM (2202), selecting the cantons according to the geographical distribution of the areas affected, and establishing a pondered average per basin, according to the area of each canton. Afterwards, the most highly affected area was assigned the highest score -10- and then the values corresponding to each basin were set proportionately.

Accessibility (Km of passable roads/Km^2)

A good accessibility to the basin is considered to facilitate the implementation of remedial actions. This parameter was determined by estimation of existing roads in the affected areas, analyzing the Cartographic Pages 1:50,000 of the National Geographic Institute. The basin with highest density of roads is assigned the highest score, and then the values corresponding to the other basins are proportionately established.

Fragility of land resources
It is considered that the higher the fragility of land resources, estimated from it's potential for degradation, the worse the problem will tend to be.
The first principle is that soils of very loose texture, or with very fragile geological substrate –perishable- or with low depth or rugged relief, produce the most fragile conditions in the analyzed basins. Taking these criteria into account, an estimated assessment was made for each basin in order to assign the corresponding score points for each. For this analysis, the maps of soils and land use capacity of Costa Rica were used, on scale 1:200,000 (Vásquez, 1989).

Capacity of recovery of plant cover
The capacity of recovery of plant cover is closely related to the total moisture retention capacity of the soil[10], that depends primarily on its effective depth and texture; the data for calculations were taken from the study on soils and land use capacity in Costa Rica, at scale 1:200,000 (Vásquez, 1989).

Climate
Assessment of this variable was made according to an index of water deficit obtained from data on monthly rainfall, potential evapotranspiration, and field capacity of the soil.

2.3.3 Summary of results obtained in the enquire on B&I of desertification and drought
This report includes a compilation of the information supplied by Costa Rica and Panama. Of these two countries, only Panama indicates the generation of proposals of desertification indicators in the national reports submitted to the Convention, however, none of them has been implemented. Workshops have been held at regional level to sensitize about the importance of implementing these indicators in the National Action Programs of the countries, and to generate projects involving indicators of desertification and drought at national and Mesoamerican levels.
Currently, a proposal has been developed for designing a basic system of indicators of desertification and drought in Mesoamerica, presented by the Environment National Authority of Panama.
In Costa Rica a project developing B&I on desertification or drought has not been generated as yet. At present, in relation to the fulfillment of the country's commitments to the UNCCD, relative to the elaboration of the NAP, a methodology has been developed for prioritizing hydrographic basins according to their land degradation level, directed to attend to the most critical sites in the country. This methodology was presented at the workshop held in Tegucigalpa-Honduras on this issue. Also the Information System on Land Degradation (SIDETI), that the Advisory Committee on Land Degradation (CADETI) is developing, attempts to generate information closely related to B&I.
The results obtained in the present diagnosis are key to the identification of national needs existing in Mesoamerican countries, and to the execution of projects that help generate B&I at different levels (national, regional and municipal) and develop methodologies applicable to each of these levels that should be consistent to obtain comparative indices able to provide an early correction to land degrading processes.
To round up, we should highlight the fact that the Mesoamerican Group of Experts in Indicators of Drought and Desertification is devoted to the drawing of a project to

[10] The total storable water is calculated as the product of the total moisture retention capacity of the soil multiplied by apparent soil density and by effective soil depth.

preview the generation of indicators for the whole sub region. The project is named "Methodological Guideline for the design of a basic system of indicators of desertification and drought in Mesoamerica" and its main goal is "to design and put in practice a sub regional monitoring system based on Drought, land Degradation and Desertification indicators, to propitiate the follow up and evaluation of participative preventive actions , the correction of these processes and all that is motioned and validated by the National Action Programmes. Simultaneously, it will promote the creation of national assessments in conjunction with the collective action and sensibility of the total of areas involved".
Its fulfillment is expected in a series of stages, among which there can be mentioned:
Stage 1. Participative processes to define the users' needs .
Stage 2. Definition of the National Desertification Monitoring System (DMS) goals and capacities.
Stage 3. Establishment of work registers and geographical units of system analysis.
Stage 4. Choice of indicators.
Stage 5. Establishment of biophysical and socioeconomic baselines for the selected indicators.
Stage 6: Implementation of a protocol for data collection and assessment of indicators.
Stage 7: Creation of an institutional network.
Stage 8: Implementation of DMS.
Central America is engaged to, as stated in the work project, a validity and follow up process , and in some cases it focuses on the presentation of plans of action at a national level. Notwithstanding, the region does not count with enough tools for the definition of criteria with the view of efficiently dealing with actions suggested by PANs, with policies validity and their effectiveness or with monitoring and evaluating elements of impact on drought and desertification. This state of affairs brings about obstacles in the presentation of united sub regional actions to favor the Sub Regional Plan of Action.

2.4 Report on Caribbean subregion[11]

The Caribbean is extended 4 000 km from east to west and 3 000 km from north to south. It is a varied mixture of south-american and central-american countries and national islands with extension, culture, language, population and economic development markedly different.
Chapter 17 of Agenda 21 recognized that small island developing states (SIDS) are a special case for environment and development and that these States are specially vulnerable and fragile. Prior to the adoption of Chapter 17 of Agenda 21 a common problem that was experienced by SIDS is the application of development scenarios developed and applied in other environments without necessarily taking into consideration the peculiarity of island ecosystems. The increasing emphasis by the international community on SIDS and the search for methodologies (i.e. vulnerability index) which better represent the objective reality in SIDS as well as the challenges posed to the countries by the implementation of the three Rio Conventions has underscored the need for methodological development specific to SIDS of some of the concepts contained in or arising from those international legal instruments.
Land degradation is a serious problem in Caribbean SIDS and it has a direct link with agricultural productivity, a major source of livelihood in these countries. Notwithstanding its importance, very little empirical analysis has been done on the

[11] This study was made by Dr. Gustavo Febles, Cuba, based on Sixth United Nations Conference of the Parties to combat Desertification and Draught. La Habana, Cuba, 2003 and Focal Point. 2004, Internal documents. Cuba

causes and severity of land degradation in the region. Interventions tend to be heavily focused on inputs and outputs, and very little attention is devoted to outcomes. This provides information on what is being done by Governments on the one hand and those who are directly or indirectly affecting land degradation. Caribbean databases on draught, land degradation, desertification and other relevant physical and bio-physical parameters still need to be developed. The best set of relevant data is probably found in the various meteorological offices. Notwithstanding, land degradation, draught and desertification in the Caribbean SIDS are not influenced exclusively by meteorological, hydrological, physical and biological events, but also by the socio-economic aspects including land use. The challenge therefore is to develop an approach to determine the factors and hence the principle parameters driving land degradation, draught and desertification in Caribbean SIDS. Central to this challenge will be the integration of traditional knowledge as a key parameter. The identification of these parameters at the local, national, sub-regional and regional level would enable the region to improve its predictive and forecasting capabilities in land degradation, draught and desertification.

From the economic point of view, these countries possess small and open economies with many and not diversified source. They mainly depend on importations to support local productions. A limited exportation economy is frequently observed depending on tourism and agriculture. Only Dominican Republic, Cuba, Jamaica and Haiti have most of the IBP of the region.

The relationships between the Caribbean area and the Convention to combat Desertification and Draught of United Nations is in an increasing period, although it should be given in the future. All the Caribbean countries have signed the Convention Letters before the end of the last century. However, the organization, development and put in practice of the National-Action Programme (NAP) is of high priority since this document is of prime importance and the heart of Convention. In this concern, Jamaica, Saint Lucia and Barbados are in the phase of popular referendum Bahamas, Belize, Guyana and Trinidad and Tobago have not yet developed the corresponding NAP since Antigua and Barbuda, Dominica, Dominican Republic, Granada, Haiti, Saint Kits and Nevis, Suriname and Saint Vincent and the Grenadines are in the elaboration process. Cuba is in a more advanced stage where NAP was discussed and is working. A National Group to Combat Desertification and Draught was created and a scientist of this country represents the Caribbean in the Group of Experts of the Committee of Science and Technology of the Convention. It should be also pointed out that in Cuba, as part of the Caribbean the sixth COP was celebrated in 2003.

On the other hand, United Nations, Caribbean State Associations, CARICOM, European Union and other government and non-governmental organizations are trying to help this area in relation to their economics, life quality, poverty, unemployment and other activities.

The United Nations Convention to Combat Drought and Desertification highlights the need for benchmarks and indicators for land degradation, draught and desertification. When applied to the small island developing states of the Caribbean, it is fair to conclude that the use of benchmarks and indicators in land degradation, draught and desertification forecasting in the Caribbean SIDS is relatively underdeveloped. of the fundamental problems facing the Caribbean SIDS is the paucity of benchmarks for land degradation and indicators of change in the condition. Yet, many Caribbean SIDS have special land degradation and desertification problems that are linked to fragile island ecosystems.

For example, GEF is working in the project named: Establishing Benchmarks and Indicators for Land Degradation and Sustainable Land Management in Small Island

Developing States (SIDS). A Pilot Demonstration in Haiti, Jamaica, Saint Vincent and the Grenadines and Cuba.
The outcome of this MSP will be the creation of the enabling environment and the necessary methods and tools for the Caribbean SIDS, as a region, to commence work on the development of benchmarks and indicators which can be used in the determining land degradation, draught and sustainable land management in the Caribbean. In this regard, a number of specific output will result from the project.
Another example of project is that developed by PAN-FRO (National Action Plan for the Frontier Zone carried out by Dominican Republic and Haiti since 1988). This project has the support of the World Mechanism, Canada, FAO, GETZ and PNUD, also under the frame of UNCCD in the Hispaniola. This project has a multisectorial approach. It is supported in only one institution and it is not a program to combat degradation of natural resources related to the fight against poverty.
FIDA (Fondo Internacional de Desarrollo Agrícola) was created in 1978. This institution has financed in Latin America and the Caribbean a total of 108 projects amounted 1 191 USD. Its activities directly benefit at about 7 millions of people from an estimated rural population of 126 million persons in relation to alleviation of poverty.
The effects in the Caribbean are offered in the following table.

Country	Projects	Financial support USD	Rural population	Populations, % with benefits
Belize	2	4433	116900	21.0
Cuba	1	14100	2774798	0.2
Dominica	3	5821	28450	74.4
Granada	2	5728	60858	37.8
Guyana	2	16500	533334	6.6
Haití	6	71294	5117637	16.5
Jamaica	3	20668	1150215	13.3
Dominican Republic	5	48092	2995300	7.1
Saint Lucia	2	4214	97032	13.9
Saint Vincent	1	2215	51980	25.9
Suriname	1	3600	290319	21.0

The other institutions that can be considered is the European Union. There are some modalities of integrations supported by the EU, for example CARICOM. Some of the objectives are:

- Develop the economics of the Caribbean countries and their integrations by means of a coordination of foreign policies. Several programmes were developed for guaranteeing complete integration and free circulation of services.

Some of the objectives promoted by EU are:

- Treatment and reinsertion
- Drugs abuse
- System of epidemiological control
- Detoxification
- Studies of marihuana
- Improvement of medical laboratories
- Food security

On the whole, it should be taken into account some considerations included in the paper "Small Island Developing States" discussed in UNCCD COPG celebrated in Cuba in 2003

- Decides to strengthen the institutional capacity of Small Island Developing States at the national and regional levels to effectively achieve the objectives of the Convention through the provision of dedicated technical and financial support;
- Welcomes the availability of the GEF to be a financial mechanism to the Convention and request the special consideration be given to SIDS in accessing the necessary funds to develop the NAPs and meet the 2005 targets as set out in the Bonn Agreement;
- Invites the Executive Director to prepare a report to United National Meetings for a review of the Implementation of the Barbados Plan of Action on the progress of the Implementation of Convention with particular reference to SIDS.
- Requests the Executive Director to identify appropriate modalities for the effective implementation of the recommendations contained in operative paragraphs 1 to 3 of the present decision;
- Also requests the Executive Director to report to the UNCCD COP as its 7th session the results of the recommendation contained in operative paragraph 4 of the present decision.

2.4.1 Results

The enquiry was sent to most of the representatives (see Annex I), but so far there has been no response. Due to lack of information the results of the St. Lucia Sub regional Meeting on B & I are transcribed.

The present document details the exchanges of the second Sub-regional workshop on the development of Benchmarks and Indicators in Latin America and the Caribbean – First of the Caribbean Sub region- which took place in Rotney Bay Gros Islet, St. Lucia in February 2003. This workshop was organized specially for the 17 countries of the Caribbean sub-region and was also attended by relevant Non-governmental Organizations (NGOs), Community Based Organizations (CBOs) and Inter-Governmental Organizations (IGOs). Its organization was a direct response to the request of the Parties of the entire region to ensure that the implementation of the UNCCD in the Caribbean sub-region keeps pace with the rest of Latin America.

2.4.2 State of knowledge and practical development of the use of indicators and benchmarks in Cuba

The process of preparing the National Programme to Combat Desertification and Drought (NPA) concluded in 2000. It is a work document that is scientifically proven as well as an objective expression of the conditions existing at national and local levels. It has built on the capacity of the existing human resources, the system of Science, Technology and Environment, as well as the organisation of all sectors of the Cuban society and the wide participation and consultancy undertaken through the aforementioned process.

The diagnosis study revealed that 76% of the agricultural lands are disturbed by some of the production-restraining factors, extreme conditions being present in 14% of them. Droughts have doubled their occurrence frequency in the last 20 years. The desertification-leading processes that have more incidence on Cuba are erosion, salinity, compaction and loss of soil fertility. The anthropic factor has unleashed these processes through deforestation, shifting land use, land overuse, poor management of water, irrigation techniques, cultivation techniques and use of inappropriate technologies, among others. The diagnosis also allowed to identify the most disturbed areas and ecosystems. Ten years after the Rio Summit and nine after its enforcement in Cuba, the National Environment and Development Programme and the National Environmental

Strategy constitute the programmatic basis for the main actions of the Cuban Government intended to give a response to the agreements made at the United Nations conference for Environment and Development (UNCED) regarding national efforts to stop or abate damage generated by human activities in the process of social and economic development.

The process of preparing and putting the Action Plan into operation is characterised by wide participation of disturbed communities, technicians and scientists from all entities involved at local and national levels as well as decision makers at all levels. Work carried out by women in all stages of NAP development has been very important.

During the NAP preparation process, some parameters and indicators were outlined. From the technical standpoint, they are used in Cuba to assess the progress made in the measures applied. They are closely linked to the environmental impact indicators that have been elaborated to measure and assess the environment status in the country and within the National System of Environmental Monitoring (SNMA) that is under preparation as a tool for decision making. The progress made on this subject is slow since it requires refining and implementing the corresponding infrastructure.

The indicators introduced to monitor the development of desertification and drought, as well as the progress of the actions executed, must be quantitative, easy to measure and few in their number.

Based on a study in dry zones, including 24 indicators, work is carried out on the selection of those of better adjustment to Cuban conditions. Fourteen out of them, are related to the climate, two to the vegetation, six to the edaphic conditions, one with water and one with social conditions. These indices must be validated in the spatial-temporal environment and the class limits must be determined according to their intensity (light, moderate, serious and extremely serious). Until these results are available, the following are used:

Variable	General indicators			
	Physical	Chemical	Biological	Socio-economic
Soils	Rill density and furrows per area (%)	Content (%) and organic matter composition	Loss of the original biota	Inhabitants per agricultural surface (inhab/ha)
	% of surface horizon loss	Change of the fertility indices pH, changeable acidity, change base capacity, phosphorus, potassium	Animal stocking rate/area	Inhabitants per cultivated surface (inhab/ha)
	Variation of actual and apparent density, structural stability, compactness, infiltration capacity	Salinisation dynamics per horizon (expressed by electricity conductivity)		Population mobility rate (migration percentage)
Water	Decrease in stored water levels (MMm^3)	Salinity contents	Variation in the composition of the microbiota and decrease of the biological activity	Demand satisfaction of the population and other users (%)
Climate	Drought index Aridity index			
	Spatial-temporal distribution of			

	rainfall, evaporation and temperature			
Vegetation	Deforestation dynamics (%)		Floral composition per type (%)	Agricultural and forestry yields per unit area (ton-m^3/ha/year)
	Plant covered area (%)			Consumption dynamics of forestry species for firewood (m^3/ha/year)
	Area covered by desertification indicator plants (%)			Replacement rate of shrub-like species (%)
Atmosphere	Air particle content	Chemical rainfall composition		

More recently, in April, 2004, a National Workshop was developed on "Indicators for the monitoring and assessment of the degradation and drought processes". The results attained in this work are attached in Annex 11.

It must be highlighted that this content is wide and all-embracing, but attains valuable synergies among an essential group of spheres.

These indicators could be used with the necessary selectivity and correctly according to the existing practical conditions in every particular region of analysis, assessment and monitoring.

Measures taken or planned within the framework of the National Action Programmes in Cuba

Pursuant to the Program for Soil Improvement and Conservation, a number of actions for soil prevention, improvement and conservation were taken in production units, through which around 600,000 hectares benefited at a cost of approximately 14 million pesos. These measures, both temporary and permanent as well as of soil conditioning, have been accompanied by drainage measures, the application of over 3 million tons of mineral and organic amendments, the incorporation of green fertilisers, and the monitoring of the quality of irrigation water.

Hydraulic and hydro-energetic works aimed at fulfilling the Programme for Drainage and water supply to the areas intensively dry and strongly disturbed by desertification processes were implemented. These works guarantee the supply of drinkable water to 28 rural communities of over 300 inhabitants each, thus benefiting 21,698 residents. Among other measures taken to mitigate drought effects, we can mention the establishment of the surveillance system comprising periodic monitoring of the levels of fountains, dams and water tables, and the requirements to decree drought alert and alarm phases as well as contingency plans, as required.

A high priority aspect within the Program to Combat Desertification and Drought is forestation and reforestation, given its effect on desertification prevention, disturbed land recovery and water protection. The experience gathered by the Integral Forest Farms –there are 798 that encompass 91,000 hectares, with a strong economic and social component, has spread all over the territory. The Cuban forest coverage is now of 21.94%, with a 0.64% of increment in the last two years thanks to the intensive work on reforestation and co-operative surveillance and protection among several entities of the country in order to protect the forest heritage.

The polluting load, as a degrading factor, had a reduction of 44,000 tons of Oxygen Biochemical Demand (DBO) in the 2000-2001 period, resulting from economic good use of wastes and systematic work on environmental protection. In addition to contributing to minimising the degrading action of pollution on water and soils, such an action reduces the use of surface water and groundwater in the irrigation of plantations, increases agricultural yields and contributes to mitigating drought effects.

As part of territorial demarcation in disturbed areas, an "Analysis and Cartography of the Vulnerability to Food Insecurity in Cuba" was conducted, with special emphasis on the five eastern provinces of Cuba, which have been affected in the last years by intensive and persistent drought processes. Drawing upon a group of physical, social and economic indicators of the aforementioned provinces, this analysis allowed to identify 33 municipalities as Very Vulnerable, 11 as Vulnerable and 10 as Little Vulnerable, the analysis constituting a highly valuable tool due to its practical and methodological usefulness. The outcomes of this study resulted in the Governmental decision to priorise investments, for development in these provinces, which coincides with the territory of three of the eight nationally priorised watersheds and with the areas most disturbed by the desertification and drought process, according to the NAP.

All the legislative level, a series of laws, decrees, resolutions and provisions that contribute to ordering and institutionalising the environment system in Cuba and applying the National Programme to Combat Desertification and Drought were enacted.

2.5 B&I Utilisation by Stakeholders

We conclude that the level of development attained by the countries conforming the Annex as regards B+I is deeply diverse and heterogeneous. In this concern, we notice that some of them count with a rich working experience in the theme, whereas others have recently started developing this line. Despite the dissimilarity, a notorious fact should be highlighted, and that is the high degree of sensitivity evidenced by every country in relation to the adoption of indicators, whilst stating their intention to integrate them as part of their NAPs.

Meanwhile, this reflects directly on the degree of adoption of B+I on the side of stakeholders. Yet, the situation in other countries is highly dissimilar when we observe a rich experience in research, in the development of training instances and in the setting in motion of locally elaborated programs, they being still at very initial levels and at design of indicators' stages.

Yet, within this framework, we recognize and mean to consider some successful experiences in the Annex.

To follow up, in the year 2003, an intensive training course mainly directed to stakeholders was held in Paraguay on the thematic of B+I and Environmental History. SAP and NAP Paraguay was attended by representatives of various working scopes like of the national government, ONGs, producers and scientists.

On a similar line, the "Course on Indicators of Desertification" organized by Los Algarrobos Civil Association in the scope of LADYOT-IADIZA – Mendoza, was quite significant and imparted to representatives of ONGs from all over the country. It was an activity viewed within the frame of reference of the PAN and supported by the National Focal Point and GTZ – Argentina.

We should highlight the National Workshops convened by the countries joined under the BID-IICA Project, which will be subsequently and in extenso deliniated. Still, we need to briefly mention that the member countries have been able to agree on B+I as a unified methodology for its obtainance, on confrontation with stakeholders and on validity strategies. The B+I developed refer either to local and national levels as to foreseeing an integrated system for evaluation and monitoring of desertification. Once the representatives of each country agreed on a uniform methodological strategy, each country repeated this methodology upcountry showing nervous tension towards the relevant stakeholders in each case.

Similarly, but this once with China and Senegal as countries joining other annexes, Argentina takes part as a pilot country of the LADA Project. Inside of this project, emphasizing land degradation assessment methodologies, lies a progressive adoption of B+I on the side of decision-makers assigned to national scopes, as by those developing actions within local governments, NGOs and the communities involved.

Chile has made enormous efforts finally materialized in the creation of the MONITOR System. This computerized system allows the country an evaluation and monitoring of a desertification processes system built on the B+I basis.

National Workshops have been summoned for sensitization and realization of NAP Honduras. So far, Brazil has approved its own NAP and is working on the development of indicators' systems and the use of water with local communities in the semiarid northeast.

Cuba evolved its NAP early with an active implication of stakeholders and the admission of indicators to get acquainted with the state and its desertification processes, and is now in readiness to give assistance to horizontal cooperation toward other countries of the region. This is the case of Santo Domingo, where the national coordinating body is keeping at the completion of the NAP and the identification of indicators. The PANFRO Project is prominent in La Hispaniola and works actively with stakeholders in the borderline of Haiti and the Dominican Republic, with the support of the Worldwide Mechanism of the UNCCD, as well as international cooperation, especially GTZ.

To round up, we highlight the present efforts of the GTZ Regional Program to incorporate impact indicators in NAPs. In this regard, and to go on with the motions drawn in the training area of the OSS and already implemented in Africa, two training activities have been carried out with trainers from Santo Domingo with the participation of stakeholders from the whole Annex. The spreading of this experience in southern countries has been planned with the support of GTZ Argentina, who has evolved special capacities in the measuring of impact projects of profitable development and in the national fight against desertification. Additionally, this activity counts with the support of the BID/IICA Program.

As we can observe, the Annex is at an active stage and vastly concentrated on promoting sub regional and upcountry exchange processes. The Workshop is the most successful procedure in bringing together in discussion forums all the social actors involved in the fight against desertification. There exist regional bodies for the exchange of information, like the DESELAC page inside the Regional Program of the UNCCD, which still need further prompting but still fulfill the task of linking and broadcasting information at a regional level.

2.6 Data availability and B&I elaboration at different levels

We should point out at this stage that the information collected by the countries tends to refer to regional and national spheres of action, while being locally infrequent. In another direction, we notice that the most requested information is that referred to biophysical support indicators, whereas the working experience with socioeconomic support data is minor.

Even in this general context, there is a tendency to enrich the analysis of desertification processes which nourish with further elements when the countries participate in international programs.

Likewise, many of the countries count with some measuring methodological data in spite of the fact that socio economic support has not been worked out in some of them. This observation is especially valid in the case of poverty measures available in all the Annex countries. Notwithstanding, these indicators are not yet wholly integrated to physical and biological ones within an entire system of evaluation that would relate poverty, land degradation and desertification. Moreover, the production of data depends on various governmental areas not holding to this issue, thus not reaching a global vision inherent to desertification matters.
So as to conclude , we must mention that in no case a Model of Entire Evaluation of Desertification has been accomplished, even including those countries with a higher level of B+I development. On the contrary, we have observed a predominance of non integrated and rather disjointed indicators unable to turn into practical measuring and follow up instruments of desertification for various users and decision - makers.

2.7 Exchange of information and communication

In relation to this matter we should highlight that the inquiry designed and spreaded inside the Annex did not focus this issue specifically. Consequently, the data collected is notoriously reduced compared to the points treated.
However, it is feasible to extract general grounds from the information collected. We observe that the workshop course of action is the most supported for exchange within the Annex ,by means of analyzing inquiries and by the use of additional techniques (basically analysis of secondary resources and close interviews to key informants) The countries summoned in each of the belonging SAP and organized in the corresponding NAPs, tend to spread information while focusing on it in workshops. Up to the time being, no unified spreading of information tool among countries and users has been fixed. Most of the best known have been sub regionally and nationally organized in country groups. In some countries strong emphasis has been lain upon local levels with workshops as the top choice, presently followed by specific training methods.
We assume that this working strategy replies firstly to the leadership of scientists, secondly to governmental and non governmental areas and much more recently to the communities involved.
We need to stress the recent release of the DESELAC web page aimed as a powerful spreading mechanism of information for the whole Annex.

3. Recent projects undertaken on development of B&I

3.1 The UNCCD and regional consolidation

The issue of desertification is effectively included in the international agenda in the late XX century. Since the decade of the 70s there is awareness that this is a worldwide issue necessarily involving all countries and governments of the world.
This degree of commitment and the magnitude of the phenomenon determine the need for an approach including instances that exceed, but at the same time integrate with, the existing initiatives and efforts at the national, regional and local levels. In this scenario, towards 1994 the International Convention to Combat Desertification is created, which thereafter, within the United Nations system, would synergize, integrate and enrich the efforts and initiatives of each one of the countries.
As we know, in order to organize its work and attend to the great variety of situations that it must integrate and coordinate, the UNCCD has grouped the countries affected by desertification problems into five annexes. Latin America and the Caribbean constitute the Third Annex.

Within each Annex the UNCCD recognizes another scale which reflects common problems that exceed national frontiers. These are issues that integrate groups of countries having common characteristics and problems which, to be solved, require integrated and coordinated responses rather than atomized and isolated ones. This refers to the regional and subregional levels which, in terms of the UNCCD, are integrated within the Regional (RAP) and Subregional Action Programs (SAP). In Latin America and the Caribbean there is one RAP for the entire Annex and various action programs at the sub regional level.
Beyond the sub regional level, the UNCCD recognizes a third level of disaggregation formed by the national levels. According to the political-administrative organization of the member countries, the UNCCD proposes that each country should organize itself under a National Action Program (NAP) that articulates the actions to be developed inside its territory. In this sense, soon after the convention is created, national efforts to elaborate these programs start being noticed.
Thus we have a dynamic system that, passing over growing levels of aggregation and disaggregation, guarantees that each of its members will be taken into account within a frame of respect for their geographical, economic, social, cultural and political-administrative peculiarities.

3.2 Consolidation of the regional level in LAC

The region shows several severe desertification processes that are not acknowledged in their real dimension, neither by decision-makers nor by a great portion of the society. This affects the assessment of priority policies as well as the allocation of funds for the fight against desertification at national and international levels.
Twenty out of the 33 countries have developed or are in the process of developing their NAPs. Seven of these have been approved already; 5 are in their final stage, and 8 are under way. This allows to predict the fulfilment of the Recife decision: by 2005 all countries will have NAP.
Four main steps can be pointed out in the process of B & I establishment, determined in the first place by national efforts and the fruitful relationship between NGOs and GOs; this leads to establishing projects at sub regional level between groups of countries, to reinforcing international cooperation –especially South / South, and to UNCCD's response accompanying the whole process. A brief summary of each of these steps is included herein, each will be dealt with in depth in the sections corresponding to each Sub region.

3.2.1. Efforts of the scientific sector and NGOs for the achievement of a unique methodology, plus the national efforts

Many of the B&I activities have been developed in the Region since the '90s thus building up national abilities that can be transferred within the frame of the actions outlined by CST and UNCCD.
1987: Argentina. UNEP/FAO/IADIZA 1º Training Course for ALC. Provisional methodology for training activities in LAC.
1991: Argentina. World Atlas of Desertification. Mendoza State Level
1992: Argentina. Case study at local level: desertification/urbanization on fragile areas.
1993: Argentina. INTA/GTZ. Desertification in Patagonia
1993: México. UNEP/FAO/UNAM Training course for ALC
1994: Brasil. Fundación Esquel. Latin America Seminar - ONGs + OGs: Regional Program
1994: Chile. UNEP/FAO/Univ.Chile. Training course for ALC

1997/98: B+I Argentinean Group (State/pressure/response)
2001: RIOD training. Statement of Mendoza
It should be noted that so far all the countries of the region have declared their interest in the development of early alert systems for desertification and drought using B&I directed toward decision-makers.

3.2.2. Specific projects, groups of countries, at sub regional level
Specific projects per group of countries represent a major advance at Sub-regional level for the establishment of E+M systems
1995: Fund. Esquel-FAO-PNUMA"Toward a unique methodology for evaluating and monitoring desertification in Latin America"
1999: GEF-PNUD "Indicators model for dry lands ecosystems"
1999: ECLAC-GTZ "Assessment of indicators of the socioeconomic impact of desertification and land degradation"
2001: LADA (Evaluation of Land Degradation in Arid Zones) Argentina Pilot Country.
2001: MEDRAP. Participation of LAC experts in the initiatives of the MEDRAP Project (Concerted Action to Support the Northern Mediterranean Regional Action Program to Combat Desertification)
2002: IDB / IICA "Regional Program to Combat Desertification in South America"

3.2.3 International cooperation, especially S-S, and synergy of projects inside and outside the Region in relation to B&I.
There are good examples of international cooperation, especially S-S, and of synergy of projects inside and outside the Region in relation to B&I. At regional level it is important to point the international cooperation actions that have contributed to settle the LAC situation. They are:

OSS - CILSS - GRULAC joint action
As indicated by the Decision 11/COP. 4 "Benchmarks and Indicators", CILSS, OSS and GRULAC, in collaboration with other partners, are making important progress on the development of benchmarks and indicators of UN CCD implementation, performance and impact. Regarding M&E, synergies must also be developed between indicators already developed by the United Nations Commission on Sustainable Development, the UNFCCC, the CBD and the UNCCD.
Decision 11/COP 4 asked CILSS, OSS and countries of the GRULAC to elaborate a document on the status of progress in the issue of benchmarks and indicators, to be considered by the CCT. This document, accepted in COP 5, presents the results of the International Workshop on B&I held in Ouagadougou, Burkina Fasso, in May 2001, and the proposals of an electronic discussion group. This work is of great importance since it sets the starting point of an effective South-South cooperation among the countries of Annexes I and IV, through the discussion of methodologies, experiences and lessons learnt. The participation of LAC experts in this initiative was possible thanks to the support of GTZ and the Global Mechanism.
At present training of trainers for implementing NAP Impact Indicators is underway through the LAC GTZ Regional Programme.
In this regard two training workshops have been held in Santo Domingo in order to reach a shared vision of the M&E in NAPs and its role in the application of the UNCCD; these being on "Monitoring and Evaluation of National Action Programmes in the Fight against desertification" to achieve a united vision between NAPs M&E and their role in the application of the UNCCD.The background of this activity finds its

roots in the training modules developed jointly by the OSS (Sahel and Sahara Observatory) and the GTZ5.

Participation of LAC experts in COP 4 & 5 in parallel events on B&I.
GTZ and the Global Mechanism have facilitated the participation of LAC experts in the Event held parallel to COP 4 (Bonn 2000) on B&I organized by GTZ. Likewise, during COP 5 (Geneva, 2001), the Global Mechanism organized a parallel event on the Great American Chaco, where the need to incorporate indicators to the PAS was discussed.

Participation of LAC experts in the initiatives of the MEDRAP Project (Concerted Action to Support the Northern Mediterranean Regional Action Program to Combat Desertification – financed by the European Union)
During COP 5 (Geneva 2001), in agreement with the Decisions of the Regional Meeting in La Serena, where the importance given to the incorporation of indicators by countries of Latin America and the Caribbean is acknowledged, this proposal was presented before the GRULAC by the Focal Point in Argentina, gaining the support of the Region representatives for being presented and implemented through the Program of the Global Mechanism for Latin America and the Caribbean, receiving a definite and sustained support from this institution.
The main objectives are: (i) Exchange experiences, technical knowledge and capacities at interregional level; (ii) Make the formulation of joint cooperative projects between the European Union and LAC possible; (iii) Verify the modes and strategies used by the European scientific community for the implementation of RAP among the countries in Annex IV; (iv) Strengthen the national capacities and PAS in LAC; (v) Identify and mobilize financial resources for scientific research and transfer of technology; (vi) Jointly implement projects to be submitted to multilateral and bilateral donors and support institutions for implementation of the UNCCD, seeking interregional cooperation and networks.
The MEDRAP Coordinating Committee decided to enlarge its constituency by including the representatives of Annex III and Annex I as guest members, and reduced the workshop programs to incorporate, as formal part, a Permanent Session for discussion of the contributions made by LAC and North Africa. It proposed to extend the “Mediterranean Clearing House on Desertification - CLEMDES”, already activated for Annex IV, to Annexes I and III, subjected to the obtainance of complementary funding from the European Union. It agreed to extend the MEDRAP electronic network to all destinations recommended by the Focal Points of LAC and North Africa.
Expositions presented and interchange of experiences, data and methodologies were considered to be very valuable for the concretion of the MEDRAP objectives, and for the development of South-South cooperation activities. In 2002 an accompanying measure was presented to the European Union for the implementation of “Two International Workshops on Desertification. Indicators and methodological approaches used and in progress in the Five Regional Annexes of the UNCCD”. Synergies have been accomplished among ongoing projects in LAC (UNEP/GEF, IDB) and in other regions: DISMED, DESERTLINK, to consider expansion of their activities, within the Region in the first case, and towards the Region in the second.
The relationship among countries of Annexes I, III and IV has proven that human and financial resources can be potentiated and lessons learnt applied.

3.2.4 Process developed in the Region by the UNCCD as a response to the demands of the member countries

It is interesting to note a process developed in the Region by the UNCCD as a response to the demands of the member countries in relation to the the usage of B+I:
1997: V Regional Meeting in La Habana (Introduction to the theme)
1998: VI Regional Meeting in Antigua and Bermuda (Presentation of motions for the Region)
2001: VII Regional Meeting in La Serena (Conferences and work groups in all the Sub regions. The Caribbean asks for a workshop).
2001: OSS-CILSS-GRULAC-Decision 11-COP 4-CCT joint action.
2002: VIII Regional Meeting in Barbados. Support to a seminar to be held in Argentina.
2002: Sub regional Seminar in Mendoza, Argentina.
2002: CRIC 1. Support of the GRULAC to the decisions taken in Mendoza.
2003: Sub regional Seminar in Santa Lucía
2003: Sub regional Seminar in Tegucigalpa
2003: IX Regional Meeting in Bogotá. A specific technical segment on B&I is accomplished.
2003: COP 6 in La Habana. (Open discussion and motion for TPN in B+I)
Even within the general frame of the unequal use of B&I, the LAC countries have requested, in the different regional meetings, the establishment of a Desertification and Droughts Benchmarks and Indicators System for the adequate application of the National Action Programs. The Argentinean and Brazilian governments presented in Antigua and Barbuda (1998) a work proposal at regional level. In La Serena (2001), a special session was devoted to B&I. There, Argentina and Chile explained their approaches and advances in the subject. It was evident in this meeting that the LAC countries were concerned for the development and application of Desertification and Droughts Evaluation and Monitoring Systems. The Caribbean countries raised the necessity of surveying the situation and of carrying out a seminar on the subject. In Barbados (2002) the issues raised were the advances and opportunities of international cooperation, especially S-S, and the support to the next International Seminar on Desertification Indicators for LAC, to be held in Mendoza, Argentina.
All three Sub regional Meetings on B & I: Mendoza, St. Lucia and Tegucigalpa, are a consequence of this process. The IX Regional Meeting in Bogotá devoted an entire Technical Segment to B & I. This process is strengthened with COP 6 in La Habana, where the B & I issue was largely discussed by the GRULAC countries and the motion for the carrying out of a Technical Programme Network was settled (TPN on B+I in the Annex) Within this process, Mendoza, Santa Lucía and Tegucigalpa workshops are basic links for:

- Capitalizing and extending the initiatives in the Region.
- Creating a mechanism for horizontal cooperation and technical training.
- Establishing a Regional Program.

This process started in Mendoza’s Seminar. The main contributions were: preparing a state of the art in LAC; outlining mechanisms and strategies for a PAR; setting a work group at regional level. Results were presented and promoted by the GRULAC in different documents like the Mesoamerican Act.
The meeting of the Caribbean countries held in Santa Lucía the next year reached important agreements as well. All the Caribbean countries took part in it and stress was put on participation and agreement. There was a critical approach on the vulnerability of the small insular states and a contact group was created. This initial process rendered several projects now being presented on B+I by different Caribbean countries to

possible funds releasing sources, especially PNUD and FAO, as could be apppreciated in the course of the "Regional Workshop on Land Degradation in the Caribbean", organized by FAO, the Global Mechanism of the UNCCD, the German Technical Cooperation GTZ, UNEP-Regional Office and the CARICOM Secretariat, Port of Spain, Trinidad and Tobago, 2 through 6 February 2004.
All Mesoamerican countries joined In Tegucigalpa's Meeting reaching the following achievements: constitution of a work group for the region; agreement on the outlined strategies; establishment of indicators for thematic areas. Also, an important project on B+I, involving the majority of Mesoamerican countries, was presented, and it will be supported with MM funds.
The specific contribution of each seminar will be tackled by the corresponding sub region.

Technical Segment. IX Regional Meeting in Bogota
The Regional Annex for Latin America and the Caribbean of the UNCCD establishes the need to hold regional meetings in order to strengthen cooperation and exchange among the country parties, and to apply the Regional Implementation Annex.
The IX Regional Meeting of Latin America and the Caribbean Country Parties to the UNCCD was held, in collaboration with the Government of Colombia, in Bogotá from 17 to 20 June 2003.
There were 28 government representatives, as well as 12 representatives from international, regional and sub regional organisations and 12 of nongovernmental organizations from the regions.
It is to be highlighted that a technical segment devoted to working on B&I was for the first time developed at the meeting in Bogota.
The results from the three sub regional meetings (Mendoza, Santa Lucía, Tegucigalpa) were presented at the meeting, a consultant hired by the UNCCD presented a proposal of a work methodology, and three work groups were formed (one per sub region) to address the issue of regional organization for presenting a regional action program on B&I: issue-specific TPN.
Later, during the COP VI sessions in La Habana, working groups resumed work in ad hoc meetings of GRULAC, and it was agreed that countries interested should provide the Secretariat of UNCCD with TPN proposals, in accordance with their needs and capacities.

TPN Proposal
According to what was expressed at the IX Regional Meeting of the Latin American and Caribbean (LAC) country parties of the UNCCD, held in Bogotá between June 17 and 20, 2003, the countries wishing to undertake any of the Thematic Projects, called "Thematic Program Network" (TPN), should inform it to the Convention Secretariat. Argentina, based on the integration of diverse institutions that are working on B&I, stands as a candidate to manage TPN 1: "Identification and use of benchmarks and indicators of desertification and drought".
The objective of this proposal is to develop, taking the capacities existing in the region as a basis, a Regional Thematic Network on Benchmarks and Indicators of Desertification, to be used by the country parties of UNCCD in Latin America and the Caribbean, with the aim of strengthening and facilitating its application through the National Action Programs and the Sub regional Action Programs, in the framework of the Regional Plan of Action.

The commitments that the country would assume, in the case its proposal to coordinate this TPN is accepted, are:

- To place the country's technical and scientific capacities to the service of the development of this TPN.
- Constitute a Coordinating Committee with a representative of each Sub region.
- To place two facilitators of renowned trajectory in the thematic issue at the disposal of the Program, as well as administrative personnel during five years, committing to provide (facilities) office facilities, a computer, telephone, fax and office materials.
- Among the possibilities of cooperation between the Argentine Government and the countries of the region is the Argentine Fund for Horizontal Cooperation (FO-AR), that depends on the Ministry of Foreign Affairs, International Commerce and Religion.

3.3 Experiences in B&I involving Groups of Countries in Latin America

Annex III incorporates very early the need to work with B&I. By 1987 results in this thematic issue had already been generated. A characteristic that distinguishes this Annex from the rest of Annexes of the UNCCD is that this work was the result of a successful alliance between governmental and nongovernmental organizations. In practice, this translated into a very early awareness in LAC of the close relationship that should exist among scientific and technical sectors, political decision makers and all other actors of the civil society. Furthermore, the fact that the civil society was very especially taken into account over the process has determined an early incorporation of participative methodologies, in the frame of B&I.

According to Santibáñez[12], *"…a series of initiatives have been developed in the Latin American region since 1994. These initiatives have as basic characteristics the following: I) the initiatives count on the involvement of 3 or more countries of the region, ii) all initiatives aim at the establishment of a system of indicators that can serve to expand knowledge of the CCD issues in the region, iii) the initiatives were formalized in terms of specific projects in order to fulfil specific scientific interests, and iv) these initiatives are at a stage of development where the results are beginning to become available".*

3.3.1 Project: "Toward a unique methodology for evaluating and monitoring desertification in Latin America", Esquel Foundation / FAO

In 1993 the Esquel Foundation organized in Brazil the "Latin American Seminar" that summoned a group of experts from NGOs to make diagnoses of desertification in Argentina, Bolivia, Chile, Brazil and Peru, and discuss the parameters for the elaboration of the Regional Plan to Combat Desertification. This is the starting point of the Project "Towards a unified methodology for desertification monitoring and assessment in Latin America", partly financed in 1995 by FAO and UNEP and, only after approval of its final version, by the IDB in 2002. This first work laid the emphasis on the indicators of biodiversity and physical environment, and to a lesser degree on socioeconomic indicators. The results were elaborated by Santibáñez and Pérez (1997).

3.3.2 Project: "Model of Indicators for Dryland Ecosystems". PNUD / GEF

In 1999 Chile, Brazil and Mexico, in cooperation with the National Heritage Institute (NHI) obtain the financial support of UNDP and GEF to develop, during three years,

[12] Santibáñez, Fernando "A proposal for the regional thematic network in Latin American and the Caribbean (LAC) on Benchmarks and indicators (B&I)", Secretariat for the Convention of Desertification Combat, United Nations.

the Project "Model of Indicators for Dryland Ecosystems". This project has designed a set of indicators for measuring dryland degradation, applicable at the local, national and regional levels, calibrated and in the process of adoption by the different users and, among other products agreed upon by the users, a basic Protocol for the establishment of an Indicator Monitoring Program in the long term.
One of its major achievements has been the building of an Information System for Desertification Monitoring, based on a series of computational models and tools for administering the information in critical areas. The most advanced contribution comes from Chile, where the Center for Agriculture and the Environment (AGRIMED) of the University of Chile, has developed the MONITOR System, currently in the process of starting operations for direct use by communities, institutions, and authorities related to desertification and drought issues in the country. This system has been spread through different training and transfer workshops. Further and more detailed information on these products, and especially on the situation of B&I in Chile can be consulted on the works submitted by Santibáñez (2002), and Alfaro (2002)[13].

3.3.3 Project "Assessment of indicators of the socioeconomic impact of desertification and land degradation" ECLAC / GTZ

Over the year 1999 Argentina, Chile and Brazil, with the support of GTZ, agree to formulate the Project, "Assessment of indicators of the socioeconomic impact of desertification and land degradation", which was presented through the Economic Commission for Latin America and the Caribbean (ECLAC), the executive agency of the project. The goal is to provide the governors of various countries of the Region with a reliable analysis of desertification processes from a social and economic perspective, as well as a basis for the proper development of public policies. The main products are: (i) Development of a methodology for measuring the economic losses brought by land degradation, and the costs and benefits of conservation and restoration. (ii) Economic and social analysis of desertification processes, their causes and consequences, included in a frame of institutional policies, based on study cases in selected countries. (iii) A set of alternative policies and criteria to encourage a better management of the land, including a contribution of economic tools and institutional reforms. (iv) Development of reliable socioeconomic indicators that may be immediately used by decision makers. (v) Development of a nationally interconnected database for the countries selected, on the basis of the economic and social impact of desertification (vi) Development of technical capacities.
The project is in execution. Meetings have been held among the three countries, and for this stage the scale of analysis in General Indicators for all three countries was agreed upon, as well as the scale in specific indicators for those areas identified as priority areas in each country. Every country and ECLAC are analyzing a group of possible indicators to be applied in the Region. An interesting product of this Project is the REDATAM software, that allows to run socioeconomic data to obtain the respective indicators at national and regional levels.

[13] Alfaro, Wilfredo "Desarrollo de Indicadores de Desertificación en Chile".In: ABRAHAM, E. M., P. MACCAGNO y D. TOMASINI (Ed.) Desertificación. Indicadores y Puntos de Referencia en América Latina y El Caribe. Mendoza, SAyDS / GTZ / UNDC / IADIZA, 19:30, ISBN 987-20906-0-2, 2003, 389 p.

3.3.4 Project "Regional Program to Combat Desertification in South America" IDB / IICA

In 2002, IDB approved the implementation of the "Regional Program to Combat Desertification in South America". Participants are: Argentina, Bolivia, Chile, Ecuador and Perú. Executive Agency: IICA (Inter-American Institute for Agricultural Cooperation).

The general goal of the Project is to provide the basic guidelines for the follow-up of land degradation in participating countries. It encompasses three components: (i) harmonization and application of existing desertification indicators/data collection and analysis; (ii) design of policies and actions to assess and combat desertification; (iii) institutional strengthening, training and public sensibility/information diffusion.

The project has three components: i) harmonization and application of existing desertification indicators; data collection and analysis; ii) formulation of normative proposals for desertification control; iii) institutional strengthening and training; raising public awareness and spreading information. These activities are in agreement with the priority topics established in the Conference of the Parties during the Convention to Combat Desertification and in the national Action Programs of the participating countries. Within the framework of the Project, a meeting of experts was held in 2003 at IADIZA, Mendoza, where party countries were recommended to hold national workshops to propose and consolidate the group of indicators to be used by the Program, with the aim of contributing to its first component, putting special emphasis on the compilation and harmonization of desertification indicators to be used by all six countries. Moreover, it was agreed to use the MONITOR as a tool that will enable to integrate the information generated in all participating countries. The preparation of benchmarks of the training module to be implemented in the Project was also agreed upon. Another important activity of the Project is the decision to conduct study cases at the local level in each of the participating countries, aiming at reaching in each country the highest possible levels of information disaggregation. This work strategy would in turn allow to put into operation processes of active participation of the communities involved and to validate the selected indicators and benchmarks.

Thus far, national workshops have been held by Argentina (July 2003); Peru (August 2003); Bolivia (August 2003) and Brazil (August 2003); those of Chile and Ecuador are planned to be held in the next months.

3.3.4.1. Consolidation of results obtained in the countries

To guarantee comparability of results, national workshops were organized on the basis of previously elaborated benchmarks. To date Argentina, Bolivia, Brazil and Peru have carried out their workshops.

Argentina: The National Workshop on Consolidation of Indicators was held in Argentina on July 17 and 18, 2003. Technicians and researchers of renowned trajectory in the issue of indicators and benchmarks participated in it.

At the national workshop in Argentina progress was made in the discussion of a common ordering framework that could be used by the countries, and also in a proposal of the methodological process to be followed for defining indicators. The national workshops held to date have elaborated a list of those indicators that each one of the member countries are currently using. It is expected that this list enables the countries to achieve consensus and thereafter start sharing a set of high sensibility indicators allowing them to integrally assess desertification processes. Argentina considered it essential, to the end of synergizing and integrating efforts, to agree on a common conceptual framework from which to later proceed to indicator definition. This acquires great importance, since a set of scattered indicators is not part of an efficient system for decision making.

Although the first ordering framework used to define desertification indicators was Pressure Status Response (PSR), this has been surpassed in the last years, and now the most frequently used method is Driving force/Pressure/Status/Impact/Response (DPSIR). This method, derived from the PSR, was introduced by the European Environment Agency as a basis for its program on environmental indicators and is the method currently recommended by the UNCCD. It is used by the project Mediterranean Regional Action Program to Combat Desertification (MEDRAP), Desertification Information Systems of the Mediterranean (DISMED), and Combating Desertification in Mediterranean Europe (Desertlinks) -all of them financed by the EU- Socioeconomic Indicators of Desertification and Land Degradation (ECLAC), and is proposed by the Food and Agriculture Organization of the United Nations (FAO) as well.

For this framework, the following definitions are considered:

Driving force: represents human activities, processes and patterns having an impact on desertification.

Pressure Indicators: include all indicators responding to the cause of the phenomenon under study, in this case desertification.

Status Indicators: this category includes all those indicators describing the status of desertification at a given time.

Impact Indicators: include indicators showing the consequences of land degradation.

Response Indicators: indicate the response of society or the political measures relative to the issue of desertification.

This framework is based on the notion that recognizing pressure factors is not enough, it is also necessary to act upon their driving forces in order to mitigate effects. It is important as well to know how resource degradation impacts on the social system. An outline of this conceptual framework is shown in Figure 1.

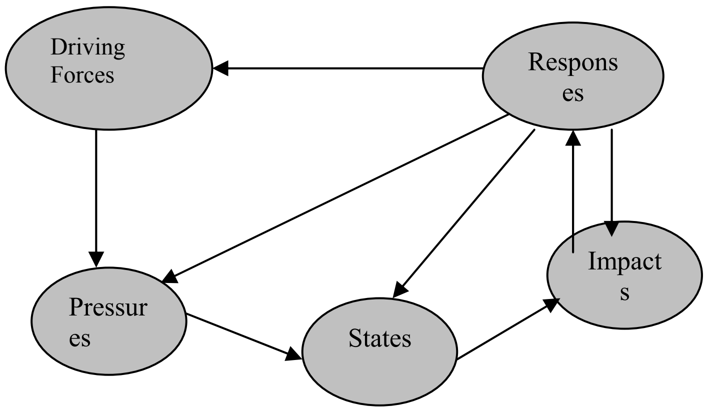
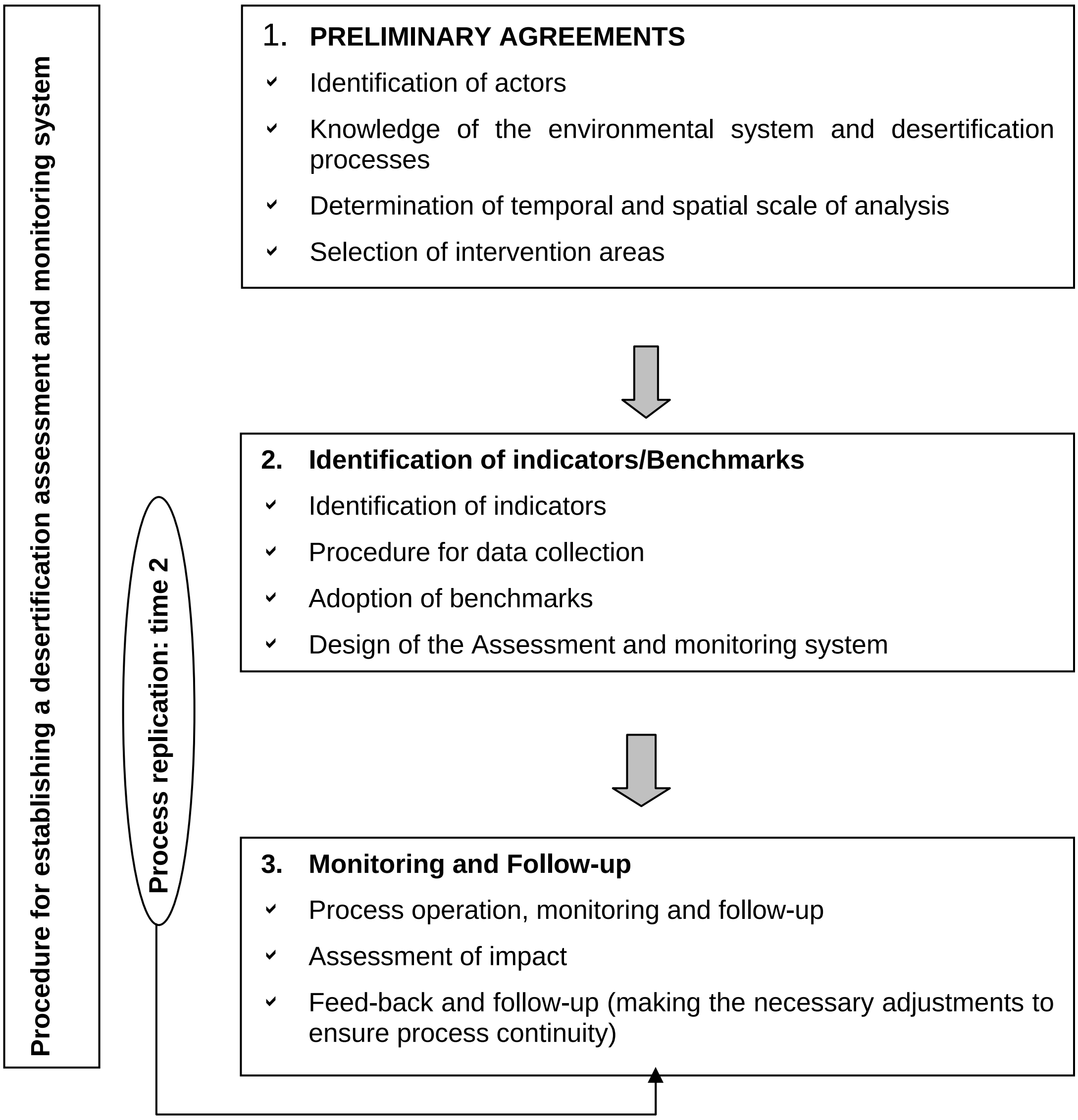


Figure 1. Outline of Conceptual Framework Driving force / Pressure / Status / Impact / Response

The methodological outline for the definition of indicators is still under elaboration[14], but progress made is detailed in Figure 2



[14] ABRAHAM, E.; MONTAÑA, E. and TORRES, L., in process

Bolivia: The National Workshop on Socialization and Validation of Desertification Indicators was conducted in Tarija – Bolivia on July 24 and 25, 2003, with the participation of more than 30 representatives of government institutions, universities, research institutes, nongovernmental agencies, experts in the thematic topic and others; from 6 Departments in the country (La Paz, Oruro, Cochabamba, Tarija, Chuquisaca and Potosí), where the Direction of Basins and Hydric Resources of the Ministry of Sustainable Development, as Focal Point of the United Nations Convention to Combat Desertification, was responsible for conducting the workshop, including organization, development and elaboration of the corresponding proceedings.
Indicators to work at national and local levels have been selected.
Brazil: The workshop in Brazil was held between August 7 and 9, 2003, in Brasilia, with the participation of the Focal Point for the Combat against Desertification, Secretary of Water Resources of the Ministry of the Environment, and the Secretariat technical staff; the Program Coordinator, the representative of the Esquel Group Foundation (Brazil), and members of the Meteorological Service, researches working on the issue, mostly from the northeast of Brazil, the area most highly affected by desertification processes. Also Patricia Maccagno from Argentina participated, in order to collaborate by presenting results from Argentina, and actively participating in the selection of indicators. In this country indicators were estimated at national and local levels.
Peru: This country held the National workshop on August 7, 2003. The National Focal Point, local governments, researchers and rural communities participated in it. In this case indicators were defined at the basin level, that is, at local level.
Neither Ecuador nor Chile have carried out their national workshops yet, but these are planned for the next months.
In each of the countries that have already carried out their national workshops, definition of a list of indicators, both national and local, has been achieved. Indicators were organized into those dimensions where desertification problems become manifest (biophysical, socioeconomic and institutional).
As a first step for the consolidation of results, a matrix was built with those indicators proposed by each country at national and local levels. This list of indicators is preliminary and tentative only, and is subjected to revision by the countries and to future discussion among the technical focal points in order to select the indicator to be used by the project.
When pilot sites start operating in the different countries it is to be expected that, given the specific characteristics of each country, some specific indicators at local level will emerge in each, in accordance with the environmental units selected. The selected indicators are included in annexes, reflecting both national and local levels.

3.4 Experiences from nongovernmental organizations

The role that NGOs in Latin America play in the combat against desertification has become increasingly consolidated over the last years. Among antecedents of these organizations in the region, the first contributions made by the Esquel Foundation (Brazil) towards1993, with the organization of the “Latin American Seminar”. As abovementioned, this experience paved the way for the concretion in 2002 of the Project “Towards a unified methodology for desertification assessment and monitoring in Latin America” (IDB / IICA , 2002).Another outstanding initiative of this sector in 2003 is the holding of the courses “Environmental History as a Tool for Environmental Management” and “Methodology for Identification of Desertification Indicators” carried out in Loma Plata, Paraguayan Chaco. These courses were organized by the

"DESDEL CHACO" Foundation, and counted on the presence of researchers, political decision makers and technical teams from Paraguay. Conduction of the course was in charge of the staff of the Instituto Argentino de Investigaciones de las Zonas Áridas. During five days of intensive work, Argentina's experience in benchmarks and indicators was shared with participants from the Paraguayan Chaco region, and the foundations for starting work in the region with desertification indicators were consolidated. On the other hand, this is one of the first experiences in the frame of PAS, and it is expected that this activity will consolidate interaction with other linking activities, synergizing the efforts of both sub regions.
In Argentina the contributions made by Los Algarrobos Foundation, a nongovernmental organization that has played an active role in the combat against desertification, ought to be highlighted. By complementing the approaches on indicators developed in Argentina, especially the practical approach on selection of indicators for decision making and the vision of horizontal cooperation "from bottom to top", Los Algarrobos Foundation (National Focal Point of RIOD), financially supported by GTZ, organized in Mendoza a training activity for adoption of indicators by NGOs in the region. Within the framework of this activity, the state of the art of advances on desertification indicators at local, national and international levels was presented, as well as the benefits of formulating and implementing projects on the fight against desertification, including indicators with examples and study cases. The aim of the workshop was to sensitize NGOs to the adoption of this tool. Results have been most encouraging, as the nongovernmental sector shows high capacity to immediately adopt these tools and, moreover, to cooperate in the obtainance and monitoring of indicators of status and impact. The NGOs from RIOD participating in the workshop expressed adherence to this proposal through the Declaration of Mendoza.

3.5 Contributions of the Sub-region for the regional level consolidation
Argentina has been the seat of the First International Seminar on "Desertification Indicators in LAC", supported by the GM, GTZ, Italian Cooperation, Regional Office of the UNCCD, and Argentine Focal Point.
The Seminar/Workshop on "Desertification Indicators in Latin America and the Caribbean. State of the Art and Proposals for a Plan of Action" was held between September 25 and 27 in Mendoza, Argentina, organized by the Instituto Argentino de Investigaciones de las Zonas Áridas (IADIZA) and the National Direction for Soil Conservation and Combat against Desertification of the Secretariat of the Environment and Sustainable Development. This Seminar counted on the support and financial aid of UNCCD, the Embassy of Italy in Argentina, the Global Mechanism and the German Cooperation (GTZ).
It is worth mentioning that ten Focal Points of LAC, or their representative, participated in this Seminar; delegates from all LAC sub regions were present: Caribbean: Jamaica and Cuba; Mesoamerica: Costa Rica and El Salvador; Southern Cone: Chile, Uruguay, Paraguay and Argentina; Andean: Venezuela and Colombia. There was also the participation of representatives of International Organizations and Projects: Regional Office of the UNCCD for LAC, GEF Project, IDB Project, ECLAC Project, MEDRAP Project, LADA Project, GTZ.
During three days of work there was interchange of experiences and lessons learnt in the obtainment and assessment of desertification indicators, aiming at the elaboration of a document including updating of methodology and successful experiences in the Region. Participants also worked on identification of mechanisms, objectives and strategies to

strengthen the process of establishment of a Regional Action Program on Desertification Indicators in Latin America and the Caribbean (LAC).

The focal points of the UNCCD or their representatives agreed to form a Regional Work Group for the Application of Indicators with the goal of promoting and coordinating actions, at Regional and Sub regional levels, relative to the issue of benchmarks and indicators, and of contributing to the elaboration of the corresponding component of the Regional Program. The group constituency is open to all countries in the Region. At this first stage, a Coordinating Committee was formed, constituted by one representative for each LAC sub region. It was agreed that Argentina should be responsible for the coordination of the Committee.

Another result was the elaboration of a document showing how decision makers and financing agencies should use B&I. As an example of the obtained indicators we list in the charts below those prepared by eight countries, indicating the relations among the country's total surface, percentage of dry lands, degraded and recovered lands surface, protected areas, number or projects related to preservation and recovering of lands, surface and affected population, and national and international financial contributions.

CHART N° 1. INFORMATION OF INDICATORS OF DESERTIFICATION IN DIFFERENT COUNTRIES

Country	Total Surface (Ha)	Total Population	Surface of Dry Lands (Ha)	Total Population in Dry Lands	Surface of Recovered Lands (Ha)	Protected Areas (Ha)
Colombia	114.178,200	44,000,000	22,000,000	5,280,000.0	Reforested period 1999-2002: 119,887.00	476,062.0 approx.
Brazil	854,740	169,799,170	108,300,000	18,500,000.0	No datum	628,778.0
Costa Rica	5,106,000	4,089,609	51,654	No datum	No datum	3,981.3
El Salvador	2,104,079	6,319,427	No datum	No datum	3,948.20	944.7
Panamá[1]	7,551,700	2,839,117	1,876,920	662,236.0	2,637.11	1,963,44.,0
Argentina	376,127,400	36,223,947	263,289,180	10,867,184.1		2,328,105.5
Uruguay	17,621,500	3,200,00	No datum	No datum	500,00.,00	61,000.0

[1] In the country, the total surface of degraded lands is 2.038.959 ha. It includes the surface of Dry lands (Dry Arc), the high lands in the province of Chiriquí (Cerro Puna y Volcán), Bayano River Basin located in the east of the Panamá Province and the west area of the Province of Darién.

Country	Projects on the Preservation or Recovery of Lands			Money Contribution (U$S)	
	N° of Projects	Surface (Ha)	Benefited Population	National	Co-operation
Colombia	80[1]	–	–	64,938,792[2]	
Brazil	4	10,830,000	18,500.000	13,000,000	40,000
Costa Rica	50	166,128	2,442	32,279,643	4,200,000
El Salvador	44	3,003.5	53,828	1,205,328	8,019,936
Panamá	8	2,800,654.5	157,671	2,582,000	4,725,000
Argentina	35	7,800,000	4,200,000	65,682,000	4,370,000
Uruguay	No datum	No datum	No datum	No datum	No datum

[1] Information given by Regional Autonomous Corporations, Institutes, the National Department of Planification, Agriculture Ministry. Ha., communities and costs were not presented
[2] The costs correspond to the reforested 119.887 ha. Holland, GTZ, KFW, China, Japan, Spain have made their contribution with relation to the projects of dry areas. We do not have the data at the moment

Also, and as a result of this initiative, the book "Desertificación: Indicadores y puntos de referencia en América Latina y el Caribe" (Abraham, E., D, Tomasini & P. Maccagno, Ed.) has been published. The book summarizes the papers presented and is meant to be a reminder of the efforts carried out in the region.
Recently, Matallo (2002)[15] published a synthesis of the development of the thematic topic in LAC.

3.6 Working relations with the CCT Group of Experts (GOEs) in the UNCCD

It is noteworthy the close relationship between activities carried out in the Annex related to B+I and the tasks brought about by the CCT of the UNCCD. Twenty five experts from all the Annexes have been selected by the members of the Bureau of the Committee on Science and Technology to conform the Group of Experts in accordance with decision 17/COP 5. The work program set forth by the member countries and approved by COP 6 bears, among other issues, the elaboration of guidelines to develop a common B+I System for monitoring and evaluating desertification. Five experts from ALC take part in GOEs, and within this framework, Elena Abraham coordinates B+I in Argentina with the support of representatives from Bulgary, Brazil, Chile, Cuba, Hungary, Morocco and the Czech Republic.
The principal aim of the project is to formulate guidelines to implement, test and disseminate an international common system for using B+I in desertification assessment and combat. This system should consider the B+I numerous demands that arise from the users' needs while achieving international, national, sub-national and local goals.
It is remarkable the cooperation tasks carried out between the thematic field of GOEs' B+I and the AID-CCD project. The inquiry adopted by GOEs was that designed to obtain information for this work. The final results of the AID CCD state of the art

[15] MATTALLO, Heitor, (2001), "Indicadores de Desertificacao histórico e perspectivas", *Cuadernos UNESCO*, Brasil, 126 p.

collection at international levels will be an essential feature for diagnosis as for further tasks planned by the Group of Experts.

4. Suggestions to support the UNCCD implementation

From the analysis of the available information, as well as from the systematization of data provided by the enquiry, it can be inferred that the region's desertification problems are severe and affect, in different degrees, diverse ecosystems and countries, worsening poverty. Nonetheless, the paradigmatic deterioration of Africa has not been reached yet.

Also, it should be noted that the progress in the implementation of integrated evaluation systems, supported by the use of B&I, is notoriously uneven within the region. Some countries have accumulated important experiences while others are just starting.

It could also be observed that the countries that take part in projects with other countries of the region show a greater progress in the solution of their problems. That means that the countries that have consolidated their national actions in coordination with other countries have more theoretical and methodological proposals for the application of B&I. Less contact with other countries results in less development.

It is interesting to observe the progress in the construction of indicators with a physical-biological support. On the other hand, obtaining indicators with anthropic support, especially as regards socioeconomic indicators, is much harder and is closely related to specific projects.

Despite the subject's development degree in LAC, there are no examples of development of impact indicators at the NAPs level, nor of the Convention's application impact. However, this is a succesful process thanks to the boost of bodies like the Regional Program for ALC of the UNCCD, the GTZ, the BID-IICA Program and the Worldwide Mechanism of the UNCCD. Countries are trying hard to admit B+I to the PANs that are underway and to those being motioned.

Regarding the development of integral evaluation systems supported by the use of B&I, it is remarkable that the countries that have only started to tackle the subject tend to rely more on their own experiences than on the other countries'. This situation is attenuated when the countries take part in projects working together with *groups of countries*, as described above.

It should be mentioned that there is not a unique criterion as regards indicators and benchmarks. Each country tends to adopt its own and differentiated systems and achieving a unique criterion is something yet to work on. However, carrying on several projects, now under way, which include the construction of evaluation systems (based on B&I) and focus on the international consensus, could attenuate this tendency.

One of the main problems that LAC have to face is the lack of visibility of their desertification problems in spite of their extension and severity in the different countries, and their final consequences of poverty worsening.

The images brought to the memory when evoking Latin America are those of the "Pampa húmeda" from Argentina, the rain forests and the beaches in the small insular Caribbean states. This generalized perception not only by the society but also by the decision-makers, sets the region in a disadvantageous situation in terms of negotiating projects to fight desertification within the UNCCD as well as before other organizations.

Deepening the work with B&I would provide excellent bases for demonstrating that the severe problems of desertification in the Region have an effect on the productive bases
in particular, civil society in general and can be observed in all the countries of the Region -featuring specific socioeconomic, natural and political situations, this is

deepened and worsened by the above mentioned situations thus contributing to the spreading of degradation.
Knowing this necessity, a great deal of diverse activities regarding B & I have been developed in the Region from the beginning of the '90's, must of them supported over the last few years by the Global Mechanism of the UN CCD (GM). All this work was carried out within the framework set up by the UN CCD and taking into consideration the importance given to it by the Convention and particularly for the Committee of Science and Technology of the UN CCD (CST). The progress that has been made regarding B & I, should be used as instruments for building up and implementing the NAP's and SRAP's in the Region.
During most of the Regional Meetings that took place, the LAC's countries have requested the sustainable management of the National Programs of Action to Combat Desertification and Drought and have called for the establishment of a System of Desertification and Drought Indicators.
Several countries of the Region have developed different capacities related to the determination of sensitive areas, and to the obtainance and evaluation of desertification indicators. All the countries are very interested in adding these capabilities, as they are aware of the importance of such indicators to be used as a powerful tool in the combat against desertification. There are also under-regional programs in progress, involving groups of countries. These Programs, like the Great American Chaco, have not incorporated yet Indicators to their working mechanism. The next step towards a Regional integration would be to add these instruments. It is necessary facilitate a mechanism of horizontal cooperation and technical training to promote the organization of the existing data and human resources training. This could be done with little effort through the consolidation of the National M & I Systems. The next step would be to design a Regional M & I System.
At the same time, there are specific projects to get indicators of desertification which are in progress or in an advanced process of administration and that involve groups of countries (i.e. the GEF Project between Chile, Brazil and Mexico; the ECLAC Project (Argentina, Chile and Brazil) on socio-economical indicators of desertification; or the IDB - IICA Project (Brazil, Argentina, Ecuador, Bolivia; Chile and Peru). These projects represent a considerable advance for the establishment of a Desertification Monitoring Evaluation Systems at sub-regional level in practical terms. Emerging results should be compared against one another in order to guarantee their transfer to the countries interested in adopting them.
There are good possibilities for the Region related to International Cooperation, particularly South – South, and a synergy of Projects within as well as outside the Region regarding B & I. Therefore the present moment is crucial in order to strengthen the GRULAC using instruments of communication, planning and management; Regional and Sub Regional Actions could be the catalyst for the Region so as to obtain a greater commitment on the part of the countries for effective partnership building, scientific – technological and political – institutional consensus, within the framework of significant issues for the UN CCD, covering dissemination and capability building.
A great deal of financial resources were invested, which yielded only partial results despite the fact that those efforts allowed for the accumulation of important experiences. Still the existing initiatives did not generate the required practical results for countries to adopt them and so make headway in the implementation of the UN CCD. The proposed TPN as a support tool to the Regional Action Program should capitalize the diverse existing initiatives in the Region, for the planning of actions as well as the implementation of activities under multidisciplinary approaches. An important element

is the pursuit of actions on benchmarks and indicators and the measurement of its results. It is therefore, required to have a Technical Network Program for the management of such indicators, derivative of the multiple initiatives, and particularly of the results of the Sub regional Workshops.

Related to the particularities that Mesoamerica presents into a Sub regional level, is outlined that, historically, farming practices of Central American countries has helped to accelerate the process of degradation and to create serious imbalances in the productive systems, affecting social, economic and environmental conditions in these countries. It is for this reason that proposals are being made to create awareness about the importance of implementing early warning systems, on the use of indicators for monitoring areas with the greatest degradation and for the implementation of NAPs, PASRs, and PARs, within the framework of UNCCD compliance.

In general, fund-raising is for most countries in Meso America one of the most important factors; this is the case of Costa Rica, Panama. As a result, although there is awareness of degradation issues, many initiatives in the region have not been implemented. However, training and other efforts have been developed with institutional resources from the academic and governmental sectors, and from nongovernmental institutions which have contributed to increase social understanding.

Although a general methodological protocol for compiling and disseminating data for the construction of indicators, and therefore for measuring degraded areas, is not yet available in Meso America, it is important to underscore that there is awareness in the region about this need, and that methodologies have been created in order to prioritize actions in certain geographical units (water basins, for example), which can be adapted to the different conditions in other Meso-American countries, under UNCCD guidelines.

In some Meso-American countries, work is already underway in pilot areas, in order to evaluate the degree of degradation and to create indicators that help to identify positive responses on the part of those directly involved. In those countries that have no pilot areas in place, reference points exist that can be used in order to generate information for the measurement of degraded areas, as well as other areas that are vulnerable to degradation processes, thus contributing to improve resource conditions in these areas, as well as those of their inhabitants.

Information systems are visualized as an important tool in order to monitor human-induced pressures that affect different resources, and for evaluation of their impacts on the state of the resource, and of the institutional response given for mitigation of the degrading processes and regeneration of the affected areas. Costa Rica is one the Meso-American countries that is pioneering the development of methodologies for the creation of pressure, state, impact and response indicators (PSIR) for the rehabilitation of degraded lands; these methodologies can be adapted to the conditions of other countries in the area.

Results from assessment in Meso-America are key in order to identify existing needs in these countries, related to I&RP development at different levels (national, regional, community), and in order to develop methods that are appropriate to each one and consistent in the construction of comparative indexes, thus contributing to early correction of the problems facing this and other regions.

As can be appreciated, the Region has made an enormous effort in obtaining B & I of desertification, which gives it comparative advantages compared to other Annexes.

Nevertheless, some critical issues assessed at regional level should be taken into account.

- There are no examples of use of B&I in NAPs, PASRs and PAR.

- A unique methodology for obtaining and evaluating B&I has not yet been achieved.
- So far, projects do not show results according to investments.
- Indicators and systems have been developed but not yet validated; there are only partial results that have neither been transferred to other counties nor used by PAN or decision-makers.
- Basically, the practical results needed by the countries have not yet been generated.

The processes started at regional, sub regional and national levels, mainly the TPN proposed ,as well as the sensitizing , training and land degradation assessments promoted by international bodies, are expected to overcome these critical sides. Likewise, the region is trusted to reach a high capacity for the measuring of land degradation, desertification and poverty processes. Human resources availability, institutional capacity, the support of international funding bodies and above all, the goodwill of member countries to put in practice their NAPs on a B+I basis are quite clear at this advanced stage.

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Annex I : List of people to whom the questionnaire was sent (and rate of response)

The list of key informants selected on a first stage is the following

Name	Institution
Carlos Ayala	Delegación de la CE en Colombia
Ana María Sibille M.	Consultora UNCCD- Perú
Fernando Santibáñez	Universidad de Chile
Joao Bosco Senra	P. F. de Brasil
Gertjan B. Beekman	Programa LCD en América del Sur, BID y IICA
Juan Pablo Iturregui	Asociación para el Desarrollo Progresivo de los Pueblos (ADEPROP poner país)
Giselle Beja Valent Carlos Victora	Dirección de la Asesoría de Asuntos Ambientales Internacionales. Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, Uruguay.
Luis Molina	Director de Gestión Ambiental. Punto Focal CCD Paraguay. Secretaria del Ambiente Paraguay
Rober León Cruz	Dirección de Política Ambiental. Departamento Nacional de Planeación. Colombia
Rodolfo Roa D.	Director General de Cuencas Hidrográficas Ministerio del Ambiente y de los Recursos Naturales. Punto Focal CCD, Venezuela
Viviane Castro S.	Coordinadora Regional ONG Earthaction, Punto Focal Cono Sur Riod. Punto Focal Nacional Chile Riod.
Mireya Quiroz	ONG Fundación Cultural de Putumayo. Colombia
Edson Duarte	Camara Federal dos Deputados, Brasil
Cecilia Leal Franco	Gerente Ejecutivo ONG Oasis de Vida, país
Carlos Andaluz	Director ONG Proterra, Perú
Guayana Páez Acosta	ONG Fundación Tierra Viva. Caracas- Venezuela
Wilfredo Alfaro	Punto Focal en Chile de la UNCCD
Osvaldo Báez	Punto Focal de Ecuador UNCCD
Chávez Torrico Luis	Representante de Punto Focal de Bolivia
Urbelinda Ferrufino	ONG Asociación Ecológica del Oriente. Bolivia
German Aliaga T.	Embajada de Bolivia
Cesar Morales	CEPAL – ONU
Roberto Forero	IICA Colombia
Carlos Gómez Sánchez	Instituto de Hidrología Meteorología y Estudios Ambientales. IDEAM Colombia
Clara Bustamante Z.	Corporación Colombiana de Investigación Agropecuaria. CORPOICA
Daniel Tomasini	Mecanismo Mundial CNULD
Francisco Brzovic	Mecanismo Mundial CNULD
Octavio Pérez Pardo	Punto Focal Argentina
Elena Abraham	Instituto Argentino de Investigación de Zonas Áridas IADIZA
Patricia Maccagno	Técnica de la Secretaria de Ambiente y Desarrollo Sustentable, Argentina
Cesar Álvarez Falcón	Jefe del INRENA. Lima, Perú
Zoraida Fajardo	Ojo, Colombia

Some of the informants kindly passed the enquiry on to others that they considered could not be absent from the initiative. Yajaira Diaz, Maria Lugo and Federico Barroso from Venezuela; the General Manager of the Fundación Tierra (Colombia) Alejandro Luy, and the Manager of the Francer Goenaga Program joined the first informants.
The level of responses to the enquiry was also diverse. Some institutions responded, others gave no response, and others sent us published material from which we were able to get the information needed. This degree of disparity made it difficult to elaborate the report, as it can be noted, the sources of information are not homogeneous.
We shall try to overcome this difficulty by using all information available, ordering it in large information blocks and trying to reach the highest level of detail possible.

CCD Focal Points

Country	Focal Point	Organization	e-mail
Barbados	The Honorable H. Elizabeth Thompson Minister and Focal Point	Ministry of Housing, Lands and the Environment 1st floor S.P. Musson Building Hincks Street Bridgetown	Minister@meenr.gov.bb
Dominica	Mr. Davis Letang Permanent Secretary Focal Point	Ministry of Agriculture and Environment Government Headquarters, Kennedy Avenue Roseau, Commonwealth of Dominica	Psagriculture@Cwdom.Dm
Guyana	Mr. Andrew Bishop Commissioner, Chief Executive Officer Lands and Service Commission	Ministry of Agriculture, Georgetown	Arbishop@networksgy.com
Haiti	M. Joseph Vernet Point Focal	Ministére de L´environment (Mde) Programme de Lutte contre la Désertification 181 Haut Turgeau Pot-Au-Prince	Josephvernet@yahoo.fr Ordonnateurnlhaiti@yahoo.com
Jamaica	Mr. Philbert Brown Director Emergency Management	Ministry of Water and Housing 6 St. Lucia Ave.Kingston 5	Sdemow@cwjamaica.com
Dominican Republic	Mr. Fernando Campos Guzmán Sub-Secretario de	Sub-Secetaría de Suelos y Aguas Secretaría de Medio	Suelo-agua@codetel.net.do

	Estado de Suelos y Aguas	Ambiente y Recursos Naturales Secretaría de Agricultura John F. Kennedy, km 6.1/2 Autopista Duarte Santo Domingo	
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St. Lucia	Mr. Michael Andrew National Focal Point Deputy Chief Forestry Officer	Ministry of Agriculture Forestry and Fisheries Castries	latanye@hotmail.com chiefforest@slumaffe.org
St. Vincent and The Grenadines	Mr. Reynold Murray Environmental Services Coordinator	Ministry of Health and the Environment Kingstown	svgenv@caribsurf.com
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MESOAMERICA

United Nations Convention to Combat Desertification Focal Points (Source : http://www.unccd.int)

Country	Organization	Contact	Position	E-mail	Telephone	Fax	Address
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Annex II: List of Indicators

ARGENTINA

NATIONAL	Topic	Indicator
Biophysical Indicators	Climate	Aridity index
		Drought index
	Water	Water demand Annual rate of population growth/water availability
		Variation in the cultivation area under irrigation
		Surface water availability (m^3-sec)
		Reservoirs of subterranean water m^3
		Number of Institutions related to the study and regulation of water
		Existence of water-related regulations at provincial and national level
		Efficiency in the application of regulatory tools associated with water
Biophysical Indicators	Soil	Degree of eolian erosion
		Degree of hydric erosion
		% of bare soil
		Erodability by incidence of wind
		Erodability by incidence of water
		Number of Institutions related to the study and regulation of soil
		Existence of soil-related regulations at provincial and national level
Biophysical Indicators	Vegetation	Fire recurrence and hazard
		% of plant cover
		Changes in types of plant cover (%)
		Number of Institutions related to the study and regulation of flora and fauna
		Existence of regulations related to flora and fauna at provincial and national level
		Change in the flora and fauna conservation status
	Fauna	N° of species with conservation problems
		Specific programs on flora and fauna conservation
Socioeconomic Indicators	Land use	Variation in % of area devoted to different productive uses
		Advance in the agricultural frontier
		Productivity Index
		% of dryland area as related to the country's total area
		% of area with protected zones in drylands
		Existence of a NAP to combat desertification
		% of recovered drylands, or in the process of recovery
		Growth rate of the Internal Net Produce in extractive activities
		Growth rate of the Internal Net Produce in activities of resource use
		% of companies that certify ISO 9000 and 14001
		% of areas under different tenure forms

NATIONAL	Topic	Indicator
Socioeconomic Indicators	Population	Migration net rate
		% of population living in drylands
		Population density
		% of rural population and % of urban population in relation to total population
	Poverty	% of homes with unsatisfied basic needs
		% of homes under the poverty line
Institutional Indicators		Nº of state organisms, and research institutions concerned with dryland recovery
		Nº of NGOs devoted to dryland recovery
		Existence of national and provincial laws related to land degradation
		Nº of institutions and projects associated with NAP financing
		Amount of provincial, national and internacional funds for financing NAP projects
		% of the population under desertification control projects
		% of the area under desertification control projects

LOCAL	Topic	Indicator
Biophysical Indicators	Climate	Amount of rain mm fallen/time unit
		Rainfall types and distribution
		Wind speed
	Water	Distribution of water sources
		Number and quality of water sources
		Permeability
		Nº of drillings per area unit
	Soil	Textura
		Gullies
		Sand dunes
		% of furrow-covered area
		Slope gradient
		Electric conductivity
		Alkalinity
		Sodicity
		% of mount-covered area
Biophysical Indicators	Vegetation	% of plant cover
		Dominant species
		Stratification
		State of degradation of plant coverl
		% of exposed roots
	Fauna	Diversity
		Density
		Distribution
		Dominant species
Socioeconomic Indicators	Land use	Stocking rate
		Extraction of Native Forest
		Evidences of overgrazing
		Existing and planned reserves

	Population and poverty	Population density
		Settlement organization and structure
		Presence/absence of infrastructure and services
		Literacy rate in the total population
		Accessibility/inaccessibility to the health system
		Age composition of the domestic units
		Distribution of housework in the domestic unit, by age and gender
		% of women head of households
		Net produce value destined to self consumption, commerce (%)
		% of subsidy beneficiaries
		Access to credit
Institutional Indicators		Presence / absence of basic organizations
		Type of basic organization
		Training
		Existence / inexistence of development programs applicable in the study area
		Stage of the process in which the population participates

BOLIVIA

NATIONAL WORKSHOP ON SOCIALIZATION AND VALIDATION OF DESERTIFICATION INDICATORS TARIJA- BOLIVIA
24 & 25 JULY 2003

SOCIOECONOMIC INDICATORS (SOCIETY)

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY		Value
					Assessmentexpert scale	Instrumental Methodology	
Socioeconomic	Income	Per capita income	Per capita income	$	Very High	Enquiries, censuses, interviews, meetings and others	1
					High		2
					Medium		3
					Low		4
					Very Low		5
		Income composition	Agricultural and non-agricultural income		Very High		1
					High		2
					Medium		3
					Low		4
					Very low		5
	Social Movement	Migrations	Final temporary migrant population/total	%	Very Low		1
					Low		2
					Medium		3
					High		4
					Very High		5
	Land tenure	Rural property	Owners / total rural families % of rented land % of small farmsteads with respect to the agricultural area	Ha	Very High		1
					High		2
					Medium		3
					Low		4
					Very low		5
	Population	Size	Population density Economically active population/total population	%	Very high	Enquiries, censuses, interviews, meetings and others	1
					High		2
					Medium		3
					Low		4
					Very low		5
Socio econo mic		Services (Health, education,	Service coverage House quality	%	Very good	Enquiries, censuses, interviews, meetings and	1
					Good		2

SOCIOECONOMIC INDICATORS (SOCIETY)

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY: Assessmentexpert scale	METHODOLOGY: Instrumental Methodology	Value
	Social Integration	Basic services, communication and housing)			Regular	others	3
					Defficient		4
					Very defficient		5
	Social Structure	Social Organizations	Nº of organizations Participation in social organizations	Nº of Org. % of participation	Very high		1
					High		2
					Medium		3
					Low		4
					Very low		5
	Poverty	Poverty	% of poverty	%	Very low		1
					Low		2
					Medium		3
					High		4
					Very high		5

SOCIOECONOMIC INDICATORS (HUMAN DEVELOPMENT - INDIVIDUAL)

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY: Assessmentexpert scale	METHODOLOGY: Instrumental methodology	Value
Socioeconomic	Education	Formation	Degree of schooling reached	degrees	Very high	School records and censuses Record of hospitals and Health Stations, health campaigns and censuses Diagnoses and censuses	1
					High		2
					Medium		3
					Low		4
					Very low		5
		Access to education	N° of school-age individuals (5 to 18) Non-formal Education	%	Very high		1
					High		2
					Medium		3
					Low		4
					Very low		5
	Health	Health state		%	Very good		1

SOCIOECONOMIC INDICATORS (HUMAN DEVELOPMENT - INDIVIDUAL)

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY Assessmentexpert scale	METHODOLOGY Instrumental methodology	Value
			N° of de people that become ill/ total population		Good		2
					Regular		3
					Bad		4
					Very bad		5
		Morbidity	N° of medical doctors /10000 inhabitants	%	Very low		1
					Low		2
					Medium		3
					High		4
					Very high		5
Socioeconomic		Access to health		%	Very high	School records and censuses Record of hospitals and Health Stations, health campaigns and censuses Diagnoses and censuses	1
					High		2
					Medium		3
					Low		4
					Very low		5
	Nourishment	Quality of alimentary diet	Number of calories/day	Calories / person	Very good		1
					Good		2
					Regular		3
					Bad		4
					Very bad		5
	Housing	House quality	Building materials N° of rooms/family group	Quality of materials M2	Very good		1
					Good		2
					Regular		3
					Defficient		4
					Very Deffic.		5
	Economic income	Income	Family income/average income in a region Fraction of family income from the agricultural activity	$	Very high		1
					High		2
					Medium		3
					Low		4
					Very low		5

PHYSICAL INDICATORS OF PRESSURE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY: Assessmentexpert scale	METHODOLOGY: Instrumental methodology	Value
Físicos	Air	Wind	Speed, suspended particles	Km/h	Very weak	Anemometer	1
					Weak		2
					Medium		3
					Strong		4
					Very strong		5
	Water	Water quality	Contamination Salinity Sedimentation	Salt Degree	Very good	Laboratory (physical, chemical and biological analyses)	1
					Good		2
					Regular		3
					Bad		4
					Very bad		5
		Water quantity	Flows	M3/sec.	Very high	Water mill	1
					High		2
					Regular		3
					High		4
					Very high		5
	Soil	Water erosion	Erosion degree	Degree	Very low	Laboratory (physico-chemical analysis)	1
					Low		2
					Medium		3
					High		4
					Very high		5
Físicos	Soil	Wind erosion	Erosion degree	Degree	Very low	Laboratory (physico-chemical analysis) Enquiries, agrarian censuses	1
					Low		2
					Medium		3
					High		4
					Very high		5
		Productive potential	Yield, type of crops	Kg/ha	Very high		1
					High		2
					Medium		3
					Low		4
					Very low		5

PHYSICAL INDICATORS OF PRESSURE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY		Value
					Assessmentexpert scale	Instrumental methodology	
		Soil quality	Salinity Compaction Organic matter	% amount of nutrients	Very good		1
					Good		2
					Regular		3
					Bad		4
					Very bad		5
	Climate	Rainfall regime	Frequency of anomalous events	mm intensity	Very low	Pluviographs	1
					Low		2
					Medium		3
					High		4
					Very high		5

PHYSICAL INDICATORS OF STATE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY		Value
					Assessment expert scale	Instrumental Methodology	
Physical	Water	Water quality	Contamination Salinity Sedimentation	Salt degree	Very low	Laboratory (physical, chemical and biological analyses)	1
					Low		2
					Medium		3
					High		4
					Very High		5
		Water quantity	Flows	M3/sec	Very low	Water mill	1
					Low		2
					Medium		3
					High		4
					Very High		5
	Soil	Water erosion	Erosion degree	Degree	Very low	Diverse methodologies	1
					Low		2
					Medium		3
					High		4
					Very High		5

PHYSICAL INDICATORS OF STATE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY Assessment expert scale	METHODOLOGY Instrumental Methodology	Value
		Wind erosion	Erosion degree	Degree	Very low		1
					Low		2
					Medium		3
					High		4
					Very High		5
Physical	Soil	Productive potential	Yield	Kg/ha	Very High	Enquiries, agrarian censuses	1
					High		2
					Médium		3
					Low		4
					Very low		5
		Soil quality	Salinity Compaction Organic matter	% amount of nutrients	Very High	Laboratory (physico-chemical analysis)	1
					High		2
					Médium		3
					Low		4
					Very low		5
	Climate	Rainfall regime	Frequency of anomalous events	Weather	Very low	Different measuring instruments, pluviographs	1
					Low		2
					Médium		3
					High		4
					Very High		5

BIOLOGICAL INDICATORS OF PRESSURE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY Assessment expert scale	METHODOLOGY Instrumental Methodology	Value
Biological	Vegetation	Agricultural Productivity	Hectares cultivated on slopes. Ha cultivated with soil conservation practices	% area yield	Very low	Satellite Images, agricultural censuses, enquiries	1
					Low		2
					Medium		3
					High		4
					Very high		5

BIOLOGICAL INDICATORS OF PRESSURE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY		Value
					Assessment expert scale	Instrumental Methodology	
		Biomass usable by man	Nº of species N° of energetic species for timber		Very low	Enquiries, censuses	1
					Low		2
					Medium		3
					High		4
					Very high		5
		Expansion of agricultural frontier	Rate of incorporation of croplands	Ha %	Very low	Agricultural censuses, enquiries	1
					Low		2
					Medium		3
					High		4
					Very high		5
		Regeneration capacity of vegetation	Rate of replacement, birth, mortality	%	Very high		1
					High		2
					Medium		3
					Low		4
					Very low		5
	Vegetation	Deforestation	Rate of deforestation, fire, cutting, selective logging	%	Very low	Forest censuses	1
					Low		2
					Medium		3
					High		4
					Very high		5
Biological		Livestock composition	Nº of animals and type of degrading livestock/family	Nº of heads	Very low	Agrarian Censuses enquiries	1
					Low		2
					Medium		3
					High		4
					Very high		5
	Livestock	Overgrazing	Stocking rate, grazing areas, perennial palatable forage species and other species	Nº of animals, ha with forage species, high peatlands	Very low	Inventories, livestock censuses	1
					Low		2
					Medium		3
					High		4
					Very high		5

BIOLOGICAL INDICATORS OF STATE

Category	Component	Indicator	Parameters	Unit of measure	METHODOLOGY Assessment expert scale	METHODOLOGY Instrumental methodology	Value
Biological	Vegetation	Plant cover	% of cover, composition, fraction of covered soil	% ha	Very high	Satellite Images, transects	1
					High		2
					Medium		3
					Low		4
					Very low		5
		Floristic diversity	Indicator species of soil empoverishment, composition of existing native species, number of taxa/area		Very low	Censuses, enquiries	1
					Low		2
					Medium		3
					High		4
					Very high		5
		Agricultural productivity	Rainfed agriculture, under irrigation, livestock raising	% Area yield	Very high	Satellite Images, agricultural censuses, enquiries	1
					High		2
					Medium		3
					Low		4
					Very low		5
		Soil biological activity	Mineralization of organic matter		Very high	Laboratory studies	1
					High		2
					Medium		3
					Low		4
					Very low		5
Biological	Livestock	Overgrazing	Extraction rate, regeneration rate	%	Very low	Inventories, livestock censuses	1
					Low		2
					Medium		3
					High		4
					Very high		5
		Fauna diversity	Animal composition, Divers. Sp/area		Very high	Biodiversity state monitoring	1
					High		2
					Medium		3
					Low		4
					Very low		5

Indicators are evaluated according to value scales that include 5 categories, where 1 represents a very light pressure and 5 the highest pressure, according to the following example,

CONCEPT	DESCRIPTION	INDICATOR VALUE
Very Low	The human or natural action is below or balanced with the system resilience capacity, so impacts are kept at levels of low significance and can be technologically managed. If the pressure is eliminated, the system will become stable in the short term. The action can stop being degrading if minor corrections are made.	1
Low	The human or natural action is above the system resilience capacity, maintenance of the pressure at this level will lead in the mid term to the appearance of impacts. The activity is qualified as degrading within moderate margins that can be corrected fairly easily.	2
Medium	The human or natural action is significantly above the system resilience capacity. Impacts are or will be noticeable in the short term. The activity can be regarded as frankly degrading.	3
High	The human or natural action is far above the system resilience. An accelerated system degradation is taking place. Pressure elimination requires major corrections.	4
Very High	The human or natural action is Duch that a significant system degradation is foreseen in the very short term.	5

The pressures exerted by the human being are not easily describable by a single parameter. Many times they are the result of multiple factors derived from an action on the environment. In addition, a human action can act on different environmental components, exerting multiple pressures on several natural resources. This is the case of agriculture, an activity that requires elimination of natural ecosystems, exerting pressure on plant diversity, soil, water and fauna simultaneously.

BRASIL

CONSENSED DESERTIFICATION INDICATORS			
DESERTICATION INDICATORS	IMPORTÂNCE	COVERAGE	HOW TO MEASURE
Plant cover	1	N	% Covered area/total area
Biomass of desert plant cover	2	N	Leaf mass ton/ha or m^3/ha
Plant biodiversity	1	L	Floristic inventory (species/ha)
Clearing	1	N	Variation in plant cover
Presence of indicator species	1	L	Floristic inventory (species/ha)
Consumption of plant products - Firewood/consumption	1	N	Ton/ha/year
Consumption of plant products - consumption/offer	1	N	Ton/ha/year
Fauna (diversity, density, distribution)	2	L	Fauna inventory
Land use	1	N	Area/use classes
Degree of erosion	1	N	Type of classes/ha
Degree of salinization	1	L	Classes
Salinized area	1	N	Salinized area/total irrigated area
Overgrazing	1	N	(Stocking rate/ha)/support capacity
Surface albedo	2	N	I/R classes/area
Use of subterranean and superficial water Supply/Demand - Water stress - IPH (index of precipitation per ha)	1	N	Supply/demand Variation (m^3/s) m^3/hab/year(class)
Water stored in the open	1	N	Estimated volume (area/ha)
Water quality	1	L	Index of water quality (IQA 9 parameters)
Discharge/Sedimentation	1	L	Solid discharge/liquid discharge
Surface flows (permanent - temporary)	1	L	m^3/s - (permanent rivers)
Wells (permanent - temporary) Demographic density (urban, rural)	2 1	L N	Pumping rate (m^3/h) DNPM inhab/km^2
Net migration rate	2	N	TM=(M/(((E+R)/2)*N)*1000
Annual mean rate of population growth	2	N	$(P_{t2} - P_{t1}) -1$
Age structure Economically Active Population/Gender	1	N	P(0 - 19 years old)/Pt*100 P(20 - 59 years old)/Pt*100 P(60 years old)Pt*100
% of women head of household	1	N	(Women head of household/total families)*100
Family income from agriculture/total family income	1	N	(agricultural $ family/$ family)
Self consumption%	1	L	$ self consumption/$production
Incidence of poverty	1	N	IDH Poverty Index
Diseases of higher incidence (water-related)	1	N	Nº of sick persons (cases) SUS
Health services	1	N	% of rural houses with sanitary installations

Child mortality	1	L	Deceased up to 5 years of age/1000
Schooling	1	L	Mean school years
Farming structure	1	L	Distribution of property classes Number of owners GINI coefficient

N - National L - Local

INSTITUTIONAL INDICATORS			
State control/Supervision			
Plano director			
Capacitation			
Association of municipalities			
NGOs/OSCIP			
Councils			
Organizational resources			
Legal framework			
Program integration			
Institutionalization			
Aridity index			
Index of Rainfall records			

CHILE

Regional indicators proposed:

Indicators	Component S-P-R (State-Pressure-Response)	Regional Validity (% countries)
Soil Loss	State	100
Soil salinization	State	100
Fertility	State	100
Albedo	State	100
Organic matter	State	100
Surface runoff	State	80
Depth of phreatic layer	State	80
Suspended Sediments	State	80
Índices of temperature-rainfall levels	State	80
Water salinization	State	60
Soil contamination	State	60
Volume of water bodies	State	60
Rainfall trenes	State	40
Soil compaction	State	40
Glacier melting	State	40
Water contamination	State	40

Regional Biological Indicators	Component S-P-R (State-Pressure-Response)	Regional Validity (% countries)
Biodiversity	State	100
Plant strata	State	100
Biomass	State	100
Primary Productivity	State	80
Plant cover	State - Response	80
Indicator species	State - Response	60
Resilience	State	40
Stocking rate capacity	Pressure	40
Livestock productivity	State - Response	40
Crop productivity	State - Response	40
Changes in trophic chains	State - Pressure - Response	40
Seed storage in soil	State	40

Regional Indicator	Component S-P-R (State-Pressure-Response)	Regional Validity (% countries)
Poverty	State	100
Income	State	100
Migration	Response	100
% of population aware of desertification	Response	80
Índex of child mortality	State	80
Índex of male population	State	80
Agricultural Income/total income	Pressure	80
Population/cultivated area	Pressure	60
Child morbidity	State	60

Age structure	Response	60
Schooling	State	60
Access to basic services	State	60
Production for self consumption/total production	Response	60
Malnutrition	Response	40
Participation in decisión making	Response	40
Presence of desertification control policies	Response	40
Presence of adapted technologíes	Response	40

CHILE

Indicators of State

Category	Indicator	Soil	Water	Vegetation	Quality of life	Social structure	
Pressure	Population density	✓	✓	✓			It attempts to assess the global demographic pressure on natural resources
	Exposure to rainfall	✓	✓	✓			It atttempts to assess the degree to which soil is exposed to erosive factors (Rain and wind). It combines plant cover and climatic regime
	Overgrazing	✓		✓			Degree to which stocking rate exceeds the vegetation capacity
	Eco-efficiency	✓		✓			It is an indirect measure of the users' level of consideration for the environment.
	Cultivation on slopes	✓					Level of aggressiveness of cultivation methods in fragile and sloping soils. It considers slope gradient and type of crops.
	Deforestation			✓			It refers to the rate of extraction of woody elements from the natural plant cover.
	Expansion of agricultural frontier	✓		✓			Measure of the degree of loss of wild areas due to the incorporation of new lands to agriculture.
	Agricultural income				✓		Participation of income from agriculture in the total family income.
	Non-agricultural income				✓		Participation of other activities in the family income. It allows to know the degree of population vulnerability to land degradation.
	Changes in land use	✓	✓	✓			It basically refers to the changes in land use caused by land degradation. It includes land desertion or transitions toward a more marginal and less profitableagriculture.

Indicators of Pressure

Category	Indicator	Soil	Water	Vegetation	Quality of life	Social structure	
Social Component	Social integration					✓	It attempts to assess the degree of functionality and articulation of social organizations. Special emphasis must be placed on the participation of the population.
	Access to services				✓		Measure of the degree of access that people have to public services of health, education, recreation, administrative services. Access is limited by existence of services, distance and communications, or bureaucratic hindrances.
	Housing quality				✓		It attempts to assess the degree to which the house meets basic functionality.
	Sanitary services				✓		It attempts to assess sanitary quality both in the house and the environment. Basically it is about assessing threats to health.
	People/housing				✓		It is a measure of population crowding.
	Illiteracy				✓		Degree of population illiteracy. It may be complemented or replaced with schooling.
	Masculinity					✓	It attempts to determine population unbalance caused by selective migration of genders.
	Employment				✓		Fraction of the population having access to employment.
	Poverty				✓		Fraction of the population with unsatisfied basic needs.
	Morbidity				✓		Indices of sickness per age stratum.
	% of Economically Active Population					✓	Fraction of the population between 15 and 65 years of age

PERU

Program to Combat Desertification in South America
PILOT AREAS - Peru

	PILOT AREAS	
	AREQUIPA	PIURA
RESPONSIBLE INSTITUTIONS	Arequipa: Universidad Nacional San Agustín de Arequipa,	Piura: Universidad Nacional de Piura
INSTITUTIONS INVOLVED	Majes Project, Regional Government	Algarrobo Project/INRENA CEPESER, Catamayo-Chira Project.
Location:	Arequipa : High basins of the Chili and Colca	Piura : Basin of the Chira
Responsible persons:	Blgo. Percy Jiménez Mitón	Dr. Edgar Rodríguez Gálvez
Telef/Fax:	51054-288971 51054-429598	073 325966 073 9936801
E-mail:	ireca@unsa.edu.pe	erg@tallan.unp.edu.pe
Area of work:	Desertification, Basin management, Rural development, Education	Desertification, Basin management, Rural development, Education
CHARACTERISTICS		
Extent of Pilot areas	Colca Approximate extent of study area in the High Basin: 2 500 km^2 Total Drainage Area: 17 220 Km^2 Collecting basin: 12 493 Km^2	Chira – Catamayo 17 358 km^2 Chira – Perú 10 273 km^2
	Chili Approximate extent of the study area in the High Basin: 2 500 km^2 Total Drainage Area: 11 955 Km^2 Collecting Basin: 7 594 Km^2	

Population involved		Colca : 80 000 inhabitants Chili: 820 000 inhabitants	Chira – Catamayo 817 968 inhabitants 596 282 inhabitants in Peru
Local governments and rural communities involved		High Basin of the CHILI: Provincial Municipalities: Arequipa and Caylloma District municipalities: San Antonio de Chuca, San Juan de Tarucani, Cañahuas and Sumbay Rural Communities: San Juan de Tarucani, Tambo Cañahuas, Salinas Huito High Basin of the COLCA: Provincial Municipalities: Caylloma District Municipalities: Tsico, Sibayo, Callalli, Tuti Rural Communities: Tsico, Sibayo, Callalli, Tuti In addition: The Cooperative Agrarian Society La Pulpera has its own population.	CHIRA (Provincial Municipalities) Ayabaca Huancabamba Morropón Sullana Piura Paita
METHODOLOGY: Monitoring System (related to the combat against desertification) Type of information		Aerophotography, satellite images Cartographic, bibliographic, enquiries.	Aerophotography, satellite images, bibliographic, enquiries.
INDICATORS (physical, biological, socioeconomic) (1)			
abiotic	-Soils	- Water erosion - Changes in land use: Affected area	- Water erosion - Changes in land use: Affected area
	-Water	- Flow	- Flow

	-Climate	- Rainfall - Temperature - Evapotranspiration	- Rainfall - Temperature - Evapotranspiration
Biotic	- Vegetation	- Plant cover - Floristic Composition	- Plant cover - Floristic Composition
	-Fauna	- Fauna composition	- Fauna composition
Socioeconomic	- Social	- Environmental policies fitted to the CCD objectives -Fitting rules applied to the CCD objective - Environmental proposal with participation of society - Chile morbidity (%) - Consumption of firewood per family (m^3) - School curricula including the environmental issue -Variation in population density.	- Environmental policies fitted to the CCD objectives -Fitting rules applied to the CCD objective - Environmental proposal with participation of citizens - Chile morbidity (%) - Consumption of firewood per family (m^3) - School curricula including the environmental issue -Variation in population density.
	- Economic	- Variation in family income - Unsatisfied Basic Needs in population centers	- Variation in family income - Unsatisfied Basic Needs in population centers
Sources of information for the monitoring system		Regional and local governments, INRENA, INEI, Majes Project, IGN, university, NGOs	Regional and local governments, INRENA, INEI, Majes Project, IGN, university, NGOs
-Other:			
EQUIPMENT (Installed capacity)			
Computers:		Pentium 1 (01), Pentium III (01), Note book (01)	PC Pentium III-IV, 1 IBM server (10)
Meteorological Stations, GPS:		Campbell Micro meteorological station, 02 GPS Garmin	GPS (5) Garmin navigators
Other:			Plotter A Φ, printers, scanner

MATERIALS		
Satellite images/Aerial photographs (scale)	The Institution lacks material	The Institution has material
HUMAN RESOURCES : Scientists and technicians integrating the Research Group:	Biologists (5) Architects (2) Chemist (1) Lawyer (1)	Water and Soils MSc.(2) Forests MSc.(2) Geographer (1) Social/economist/informatics (4)
Degree of participation of the local populations (Local governments, communities, etc)	Regular The rural communities are sensibilized about the importante of the combat against desertification, but the local governments and the urban population are just becoming aware of the importance of desertification in the regional enviroment.	Regular The rural communities are sensibilized about the importante of the combat against desertification, but the local governments and the urban population are just becoming aware of the importance of desertification in the regional enviroment.
SPECIFIC STUDIES Study areas within the geographic jurisdiction that have a monitoring system and a good base-line research related to the issue of combating desertification	High basin of the Chili: Flora and fauna inventories, meteorological and demographic inventories High basin of the Colca: Flora and fauna inventories, meteorological and demographic inventories There is no monitoring system.	Basin of the Chira: it has information for a monitoring system and enough information for its base-line.

(1) Indicators approved at the workshop in Lima on 7-8 2003

VENEZUELA

Brief List of Indicators and Variables relative to the Soil Resource

Nº	INDICATOR	DEFINITIÓN	SOURCE
1	Proportion of Potentially Cultivable Area in the National Territory	Percentage that represents the potentially cultivable area (Classes I, II, III and IV) in relation to the total National Territory	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
2	Proportion of potentially Cultivable Soils currently under Cultivation	Percentage that represents the cultivated area in relation to potentially cultivable soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
3	Proportion of cultivated area	Proportion of the territory under cultivation (including all types of agricultural systems existing in the country) in relation to the total surface of a given Geographic Entity	Dirección de Suelos; Dirección General de Cuencas Hidrográficas del MARN y el Ministerio de Agricultura y Tierra
4	Proportion of high quality soils	Percentage that represents the area with high quality soils (Classes I and II), with respect to the total area of the Country or of a particular Federal Entity	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
5	Proportion of potentially cultivable soils classified as high quality soils	Percentage that represents the area with high quality soils (Classes I and II), with respect to the total area of potentially cultivable soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
6	Proportion of cultivated soils classified as high quality soils	Percentage that represents the area with high quality soils (Classes I and II), with respect to the total area of cultivated soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
7	Proportion of medium quality soils	Percentage that represents the area with medium quality soils (Class III), with respect to the total area of the Country or of a particular Federal Entity	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
8	Proportion of potentially cultivable soils classified as medium quality soils	Percentage that represents the area with medium quality soils (Class III), with respect to the total area of potentially cultivable soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
9	Proportion of cultivated soils classified as medium quality soils	Percentage that represents the area with medium quality soils (Class III), with respect to the total area of cultivated soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
10	Proportion of low quality soils	Percentage that represents the area with low quality soils (Class IV), with respect to the total area of the Country or of a particular Federal Entity	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
11	Proportion of potentially cultivable soils classified as low quality soils	Percentage that represents the area with low quality soils (Class IV), with respect to the total area of potentially cultivable soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN

Nº	INDICATOR	DEFINITION	SOURCE
12	Proportion of cultivated soils classified as low quality soils	Percentage that represents the area with low quality soils (Class IV), with respect to the total area of cultivated soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN
13	Proportion of lands protected by diverse Legal Figures	Percentage that represents the areas of the National Territory decreed as Areas under a Special Administration Regime in relation to the total area of the National Territory	Instituto Nacional de Parques (INPARQUES)
14	Proportion of lands devoted to Tourism and recreation	Percentage that represents the land area devoted to tourism and recreation-related activities, in relation to the total area of the National Territory	Instituto Nacional de Parques (INPARQUES) y la Dirección General de Planificación y Ordenación del Ambiente. MARN
15	Proportion of lands devoted to Forestry	Percentage that represents the land area devoted to Forestry, in relation to the total area of the National Territory	Dirección General de Recurso Forestal. MARN.
16	Proportion of cultivable soils subjected to agricultural activities	Percentage that represents the area of cultivable soils subjected to agriculture in relation to the area of cultivable soils	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN y el Ministerio de Agricultura y Tierras
17	Proportion of Mountainous area under agriculture	Percentage that represents the mountainous area under agriculture in relation to the total mountainous area of the Country	Dirección de Suelos; Dirección General de Cuencas Hidrográficas; MARN y el Ministerio de Agricultura y Tierras

VENEZUELA
Tables including Environmental, Socioeconomic and other Indicators

VARIABLE	GROUP OF INDICATORS	PARÁMETER
VEGETATION	Alteration of Vegetation Physiognomy	Vertical stratification
		% cover of herbs, shrubs, trees and bare soil
		Dominant species
		Vegetation structural profile
		Vegetation structural and physiognomic profile Deforestation rates
	Alteration of Plant specific composition (flora)	Diversity index
		Mínimal Área
		Vegetation structural profile
		Dendrological survey Inventory
		Typification Dendrological survey Soil survey Inventory
CLIMATE	Temperature	Mean, Maximum Mean and Mínimum Mean Temperature
	Relative Humidity	Mean Relative Humidity
	Precipitation	Total, Maximum and Mínimum Precipitation
	Potential evapotranspiration	Total, Maximum and Mínimum
	Wind	Directions
ATMOSPHERE	Gas emissions	Índex of emissions of carbon dioxide, methane, nitrous oxide and halocarbons
		Mean temperature
	Emissions of Acidifying Substances	Sulphur and nitrogen indices

VARIABLE	GROUP OF INDICATORS	INDICATORS	PARÁMETER
	Demographic	Name	Name of population center
		Municipality	Nº of municipalities
		Total Population	Total Population
		Population spread	inhabitants / km^2
		Demographic growth	
		Population by age	Ages (ranking)
		Population by sex	Nº of persons (Masculine)
			Nº of persons (Femenine)
	House	House types	Country house
			House
			Apt. in building
			House in residencial neighbourhood
			Apt. in residencial neighbourhood
			Rural house
			Urban Ranch
			Rural Ranch
			Own

SOCIOECONOMIC		Infrastructure	Presence of highways
			Presence of asphalted streets
			Presence of unasphalted streets
			Other
	Education	Matriculation rate per educational level	
		Educational level reached	Degree of schooling reached
		Literacy rate	Nº of alphabetized people
		Formal educational resources	Nº of basic and intermediate schools, sections and teachers Nº of diversified schools, sections and teachers Nº of superior institutions, sections and teachers
		Non-formal educational resources	Nº of libraries Nº of culture houses Other
	Health	Birth rate	
		Mortality rate	
		Child mortality	
		Morbidity	Diseases suffered over the last year
		Life expectations at birth	

VARIABLE	GROUP OF INDICATORS	PARAMETERS
SOILS	Soil characteristics	Soil orders present, in particular: Aridisol, Entisol, Inceptisol, Alfisol and others occurring in the areas defined
		Depth of the arable layer
		Land use capacity: Classes and Subclasses
	Soil management (Estimates)	Percentage (%) of ha with bad drainage
		Percentage (%) of ha affected by water and wind erosion. Classify into: Low, Moderate and Severe.
		Percentage (%) of ha under mechanized soils

CUBA

CRITERION	PHYSICAL DIMENSION (INDICATORS)
Erosion	Soil loss
	Type of erosion
	Aridity index
	Spatial and temporal distribution of precipitation
	Amount and intensity of precipitation
	Deforestation dynamics
	Evapotranspiration
Physical degradation	Compactation
	Variation of soil permeability
	Variation of soil structure
	Variation of the phreatic level
	Surface draining (runoff)

TABLE 1a. Proposal of indicators of land degradation

CRITERION	CHEMICAL DIMENSION (INDICATORS)
Salinisation	Dynamics of the presence of total soluble salts
	Dynamics of the salt composition
	Salt surface incrustations
	Water salt content
Chemical degradation	Loss of soil nutrient elements
	Acidification
	Alkalinisation
	Presence of toxic elements

TABLE 1b. Proposal of indicators of land degradation

CRITERION	BIOLOGICAL DIMENSION (INDICATORS)
Biological degradation	Variation in the organic matter level
	Variation in the humus level
	Decrease of the total biological activity
	Loss of the original soil biota
	Plant cover
	Variation in the microbiota composition and of the water biological activity

TABLE 1c: Proposal of indicators of land degradation

General indexes	Pertinent or specific variables	Indicator	Unit of measurement
Population dynamics	Life expectancy	1. Years of life span expectancy at birth x sex	To be determined
	Birthrate	2. Birthrate	No. of born alive per 1000
	Migratory movement	3. Migration rate	
	Mortality	4. Mortality rates by age, sex and causes	No. of deaths per 1000 inhabitants
	Morbility. Diseases related to desertification processes and nutrition	Still to be assessed by health specialists. Respiratory and skin diseases Population below the poverty index	 %
Structural	Settlement hierarchy within the Population Settlement System (PSS). Availability of technical networks	7. Water availability/inhabitant	Litres/ha/day
		8. Population with access to treated water	%
		9. Population with access to sanitation	%
		10.Housing conditions	Amount, typology and % in good condition
		11. Energy coverage (electricity)	% of the population connected to the local electricity service % of the population connected to alternative sources
		12. Road accessibility	km of road X km^2
Cont. Structural	Education and technical training	13. Percentage X education level	%
		14. Percentage of persons with technical training	%
		. Inhabitants/physician	%
		. Education	%
		15. Workshops and work groups involved in the desertification processes	No. of persons No. of technicians
		16. Incorporation of Scientific Projects on Technical and Technological Innovation to sensitive areas	Population linked No. of existing projects

TABLE 2a: Proposal of indicators for the social dimension

General indices	Pertinent or specific variables	Indicator	Unit of measurement
Population economically active	Employment direction of economical-ly active population	1. Employment rates by eco-nomy branches related to the desertification and drought pro-cesses	
	Woman incorporation to the labour force	2. Women employed from the total employed	%
General use of land	Use of agricultural land	3. Relationship between the cultivated and uncultivated area and its temporal dynamics	%
	Crop structure	4. According to the Local Statistics Information System (LSIS)	
	Relationship between forest and deforested surface	5. According to the Local Statistics Information Service (LSIS)	

TABLE 2b: Proposal of indicators for the economic dimension

General indices	Pertinent and specific variables	Indicator	Unit of measurement
Development policies	On hand information on water use systems and on availability	1. Balance of the hydric resource use	% of actual uses
	Adaptation of the Action Programme on Feeding to the conditions of the identified sensitive areas	2. Consumption satisfaction of tubers and vegetables	kg/inhabitant/year
	Realisation of extension activities	3. Coverage of actions and agricultural extension projects in sensitive areas	No. of projects and persons incorporated
	Implementation of communitary local development	4. Number of communities of each sensitive area linked to self-handled development projects	No. of communities
	Links with the organisation mechanisms	5. Creation of councils, groups, teams in sensitive areas linked to the mechanisms of managerial levels	No. of groups per community
General indices	Pertinent and specific variables	Indicator	Unit of measurement
Development policies		6. Actors, social groups participating in the council, groups or teams of each sensitive area	No. of participating actors
	General aspects of the desertification and drought processes identified at each sensitive area and definition of casuistry peculiarities	Stock databases for decision making and to integrate future Geographic Information Systems on the Combat against Desertification and Drought Processes of Desertification and Drought identified at each sensitive area and definition of casuistry peculiarities.	No. and type of base stock

TABLE 2c. Proposal of indicators for the political dimension

Criterion	Pertinent or specific variables	Indicator
Changes in the temperature and precipitation patterns	1. Estimation of biomass changes and carbon sequestration	Biomass density and carbon content
	2. Stability of the ecosystems	Plant and fauna physiognomy
Anthropic activity	3. Use of alternative energy sources	Biogas, eolian and solar energy X community served
	4. Soil pollution by toxic substances	
	5. Water pollution	
	6. Atmosphere pollution	Powder suspension
	7. Biodiversity change	
	8. Change in the plant coverage	Improvement (+) Degradation (-)
	9. Use of residual	T or m^3
	10. Production of organic fertiliser	T or m^3
	11. Productivity	Types, amount and quality of the products

TABLE 2d: Proposal of indicators for the environmental dimension

Annex III: St. Lucia Workshop on the development of Benchmarks and Indicators

The Parties in Latin America and the Caribbean have identified development of benchmarks and indicators on land degradation and drought as a key area to be addressed if there is to be proper implementation of the UNCCD in the region. If this is so, there must be relevant tools, which can be used to measure the changes taking place in desertification and drought, and also the effect implemented plans and programs are having. Consequently, the development of benchmarks and indicators forms an integral project of the Regional Action Program for the implementation of the UNCCD in Latin America and the Caribbean, adopted by the countries over a series of regional meetings.

The regional project is in keeping with the objectives of the convention as concretized in its Articles 1, 16 and 17 among others. It is also reflective of the various decisions of different Conferences of the Parties to the Convention including, Decision 22/COP.1 and Decision 11/COP.4 calling on the Parties to continue working on the development of benchmarks and indicators on desertification and drought.

As regards this exercise in the Caribbean, the main thrust was to start the process of the development of these benchmarks and indicators paying special attention to the small island developing states represented by the overriding majority in this sub-region. The workshop was particularly concerned with ways of addressing this issue bearing in mind the small size of these countries, their extreme vulnerability, their very limited resources, and the need for close co-operation and the development of synergies among the relevant international instruments in this process.

The development of benchmarks and indicators is an ongoing process and the need to put a mechanism in place that would not only begin this work but also continue the process ensuring that a minimum set is developed, was a key concern of the workshop. In this regard, the creation of a working group was a major achievement. The establishment and content of a set guiding principles for this group point to the direction this process is heading in the Caribbean sub-region.

Objectives

- Providing the Parties a stage from which they can initiate the development of benchmarks and indicators that would be applicable both at the national and sub-regional level.
- To allow the participants to ascertain how much work has been done in the sub-region on benchmarks and indicators as regards the issue of land degradation and drought and providing them an opportunity for sharing the same.
- To allow the countries to work together in the identification of the types of benchmarks and indicators that the sub-region requires and how these can be complementary to those worked out for the rest of the region.
- An agreement for closer co-operation among all concerned in the further development of the benchmarks and indicators.
- The establishment of a contact group to work directly on the development of benchmarks and indicators.

Subjects discussed:

a) ***Work undertaken by Committee of Science and Technology since 1996. Mr. Ahmed Cissoko***

Issues raised:

d) The need to develop synergies with other Conventions.
e) The lack of clarity between definitions of benchmarks and indicators.
f) The relevance of local benchmarks in the Caribbean context.

g) The need for metadata on benchmarks and indicators.
h) What are the objectives of having benchmarks and indicators?
i) The need for sustainable development indicators.
j) The lack of information on how much land is loss as a result of degradation each year.
k) The lack of indicators showing activities implemented and their results.
l) The need to identify the characteristics of benchmarks and indicators that may be applied to Small Island State, in particular the Caribbean.
m) The need to link land degradation and drought indicators with the Action Indicators.
n) Indicators for the sub-region need to be fully representative, reliable and feasible.
o) Conclusions/Responses/Recommendations:
p) To be useful, indicators must be clearly defined, well founded and accurate, and should take into account the different realities of the sub-region.
q) There is need to draw upon the experiences of other regions in the development of benchmarks and indicators for the Caribbean.
r) In designing benchmarks and indicators care must be taken to make them as user-friendly as possible.
s) There should be indicators to address different policy issues.
t) Indicators should be simple, practical and useful, and provide a guide for policy intervention.
u) The proposed contact group to be established will need to address, inter alia, issues related to objectives, characteristic and the role of benchmarks and indicators.

b) Presentation by the Global Mechanism (GM): "Ongoing Partnerships on CCD Implementation." Mr. Alejandro Kilpatrick

Issues raised:

- The non-inclusion of bio-diversity in the synergy position of the GM.
- The adequacy of funding programmed by the GM for the Caribbean.
- The proper identification of the precise sources of funding for the sub-region.
- Possible access for the sub-region to financial resources allocated to the LADA Project.

Conclusions/Responses/Recommendations:

- Further funding to the sub-region would be based on project proposals.
- FAO indicated a willingness to assist in securing access to funding from the LADA Project.

c) Importance of benchmarks and indicators to the UNCCD Process and the need for their establishment in the sub-region. Mr. Sergio Zelaya

Issues raised:

- Participants voiced their concerns of the consistent compartmentalization of synergies by the various conventions and funding agencies. The continuous requests and documents produced by each convention suggest great inefficiency and poor communication.
- The seriousness of the international community in promoting synergies was questioned in the light of the many but similar requirements imposed on developing countries in the implementation of the various Conventions. This situation, given the resource constrains of Small Island Developing States (SIDS) in both manpower and finances, militated against implementation performance.

d) Work done in the sub-region on the development of Benchmarks and Indicators in the past and their application. Mr. Ato Lewis

Issues raised:

- Whether Science is replacing traditional customs and culture and what are the costs and benefits from such a development.
- The lack of resources allocated to validate the underlying scientific underpinnings of traditional indicators.
- The absence of structured mechanisms to explore the full potential of traditional indicators and to promote the integration of traditional and scientific indicators.

Conclusions/Responses/Recommendations:

- Every effort should be made to integrate traditional and scientific indicators.
- Traditional knowledge does have a valid role since it can be the basis for scientific investigation.
- An inventory of indigenous influences should be made.
- More resources should be allocated to validate the underlying scientific underpinnings of traditional indicators.

e) On Socio-Economic Benchmarks and Indicators of Land Degradation and Nexus to poverty in the Caribbean. Dr. Jaslin U. Salmon

Issues raised:

- The lack of health indicators.
- Should benchmarks record “negative” conditions?
- Global definition of land degradation versus definition provided in the Convention.
- Whether health and safety should be included in socio-economic indicators?
- Whether focus should be placed on integrated land use policy as opposed to agricultural policy?
- The absence of a common terminology for land degradation.
- The heavy emphasis of the presentation on bio-physical indicators.

Conclusions/Responses/Recommendations:

- Education should be included as a benchmark and/or indicator.
- Benchmarks should not record “negative” conditions, but should capture “level” or adaptation?

f) Physical and Bio-Physical Indicators of Drought and Desertification in the Caribbean. Dr. Reynold Murray

Issues raised:

- The importance of impacts on people.
- The lack of consistency as regards definitions.
- The feasibility of using satellite data for developing benchmarks and indicators.
- The innovativeness of the approach in the Caribbean, especially in the use of experts.
- Inadequate knowledge of data sources.
- The need for increase awareness of the importance of benchmarks and indicators.

Conclusions/Responses/Recommendations:

- The best kind of indicator should be simply and not data intensive.
- Satellite data was available to be used in the developing indicators.

- There is an urgent need for clearly defined sources of data and metadata on benchmarks and indicators.
- There is need for public awareness and education programs to sensitize potential end users of the importance of benchmarks and indicators.

g) Methodology approaches, mechanisms and institutions that may be used in the development of benchmarks and indicators of land degradation and drought both at the national and sub-regional level. Mr. Michael Andrew

h) Benchmarks and Indicators of Participatory approaches in the implementation of the UNCCD in the Caribbean. The Role of the Caribbean NGOs and Community-Based Organizations (CBOs) in the Developmental and Implementation of a Monitoring System of Land Degradation Utilizing Developed Benchmarks and Indicators. Ms. Zakiya Uzoma-Wadada

i) Channels for Lateral Co-operation Within the Caribbean Region which would allow for Effective Collaboration within a common Framework as Regards the Development of Benchmarks and Indicators for the Monitoring of Land Degradation and Drought within the Region. Mr. Vincent Sweeney

Issues raised:

- The capacity of Caribbean NGOs to effectively participate in the development process.
- The relevance of NGOs in the Caribbean in terms of their level of involvement in development activities.
- The inadequacy of financial resources of NGOs, particularly to finance their administrative cost.
- Concerns as to the feminization of poverty.
- The inadequacy of investment in the participatory approach.
- The role that can be played by local government bodies in the documentation of the participatory process.
- The measurement of levels of participation.
- The limited used made of NGOs by Governments of the region.
- Limited enforcement of legislation and provisions of various conventions as regards the participatory approach.
- The short life span of NGOs.
- The role of local government bodies.

Conclusions/Responses/Recommendations:

- There is an increasing trend for governments to involve NGOs and CBOs in co-management of the Environment.
- The current trend is for NGOs and Government to work in partnerships which are mutually beneficial.
- Local government bodies are highly politicized which create challenges and detract from the real issues.
- Both the top-down and bottom-up approaches are necessary.
- Effective avenues need to be created to ensure that relevant information filters down to the local level.
- Regional institutions should be the bridge between policy makers and the people.
- Regional organizations can provide a buffer to insularity.

- Regional organizations can catalyze actions at the national level with respect to the Convention, and can assist in the mainstream in of the issue of land degradation.
- There is need for the strengthening of national legislation, including enforcement mechanisms to provide for public participation in the development process.

j) Identification of Sensitive Areas in Latin America and the Caribbean Region the Argentine Experience. Ms. Elena Abraham

Issues raised:

- Clarification was sought on the methodology and, in particular, the role of research institutions and public participation in the process. The need for validation of the process was raised.

Conclusions/Responses/Recommendations:

- It was pointed out that the exchange between Latin America, MEDRAP and RIOD allowed for an opportunity to compare and share experiences and to identify areas of possible co-operation.
- An explanation was provided on the sequencing of activities in the development of benchmarks and indicators showing the entry points for public participation and outlining Argentina's experience in the development of their National Action Program.

k) Panel discussion on benchmarks and indicators for CCD implementation.

Four points were analyzed and discussed:

1. Opportunities for co-operation among the Caribbean country Parties.
   - Technical, as is evidenced in the existence of various relevant technical institutions that may assist and participate in the process.
   - The National Focal Points have remained constant over the past four years thus they know each other and interact on basically all aspects.
   - Some countries are more advanced than others and this means that there can be the profitable sharing of experiences.
   - A regional approach to donor agencies as regards the development of the NAPs.
   - There are many regional organizations that can play positive roles in the process.

2. Institutional development of benchmarks and indicators.
   - Development should be people centered.
   - People's participation should be accepted as a right and must be advocated at all levels of decision making.
   - Affected people must be the subject and not of the object of implementation and need to be empowered to response in the new paradigm.
   - There is need to develop and create access to user-friendly information and also to make communication easier.
   - The NGO/CBO networks must be strengthened to allow their full participation in the process.

3. Benchmarks and indicators of natural resource use.
   - The process starts with making an inventory of existing data both qualitative and quantitative.
   - Indicators of change in the ecosystem must be obtained and/or developed.

- Study of environmental history to allow for comparative analysis and studies of ecosystems and social groups. There must also be research on traditional knowledge.
- Integration of the information to allow for proper problem diagnosis and to develop a relevant program.

4. Benchmarks and indicators for decision makers.
   - The need for an established policy that must be applied.
   - Clear understanding resource allocation to support/implement the policy.
   - Proper institutional arrangements to facilitate implementation.
   - The development of the policy should be a participatory process facilitated through the office of the National Focal Point.
   - The fundamental basis of the policy must be the recognition that soil loss and land degradation has real socio-economic effects and direct relevance for decision makers.
   - While the government has a major role to play, implementation is the responsibility of all.

It was shown that based on Barbados experience to facilitate public participation there would have to be:

- Consultation involving preparation of the target group through relevant outreach programs.
- General public awareness raising and education involving outreach with technicians going to locales in order to put the problem into perspective.
- There must be a mechanism for two-way feed back between politicians and technocrats. This does not necessarily have to be a formal mechanism.

The importance of close co-operation between the focal Points of the different conventions as regards implementing the NAP was underlined. Further on the questions of NAP development, it was pointed out that the future role of relevant regional technical institutions in this process should be determined.

The suggestion was made that benchmarks and indicators on land degradation and drought should become a policy tool for decision-makers.

The issue of external funding for the UNCCD precise in the sub-region was also raised.

The discussion also pointed to the fact that there must be more exchange of information not only between the focal points of related environmental agreements but all relevant professionals, and that country-coordinated mechanisms/body should be used to facilitate synergies.

Finally, the discussion touched on some of the existing mechanisms that can be used to facilitate the UNCCD process in the region. In this regard it was pointed out that the MOU signed between the UNCCD and CARICOM should be made to work and that the St. George's Declaration sets the framework for certain actions at the sub-regional. Greater use of the existing agencies for technical co-operation, such as the Caribbean Pesticide Control Board was also advertised for while they had no funds to offer, they could give a lot of technical assistance.

l) Methodologies on a synergistic approach in the development of benchmarks and indicators in Latin America and the Caribbean:

- Identify synergies among RIO Conventions
- Organise pilot national workshop

- Implement activities using a synergestic and bottom-up approach in the implementation of the Convention
- Identify synergies at the national level among the various Conventions
- Develop a common set of benchmarks and indicators to be used for CCD NAP preparation, FCC communication and CBD National Strategy

m) Establishment of four working groups.

These groups were established to make recommendations with respect to the functions, programs, plans and composition of the proposed Contact Group to begin work on the development of a common set of benchmarks and indicators of land degradation and drought applicable to the entire sub-region.
This guide is followed precisely.

Guiding principles for working group

TASK: to identify benchmarks and indicators of land degradation and drought (biophysical, socio-economic and participatory approaches) common to the entire sub-region towards informed decision-making.

Objectives

- To develop and propose a methodology for deriving appropriate benchmarks an indicators for the sub-region
- To liaise with relevant agencies (scientific, donor, technical etc.) both within and outside of the region, which can facilitate the development of benchmarks and indicators to the Caribbean Region
- To propose a mechanism for implementation of benchmarks and indicators at local, national and regional levels

Functions

- Situational Analysis
  - To co-ordinate, collect and review existing data and other relevant information
  - To review work of other existing technical agencies including UWI, CEHI, FAO, UNEP
  - To analyze information identifying gaps, common key issues and priorities
- To ensure the development of a methodological framework for benchmarks and indicators
- To establish criteria for the selection of benchmarks and indicators
- To review selection of benchmarks and indicators with respect to existing data
- To make recommendations of proposed benchmarks and indicator
- To identify funding sources
- To submit reports to National focal Points, RIOD, the LAC Unit and relevant subsidiary Bodies of Secretariat
- Monitoring and Evaluation

Programs and plans

To develop a work plan which incorporates the following:

- Situational analysis which includes identification of key issues and priorities
- Development of Methodological Framework for benchmarks and indicators
- Recommendation for implementation
- Reporting
- Monitoring and evaluation

Composition
Proposed size – 9 – 11 persons
Criteria for selection:
- Technical expertise
- Geographic balance
- Experience in developing benchmarks and indicators
- One member of RIOD Caribbean Sub-regional Network
- Experience in Traditional Knowledge
- Participatory Rural/Rapid Appraisal Skills

STATE OF THE ART ON EXISTING INDICATORS AND THEIR USE FOR DESERTIFICATION MONITORING AND CCD IMPLEMENTATION IN THE NORTHERN MEDITERRANEAN

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Executive Summary

Under the auspices of the UNCCD's Committee for Science and Technology, a need has been identified to obtain information about the state of the art of desertification benchmarks and indicators at national levels. For this process, a Group of Experts from the Project "Active exchange of Experience on Indicators and Development of Perspectives in the Context of the UNCCD", (Commission of the European Communities- AID-CCD-EVK2-2002-00609) designed a questionnaire entitled *Enquiry: benchmarks and indicators of desertification processes*. The questionnaire was circulated to the Focal Points of the Northern Mediterranean countries listed below. If the questionnaire could not be completed, the Focal Points were given the alternative of listing relevant reports. The results of these enquiries, using questionnaires and available reports, are provided here. Contact personnel were identified in the National Focal Points of the following countries:

- Countries of the Annex IV Group: Greece, Italy, Portugal, Spain, Turkey
- Other affected country parties of the Northern Mediterranean region: Albania, Croatia, Cyprus, Malta
- Non-affected country parties of the Northern Mediterranean region: France, Monaco, San Marino

The questionnaire was sent to each with the aim of generating a simple inventory of projects using indicators, and attempting to pinpoint the practical application of benchmarks and indicators related to the implementation of the NAPs, SRAPs and RAPs. By the time of the deadline, replies had been received only from Malta. In order to compile this report, information for the other countries was extracted from the following sources:

- from reports available from the UNCCD website.
- from recent reports to individual working groups associated with the UNCCD, such as the CST and CRIC.
- from reports available through relevant desertification projects, e.g. MEDRAP, DISMED.

The countries of Annex IV vary in their approach to combating and monitoring desertification but they all agree on the following points:

- The countries of Annex IV recognise the benefit of mapping threatened areas and monitoring changes over time.
- The ranges of the mapping units of headline indicators may suggest useful benchmarks.
- A consensus on the use of a standard set of indicators or standard headline indicators has not yet been reached but most countries use a bioclimatic or aridity index and an index related to soil type or soil loss by erosion.
- Other headline indicators are related to land use and damage to landscapes by desertification in the form of e.g. drought, fire, salinisation or flood risk.

- The relevance of social and economic indicators of desertification, such as old age index, human poverty index, population density or areas under subsidies, is also beginning to be recognised.
- All countries recognise the DESERTLINKS Indicator System DIS4ME and many of the DESERTLINKS indicators are already in use.

Across southern Europe there is a close collaboration among the scientific community, local stakeholders and the National Committees to test the application of the DIS4ME indicator system and to validate the local identification of high-risk areas and the implications of local scenario analyses. The principal expected product of existing research projects regarding Desertification Indicators is a system tested and evaluated by both the local stakeholders and the National Committee to explore alternative management scenarios and national and regional management and monitoring strategies. In collaboration with the DESERTLINKS Project, the Portuguese Focal Point have conducted, in May 2002, a series of workshops in four pilot areas Alcoutim (Serra Algarvia), Mértola (Margem Esquerda), Mação (Pinhal Interior Sul) and Mogadouro (Arribas do Douro). This participatory process involved 200 participants, representatives of four pre-defined local actors: policy makers; technicians with local intervention; economic agents; citizens and local associations. The participants were asked to identify the signs of desertification that they though were particularly relevant for their area, to make proposals for their solution, identify potential partners and also the main barriers to the solutions. Extensive collaboration with local stakeholders in desertification affected areas of southern Italy is identifying: impact indicators relating to perceptions of land function; driving force and pressure indicators relating to decision making; response indicators relating to land management measures taken to combat desertification. In Greece much more work is required for improving the degree of perception regarding the threat and consequences of desertification of stakeholders and their ability to early recognize them. To cope with this problem the team of Agricultural University of Athens has contacted and is working with some two hundred individual stakeholders and is planning to increase this number.

1. The regional context

The concept of Desertification and desertification indicators in the context of European Mediterranean region is still quite new for most of the scientific community. Scientific work on the subject has often been deficient in terms of interdisciplinarity, and restricted to the natural sciences, but even there the different approaches have not been harmonised. The results of the Porto Torres Seminar [1], despite the quality of the individual contributions, are proof of the existence of these problems. Relevant specific contributions come from various disciplines, and principally from various approaches/objectives (studies on biodiversity conservation, on the effects of global climate change, environmental risk and impacts assessment, vulnerability and resilience of ecosystems, sustainable land use management, status or level of degradation of natural resources, etc.). Fortunately, the European Mediterranean region can count on a vast and consolidated heritage in terms of knowledge and on the many initiatives that have contributed to filling the gaps, but there still remains much work to be done. In the 1990s, research on desertification, especially within projects financed by the EU within Framework Program IV (1994-1998), mainly dealt with the understanding and modeling of degradation processes, in particular of those concerning erosion, or fire

[1] "Indicators for assessing Desertification in the Mediterranean", Porto Torres, 18-20 September 1998

monitoring and the state of vegetation. In Particular, in projects such as MEDALUS (I, II and III), considerable resources were invested in basic field research all over Europe.
A turning point occurred around 1997/1998. The necessity of developing more applied research was recognised. This aimed to provide tools to combine the existing knowledge in new ways, to suggest new ways of combating desertification..At the same time there was an increase in the number of requests for scientific support from National a and Regional authorities responsible for environmental policy and land use planning and management, in the context of the obligations arising from the ratification of the UNCCD. This has strongly contributed to the focus of attention of European research on indicators. In fact, the UNCCD text clearly requests all Country Parties to be equipped with sets of specific indicators for desertification monitoring and mitigation actions. The starting point for new approaches based on indicators was the Framework Program V (1998-2002): many projects on desertification were approved, taking into consideration all aspects concerning indicators (DESERTLINKS, GEORANGE) and policies (MEDACTION, MEDRAP).
Therefore it can be stated that in the Countries of Annex IV, the development of indicators has received the input from different requirements, which have generated parallel initiatives:

- institutional requirements, concerning the necessity of realizing the national and regional action plans and, therefore, the necessity of locating, approximately, the areas sensitive to desertification. This requires an identification of the main processes or factors, and their mapping;
- scientific requirements aiming at establishing a common understanding of the problem, with common terminology and concepts, as a starting point for specific future projects which could define optimal sets of specific indicators;
- other requirements such as:
  - rationalization of monitoring networks and promotion of important data collection through common standards;
  - improvement of the efficiency in using the limited environmental data;
  - increase in the availability, accessibility and circulation of data;
  - increase in the efficiency and objectivity in communicating the monitoring results to the public.

1.1 Institutional developments

Since 1997 (the first UNCCD Conference of the Parties – COP – and the first coordination meetings of the Annex IV countries), at different times, all Countries of the Annex IV (Spain, Portugal, Italy, Greece and Turkey), have started to constitute working groups with the aim of defining desertification as it appears in the specific national contexts, in order to derive maps of vulnerability or sensitivity to desertification, to be inserted in the National Action Programs (PAN). PAN have since been prepared and partially completed. At the same time the regional coordination activities started. After a series of interdepartmental and informal meetings, the Focal Points (people responsible, at national level, for the UNCCD implementation) achieved the definitions: “Terms of Reference (TOR) of the Regional Action Programme (RAP)” for the Northern Mediterranean area. The TOR highlights the problem of indicators, as one of the most important transnational issues (issue b: “common regional indicators and benchmarks for processes and mitigation”) and fixes the following objectives and expected results:

Objectives:

- testing agreed preventive and mitigating practices and policies in a regional network of selected pilot areas;
- to propose the suitable instruments and systems for the production of adequate information for planning needs;
- to evaluate the extent and severity of desertification at regional level, using agreed criteria and definition in assessing;
- to evaluate, in the pilot areas, by means of monitoring the evolution of desertification processes, both the environmental and social impact of the European Commission policies and the implementation of the Regional ActionProgramme.

Expected results:

- a regional network for planning needs to combat desertification in the Annex IV Member Countries of the UNCCD, taking into account the Mediterranean Basin context;
- benchmark and indicators for measuring the progress of the fight against desertification, at national and regional level to implement Action Programmes;
- environmental and socio-economic indicators to monitor the application and the efficiency of European Commission policies;
- better definition of the participation indicators of different sectors, mainly those of NGOs and rural communities.

The most relevant element emerged from the TOR preparatory meetings is perhaps the establishment of the necessity of creating meetings for contact and comparison, to harmonise the different approaches, in particular those concerning the use of indicators and mapping activities.

The MEDRAP project (Concerted Action to support the introduction of the RAP), coordinated by NRD (Centro Interdipartimentale di Ateneo – Nucleo di Ricerca sulla Desertificazione dell'Università di Sassari, Italy) was a direct answer to these requirements. On the occasion of the second international Workshop of MEDRAP, held in Lisbon in June 2002, for the first time it was possible to compare, in a systematic way, the methods adopted by different countries and to go further towards the harmonisation of the different approaches.

1.2 The problem of data

During the same period of time there were other initiatives with the objective of promoting the availability, accessibility and circulation of data, the adoption of common standards for monitoring, and data bases. The availability, accessibility and comparability of data are often the bottleneck through which the environmental monitoring passes, and the choice of effective indicators must consider this.

- Many events have been organized at regional (Annex IV) and interregional level (in particular between the Northern and Southern shores of the Mediterranean basin):
- International Workshop in Marrakech[2], on the role of the informative systems in combating Desertification.
- International Workshop in Alghero[3], on the requirements in terms of data of the interdisciplinary research on Desertification.

[2] "Desertification Information Systems for planning needs in the Mediterranean region" Marrakech, 9-13 November 1998

[3] "Desertification Convention: data and information requirements for interdisciplinary research" Alghero, 9-11 October 1999

- DISMED[4] project, financed by the Italian Cooperation after the Workshop in Marrakech, that has started an active and concrete dialogue between the Northern and Southern shores of the Mediterranean basin.
- Other initiatives such as ROSELT[5], RICAMARE[6] , etc.

2. State of art on Benchmarks and Indicators

2.1 Details of applications of benchmarks and indicators in different countries

2.1.1 Details of applications of benchmarks and indicators in Greece

The report from Greece in the document *Repères et Indicateurs (ICCD/COP(6)/CST/5, 28 May 2003)*[7] gives comprehensive information about the current application and use of benchmarks and indicators in Greece. The material in this section is almost entirely extracted from that report.

The Greek National Committee for Combating Desertification and the Agricultural University of Athens have recently developed systems for small and large scale mapping of desertification sensitive areas and have produced respective maps. The systems are empirical and they have been incorporated in the National Action Plan Against Desertification. The results obtained by the research projects described below have been communicated to the scientific society and the stakeholders.

Objectives and actions proposed in National Action Programme and indicators used for mapping at the national scale

OBJECTIVES	ACTIONS PROPOSED	NATIONAL INDICATORS
1. Determination of the threatened areas and their extent. 2. Estimation of the effectiveness of the applied policy and of the measures taken. 3. More effective application and use of the existing structures and institutions. 4. Elaboration of additional political, institutional, economical, social, and technical measures, and proposals on mechanisms required for their specification and implementation. 5. Formulation of a national strategy, to prevent and mitigate desertification, and to promote sustainable land and water use, and to secure biodiversity, while minimising social conflicts concerning land use 6. Promotion of public awareness and encouraging active	1. Codes of good agricultural practice 2. Subsidies for sustainable or biological agriculture 3. Recovery and reconstruction of terraces 4. Reduction of groundwater pollution 5. Regulation of livestock production to avoid over grazing 6. Clarification of forest-land ownership 7. Improved forest management, to reduce fire damage, etc. 8. Institutional and legal measures for sustainable management of water resources 9. Repairing and renovation of irrigation networks 10. More dams to store water and combat drought *Source*[8]	1. The soil mapping units of the ESB 1:1,000, 000 Soil Map of Europe. 2. Slope gradient 3. Bioclimatic zone 4. Irrigation intensity and salt seawater intrusion. *Source*[9],[10]

[4] "Desertification Information System for the Mediterranean"
[5] "Reseau d'Observatoires de Surveillance Ecologique à Long Terme
[6] "Research in global change in the Mediterranean: a regional network"
[7] Repères et indicateurs. UNCCD, CST, May 2003. ICCDCOP(6)CST5.pdf
[9] p13 Second National Report of Greece on the implemenation of the UNCCD, 2002 http://unccd.int/cop/reports/northmed/national/2002/greece-eng.pdf
[10] p12 Repères et indicateurs. UNCCD, CST, May 2003. ICCDCOP(6)CST5.pdf
[11]p3 Greek National Action Plan for Combating Desertification, Athens Jan. 2001. www.unccd.int/actionprogrammes/northmed/national/2001/greece-eng.pdf

participation of affected populations and of their local agencies to the formulation and implementation of local and specialised measures. 7. Selection and formulation of priorities and pilot - actions. 8. Demographic and socio-economic rehabilitation of areas facing desertification. 9. Establishment of a network for early diagnosis and warning. 10. Co-operation with respective National Programs from other countries and linking to corresponding international networks. *Source*[8]		

Table 1. National Indicators for Greece

A 1:000,000 scale Desertification vulnerability map (Yassoglou et al. 2001[12]; GNCCD, 2002[13]) was compiled on the basis of principles and indicators proposed by Yassoglou (1995)[14] and of CORINE (1992)[15]:
Indicators used for the definition of the sensitivity of the mapping units were derived from:

1. The soil mapping units of the ESB 1:1,000, 000 Soil Map of Europe. The Greek mapping units are characteristic of erosional sequences of each soil in each geologic formation, climatic zone and vegetation cover. Therefore, soil units are indicative of the extent of the erosion that has taken place, the erosion risk, the soil depth and the soil drought risk. Tabular data concerning the composition of the soil mapping unit and the erodibility of the soils are derived from the tabular data of the ESB georeferenced Soil Map of Europe.
2. Slope gradient as determined by the CORINE project (1992) and tabular data from the ESB 1:1,000,000 Soil Map of Europe data base were used to assess the potential erosion risk of the soil-mapping units.
3. The bioclimatic zone classified according to the Bagnouls-Gaussen bioclimatic index (BGI) for each soil-mapping unit were derived from the Bioclimatic Map of Greece. The aridity of each unit was derived from this map and it was used to estimate soil drought, soil salinity and potential resilience of damaged vegetation cover.
4. Irrational irrigation and salt seawater into coastal aquifers intrusion were derived from information on irrigation works and the seawater intrusion map (Ministry of Agriculture). The data were used along with the proximity to the sea estimate the secondary salinization risk of the irrigated soils.

[8] p24 2[nd] National Report of Greece on the implemenation of the UNCCD.
http://unccd.int/cop/reports/northmed/national/2002/greece-eng.pdf
[12] Full reference not available
[13] Full reference not available
[14] Yassoglou, N. 1995. Land and Desertification, In Fantechi, R., Peter, D. Balabanis, P. and Rubio, J.L. eds. Desertification in the a European context. Physical and socio-economic aspects. Europeans Commission EUR 15415 EN.
[15] CORINE 1992 Soil erosion risk and important land resources. European Commission, EUR 13233 EN.

Full descriptions of these indicators are given in *Repères et Indicateurs (ICCD/COP(6)/CST/5, 28 May 2003)*[16].
The indicators were used as layers to delineate the mapping units in a 1:1,000,000 potential desertification risk map for Greece in an ARCINFO environment.
The defined units correspond to the two main processes and are the following:

- Low risk, due to soil erosion and bioclimatic aridity
- Medium risk, due to soil erosion and bioclimatic aridity
- High risk due, to soil erosion and bioclimatic aridity
- Salinization risk due to irrational irrigation, bioclimatic aridity and sea proximity

Indicators used for mapping at other scales
A system developed under the auspices of the MEDALUS III project was used for preparing the desertification sensitive areas map of the island of Lesvos at a scale of 1:50,000. Fifteen separate indicators are combined to give a quantitative evaluation of desertification sensitivity. For further details see the MEDALUS III section below.
The full-scale application of the methodology requires databases for the parameters used, especially soil maps. Difficulties encountered were those related to the availability of dependable databases and the shortage of experts capable of applying the medium scale systems in the field. However, the ESA methodology has been applied in mapping desertification sensitive lands at a scale 1:50,000 in a pilot area in Lesvos. The validation of the system in Greece has been satisfactory. Further validation may be required when the number of the parameters is reduced and new ones are introduced to the medium scale system. Much more work is required for improving the degree of perception regarding the threat and consequences of desertification of stakeholders and their ability to early recognize them. To cope with this problem the team of Agricultural University of Athens has contacted and is working with some two hundred individual stakeholders and is planning to increase this number.

Collaboration with research programmes

INDICATORS CATEGORY				
IMPACTS	PHYSICAL-ENVIRONMENTAL	MANAGEMENT	SOCIAL	ECONOMIC
Frequency of flooding	Rainfall	Animal grazing	Ownership	Loss in plant production
Dam sedimentation rate	Xerothermic index	Controlled grazing	Farmer age	Loss in farmers' income
Land salinization rate	Soil texture	Policy enforcement	Number of parcels	
Land abandonment rate	Parent material	Land use intensity	Migration rate	
	Rock fragments	Water available		
	Soil depth	Tillage depth		
	Drainage	Storage of water runoff		
	Slope gradient	Tillage operations		

[16] pp 19 to 28 Repères et indicateurs. UNCCD, CST, May 2003. ICCDCOP(6)CST5.pdf

	Slope aspect	Tillage direction		
	Type of vegetation	Sustainable farming		
	Plant cover	Period of land use		
	Previous type of land use	Erosion control		
	Bioclimatic zone	Irrational irrigation		
	Soil mapping unit			

Table 2. Categories of candidate indicators for Greece

The Greek National Committee to Combat Desertification (GNCCD) is collaborating with the European Commission research projects DESERTLINKS and MEDACTION in developing indicators of land desertification (see below for further details of the DESERTLINKS project). A list of about 38 candidate indicators has been described and analysed in order to define and map (a) the present stage of land desertification and (b) the desertification risk. The indicators are divided in the following two broad categories: regional and local. Regional indicators are used to define desertification risk of broad areas at a small scale (>1:100,000) and local indicators are used to define desertification risk at large scale (<50,000). The list of candidate indicators was studied in detail under field conditions in collaboration with the land-users. The Table above shows those indicators of relevance to Greek conditions that can be used for mapping ESAs to desertification and defining desertification risk.

2.1.2 Details of applications of benchmarks and indicators in Italy

The report from Italy in the document *Repères et Indicateurs (ICCD/COP(6)/CST/5, 28 May 2003*[17]*)* gives comprehensive information about the current application and use of benchmarks and indicators in Italy. The material in this section is almost entirely extracted from that report.

Environmental benchmarks and indicators in Italy are based on observation and monitoring system of National (APAT) and Regional Environmental Protection Agencies (ARPAs). The National Topic Centers (NTC) system operationally supports APAT in gathering and managing environmental and monitoring data and information and in particular desertification data and indicators are under responsibility of the NTC TES (Territory and Soil).

[17] pp 29 to 36 Repères et indicateurs. UNCCD, CST, May 2003. ICCDCOP(6)CST5.pdf

Objectives and actions proposed in National Action Programme and indicators used for mapping at the national scale

OBJECTIVES	ACTIONS	NATIONAL INDICATORS
1. The support necessary for Italian regions and watershed authorities to identify “areas vulnerable to desertification” 2. The adoption of standards and methods better suited to understanding, preventing and alleviating desertification phenomena in “vulnerable areas”; 3. The preparation of the Italian contribution to the Northern Mediterranean Regional Action Programme aimed at ensuring adequate participation in the coordination works with the Annex IV partners; 4. The gathering of uniform soil data for all of Italy based on the activities of the National Soil Monitoring Centre, the regional Soil Services and other offices with similar duties, in close working relationship with the European Soil Office. Source[18]	1. Soil protection, including forest management, slope protection and flood control 2. Sustainable management of water resources, identification of water requirements and control of water demand. 3. Reduction of the impact of productive activities; prevention of physical, chemical and biological damage to the soil; production and use of compost 4. Territorial rebalance, including reclamation and re-naturalisation; re-evaluation of traditional knowledge; integrated planning policies Source[19]	1. Aridity index, defined as the relationship between the average yearly precipitation and the average yearly potential evapo-transpiration; 2. Soil characteristics index, related to the pedo-climatic classification of the Italian territory (dependent on soil and its biotic cover); 3. Land use index, obtained by means of a reclassification of the original Corine Land Cover classes; 4. Demographic variation index, defined as the percentage of population variation between 1981 and 1991, at the municipal scale. 5. A final index of sensitivity to desertification was developed on the basis of the four indexes above Source[20][21]

Table 3. National Indicators for Italy

Indicators used for mapping at other scales

Under the auspices of the MEDALUS III project, the University of Basilicata developed a map of the environmentally sensitive areas of the Agri Basin, following the methodology described in the MEDALUS III section below.

After the preliminary identification of the Italian areas sensitive to desertification done in 1999, in December 2001 the Italian Ministry for the Environmental Protection and the Territory funded a project aiming to build an Italian “Desertification Atlas”, to both formulate and fill in a set of specific indicators: chemical – physical, biological, and socio-economic. According to the provisions of the guidelines for NAP implementation, Regions and River Basin Authorities formulated their programmes using environmental and socio-economic indicators. Most affected regions also complemented their programmes with sensitivity maps in order to support decision makers in understanding ongoing processes, planning interventions of mitigation and in the monitoring of their effectiveness. Sensitivity has been assessed on the basis of several parameters and indicators concerning broad categories (soil, climate, vegetation and land management).

[18] p4 National Action Programme to combat desertification, Rome, December 1999. www.unccd.int/actionprogrammes/northmed/national/2000/italy-eng.pdf
[19] p14 National report of Italy on the implementation of the UNCCD, 2000. www.unccd.int/cop/reports/northmed/national/2000/italy-eng.pdf
[20] p31 Italy National Report, CRIC, November 2002. http://unccd.int/cop/reports.northmed/national/2002/italy-eng.pdf
[21] p29 Repères et indicateurs. UNCCD, CST, May 2003. ICCDCOP(6)CST5.pdf

MAP	YEAR	SCALE	INSTITUTION
Vulnerability areas to the desertification risk in Sardinia Region	2000	1: 250,000	Regional Agro-Meteorological Service (SAR s.r.l)
Vulnerability areas to the desertification risk in Sicily Region (1)	2001	1:250,000	Sicily Region-Territory and Environment Department
Desertification sensitivity map of Sicily Region (2)	2001	1: 250,000	ENEA-INEA
Desertification sensitivity map of Puglia Region (1)	2001	1: 350,000	Puglia Region-CNR (Research National Committee)
Desertification and drought vulnerability map of Puglia Region (2)	2001	1:250,000	European Soil Bureau; Space Application Institute and Puglia Region
Map of desertification and drought sensitivity areas of Basilicata Region	2001	1: 250,000	Basiliciata Region- CNR (Research National Committee)
Vulnerability areas to the desertification for the groundwater salinity in the Magra River Basin Authority	2001	1:25,000	Magra River Basin Authority
Desertification and drought vulnerability preliminary map of Sarno River Basin Authority	2001	1: 1,200,000	Sarno River Basin Authority
Desertification and drought vulnerability preliminary map of Left Sele River Basin Authority	2001	1:1,200,000	Left Side of Sele River Basin Authority
Desertification and drought vulnerability preliminary map of Right Sele River Basin Authority	2001	1:1,100,000	Left Side of Sele River Basin Authority

Table 4. List of available maps, with time and spatial scale for Italy

Collaboration with research and international cooperation programmes
National and international research projects in Italy come at a time when an effective synergy between policy and scientific community is most needed. The implementation of the National Action Programme requires the development of monitoring techniques and of systems of indicators and benchmarks addressing bio-physical and socio-economic issues also involving stakeholders. The main scientific projects addressing the issue of development and of the use of indicators of desertification are DESERTLINKS, RIADE, DESERTNET and DISMED.
DESERTLINKS is a European-funded project, designed to provide, among other results, valuable and useful knowledge and expertise for the identification of proto-type indicator systems at different scales. The current effort of scientific research is to combine new kinds of indicators, identified by the local stakeholders with existing bio-physical indicators in a number of desertification-affected areas (for further details see part 3). The "Desertification Information System to support National Action Programmes in the Mediterranean (DISMED)" project is a jointly managed by the European Environment Agency (EEA), the Applied Meteorology Foundation FMA of Italy and the UNCCD secretariat with the participation of affected northern and southern Mediterranean countries. The purpose of the DISMED project is to improve the capacity of national administrations of Mediterranean countries, to effectively programme measures and policies to combat desertification and the effects of drought. This aim will be pursued by reinforcing the communication amongst them, facilitating the exchange of information and establishing a common information system to monitor the physical and socio-economic conditions of areas at risk, assess the extent, severity and the trend of land degradation (for further details see part 3).

The DESERTNET and RIADE projects will contribute to the identification of indicators and are also expected to be a significant test for the use of indicators for the implementation of NAPs in affected areas.

Project name:	Monitoring and actions to Combat Desertification in Mediterranean Europe (DESERTNET)
Website	In preparation
Objectives:	To study, monitor and sustainably manage the areas threatened by Desertification in Mediterranean Europe. To rationalise information and technical-scientific experiences acquired and elaborated for risk areas identified in previous national and regional programmes.
Geographic area	Ten regions within Italy (Liguria, Campania, Calabria, Toscana, Sicilia, Romagna, Sardegna, Basilicata) and Spain (Murcia, Andalucia).
Project type (research, planning/management, dissemination, training, other):	Research and training: a network of pilot actions and users and an Interregional Observatory to Combat Desertification.
Institution in charge of project implementation:	Desertification Research Group (NRD) University of Sassari
Start/end date:	2002-2004
Director:	Prof. Giuseppe Enne
Participating institutions	Representatives from the regions, plus APAT, CINSA, Institut de Régions Arides
Contact persons (names and email addresses):	Prof Giuseppe Enne E-mail: nrd@uniss.it Telephone: 0039 079 2111016
Other information:	
Spatial scale of the proposed indicators:	Regional

Table 5. DESERTNET

Project name:	Integrated Research for Applying new technologies and processes for combating desertification (RIADE)
Project website	www.riade.net
Objectives:	The development of an integrated and technologically innovative system for monitoring desertification processes localized in the southern areas of Italy, able to contribute to determining the cause-effect relationship in the observed phenomena, and to promote interventions towards the territory safeguard.
Geographic area	Italian regions of Basilicata, Puglia, Sardinia and Sicily
Project type (research, planning/management, dissemination, training,etc.):	Research and training
Institution in charge of project implementation:	
Start/end date:	October 2002 to September 2005
Director:	
Participating institutions	Advanced Computer Systems S.p.A. ENEA (Institute for the New Technologies, Energy and Environment) Desertification Research Group (NRD) University of Sassari
Contact persons (names and email addresses):	Prof. Giuseppe Enne (NRD-UNISS) nrd@uniss.it Dr Massimo Iannetta (ENEA) miannetta@casaccia.enea.it
Other information:	
Spatial scale of the proposed indicators:	

Table 6. RIADE

All research projects are working with the extensive collaboration with local stakeholders in desertification affected areas of southern Italy in order to identify: impact indicators relating to perceptions of land function; driving force and pressure indicators relating to decision making; response indicators relating to land management measures taken to combat desertification. A conceptual and database framework is under development for these and the other indicators identified.There is a close collaboration among the scientific community, local stakeholders and the National Committees to test the application of the indicators system and to validate the local identification of high-risk areas and the implications of local scenario analyses. The principal expected product of existing research projects regarding Desertification Indicators is a system tested and evaluated by both the local stakeholders and the National Committee to explore alternative management scenarios and national and regional management and monitoring strategies.

2.1.3 Details of applications of benchmarks and indicators in Portugal
Objectives and actions proposed in National Action Programme and indicators used for mapping at the national scale

OBJECTIVES	ACTIONS	NATIONAL INDICATORS
1. Soil and water conservation 2. To fix working-age population in rural areas 3. Recovery of affected areas 4. Campaigns to raise public awareness of the issue of desertification 5. Making the fight against desertification an integral part of general and sectorial policy *Source* [22]	1. Soil and water conservation 2. Keeping the population in rural areas 3. Recovery of areas most threatened by desertification 4. Research, experimentation and diffusion 5. Ensuring that desertification is included in development policy *Source* [23]	The following four indices[24] have been mapped and will be monitored: 1. Climate Index (Penman) 2. Soil loss index 3. Drought index 4. Combined index of susceptibility to desertification By April 2002, 19 indicators were chosen for trial[25]: population density, rock fragments, soil depth, slope, rainfall, aridity, fire risk, erosion protection, drought resistance, plant cover, employment index, old age index, aridity index, rain erosivity, drought index, urban sprawl, infiltration capacity, stability of surface horizon, grazing intensity.

Table 7. National Indicators for Portugal

Under the auspices of DISMED (for further details see part 3), Portugal has made substantial progress in mapping a number of indicators at the national scale. The following is a summary of the presentation made by Portugal at the DISMED technical workshop, Djerba 2002[26]. The NAP was based on the scientific and technical information given by different organisations and with the support of the civil society.

[22] p15 Portugal National Action Programme
www.unccd.int/actionprogrammes/northmed/national/2000/portugal-eng.pdf
[23] p16 Portugal National Action
Programmewww.unccd.int/actionprogrammes/northmed/national/2000/portugal-eng.pdf
[24] p13 Portugal National Action programme
www.unccd.int/actionprogrammes/northmed/national/2000/portugal-eng.pdf
[25] p7 National report on the implementation of the convention to combat desertification in Portugal.
http://www.unccd.int/cop/reports/northmed/national/2002/portugal-eng.pdf
[26] Portugal report DISMED technical workshop on thematic and sensitivity mapping on desertification and drought: Minutes of the meeting, February 27– March 2, 2002, Djerba, Tunisia.
http://dismed.eionet.eu.int/events

In this process 21 Services of 8 Ministers, NGOs, Schools and Research Institutions participated. Specific thematic products have been identified according to the condition that the information should be reported to the county level (NUT IV). The geographic information system supporting the Portuguese NAP is described in the work of Pimenta et al. (1997)[27]. The work of development of these indicators, carried out by the DISMED Portuguese Group, is conducted along these main lines:
The present information system will be used until a new one is made available;
Any new information system aimed at supporting the NAP in future must be able to include all the results produced by the research made during the different activities currently in progress;
All the technical work developed by the Portuguese DISMED is referred to in the group of indicators and indexes proposed by Enne & Zucca (2000)[28], which already includes the indicators and indexes used by the Portuguese system.
Use of indicators as reported to the Desertification Information System to support National Action programmes in the Mediterranean (DISMED)[29].

Nº ANPA	**Indicator name**	**Method of measure**
1	Population Density	inh / km2
2	Rock fragments	% area
3	Soil depth	cm
4	Slope	%
5	Rainfall	mm
6	Aridity	class
7	Fire risk	class
Nº ANPA	**Indicator name**	**Method of measure**
8	Erosion Protection	class
9	Drought resistance	class
10	Plant cover	%
11	Employment index	%
12	Old age index	%pop > 65/?5 y
13	Aridity index	class
14	Rain erosivity	J mm m^{-2} $h^{-1}ano^{-1}$
15	Drought index	class
16	Urban sprawl	ha / year
17	Infiltration capacity	mm / hour
18	Stability of surface horizon	class
19	Grazing intensity	class

Table 8. Indicators that are being worked on by DISMED in Portugal

[27] Pimenta, Santos & Rodrigues (1997) A proposal of indices to identify desertification prone areas, presented in the *"Jornadas de reflexión sobre el Anexo IV de aplicatión para el Mediterrâneo Norte – Convenio de Lucha contra la Desertificación"*, Murcia (22–23 May).
[28] Enne, G. and Zucca, C. 2000. Desertification Indicators for the European Mediterranean region. State of the art and possible methodological approaches. ANPA/NRD/UNCCD/Ministero dell'Ambiente. Rome.
[29] Portugal report DISMED technical workshop on thematic and sensitivity mapping on desertification and drought: Minutes of the meeting, February 27– March 2, 2002, Djerba, Tunisia. http://dismed.eionet.eu.int/events

Indicator name	Raw data	Portuguese NAP use	Data sources
Population Density	Demographic statistics		INE
Rock fragments	Soil cartography		IHERA
Soil depth	Soil cartography	*	IHERA
Slope	Topographic maps / DTM	*	IgeoE
Rainfall	Rainfall (Annual mean)	*	INAG / IM
Aridity	Rainfall / Temperature (Monthly means)		IM
Fire risk	Soil Use / Vegetation Cover		CLC-CNIG-DGF(IS)
Erosion Protection	Soil Use / Vegetation Cover	*	CLC-CNIG-DGF(IS)
Drought resistance	Soil Use / Vegetation Cover	*	CLC-CNIG-DGF(IS)
Plant cover	Soil Use / Vegetation Cover	*	CLC-CNIG-DGF(IS)
Employment index	Employment statistics		ME – INE
Old age index	Demographic statistics		INE
Aridity index	Rainfall (anual mean) / Temperature (monthly mean)	*	INAG / IM
Rain erosivity	Rainfall	*	INAG
Drought index	Rainfall (Annual mean)	*	INAG / IM
Urban sprawl	Soil Use / Vegetation Cover		CLC/CNIG/DGOTDU/DGF (IS)
Infiltration capacity	Rainfall / Infiltration	*	IHERA / INAG
Stability of surface horizon	Soil cartography		IHERA
Grazing intensity	Livestock statistics / Vegetation Cover		INE

Table 9. Raw data for Portuguese thematic and sensitivity mapping of drought and desertification

Indicator name	Spatial scale	Time scale
Population Density	Freguesia	10/10years (.../1991/2001)
Rock fragments	1:1.000.000 / (1:25.000)	
Soil depth	1:1.000.000 / (1:25.000)	
Slope	1:250.000 - 1:25.000	
Rainfall	(1:300.000) / 1:3.000.000	1961 - 90 and to present
Aridity	(1:300.000)	1961 - 90 and to present
Fire risk	1:25.000 / 1:100.000	.../1985/90/95 e 1990-2001
Erosion Protection	1:25.000 / 1:100.000	.../1985/90/95 e 1990-2001
Drought resistance	1:25.000 / 1:100.000	.../1985/90/95 e 1990-2001
Plant cover	1:25.000 / 1:100.000	.../1985/90/95 e 1990-2001
Employment index	Municipality	Monthly (1970 – 2001)
Old age index	Freguesia	10/10years (.../1991/2001)
Aridity index	(1:100.000) / 1:3.000.000	Annual
Rain erosivity	(1:100.000) / 1:3.000.000	Continuous records
Drought index	(1:100.000) / 1:3.000.000	Annual
Urban sprawl	1:25.000 / 1:100.000	.../1985/90/95 e 1990-2001
Infiltration capacity	1:1.000.000 / (1:25.000)	
Stability of surface horizon	1:1.000.000 / (1:25.000)	
Grazing intensity	Freguesia	10/10years (.../1991/2001)

Table 10. Time and spatial scale for thematic and sensitivity mapping

Indicator	**Raw data**	**Inf. Existence**	**Pt NAP use**	**Data sources**	**Developers**	**Realization difficulties**
Population Density	Demographic statistics	Y		INE	DGDRural	1
Rock fragments	Soil cartography	n		IHERA	IHERA	2 - 3
Soil depth	Soil cartography	(y)	*	IHERA	IHERA	2 - 3
Slope	Topographic maps / DTM	Y	*	IGeoE	DGF	1 - 3
Rainfall	Rainfall (Annual mean)	Y	*	INAG / IM	INAG / IM	0 - 1
Aridity	Rainfall / Temperature (Monthly means)	Y		IM	IM	1
Fire risk	Soil Use / Vegetation Cover	Y		CLC-CNIG-DGF(IS)	DGF	1
Erosion Protection	Soil Use / Vegetation Cover	Y	*	CLC-CNIG-DGF(IS)	DGF	0 - 1
Drought resistance	Soil Use / Vegetation Cover	Y	*	CLC-CNIG-DGF(IS)	DGF	0 - 1
Plant cover	Soil Use / Vegetation Cover	Y	*	CLC-CNIG-DGF(IS)	DGF	0 - 1
Employment index	Employment statistics	Y		ME - INE	DGDRural	1
Old age index	Demographic statistics	Y		INE	DGDRural	1
Aridity index	Rainfall (annual mean) / Temperature (monthly mean)	Y	*	INAG / IM	INAG	0 - 1
Rain erosivity	Rainfall	Y	*	INAG	INAG	0 - 1
Drought index	Rainfall (Annual mean)	Y	*	INAG / IM	INAG / IM	0 - 1
Urban sprawl	Soil Use / Vegetation Cover	Y		CLC/CNIG/ DGOTDU/DGF(IS)	DGOTDU / CNIG	1
Infiltration capacity	Rainfall / Infiltration	(y)	*	IHERA / INAG	IHERA	3 - 4
Stability of surface horizon	Soil cartography	n		IHERA	IHERA	3 - 4
Grazing intensity	Livestock statistics / Vegetation Cover	Y		INE	DGDRural / DGF	2
		Y - yes (y)- only part n - No	high scale			4 High difficulty 3. With additional costs 2. Indirect solution 1. Without problems 0 Already do

Table 11. Sources, developers and realization difficulties of Portuguese DISMED indicators and index

The Portuguese presentation at the UNCCD COP6, DISMED Side Event, 28 August 2003, shows that this work has continued to be developed.[30]

[30] Lúcio do Rosário, DISMED Portuguese Experience, Presented at the DISMED Side Event, UNCCD COP6, Havana, Cuba, 28 August 2003

Biophysical indicators	
Aridity Index	Rainfall/ETP
Soil Sensitivity Index	Arithmetic mean of classes of soil depth; soil permeability; soil structural stability; surface stoniness; drainage; slope
Vegetation Quality Index	PCA (principal components analysis) 1st axis with 65.5% explanation of: fire resistance; drought resistance; erosion protection; ground cover; structural cover; proximity to climax
Land use Quality Index	Urban, industrial and touristic land (actual and projected); wetlands; irrigated lands (actual and projected
Index of Sensitivity to Desertification and Drought	Combining the Aridity; Soil Sensitivity, Vegetation Quality and Land Use Quality Indices
Economic indicators	
Purchasing Power by Municipality	PCA (1st axis with 77% explanation): Employment in commerce, Employment in tourism and restaurants; Touristic and restaurant enterprises; Gross profits in the hotel sector; Electricity domestic consumption; Fixed telephone numbers; Transaction value/urban buildings; Buildings with elevator; Gross profits declared for taxes; Singular people profit taxes; Municipality property transfer taxes; Municipality vehicle taxes; Municipality urban taxes; Urbanisation taxes/number of inhabitants; Transaction value on bankboxes; Domestic hypothecary credit; Population with high degree formation; Divorced population.
Social indicators	
Population density	Number of inhabitants per ^{km2}
Decrease of population	% 2000/1990
Population Vitality Index	Population> 60 years/<14 years *1000
Old People Dependency Index	Population>65 years/20-59 years*100
Population Illiteracy Index	Pop s/niv ens/total - %)
Seasonal or Secondary Houses	%/total houses

Table 12. Existing maps for Portugal

Consultation with Local Stakeholders

In collaboration with the DESERTLINKS Project, the Portuguese Focal Point also conducted, in May 2002, a series of workshops in four pilot areas Alcoutim (Serra Algarvia), Mértola (Margem Esquerda), Mação (Pinhal Interior Sul) and Mogadouro (Arribas do Douro)[31]. This participatory process involved 200 participants, representatives of four pre-defined local actors: policy makers; technicians with local intervention; economic agents; citizens and local associations. The participants were asked to identify the signs of desertification that they though were particularly relevant for their area, to make proposals for their solution, identify potential partners and also the main barriers to the solutions.

[31] National Coordination Committee of the NAPCD, Public Participation in the Fight Against Desertification, May 2002

Indicators used for mapping at other scale

Under the auspices of the MEDALUS III project, the Universidade Nova de Lisboa developed a map of the environmentally sensitive areas of Mértola Municipality following the methodology described in Kosmas et al. 1999[32] and in the MEDALUS III section below.

Other relevant reports

Report from Portugal. MEDRAP Second workshop, Troia, Portugal, June 2002. Part B, Methodology used to define and map sensitive areas. (pp 3-7). http://www.uniss.it/nrd/medrap/documents/w2/portugalw2.pdf

DISMED first validation workshop: benchmarks and indicators – circulation of information. Minutes of the meeting, October 2002, Tamanrasset, Algeria. http://dismed.eionet.eu.int/events

DISMED technical workshop on desertification mapping needs for decision-makers – mapping desertification dynamics. Minutes of the meeting, Sesimbra, Portugal June 2003. http://dismed.eionet.eu.int/events

2.1.4 Details of applications of benchmarks and indicators in Spain

Objectives and actions proposed in National Action Programme and indicators used for mapping at the national scale

Maps have been compiled for each of the indicators described below in order to obtain a first determination of the areas affected by desertification in the Spanish territory[33]. The objective is to identify physical and socio-economic areas that are affected, and where actions to combat desertification should be focused.

ACTIONS	NATIONAL INDICATORS
1. Hydrological Basin Plan and National Hydrological Plan 2. Spanish Strategy against Climate Change 3. Spanish Strategy for the Conservation and Sustainable Use of Biological Diversity 4. Spanish Forestal Strategy (EFE) and Spanish Forestal Plan 5. Priority Action Plans against Forest Fires (PAP National Plan to Recover Contaminated Soils) 6. White book on Environmental Education in Spain 7. National Plan of irrigated areas (PNR) 8. National Plan of Research, Development and Technological Innovation *Source* [34]	1. Aridity index 2. Soil Loss Index (USLE) 3. Percentage of the accumulated surface area affected by fire over a 10 year period 4. Damage caused to forests by drought 5. The existence of over-exploited aquifers *Source* [35]

Table 13. National Indicators for Spain

[32] Kosmas C, Kirkby M and Geeson N, 1999. The MEDALUS project. Mediterranean Desertification and Land Use. Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification. European Commission, Brussels.

[33] The maps can be viewed on the DESERTLINKS Project web site www.kcl.ac.uk/desertlinks/indicator system/regional scale/spain

[34] Informe sobre el Programa de Acción Nacional Contra la Desertificación España, 2002

[35] DISMED Technical Workshop on NAP information needs. Spanish NCB report. DISMED-florence-spain-NCB.rtf

As a first approximation, a simple model has been applied based on the characterisation of hydrological sub basins, paying attention to indicators which reflect the intensity with which factors and processes determining desertification occur. Using this model a map of sub-basins showing the degree to which they are affected by desertification has been produced.

Spain was divided into 340 hydrographic sub-basins, the advantage being that this working unit has also been employed as a physico-biological and socio-economic-political unit for planning and arranging natural resources.

For each sub-basin the intensity of four factors and processes that determine desertification was determined. These were aridity, erosion, fire and non-sustainable use of water resources, specifically the over-exploitation of aquifers. The combination of these four factors gives a first approximation of how affected each sub-basin is by desertification.

- Aridity index: In accordance with the definition of desertification by the UNCCD, the sub-basins included in the arid, semi-arid and dry sub-humid areas have been characterised. These are those in which the ratio between annual rainfall and potential evapotranspiration is between 0.05 and 0.65. In the context of the Convention it is considered that, because of their climatic conditions, humid and sub-humid zones are not affected by desertification.
- Soil Loss Index: For the whole of Spain, there are maps showing the erosive state. From these maps the median soil loss, expressed in t/ha/year has been obtained for each sub-basin.
- Fire intensity: A map of fire intensity, measured as a percentage of cumulated surface affected by fire over a 10 year period was used to characterise forest fires for each sub-basin. Intensity was classified into four groups according to these ranges >25%, 10-25%, 1-10%, <1%.
- Aquifer over-exploitation: finally, with regard to non-sustainable use of water resources the state of exploitation of aquifers was used as an indicator (source Libro Blance de las Aguas Subterráneas) classified according to these ranges (E = extraction of underground water, R = reloading due to infiltration): E>R, R>E>0.8R, Overexploitation with local problems, Without problems.

For each sub-basin the four factors were combined, in order to obtain a map showing a first approximation of the degree of desertification. Numerical values were assigned to each of the classes. The heaviest weighting was given to erosion that encompasses various factors like erosivity of the rain, slope gradient, type and density of vegetation cover and the susceptibility to erosion of the parent material. Also it was considered that aridity had a heavier weight than fire intensity and over-exploitation of aquifers.

The sum of each of the numerical values characterising each sub-basin were grouped into four categories of degree to which they are affected, very high, high, medium and low.

2.1.5 Details of applications of benchmarks and indicators in Turkey
Objectives and actions proposed in National Action Programme and indicators used for mapping at the national scale

OBJECTIVES	**ACTIONS**	**NATIONAL INDICATORS**
1. Implementation of the goals of the UNCCD. 2. Monitoring and assessment of desertification processes[36]	1. Soil and erosion maps based on 1/25000 scale topographic maps. Also maps for provincial and basins printed at 1/100000 and 1/200000 scales respectively.[37] 2. Review of the legal, institutional, financial and socio-economical problems faced in the context of combating desertification and minimizing drought effects.[38]	1. Standardized Precipitation Index (SPI). (Precipitation deficit for multiple time scales) 2. Palmer Drought Severity Index (PDSI). (Based on precipitation, temperature and Available Water Content (AWC) of the soil) 3. Potential Evapotranspiration /Precipitation. (Index quantifies precipitation deficiency) 4. Natural Vegetation Difference Index (NDVI) provides a crude estimate of vegetation health and a means of monitoring changes in vegetation over time. [39]

Table 14. National Indicators for Turkey

2.1.6 Details of applications of benchmarks and indicators in Malta
Projects and/or actions that are developing desertification benchmarks and indicators

Project name:	MAP CAMP The Malta Project
Objectives:	The MAP CAMP Malta Project was the first exercise in integrated coastal area management carried out for the Maltese Islands. The Project focused on the sustainable management of the coast of Malta in particular the Northwest area. Principles, methodologies and practices of sustainable coastal management and integrated coastal and marine areas management (ICAM) were introduced and applied.
Geographic area	Northwest of Malta.
Project type (research, planning/management, dissemination, training, other):	Planning and management of the coastal area of Northwest Malta. However, the Project included also training and public participation.
Institution in charge of project implementation:	Environment Protection Department, Ministry for the Environment.
Start/end date:	February 2000 – November 2002.
Director:	Louis Vella (National Project Co-ordinator), Christine M Tanti (National Project Administrator).
Participating institutions	Mediterranean Action Plan, Priority Actions Programme/Regional Activity Centre, Blue Plan and Regional Activity Centre for Specially Protected Areas; Department of Agriculture Malta, University of Malta (Institute for Mediterranean Studies and Department of Biology), Planning Authority and Environment Protection Department (recently forming the Malta Environment and Planning Authority).

[36] p22 Turkish National Report, 11 October 2000.
http://www.unccd.int/cop/reports/northmed/national/2000/turkey-eng..pdf
[37] p23 Turkish National Report, 11 October 2000.
http://www.unccd.int/cop/reports/northmed/national/2000/turkey-eng..pdf
[38] p21 Turkish National Report, 11 October 2000.
http://www.unccd.int/cop/reports/northmed/national/2000/turkey-eng..pdf
[39] p23 Turkish National Report, 11 October 2000.
http://www.unccd.int/cop/reports/northmed/national/2000/turkey-eng.pdf

Contact persons (names and email addresses):	Louis Vella (louis.vella@mepa.org.mt), Christine M Tanti (christine.tanti@mepa.org.mt).
Other information:	
Spatial scale of the proposed indicators:	Northwest, Malta.
Methodology:	During the MAP CAMP Project, the systemic and prospective sustainability analysis (SPSA) methodology was adopted. This activity was led by the Blue Plan Regional Activity Centre of the Mediterranean Action Plan.

Table 15. MAP CAMP

The basis of SPSA is systemic analysis and the concept of prospective sustainability. Therefore, SPSA combined the main themes of systemic analysis with core elements from sustainability indicators and forecasting, i.e. it allowed for the analysis of exploration, description and assessment of the level of sustainability of an agreed system by the use of indicators, in the past, present and future. Systemic and Prospective Sustainability Analysis (SPSA) has, therefore, been designed to produce sustainability indictors in a manner that maximises their chances of producing an holistic perception of the context in question, and in an inclusive and participatory manner. In general, the SPSA approach provided a global approach even though it was applied on a local region. This approach also took into account the relations between the indicators, which describe the elements of the system and their interactions. The system was represented by indicators chosen by a team of participatory stakeholders engaged in the SPSA, thus they were decided from the perspective of contributing stakeholders. The external context was considered in terms of beneficial or harmful influence.

Brief description of desertification benchmarks and indicators and/or drought currently described and/or used in MAP CAMP

The development of sustainability indictors for soil erosion/desertification was based on the following criteria:

- Description of the indicator;
- Why was this particular indicator chosen?
- Efficiency and effectiveness of the indictor vis-à-vis soil erosion.

The proposed Sustainability Indictors for erosion/desertification control management in Malta are grouped and described in the Table below.

Indicator 1. Official flood warnings			
Description	Source of data	Time factor	Interpretation of indicator
The flood warning gives a warning for a certain amount of precipitation and intensity that will lead to a volume of water that is hazardous for safety of humans in urban and specific areas which are prone to flooding.	Civil Protection Department	Seasonal/ yearly	This indicator gives a good estimate of the intensity and volume of water following a rainstorm. The greater the number of flood warnings in a particular season, the greater the risk of soil erosion. Most serious flood warnings expected to occur around beginning of autumn when farmers deep plough fields and therefore no vegetation cover can mitigate rain splash effect.

Indicator 2. Land tenure			
Description	Source of data	Time factor	Interpretation of indicator
Land tenure refers to the way land is held, i.e. being the owner of the land, being the tenant, i.e. owns title of land (Government/private owner).	Lands Department and Joint Office	Decade	Farmers owning land they work tend to be more willing to invest in augmenting agricultural productivity of their holdings, i.e. irrigation; water retention structures; e.g. reservoirs; building and maintaining rubble walls. Also, any soil lost from the fields has to be replaced by the farmer himself at a considerable amount.

Indicator 3. Number of claims for compensation			
Description	Source of data	Time factor	Interpretation of indicator
Compensation (monetary) was given to farmers suffering for storm damages (including wind storm/whirlwind, flash floods). Soil loss is one of the claims. Claims could be monetary or in kind, i.e. material including soil.	Department of Agriculture	Seasonal	A decrease in the number of claims shows that less damage is done to agricultural holding (maintenance of rubble walls and terraces), therefore indicating better maintenance regime within farming community.

Indicator 4. Number and length of breaches in rubble walls (2 indicators)			
Description	Source of data	Time factor	Interpretation of indicator
A breach can be described wherever the level of soil is higher than the retaining rubble wall and wherever there is a physical evidence of failure to the retaining wall, therefore exposing the soil layer at that particular point.	Erosion /desertification national team (CAMP Malta Project)	Seasonal	A high number of breaches in retaining rubble walls indicate that a considerable amount of soil is being lost following rainfall as well as an increase in annual rainfall intensity. The state of repair of rubble walls is linked to land tenure since farmers owning the land tend to maintain the rubble walls.

Table 16. Sustainability indictors for soil erosion (reproduced from Tanti, C. M., A. Role', A. Borg and I. Calleja (2001) Protection of Soil and rural landscapes in Northwest Malta. Final Activity Document, Activity 5: Soil erosion/desertification control management, MAP CAMP Malta)

Although the above indicators were drawn up for the Northwest region of Malta, they can also be applied on a national scale. The development of these indicators had a strong stakeholder (farmers) participatory approach. Therefore the farmers themselves can easily monitor them.

Overview on the methodology of benchmarks and indicators in MAP CAMP
The Systemic and Prospective Sustainability Analysis approach is designed to develop indictors in a manner that maximises their chances of producing an holistic perception of the context in question, and in an inclusive and participatory manner.
Participation was achieved through several formal and informal (in the field) meetings with the farmers and their co-operatives. However, stakeholders were also invited to participate in the actual training courses and workshops held for the development of sustainability indicators. This proved to be successful since the farmers did not feel threatened by bureaucratic institutions and also felt that they owned the indicators. Moreover, baseline data and bands of equilibrium for each indicator were produced. The indicators developed in the SPSA approach also provided the basis for scenario building, identifying what is likely to happen and what could happen should certain tasks be undertaken.

Examples on practical use of benchmarks and indicators in MAP CAMP
To date, the indicators are not being monitored. However, it is envisaged that these will be monitored in the National Action Plan.

Brief description of desertification indicators drawn up by SI-MO
Ratio of land exploitation. This indicator looks at the land area taken up by agricultural land over the total cultivable surface. Whilst the definition is clear, data is rare in this area and is being updated to provide a full dataset. These initiatives include a habitats survey, an agricultural information system, and a field plot survey, amongst other studies carried out by the Planning Authority, Agricultural Department, and National statistics Office. Land use change. This indicator lists the different categories of data that can be gathered in a similar exercise to that carried out by the National Statistics Office for Eurostat. This indicator should be updated by this same questionnaire.
Arable land change. This indicator is clearly defined and is being used on data available at the National Statistics Office. This indicator is calculated on the land that is used for purposes related to agriculture. Note has to be taken that the figure for agricultural land in Malta include areas such as garrigue. The further splitting of the data into categories as outlined by MAP/UNEP in the future will help to align this indicator with the MAP data. The Maltese data can be split up into irrigated and dry land as described below.

Project name:	Malta Observatory for Sustainability Indicators (SI-MO)
Objectives:	The main aim of SI-MO is to set up a system for monitoring of sustainability indicators for Malta.
Geographic area	Malta
Project type (research, planning/management, dissemination, training, other):	Monitoring
Institution in charge of project implementation:	Islands and Small States Institute, Foundation for International Studies.
Start/end date:	December 2000 – December 2002.
Project name:	Malta Observatory for Sustainability Indicators (SI-MO)
Director:	Prof. Lino Briguglio
Participating institutions	Blue Plan, National Statistics Office, Malta Environment and Planning Authority, Department of Agriculture.
Contact persons (names and email addresses):	Prof. Lino Briguglio (si-mo@um.edu.mt).
Other information:	
Spatial scale of the proposed	Malta

indicators:	
Methodology:	The Observatory was funded through a 2-year project called Med-EMIS (Mediterranean Environmental reporting monitoring and information system). In Phase 1 of the Project, SI-MO commissioned expert consultants to prepare studies on various themes related to particular area of sustainable development concern. Reports were drawn up in the following themes: water, air quality, biodiversity, population and society, waste and social and cultural aspects. Phase 2 required that various consultants update the indicators already computed for Malta in the MAP/Blue Plan list and to compute additional ones. The computation of these indicators was also aimed at laying ground for long-term arrangements for ongoing development of sustainability indicators for Malta.

Table 17. SI-MO

2.2 Conclusions on Benchmarks and Indicators

2.2.1 Historical perspective

The historical perspective within Annex IV is described well by Enne and Zucca (2000)[40]. The International Conference on "Mediterranean Desertification: Research results and policy implications", held in Crete, October 1996, was an important land mark, when scientists from a wide range of desertification research projects met to review the issues of desertification across Mediterranean Europe. Indicators to describe the physical occurrence of desertification, such as "low, variable and intensive rainfall, poor vegetation cover, thin or easily disaggregated soils, steep slopes, intensive grazing, excessive water extraction and poor water use, and agricultural practices that encourage erosion, and agricultural uses that are unsustainable and lead ultimately to abandonment"[41] were suggested. It was recognised that capacity to monitor desertification was rudimentary in many countries affected by it and that national systemic efforts would be very helpful. After that the Convention to Combat Desertification entered into force in December 1996 and Italy, Spain, Portugal and Greece prepared a joint document for COP 1 in Rome, 1997.

2.2.2 Benchmark and Indicator utilisation by stakeholders

As the affected Country Parties began to prepare National Action Programmes they began to see the importance of involving stakeholders and decision-makers in research projects. The EU called for scientific project proposals that addressed these ideas.
MEDACTION (2000-2003) examined past policies affecting desertification and how new frameworks for policy implementation could be designed. DESERTLINKS (Combating Desertification in Mediterranean Europe: linking science with stakeholders) began in December 2001. DESERTLINKS has consulted local stakeholders and representatives of the Focal Points and compiled lists of the most useful available indicators.

[40] Enne, G. and Zucca, C. 2000. Desertification Indicators for the European Mediterranean region. State of the art and possible methodological approaches. ANPA/NRD/UNCCD/Ministero dell'Ambiente. Rome.
[41] Thornes, JBT, p13 iin Mediterranean Desertification: Research results and policy implications. Vol. 1 EUR 19303, 1999.

2.2.3 Data availability and Benchmark and Indicator elaboration at different levels

An international workshop in Alghero, Italy, 1999, reported on data and information requirements for interdisciplinary research[42]. Since data were often fragmented and incomplete the need for an organisational framework to link existing and future databases and information systems on the basis of core data compatibility and comparability was suggested. Data availability is still a problem and therefore some proposed indicators fail to be useful if necessary data is inadequate. However, there are many indicators described that are dependent only on visual assessment (from the ground or on satellite imagery), or existing available data (agricultural, climate, socio-economic, etc.).

2.2.4 Exchange of information and communication

Information systems have been slow to develop, hindered by language barriers and lack of additional resources within the National Focal Points. The Italian National Committee have set up the Italian Clearing House Mechanism on Desertification[43] and plan to extend to a network of clearing houses through Annex IV. Since 2001 the series of international workshops organised by the MEDRAP Concerted Action, [44] has worked to consolidate ideas for a Regional Action Plan and has produced some very valuable reports and recommendations. MEDRAP has been a prime force to establish better links between scientists and decision makers, NGOs and the civil society. Another recent initiative to share information and data sets about desertification is the Euro-Mediterranean Disaster Information Network (EU-MEDIN) [45].

3. Recent Projects undertaken on development of B&I

3.1 International research projects identifying desertification indicators in Europe

MEDALUS III

Project name:	MEDALUS III: Target Areas Project, Regional Indicators Project
Objectives:	• Identification and mapping of Environmentally Sensitive Areas (ESAs) including techniques such as geographical information systems, overlays of digital elevation models, land use and soil maps in conjunction with climatic data. • Definition of ESAs to desertification based on sets of measured attributes such as climate variability, ecosystems, land use changes, land abandonment, and landscape characteristics. • Development of a set of regional indicators that provide a planning tool for application to desertification at regional, national and European scales.
Geographic area	Portugal (Alentejo), Spain (Guadalentín), Italy (Agri) and Greece (Lesvos)
Project type (research, planning/management, dissemination, training, other):	Research
Institution in charge of project implementation:	King's College, London

[42] Enne G, Peter D, Pottier D. 2001. Desertification Convention: Data and information requirements for interdisciplinary research. EUR 19496
[43] http://www.desertification.it
[44] http://www.uniss.it/nrd/medrap
[45] http://www.eu-medin.org/index/php

Start/end date:	1996 to 1998
Director:	Prof John B. Thornes
Participating institutions	Universidade Nova de Lisboa, University of Amsterdam, Universidade de Lisboa, Fundación Universidad Empresa de Murcia, Universitat de València, Estación Experimental de Zonas Aridas (CSIC), DGCONA, Università di Basilicata, University of Newcastle upon Tyne, Agricultural University of Athens, Aristotelian University, Katholieke Universiteit de Leuven, King's College London, JRC Ispra, University of Leeds, University of East Anglia, ERSAL Milan, NRD Nucleo Ricerca Desertificazione Univeristà degli Studi di Sassari
Contact persons (names and email addresses):	Dr Jane Brandt and Dr Nichola Geeson MEDALUS Project Office medalus@medalus.demon.co.uk
Other information:	This research was funded by the European Commission, Contract numbers ENV4-CT95-0119 and 0121
Spatial scale of the proposed indicators:	Mediterranean-wide and sub-national

Table 18. MEDALUS III

3.2 Details of development of indicators

The MEDALUS III project developed indicators of desertification at two scales, Mediterranean-wide and sub-national. The methodologies are fully described in Kosmas, Kirkby and Geeson 1999[46].

Mediterranean-wide scale indicators

The Regional Degradation Index (RDI) is a composite index that estimates soil erosion by water. It uses a one-dimensional hydrological model, which is used to estimate potential vegetation cover and storm runoff based on climatic and vegetation data. The forecast runoff, accumulated across the frequency distribution of storms, is used to give a climatic erosion potential, which is then appropriately combined with measures of topography and soil erodibility to estimate the expected rate of soil erosion at a resolution of 1 km.

Areas vulnerable to desertification are identified as those with unacceptably high current rates of erosion and with high sensitivity of erosion rates to potential changes in climate or land use. Maps showing erosion potential under current climatic conditions and under a 2°C rise in average temperature were produced for the Mediterranean basin. The methodology was further developed in the DESERTLINKS project (page 39).

Sub-National Scale Indicators

Using key indicators for assessing the capability of land to withstand further degradation or the suitability of land for supporting specific types of land use, various types of Environmentally Sensitive Area to desertification were distinguished and mapped. In this system:

- soil texture, rock fragment, soil depth, drainage, slope gradient are combined to give a soil quality index
- rainfall, aridity index and aspect are combined to give a climate quality index
- fire risk, erosion protection, drought resistance and plant cover are combined to give a vegetation quality index
- land use type, land use intensity and policy are combined to give a management quality index.

[46] Kosmas C, Kirkby M and Geeson N, 1999. The MEDALUS project. Mediterranean Desertification and Land Use. Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification. European Commission, Brussels.

The four quality indices were then combined to give an environmentally sensitive area (ESA) index. In developing the methodology care was taken to use parameters that can be easily found in existing soil, vegetation, and climate reports of an area. See Kosmas et al. 1999, and also in the Desertification Indicator System for Mediterranean Europe www.kcl.ac.uk/desertlinks/indicator system.

Three general types of Environmentally Sensitive Areas (ESAs) to desertification are distinguished based on the stage of land degradation:

- Type A: Areas already highly degraded through past misuse, presenting a threat to the environment of the surrounding areas. For example, badly eroded areas subject to high runoff and sediment loss. This may cause appreciable flooding downstream and reservoir sedimentation. These are *critical* ESAs.
- Type B: Areas in which any change in the delicate balance of natural and human activity is likely to bring about desertification. For example, the impact of predicted climate change due to greenhouse warming is likely to enhance reduction in the biological potential due to drought causing areas to lose their vegetation cover, subject to greater erosion, and finally shift to the Type A category. A land use change, as for example, a shift towards cereals cultivation, on sensitive soils might produce immediate increase in runoff and erosion, and perhaps pesticide and fertilizer pollution downstream. These are *fragile* ESAs.
- Type C: Areas threatened by desertification under significant climate change, if a particular combination of land use is implemented or where offsite impacts will produce severe problems elsewhere, for example pesticide transfer to down slope or downstream areas under variable land use or socio-economic conditions. This would also include abandoned land, which is not properly managed. This is a less severe form of Type B, for which nevertheless planning is necessary. These are *potential* ESAs.
- Areas with deep to very deep, nearly flat, well drained, coarse-textured or finer soils, under semi-arid or wetter climatic conditions, independently of vegetation were considered as *non-threatened by desertification.*

Small and medium scale maps are compiled by overlapping the respective layers of data for the various indicators using ARC-INFO methodology. The system has already been applied in areas of Greece, Spain, Italy and Portugal. The weight placed on each of the indicators used may have to be adjusted according to local conditions. Future actions planned for improving this medium scale indicator system (some of which are being developed in the DESERTLINKS project) are:

- Reducing the number of parameters used by running sensitivity and correlation tests.
- Better assessment of land use intensity.
- Better evaluation of policy enforcement and efficiency in combating desertification.
- Introduction of new parameters more friendly and easier used by the stakeholders.
- Better evaluation and efficient application of the socio-economic parameters
- Introduction of indicators for the assessment of the response to measures taken and planned.

3.3 Other specific initiatives (seminars, workshops, etc.)

Several initiatives that, addressed to the Annex IV Countries, have had wider impact particularly from a methodological standpoint and paved the way to the following advances:

1. International Seminar on "*Indicators for Assessing Desertification in the Mediterranean*", held in Porto Torres, Italy, from 18th to 20th September 1998[47].
2. International Workshop on "*Desertification Convention: Data and Information Requirements for Interdisciplinary Research*", held in Alghero, Italy, 9-11 October 1999[48]
3. The study on "*Desertification indicators for the European Mediterranean Region. State of the Art and Possible Methodological Approaches*"[49], published in 2000.

The contents and results obtained are described in Enne et al (2003),"*Indicators and Information Requirements for Combating Desertification*" in "Mediterranean Climate. Variability and Trends" Hans-Jurgen Bolle

3.3.1 International Seminar on Indicators for Assessing Desertification in the Mediterranean

Very briefly, the following priorities were identified at the Porto Torres Seminar:

1. Need for methodologies that, starting from the experiences already matured in national and international research projects, integrate the evaluation of the physical, biological and socio-economic processes contributing to the land degradation and desertification so as to identify indicators useful in land planning and information dissemination at all levels.
2. Need for beginning the testing of indicators already available.
3. Need for setting up a network to monitor desertification both at national and at Mediterranean basin scale and to improve availability and accessibility of data sets.
4. Need for a greater participation of local populations by means of activities aiming at stimulating local administrations and NGOs to contribute to identify problem-driven indicators.

3.3.2 International Workshop on Desertification Convention: Data and Information Requirements for Interdisciplinary Research

The Workshop highlighted that many institutions in Europe have a long-standing scientific experience in research and information exchange relating to desertification, both in Europe's own affected territory, as well as through research collaboration with developing countries, particularly in Africa. A great number of national and international institutions located in Europe own established databases and information systems with high relevance to monitoring, modelling and managing desertification processes and mitigation strategies. In view of emerging UN CCD activities, European institutions bear the potential to become major partners in research and development co-operation towards finding and implementing viable solutions to the syndrome of desertification, both in Europe and its partner countries. Improvements relating to research strategies, data accessibility and information sharing can be addressed in the frame of Co-operation Programmes of the European Commission. This will add further value to European current research for combating desertification. A major challenge in data and information exchange, however, is to make them better available for research and implementation. *There exist many more data than are actually accessible*. This was a major concern of all thematic groups during the workshop. In addition, the need for

[47] Organised in collaboration with the Italian National Observatory on Desertification - Italian Ministry of the Environment, the Town of Porto Torres and the Universities of Sassari and Cagliari.
[48] Enabled by DG Research and DG VIII of the European Commission (EC) and organised in collaboration with the Italian National Observatory on Desertification - Italian Ministry of the Environment.
[49] In collaboration with ANPA and the Italian National Observatory on Desertification - Italian Ministry of the Environment.

better integration of information, for better definition of vulnerability indicators, and for more information directed towards the support of mitigation strategies was expressed.

3.3.3 Study on Desertification indicators for the European Mediterranean Region. State of the Art and Possible Methodological Approaches

This study, presented and circulated at the UN-CCD Secretariat at the Fourth Conference of the Parties in 2000, constitutes the natural prosecution of the Seminar held in Porto Torres and of the Workshop held in Alghero, providing a first answer to the questions emerged from them. The study is an attempt to provide the international scientific community with a comprehensive framework of desertification indicators as well as guidelines deriving from an accurate methodological research. The work is thought to provide both a comprehensive vision of the approach adopted by international organisations to the problem of desertification, and also methodological indications for the identification and selection of the different types of indicators and for their use within the NAPs and RAPs. Indications as to the method and the course to follow, overriding the hierarchical and relational confusion that often exists when different disciplinary fields are at play, to lay the ground, without bias, for an unequivocal and objective interpretation of indicators and their application. On the basis of the approaches suggested by the study the DESERTLINKS project created a data bank for indicators organised according to the classification framework and the descriptive schemes proposed.The user of this data bank, available on the web, have the possibility to find the desired indicators by means of keys constituted by the classification and grouping criteria (that provide an answer, among the others, to the questions “what is it for”, “at what scale does it apply”, “what kind of data is it based on”). Once the user has found the indicators, he must also have the possibility to reach the related methodological charts.

DESERTLINKS

Project name:	DESERTLINKS
Website	www.kcl.ac.uk/desertlinks
Objectives:	1. To work with local stakeholders to identify impact indicators relating to perceptions of land function; driving force and pressure indicators relating to decision making; and response indicators relating to land management measures taken to combat desertification. To provide a conceptual framework for the indicators of different types and scales. 2. To develop composite indicators, combining those stakeholder-identified ones with a number of bio-physical and socio-economic state indicators already developed for Mediterranean Europe at the sub-national scale. To develop composite indicators at the Mediterranean-wide scale. 3. To combine the indicators of different scale and type into a desertification indicator system for Mediterranean Europe, which can be used to explore different management options. To work with both local stakeholders and the National Committees to test and validate the indicator system. To develop guidelines for the UNCCD on the development and use of indicators to manage desertification.
Geographic area	Portugal, Spain, Italy, Greece, Mediterranean-wide
Project type (research, planning/management, dissemination, training, other):	Research
Institution in charge of project implementation:	King's College London

Start/end date:	December 2001 to November 2004
Director:	Dr Jane Brandt and Dr Nichola Geeson
Participating institutions	King's College, London; University of Basilicata, Department of Crop Production; 3D Environmental Change, Netherlands; University of Leeds; Agricultural University of Athens; University of Murcia; University of Basilicata, Department of Agricultural Economics and Land Management; DGCONA, Madrid; Universidade Nova de Lisboa; University of Sassari, Nucleo Ricerca Desertificazione; JRC, Environmental Institute
Contact persons (names and email addresses):	Dr Jane Brandt and Dr Nichola Geeson DESERTLINKS Project Office desertlinks@medalus.demon.co.uk
Project name:	DESERTLINKS
Other information:	This research is funded by the European Commission, Contract number EVK2-CT-2001-00109
Spatial scale of the proposed indicators:	Mediterranean-wide, national and sub-national
Methodology:	See below

Table 19. DESERTLINKS

3.4 Details of development of desertification indicator system for Mediterranean Europe

For further details see Brandt, Geeson, Imeson 2003[50] and the on-line system www.kcl.ac.uk/desertlinks/indicator_system. In brief, the indicator system contains a data base of indicators relevant to Mediterranean desertification plus a number of explanatory or interactive sections showing how various sub-sets of indicators from the data base can be used to understand and evaluate the effects of desertification according to local conditions.

PHYSICAL AND ECOLOGICAL INDICATORS, under the following classes:			
CLIMATE	FIRE RUNOFF	SOILS	VEGETATION WATER
ECONOMIC INDICATORS, under the following classes:			
AGRICULTURE	CULTIVATION HUSBANDRY LAND MANAGEMENT	LAND USE MACRO ECONOMICS	TOURISM WATER USE
SOCIAL INDICATORS			
INSTITUTIONAL INDICATORS			

Table 20: DIS4ME Indicator Database classification (see Appendix II for full list of indicators)

Sources of the indicators include:

- MEDALUS III Environmentally Sensitive Area research
- indicator systems described in the literature
- Indicators used in annex IV National Action programmes
- those suggested by stakeholder workshops
- other research projects

Although the indicators are grouped here according to their relevance to physical and ecological, economic, social and institutional dimensions of desertification, they are also categorised in the database according to the DPSIR framework. Many of these

[50] Brandt, Geeson, Imeson (eds) 2003. A desertification indicator system for Mediterranean Europe. Report presented at the UNCCD COP 6 meeting, Havana Cuba August 2003. Available for download from www.kcl.ac.uk/desertlinks.

indicators (those underlined in Appendix II) have already been fully described, see www.kcl.ac.uk/desertlinks/indicator system for details.

Benchmarks
Where possible, benchmarks have been suggested for each described indicator. This may be easiest for performance indicators. Many indicators can be assigned to classes, whose boundaries are also benchmarks. Precise data may not be required. For example, in the DESERTLINKS Environmental Sensitivity Index tool (see below) three classes of % plant cover are used in the calculations: <10%, 10-40%, >40%. Visual assessment of the landscape is used wherever possible. For many indicators such as soil depth, drainage, land use intensity, and policy enforcement, three or four classes are designated so that the Indicator System can easily be used by non-experts as well as experts. They can obtain at least an overall indication or estimate of the severity of the desertification problem in a particular area.

Headline indicators and indexes
Headline indicators are mentioned in a number of indicator systems but may not always have the same meaning. In DESERTLINKS key headline indicators can be defined and measured in the same way in adjacent areas or countries to provide a credible basis for comparison and monitoring change. Headline indicators are often a collection of indicators calculated as an index, e.g. soil quality, climate indices. Where indicators are combined into indexes there is a better chance of obtaining benchmarks because the balance between at least some of the major desertification-causing factors is incorporated.

A basic (minimum) set of indicators
In DIS4ME the Environmental Sensitivity Index tool includes a basic set of indicators. The indicators used to calculate this Index are: rainfall, aridity index, aspect, drainage, soil depth, rock fragments, soil texture, soil parent material, slope gradient, type of vegetation, plant cover, soil erosion protection, drought resistance, policy enforcement and land use intensity. Precise values for data are not necessary. Scores for empirically derived classes of these indicators are used for the calculation. The Environmental Sensitivity tool can also be used to predict the effect of changing a variable, for example, what might happen in a particular area if the vegetation cover changed, or climate changed.

Major issues associated with desertification in Mediterranean Europe
In participation with local and national stakeholders (see the project reports for further details) a number of ways are being developed to enhance the use of indicator information to understand and evaluate the effects of desertification according to local conditions. One of these ways is to look at specific aspects or issues of desertification. All the issues associated with desertification in Mediterranean Europe that have been identified in the NAPs and in documents reporting the implementation of the Convention, plus more local issues identified by groups of stakeholders at workshops have been classified under 10 major headings:

- Land abandonment
- Increase in intensive irrigated farming
- Deforestation
- Littoralisation (concentration of economic and social activity in coastal areas)
- Inappropriate dry farming agricultural practices on marginally productive land

- Changes in the economic activity in desertification affected areas
- Degradation of the physical environment
- Changes in the availability of water resources
- Changes in the social structure
- Institutional organisation to combat desertification.

Indicators for mapping desertification at different scales
The ESA methodology developed in MEDALUS III is being developed in two directions. Firstly an expert system has been introduced, based on the ESA methodology but using a slightly adjusted calculation method, to calculate ESA status at a point. Using different sets of indicators, tools to calculate desertification risk under different land uses are being developed.
At the sub-national scale, the ESA methodology has been developed with some changes to the number and type of layers of indicators, and improvement in the quality of data in others. Maps have been produced for Lesvos and the Agri are planned for the Guadalentín and Alentejo. Improvements in the quality and level of resolution of data for the Regional Degradation Index are allowing direct comparisons of ESA and RDI values at the sub-national scale.

Under the auspices of the Desert Net project (page 11), a web-based tool will be developed for public administrations (mainly regional and municipalities) to check the desertification risk in their areas and to plan and verify the type of interventions at different levels (regional, basin, municipality). The Italian regions of Basilicata, Calabria, Campania, Emilia Romagna, Liguria, Sardegna, Sicilia and Toscana will use the ESA/ESI methodology as the basis for this tool.

Advances with selecting and using socio-economic indicators
DESERTLINKS has also made advances with describing socio-economic indicators. The new ManPras tool is being developed to allow land users to assess the economic and environmental consequences of the decisions they make, according to the various agricultural practices they use.

Input of indicators from stakeholders
A key feature throughout the DESERTLINKS Project has been regular consultation with stakeholders at the local level and national level (Focal Point) to discuss the major issues of desertification and select indicators, especially under the categories of driving force, pressure, impact and response indicators.

Evaluation of the indicator system by stakeholders
The major task of the final year of DESERTLINKS is the evaluation of the indicator system by stakeholders and decision-makers. It is expected that feedback from the evaluation will greatly enhance the capacity of the system to meet their needs. Agreements have already been made to evaluate DIS4ME in pilot areas in Portugal, Spain, Italy and Greece, according to the suggestions of the Focal Points.

DISMED

Project name:	Desertification Information System to support National Action Programmes in the Mediterranean (DISMED)
Website	http://dismed.eionet.eu.int
Objectives:	To improve the capacity of national administrations of Mediterranean countries to effectively program measures and policies to combat desertification and the effects of drought

Geographic area	Mediterranean - wide (northern and southern shores)
Project type (research, planning/management, dissemination, training, other):	Research, management, dissemination
Institution in charge of project implementation:	European Environment Agency (EEA) Applied Meteorology Foundation FMA (Italy) UNCCD secretariat
Start/end date:	
Director:	Dott. Lorenzo Genesio
Participating institutions	European Environment Agency (EEA) Applied Meteorology Foundation FMA (Italy) UNCCD secretariat, Country representatives, Mediterranean-wide
Contact persons (names and email addresses):	http://dismed.eionet.eu.int . FMA: Andrea Di Vecchia, Program Director, Applied Meteorology Foundation FMA Via Caproni n. 8, 50145 Florence, Italy, E- Mail : a.divecchia@ibimet.cnr.it. EEA: Sheila Cryan, EIONET data flow, European Environment Agency (EEA), Kongens Nytorv 6, 1050 Copenhagen K, Denmark, E-mail sheila.cryan@eea.eu.int. UNCCD: Massimo Candelori, Co-ordinator, COPSUBLA, CCD secretariat, Martin-Luther-King str, 8, 53175 Bonn, Germany, E-mail: mcandelori@unccd.int
Other information:	
Spatial scale of the proposed indicators:	Mediterranean-wide

Table 21: DISMED

The National Co-ordination Bodies and scientific institutions from the following countries are all involved in DISMED:

- Northern African sub-region: Algeria, Egypt, Libya, Morocco, Tunisia
- Northern Mediterranean region: France, Greece, Italy, Portugal, Spain, Turkey

Among the expected results, which are of particular relevance to this report on benchmarks and indicators, are

- standards and procedures for vulnerability mapping, impact indicators, databases all agreed for the Mediterranean area.

A number of workshops are being held during the implementation of the project including: a start up workshop and three yearly workshops for the evaluation of the results achieved (validation workshops); nine thematic workshops for the endorsement of technical options (operational workshops). These workshop reports have yielded a lot of valuable information, some of which has been quoted in this document.

MEDRAP

Project name:	Concerted Action to support the Northern Mediterranean Regional Action Programme to combat Desertification (MEDRAP)
Website	http://www.uniss.it/nrd/medrap
Objectives:	To support the processes of elaboration of the Regional Action Programme (RAP) of the Annex IV Countries by involving stakeholders in five Workshops
Geographic area	Annex IV of the UNCCD
Project type (research, planning/management, dissemination, training, other):	Research and dissemination. A wide telematic network for information and knowledge exchange between scientific community and stakeholders involved in land management at all levels (UNCCD National Focal Points, Institutional Agencies, NGOs)
Institution in charge of project implementation:	Nucleo Ricerca Desertificazione Universita de Sassari (NRD)

Start/end date:	2001 - 2003
Director:	Prof Giuseppe Enne
Participating institutions	Universities, UNCCD National Focal Points, Institutional Agencies, NGOs
Contact persons (names and email addresses):	Prof Giuseppe Enne E-mail: nrd@uniss.it Tel: 0039 079 2111016
Other information:	EU-funded, Project number: EVK2-CT2000-20008
Spatial scale of the proposed indicators:	Northern Mediterranean, (Annex IV)

Table 22: MEDRAP

The UNCCD Annex IV Countries are required to attain the Convention objectives with particular reference to land planning and management both at national and regional (Northern Mediterranean regions) level. In this context there is an urgent need to harmonise the policies of European Mediterranean Countries. Prevention and mitigation actions must be supported by common strategies for a sustainable development. The implementation of such policies requires a deeper understanding of natural and socio-economic aspects related to land degradation. It is also recognised that the lack of institutional co-ordination at all levels, the weak social participation, the difficult communication between scientists and users are major obstacles to the achievement of these goals. In this context, a participatory multidisciplinary approach has been considered essential.

A comparison of the different degrees of perception and awareness on relevant themes has been channelled into five thematic Workshops. The Workshops focussed on the following issues: sustainable management of soil and water resources, political and socio-economic aspects of desertification, identification of sensitive areas, prevention and mitigation, elaboration of regional strategies, focussing on finding solutions and providing options to decision makers. The stakeholders involved were asked to actively contribute both to define problems and to formulate strategies. The degree of acceptance of the suggested measures was evaluated and will help in drawing conclusions. The final result of the project will be guidelines, and strategies for the elaboration of the RAP. Its effectiveness is expected to be high, because the National Focal Points are directly involved. The wide exchange of knowledge among the stakeholders will be the other major result. The MEDRAP Workshop No. 5 on “What Regional Strategies for Combating Desertification in the Northern Mediterranean?”, Rome, Italy, 18-19 November 2003 has provided some comparisons between Annex IV countries. M. Sciortino of the Italian Focal Point compiled the following Tables.

National Comparisons

Methodology and scale

	Portugal	Spain	Italy	Greece	Turkey
Scale	1:1.000.000	1:1.000.000	1:1.250.000	1:1.000.000	1:1.000.000
Climate	x	x	x	x	x
Soil	x	x	x	x	x
Erosion Control				x	x
Vegetation	x		x	x	x
Drought	x			x	x
Demography			x		
Acquifers over-exploitation		x			
Forest fires		x			
Sensitivity	1997-2003		1999	2000	

Table 23. This Table shows the scales at which parameters related to desertification have been mapped in the different countries.

National Comparisons
Sensitive Areas (%)

	Portugal 1997 2003	Spain	Italy	Greece	Turkey
High	11 28	31.49	n.a.	33.25 erosion 1.53 salinzat	n.a.
Medium	60 8	21,68	n.a.	49.76	n.a.
Low	39 40	13.98	n.a.	15.17	n.a.
Total sensitive	100 76	67.14	5.5	99.71	n.a.
Non sensitive	0 24	32.86	94.5	0.29	n.a.

Table 24. This Table was used by MEDRAP to compare sensitivity to desertification between countries.

Sub-national and watershed comparisons
Methodology and scale

	Lesvos Greece	Agri Italy	Mertola Portugal	Guadalent. Spain	Sicily Italy	Sardinia Italy	Basilica. Italy	Puglia Italy
Scale	50.000	50.000	50.000	200.000	250.000	100.000	250.000	250.000
Area Km^2	1.632	1.700		3.500	25.700	24.700	10.130	19.230
Climate	x	x	x	x	x	x	x	x
Soil	x	x	x	x	x	x	x	x
Vegetation	x	x	x	x	x	x	x	x
Drought					x			
Socio-economic	x	x		x	x	x		
Sensitive areas	x	x	x		x	x	x	x
	University of Athens	University of Basilicata		University of Murcia	Regional + ENEA	Regional	Regional	Regional

Table 25. This Table shows the scales at which parameters related to desertification have been mapped in Target Areas within Annex IV Countries.

Sensitive areas at sub-national scale

	Lesvos Greece	Mertola Portugal	Guadalentin (Spain)	Sicily Italy	Sardinia Italy	Basilicata Italy	Puglia Italy	Agri Basin Italy
Very High		7.2	n.a.			n.a.	n.a.	0
High	37	23.3		6.9	51			1.4
Medium high		5.6		46.5				
Medium	52.4	31			38			34.5
Low	7	7.1		32.5	5			64
Total sensitive	96.4	83.1		85.9	94			99.9
Non sensitive	3.6	14.3		7.2	1			0.1
Excluded Areas		2.6		6.9	5			

Table 26. This Table compares sensitivity to desertification in Target Areas of the Annex IV Countries.

The 5th MEDRAP workshop reported the following conclusions:

- Although social and economic indicators are used at sub-national and watershed scale they are barely used at national scale and not at all at regional or global scale.
- The identification of areas sensitive to desertification should be a priority.
- Validation of the assessment of sensitive areas is necessary at all scales.

- Data and information on sensitive areas are, in general, still poorly accessible to policy makers and scientific community.
- Scales and methodologies are not comparable in most cases; therefore it is still difficult to compare results.

GEORANGE

Project name:	GEORANGE
Website	www.georange.net
Objectives:	Increasing ecosystem vulnerability in Mediterranean countries is partially due to dramatic land use changes, which frequently lead to an unstable state of ecosystems. Large areas of Mediterranean Rangelands are affect from transitional processes that cause conflicts between past and present land uses or economic and ecological priorities, and which may encompass the depletion of range resources or, in case of land abandonment, the accumulation of combustible biomass with the increasing risk of wildfires. In order to facilitate optimised management strategies, the *GeoRange* project pursues an integrated approach of experts in range ecology and management, ecosystem conservation and restoration, remote sensing and spatial information systems (Geomatics). With the direct involvement of responsible land managers, it aims at formalising concepts and strategies for multi-functional range assessments and the design and implementation of management plans, based on a dedicated software environment that includes range-specific remote sensing and GIS-related processing modules for end-users.
Geographic area	Spain, Italy, Greece, Mediterranean-wide
Project type (research, planning/management, dissemination, training, other):	Research
Institution in charge of project implementation:	University of Trier
Start/end date:	January 2001 to March 2004
Director:	Prof. Joachim Hill
Participating institutions	Fundation Centro de Estudios Ambientales del Mediterraneo, Campamento/Paterna; Consejo Superior de Investigaciones Cientificas, Almeria; Generalidad Valenciana, Valencia; Aristotle University Of Thessaloniki; Region of Central Macedonia, Ntepo; National Agricultural Research Foundation, Vassilika Thessalonikis; Regione Autonoma della Sardegna, Sassari; Commission of the European Communities, Barasso
Contact persons (names and email addresses):	Prof. Joachim Hill Mr Joseph Puetz roeder@uni-trier.de
Project name:	GEORANGE
Other information:	This research is funded by the European Commission, Contract number EVK2-CT-2000-00091
Spatial scale of the proposed indicators:	Mediterranean-wide, national and sub-national

Table 27: GEORANGE

DeMon

Project name:	DeMon
Website	
Objectives:	The objectives are to develop and validate methodological procedures for extracting vegetation and soil surface parameters from remotely sensed data for monitoring changes and trends in areas submitted to land degradation and to develop a GIS oriented

	approch to erosion hazard modelling and mapping.
Geographic area	Spain, France
Project type (research, planning/management, dissemination, training, other):	Research
Institution in charge of project implementation:	Centre Nationale de la Recherche Scientifique, Montpellier
Start/end date:	July 1992 to December 1994;
Director:	B.Lacaze
Participating institutions	Universitat de Valencia ;Rijksuniversiteit Utrecht ;
Contact persons :	B. Lacaze
Project name:	DeMon
Other information:	This research is funded by the European Commission, Contract number EV5V-CT91-0035
Spatial scale of the proposed indicators:	Mediterranean-wide, sub-national

Table 28: DeMon

DeMon-2

Project name:	DeMon-2
Website	
Objectives:	The objectives is to use an integration of ecological models and information from operational earth observation and metereological satellites to assess and monitor regional scale indicators of sensitivity to desertification
Geographic area	Spain, France,Greece
Project type (research, planning/management, dissemination, training, other):	Research
Institution in charge of project implementation:	Universitat Trier
Start/end date:	1996 to 1999
Director:	Prof Joachim Hill
Participating institutions	Centre National de la Recherche Scientifique ; Universitat de Valencia ;Rijksuniversiteit Utrecht ; Communautè Europèenne Institute for Remote Sensing Application Ispra, Varese ; University of Crete
Contact persons :	B. Lacaze, V. Caselles Miralles, H. Riezebos, S. Sommer, G. Tsiourlis
Project name:	DeMon-2
Other information:	This research is funded by the European Commission, Contract number CT95-0166
Spatial scale of the proposed indicators:	Mediterranean-wide, sub-national

Table 29: DeMon-2

The research project DeMon – Integrated Approaches to Desertification Mapping and Monitoring in the Mediterranean Basin concentrated on the definition of spatial indicators of degradation and on pathways towards their operational derivation. With regard to optical remote sensing, soil- and vegetation-related parameters appeared most promising for characterising the degradation status of different surfaces. However, it was found that especially with respect to soil erosion no suitable indicators could be directly inferred from satellite imagery due to scale reasons, and that alternative, indirect indicators had to be identified.

Among the most prominent tasks of DeMon was the establishment of a *standardised processing chain for optical-reflective remote sensing data*, to support geometric and image-based radiometric correction of data in order to yield reflectance values as a physical-based and comparative primary indicator. Initial validation experiments were conducted using Landsat-TM data for the Xilokastron test site (Greece) and different hyperspectral AVIRIS data sets.

However, classification approaches appeared problematic due to limitations in spectral separability of surface classes in heterogeneous areas, and vegetation indices are known to be prone to a number of errors and distortions in areas of low vegetation cover. As an alternative, spectral mixture analysis was introduced to derive quantitative information on surface properties, such as proportional surface cover of different reference surface materials.

While SMA had previously been successfully applied to derive information on vegetation cover in the frame of experimental environmental studies, it was put into practice for the first time in the frame of DeMon to characterise soil condition.

The transferability of the models and approaches was assessed by applying them to two Landsat-TM images for the Xilokastron test area. It could be shown that despite variations in geological and pedogenetic properties a differentiation of groups of soil status was possible. In addition, the synoptic interpretation of SMA-based information on soils and vegetation supported the spatially differentiated identification of changes in surface properties, which was a first step towards the definition of a degradation risk index.

DeMon-II was launched aiming at the methodological development, conceptual extension and operational application of results gained from DeMon-I. In this frame, major issues were the optimisation of indicators of the development of vegetation cover and soil status, the integration of ecological models using remote sensing methods, and especially the assessment of the time component of degradation processes. These developments eventually led to the conceptualisation of a degradation risk index and the integration of different components in the frame of an interdisciplinary case study on the Crete test site.

Based on the principles developed in the frame of DeMon-I, the geometric and radiometric processing chains were further enhanced. The most prominent goal of enhancing the processing chain was the establishment of long time series of satellite imagery, which was realised for the Crete test site with a set of Landsat MSS and TM data, consisting of 14 scenes covering the period from 1975 to 1997. To this end, Landsat based data proved their suitability for establishing such long series by providing consistent data since 1972. With its heterogeneous landscapes and extreme topographic gradients, Crete represented an excellent case to test the developed procedures for geometric and radiometric correction. Following geometric and radiometric processing, spectral mixture analysis was applied to derive proportional vegetation cover.

For the grazed areas of the Psiloritis mountains, it could be shown that at the given scale a clear spatial differentiation becomes apparent, where areas of degradation, stability and regeneration are adjacent, which was in high coincidence with field investigations. The key to a successful identification of environmental risks by the use of remote sensing methods proved to be the integration of such information with auxiliary data, which allow to identify driving factors.

Beside this temporal analysis, approaches to upscaling of plot-scale information to larger spatial scales were investigated. Based on a large number of field- and laboratory based measurements of biomass and its relation to vegetation cover, the resulting

empirical functions could be employed to apply these models to SMA-derived vegetation cove estimates, and produce spatial maps of different biomass parameters for the different time periods addressed.
Other research components included approaches to ecozoning, which was considered an important means to stratify larger areas and support the transfer of interpretation models to similar regions. The concept developed in the frame of DeMon-II was based on the integration of climatic parameters, lithology, soils and pedogenetic characteristics to identify zones with similar ecological attributes. Also, analyses were carried out to couple remote sensing based information with ecological process models using the Forest BGC model. The model was parameterised to simulate LAI, evapotranspiration and biomass for a Quercus coccifera dominated forest in the Languedoc test site (France), and was validated using LAI values derived using empirical relationships with Landsat TM-based vegetation cover estimates.
Summarising, the DeMon and DeMon-II initatives provided a significant development towards a spatially differentiated long-term monitoring of Mediterranean landscapes at risk of desertification. Based on a high-level data pre-processing scheme, Spectral Mixture Analysis could be established as an efficient tool to derive enhanced indicators of the state of ecosystems, which could in turn be used to analyse relevant processes and their effects. In addition, the successful combination of remote sensing techniques with ecological theories and modelling strongly underlined the potential of such interdisciplinary approaches, and laid the foundation for subsequent initiatives, such as the GeoRange or Ladamer projects.

3.5 Other key organisations providing desertificationindicators in Europe

Organisation name:	OECD, Organisation for Economic Co-operation and Development
Website	www.oecd.org
Objectives:	To determine agri-environmental indicators to cover a range of issues such as agricultural impacts on soil, water, air, biodiversity, habitats and landscape

Table 30

Organisation name:	EEA, European Environment Agency
Website	www.themes.eea.eu.int/indicators
Objectives:	To publish indicators on a regular basis covering specific sectors and topics

Table 31

Project name:	FAOLADA, Land Degradation Assessment in drylands
Website	www.fao.org/ag/agl/lada
Objectives:	To generate up-to-date ecological, social and economic and technical information to guide integrated and cross-sectoral planning and management in drylands

Table 32

4. Suggestions to support the UNCCD implementation

- A consensus on the definition and use of standard headline indicators should be reached as soon as possible. Most countries already use some sort of a bioclimatic or aridity index and an index related to soil type or soil loss by erosion. Other suggested headline indicators are related to land use and damage to landscapes by desertification in the form of e.g. drought, fire, salinisation or flood risk.

- The relevance of social and economic indicators of desertification, such as old age index, human poverty index, population density, or areas under subsidies, is beginning to be recognised. Social and economic factors can often be changed much more easily than physical landscape factors, and opportunities to combat desertification by such methods should be pursued.
- The countries of the Annex IV group recognise the benefit of mapping threatened areas. Mapping enables monitoring desertification changes over time, where maps from specific time periods are compared. If standard headline indicators are mapped, then it will be possible to monitor changes over regions and not just within individual countries.
- The ranges of the desertification indicator mapping units may suggest useful benchmarks. However, it is not often possible to provide single value benchmarks for individual simple indicators because of the varying extent of interrelationships between desertification factors. Ranges of values may be used more readily as benchmarks, e.g. classes of vegetation cover, soil depth. Research on combinations of indicators to provide composite indexes is ongoing.
- Social and economic indicators are used at sub-national and watershed scale but are barely used at national scale and not at all at regional or global scale. This should be remedied.
- The identification of areas sensitive to desertification should be a priority. Work from the MEDALUS Projects to define Environmentally Sensitive Areas has provided a sound basis for mapping and monitoring, and is used in subsequent projects such as DESERTLINKS, DISMED, and DesertNet.
- Validation of the assessment of sensitive areas is necessary at all scales.

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Annex I: List of people/institutions to whom the questionnaire was sent (and rate of response)

About 40 persons were sent the questionnaire. Only Malta provided answers to the questionnaire. Portugal, Spain, Italy and Greece were asked to check information assembled from the literature and websites but only Portugal provided a list of desertification indicators in current use. All non-respondents were sent reminders.

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Table 33: Contact addresses for persons and institutions in Annex IV countries

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Institutional objectives:	Focal Point
Level (national, state, local):	National
Governmental, non governmental:	Governmental

Italy: institutional data

Institution full name:	Ministero dell'Ambiente e della Tutela del Territorio
Contact persons:	Prof. Piero Gagliardo, Presidente del Comitato Nazionale per la Lotta alla Siccità e alla desertificazione Dr. Maurizio Sciortino, Member of National Committee
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Institutional objectives:	Focal Point
Level (national, state, local):	National
Governmental, non governmental:	Governmental

Portugal: institutional data

Institution full name:	Ministry of Agriculture, Rural Development and Fisheries
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Level (national, state, local):	National
Governmental, non governmental:	Governmental

Spain: institutional data

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Level (national, state, local):	National
Governmental, non governmental:	Governmental

Turkey: institutional data

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Level (national, state, local):	
Governmental, non governmental:	

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Level (national, state, local):	
Governmental, non governmental:	

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Institutional objectives:	
Level (national, state, local):	
Governmental, non governmental:	

No response to the questionnaire was received.

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Institutional objectives:	
Level (national, state, local):	
Governmental, non governmental:	

No response to the questionnaire was received.

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Governmental, non governmental:	Government (public)

France: institutional data

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Institutional objectives:	
Level (national, state, local):	
Governmental, non governmental:	

No response to the questionnaire was received.

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Institutional objectives:	
Level (national, state, local):	
Governmental, non governmental:	

No response to the questionnaire was received.

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Institutional objectives:	
Level (national, state, local):	
Governmental, non governmental:	

No response to the questionnaire was received

Annex II: List of indicators, example from the DESERTLINKS Desertification indicator system for Mediterranean Europe (DIS4ME)

DIS4ME is available on-line at http://www.kcl.ac.uk/projects/desertlinks. Full descriptions are given for each indicator on the web site.

PHYSICAL AND ECOLOGICAL INDICATORS	
Climate	Air temperature
	Aridity index (1)
	Aridity index (2)
	Climate quality index
	Drought
	Drought index
	Effective precipitation
	Potential evapotranspiration
	Rainfall
	Rainfall erosivity
	Rainfall seasonality
	Wind speed
Water	Groundwater depth (change in)
	Water quality
Runoff	Area of impervious surface
	Dam sedimentation
	Drainage density
	Erosivity (RDI)
	Flooding frequency
	Floodplain and channel morphology
	Rainfall-runoff relationship
	Runoff threshold (RDI)
	Soil permeability
Soils	Acidified area
	Drainage
	Erosion risk (RDI)
	Infiltration capacity
	Organic matter in surface soil remote sensing
	Organic matter in surface soil
	Organic matter mixing with depth
	Parent material
	Rock fragments
	Salinization potential
	Slope aspect
	Slope gradient
	Soil crusting
	Soil depth
	Soil erosion (USLE)
	Soil erosion (measured)
	Soil loss index
	Soil quality index
	Soil structure
	Soil surface stability
	Soil texture
	Soil type
	Water storage capacity
Vegetation	Area of matorral
	Biodiversity conservation
	Deforested area

	Drought resistance
	Ecosystem resilience
	Erosion protection
	Forest fragmentation
	Vegetation cover
	Vegetation cover remote sensing
	Vegetation cover type
	Vegetation quality index
Fire	Burned Area
	Fire Frequency
	Fire Risk
	Forest and wild fires
	Fuel models
	Wild fire incidence
ECONOMIC INDICATORS	
Agriculture	Expenditure on water
	Family size
	Farmer's age
	Farm ownership
	Farm size
	Forest productivity
	Fragmentation of land parcels
	Gross margin index
	Traditional agricultural products
	Net farm income
	Parallel employment
Land management	Agri-environmental management
	Fire Protection
	Forest management quality
	Management quality index
	Organic farming
	Reclamation of affected soils
	Reclamation of mining areas
	Soil erosion control measures
	Soil water conservation measures
	Sustainable farming
	Terraces (presence of)
Land use	Area of cultivated & semi-natural vegetation (rs)
	Area of marginal soil used
	Land abandoned from agriculture
	Land use evolution
	Land use intensity
	Land use type
	Natural vegetation
	Period of existing land use type
	Shannon's diversity index
	Urban sprawl
Cultivation	Area of hillslope cultivated
	Fertilizer application
	Mechanisation index
	Tillage direction
	Tillage depth
	Tillage operations
Husbandry	Grazing
	Grazing control
	Grazing impact
	Grazing intensity
	Husbandry intensity

Water use	Aquifer over exploitation
	External water resources
	Groundwater exploitation
	Hydrological regulation (artificial)
	Irrigated area
	Irrigation intensity and seawater intrusion
	Irrigation percentage of arable land
	Irrigation potential realised
	Runoff water storage
	Water consumption by sector
	Water leakage
	Wastewater recycling
	Water scarcity
	Water availability
Tourism	Penetration of tourist eco-labels
	Tourism contribution to local GDP
	Tourism change
	Tourism intensity
Macro economics	Employment index
	GDP per capita
	Accessibility
	Unemployment rate
	Value added by sector
SOCIAL INDICATORS	
	Adult education level
	Depopulation caused by degradation
	GINI index
	Human poverty index
	Number of technicians with a knowledge of desertification
	Old age index
	Population density
	Population growth rate
	Public perception of desertification
INSTITUTIONAL INDICATORS	
	EU production subsidies
	Hydrological and forestry plans
	Internal resources mobilisation
	Local agenda 21
	NGO contribution
	Policy enforcement
	Protected areas
	Recycled waste
	R & D expenditure
	River basin management plan
	Water use policy/law
COMPOSITE INDICATORS	
	ESI

THINK TANK EXECUTIVE REPORT ON THE AIDCCD STUDIES ON *THE STATE OF ART ON EXISTING INDICATORS AND CCD IMPLEMENTATION IN THE UNCCD ANNEXES*

S. JAUFFRET
OSS, Observatoire du Sahara et du Sahel, Tunis, Tunisia

Introduction

The AID CCD project aims at:

- Develop and coordinate exchanges of experiences within scientific institutions involved with UNCCD, focussing on “scientific and technical aspects of desertification benchmarks and indicators and remote sensing”;
- Elaborate a review on the use of indicators and benchmarks in the different annexes, with specific references to the response on impact indicators adopted in the NAP within UNCCD;
- Identify core problems related to indicators to identify future needs to improve UNCCD implementation.

In the view to exchange experiences and lessons learnt between the four annexes, similar questionnaires were sent to UNCCD National Focal Points and various levels of users in order to give their opinion and to disseminate their experiences on the use of indicators.
Based on the available information, six reports have been elaborated such as follows:

- Study of the existence and use of desertification indicators at the global scale: preparatory activity for AID-CCD. Report for the northern Mediterranean countries;
- Report on the use of indicators in the NAPs relevant activities in Annex III (Caribbean, Latin America);
- Report on the use of indicators in the NAPs relevant activities in Western Asia;
- Report on the use of indicators in the NAPs relevant activities in East and South East Asia;
- State of the art on available indicators and their use for the monitoring of desertification and the implementation of the CCD in North Africa;
- State of the art on existing indicators and their use for desertification monitoring and CCD implementation in Southern Africa.

1. Relevance of the studies

1.1. General Comments

While the annexes’ reports vary in depth and comprehension, it is clear that all of them constituted the culmination of much effort. The six available studies provide a great overview about all the work done in the different annexes and an excellent basis to compare:

- the implementation of the UNCCD in each annex and,
- the different approaches used.

Reports tended to concentrate at National level issues, probably as a result of an emphasis on National Action Programmes (NAP) and implementation of UNCCD.
Each report describes:

- suites of indicators according to different levels taking into account (1) a DPSIR (PSR) framework and (2) orientation within biophysical, socio-economic, institutional aspects;
- potential measurements to be made, interpretation of results and intended users typically at decision maker levels;
- numerous indicators and maps elaborated in the framework of research and development projects.

Globally, the reports highlight:

- the need to built integrated indices of indicators,
- the need to pay more attention on socio-economic issues,
- the importance of education, training and capacity building,
- the effort that should be made to bridge the gap between local and community users and traditional knowledge,
- the increasing of activities and efficiency due to international cooperation among countries,
- the importance of desertification issues with regard to the numerous projects undertaken in each annex.

Nevertheless, in all cases, the strategy of communication and dissemination of information and indicators is not clear, maybe because of the lack of link between the producers of indicators and the users such as decision-makers and local actors. No detailed information is available on how the indicators are calculated.

Otherwise, it will be really interesting to dissociate the elaborated indicators at the different scales (local, national and regional). The link between the projects and the NAP coordination body is rarely put in evidence. This can be explained by the fact that the projects are generally undertaken in other framework than those of the NAP and the produced indicators are not used by the National Coordination Body.

All the annexes miss benchmarks. This makes clear that it is really difficult to identify and calculate benchmarks. However, all the authors recognised the importance to provide indicators and benchmarks to better monitor and assess desertification processes.

Finally, the questions related to the extrapolation of the local indicators and the indicators' comparison between regions without harmonization of the collection and processing methodologies still remain.

1.2 Annex I: Africa

Northern Africa

No countries answered to the questionnaire. This absence of response was explained by the fact that all the countries involved in the identification of indicators are "actors" of the OSS programmes and all the main informations are available at OSS level.

Algeria, Egypt, Morocco and Tunisia are greatly involved in the implementation of UNCCD and the development and the use of desertification monitoring indicators whereas Libya have not yet elaborated indicators and Mauritania is calculating indicators of process with IUCN. The study gives a great overview of all the work done in North Africa at the different level (regional, national and local) about indicators but also focuses on institutionnal aspects in the implementation of monitoring-evaluation system (in Tunisia and Morocco), particularly the link between researchers, decision-makers (Coordination Unit of the NAP) and users/stake holders.

The indicators are generally classify using PSRI model (Pressure-State-Response-Impact) that it allows to better fit within the international frame of the OECD and EEA. Moreover indicators are often illustrated with elaborated products (for instance maps) that permit to better know what kind of products are needed at all the level (from local and national to sub-regional).
Three case studies constitute a fine example of the use of harmonised methodologies to collect and process data: the Lebanon case study and the DISMED project used the same methodology than the MEDALUS project to elaborate desertification sensitivity maps. In the same time, the regional project called “Set up of desertification monitoring systems in the countries of the southern shore of the Mediterranean” allows to develop harmonised methodologies to collect and process remote sensed data in the sub-region. Finally, at the regional level and in order to compare local observations, OSS implements the Long Term Ecological Monitoring Observatories Network (ROSELT/OSS) programme with the view to produce local indicators having the same meaning. These examples show the relevance to provide standardized and harmonised methodologies to compare results at more global scale (sub-regional and regional).
It is important to underline the effort made in the sub-region to harmonise their approaches in order to implement both National and Sub-regional Action Programmes (NAP and SRAP).

Southern Africa
This study emphasises that very good research projects exist and produce very amazing information about indicators (approximately 225 unique indicators were defined). Once again, this study highlighted the difficulty to analyse in depth the results obtained because they are too much heterogeneous.
This study highlights early warning systems that are operational in the sub-region.
Even if the process to develop B&I in the sub-region have started, the study underlines that a lot of work has to be done to identify B&I, without confusion between definitions. In few cases only, countries have implemented the suggested indicators.

1.3 Annex II: Asia
The given information is really relevant, particularly for China with regards to the presented assessment methodology. The assessment system for degree of desertified land is completely described as well as the assessment methodology for regional land desertification. Research projects also focussed their effort on the desertification mapping.
The studies describe widely the environmental context (population pressure, rapid urbanisation, natural resources…) in the different sub-region.
However, it is not clear how indicators are used by decision makers in the different countries and how they are used to implement NAP.

1.4 Annex III: Carribean, Meso and Latin America
The state of the art in the Annex III is complete and a lot of information is available. Particularly, the annexes provide a lot of list of indicators in each countries of the region. However, benchmarks and indicators are not used for the implementation of the NAP, SRAP and RAP.
Methodologies to collect and process data are heterogeneous and a unique methodology to assess desertification is not yet achieve.

The study underlines that the need to have permanent systems for monitoring and assessing both the processes generating desertification and the effects of drought is imperative in order to help decision making.
At present, indicators and systems have been developed but they are not validated.
It is interesting to point out that the report proposes way to consolidate regional level in the LAC through :

- the consolidation of the efforts of scientific sector and NGOs to achieve unique methodology and national efforts;
- the development of specific projects built with groups of countries at sub-regional level;
- the development and the consolidation of international cooperation, especially South-south partnership, and synergy of projects within the regions in relation to benchmarks and indicators (ex: OSS-CILSS-GRULAC joint action);
- the continuation of the process developed in the region by the UNCCD as a response to the demands of the member countries.

The studies undertaken in the region used also the DPSIR international frame to classify indicators. These indicators deal with biophysical aspects essentially due to the difficulty to obtain socio-economic indicators that are less numerous.
Once again there are no examples of elaboration of impact indicators at the NAP level nor of the Convention's application impact.

1.5 Annex IV: Northern Mediterranean Countries

This study present a complete review of the countries involved in combating desertification in Northern Mediterranean Countries (affected and non-affected countries). From an institutional point of view, this study gives the detail about focal point institution and the objectives of the NAP. This information is really interesting to better understand the strategies used by each affected countries and their focus. It is a good baseline to compare the different governmental strategies in these countries to assess a such difficult problem than those of land degradation.
It is evident that a lot of interest exist in northern Mediterranean countries to better understand desertification processes. A lot of indicators sound to be available but no data about the quantification of these ones appear. Desert risk mapping is highly heterogeneous. The study misses benchmarks, probably due to the difficulty to identify them.
This is a crucial point to underline that even if the northern Mediterranean countries have very good research projects and a lot of indicators, they are not so useful for decision makers. No linkage between indicators and demand exist. Stakeholders are not a lot take into account in the implementation of all the research projects at national and/or local level, even if the European project are more and more implemented in response to range managers. In fact, stakeholders are often involved to evaluate the indicators at the final stage (ex: DESERTLINKS) and we can think that the indicators developed from a scientific point of view can not really fit with the users and land managers needs.
There is a great need to bridge de gap between research projects and decision making.
Based on the state of the art in Northern Mediterranean countries, it is still difficult to answer to the third question of the questionnaire. Combating desertification in northern mediterranean countries seems to be more a "research problem" than a "sustainable development problem" in the view of range management with decision makers.

2. Most important issues that emerge from the analysis

The most important issues that emerge from the analysis can be divided in two parts : institutional aspects and technical aspects as follows:

- At the institutional level, it is necessary:
  - to take in account the reality of the implementation of the NAP process whose speed varies from a region to the other and a country to the other, particularly in a same region;
  - to make the linkage between the NAP and the other national strategic frame and to pursue the integration of the NAP in the national strategies (it is not the case in South America for instance);
  - to identify who are the actors involved in the implementation of the NAP;
  - to develop the NAP monitoring-assessment system and all its components, not only the biophysical indicators of desertification;

- At the technical level, the studies allowed to make the state of the knowledge on the indicators. The quantity of information produced is huge and the lists of indicators are very numerous. But combating desertification still needs:
  - to specify the definition of the terms benchmark and indicator and to put in evidence the necessity to have benchmark as reference (giving a meaning to the indicators). Benchmarks must be considered within the context of indicators and indicators are not relevant without benchmarks;
  - to harmonise methodologies at the different scales (local, national, sub-regional and regional) in order to facilitate results comparison;
  - to develop local level indicators such as in Africa (Namibia, ROSELT experience). This aspect has not received strong attention in most of the countries. However, this is an alarming issue because local resource users are the ones who eventually take management decisions in order to maintain the land resource in good condition for their livelihood;
  - to develop socio-economic indicators without which the concept of indicators remains incomplete;
  - to establish the link between biophysical and socio-economic indicators. The integration of biophysical and socio-economic indicators has not been attempted to the desires extent (except ROSELT experience): Relationships/interactions between the two categories of indicators should be studied.
  - to define common sets of indicators for different levels, from global to local,
  - to define minimum set of indicators for every region and/or country taking into account their peculiarities: Testing and validating a large number of technical indicators to enable a meaningful assessment (including indicators based on available traditional wisdom), the most relevant ones maybe selected for application by users, particularly local resource users.
  - to take in account the cost of the measures which must be as low as possible;
  - to develop the participatory approach that, besides making use of time tested local wisdom, can also ensure at least some capacity building by creating real awareness and appreciation of hazards of drought and desertification and ways and means of coping with these problems;
  - to develop “top-down " and " bottom-up" approaches;

- to develop local pilot studies (Peru case study, ROSELT/OSS experience) to other zones;
- to develop adequate harmonised information circulation systems using international standards;
- to implement operational Monitoring-Evaluation systems using elaborated benchmarks and indicators. Lessons could be learnt from North Africa experience;
- to communicate the results of the projects of research on the indicators to the NAP coordination body;
- to translate the scientific knowledge into useful knowledge to the decision-makers;
- to put in evidence how the indicators are used if they are and/or to consider how could the indicators be used by the decision-makers;
- to elaborate indicators in response to the help to decision;
- to identify who are the "customers" interested by the elaborate indicators;
- to involve the decision-makers / actors / users in the NAP process;
- to develop the national capacities (capacity building, training and workshop awareness for farmers, technicians of NGOs and governments departments, higher level of stakeholders).

Generally, it is worth mentioning the need to develop the south - south cooperation (experience exchange, sub-regional and regional projects) and to reinforce the capacity building (training).

3. Issues for future developments

The issues that should be further deepened and analysed in the future will be:

- To better take into account traditional wisdom, indigenous technical knowledge and local know-how;
- To explain how the indicators are elaborated and calculated, at least for the most common indicators in all the countries (plant cover for instance);
- To describe how the indicators are disseminated, communicated and used describing the information circulation systems when they exist;
- To develop the information circulation systems when they don't exist;
- To underline the problems of validation : by whom? how? at which level : at the scientific level or at the users level, by both?;
- To put in evidence the need of reference (benchmark);
- To develop some indices from the elaborated indicators (aggregation);
- To strengthen the exchanges of experiences, particularly through networks (TPN or other);
- To consider how to better develop the participatory approach that remains insufficient at all levels.

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EAST AND SOUTHERN ASIA

WESTERN AND MIDDLE ASIA

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ANNEX IV FOR THE NORTHERN MEDITERRANEAN

This volume presents the reviews on the use of Benchmarks and Indicators in the different UNCCD Annexes with specific reference to the response and impact indicators adopted in the National Action Plans (NAPs). The reports constitute a valuable contribution to achieve a global overview on the utilisation of desertification B&I, while providing an excellent basis to compare the level of implementation of the UNCCD in its Annexes and the approaches utilised.

The reviews were elaborated in the framework of the AIDCCD project (Active Exchange of Experience on Indicators and Development of Perspectives in the Context of UNCCD), an Accompanying Measure funded by the European Commission, Research Directorate General. These documents are also available on the project web site: www.nrd.uniss.it/sections/aid-ccd/