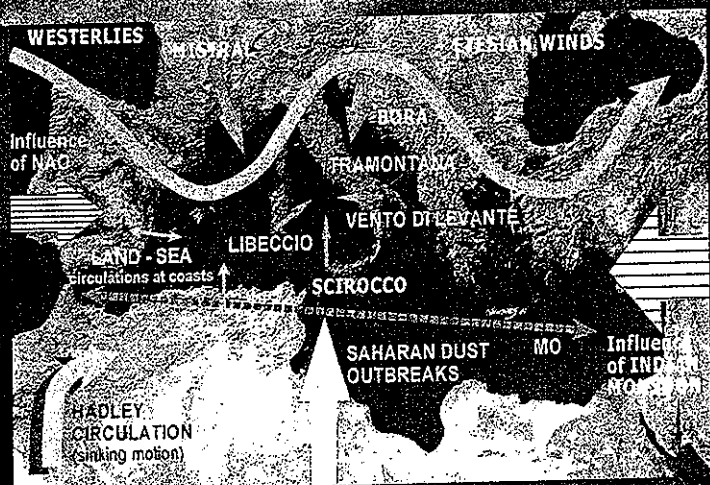


REGIONAL CLIMATE STUDIES

Hans-Jürgen Bolle
Editor

Mediterranean Climate

Variability
and
Trends



Springer

Hans-Jürgen Bolle (Ed.)

Mediterranean Climate

Variability and Trends

With 103 Figures and 24 Tables

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Series Editors:

PROFESSOR A.D. DR. HANS-JÜRGEN BOLLE
Stücklenstrasse 18c
81247 München
Germany

DR. MASSIMO MENENTI
Laboratoire des Sciences de
l'Image, de l'Informatique et
de la Télédétection (LSIT)
Université Louis Pasteur
5 Blvd. Sébastien Brant
67400 Illkirch
France

Dr. Ichtiague Rasool
60 Quai Louis Bleriot
75016 Paris
France

Editor: PROFESSOR A.D. DR. HANS-JÜRGEN BOLLE

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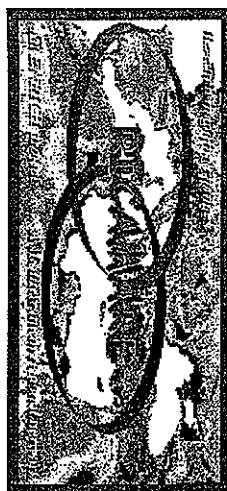
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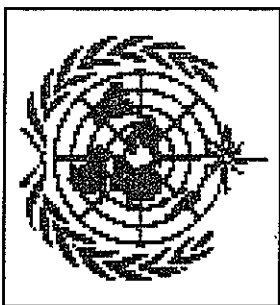


This publication results from two workshops organized back to back in Casablanca, Morocco, in February 2001. The workshop on the "Assessment, assimilation, and validation of data for 'Global Change' related research in the Mediterranean area" was

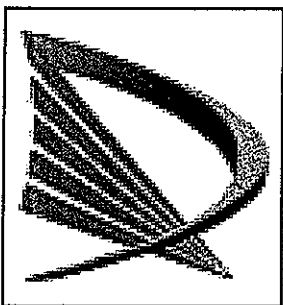
organized in the context of the project on "Research in global Change in the Mediterranean: A Regional network" (RICAMARE) coordinated by Gérard Begni (France) and Jose Moreno (Spain). RICAMARE is a project of the European Commission (FP5, ENRICH) and was supervised by Julia-Maria Kunderman, EC-DG Research, with financial and ideal support of Hassan Virji, IGBP/HDP/WCRP START.



The workshop "Development of Priority Climate Indices for Africa: A CC/CLIVAR Workshop of the World Meteorological Organization and the World



Climate Research Programme" was organized by Valerie Determenman on behalf of WMO, and David Easterling on behalf of the chair of the CC/CLIVAR Working Group on Climate Change Detection, Tom Peterson, jointly with the Regional CCDAS Rapporteur Abdallah Mokssit, of the Direction Nationale de la Météorologie of Morocco which hosted both workshops.



The scientific organizers of the workshop, Hans-Jürgen Bolle and Emin Ozsoy as well as the participants would like to express their sincere thanks to these organizations and persons involved for hospitality and support. Special thanks are going to Ms. Chantal Le Scouarnec, MEDIAS-FRANCE, who was responsible for the technical and administrative arrangements. Thanks are furthermore extended for additional financial support to the Head of Earth Observation Delegation, Program Directorate, CNES, Jean-Louis Fellous, who was one of the founders of RICAMARE, and to MEDIAS-FRANCE for logistic support.

Indicators and Information Requirements for Combatting Desertification

G. Enne, C. Zucca, C. Zanolla

1 Introduction

The development of indicators and the availability and circulation of information are two correlated and relevant issues in the fight against desertification as highlighted by the United Nations Convention to Combat Desertification (UN-CCD). Article 16 of the UN-CCD notifies that the ratifying countries have accepted integrating and co-ordinating the collection, analysis and exchange of relevant short and long term data and information to ensure systematic observation of land degradation in the affected areas and to better understand and assess the processes and effects of desertification and drought.

Desertification integrates a complex system of dimensions, parameters and variables involving the environment and society. In order to facilitate global understanding of the status of desertification and be able to assess what is happening to soil, vegetation, water resources and the quality of life of populations in the affected areas, indicators must be developed to represent precisely and unambiguously quantifiable qualities or properties, symptoms or parameters of a phenomenon relating to a feature of the environment or of society, a change in which over time or space is related to this process.

Affected countries are invited to develop Desertification Monitoring Systems (DMS). DMS should be able to generate diagnoses integrated in space and time with respect to the status of natural resources and populations in the regions affected. They must likewise act as a support to the decision making process by supplying information on the biophysical and socio-economic environmental problems. DMS should aid actors at different levels to assess the progress achieved, examine their priorities and improve their situation as against the degradation process. However the identification of indicators would be a useless effort unless they are supported by the necessary data. It is therefore essential:

- to identify indicators from a compromise between knowledge of processes (objective need for information) and real and cost effective data availability;
- to make data supply and demand to meet so that the agencies involved in monitoring and relevant data production are stimulated to concentrate all efforts on the topical issues and to adopt protocols that better meet the needs of the DSM;

- to set up mechanisms and terms of reference to favour an increasingly better circulation and availability of data.

In this context the Nucleo di Ricerca sulla Desertificazione (NRD) of the University of Sassari has organised several initiatives that, although mainly addressed to the Annex IV Countries, have had wider impact particularly from a methodological standpoint:

- ▶ International Seminar on "*Indicators for Assessing Desertification in the Mediterranean*", held in Porto Torres, Italy, from 18th to 20th September 1998¹.
- ▶ International Workshop on "*Desertification Convention: Data and Information Requirements for Interdisciplinary Research*", held in Alghero, Italy, 9-11 October 1999².
- ▶ Elaboration of a study on "*Desertification indicators for the European Mediterranean Region. State of the Art and Possible Methodological Approaches*"³.

The major results of these three activities are summarized in the following sections.

2 International Seminar on Indicators for Assessing Desertification in the Mediterranean

2.1 Objectives and Assumptions

This Seminar was the first initiative promoted by the constituting Italian National Observatory on Desertification, among whose main objectives is the implementation of UN-CCD in Italy and in the Mediterranean basin.

The main aim of this seminar was to allow a general overview on the indicators of desertification and their applicability to the Mediterranean basin, with particular reference to the UN-CCD Annex IV Countries.

This event constituted an important opportunity for researchers from European Mediterranean Countries to examine jointly the outputs of years of experimental activities in the field of land degradation and desertification, and a rare chance of discussion among scientists and decision makers involved in land management. It

¹ 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.

² 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.

³ Supported by ANPA and the Italian National Observatory on Desertification - Italian Ministry of the Environment.

contributed to highlight the main issues on which much work must still be carried out.

Discussion was based on the following general assumptions:

- (i) Definitions and terms as defined by the UN-CCD must be the only term of reference.
- (ii) Indicators are the objective answer to the necessity for a direct knowledge on desertification, its state and its evolution. This means that an indicator must be able to describe key issues on desertification in a specific area or in a particular country.

2.2 Results and Conclusions

The general discussion at the end of the event allowed to better define:

- The importance of the identification and utilisation of indicators;
- The limits of the current knowledge on and approaches to the research on indicators and the advantages that would derive by adopting the criteria suggested by the UN-CCD.
- The necessity to identify useful indicators given by the widespread need to simplify in a limited number of variables a complex phenomenon like desertification, particularly when actions must be taken to halt and/or mitigate its effects.

One of the main problems encountered by policy-makers, end users and all institutions involved in land planning is connected to the application of scientific theories to real situations. It is very difficult for them to translate the scientific abstractions into actions, and the use of indicators would really constitute an important step towards the implementation of actions to combat desertification.

Indicators would in fact make it possible:

- ▶ to provide information to policy makers and the wider public on the current state and changes in the conditions of the environment;
- ▶ to allow policy makers to better understand the linkages between causes and effects of the impact of environmental policies; and
- ▶ to contribute to monitor and evaluate the effectiveness of policies in promoting sustainable development.

From a scientific perspective, indicators would:

- ▶ enable the assessment of the present status of the environment and the prediction of future trends;
- ▶ ease the identification of the main causes of desertification and therefore suggest proper management of natural resources; and
- ▶ enable an identification of detrimental changes and therefore the adoption of the necessary measures to prevent irreversible damage.

In the light of all the examples, case studies and methodological contributions presented, it appeared clear that there is a urgent need to carry out specific studies on the identification of indicators for the Mediterranean area.

Most research on the subject of desertification was undertaken before that the recent guidelines on research and application of useful indicators were issued by the CST-UN-CCD, the Committee on Science and Technology of the United Nations Convention to Combat Desertification. The concept of Desertification itself in the context of our regions is still quite new for most of the scientific community. Consequently, it is not surprising that international bibliography on the subject often seems to lack uniformity and is frequently conditioned by the specificities of individual disciplines, generally ill-suited to the extrapolation of elements that could be applied to more general and complex situations.

The task of developing these indicators is a multidisciplinary one, therefore involving natural, social and economic sciences. Moreover, since among the causes of Desertification the Convention mentions political and cultural factors, the contribution of political science and anthropology is absolutely necessary to complete the frame of knowledge.

Hitherto scientific work on the subject has not only been deficient in terms of interdisciplinarity, often restricted to the natural sciences, but even within the disciplines themselves where comparisons have not been carried out to overcome the major differences in approach prevailing to this day.

Finally, the task of identifying a limited set of essential and efficient indicators does not only require the contribution of all the disciplines involved, but also calls for an awareness of the problem and a thorough grasp of objectives within the individual groups of disciplines. With regard to this aspect the international scientific community has understood the impossibility to determine a set of universal indicators and, on the other hand, the importance to devise a method for the identification of context driven indicators able to effectively represent the different aspects of Desertification. This requires a higher level of perception of the desertification processes and of the real priorities, which can only be attained by an adequate social participation.

The results of the Porto Torres Seminar are proof of the existence of these problems. Consequently, there still remains much work to be done with particular reference to harmonisation and comparison, which hopefully could be done by interdisciplinary groups specially set up for the purpose and through international concerted actions.

In the light of the above and of the experiences matured in this field, the following priorities were identified at the Porto Torres Seminar:

- 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.
Need for supporting the testing of indicators already available.
- 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.

- 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 International Workshop on Desertification Convention: Data and Information Requirements for Interdisciplinary Research

3.1 Objectives

The main objectives of the international workshop held in Alghero were

- to assess data and information systems with relevance to UN-CCD, and
- to agree on requirements for data and meta-data needed to monitor causes and effects of man induced desertification.

These objectives were based on the assumption that the identification of the available data for the Convention can help to propose suitable instruments methodologies and information systems for planning needs in the Mediterranean countries, and to evaluate the costs for the implementation and running-up of easy information systems.

Introductory statements set the scene relating to research approach and methodology, and the requirements of scientific support for implementing the UN-CCD. Data problems related to soil degradation, water availability, economy, policy, and population were then presented, as well as interdisciplinary approaches for regional focal areas. Data availability in international institutions was also outlined, including FAO, the European Soil Bureau, WMO, Joint Research Centres of the EU and NGOs.

Working groups specially set up on the themes climate/remote sensing (WG1 co-ordinated by Prof. Bolle), soil/water/vegetation (WG2 co-ordinated by Prof. Imeson), and socio-economy/policy (WG3 co-ordinated by Profs. Homewood and Steen) looked into needs, existence and availability of data and information, as well as into the requirements for better exchange of information and data. The open discussions were strongly finalised to the achievement of concrete solutions. Their specific objectives were:

- to identify the core data sets and information (soil, water and vegetation) available at different scales (local, national and continental) in Mediterranean Europe and Africa;
- to document the experience of interdisciplinary desertification projects and data providers with respect to the current situation and future possibilities;
- to identify the data sets and information needed to meet future requirements;
- to consider how data and information should be organised and made available;

- to propose the way forwards and formulate appropriate actions.

In particular, WG1 stressed that the analysis of data availability and requirements for climate/remote sensing related research aims at assessing the role of climate variability and global climate change in land degradation and desertification in the Mediterranean - North African region, to achieve an improved disentanglement and quantification of climatic versus human influences.

WG3 underlined the importance of the assessment of data requirements by focusing on needs of different users and on improving data flows from "micro to macro" (local communities to sectorial programmes), also highlighting the different perceptions of researchers and managers.

3.2 Results

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 with the help of the Second International Co-operation Programme (INCO II) of the European Commission. This will add further value to European current research for combating desertification.

Data availability

An overview of data which exist at the level of the Joint Research Centres (JRC), the international institutions, and the individual research institutions revealed the wealth of information available for Mediterranean and African regions. Of particular interest for desertification research are specific case studies in desertified regions. Existing information is primarily concerned with describing the status and dynamics of symptoms of desertification, and to a lesser extent their causes and effects. Models which allow predictions and the analysis of trends are available for key natural resources. Indicators of pressure and societal responses have been assessed in case studies and in an exemplary manner.

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 better integration of information, for better definition of vulnerability indicators, and for more information directed towards the support of mitigation strategies was expressed.

The working groups added some specific considerations.

Working Group 1: Climate and remote sensing related

Relevant existing data are archived at international data centres as well as at national meteorological and hydrological services. These data basis should be broadened by data which exist in regional and "private" archives (individual researchers, research institutes, universities, industries such as energy producers, etc); existing data should be made easier available for this research and, as far as possible, be brought physically together; reliability and accuracy control should be mandatory.

Working Group 2: Soil, water, and vegetation related

Both Mediterranean and African research teams have relevant interdisciplinary data and information that could be of benefit to the National Action Plans.

With respect to *hydrological data*, organisations responsible for collecting and storing hydrological data have long been established, but there is a threat to existing data, where institutions formerly responsible for running and documenting gauging stations etc., are being disbanded or privatised. The following needs were identified: a) a data and information retrieval or preservation initiative, comparable to that described for meteorological data should be considered, and b) meta data from sets from completed desertification projects should be archived at one of the identified centres.

With reference to *soil data*, although the availability of large scale surveys may give the impression that much is known about the distribution of degraded soils or those threatened by desertification, in practise, the data and information used for compilation and validation of the maps is limited. At more detailed scales, important data and information is often available outside the national catalogues and archives.

As with the hydrological data, efforts should be made to retrieve, compile and incorporate this information into existing archives. Furthermore, there has been a contraction in the number of organisations compiling detailed information on soils and there is urgency in rescuing archives before they are lost. Finally, soil map legends and profile descriptions were usually made for purposes other than desertification or soil degradation.

In relation to *vegetation*, much information is available with respect to "land cover types" and data from remote sensing. However, it was the experience of the working group that the data available, although in itself an achievement, often missed critical qualities and did not provide what was needed for monitoring and understanding change.

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Working Group 3: Socio-economy and policy related

Despite differences in aims, scope, coverage and depth, managers and researchers are largely seeking data from the same wide array of variables and indicators. Although there is great availability of these data, they are for the most part aggregated at national level, and have therefore little relevance to the real situation of an area affected by land degradation. The needs for these data must therefore be defined in a case specific way.

Data needs

Defining data need was considered to be a difficult task in view of the complexity of desertification problems observed in the different bio-physical, social and economic settings. It appeared necessary to identify the needs for each specific research field of the different working groups. Among the general needs the followings can be emphasised:

- better aggregation of data sets at multiple scales;
- improved compilation of information;
- better integration of different case studies through improved networking among all institutions dealing with desertification research;
- more efficient up- and downscaling of information for different user groups, be it research teams, or policy and other decision makers at different levels of intervention, from local to community, regional to national, and the international levels.

Future research needs

It was concluded that such needs be based on a research strategy, that would have to be defined beforehand. A general consensus was reached on the following:

- research focusing on monitoring and understanding the processes and causes of desertification would have to be ongoing;
- new research initiatives focusing on aspects of mitigation, restoration, and prevention of desertification should receive equal attention. Here major gaps were identified. Research in support of pro-active interventions would have to be multi-level, multi-scale, and multi-temporal, and include different methodologies, from disciplinary to multi-, inter- and transdisciplinary approaches, the latter being the most participatory type of research;
- a key requirement for such types of research would be the identification of joint case study areas, where more demand-driven, participatory activities could lead to better decision-support systems serving different users of the information. A better understanding of institutions, policies and desertification systems, and the development of tools for mitigation should be at the centre of future research. The working groups introduced the following more specific considerations.

Working Group 1: Climate and remote sensing related

The problem which has to be solved is the scaling between global modelling and local impact. The downscaling from global models requires additional techniques to include topography and vegetation and small scale circulation systems which are available from different studies but not used in a systematic way. Similarly, the studies of regional and local effects need regional expertise which may be available but is not yet organized enough.

A Mediterranean/North African GEWEX (Global Energy and Water-cycle Experiment) is proposed for which main requirements are:

- Measurements in representative areas necessary to provide input data for models and to validate model results.
- Satellite data bridge from isolated measuring sites to larger land-surface units.

A GEWEX has to be build upon a networked scientific community able to provide the logistic support for experiments as well as regional expertise. Some ground stations should in any case be selected as "anchor stations" for satellite data. At these stations surface properties should be measured such as albedo, net radiation, carbon dioxide and water exchange between surface and atmosphere, state and density of vegetation, as well as subsurface quantities such as the piezometric level, soil moisture profiles and root depth precipitation, evaporation, river run-off, maps of "functional land-cover types". Time series of Satellite data must be extended to 20 years minimum.

Working Group 2: Soil, water, and vegetation related

Concerning water resources, there are major gaps with respect to data and information relating to the monitoring of water use, the use of water for irrigation and for public water supply.

Data should be collected at a variety of scales in catchments where all the collateral data relating to land use change, vegetation, soil and climate are available, as well as information on socio-economic and policy drivers. Too often critical data sets required to interpret results are missing.

With particular reference to soil, particularly valuable are observations related to the dynamic features of soils such as various aspects of soil structure (including surface crusts, bulk density and roughness), soil chemistry and nutrient dynamics and various soil biological indicators. Soil moisture amounts, fluctuations and distributions were also considered to be important.

It was stressed that these data and the indicators that will be derived from them should be specifically targeted at :

- the reconstruction or rehabilitation of soils that are already degraded
- the prevention of degradation in areas that are likely to be threatened.
- deriving indicators that could provide early warning of degradation.

Concerning methods, it was thought that low-cost simple field tests or measurements should be given priority. Detailed DEMs are very important for erosion modelling.

Concerning vegetation, information is specially needed with respect to a) the vegetation cover and land use and their dynamics, b) data and information on vegetation cover, biomass, vegetation growth and plant phenology.

Understanding how different techniques of land use and management affect vegetation was mentioned as a gap.

A general conclusion of the working group 2 was that *trans-disciplinary pilot areas* would be of extreme benefit to:

- Provide locations within which the complete trans-disciplinary data and information requirements, identified by the working groups as being needed for combating desertification, would be obtained. The pilot areas would constitute a desertification research and mitigation facility.
- Provide areas, selected by the National Committees, within which the scientific knowledge built up during previous "Environment" and INCO programmes projects would be efficiently used to support and underpin the action programmes proposed by the National Committees.
- Provide areas within which restoration and prevention strategies would be monitored and tested and best practices be demonstrated. The impact of policies in different sectors would be evaluated.

Working Group 3: Socio-economy and policy related

There exist a urgent need for indicators of response, particularly those which are local and site specific. Understanding responses means understanding local knowledge and perceptions, the ways in which broad scale incentives translate into local opportunities and constraints, understanding locally successful initiatives that form and inform local behaviour, and understanding how the impact of interventions are seen at the local scale.

This is the type of information that managers and researchers commonly lack. It can only be gained by in-depth field work using participatory approaches. It cannot readily be extrapolated because of the complexity of interacting variables, some operating from afar and some intimately local, producing the behaviour observed in any given site.

In synthesis, WG3 highlighted the following:

- data requirements can only be defined in relation to specific problems, but local land users commonly have a different perception of 'the problem', and radically different priorities, from researchers and managers at regional, national and international levels;
- there is a strong flow of information from macro to micro, but all levels sense a lack of bottom-up, micro to macro flow.
- it is only possible to compile inventories and identify gaps of existing data sets with respect to specific sites. However there is a general need for basic data at a disaggregated (potentially household) level on demography, health, education, economy and land use trends for:
 - populations living in marginal areas – by definition hard to document (mobile people, minorities, remote area dwellers, refugees)

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- local level information (on a socio-economic and political/ cultural "catchment" scale) for sites of special concern on local knowledge, local level priorities/ perceptions of environmental issues, decision making on land use/ resources, response to change in climate, policy, institutions and interventions.

3.3 Conclusions

The scientific contribution of the European Union to UN-CCD is a valuable asset and an added value to help combating desertification processes both within and outside Europe. Many of the existing research programmes and databases have a documented potential which can be used at multiple levels of intervention.

A major homework for the European Commission should be:

- to stimulate improved access, quality, user friendliness, documentation, and integration of the various sources of data and information;
- to co-ordinate its activities with other international and national institutions;
- to provide a conceptual framework for mitigation research.

The research community, on the other hand, should make better use of the instruments offered by the EC, such as INCO II, particularly in relation to joint research actions, concerted actions, and thematic networks related to combating desertification.

It was suggested to propose a *thematic network dealing with 'mitigation of desertification'*, to be organised among research and database institutions working in this field inside and outside Europe. This would allow to enhance methodological approaches, from disciplinary to transdisciplinary, and to develop a research strategy focusing on desertification mitigation, including the monitoring of key problems and the finding of pathways for mitigation. In particular, tools could be developed for monitoring, appraisals, predictions, and mitigation scenarios, including the identification of bio-physical and socio-economic indicator systems.

4 Study on Desertification Indicators for the European Mediterranean Region: State of the Art and Possible Methodological Approaches

4.1 Objectives

This study, that the Nucleo di Ricerca sulla Desertificazione has presented at the UN-CCD Secretariat at the Fourth Conference of the Parties, 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. It also

constitutes the NRD fulfilment of the engagement taken on at the International Seminar on the CCD Impact indicators, organised by OSS-CILSS at the UNESCO in Paris in the summer 1999. On that occasion a first definition of common terms of reference was achieved. In particular, this study is an attempt of the NRD to provide the international scientific community with a comprehensive framework of desertification indicators as well as guidelines deriving from an accurate methodological research.

The report is the result of a critical appraisal of the state of the art in the field of Desertification, starting from the Rio de Janeiro conference up to the present day, setting out a methodological approach in line with the CCD mandate and inspired from the recommendations and decisions of the CST-UN-CCD and of the first three COP held in Rome, Dakar and Recife. The COP-3 in particular, held in Recife in November 1999, focused on the urgent need to draw up a synthesis of work accomplished in the sphere of indicators in order to proceed as soon as possible to the next phase of testing these indicators.

This report is thought to provide both a comprehensive vision of the approach adopted by international organisations to the problem of desertification, and also and above all, important 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.

4.2 Contents

The report is divided into three parts, as follows:

The first part deals with the background of the Desertification indicator concept, with a summary of scientific progress made from Rio onwards by the Conference of Parties technical and scientific bodies on the subject of indicators and a brief analysis is made of the environmental and socio-economic specificities of the Northern Mediterranean Annex. This section also clarifies the position and role of all the indicators that are part of the large family of indicators for use in the implementation of the Convention (Fig. 1).

In part two, a synthesis of the most recent achievements in the field of Desertification indicators for the European countries of the Mediterranean is made and some suggested methods are described with reference to the identification and management of indicators.

The third and last part contains useful information for those wishing to undertake further research on the subject of indicators to assess Desertification (bibliographical references, organizations and research and experimental programmes under way, addresses and web sites devoted to indicators).

The major methodological contributions are summarised below.

- a) Operational definition of desertification indicators.
- b) Characterisation system for the desertification indicators.
- c) Classification system for the desertification indicators.
- d) Definition of the indicators development procedure.
- e) Proposal of an implementation indicators matrix for the Italian National Action Programme.

The first 4 methodological contributions, in particular, are worth further clarification.

a) Operational definition of the indicator.

What identifies a parameter or an index as an indicator (for a specific, well defined use) is a set of characteristics, amongst which are the following:

Objective: An indicator is such if it serves to characterise/measure/monitor a state or process in a determined context, for a specific purpose.

Method: The method of measurement and/or calculation of the value of a parameter/index. Required is the level of accuracy, number of repetitions, periodicity, statistical processing, fields and contexts of application, spatial scale at which it is significant.

Benchmarks of the parameter/index: Threshold values, reference intervals.

Type and quality of the final information: Site-specific or distributed spatially; spatial density of the sampling; specific techniques for space/time interpolation of point data (data from a single site are often interpolated with undiscerning use of geostatistical algorithms, whereas the choice of a suitable method is an important aspect).

To conclude, it can be said that an environmental indicator is not a parameter/index, but a set defined by at least five elements: parameter/index; objective; method of measurement; benchmarks; type and quality of information output. The following formula borrowed from vector algebra may be applied:

indicator = {parameter, objective, method, benchmark, spatial scale/type of spatial extension}

b) Framework for characterising desertification indicators

It was obtained by adopting a conceptual frame of reference (the well-known DPSIR also adopted by the European Environment Agency) and by elaborating a technical-methodological chart that lists all the necessary information that should accompany a ready-for-use indicator.

In particular, it highlights the

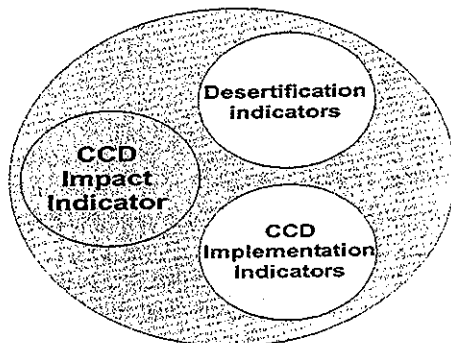


Fig. 1. The family of indicators related to CCD implementation

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relevance of the criteria summarised below (for more detail, please refer to the volume):

- Accurate definition of the indicator;
- Position within the logical framework (DPSIR);
- Target and political pertinence (position within the Agenda 21, importance with respect to sustainable development, to the Conventions and to the international agreements);
- Methodological description and basic definitions, with particular reference to the methods of measurement and to the characteristics and operational limits of the indicator;
- Necessary data to calculate the indicator and evaluation of data availability;
- Additional information, authors and bibliographical references.

Table 1. Classification framework for indicators¹⁾ in five hierarchical levels

Criteria		Classes and relative codes				
Scale	Operational Objective	prevention P	monitoring Mo	mitigation Mi		
	Position in the logical framework	driving force D	pressure P	state S	impact I	response R
	Space	punctual P	local L	sub-region Sr	region R	European Mediterranean region M
	Time	daily or more g	monthly or seasonal m	annual a	less than annual b	single event s
	Component of the system under consideration	soil S	water resources W	vegetation V	climate C	socio-economic aspects SE
	Nature of data	in data banks B	direct gathering F	remote sensing RS		

¹⁾ In this framework an indicator is characterized by five letters. As an example an indicator for prevention describing a state of a spatial scale from sub-region to region and of seasonal periodicity that refers to vegetation cover and is assessed by remote sensing is classified by the following sequence of letters:

P S Sr/R - m V RS

Table 2. Schematic procedure for the production of impact indicators (simplified from Enne and Zucca, 2000)

Step	Synthetic description
1	Identification of the general and specific <u>objectives</u> and their classification according to the specific field of application and users
2	Establishment of a mechanism for consultation amongst all the potential <u>users</u> and the potential providers of data.
3	Integrated analysis of the objectives and <u>key issues</u> to which they pertain, referring the DPSIR logical framework.
4	Identification of <u>indicators</u> able to best describe, at each level, the key issues identified above.
5	Identification and characterisation of <u>necessary data</u> to measure and/or derive the adopted indicators and benchmarks.
6	Analysis of national and/or local situations relative to production and/or <u>availability of data</u> on the different key issues identified.
7	<u>Calculation/measurement</u> and analysis of indicators
8	Preparation of an <u>action plan</u> to provide for the production of necessary but as yet unavailable data.
9	Dissemination of <u>results</u>
10	Testing <u>perception</u> (feed-back from users)

c) Classification framework for desertification indicators

The NRD has proposed a classification framework for desertification indicators structured on five hierarchical levels corresponding to the following criteria:

1. Operational objectives of the Convention (Prevention, Monitoring, Mitigation).
2. Position in the DPSIR logical framework (Driving force, Pressure, State, Impact, Response).
3. Operational spatial scale (punctual, local, sub-region, regional, European Mediterranean region) and operational time scale (high frequency, daily or more; monthly or seasonally; annual; less than annual; single measure).
4. Component of the environmental or socio-economic system (climate, soil, water resources, vegetation; socio-economic aspects).
5. Type of data and acquisition platform (pre-existing data banks, direct gathering, remote sensed).

Table 1 describes schematically the proposed framework.

d) Definition of the procedure for the production of indicators

This procedure described in Table 2 was elaborated with the aim of facilitating the establishment of a selection mechanism for the indicators as described by the COP.

In addition to the fundamental principles outlined by the COP, indications given result from the analysis of contributions from various international bodies (in particular OSS-CILSS, 1999).

5 Conclusions and Perspectives

On the basis of the experience acquired during the above mentioned activities, the following conclusions can be drawn:

- Studies and interventions related to indicators should be qualified and finalised to respond to the criteria and methodologies proposed by the UN-CCD.
- The guidelines proposed in the volume "Desertification Indicators for the European Mediterranean region. State of the Art and Possible Methodological Approaches" can effectively contribute the necessary harmonisation of the efforts towards this direction.
- It is necessary to promote a better integration, both horizontal and vertical, of the frameworks to facilitate the exchange of data and experiences.

With the aim of further contributing to the considerable efforts already made, the Nucleo Ricerca Desertificazione wishes to promote a fully participative type of process for developing indicators based on the methodology proposed by the Conference of Parties and revised by NRD, and in which organisations in possession of relevant knowledge, from the scientific to knowledge at all levels, will undertake to organise their experience systematically in order to come up with simple indicators so that they may be used by a wide range of users and be clearly and unequivocally interpreted.

This process should lead to the creation of a data bank for indicators that might be organised according to the classification framework and the descriptive schemes proposed. The steps leading to the production of impact indicators are specified in Table 2.

The future user of this data bank, possibly available on the web, must have the possibility to find the desired indicators by means of keys constituted by the five classification 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.

The NRD is now co-ordinating the MEDRAP project, a three- year Concerted Action funded by EC, whose main objective is to support the elaboration of the Regional Action Programme of the Annex IV Countries "and which include a workshop on desertification indicators". The National Focal Points are also involved in this project based on the participation of a wide telematic network of stakeholders. The CA will surely also provide relevant information to the other UN-CCD regional annexes.



References

- Enne G, d'Angelo M., Zanolla C (1999) Proceedings of the International Seminar on Indicators for Assessing Desertification in the Mediterranean, Porto Torres (Italy) 18-20 September. Pp 333. ANPA. Rome.
- Enne G, Zucca C (2000) Desertification indicators for the European Mediterranean region. State of the art and possible methodological approaches. Pp. 261. ANPA. Rome.
- Enne G, Peter D, Pottier D (2001). Proceedings of the International Workshop on the Desertification Convention: Data and Information Requirements for Interdisciplinary Research. Alghero, Sardinia, Italy, 9-11 October 1999. European Commission EUR 19496, pp. 374
- OSS-CILSS (1999) Les indicateurs d'impact de la CCD. Compte rendu et communications de l'Atelier international de Paris, 29 juin - 2 juillet.