

UNCCD Recommended Minimum set of Impact Indicators

Consultancy report

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This document was prepared by an informal group of experts, under the leadership of the CST Bureau and with the technical assistance of the UNCCD secretariat. It contains background information to the official document ICCD/COP(9)/CST/4: “Advice on how best to measure progress on strategic objectives 1, 2 and 3 of the 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018)”. Views and positions contained therein may not reflect those of the secretariat and or the Parties to the UNCCD.

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Table of Contents

Executive Summary	i
1 Introduction.....	1
1.1 Background.....	1
1.2 The Strategic Objectives.....	1
1.3 Terms of Reference.....	2
1.4 The International Group of Experts (IGE).....	3
2 Process and Methodologies Used in the Selection of the Minimum Set of Indicators.....	3
2.1 Organization of Work.....	3
2.2 Literature Review.....	4
2.3 Questionnaire on Impact Indicators in Use in Affected Countries.....	4
3 Results.....	5
3.1 Frequently Reported Indicators.....	6
3.2 Indicator Sets from International and Regional Institutions.....	7
3.3 Approach to Indicator Framework.....	11
4 Identifying Affected Areas.....	11
5 Minimum Set of Impact Indicators.....	14
5.1 Discussion of Indicators.....	16
5.2 Proposed Methodologies for Each Indicator of the Minimum Set.....	19
6 Conclusions and Recommendations.....	20
7 References.....	21
Annex 1. Sample Questionnaire.....	25
Annex 2. Expert Consultations.....	34
Annex 3. Identifying Affected Areas.....	35
Annex 4. Countries to whom Questionnaire was sent.....	45
Annex 5. Countries who responded to Questionnaire.....	47
Annex 6. Summary of Questionnaire Outcomes.....	48
Annex 7. Key Indicator Sets.....	52
Annex 8. Detailed Description of Impact Indicators.....	57

Executive Summary

Decision 3/COP 8 requests the CST to provide advice to the CRIC on how to best measure progress on the strategic Objectives 1, 2 and 3. Discussions held during the First Special CST Session in Istanbul indicated that the future work of the CST regarding this issue should focus on the establishment of the basic set of impact indicators and should also take in consideration the following:

- The core seven indicators already identified in The Strategy;
- The relevant indicators already in use under the Convention at the national, subregional, regional and global levels; existing indicators from the sister Rio Conventions, Poverty Reduction Strategy Papers (PRSPs), the Millennium Development Goals, the United Nations Development Program, the United Nations Environment Program the Food and Agricultural Organization of the United Nations and the Global Environment Facility;
- Their measurability, reliability, simplicity and applicability and cost-effectiveness at various levels;
- The relevant previous decisions of the COP and the related reports of CST;
- The special circumstances and needs of developing countries.

To follow up on this task and to provide advice to the CST and the Secretariat this informal group of experts was convened. Questionnaires were sent to the countries to review what indicators are currently being used. Some 54 questionnaires were returned and these provided a good indication of the wide range of indicators that are being used in the countries and emphasized the need for a minimum set of universally used indicators. For example, the received questionnaires mention more than 400 different indicators for each one of the three considered objectives. Most indicators are focused on the local level since they come from specific projects. Very few indicators are used at national level and still fewer address affected areas. Many of the countries are proposing desirable indicators, suitable for potential use but currently not applied by the countries.

In addition, the literature and current practices of other conventions, UN agencies and regional bodies were reviewed. As a result of this analysis, and feedback from the CST bureau and the Secretariat the following set of eleven minimum indicators for national and global levels are recommended:

- I. Water availability per capita in the affected areas (National and global)
- II. Change in land use (National)
- III. Percentage of population in affected areas above poverty level (National and global)
- IV. Childhood malnutrition and/or food consumption/caloric intake per capita (National)
- V. Human Development Index (HDI) (Global)
- VI. Level of land degradation (National)
- VII. Plant and animal biodiversity (National)
- VIII. Aridity index (National)
- IX. Carbon stocks above and below ground (National)
- X. Lands under Sustainable Land Management (SLM) (National and global)
- XI. Land cover status (Global)

In the judgment of the international group of experts these indicators, used together, will identify progress on each of the three major objectives and will allow valid comparisons between regions and countries. Regions and countries will of course be free to use additional indicators if necessary. In our judgment, data is available for each of these indicators, many of which are already in use by national and international organizations.

In the process of selecting this minimum set of impact indicators the IGE has identified a number of important issues:

1. At the national level, the issue of the area to which the indicators refers is not clearly defined in most cases. In some countries with a wide range of ecological conditions definition of the affected areas is important. The group has presented some of the current tools in use for defining these areas but in our opinion this area needs further special attention. In any follow-up on this issue country and regional level inputs would be most important.
2. The large number of indicators used by the countries in response to the questionnaires show clearly that the philosophy of sharing common indicators has not worked up to the present. Many indicators appear to be focused on the project level. We judge that it is better to have fewer, shared and well-known proxy indicators rather than a long list of scientific ones. The Millennium Assessment criteria for selecting indicators is useful.
3. This first list of indicators must be considered as a starting point of a harmonized work of the Parties rather than a final list. Indicators have to be improved and strengthened considering the results of their use by Parties, on one hand, and the scientific progress, on another hand.
4. For that, it is important that the CST works to establish standardized methodologies which will be used by Countries (as it is done in the UNFCCC framework). These methodologies have to be elaborated by a group of experts within sufficient time to allow the broadest possible consultation.
5. If this list is accepted a strong program of capacity development will be important.
6. This report focused on global and national indicators. Regional based indicators are important and should be part of a follow-up activity to develop specialized coordinated minimum sets.

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1 Introduction

1.1 Background

Decision 3 at COP 8 set out new directions for the UNCCD in the form of a comprehensive 10 year strategic plan to enhance the implementation of the convention (2008-2018). The purpose of the plan is “to establish a global partnership to halt and prevent desertification and land degradation and to mitigate the effects of drought in the affected areas in order to help to reduce poverty and foster lasting respect for the environment.” That plan detailed in ICCD/COP8/16 Add. 1 Paper 8 sets out four overarching strategic objectives which will “guide the actions of all UNCCD stakeholders and partners in the period 2008–2018, including raising political will.” Meeting these long-term objectives will contribute to achieve the above-mentioned vision. The “expected impacts” are the long-term effects intended by the strategic objectives.

1.2 The Strategic Objectives

The strategic objectives are as follows:

1. To improve the living conditions of affected populations;
2. To improve the condition of affected ecosystems;
3. To generate global benefits through effective implementation of the UNCCD;
4. To mobilize resources to support implementation of the Convention through building effective partnerships between national and international actors.

To measure the progress of the strategic objectives the following nine core indicators were identified:

- S-1: *Decrease in numbers of people negatively impacted by the processes of desertification/land degradation and drought;*
- S-2: *Increase in the proportion of households living above the poverty line in affected areas;*
- S-3: *Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas;*
- S-4: *Reduction in the total area affected by desertification/land degradation and drought;*
- S-5: *Increase in net primary productivity in affected areas;*
- S-6: *Increase in carbon stocks (soil and plant biomass) in affected areas;*
- S-7: *Areas of forest, agricultural and aquaculture ecosystems under sustainable management;*
- S-8: *Increase in the level and diversity of available funding for combating desertification/land degradation and mitigating the effects of drought;*
- S-9: *Development policies and measures address desertification/land degradation and mitigation of the effects of drought.*

The committee on Science and Technology at its first special session, Istanbul 3-6 November 2008, provided advice on how best to measure progress on strategic objectives 1, 2 and 3 of the strategic plan (ICCD/CST(S-1)/4/add 3.). It emphasized in implementing the strategy (and its indicators), a federative and harmonized data collection process may be used, in conjunction

with action at the international, regional and national levels, for this would constitute a considerable advance over a process addressing only the national situations of the affected countries and the developed countries and the regional and subregional situations. The use of strategic indicators is a part of a decision-making and institutional process which should both promote the identification, mobilization and incorporation of new actors at the international, regional and national levels and help to harmonize the interpretation of the data and the monitoring methods used at these different levels. It is absolutely essential for the Parties to achieve a consensus on the indicators.

At COP 8 the CST advised the CRIC of the need for the selection of a minimum set of indicators to measure progress on strategic objectives 1, 2 and 3 taking into account:

- The core seven indicators already identified in The Strategy;
- The relevant indicators already in use under the Convention at the national, subregional, regional and global levels; existing indicators from the sister Rio Conventions, Poverty Reduction Strategy Papers (PRSPs), the Millennium Development Goals, the United Nations Development Program, the United Nations Environment Program the Food and Agricultural Organization of the United Nations and the Global Environment Facility;
- Their measurability, reliability, simplicity and applicability and cost-effectiveness at various levels;
- The relevant previous decisions of the COP and the related reports of CST;
- The special circumstances and needs of developing countries.

To follow up on this task and to provide advice to the CST and the Secretariat this informal group of experts was convened with the following terms of reference.

1.3 Terms of Reference

The task undertaken by the consultants is the selection of a minimum set of impact indicators for each of the following strategic objectives formulated in the Strategy:

Objective 1: To improve living conditions of affected populations

Objective 2: To improve the conditions of the ecosystems

Objective 3: To generate global benefits through effective implementation of the Convention

The purpose of this consultancy is to select a minimum set of impact indicators that takes into account and builds on, but not bound by the seven core indicators described in the UNCCD ten-year Strategy for measuring progress on the achievement of the associated strategic objectives 1, 2 and 3 (core indicators S-1 – S-7 on listed on pg. 1).

1.4 The International Group of Experts (IGE)

The team members were chosen to represent a diverse set of skills, language and cultural backgrounds and regional knowledge.

Prof. Elena Maria de las Nieves Abraham is director of the laboratory of desertification and land management and director of the Argentine Institute for Research on Arid Lands with experience in Latin America and with UNCCD.

Eng. Wafa Essahli has experience in North Africa and the Sahel and works with the general Secretariat of the Community of Sahel and Saharan States.

Dr. Leonard Berry, the team leader, is director of the Florida Center for Environmental Studies and has considerable experience in Africa, South America and Asia and has worked with GEF, GM and many international agencies in drylands and land degradation.

All team members are familiar with the UNCCD process. The team has also benefited from information and advice from colleagues as detailed in the acknowledgments.

2 Process and Methodologies Used in the Selection of the Minimum Set of Indicators

2.1 Organization of Work

Several interlocking processes were used to develop the minimum set of indicators, following the terms of reference for the informal group.

- A wide ranging review of the literature and indicators used by other conventions, agencies and institutions, as well as analyzing indicator development in progress by FAO, GEF, World Bank, OSS and others.
- Analysis of responses from the countries in a questionnaire showing information about indicators already in use. (Annex 6: Questionnaire Outcomes)
- Formal and informal discussion with experts (see Annex 2 for list).
- Regular e-mail exchanges and conference calls between the IGE and the UNCCD Bonn
- Discussion and feedback from the CST Bureau members (3-4 March, 2009 and 25-26 meetings).

The analysis of the questionnaires enables the identification of the most common indicators used by the affected Parties, while the literature review helps to identify existing indicators that could be used. The comparison of the two lists allows the establishment of the proposed indicators which were discussed with the CST Bureau at its meeting on March 3-4, 2009 and again on May 25-26. Then existing and improved methodologies are identified and proposed for each indicator of the minimum set retained. Global and national levels are considered in this document; the regional level will be addressed separately.

2.2 Literature Review

Over 100 papers and reports were reviewed for relevant methodology and indicators. Among the literature reviewed, particular emphasis was put on reviewing the indicator work of the Global Environment Facility (GEF), the French Scientific Committee on Desertification (CSFD), Sahara and Sahel Observatory (OSS), Land Degradation Assessment in Drylands (LADA), Land Use Change, Impacts and Dynamics (LUCID), Land use, Land use change and Forestry (LULUCF) under the United Nations Framework to Combat Climate Change.

Key indicators in use by GEF, LADA and LUCID are summarized in Annex 7. It is important to emphasize that a number of agencies are presently working on indicator development. The FAO LADA project is refining global indicators, GEF/UNDP has a medium-sized project which will produce a set of indicators in a two-year time frame, the French Scientific Committee on Desertification are also in the final stages of preparing a report on indicators and, OSS and its partners, has developed several concepts and tools for the monitoring and evaluation of National and Regional Action Programs (NAP and SRAP/UNCCD) as well as a set of indicators at the local level generated from the long-term socio-ecological surveillance network¹. For biodiversity related indicators the work of the Convention on Biodiversity also provided important input.

However, because of the urgency of the need for a minimum set of indicators it was necessary to develop a set based on currently available information, though refinement may be possible at a later stage.

2.3 Questionnaire on Impact Indicators in Use in Affected Countries

During its first special session, the CST prepared an in-session document (ICCD/CST (S-1)/5/Add.1), which proposed guidelines and concrete steps to be undertaken for providing advice on the optimum measurement of strategic objectives 1, 2 and 3. The immediate steps include the selection of a minimum set of impact indicators coherent with each of the seven core indicators identified in The Strategy within the framework of the Strategic Objectives 1, 2 and 3.

Therefore the CST Bureau, in cooperation with the UNCCD Secretariat, developed a process designed to compile a minimum set of impact indicators that could be used by all Parties to provide information on the trends in affected areas. The implementation of impact indicators requires Parties to dispose of relevant data, baseline and capacity. In order to enable Parties to report on impact indicators from the first reporting cycle in 2010, the CST Bureau, following an innovative approach, agreed to select this minimum set of impact indicators taking into consideration the indicators which are already in use in affected countries.

For this purpose, the CST Bureau decided to involve directly the affected Countries, through their National Focal Points and Science and Technology Correspondents (STCs), in providing information on the impact indicators already in use in their country. Data have been collected through a questionnaire which was prepared by the CST Bureau in cooperation with the STCs participating in the CST S-1. This questionnaire (Annex 1), translated in all 6 UN official languages, was subdivided in three sections, one for each Strategic Objective, and seven sub-

¹ ROSELT/OSS

sections, one for each core indicator identified in The Strategy. It was structured in such a way to get, for each core indicator, a list of related impact indicators in use at country level and an estimate of their degree of measurability, reliability, simplicity, applicability and cost effectiveness Annex 4 lists the countries to whom the questionnaire was sent.

3 Results

Some 54 questionnaires (Annex 5 lists the countries who responded to the questionnaire) were received and these provided a good indication of the wide range of indicators that are being used in the countries and emphasized the need for a minimum set of universally used indicators. For example, the received questionnaires mention more than 400 different indicators for each one of the three considered objectives).

Apart from the large number of indicators used, the IGE had concerns with the lack of common indicators among adjacent countries. For example, countries members of CILSS, ECOWAS, OSS, Club of Sahel, as well as Latin American countries, experienced a great number of projects and actions to fight against desertification, projects to identify indicators and benchmarks; some of these projects were implemented at the regional level and aimed, among others, at harmonizing and sharing methodologies and data. It was expected to have common indicators in their questionnaires, but this is not the case, the indicators listed are completely different, without even one common indicator.

Most indicators are focused on the local level since they come from specific projects. Very few indicators are used at national level and still fewer address affected areas. Many of the countries are proposing desirable indicators, suitable for potential use but currently not applied by the countries.

A majority of the indicators do not focus on areas affected by desertification, and it can be assumed that only a few countries have defined their sensitive and affected areas, consequently, there is the need to accomplish this task as a prerequisite for determining the indicators. At the same time, only a few indicators allow spatializing the information for mapping, which would be important to characterize the affected areas through reference units.

The questionnaires show very clearly the lack of defined methodology and guidelines to be used by all Parties in addition to the limited interaction between research communities and the decision makers (i.e. very few indicators listed by the CSFD –scientific review- are mentioned in the questionnaires).

3.1 Frequently Reported Indicators

Despite the large number and diverse indicators used some common trends were observed as listed below.

Core Indicator S1: Decrease in the numbers of people negatively impacted by the processes of desertification/land degradation and drought.

- Number of households affected
- Population change
- Household income/(un)Employment rate (S1 & S2)
- Immigration

Core Indicator S2: Increase in the proportion of households living above the poverty line in affected areas.

- Household income/(un)Employment rate (S1 & S2)
- Population living below/above poverty level

Core Indicator S3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.

- Daily food consumption/caloric intake
- Childhood malnutrition

Core Indicator S4: Reduction in the total area affected by desertification/land degradation and drought.

- NDVI/change in land cover
- Drought
- Salinization

Core Indicator S5: Increase in net primary productivity in affected areas.

- Crop production/yield
- Biomass/vegetation cover/NDVI

Core Indicator S6: Increase in carbon stocks (soil and plant biomass) in affected areas.

- Change in forest areas/forest stocks
- Soil organic matter
- Total biomass

Core Indicator S7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management.

- Change in carbon sequestration/carbon stocks
- Afforestation/regeneration area
- Lands under sustainable management
- Conservation areas

3.2 Indicator Sets from International and Regional Institutions

To identify the existing indicators at international and regional levels, the IGE has used literature and the internet. Most relevant organizations and initiatives related to land degradation/desertification and drought were reviewed; among them: FAO, UNEP, World Bank, CIESIN, WRI, UNFCCC, UNFCBD, UNSD, IIED, OECD, LADA/FAO, TerrAfrica/World Bank; KM: Land Initiative/GEF-UNU-INWEH and Desert Atlas/JRC. We also used the review of environmental indicator systems made by DesertLinks² which contains the best known systems and determines indicators already in general use that can be adapted for the specific purpose of desertification.

The most relevant initiative for the on-going IGE's work is the KM: Land initiative. It is a MSP/GEF project implemented by the UNU-INWEH assisted by an Expert Advisory Group and an Inter-Agency Working Group. It is developed in order to address the lack of knowledge management to mitigate land degradation in the land degradation focal area of the Global Environment Facility. KM: Land initiative has made progress on the selection of global level indicator categories; a review of methodologies and data availability for these global level indicators was provided by the Centre for International Earth Science Information Network (CIESIN), discussed and finalised at the level of the Expert Advisory Group and the Inter-Agency Working Group of which the UNCCD General Secretariat is member³.

The selected set of global-level indicators for which data and methodologies are readily available is:

- Land cover: measured as fractions of cropland, forest, rangeland, urban areas etc.
- Land productivity: Greenness measure in order to reflect land productivity trends.
- Water availability per capita (surface and ground water)
- Rural income:
 - Fraction of population below 1\$US/day, as a measure that is globally used and accepted;
 - Income per capita distribution.
- HDI (Human Development Index)

These global level data can be provided to the parties for field verification and validation.

² DesertLinks: Combating desertification in Mediterranean Europe. Linking science with stakeholders;- Contract EVK2-CT-2001-00109;- Deliverable 1.1a (ii) review of other indicator systems;- N. Geeson

³ KM: Land Initiative. Medium Size Project: Ensuring Impact of SLM- Development of a Global Indicator System. 2nd Expert Advisory Group, 21-23 January 2008, Bonn (Germany). Meeting Report.

GEF

The Global Environment Facility (GEF) has developed and is developing a set of impact indicators to record change in a number of Land Degradation parameters, particularly at the global level (Annex 7). This process will not be finalized until 2010 but much useful information is already available (See GEF indicators, Annex 7).

CSFD

The Informal Group of Experts (IGE) has also the opportunity to have the first working list of indicators established by the French Scientific Committee and submitted to the European Desert Network. This list was established taking into account the existing indicators in literature as well as statistics and databases on international organization websites. This list of indicators was compared to the indicators listed by the countries on the received questionnaires, to identify existing indicators in the literature (CSFD list) currently used. Very few indicators from the literature (so developed at the academic and/or project levels) are used. That confirms the generally accepted idea of the existing gap between scientific/academic/project and policy level and the sustainability of the methodologies developed by the projects after their completion.

LADA

The Land Degradation Assessment in Drylands project (LADA) (2006 – 2010) aims at the assessment of land degradation at different spatial and temporal scales and the creation of a baseline at global level for future monitoring. FAO and UNEP are the executing and the implementing agency respectively, while the Global Environment Fund (GEF) is the main donor of the project.

The LADA project aims to develop assessment tools to collect up-to-date information on the status of land at local, national and global levels. For this it has developed a flexible methodological framework that relies on traditional and digitally assisted methods of data collection. The LADA project will produce an overview of the global status, pressures and causes of land degradation, indicating hot spots and bright spots. Six pilot countries will produce higher resolution assessments, which will allow the further refinement of the methodological framework. Both the global and the country assessments will serve as a baseline to design policies for combating land degradation and rehabilitating degraded land. This baseline will also allow countries to monitor the success of these policies.

During its first year of work, the LADA project prepared, in collaboration with national partners, an indicator toolbox containing a minimum set of indicators that can be measured at local and global scales, and that allow for extrapolation at these different scales. LADA now covers 12 countries. Land Use Systems (LUS) are the most suitable units that capture the status and causes that influence land degradation and sustainable land management. LADA has developed global land use systems that are adapted and refined by each LADA country at national scale and are used as a reference at local scale. This approach allows extrapolations.

The global component of LADA provides a baseline assessment of global trends in land degradation using a range of indicators collected by processing satellite data and existing global databases. The main indicators are:

- Net Primary Productivity Trends (NPP): can be determined by NDVI analysis (Remote Sensing) and corrected for climatic influences such as Rainfall use efficiency (RUE). A state indicator.
- Rainfall Use Efficiency (RUE): is the ratio of Net Primary Production over Rainfall: NPP/rainfall. In drylands, with varying rainfall RUE is a method to identify vegetation changes caused by other factor than the direct effects of changes in rainfall.
- Aridity Index (Bioclimatic Index) trend. Pressure indicator defined as the ratio between mean annual precipitation (P) and mean annual evapotranspiration (ETP).
- Erosion risk: pressure indicator giving information on the vulnerability of the land as a function of land cover, soil type, slope and rainfall erosivity.
- These indicators are then interpreted on the basis of a [Global Land Use Systems map](#).

OSS

Since the UN Convention to Combat Desertification (UNCCD) was adopted in 1994, OSS⁴, in strong partnerships with some of its member countries, sub-regional organizations⁵ and development partners, launched efforts to define and identify CCD process implementation indicators, and then impact indicators of actions to combat desertification. This led to the conceptualization of NAP/CD monitoring-evaluation comprising three aspects⁶: the extent of application of the principles advocated by the CCD (*monitoring-evaluation of CCD implementation*), the degree of scientific and technical control of the phenomenon itself (*monitoring-evaluation of the biophysical and socio-economic dimension of desertification*) and monitoring-evaluation of NAP/CD impacts. This concept was tested at three national levels and a sub-regional level. It was implemented in Tunisia, Morocco and Niger and at the Arab Maghreb Union level.

Alongside this NAP/CCD monitoring-evaluation experience, OSS, from the start, sought relevant information in Africa that could serve to calculate indicators at local and sub-national level. Its Long Term Ecological Observatories Monitoring Network (ROSELT), launched in 1995, is devoted to characterizing and monitoring the evolution of natural and cultivated ecosystems by exploring the relations between human activities and environmental change.

Capacity building through training has also been an important element in OSS actions. The results have been: greater awareness of the CCD by the main national actors, faster introduction of national monitoring-evaluation systems, and upskilling. The early modules are constantly being readapted to meet the changing needs of the stakeholders, especially those related to the implementation of national schemes of monitoring desertification. A virtual training platform capitalizes the results of sessions organized in OSS member states, and in other regions of the world, especially Latin America where GRULAC has shown interest in OSS' experience. This platform, which can be accessed through the OSS website or at the following address: <http://geooss.oss.org.tn/plateforme/index.php>, can be used by the next UNCCD's program of capacity building.

⁴ The monitoring and evaluation of national action programmes to combat desertification;- OSS;- 2006;- Tunis

⁵ Namely, CILSS and Arab Maghreb Union

⁶ ICCD/COP(4)/CST/7 and ICCD/COP(6)/5

UNFCCC/IPCC

Parties are due to prepare national annual reporting on greenhouse gas inventory under the UNFCCC framework and supplementary information of carbon stocks changes under the Kyoto Protocol. Information about land area is needed to estimate carbon stocks and emissions and removals of greenhouse gases associated with land use, land use change and forestry (LULUCF) activities. The GPG for LULUCF described six broad land-use categories for reporting national inventories under the Convention⁷:

- Forest land
- Cropland
- Grassland
- Wetlands
- Settlements
- Other land

In order to help national inventory agencies and projects participants, independent entities and operational entities, IPCC was invited to elaborate guidelines and to collect best practices. “Good Practice Guidance for Land Use, Land-Use Change and Forestry”⁸ was edited in 2003, it contains whole chapter (chapter 2) describing the basis for consistent representation of land areas.

Three main approaches are described and commented;

- Approach 1, Basis land – use data, uses datasets which have been prepared for other purposes such as forestry or agricultural statistics or inventories;
- Approach 2, Survey of land use and land use change, provides a national or regional scale assessment of the signification of the changes;
- Approach 3, geographically explicit land use data, which requires explicit observations of land use and land use change.

It is worth mentioning the need to capitalize these existing materials and experiences. As land degradation will lead to emissions and restoration to sink, the UNCCD, through the Secretariat or the CST or another liaison group, should contribute to the task-force in order to adapt existing methodologies to the UNCCD context. That will ensure more synergies between the two sister conventions and allow national stakeholders to work with the harmonized guidance, methodologies and common data.

Millennium Assessment Criteria for Selecting Indicators

The Millennium Assessment criteria⁹ for selecting indicators is useful, especially the last one related to the policymakers understanding:

- Does the indicator provide information about changes in important processes?
- Is the indicator sensitive enough to detect important changes but not so sensitive that signals are masked by natural variability?

⁷ http://unfccc.int/methods_and_science/lulucf/items/4127.php

⁸ http://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf_contents.html

⁹ Millennium Ecosystem Assessment, 2000. Analytical Approaches for Assessing Ecosystem Condition and Human Wellbeing. World Resource Institute, Washington DC. p.50

- Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?
- Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?
- Are reliable data available to assess trends and is data collection a relatively straightforward process?
- Are monitoring systems in place for the underlying data needed to calculate the indicator?
- Can policymakers easily understand the indicator? (NRC 2000)

LUCID

This Land Use Change project in East Africa also provided important guidelines for indicators of change associated with land degradation (Annex 7).

3.3 Approach to Indicator Framework

A concrete conceptual approach of desertification should be considered as a guide for the selection and use of indicators.

Desertification is a process that includes a complex chain of cause-effect between biophysical and social factors (Figure 1 is one way of approaching this relationship). Its understanding requires an important effort to integrate the relationships between physical, biological and social components of the territory.

The overlapping environmental, social and economic spheres (Figure 1) emphasize the central role of human/environmental actions embedded in UNCCD and indicators set in this framework provide the best measure of progress in restoring peoples well being and environmental sustainability. The indicators selected for the minimum set tend to group in the overlap areas of the three subsystems. Rural poverty rate, HDI and childhood malnutrition are socio-economic indicators. Access to safe water, land under SLM are examples of environmental/social indicators, while level of land degradation is an environmental/economic indicator.

4 Identifying Affected Areas

As the IGE developed the minimum set of indicators, described below, it was clear that an important missing link in the process was an agreed upon methodology of defining affected areas. Some countries are subject to land degradation over much of their territory; others for example Brazil have areas of severe land degradation in defined parts of the national territory. While it is not strictly in the mandate of the IGE, we wish to emphasize the importance of a more uniform identification of affected areas at least on a regional basis.

The two first objectives of the 10-year strategy of UNCCD, referred to the affected population and affected ecosystems by desertification, land degradation and droughts. So, the first task of assessment at local, national, regional and global scales is to identify most affected and most vulnerable ecosystems and population.

At the Global level, this can be derived from global assessments such as GLADA (Bai et al, 2008). At the national level, it is necessary to define a harmonized and concerted methodology which can be used by all member countries to map the affected areas at national scale. This map will be the basic layer on which all the indicators, of the minimum set, have to be referred because if the indicators don't refer specifically to the affected area, their national meaning is missed. The mapping and monitoring of the spatial extension of land degradation and desertification is necessary to understand the phenomenon and to elaborate sustainable national strategy and programs to combat it and to mitigate the impact.

Used methodologies were analyzed and the proposed methodology is based on the MEDALUS (Mediterranean Desertification and Land Use project funded by the EU), and the LADA Project assessment at national level. The IGE emphasized the need to work on obtaining a unified methodology for the identification of areas affected, which can be used by countries (see Annex 3).

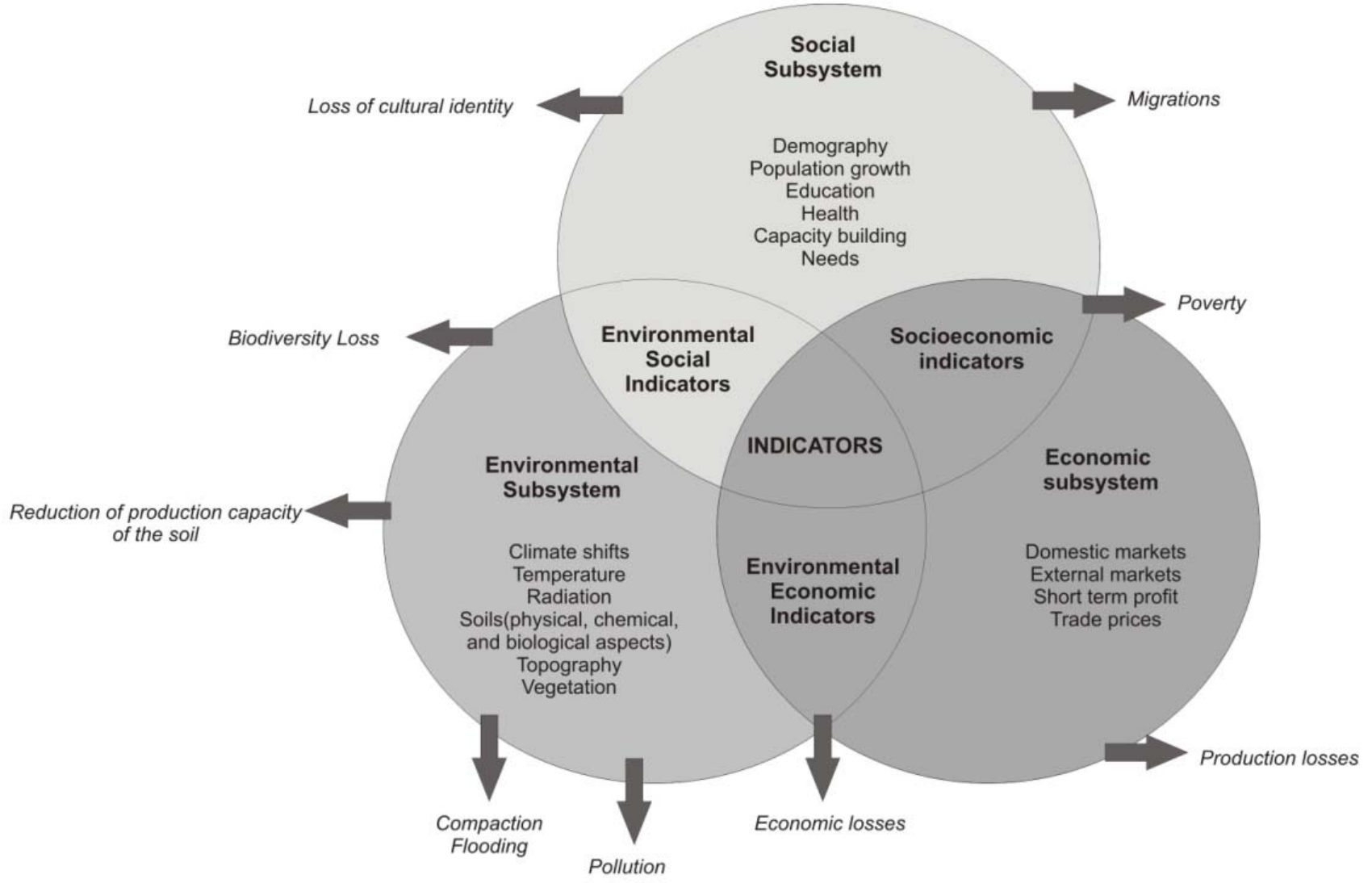


Figure 1: An Example of a Land Degradation Assessment Framework
 Source: Nap Argentina, 2002

5 Minimum Set of Impact Indicators

On the basis of all above reviews, analyses, consultations and syntheses a minimum set of indicators for each of the core objectives was identified using the following criteria: measurability, reliability, simplicity, applicability at various levels (local, national, regional, global), cost effectiveness, the special circumstances and needs of developing countries and the availability of existing data. A draft set was presented to the CST in March 2009 and in May 2009, after discussion and feedback, a final revised set presented is in outline form below. The IGE has attempted to keep the indicators to a minimum set and in some cases to use an indicator in more than one context. Eleven indicators are presented as the set that can best identify the impact of the UNCCD in implementing its 10-year strategic plan. If parties complete the 11 proposed indicators they will of course be free to use additional regional or national indicators that they deem appropriate.

List of eleven proposed indicators:

- I. Water availability per capita in the affected areas
- II. Change in land use
- III. Percentage of population in affected areas above poverty level
- IV. Childhood malnutrition and/or food consumption/caloric intake per capita
- V. Human Development Index (HDI)
- VI. Level of land degradation
- VII. Plant and animal biodiversity
- VIII. Aridity index
- IX. Land cover status
- X. Carbon stocks above and below ground
- XI. Lands under Sustainable Land Management (SLM)

Objective 3 focuses on the global benefits that can be determined through the implementation of the convention. The core of the convention is to combat land degradation for the benefit of people in degraded areas and for rehabilitation of the affected ecosystems. To some extent the core set of minimum indicators for objectives 1 and 2 provide an insight into the relevance of the convention at the global level, but a few additional indicators help to focus on this issue

For the current set of minimum indicators we have focused on two areas- the impact of the convention activities on the growth of sustainable land management (SLM) and the reduction of poverty in the affected areas.

Table 1: Proposed set of impact indicators in relation to the Strategic Objectives and Core Indicators

	National Level	Global Level
Objective 1: To improve living conditions of affected populations		
<p>Core Indicator S1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought</p> <p>Core Indicator S-2: Increase in the proportion of households living above the poverty line in affected areas.</p> <p>Core Indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.</p>	<ul style="list-style-type: none"> • I. Water availability per capita in the affected areas • II. Change in land use • III. Percentage of population in affected areas above poverty level • IV. Childhood malnutrition and/or food consumption/caloric intake per capita 	<ul style="list-style-type: none"> • I. Water availability per capita in the affected areas • III. Percentage of population in affected areas above poverty level • V. HDI (Human Development Index as defined by UNDP)
Objective 2: To improve the conditions of the ecosystems		
<p>Core Indicator S-4: Reduction in the total area affected by desertification/land degradation and drought</p> <p>Core Indicator S-5: Increase in net primary productivity in affected areas.</p>	<ul style="list-style-type: none"> • II. Change in land use • VI. Level of land degradation (including Salinization, erosion, wind erosion, etc) • VII. Plant and animal biodiversity • VIII. Aridity index 	<ul style="list-style-type: none"> • IX. Land cover status
Objective 3: To generate global benefits through effective implementation of the UNCCD		
<p>Core Indicator S-6: Increase in carbon stocks (soil and plant biomass) in affected areas.</p> <p>Core Indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management</p>	<ul style="list-style-type: none"> • I. Water availability per capita in the affected areas • X. Carbon stocks above and below ground • XI. Lands under Sustainable Land Management (SLM) 	<ul style="list-style-type: none"> • III. Percentage of population in affected areas above poverty level • XI. Lands under Sustainable Land Management (SLM)

5.1 Discussion of Indicators

Of the 11 indicators presented 4 focus primarily on measurements of well being among the affected population (Water availability per capita in the affected areas, Percentage of population in affected areas above poverty level, Human Development Index and childhood malnutrition and/or food consumption/caloric intake per capita), 4 focus primarily on the status of the ecosystems (level of land degradation, plant and animal biodiversity, Aridity Index and level of carbon stocks above and below ground), 3 combine elements of both (change in land use, land cover status and lands under Sustainable Land Management).

I. Water availability per capita in the affected areas.

Purpose: To monitor progress in the accessibility of the affected population to improved water sources.

Relevance to UNCCD: Land degradation affects the quantity and quality of fresh water supplies. Drought and desertification are associated with lower water levels in rivers, lakes, and aquifers. The Convention text refers frequently to water scarcity¹⁰. In particular, the projected intensification of freshwater scarcity as a result of climate change will cause greater stresses in drylands.

II. Change in land use.

Purpose: The purpose of this indicator is to highlight changes in the productive or protective uses of the land resource.

Relevance to UNCCD: Information on land use change is critical for integrated and sustainable land use planning and as an indicator of economic change. Changes in arable and permanent crop land and wooded areas give important information about a country's endowment in agricultural and forest resources, both from an economic and an environmental perspective. Economically, changes in land use will result in changes in the volume of produce available and influence employment opportunities. Unsustainable land use is an important factor in erosion and desertification may pose a threat to ecosystems, and lead to natural habitat loss and landscape changes.

III. Percentage of population in affected areas above poverty level.

Purpose: Poverty is the most important defining characteristic of underdevelopment. National poverty rate is one of the core measures of living standards and it draws attention exclusively towards the poor. National estimates are based on population-weighted subgroup estimates derived from household surveys.

Relevance to UNCCD: Measures of poverty are a very significant consideration of assessing the impact of actions against desertification due to the centrality of poverty as a root cause, and at the same time consequences, of land degradation and desertification¹¹. In the affected areas, peoples incomes as a strongly dependent on ecosystems services, it is worth mentioning that

¹⁰ <http://www.unccd.int> (8 April 2009)

¹¹ Mathilde Snel & Alexandra Bot

poverty is linked to the state of ecosystem services. Several determinants of human well-being are directly dependent on ecosystem services¹².

IV. Childhood malnutrition and/or food consumption/caloric intake per capita.

Purpose: The purpose of this indicator is to measure long term nutritional imbalance and malnutrition resulting in undernutrition (assessed by underweight and stunting) and overweight.

Relevance to UNCCD: Health and development are intimately interconnected. Meeting primary health care needs and the nutritional requirement of children are fundamental to the achievement of sustainable development. Nutritional status is the best global indicator of well-being in children and of the availability of ecosystem services.

V. Human Development Index (HDI).

Purpose: The HDI indicator is an attempt to measure the status and change in the well being of populations. The HDI is a compilation of achievements in three dimensions of human development; a long and healthy life; access to knowledge; and a decent standard of living. These basic dimensions are measured by life expectancy at birth, adult literacy and combined gross enrolment in primary, secondary and tertiary level education, and gross domestic product (GDP) per capita in Purchasing Power Parity US dollars (PPP US\$), respectively. The index is constructed from indicators that are available globally using a methodology that is simple and transparent.

Relevance to UNCCD: While the concept of human development is much broader than any single composite index can measure, the HDI offers a powerful alternative to GDP per capita as a summary measure of human well-being. It provides a useful entry point into the rich information contained in the subsequent indicator tables on different aspects of human development. While the HDI provides data on status and trends for the country as a whole in many cases it should be possible to provide this data for affected areas. If this can be done it will be an effective surrogate for the impact of the efforts to combat desertification on the livelihood of peoples.

VI. Level of land degradation.

Purpose: The indicator will measure the extent and severity of land degradation at the national level. It also measures the implementation of agreements and programmes to address causes of land degradation and to reclaim degraded lands.

Relevance to UNCCD: The UNCCD was mandated to address land degradation and drought. An assessment of the degree of land degradation provides an indicator of the progress to restore ecosystem services. Land degradation is an impediment to sustainable development in general, and to sustainable agriculture in particular. Land degradation and soil loss threaten the livelihood of millions of people and future food security, with implications for water resources and the conservation of biodiversity.

¹² Poverty and Ecosystems: Prototype assessment and reporting method, Kenya case study;- By Dr. Anantha Kumar Duraiappah and Marlene Roy;- July 2007;- <http://www.iisd.org>

VII. Plant and animal biodiversity.

Purpose: The BII was designed to fulfill the requirements set out by the Convention of Biological Diversity (CBD) which stipulated that an indicator for biodiversity change should be scientifically sound, be sensitive to changes at policy-relevant spatial and temporal scales, allow for comparison with a baseline situation and policy target, be useable in models for future projections, and be amenable to aggregation and disaggregation at ecosystem, national and international levels (CBD 2003; Scholes & Biggs 2005; Biggs et al., 2006). In addition it requires that the index be easy to understand and use, broadly accepted and measurable with sufficient accuracy at affordable cost (Biggs et al. 2006). The purpose of the BII was to help fulfill the goal of the signatories of the CBD, who aimed to “achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level” (CBD 2003; Mace 2005).

Relevance to UNCCD: Knowledge of plant and animal biodiversity is a basic input to the UNCCD, which helps determine the baseline to identify changes induced by pressure on land use on natural ecosystems and biodiversity status with synergies with the Convention of Biological Diversity (CBD). There are direct and indirect relationships between the state of natural resources (soil, vegetation, water, ecosystem), the biological diversity at species level (animal, plant and microbial species), ecosystem level (habitats, interactions, functions) and the management of those resources. Changes in biodiversity are the result of land degradation and unsustainable land management. The management practices affect the capacity of land users to conserve and sustain resources and provide goods and ecological services.

VIII. Aridity Index.

Purpose: To contribute to UNCCD core indicator S4 and S5 to classify desertification-prone areas and monitor land degradation in terms of long-term loss of ecosystem primary productivity.

Relevance to UNCCD: UNCCD refers not only to desertification, but also to effects of droughts, Aridity Index allows definition of intervals of climatic water deficiency and excess within a specific time period, aims to identify and map areas prone to drought and vulnerable areas. This is a base indicator for characterizing sensitive and desertification-affected areas, and for the construction of indicators associated with land degradation and productivity. “Aridity is a natural environmental condition that describes climate extremities particularly referring to water scarcity. It is a determinant of ecosystem characteristics affecting soil health capacity. Soil moisture influences the distribution and growth pattern of vegetation, soil microbial activity, soil erosion, wind erosion, nutrient movements and other soil properties. A part of land degradation assessment procedure that will provide understanding on developing strategies and approaches to mitigate/combat land degradation in drylands”¹³.

IX. Land cover status.

Purpose: To contribute to UNCCD core indicators S4 and S5 by providing two integrated indicators suited to monitor land degradation in terms of long-term loss of ecosystem primary productivity and taking into account to effects of rainfall on NPP.

¹³ LADA, Technical report 2, biophysical indicator toolbox, (pressure/state), April 2007.

Relevance to UNCCD: The Global Assessment of Land Degradation and Improvement (GLADA) uses remote sensing to identify degrading areas and areas where degradation has been arrested or reversed. The indicator is specifically targeted to meet the UNCCD demand for quantitative assessment at the global scale. The indicators proposed are: Net Primary Production (NPP), Rain Use Efficiency (RUE).

X. Level of carbon stocks above and below ground.

Purpose: To encourage countries to take note of their carbon stocks and to record changes in above and below ground stocks as a global benefit.

Relevance to UNCCD: One purpose of the UNCCD is to reduce land degradation and to combat drought. A measure of success in this regard is the increase in carbon stocks held by both above ground and in ground carbon. Carbon sequestration as a result of the UNCCD has global significance in climate change. It is likely that the UNFCCC will require carbon stock measurement from the parties and it now appears possible to provide countries with adequate estimates.

XI. Lands under Sustainable Land Management.

Purpose: Land under Sustainable Land Management (SLM) is an important surrogate for a number of global benefits. Sustainable land management affects albedo, evapotranspiration, vegetation cover and carbon sequestration all of which have climate change implications. SLM seeks to harmonize the complementary but often conflicting goals of production and environmental protection. The aim must be an agreed trade-off from farm level and community level to the international level. The central question is not how to preserve nature in a pristine state but how to co-exist with nature in order to maintain the functions of the land resources for the benefit of society in a sustainable manner (World Bank 2006).

Relevance to UNCCD: Sustainable land management impacts vegetation cover and composition which is globally important for biodiversity. Sustainable land management also reduces soil erosion and stream and lake sedimentation which is important for water retention and the regional hydrologic balance. SLM is thus an effective measure of a number of global benefits.

A detailed analysis of each indicator can be found in Annex 8.

5.2 Proposed Methodologies for Each Indicator of the Minimum Set

Existing methodologies are reviewed; when the indicator is already used in another context, it is recommended to use exactly the same methodology in order to avoid duplication, and to strengthen synergies between the different initiatives.

As the UN Sustainable Development Initiative has done a very great work on the development indicator and drafted a well-know referential guide to the adopted indicators, it is suggested to adopt the profile used by the UNSD and to complete it by the relevance to the UNCCD.

6 Conclusions and Recommendations

In The process of selecting this minimum set of impact indicators the IGE has identified a number of important issues.

1. At the national level, the issue of the area to which the indicators refers is not clearly defined in most cases. In some countries with a wide range of ecological conditions definition of the affected areas is important. The group has presented some of the current tools in use for defining these areas but in our opinion this area needs further special attention. In any follow-up on this issue country and regional level inputs would be most important.
2. The large number of indicators used by the countries in response to the questionnaires show clearly that the philosophy of sharing common indicators has not worked up to the present. Many indicators appear to be focused on the project level. We judge that it is better to have fewer, shared and well-known proxy indicators rather than a long list of scientific ones. The Millennium Assessment criteria for selecting indicators is useful, especially the last one related to the policymakers understanding (See pg. 10).
3. This first list of indicators must be considered as a starting point of a harmonized work of the Parties rather than a final list. Indicators have to be improved and strengthened considering the results of their use by Parties, on one hand, and the scientific progress, on another hand.
4. For that, it is important that the UNCCD works to establish standardized methodologies which will be used by Countries (as it is done in the UNFCCC framework). These methodologies have to be elaborated by a group of experts within sufficient times to allow the broadest possible consultation.
5. If this list is accepted a strong program of capacity development will be important.
6. This report focused on global and national indicators. Regional based indicators are important and should be part of a follow-up activity to develop specialized coordinated minimum sets.

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Annex 1. Sample Questionnaire



UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION (UNCCD)
COMMITTEE ON SCIENCE AND TECHNOLOGY (CST)



COUNTRY:
Date of submission:

QUESTIONNAIRE ON IMPACT INDICATORS IN USE IN YOUR COUNTRY

Purpose

The eighth session of the Conference of the Parties by decision 3/COP.8, requested the CST to provide advice to the CRIC discussion on reporting at the nine session of the conference of the Parties (COP 9) on how best to measure progress on Strategic Objectives 1, 2 and 3 of The Strategy, inter alia, based on the deliberations and outcomes of its ninth session. Pursuant to this decision, a framework document was presented to the CST during its First Special Session in Istanbul, Turkey, 05 November 2008. This document (ICCD/CST(S-1)/4/Add.3) offered an approach and some advice on the methodology and procedure to be put in place for an optimum measurement of the Strategic Objectives 1, 2 and 3 and their related seven core indicators (S1-S7). The CST considered this item and prepared a related in-session document, ICCD/CST(S-1)/5/Add.1, available in UNCCD website (<http://www.unccd.int/cop/officialdocs/cst-s1/doclist.php>).

The CST Bureau further decided to involve directly the affected Countries, through their Science and Technology Correspondents (STCs), in providing information on the **IMPACT INDICATORS WHICH ARE IN USE IN THEIR COUNTRY**.

We are kindly asking your help in identifying relevant impact indicators in your country and in answering this questionnaire.

Please kindly return the questionnaire by e-mail to: **kmst@unccd.int BY 23 JANUARY 2009**

Please send also a copy to your respective regional CST Bureau member:

Africa group:

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Asia group:

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Submission languages:

Preferably English, French or Spanish

STRATEGIC OBJECTIVE 1:

TO IMPROVE THE LIVING CONDITIONS OF AFFECTED POPULATIONS

CORE INDICATORS S-1, S-2 AND S-3

CORE INDICATOR S-1: DECREASE IN NUMBERS OF PEOPLE NEGATIVELY IMPACTED BY THE PROCESSES OF DESERTIFICATION/LAND DEGRADATION AND DROUGHT.

1) Please check the number of impact indicators related to S-1 currently in use in your country.

0 1 2 3 4 5 more than 5

2) Please list a maximum of five impact indicators related to S-1 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: Please indicate if the indicator is implemented through the NAPs or at project or local level

3) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

CORE INDICATOR S-2: INCREASE IN THE PROPORTION OF HOUSEHOLDS LIVING ABOVE THE POVERTY LINE IN AFFECTED AREAS.

4) Please check the number of impact indicators related to S-2 currently in use in your country.

0 1 2 3 4 5 more than 5

5) Please list a maximum of five impact indicators related to S-2 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: *Please indicate if the indicator is implemented through the NAPs or at project or local level*

6) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

CORE INDICATOR S-3: REDUCTION IN THE PROPORTION OF THE POPULATION BELOW THE MINIMUM LEVEL OF DIETARY ENERGY CONSUMPTION IN AFFECTED AREAS.

7) Please check the number of impact indicators related to S-3 currently in use in your country.

- 0 1 2 3 4 5 more than 5

8) Please list a maximum of five impact indicators related to S-3 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: *Please indicate if the indicator is implemented through the NAPs or at project or local level*

9) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

- XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

STRATEGIC OBJECTIVE 2:

TO IMPROVE THE CONDITION OF AFFECTED ECOSYSTEMS

Core Strategic indicators S-4 and S-5

CORE INDICATOR S-4: REDUCTION IN THE TOTAL AREA AFFECTED BY DESERTIFICATION/LAND DEGRADATION AND DROUGHT.

10) Please check the number of impact indicators related to S-4 currently in use in your country.

0 1 2 3 4 5 more than 5

11) Please list a maximum of five impact indicators related to S-4 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: Please indicate if the indicator is implemented through the NAPs or at project or local level

12) For each of the above-mentioned impact indicators, please indicate, *if known*, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

CORE INDICATOR S-5: INCREASE IN NET PRIMARY PRODUCTIVITY IN AFFECTED AREAS.

13) Please check the number of impact indicators related to S-5 currently in use in your country.

0 1 2 3 4 5 more than 5

14) Please list a maximum of five impact indicators related to S-5 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: *Please indicate if the indicator is implemented through the NAPs or at project or local level*

15) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

STRATEGIC OBJECTIVE 3:

TO GENERATE GLOBAL BENEFITS THROUGH EFFECTIVE IMPLEMENTATION OF THE UNCCD

More Strategic indicators S-6 and S-7

CORE INDICATOR S-6: INCREASE IN CARBON STOCKS (SOIL AND PLANT BIOMASS) IN AFFECTED AREAS.

16) Please check the number of impact indicators related to S-6 currently in use in your country.

- 0 1 2 3 4 5 more than 5

17) Please list a maximum of five impact indicators related to S-6 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: *Please indicate if the indicator is implemented through the NAPs or at project or local level*

18) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

- XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

CORE INDICATOR S-7: AREAS OF FOREST, AGRICULTURAL AND AQUACULTURE ECOSYSTEMS UNDER SUSTAINABLE MANAGEMENT.

19) Please check the number of impact indicators related to S-7 currently in use in your country.

0 1 2 3 4 5 more than 5

20) Please list a maximum of five impact indicators related to S-7 that are currently in use in your country.

If needed, please list in italic up to 2 other impacts indicators that are not in use, but that you consider useful.

IMPACT INDICATOR	DEFINITION/DESCRIPTION	USED SINCE WHEN	LEVEL OF IMPLEMENTATION*	COMMENT

*: *Please indicate if the indicator is implemented through the NAPs or at project or local level*

21) For each of the above-mentioned impact indicators, please indicate, if known, the degree of measurability, reliability, simplicity, applicability and cost effectiveness.

XXX: High XX: Medium X: Low 0: Not assessed

IMPACT INDICATOR	MEASURABILITY	RELIABILITY	SIMPLICITY	APPLICABILITY	COST EFFECTIVENESS

OBSERVATIONS/COMMENTS:

indicators other than S-1 to S-7

Should you currently use in your country for Strategic Objectives 1, 2 ad 3 other core indicators than the one identified in the Strategy (S-1 to S-7), please provide for each of them the same information requested above (Question 1 to 3 on impact indicators)

Other observations or comments:

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Annex 3. Identifying Affected Areas

Mapping experiences synthesis

In Algeria

The desertification mapping was mainly based on the classification criteria of the arid lands and the steppe, these criteria are numerous, climatic, phytogeographic, pedology and agronomic. The approach is based on the LANDSAT data images completed with terrain observation. The scale was the 1/200 000 and the map covered 20 million of hectare in the steppique zone. With regard to the ecosystem fragility a synthesis chart was designed classifying land in to five classes. A deserted class, a very sensible to desertification class, a sensible to desertification class, a more or less sensible to desertification class, a little or most sensible to desertification class.

China

For the need of evaluating the dynamic of desertification, formulating NAP of China and planning for main ecological construction programs, 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 sets developed by CNDMC¹⁴. 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 order of severity¹⁵.

A double entry nomenclature is used to classify the various types of desertification:

Degree of desertification + Type of desertification + Type of land use.

In this classification, land desertification types comprise: desertification through wind erosion, soil salinization, water erosion, etc. Using these types, land desertification is expressed in terms of degradation of arable land, rangelands, and forests.

Based on quantified and measured indicators and indices, the degree of desertification is classified according to type of desertified land, i.e.:

- Not desertified,
- Little desertified,
- Fairly desertified,
- Seriously desertified,

¹⁴ the China National Desertification Monitoring Centre, State Forestry Administration of China

¹⁵ SUN SIHENG , LI FENG, Academy of Forest Inventory & Planning (AFIP) /China National Desertification Monitoring Center (CNDMC), State Forestry Administration), Beijing, China;- AIDCCD - Active exchange of experience on indicators and development of perspectives in the context of UNCCD, Coordinated by Nucleo Ricerca Desertificazione (NRD) – University of Sassari, Italy, State of the art on existing indicators and CCD implementation in the UNCCD Annexes

- Very seriously desertified,
- Extremely desertified.

The monitoring-evaluation indicators grid includes target indicators such as the texture of the land, vegetation, soil type, etc. that could reflect the various types and degree of desertification. The indicators selection criteria need to be representative, useful, scientific and applicable. Up to now, China has used the main indicators on the state of desertification, which are used to describe and interpret the state and trends of desertification. The value of this activity is that it produces thematic maps and indicators to inform decision-makers of the scope of the desertification phenomenon and provide them with an objective basis for making decisions related to plans¹⁶.

Tunisia/Maroc

The National Remote Sensing Center of both countries experience several methodologies to elaborate indicators for monitoring desertification. One of these experiences is implemented in the framework of an EC funded project coordinated by the Sahara and Sahel Observatory, between 2002 and 2004. The project develops an approach for the study and the evaluation of the desertification phenomenon at national and local levels by using remote sensing techniques. Thus, low resolution images combined to field data have allowed obtaining desertification risks maps at national scale by using biophysical parameters (vegetation index, surface temperature) derived from NOAA/AVHRR images covering the period between 1996 and 2002. The cartography of changes has permitted to identify stable areas and zones presenting regressive or progressive variations. These variations have been directly validated by field data in order to analyse the evolution of each land cover class.

Processing high resolution satellite data on areas presenting changes has allowed the production of mesogeographic indicators at the scale of the studied area. These indicators characterize the pressure exerted on natural resources of the studied area. This pressure is linked to human activities (land use, deforestation...) and to climatic aggressions (drought...)¹⁷.

Lebanon¹⁸

Taking into consideration the local context, the limited resources available and experience from previous attempts at monitoring at the national level, the Lebanese “Desertification Prone Areas” Model project (2001) attempted a methodological integration and proposes “a basic approach”, a pragmatic comprehensive approach based on data which is regularly collected by the various institutions.

It developed five thematic layers based on the MEDALUS approach as adapted to the specific context of the country:

¹⁶ ICCD/COP(6)/CST/

¹⁷ Projet LIFE : Suivi de la désertification dans les pays de la rive sud de la Méditerranée, « Mise en place de systèmes pilotes au Maroc et en Tunisie, Etude de l’extension à l’Algérie», Application au cas concret du Maroc ;- Noureddine BIJABER & al ;- Revue Française de la Photogrammétrie.

¹⁸ Youssef Brahim, Observatoire du Sahara et du Sahel;- - Active exchange of experience on indicators and development of perspectives in the context of UNCCD, Coordinated by Nucleo Ricerca Desertificazione (NRD) – University of Sassari, Italy, State of the art on existing indicators and CCD implementation in the UNCCD Annexes

- Climate: Precipitation, Evapotranspiration
- 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.

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 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:

$$\text{Index}_x = (\text{layer}_1 x * \text{layer}_2 x * \text{layer}_3 x * \dots * \text{layer}_n x) (1/n)$$

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:

$$\text{DPA} = (\text{CI} * \text{SI} * \text{VI} * \text{LUII} * \text{DPI}) (1/5)$$

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

Argentina: Determination of desertification indicators at state level (Mendoza Argentina), for the World Atlas of Desertification (Roig et al., 1991). The methodology is based on the definition of a theoretical framework, which starts from an inventory of processes of desertification per *environmental unit* (ecosystems). These factors and processes are turned into indicators evaluated to obtain the fragility grade (inherent risk) of the system to desertification (amount of all indicators that come from physical and biological support) and the degree of human pressure these ecosystems may withstand (amount of all indicators related to the demand of resources made by social groups). Once these intermediate products have been obtained, the relationship between fragility and human pressure per ecosystem related to number of evaluated indicators is used to know the status of desertification per ecosystem. This result is translated to a cartographic representation (desertification status), which allows decision-makers to quickly identify deterioration degree and leaders indicators, natural or human that conduct the process (e.g. wind erosion, firewood extraction, cattle pressure, etc.)

The method used is essentially cartographic, based on the use of remote sensing. The field control is made taking into consideration critical selected sites (transects) that are representative. Following consecutive steps the basic information is integrated into thematic maps (climate, geology, geomorphology, water resources, vegetation, soils, population, land use) until

overlapping the first integrated map of ecosystems or environmental units for reference. The work done to obtain the thematic maps must serve to determine the most outstanding indicators of desertification of the area. Those indicators are selected taking into consideration their easy quantification in percentages and at the same time their representation in thematic maps (soil alcalinization/salinity, wind and water erosion, texture and soil thickness, cover and stratification of vegetation, aridity index, wind speed, soil freezing, density of population, cattle load, use of wood and firewood, poverty index...). Taking into consideration the first integrated map of ecosystems or environmental units, the thematic indicators maps are overlapped, obtaining the values of each environmental unit taken as a reference. This information is located in a double – entrance table, in which the addition of the values of all the indicators of each ecosystem gives the inherent risk or the human pressure, depending on which indicators are taken into consideration: only the indicators of the natural environment or the ones related to human activity. The addition of the inherent risk and of human pressure indicators in each ecosystem allows making a map of Desertification Status.

Complementing this approach was recently developed a participatory procedure for obtaining indicators at local level, which can be adapted to the national level (Abraham et al. 2006). A methodology to address the temporal scale, using the input of environmental history to identify causes and consequences of desertification has also developed (Abraham, 2003).

North Africa¹⁹ (adapted to MEDALUS)

The Sensitive to the desertification of the North African Countries Map was elaborated on the framework of the DIS-MED project. The methodology developed at the European level by the MEDALUS (Mediterranean Desertification and Land Use, European project, which identifies the desertification prone areas on the basis of the ESA -Environmentally Sensitive Areas- index) was adapted to the South Mediterranean context.

The areas sensitive to desertification are identified by the combination of 4 quality indexes about:

- Soil
- Climate
- Vegetation
- Land management

The first three quality indexes provide a picture of the environmental conditions while the last one expresses an assessment of the pressure resulting from anthropogenic activities.

The methodology is based on the classification of each quality index obtained as the geometric mean of the available environmental and anthropogenic parameters. The available parameters are quantified in relation to their influence on the desertification processes assigning a score to each. We tried, as far as possible, to use the classifications adopted by the MEDALUS methodology. However, MEDALUS does not prescribe the number and type of classes, leaving the necessary flexibility to adapt to the data availability.

¹⁹ See: http://scide.oss.org.tn/scide-uma/uma/carte_sensibilite.pdf

The scores assigned to the different parameters range between 1 (best value) and 2 (worst value). The quality indexes were estimated utilizing the following parameters and formulae:

- SQI (Soil Quality Index) = $(\text{Parent material} * \text{Texture} * \text{Soil Depth} * \text{Slope})^{1/4}$
- CQI (Climate Quality Index) = Aridity
- VQI (Vegetation Quality Index) = $(\text{Fire risk} * \text{Erosion protection} * \text{Drought resistance} * \text{Plant Cover})^{1/4}$
- The MQI (Management Quality Index) was not calculated because a lack of data.

The geometrical average of the parameters, referring to each of the three indexes mentioned above, has been classified according to regular intervals (i.e. same range) shown in Table 1, representing quality classes on a downwards scale.

Table 1 - Quality classes

Class	Range
High	1 – 1.33
Medium	1.34 – 1.66
Low	1.67 – 2

The final overall ESA index is obtained as a geometrical average of the quality indexes.

$$ESA = (SQI * CQI * VQI)^{1/3}$$

The integration, management and processing of data were performed by means of ArcView Geographical Information System and its Spatial Analyst extension and the result was finalized at each national level by an multidisciplinary workshop.

Conclusion

These examples are certainly not exhaustive; it is worth noting the multitude of projects implemented with the aim of developing methodologies and approaches mapping sensitive or/and affected areas; but most of these projects have not gone beyond the “scientific publication” phase, and have not been operationalized in the decision-making process. So, we tried to review the projects which were proposed by national bodies to be used in the framework of the NAP/M&A thinking it could be a guaranty of an operational implementation.

International efforts

UN SD Indicator Land affected by desertification: This indicator profile is issued from the Sustainable Development indicators manual, Indicators of Sustainable Development: Guidelines and Methodologies, Third edition, Methodology sheets, United Nations, New York, October 2007²⁰. The methodology for this indicator is currently under revision in the context of the Land Degradation Assessment in Drylands (LADA) project implemented by the Food and Agricultural Organization (FAO) and partners. Consequently, the information contained in the present version mainly reflects the status of the methodology in the previous two editions of the CSD indicators.

²⁰ (<http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001socialA.htm>)

“Land affected by desertification” indicator is a measure of the amount of land affected by desertification and its proportion of national territory. The unit of measurement is area (Km²) and percent (%) of land area affected. The indicator describes the extent and severity of desertification at the national level. It should be: (i) a measure of the state of the problem at any one time; (ii) an indication of the trend in the severity of the problem over time and success of response mechanisms; and (iii) a means of comparing the severity of the problem from one country to another. The indicator should be a mechanism for determining the importance of this issue at the national level. Trend data over time can indicate success of response mechanisms. For dryland areas, desertification is a central problem in sustainable development. While many dryland ecosystems have generally low levels of absolute productivity, maintenance of that productivity is critical to the present and future livelihood of many hundreds of millions of people. Combating desertification is the core of sustainable development for large areas of the world. Severe degradation is a major impediment to sustainable development; moderate or slight degradation is also a significant barrier. The two most significant agreements are: Agenda 21 of the 1992 UN Conference on Environment and Development; and the UN Convention to Combat Desertification, 1994. In addition, the Desertification Convention texts (INCD-10/ New York) spell out a sound methodology for developing indicators. No definitive set of indicators has been agreed upon within the context of the desertification Convention.

Methodological Description

Underlying Definitions and Concepts: For the purposes of this indicator, desertification is defined as land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UN Convention to Combat Desertification, 1994). Land degradation means reduction or loss, in arid, semi-arid and dry sub-humid areas of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and, (iii) long-term loss of natural vegetation. Land degradation, therefore, includes processes which lead to surface salt accumulation and waterlogging associated with salt-affected areas.

Arid, semi-arid, and dry sub-humid areas means areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65 (UN Convention to Combat Desertification, 1994).

Measurement Methods: Measurement for this indicator initially requires an assessment of the extent of land degradation throughout the arid, semi-arid, and dry sub-humid zones of the nation. This is best done by a combination of previous assessments represented in map form, carried out by the United Nations Environment Program (UNEP) with the United Nations Office to Combat Desertification and Drought (UNSO), and the Food and Agricultural Organization (FAO); and updates from a combination of remote sensing and local knowledge.

The creation of an index that combines degrees of severity will require the following measures:

- (i) Area subjected to severe land degradation $x\text{Km}^2$ (severe here includes both the severe and very severe categories of UNEP).
- (ii) Area subjected to moderate land degradation $y\text{Km}^2$.
- (iii) Area subjected to slight land degradation = $z\text{Km}^2$.
- (iv) National area (excluding surface water bodies) $n\text{Km}^2$.
- (v) National area of drylands (vulnerable to desertification, assuming that all drylands are potentially vulnerable to desertification. Hyper-arid lands are excluded), consisting of arid, semi-arid, and dry subhumid land = $d\text{Km}^2$.

From the above measurements, the following sets of numbers can be derived:

Indicator computations:

a. National area affected by desertification

$$= x + y + z\text{Km}^2$$

b. Percent of national area affected by desertification

$$= \frac{x + y + z}{n} \times 100$$

c. Percentages of national area affected by severe, moderate and slight desertification respectively can be calculated in the same way.

d. Percent of national drylands affected by desertification

$$= \frac{x + y + z}{d} \times 100$$

e. National area not affected by desertification

$$= n - (x + y + z)\text{Km}^2$$

f. National dryland area not affected by desertification

$$= d - (x + y + z)\text{Km}^2$$

Trends can be determined by comparing results computed for a sequence of years (for example, every five years).

A useful extension of the indicator would be for countries to report dryland areas (d) as a percentage of all agriculturally productive areas ($e=n$ -hyper arid land) to give an indication of the overall vulnerability of the country to desertification.

While it is based on a combination of analytical and subjective assessment, if these are done systematically on an annual basis, a sound data base can be developed. Given the importance of determining the extent and severity of desertification to the index, it may be that a periodic special survey using remote sensing and ground assessment may be important, though this may only be technically feasible for some countries.

An important issue in the basis measurement of degradation is the factors that are measured to assess the degree of local degradation. As Bie (1990) clearly points out, the two factors of productivity and resilience are the most important elements in assessing the existence and the extent of dryland degradation. Accurate measurement of land affected by desertification is a problem about which there is not yet complete consensus and further work needs to be done to agree on a comparable methodology for the various countries affected by desertification (UNEP,

Atlas of Desertification; UNEP/ISRIC/ISS/FAO, Global Assessment of the Status of Human-induced Soil Degradation (GLASOD)).

Limitations of the Indicator: There are a number of issues to be resolved before this indicator can be entirely satisfactory. The ecosystems addressed in this definition undergo cyclic episodes of more or less rainfall, as well as long-term degradation in many cases. Separating short-term fluctuations from longer-term trends is important, though scientists often find this difficult to determine, except for longer time periods. Also, the United Nations Environment Program (UNEP) has generally defined desertification (degradation) in categories (severe, moderate, slight), and a national indicator needs to include an assessment of this kind. It has been a practice to include problems of waterlogging and salinization as part of desertification, if they occur within the ecosystems as defined above. In this case, the area affected by these problems should also be included in the desertified area. Because of these issues, the indicator may well benefit from further refinement and definition. The concepts of land degradation in arid, semi-arid, and dry sub-humid areas are well defined and described in a number of UNSO, UNEP, and other UN publications, as well as in the academic literature. The translation of these concepts into agreed national level indicators has not been so well articulated. (Mabbutt, J.A. 1986; Maimuet 1991).

Status of Methodology: The methodology is currently under revision.

Assessment of Data

Data Needed to Complete the Indicator: The data needed to compile the indicator are the extent and severity of dryland degradation in the country concerned, the dryland area, and national area (excluding surface water bodies). The degree of accuracy and reliability of both spatial and statistical data varies considerably and are often poorly documented and/or out of date. For some countries, the data do not yet exist. Benchmark data on desertification is critical to measuring progress.

National and International Data Availability and Sources: The webpage of the LADA project contains a number of country case studies and a wealth of related information. Information on drylands and national areas can also be obtained from national statistical institutions and publications, and can also be found in standard World Resources Institute (WRI), UN and World Bank publications. Some data on extent and degree of land degradation are available at the country level in national institutions or from non-government organizations, in donor countries, and in publications of the United Nations Development Program (UNDP)/UNSO, UNEP, FAO and other international institutions.

Data References: <http://lada.virtualcentre.org/pagedisplay/display.asp>,
<http://www.fao.org/desertification/default.asp?lang=en>, <http://www.unccd.ch>,
<http://www.undp.org/drylands/>, <http://www.isric.org/>

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agency will be the Food and Agricultural Organization (FAO).

Other Contributing Organizations: Other contributing organizations include: UNDP Dryland Development Centre, UNEP, Consultative Group on International Agricultural Research (CGIAR), International Fund for Agricultural Development (IFAD), World Soil Information (ISRIC).

LADA National Land Degradation Assessments: LADA have developed innovative concepts and can provide a wealth of information on state and drivers of land degradation, worldwide and nationally.

LADA has developed global **land use systems (LUS)** that are adapted and refined by each LADA country at national scale and are used as a reference at local scale. This approach allows extrapolations from Global to National/Local and from Local/National to Global. The on-line system includes *LUS Mapping Unit*: Land Cover (including urban areas and open water); irrigated areas; protected areas and livestock density. The attributes of the LUS are: ecosystems (climate, soil, terrain), crop types, crop management index, livestock types and socio-economics (population density and poverty level).

LUS are the most suitable units that capture the status and causes that influence land degradation and sustainable land management interventions (Nachtergaele, 2008).

LUS includes: type, area trend and intensity trends.

Degradation per LUS: type (soil, vegetation and water), relative extent (area), degree and rate, impact on ecosystem services (type and level), trend in provision of ecosystem services, direct causes of land degradation and indirect causes of land degradation (population pressure, tenure, poverty).

Sustainable management per LUS: name / SWC category, relative extent (area), impact on ecosystem services (type and level) and trend in provision of ecosystem services.

Technical Procedure to obtain the Major land use systems (Nachtergaele and Petri, 2008)

- Step 1:** Simplify the classes of GLC-2000 to 6 basic classes: Forests, Herbaceous, Wetlands, Bare land, and Agricultural land.
- Step 2:** Overlay this simplified land cover database with the urban area database and replace any pixel indicated as urban with urban class.
- Step 3:** Overlay result with irrigated area data base and classify any pixel with irrigation occupying more than 25 % of the pixel as agricultural land.
- Step 4:** Overlay protected area map and define land cover classes concerned as protected use.
- Step 5:** Classify Livestock densities in the FAO map as low, moderately intensive and intensive according to the procedure (explained in Nachtergaele and Petri, 2008 Annex 2).
- Step 6:** Classify “Bare land cover areas” and “Herbaceous areas” as Pastoral and specify the intensity of the system.
- Step 7:** If livestock density corresponds with moderate or intensive classify “Agricultural land areas” as Agro-pastoral and “Wetlands” as Agro-pastoral (wetland) systems. If the moderate or higher density occurs in Forest areas classify them as forest-pastoral systems.
- Step 8:** Classify all areas with irrigation covering more than 25 % of the pixel as large scale irrigated agriculture.
- Step 9:** Classify all remaining agricultural land as rain fed agriculture.
- Step 10:** Classify all open water areas as inland fisheries.

At national level, **WOCAT/LADA/ (DESIRE) Standard Land Degradation and Sustainable Management Questionnaire** is applied for each LUS, participatory evaluation involving many local experts in a harmonized way.

Annex 4. Countries to whom Questionnaire was sent

AFRICA	ASIA	LAC	WEOG	EEG
Algeria	Afghanistan	Antigua and Barbuda	Australia	Albania
Angola	Bahrain	Argentina	Canada	Armenia
Benin	Bangladesh	Bahamas	Croatia	Azerbaijan
Botswana	Bhutan	Barbados	Cyprus	Belarus
Burkina Faso	Brunei Darussalam	Belize	Greece	Bosnia and Herzegovina
Burundi	Cambodia	Bolivia	Hungary	Bulgaria
Cameroon	China	Brazil	Israel	Croatia
Cape Verde	Cook Island	Chile	Italy	FYR. of Macedonia
Central African Rep.	Fiji	Colombia	Latvia	Georgia
Comoros	India	Costa Rica	Malta	Hungary
Congo Republic	Indonesia	Cuba	Portugal	Latvia
Cote d'Ivoire	Iran	Dominica	Slovenia	Montenegro
Djibouti	Jordan	Dominican Republic	Spain	Republic of Moldova
Egypt	Kingdom of Saudi Arabia	Ecuador	Turkey	Romania
Eritrea	Kazakhstan	El Salvador	United States	Russian Federation
Ethiopia	Kiribati	Grenada		Serbia
Gabon	Korea	Guatemala		Slovenia
Gambia	Kuwait	Guyana		Ukraine
Ghana	Kyrgyzstan	Haiti		
Guinea	Lao People's Dem. Rep	Honduras		
Guinea Equatorial	Lebanon	Jamaica		
Guinea-Bissau	Malaysia	Mexico		
Kenya	Maldives	Nicaragua		
Lesotho	Marshall Islands	Panama		
Liberia	Micronesia federated states of	Paraguay		
Libya	Mongolia	Peru		
Madagascar	Myanmar	Saint Lucia		
Malawi	Nauru	Saints Kitts and Nevis		
Mali	Nepal	St Vincent and the Grenadines		

Mauritania	New Zealand	Suriname		
		Trinidad and Tobago		
Mauritius	Niue			
Morocco	Oman	Uruguay		
Mozambique	Pakistan	Venezuela		
Namibia	Palau			
Niger	Palestine			
Nigeria	Papua New Guinea			
Rep. Dem. Congo	Philippines			
Rwanda	Qatar			
Sao Tome et Principe	Republic of Korea			
Senegal	Samoa			
Seychelles	Singapore			
Sierra Leone	Solomon Islands			
South Africa	Sri Lanka			
Sudan	Syria			
Swaziland	Tajikistan			
Tanzania	Thailand			
Chad	Timor Leste			
Togo	Tonga			
Tunisia	Turkmenistan			
Uganda	Tuvalu			
	United Arab Emirates			
Zambia				
Zimbabwe	Uzbekistan			
	Vanuatu			
	Vietnam			
	Yemen			

Annex 5. Countries who responded to Questionnaire

AFRICA	ASIA	LAC	WEOG	EEG
Algeria	Bhutan	Argentina	Australia	Belarus
Benin	Cook Island	Bolivia	Canada	Bulgaria
Botswana	Fiji	Colombia	Greece	Hungary
Burkina Faso	Indonesia	Cuba	Hungary	Romania
Congo	Iran	Dominican Republic	Israel	
Egypt	Kingdom of Saudi Arabia	El Salvador	Italy	
Eritrea	Kazakhstan	Mexico	Portugal	
Ethiopia	Lebanon	Panama	Spain	
Guinea Equatorial	Mongolia	Venezuela	Turkey	
Madagascar	Nepal		United States	
Mali	Philippines			
Morocco	Sri Lanka			
Niger	Syria			
Sudan	Uzbekistan			
Swaziland	Vietnam			
Tanzania	Yemen			
Uganda				
Zambia				

Annex 6. Summary of Questionnaire Outcomes

Country	Indicators S-1		Indicators S-2		Indicators S-3		Indicators S-4		Indicators S-5		Indicators S-6		Indicators S-7	
	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No	Present/ Absent	Assessed Yes/No
Ethiopia	Present	No	Present	No	Absent	N/A	Present	No	Present	No	Absent	N/A	Present	No
Swaziland	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A
Morocco	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Absent	N/A	Present	Yes
Niger	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Uganda	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Egypt	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Guinea Ecuatorial	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Madagascar	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes
Algeria	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes
Tanzania	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Absent	N/A
Benin	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Absent	N/A	Absent	N/A	Absent	N/A
Sudan	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Zambia	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes

Eritrea	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Congo	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Absent	N/A	Present	Yes
Burkina Faso	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Botswana	Present	Not all	Present	Not all	Present	Not all	Present	Not all	Present	Not all	Present	Not all	Present	Not all
Mali	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Sri Lanka	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Absent	N/A	Present	Yes	Present	Yes
Mongolia	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Indonesia	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Fiji	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Bhutan	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Philippines	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes
Nepal	Present	No	Present	No	Present	No	Present	No	Present	No	Present	No	Present	No
Vietnam	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Syria	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Kingdom of Saudi Arabia	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Lebanon	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	No	Present	Yes	Present	Yes
Iran	Present	Yes	Present	Yes	Present	Yes	Present	No	Present	Yes	Present	Yes	Present	Yes

Israel	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Absent	N/A
Kazakhstan	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Uzbekistan	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Yemen	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Turkey	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Bulgaria	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Australia	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Cook Islands	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Hungary	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Belarus	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Spain	Absent	N/A	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Portugal	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Greece	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Romania	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Italy	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Absent	N/A
Venezuela	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes
Colombia	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes

Cuba	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Panama	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	No	Present	No
Argentina	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Present	No	Present	Yes
El Salvador	Absent	N/A	Absent	N/A	Absent	N/A	Present	Yes	Absent	N/A	Absent	N/A	Absent	N/A
Bolivia	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Absent	N/A	Present	Yes
Mexico	Present	Yes	Present	Yes	Present	No	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Dominican Republic	Present	Yes	Present	Yes	Present	Yes	Present	Yes	Absent	N/A	Absent	N/A	Present	Yes
United States	Present	Yes	Present	Yes	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Present	Yes
Canada	Absent	N/A	Absent	N/A	Absent	N/A	Present	Yes	Present	Yes	Present	Yes	Absent	N/A

Annex 7. Key Indicator Sets

GEF Impact Indicators

Indicator	Scale	Rationale
Change in status of land degradation	Global	This indicator is based upon the Global Land Degradation mapping, 1981-2003 (LADA). The map may be used to identify areas where GEF intervention is needed; also may be used to prioritize proposed project interventions.
Change in vegetation land cover using NDVI	Global	This indicator is based on the land cover assessment for year 2000 from the work of the European Union Joint Research Centre based in Italy. The map may be used for comparison with the global land degradation map in order to assess which land cover categories are most affected by land degradation.
Prevalence of child malnutrition	Global	To identify areas where land degradation and poverty are closely linked – and, therefore must be addressed simultaneously.
Vulnerability to environmental disturbance	Global	The Human Vulnerability Index is one of the five key measurements of the Environmental Sustainability Index. This component seeks to measure the interaction between humans and their environment, with a focus on how human livelihoods are affected by environmental changes
Vulnerability to climate change	Global	The vulnerability index to climate change combines national indices of exposure and sensibility.
Water stress	Global	This indicator measures the ratio of withdrawals to availability, a conventional indicator of water stress. Water stress is a measure of the amount of pressure put on water resources and aquatic ecosystems by the users of these resources, including domestic users, industries, power plants and agriculture.
Rural poverty rate	National/Local	The poverty rate is part of a suite of decomposable poverty measures referred to as the Foster, Greer, and Thorbecke (FGT) Poverty Measures (Foster <i>et al.</i> , 1984), that also include the poverty gap and the poverty severity measure. The inputs required to produce these measures include a population estimate, a poverty line/threshold, and a welfare estimate.
Rural income	National	This indicator measures the poorest fifth's share of national income (or consumption). Related measures include the Rural Poverty Rate (see separate profile) and inequality measures such as the Gini coefficient, Generalized Entropy Measures and Coefficient of Variation, which describe how resources are distributed across a population.

LD Process	Variables	Climate change	Biodiversity	International waters	POPs	MDGs	
						Food security	Human Health
Land use change	Albedo	++					
	Evapotranspiration	++			++		
	Roughness	++					
	Vegetation cover	++		+		+	+
	Vegetation composition	++	+++	+		+	+
	Habitat loss		+++			++	+++
	Carbon loss from vegetation removal	+++					
	Land use conversion	+++				++	+++
Biomass burning	Aeolian dust emission	++					+++
	GHGs emission	+++					
	POPs emission				+++		++
Dust storms	Absorbing/deflecting incoming radiation	++	++	++	++		
	Nutrient cycle and deposition	+	++	++	++		
	Air pollution						++
Decline in Soil Organic Carbon	GHG emission from soil	+++					
	Microbial activities		++		++	+++	
	Soil nutrient availability		++	++		+++	
	Soil structure					+++	
Land	Agro-chemicals in soil		++	+++	+++	+++	
Contamination	- in surface runoff		++	+++	+++		++
	- in sediments		++	+++	+++		++
	- in groundwater		+		+++		++
	- in food chain		++	++	+++		++
	- in atmosphere		++	++	+++		++
Irrigation	Biomass production	++				+++	
	Waterlogging	+				+++	
	Salinization					+++	
	Surface water extraction			++		+++	
	Groundwater depletion		++	++		+++	
Soil Erosion	Soil redistribution	++	+++	+++	++		
	Biomass production	++				+++	
Habitation change (mining, road construction)	Land surface disturbance			++			++
	Landscape fragmentation		+++				

Qualitative degree of severity, sensitivity and certainty in the process linkage represented by:

+ = slight; ++ = moderate; +++ = strong

OSS Indicator Grid

CCD Objective	Domains concerned	Indicators	Categories P.S.R.I
Natural resources management	Biophysical aspects	Specific diversity of wildlife	S
		Specific diversity of flora	S
		Percentage of land recovered in relation to objectives	R
		Evolution of herbaceous biomass	S
		Soil utilisation rates, according to utilisation	P
Poverty eradication	Economic aspects	Growth rate of agricultural production	I
		Growth rate of pastoral production	I
		Growth rate of sylvo-cultural production	I
		Growth rate of agricultural GDP	I
	Growth rate of irrigated areas	R	
	Institutional and organisational aspects	Number of farmers' organisations involved in NRM	I
	Social aspects	Percentage of high-level posts occupied by women within rural organisations	S
		Percentage of rural women with access to credit	S
		Percentage of populations with access to potable water	R
		Health cover rate	S
		Gross schooling rate in primary school	S
		Adult literacy rate	S
		Land tenure conflicts resolution rate	R
	Number of declared land tenure conflicts	S	
	Institutional aspects	Share of state investment budget allocated to NRM	R
		Share of investment budget of territorial communities allocated to NRM	R
Share of partners' development aid allocated to NRM		R	

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

LUCID Indicators

Land Use Change Analysis to Identify and Monitor Land Degradation

Indicator	Methodology	Rationale
Land use change analysis	Needed to guide data collection and analysis	Provides historical, baseline and trends data on socioeconomic, agricultural system, vegetation type, structure, extent, wildlife fragmentation, migration corridors, changing productivity, erosion, land degradation, above ground carbon stocks
Conversion of land to a new use		The largest extent of LUC in many places, big impact on natural systems (forests, savannas, soils, water).
Change in use of key resource, e.g. water		Implications for loss of access to water for livestock and wildlife, and for water pollution.
Land adjacent to protected areas converted		Vegetation inside most protected areas maintained, land immediately adjacent to many protected areas was cleared. Implications for human-wildlife conflict and wildlife migration.
Intensification of rural land use, urbanization		Link to land and soil management, rapid response to markets and prices. Much variation between areas and between households in soil management and productivity. Intensification and conversion to crops can lead to initial rapid loss of organic matter, nutrients.
Root causes of land use change	Changes in Policy and regulations, especially land tenure, agricultural policies; economic changes: prices, markets; Population growth and in-migration; Environmental conditions.	Aid in design of effective policies and programs, and to forecast future pressures and trends. Major changes often correspond to changes in national land use policies.
Changes in vegetation type/productivity	Satellite imagery	To identify changes over large areas.

Summary of Millenium Assessment Datasets

Core Dataset	Brief Description	Lead Agencies
Global land cover	Global Land Cover 2000 dataset; a global product of land cover in year 2000, based on SPOT Vegetation satellite data	EU JRC, with regional networks
Human population density	an updated Gridded Population of the World dataset, referenced to year 2000, and including a rural/urban split, including a point database of human settlements >5,000 people, an urban mask (polygons), and a complete urban-rural gridded surface	CIESIN, with World Bank and IFPRI
Protected areas	the 13th UN List of Protected Areas, from which a “snapshot” of the extent of Protected Areas in the year 2000 has been generated, as a baseline dataset for the MA	UNEP-WCMC, with WCPA
Subnational agricultural statistics	sub-national time series and single year crop production data including area, production, and yield, available for the globe	IFPRI, with wider consortium
Climate	0.5-degree dataset of monthly surface climate extending from 1901 to 2000 over global land areas, excluding Antarctica 10-minute mean monthly surface climate grids for the 1961–90 period covering a similar area	University of East Anglia CRU and University of Oxford, UK
Human well-being indicators	sub-national infant mortality, malnutrition, and GDP data; global data, although malnutrition index only available for the developing world	CIESIN
Areas of rapid land cover change	a synthesis of the knowledge of areas affected by rapid land cover change during the last 20 years for various change classes, including deforestation, cropland and pasture expansion, soil degradation and desertification, urban expansion, and exceptional fire events	IGBP/IHDP, LUCC, GOFC/GOLD
Global MA reporting “units”	datasets delineating MA system boundaries (see Appendix Table 2.2), biomes and biogeographical realms, and socioeconomic regional reporting units	Various

Annex 8. Detailed Description of Impact Indicators

I. Water availability per capita in the affected areas	
Category: Health	Country Coverage: National and Global
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 1: To improve conditions of affected area</p> <p>Core Set Indicator S1: Decrease in number of people impacted by desertification, Land degradation and droughts</p> <p>Objective 3: To generate global benefits through effective implementation of the UNCCD</p>	<p>Status:</p> <p>Indicator in progress: Population With Water Stress - Water Poverty Index</p>

This indicator profile is issued from the Sustainable Development indicators manual, *Indicators of Sustainable Development: Guidelines and Methodologies, Third edition, Methodology sheets*, United Nations, New York, October 2007²¹.

Indicator

Name: Water availability per capita in the affected areas.

Brief Definition: Ratio of ground and surface water to population in the affected area.

Unit of Measurement: Percent (%)

Relevance

Purpose: To monitor progress in the accessibility of the population to improved water sources.

Relevance to UNCCD: Land degradation affects the quantity and quality of fresh water supplies. Drought and desertification are associated with lower water levels in rivers, lakes, and aquifers. The Convention text refers frequently to water scarcity²². In particular, the projected intensification of freshwater scarcity as a result of climate change will cause greater stresses in drylands.

When describing water availability in a country, the Falkenmark Water Stress Indicator, which was developed by the Swedish water expert Falkenmark in 1989, is one of the most commonly used indicators. Originally, the indicator based on the estimation that a flow unit of one million cubic metres of water can support 2,000 people in a society with a high level of development,

²¹ (<http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001socialA.htm>)

²² <http://www.unccd.int> (8 April 2009)

using Israel as a reference by calculating the total annual renewable water resources per capita. Water availability of more than 1,700m³/capita/year is defined as the threshold above which water shortage occurs only irregularly or locally. Below this level, water scarcity arises in different levels of severity. Below 1,700m³/capita/year water stress appears regularly, below 1,000m³/capita/year water scarcity is a limitation to economic development and human health and well-being, and below 500m³/capita/year water availability is a main constraint to life.

This is a useful indicator despite its shortcomings. First of all, only the renewable surface and groundwater flows in a country are considered. Moreover, the water availability per person is calculated as an average with regard to both the temporal and the spatial scale and thereby neglects water shortages in dry seasons or in certain regions within a country.

Ohlsson developed a “Social Water Stress Index,” which incorporates “adaptive capacity” into Falkenmark’s measure, essentially weighting the index by a factor based on the UNDP’s Human Development Index. The spatial component is also missed in this index. Similarly, neither Falkenmark nor Ohlsson suggest much about the geopolitical results of scarcity, focusing instead on implications for water management.

The access of water is an important well-being indicator. When broken down by geographic (such as rural/urban zones or, much better, affected areas), or social or economic criteria, it will provide useful information on equity issues within the country. It has the benefit to be based on well-understood and generally accepted conceptual models and to be easily understood by policymakers.

International Conventions and Agreements: Agenda 21 of UNCED (1992) indicates the need for universal coverage and the Second World Water Forum and Ministerial Conference, The Hague, March 2000 established the target of universal coverage by the year 2025, the Millennium Summit, 2000, established the target of halving the proportion of unserved by 2015.

International Targets/Recommended Standards: International targets for this indicator have been established according to different international events (see above).

Linkages to Other Indicators: This indicator is closely associated with other socioeconomic indicators on the proportion of people covered by adequate sanitation. These indicators are among the eight elements of primary health care and are one of the targets of the Millennium Development Goals. It also has close links to other water indicators such as withdrawals, reserves, consumption, or quality (see above).

Assessment of Data

National and International Data Availability and Sources: Routinely collected at the national and sub-national levels in most countries using censuses and surveys. Household surveys used by the JMP include: USAID supported Demographic and Health Surveys (DHS); UNICEF supported Multiple Indicator Cluster Surveys (MICS); national census reports; WHO supported World Health Surveys; and other reliable country surveys that allow data to be compared.

Data References: International data is included in the MDG database maintained by the United Nations Statistics Division.

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7. World Health Organization and UNICEF, Meeting the MDG drinking water and sanitation target: the urban and rural challenge of the decade. Geneva, WHO, 2006

Internet sites:

1. World Health Statistics: <http://www.who.int/whosis/en/index.html>
2. Water, Sanitation and Health: http://www.who.int/water_sanitation_health/en/
3. MDG Indicators: <http://mdgs.un.org/unsd/mdg/Default.aspx>

II. Change in Land Use	
Category: Environment	Country Coverage: National
Time Series: 2000 GLC data	Spatial Refinement 30 arc min
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 1: To improve conditions of affected area</p> <p>Core Indicator S1: Decrease in number of people impacted by desertification, Land degradation and droughts</p> <p>Objective 2: To improve the conditions of the ecosystems</p> <p>Core Indicator S4: Reduction in the total area affected by desertification/land degradation and drought.</p>	<p>Status:</p> <p>UN Developed by Commission on Sustainable Development (CSD). Under development by FAO LADA at national level.</p>

Indicator

Name: Change in Land Use

Brief Definition: Change with time of the distribution of land uses within a country.

Unit of Measurement: Proportion of change of each category of land use to another land use per unit of time.

Comments: Agenda 21: Chapter 10: Integrated Approach to the Planning and Management of Land Resources. This indicator was developed by the UN Commission on Sustainable Development (CSD). Is currently under development by FAO LADA at national level.

Type of Indicator: Driving Force, but can be used as impact.

Relevance

Purpose: The purpose of this indicator is to highlight changes in the productive or protective uses of the land resource.

Relevance to UNCCD: Information on land use change is critical for integrated and sustainable land use planning and as an indicator of economic change. Changes in arable and permanent crop land and wooded areas give important information about a country's endowment in agricultural and forest resources, both from an economic and an environmental perspective. Economically, changes in land use will result in changes in the volume of produce available and influence employment opportunities. Unsustainable land use is an important factor in erosion and

desertification may pose a threat to ecosystems, and lead to natural habitat loss and landscape changes.

Application: This analysis should be done globally and made available to the countries so that ground truthing and assessment can be carried out.

Methodological Description

Underlying Definitions and Concepts: Work coordinated by the United Nations Food and Agriculture Organization (FAO) is currently underway to harmonize classification systems and databases to improve national and international land use information. This includes the development of definitions and protocols, computerized land use database structure, and broadly accepted structure of land use classifications. LADA has developed global land use systems that are adapted and refined by each LADA country at national scale and are used as a reference at local scale.

Land use is generally determined by socio-economic market forces and the biophysical constraints and potentials imposed by the ecosystems in which they occur (Nachtergaele and Petri, 2008).

The LUS (Land Use System) is an important concept developed by FAO-LADA as the unit of reference and mapping. LUS are the most suitable units that capture the status and causes that influence land degradation and sustainable land management interventions.

Measurement Methods: Land use change data can be derived from periodic mapping and monitoring, (every 5-10 years recommended), partly on the basis of land cover information; from remote sensing, supported by ground truthing; and the use of land use aspects from agricultural census. It is essential to use a uniform classification of land use and cover. The FAO/United Nations Environment Program (UNEP) approach is recommended. Land use and land cover database software is also available. Use of these tools will lead to the production of uniform results and statistics. The definition of LUS mapping units according to the approach codified by LADA requires that a number of data layers are available and processed following the specific procedure developed by LADA. The procedure developed by LADA can be implemented at different scales. FAO produced a Global LUS and partners LADA countries tested the approach at the national level. The required data are a land cover map (including urban areas and open water) and other more specific information to be integrated in it: irrigated areas, protected areas and livestock density. Further attributes of the LUS (to be “attached” to it) are: ecosystem (climate, soil, terrain), crop types, crop management index, livestock types and socio-economics (population density and poverty level) (Nachtergaele, F., 2008).

Limitations of the Indicator: At the international level, sufficient harmonization of land use classification has yet to be achieved. Georeferenced land use change data are generally not available.

Status of Methodology: LADA LUS methodology has not been agreed as land cover mapping method by any intergovernmental fora.

Assessment of Data

Data Needed to Compile the Indicator: The data required includes updated statistics and remote sensing coverage, dependable agricultural census data on land uses, and dependable land use maps, all updated at regular intervals. In the absence of databases at national level, global databases can be used. Layers needed to define the LUS are: Land Cover, Irrigation, Urban areas, Protected areas and Livestock presence.

National and International Data Availability and Sources: Broad land use statistics are available for most countries. However, variable definitions, and the lack of consistent land use change data which is spatially referenced are serious impediments to, for example, temporal analysis and international comparisons. Global datasets as used by LADA to derive the Global LUS are listed below. At the national level, countries should find corresponding datasets and implement the same procedure at a higher, suited, level of detail.

Land Cover: The Global Land Cover 2000 (GLC2000) map, realized by the Joint Research Centre (JRC, 2006, FAO, 2005), was simplified by reclassification (6 versus 11 original classes: forests, Shrub and herbaceous sparse shrub, cropland and mosaic cropland, wetlands, artificial and bare areas and open water).

Irrigation: Global map of irrigated areas (version 4.0.1, February 2007). Center for Environmental Systems Research, University of Kassel, and Land and Water Development Division (FAO). Original resolution: 3 arc min.

Urban areas: Global Rural Urban Mapping Program (GRUMP), developed by CIESIN. Original resolution: 3 arc min. Database based on administrative population data and a global database of cities and towns (points).

Protected areas: WCMC and UNEP have prepared a geographic coverage of protected areas worldwide that includes National sites known boundary, national sites without IUCN category, sites within other International Conventions and agreements with known boundary, wetlands with international importance (Ramsar), World Heritage Sites and UNESCO-MAB Biosphere Reserves. The data originally are given at 1:1 000 000 scale.

Livestock presence: the indicator used is the TLU (Tropical Livestock Unit) density as an indicator for the intensity of livestock within a land use unit. Data and data sources available are: Cattle density and small ruminants (sheep+goats) from Wint and Robinson: (lat/long, WGS84, 3 arc minutes); Global livestock production systems by Thornton et al, 2002: (lat/long, WGS84, 3 arc minutes, qualitative data description).

Data References: Data are available from national governments and regional and international programmes which focus on land use information. <http://sedac.ciesin.columbia.edu/>; <http://www.landcover.org/data/gimms/>; <http://www-gvm.jrc.it/glc2000/>; <http://www.wdpa.org/>

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agency for the development of this indicator is the United Nations Food and Agriculture Organization (FAO).

Other Contributing Organizations: The United Nations Environment Programme is a partner in the development of this indicator. National experts from governments and institutes, for example the International Institute for Aerospace Survey and Earth Sciences and the Institute for Terrestrial Ecology, have also contributed.

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2. http://esl.jrc.it/envind/un_meths/UN_ME089.htm

III. Percentage of population in affected areas above poverty level	
Category: Income	Country Coverage: National and Global
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 1: To improve conditions of affected area</p> <p>Core Set Indicator S2: Increase in number of people living above poverty line</p> <p>Objective 3: To generate global benefits through effective implementation of the UNCCD</p>	<p>Status:</p> <p>Indicator ready, used by countries in the framework of UN Sustainable Development Indicators</p>

This indicator profile is issued from the Sustainable Development indicators manual, *Indicators of Sustainable Development: Guidelines and Methodologies, Third edition, Methodology sheets*, United Nations, New York, October 2007²³.

Indicator

Name: Percentage of population in affected areas above poverty level or proportion of population living below national poverty rate, the UN Sustainable Development Indicator used.

Brief Definition: The percentage of the affected population with a standard of living above the poverty line.

Unit of Measurement: Percent (%)

Related Measures: The most important purpose of a poverty measure is to enable poverty comparisons. These are required for an overall assessment of a country's progress in poverty alleviation and/or the evaluation of specific policies or projects.

Relevance

Purpose: Poverty is the most important defining characteristic of underdevelopment. National poverty rate is one of the core measures of living standards and it draws attention exclusively towards the poor. National estimates are based on population-weighted subgroup estimates derived from household surveys.

Relevance to UNCCD: Measures of poverty are a very significant consideration of assessing the impact of actions against desertification due to the centrality of poverty as a root cause, and at the same time consequences, of land degradation and desertification²⁴. In the affected areas,

²³ (<http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001socialA.htm>)

²⁴ Mathilde Snel & Alexandra Bot

people's incomes as a strongly dependent on ecosystems services, it is worth mentioning that poverty is linked to the state of ecosystem services. Several determinants of human well-being are directly dependent on ecosystem services²⁵.

International Conventions and Agreements: Millennium Development Goals (MDGs).

International Targets/Recommended Standards: The United Nations Millennium Project set a target to reduce the proportion of the population living in poverty by half between 1990 and 2015.

Comparison to Other Indicators and Strengths and Weaknesses: In general, this indicator is linked to many other sustainable development measures, for example, net migration rate, adult literacy rate, Gross Domestic Product per capita, and population living below the poverty line in dryland areas. In particular, the percent (%) of Population Living Below Poverty Line is closely associated to the Poverty Gap Index and the Squared Poverty Gap Index which capture successively more detailed aspects of the poverty situation. The percent (%) of the Population Living Below Poverty Line measures how widespread poverty is, the Poverty Gap Index measures how poor the poor are, and the Squared Poverty Gap Index measures the severity of poverty by giving more weight to the poorest of the poor

Methodological Description

National poverty rates use a country specific poverty line, which reflects the country's economic and social circumstances. In some case, the national poverty line is adjusted for different areas (such as urban and rural) within the country, especially when prices or the availability of goods and services differs. National poverty lines tend to have higher purchasing power in rich countries, where more generous standards are used, than in poor countries. In some countries the urban poverty line in common use has a higher real value—meaning that it allows the purchase of more commodities for consumption—than does the rural poverty line.

Limitations of the Indicator: National poverty lines are set to reflect the country's specific economic and social circumstances, and national poverty rates are not intended for comparisons across countries. Local poverty lines tend to have higher purchasing power in rich countries, where more generous standards are used, than in poor countries. Issues also arise when comparing poverty measures within countries when urban and rural poverty lines represent different purchasing powers²⁶.

The national poverty rate is a “headcount” measure, which is by far the most commonly calculated measure of poverty. But it fails to reflect the fact that among poor people there may be wide differences in income levels, with some people located just below the poverty line and others experiencing far greater shortfalls. Policymakers seeking to make the largest possible impact on the headcount measure might be tempted to direct their poverty alleviation resources

²⁵ Poverty and Ecosystems: Prototype assessment and reporting method, Kenya case study;- By Dr. Anantha Kumar Duraiappah and Marlene Roy;- July 2007;- <http://www.iisd.org>

²⁶ For further details, refer to the About the data section of the Table 2.6 in *World Development Indicators 2007*, The World Bank (2007).

to those closest to the poverty line (and therefore least poor)²⁷. Lastly, this income/consumption based poverty indicator does not fully reflect the other dimensions of poverty such as inequality, vulnerability, and lack of voice and power of the poor²⁸.

Status of Methodology: The methodology is generally well developed.

Alternative Definitions/Indicators: There are other useful indicators of measuring poverty: the poverty rate at the international poverty line, which is more suitable for assessing poverty level worldwide; the poverty gap, which takes into account the distance of poor people from the poverty line; and the squared-poverty gap, which take into account the degree of income inequality among poor people²⁹. Moreover, quantitative methods of measuring income/consumption poverty are increasingly being complemented by participatory methods, where people are asked what their basic needs are and whether such needs are met. Interestingly, new research shows a high degree of concordance between poverty lines based on objective and subjective assessments of needs³⁰.

Assessment of Data

Data Needed to Compile the Indicator: Poverty estimates are calculated from nationally representative household surveys.

National and International Data Availability and Sources: The World Bank produced its first global poverty estimates for developing countries for World Development Report 1990 using household survey data for 22 countries (Ravallion, Datt, and van de Walle 1991). Incorporating survey data collected during the last 17 years, the database has expanded considerably and now includes more than 550 surveys representing about 100 developing countries. Some 1.1 million randomly sampled households were interviewed in these surveys, representing 93 percent of the population of developing countries. The surveys asked detailed questions on sources of income and how it was spent and on other household characteristics such as the number of people sharing that income. Most interviews were conducted by staff of government statistics offices. Along with improvements in data coverage and quality, the underlying methodology has also improved, resulting in better and more comprehensive estimates. In the last 25 years there has been enormous progress in designing, implementing and processing such surveys for developing countries — thanks in large part to the efforts of national statistics agencies throughout the world, and the support of the donor community and international development agencies³¹.

²⁷ More information is available at the World Bank's website: www.worldbank.org/poverty.

²⁸ For further discussions on different dimensions of poverty, refer to *World Development Report 2000/2001: Attacking Poverty*, The World Bank (2000).

²⁹ Source: *World Development Report 2000/2001: Attacking Poverty*, The World Bank (2000).

³⁰ Source: About the data section of the Table 2.6 in *World Development Indicators 2007*, The World Bank (2007).

³¹ Source : About the data section of the Table 2.6 in *World Development Indicators 2007*, The World Bank (2007).

Data References: Data on national poverty rate are included in the World Development Indicators (WDI) publications and WDI Online database of the World Bank, see <http://go.worldbank.org/3JU2HA60D0> and <http://go.worldbank.org/6HAYAHG8H0>.

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agency is the World Bank. The contact point is Data Help Desk: data@worldbank.org

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3. World Development Indicators: www.worldbank.org/data
4. United Nations. Millennium Indicators Database. Statistics Division Internet site. Available at: <http://mdgs.un.org/unsd/mdg/> (Accessed on March 10, 2009)
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IV. Childhood malnutrition and/or food consumption/caloric intake per capita	
Category: Health	Country Coverage: National
<p style="text-align: center;">Placement Within 10YSP:</p> <p style="text-align: center;">Objective 1: To improve conditions of affected area</p> <p style="text-align: center;">Core Set Indicator S3: Decrease in number of people below the minimum level of dietary energy consumption in affected areas</p>	Status: Indicator ready

This indicator profile is adapted from the Sustainable Development indicators manual, *Indicators of Sustainable Development: Guidelines and Methodologies, Third edition, Methodology sheets*, United Nations, New York, October 2007³².

Indicator

Name: Nutritional Status of Children

Brief Definition: Percentage of underweight (weight-for-age below -2 standard deviation (SD) of the WHO Child Growth Standards median) among children under five years of age; percentage of stunting (height-for-age below -2 SD of the WHO Child Growth Standards median) among children under five years of age; and percentage of overweight (weight-for-height above +2SD of the WHO Child Growth Standards median) among children under five years of age.

Unit of Measurement: Percent (%)

Relevance

Purpose: The purpose of this indicator is to measure long term nutritional imbalance and malnutrition resulting in undernutrition (assessed by underweight and stunting) and overweight.

Relevance to UNCCD: Health and development are intimately interconnected. Meeting primary health care needs and the nutritional requirement of children are fundamental to the achievement of sustainable development. Nutritional status is the best global indicator of well-being in children and of the availability of ecosystem services.

International Conventions and Agreements: The United Nations World Summit for Children and the Millennium Development Goals represent international agreements relevant to this indicator.

³² (<http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001socialA.htm>)

International Targets/Recommended Standards: To half the prevalence of underweight among children younger than 5 years between 1990 and 2015. This target of the Millennium Development Goal No. 1 to "eradicate extreme poverty and hunger" has been established at the Millennium Summit in 2000, where representatives from 189 countries committed themselves to give highest priority to sustaining development and eliminating poverty.

Comparison to Other Indicators and Strengths and Weaknesses: This indicator is closely linked with adequate birth weight. It is also associated with such socioeconomic and environmental indicators as squared poverty gap index, access to safe drinking water, infant mortality rate, life expectancy at birth, national health expenditure devoted to local health care, Gross Domestic Product (GDP) per capita.

Assessment of Data

Data Needed to Compile the Indicator: The data needed to compile this indicator are the weight, length/height, age and sex of the children in the index populations

National and International Data Availability and Sources: The data are routinely collected by ministries of health at the national and subnational levels for most countries. Other sources are: Demographic and Health Surveys (DHS, www.measuredhs.com); Multiple Indicators Cluster Surveys (MICS, www.childinfo.org); Living Standards Measurement Surveys (LSMS, www.worldbank.org/lms/). All data from these four sources are being collected and standardized by the WHO Department of Nutrition and disseminated via the WHO Global Database on Child Growth and Malnutrition web site www.who.int/nutgrowthdb.

Data References: Available via the WHO Global Database on Child Growth and Malnutrition web site www.who.int/nutgrowthdb

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agency is the World Health Organization (WHO). At WHO, the contact point is the Director, Department of Nutrition for Health and Development; fax no. (41 22) 791 3111.

Other Contributing Organizations: UNICEF.

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5. http://www.who.int/childgrowth/endorsement_scn.pdf

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V. Human Development Index (HDI)	
Category: Human Development	Country Coverage: Global
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 1: To improve conditions of affected area</p> <p>Core Set Indicator S2: Increase in number of people living above poverty line</p> <p>Core Indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.</p>	Status: Well established

Indicator

Name: Human Development Index (HDI)

Brief Definition: Index measuring three dimensions of human development; a long and healthy life; access to knowledge; and a decent standard of living

Unit of Measurement: Index

Relevance

Purpose: The HDI indicator is an attempt to measure the status and change in the well being of populations. The HDI is a compilation of achievements in three dimensions of human development; a long and healthy life; access to knowledge; and a decent standard of living. These basic dimensions are measured by life expectancy at birth, adult literacy and combined gross enrolment in primary, secondary and tertiary level education, and gross domestic product (GDP) per capita in Purchasing Power Parity US dollars (PPP US\$), respectively. The index is constructed from indicators that are available globally using a methodology that is simple and transparent.

Relevance to UNCCD: While the concept of human development is much broader than any single composite index can measure, the HDI offers a powerful alternative to GDP per capita as a summary measure of human well-being. It provides a useful entry point into the rich information contained in the subsequent indicator tables on different aspects of human development. While the HDI provides data on status and trends for the country as a whole in many cases it should be possible to provide this data for affected areas. If this can be done it will be an effective surrogate for the impact of the efforts to combat desertification on the livelihood of peoples.

Methodological Description

Primary Data Sources

Life expectancy at birth: The life expectancy at birth estimates are taken from World Population Prospects 1950–2050: The 2006 Revision (UN 2007e) the official source of UN population estimates and projections. They are prepared biennially by the United Nations Department of Economic and Social Affairs Population Division (UNPD) using data from national vital registration systems, population censuses and surveys. The life expectancy estimates published by UNPD are usually five-year averages although it does also produce annual life expectancy estimates interpolated from the five-year averages.

Adult literacy rate: The 2007/2008 UNDP Human Development Report uses data on adult literacy rates from the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (UIS) April 2007 Assessment, that combines direct national estimates with recent estimates based on its Global age-specific literacy projections model developed in 2007. The national estimates, made available through targeted efforts by UIS to collect recent literacy data from countries, are obtained from national censuses or surveys between 1995 and 2005. Where recent estimates are not available, older UIS estimates, produced in July 2002 and based mainly on national data collected before 1995, have been used instead.

Combined gross enrolment ratios in primary, secondary and tertiary education: Gross enrolment ratios are produced by the UIS (UNESCO Institute for Statistics 1999) based on enrollment data collected from national governments (usually from administrative sources) and population data from the *World Population Prospects 1950–2040: The 2004 Revision*. The ratios are calculated by dividing the number of students enrolled in primary, secondary and tertiary levels of education by the total population in the theoretical age group corresponding to these levels. The theoretical age group for tertiary education is assumed to be the five-year age group immediately following on the end of upper secondary school in all countries.

GDP per capita (PPP US\$): In comparing standards of living across countries, economic statistics must be converted into purchasing power parity (PPP) terms to eliminate differences in national price levels. The GDP per capita (PPP US\$) data for the HDI are provided by the World Bank (World Bank 2007) for 168 countries based on price data from the last International Comparison Program (ICP) surveys and GDP in local currency from national accounts data). For details on the ICP and the PPP methodology, see the ICP website at www.worldbank.org/data/icp.

Assessment of Data

Comparisons over time and across editions of the report

The HDI is an important tool for monitoring long-term trends in human development. To facilitate trend analyses across countries, the HDI is calculated at five-year intervals for the period 1975–2005. These estimates are based on a consistent methodology and on comparable trend data available when the Report is prepared. As international data agencies continually improve their data series, including updating historical data periodically, the year to year changes

in the HDI values and rankings across editions of the *Human Development Report* often reflect revisions to data—both specific to a country and relative to other countries—rather than real changes in a country. HDI trend analysis should not be based on data from different editions of the Report.

Detailed descriptions on calculating the HDI see UNDP Human Development Report 2007/2008.

Agencies Involved in the Development of the Indicator

Lead Agency: UNDP World Bank.

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VI. Level of Land Degradation	
Category: Environment	Country Coverage: Global/National
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 2: To improve the conditions of the ecosystems</p> <p>Core Indicator: S4: Reduction in the total area affected by desertification/land degradation and drought.</p>	<p>Status:</p> <p>Development on going by LADA</p>

This indicator profile is adapted from the Sustainable Development indicators manual, *Indicators of Sustainable Development: Guidelines and Methodologies, Third edition, Methodology sheets*, United Nations, New York, October 2007³³.

The methodology for this indicator is currently under revision in the context of the Land Degradation Assessment in Drylands (LADA) project implemented by the Food and Agricultural Organization (FAO) and partners. Consequently, the information contained in the present version mainly reflects the status of the methodology in the previous two editions of the CSD indicators.

Indicator

Name: Level of land degradation

Brief Definition: The indicator intends to measure the amount of land affected by degradation and its proportion of national territory.

Unit of Measurement: Area (Km²) and Percent (%) of land area affected.

Placement in the CSD Indicator Set: Land/Desertification.

Relevance

Purpose: The indicator will measure the extent and severity of land degradation at the national level. It also measures the implementation of agreements and programmes to address causes of land degradation and to reclaim degraded lands.

Relevance to UNCCD: The UNCCD was mandated to address land degradation and drought. An assessment of the degree of land degradation provides an indicator of the progress to restore ecosystem services. Land degradation is an impediment to sustainable development in general, and to sustainable agriculture in particular. Land degradation and soil loss threaten the livelihood of millions of people and future food security, with implications for water resources and the conservation of biodiversity.

³³ (<http://www.un.org/esa/sustdev/natlinfo/indicators/isdms2001/isd-ms2001socialA.htm>)

International Targets/Recommended Standards: No specific targets have been defined, however, the goal should be to reduce the area and percentage of land affected by desertification, and/or reduce the severity of desertification.

Linkages to Other Indicators: This state and trends indicator needs to be considered in conjunction with related driving force and response indicators, integrating physical and socio-economic processes, for meaningful interpretation and policy relevance at the national level. It is closely linked with indicators concerning land use, such as deforestation, use of marginal land, protected area as a percent of total land area, and population living below the poverty line.

Methodological Description

Underlying Definitions and Concepts: The methodology for this indicator is currently under development, in relation to the Land degradation assessment in drylands (LADA) project executed by the Food and Agricultural Organization (FAO).

Land degradation means reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and, (iii) long-term loss of natural vegetation. Land degradation, therefore, includes processes which lead to surface salt accumulation and waterlogging associated with salt-affected areas.

Measurement Methods: A variety of assessment tools for measuring land degradation is investigated for the LADA project, including expert opinions, remote sensing, field monitoring, land productivity, participatory surveys (such as farmers' opinion). The Global Assessment of the Status of Human-Induced Soil Degradation (GLASOD) project (1987-1990) was based on expert opinions.

An important issue in the basis measurement of degradation is the factors that are measured to assess the degree of local degradation. As Bie (1990) clearly points out, the two factors of *productivity* and *resilience* are the most important elements in assessing the existence and the extent of dryland degradation.

Limitations of the Indicator: There are a number of issues to be resolved before this indicator can be entirely satisfactory. The ecosystems addressed in this definition undergo cyclic episodes of more or less rainfall, as well as long-term degradation in many cases. Separating short-term fluctuations from longer-term trends is important, though scientists often find this difficult to determine, except for longer time periods. Also, the United Nations Environment Program (UNEP) has generally defined desertification (degradation) in categories (severe, moderate, slight), and a national indicator needs to include an assessment of this kind. It has been a practice to include problems of waterlogging and salinization as part of desertification, if they occur within the ecosystems as defined above. In this case, the area affected by these problems should also be included in the desertified area.

Because of these issues, the indicator may well benefit from further refinement and definition. The concepts of land degradation in arid, semi-arid, and dry sub-humid areas are well defined and described in a number of UNSO, UNEP, and other UN publications, as well as in the academic literature. The translation of these concepts into agreed national level indicators has not been so well articulated. (Mabbutt, J.A. 1986; Maimuet 1991).

Status of the Methodology: The methodology is currently under revision.

Assessment of Data

Data Needed to Complete the Indicator: The data needed to compile the indicator are the extent and severity of land degradation in the country concerned. The degree of accuracy and reliability of both spatial and statistical data varies considerably and are often poorly documented and/or out of date. For some countries, the data do not yet exist. Benchmark data on desertification is critical to measuring progress.

National and International Data Availability and Sources: The webpage of the LADA project contains a number of country case studies and a wealth of related information, including references. Information on extent and severity of land degradation based on the Global Assessment of the Status of Human-Induced Soil Degradation (GLASOD) project (1987-1990) is available at the webpage of the World Soil Information (ISRIC).

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agency will be the Food and Agricultural Organization (FAO).

Other Contributing Organizations: Other contributing organizations include: UNDP Dryland Development Centre, UNEP, Consultative Group on International Agricultural Research (CGIAR), International Fund for Agricultural Development (IFAD), World Soil Information (ISRIC).

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Internet sites:

1. Food and Agricultural Organization: *Land Degradation Assessment in Drylands* <http://lada.virtualcentre.org/pagedisplay/display.asp>
2. FAO Webpage on Desertification: <http://www.fao.org/desertification/default.asp?lang=en>
3. United Nations Convention to Combat Desertification. <http://www.unccd.ch>
4. United Nations Development Programme's Dryland Development Centre: <http://www.undp.org/drylands/>
5. World Soil Information (ISRIC): <http://www.isric.org/>

VII. Plant and animal biodiversity	
Category: Biodiversity	Country Coverage: National
Time Series: 2001	Spatial Refinement 1 degree arc (global level) / 6 min arc at national level – occurrences sites
Placement Within 10YSP: Objective 2: To improve the conditions of the ecosystems Core Set Indicators: S5: Increase in net primary productivity in affected areas	Status: Development on going

Indicator

Name: Biodiversity intactness index (BII)

Brief Definition: The Biodiversity Intactness Index (BII) is a measure of the change in abundance across all well-known elements of biodiversity, relative to their levels prior to some predetermined point in time (Scholes & Biggs 2005; Biggs, Reyers & Scholes 2006). It is an indicator of the average abundance of a variety of organisms in a given geographical area, relative to their reference populations (Scholes & Biggs 2005).

Unit of Measurement: Rate of change of BII in percentage (%)

Comments: The index is built up from relative abundances of populations of species belonging to different taxonomic groups in different ecosystems, and facing different land-use management practices. It can be calculated for any political or geographical unit, and will give an indication of the overall condition of a region relative to a ‘pristine’ state. This state is defined by Scholes and Biggs as the unaltered, pre-industrial state, for which they use the current condition in protected areas as a surrogate measure.

Relevance

Purpose: The BII was designed to fulfill the requirements set out by the Convention of Biological Diversity (CBD) which stipulated that an indicator for biodiversity change should be scientifically sound, be sensitive to changes at policy-relevant spatial and temporal scales, allow for comparison with a baseline situation and policy target, be useable in models for future projections, and be amenable to aggregation and disaggregation at ecosystem, national and international levels (CBD 2003; Scholes & Biggs 2005; Biggs et al., 2006). In addition it requires that the index be easy to understand and use, broadly accepted and measurable with sufficient accuracy at affordable cost (Biggs et al. 2006). The purpose of the BII was to help fulfill the goal of the signatories of the CBD, who aimed to “achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level” (CBD 2003; Mace 2005).

Relevance to UNCCD: Knowledge of plant and animal biodiversity is a basic input to the UNCCD, which helps determine the baseline to identify changes induced by pressure on land use on natural ecosystems and biodiversity status with synergies with the Convention of Biological Diversity (CBD). There are direct and indirect relationships between the state of natural resources (soil, vegetation, water, ecosystem), the biological diversity at species level (animal, plant and microbial species), ecosystem level (habitats, interactions, functions) and the management of those resources. Changes in biodiversity are the result of land degradation and unsustainable land management. The management practices affect the capacity of land users to conserve and sustain resources and provide goods and ecological services.

Application: This analysis should be done centrally and made available to the countries so that ground truthing and assessment can be carried out.

Assessment of Data

Data Needed to Compile the Indicator:

Processing of the indicator requires:

- Land use
- Ecosystems
- Taxon, Species Richness

National and International Data Availability and Sources: The layers available at world level for the definition of Land use are: SADC Landcover Data set (1 km resolution), Urban extents (available grid in 30 arc seconds), Protected areas -UICN, WDPA- (provides thematic coverage of national and international protected areas), GIMMS NDVI data.

The Gbif grid has data on worldwide animal and plant species diversity. The spatial resolution of the grid is 1 degree, so increase of the resolution is recommended for its use at national level, making the data denser through the systematizing of available biological collections and surveys.

Data References:

<http://sedac.ciesin.columbia.edu/>;

<http://www.landcover.org/data/gimms/>;

<http://data.gbif.org/welcome.htm>; <http://www.wdpa.org/>

Agencies Involved in the Development of the Indicator

Lead Agency: Convention of Biological Diversity (CBD)

Other Contributing Organizations: Center for International Earth Science Information Network (CIESIN) of Columbia University.

References

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VIII. Aridity Index	
Category: Climate	Country Coverage: National
Time Series: Minimum 30 years	Spatial Refinement 30 arc min
Placement Within 10YSP: Objective 2: To improve the conditions of the ecosystems Core Set Indicator: S-5: Increase in net primary productivity in affected areas.	Status: Developed by FAO and UNESCO (1977) UNEP (1992); UICN/CCD (2002) and CAZALAC (2007).

Indicator

Name: Aridity Index

Brief Definition: Aridity Index (Bioclimatic Index). Pressure indicator defined as the ratio between mean annual precipitation (P) and mean annual evapotranspiration period: (ETP) $I_a = P_a / ET_o$.

Unit of Measurement: Indicative value of the ratio P_a / ET_o

Comments: The index allows definition of intervals of climatic water deficiency and excess within a specific time period, which should be basically related to precipitation and reference evapotranspiration in the system considered.

One of the most widely used criteria to set the boundaries of climatic zones is the P/ETP climate index, developed by FAO and UNESCO in 1977, on the basis of the humidity index proposed by Thornthwaite (1948), Penman (1948) method and the procedure proposed by Meigs (1953). This index expresses the relationship between mean annual precipitation and potential evapotranspiration in a given area (UNEP, 1992; UICN/CCD, 2002) (Cazalac, 2007).

Relevance

Purpose: To contribute to UNCCD core indicator S4 and S5 to classify desertification-prone areas and monitor land degradation in terms of long-term loss of ecosystem primary productivity.

Purpose: To contribute to UNCCD core indicator S4 and S5 to classify desertification-prone areas and monitor land degradation in terms of long-term loss of ecosystem primary productivity.

Relevance to UNCCD: UNCCD refers not only to desertification, but also to effects of droughts, Aridity Index allows definition of intervals of climatic water deficiency and excess within a specific time period, aims to identify and map areas prone to drought and vulnerable

areas. This is a base indicator for characterizing sensitive and desertification-affected areas, and for the construction of indicators associated with land degradation and productivity. “Aridity is a natural environmental condition that describes climate extremities particularly referring to water scarcity. It is a determinant of ecosystem characteristics affecting soil health capacity. Soil moisture influences the distribution and growth pattern of vegetation, soil microbial activity, soil erosion, wind erosion, nutrient movements and other soil properties. A part of land degradation assessment procedure that will provide understanding on developing strategies and approaches to mitigate/combat land degradation in drylands”³⁴.

Application: This analysis should be done centrally and made available to the countries so that ground truthing and assessment can be carried out.

Methodological Description

Underlying Definitions and Concepts:

Aridity: implies permanent rainfall deficit (long-range climate phenomenon), which is linked to other specific climate conditions such as high temperature, low air humidity and strong evaporation. It is usually defined in terms of low average rainfall or available water (Cazalac, 2007).

Evapotranspiration (ET): is the process whereby water is transferred from the Earth’s surface to the atmosphere. It includes evaporation of solid and liquid water directly from the ground or from living or dead plant surfaces (dew, frost, rainfall intercepted by vegetation) as well as water loss through plant surfaces, particularly leaves.

Measurement Methods:

$$P / ET_0 \text{ (UNEP, 1997)}$$

P: average precipitation in the period

ET₀: reference evapotranspiration in the period

Classification of the P/ET₀ Index

Zones	P/ET ₀
Hyper-arid	< 0.05
Arid	0.05<0.20
Semiarid	0.20<0.50
Dry subhumid	0.50<0.65
Humid subhumid	0.65-1
Humid	>1

Limitations of the Indicator: availability of complete series of temporal data at national level, lack of homogeneity in data series.

³⁴ LADA, Technical report 2, biophysical indicator toolbox, (pressure/state), April 2007.

Status of Methodology: this indicator was used in the World Atlas of Desertification, developed by UNEP IN 1997. It is currently applied on different scales and easy to use.

Alternative Definitions/Indicators: Not Available.

Assessment of Dataune

Data Needed to Compile the Indicator:

Precipitation: The proposal is to use data on monthly precipitation for a 30-year period.

Evapotranspiration: The term reference Evapotranspiration (ET0), which is estimated with the FAO Penman-Monteith method, is used as reference for estimating evapotranspiration.

National and International Data Availability and Sources:

To estimate the aridity index, it is necessary to rely on databases on climate series at national level, which have to be consistent, homogeneous and allow for their specialization. In the case that said information is lacking, it is possible to make use of global-level databases available in the network.

VASClimO comprises the most complete monthly precipitation data for 1951-2000, compiled from long, quality-controlled station records, gridded at resolution of 0.5°, from 9 343 stations (Global Precipitation Climatology Centre -GPCC)

GEO Data Portal: coverage of worldwide precipitation and evapotranspiration in different time periods.

Data References: <http://www.juergen-grieser.de/downloads/VASClimO/vasclimo.htm>; <http://www.grid.unep.ch/data/index.php>; <http://www.worldclim.org/>

Agencies Involved in the Development of the Indicator

Lead Agency: FAO and UNESCO, UNEP, UICN/CCD.

Other Contributing Organizations: CAZALAC. (Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean)

References

Literature:

1. CAZALAC PHI-UNESCO, 2007. Methodology guide for elaboration of the map of arid, semiarid and subhumid areas in Latin America and the Caribbean. Chile.
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Internet sites:

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2. <http://www.fao.org/docrep/T0122E/t0122e03.htm>

IX. Land cover status	
Category: Vegetation	Country Coverage: Global
Time Series: 1981-2003 GIMMS data	Spatial Refinement 8km resolution
Placement Within 10YSP: Objective 2: To improve the conditions of the ecosystems Indicator S-5: Increase in net primary productivity in affected areas.	Status: Development on going by LADA

This indicator profile is issued from Bai et al., 2008³⁵ and from LADA technical working documents, among which the fact sheets recently published within DIS4LADA web site at www.nrd.uniss.it/dis.

Indicator

Name: Land cover status

Brief Definition: Land cover status -in both cultivated and non-cultivated lands- based on NPP and RUE trends as obtained through long term series NDVI data

Unit of Measurement: Normalized difference vegetation index (NDVI). kgC ha⁻¹ year⁻¹% (NPP) and mm⁻¹ (RUE)

The purpose of this measure is to assess changes in vegetation status, and to attempt to factor out the impact of changes in rainfall.

The deviation of the NDVI from the norm can be an indicator of land status change whether degradation or improvement. This assessment will only be effective if the impact of other factors (weather, terrain, soil and land use for example) are accounted for.

Rainfall and temperature effects can be identified through Rain-use efficiency (RUE) and Energy-use efficiency analysis. Translation of NDVI to primary productivity enables general economic analysis of land degradation.

³⁵ Bai ZG, Dent DL, Olsson L., Schaepman M E. 2008 Global assessment of land degradation and improvement - 1. Identification by remote sensing. Report 5 2008/08, GLADA - World Soil Information

Relevance

Purpose: To contribute to UNCCD core indicators S4 and S5 by providing two integrated indicators suited to monitor land degradation in terms of long-term loss of ecosystem primary productivity and taking into account to effects of rainfall on NPP.

Relevance to UNCCD: The Global Assessment of Land Degradation and Improvement (GLADA) uses remote sensing to identify degrading areas and areas where degradation has been arrested or reversed. The indicator is specifically targeted to meet the UNCCD demand for quantitative assessment at the global scale. The indicators proposed are: Net Primary Production (NPP), Rain Use Efficiency (RUE).

Application: This analysis should be done centrally and made available to the countries so that ground truthing and assessment can be carried out.

Assessment of Data

Underlying Definitions and Concepts: The remotely sensed normalized difference vegetation index (NDVI) has been shown to be related to biophysical variables that control vegetation productivity and can be used as a proxy. A negative trend in NDVI does not necessarily indicate land degradation, nor does a positive trend necessarily indicate land improvement. Biomass depends on several factors including climate and especially fluctuations in rainfall (among others, as explained by Bai et al., 2008). The analysis of the correlation of annual sum NDVI and annual rainfall for each pixel over a long-time series of high temporal resolution satellite images can allow for discriminating the component driven by rainfall. NPP is defined as the rate at which vegetation fixes CO₂ from the atmosphere less losses through respiration. RUE is the estimate of the rain use efficiency of vegetation (“biomass production per unit of rainfall”).

Measurement Methods

Both indicators are calculated based on annual sum NDVI values generated from long term series defined below.

NPP is calculated from NDVI values based on a regression equation:

$$\text{NPPMOD17 [kgC ha}^{-1} \text{ year}^{-1}] = 1106.37 * \text{sum NDVI} - 564.55 \quad [1]$$

($r = 0.83$, $n = 3\ 128\ 207$)

Where NPPMOD17 is annual mean NPP derived from MODIS MOD17 Collection 4 data, and sum NDVI is the four-year (2000-2003) mean annual sum NDVI derived from GIMMS. Uncertainty is for slope ± 3.818 , and for intercept ± 16.364 .

RUE is calculated as the ratio of annual sum NDVI and annual rainfall.

Where rainfall is the main limiting factor on biomass productivity, the long-term trend of RUE is a good indicator of land degradation or improvement. It is assumed that, where NPP is limited by rainfall, a declining trend in RUE indicates land degradation. Where rainfall is not limiting, NPP is the best indicator available. Taken together, the two indicators may provide a more robust assessment than either used alone.

Limitations of the Indicator: The indicator is still under development. However, the basic approach adopted is considered as most promising and is being explored also by large research projects such as DeSurvey. The indicator is currently the object of international debate and its interpretability has been questioned (Wessels, 2009). Some agreed limitations of the indicator are here reported.

Conceptual: A declining trend of NPP (Net Primary Productivity) may not be reckoned as land degradation: urban development is generally considered to be development - although it brings a loss of ecosystem function; land use change from forest or grassland to cropland of lesser biological productivity may or may not be accompanied by soil erosion, compaction and nutrient depletion - and it may well be sustainable and profitable, depending on management. Similarly, an increasing trend of NPP means greater biological production but may reflect, for instance, bush encroachment in rangeland or cropland - which is not land improvement as commonly understood.

Technical: the 8km resolution of the GIMMS data is a limitation in two senses. First, an 8km pixel integrates the signal from a wider surrounding area. Secondly, an 8km pixel or even a 1km pixel cannot be checked by a windscreen survey; and a 23-year trend cannot be checked by a single snapshot.

Status of Methodology: Improvement and further development on-going. Although the international scientific debate is warming, the approach can be considered as suited to be a feasible and cost effective proxy, provided the assumptions and conditions allowing univocal interpretation are duly clarified. It is expected the in the near future a significant progress will be made.

Assessment of Data

Data Needed to Compile the Indicator:

Processing of the indicator requires:

- NDVI calculated for time series (at least multi-annual) of high temporal resolution satellite data
- Annual rainfall for corresponding time series.

National and International Data Availability and Sources: Data sources used by GLADA are GIMMS (Global Inventory Modelling and Mapping Studies) and VASClmO 1.1 (Variability Analyses of Surface Climate Observations). GIMMS (Global Inventory Modelling and Mapping Studies) radiometer (AVHRR) data are collected by National Oceanic and Atmospheric Administration satellites. They are corrected for calibration, variations in solar and view zenith angle. Global data are currently available for the period July 1981-December 2003. The VASClmO comprises the most complete monthly precipitation data for 1951-2000, compiled from long, quality-controlled station records, gridded at resolution of 0.5°, from 9 343 stations. For 2001-2003, these were supplemented by the GPCC full data re-analysis product (Schneider and others 2008) to produce monthly rainfall values matching the GIMMS NDVI data.

Data References: http://apdrc.soest.hawaii.edu/datadoc/gpcc_1.htm;
<http://www.landcover.org/data/gimms/>

Agencies Involved in the Development of the Indicator

Lead Agency: FAO, ISRIC.

Comments

The deviation of the NDVI from the norm can be an indicator of land status change whether degradation or improvement. This assessment will only be effective if the impact of other factors (weather, terrain, soil and land use for example) are accounted for.

Rainfall and temperature effects can be identified through Rain-use efficiency (RUE) and Energy-use efficiency analysis. Translation of NDVI to primary productivity enables general economic analysis of land degradation.

Note: This analysis should be done centrally and made available to the countries so that ground truthing and assessment can be carried out.

Derivation of NDVI indicators

ArcGIS Spatial Analyst, ERDAS IMAGINE and ENVI-IDL are used to calculate NDVI minimum, maximum, maximum-minimum, mean, sum, standard deviation, and coefficient of variation (definitions below), as well as climate variables. NDVI data are geo-referenced and averaged to monthly; annual NDVI indicators are derived for each pixel; their temporal trends determined by linear regression at an annual interval and mapped to depict spatial changes.

A negative slope of linear regression indicates a decline of green biomass and a positive slope, an increase – except for STD and CoV which indicate trends in variability. The absolute change (Δ in map legends, titled “changes in”) is the slope of the regression; the relative change (% in map legends, titled “trend in”) is $100(\text{slope of the regression}/\text{multi-year mean})$. Monthly grids of rainfall for a period are geo-referenced and resampled to the same spatial resolution as the NDVI using neighborhood statistics. Spatial pattern and temporal trend of rainfall and rain-use efficiency (RUE, the ratio of annual NDVI and annual rainfall) for each pixel are determined by regression.

Land degradation is identified by negative trends of both biomass and rain-use efficiency. To distinguish between declining productivity caused by land degradation, and declining productivity due to other factors, rainfall variability is accounted for by, first, identifying pixels where there is a positive relationship between productivity and rainfall. Secondly, for those areas where productivity depends on rainfall, rain-use efficiency is considered: where productivity declined but RUE increased, we can attribute the decline of productivity to declining rainfall and those areas are masked.

Land improvement is identified by positive changes in sum NDVI, positive rain-use efficiency in those areas where there is a positive correlation between sum NDVI and rainfall and RUE, and positive energy-use efficiency.

Plots of both land degradation and land improvement are masked by the mapped urban extents.

Key Definitions

Minimum NDVI: The lowest value that occurs in any one year (annual) - which is usually at the end of the dry season. Variation in minimum NDVI may serve as a baseline for other parameters.

Maximum or peak NDVI: Represents the maximum green biomass. The large spatial variations reflect the diverse landscapes and climate.

Maximum-minimum NDVI: The difference between annual maximum and minimum NDVI reflects annual biomass productivity for areas with one, well-defined growing season but may not be meaningful for areas with bimodal rainfall.

Sum NDVI: The sum of fortnightly NDVI values for the year most nearly aggregates annual biomass productivity.

Standard deviation (STD): NDVI standard deviation is the root mean square deviation of the NDVI time series values (annual) from their arithmetic mean. It is a measure of statistical dispersion, measuring the spread of NDVI values.

Coefficient of variation (CoV): CoV can be used to compare the amount of variation in different sets of sample data. NDVI CoV images were generated by computing for each pixel the standard deviation (STD) of the set of individual NDVI values and dividing this by the mean (M) of these values. This represents the dispersion of NDVI values relative to the mean value.

Temporal trends: The long-term trends of the indicators of biological productivity may be taken as indicators of land degradation (where the trend is declining) or land improvement (where the trend is increasing). A positive change in the value of a pixel-level CoV over time relates to increased dispersion of values, not increasing NDVI; similarly, a negative CoV dispersion – which is the case over nearly the whole country - means decreasing dispersion of NDVI around mean values, not decreasing NDVI

References

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2. Bai, Z.G., Dent, D.L., Olsson, L. & Schaepman, M.E. 2008. Proxy global assessment of land degradation. *Soil Use and Management*, 24, 223–234.
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Internet sites:

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2. <http://www.fao.org/nr/lada/index.php?/Documents/View-category.html>.
3. <http://nrd.uniss.it/dis/index.php>
4. http://apdrc.soest.hawaii.edu/datadoc/gpcc_1.htm
5. <http://www.landcover.org/data/gimms/>

X. Level of carbon stocks above and below ground	
Category: Carbon Sequestration	Country Coverage: National
<p>Placement Within 10YSP:</p> <p>Objective 3: To generate global benefits through effective implementation of the UNCCD</p> <p>Core Indicator S-6: Increase in carbon stocks (soil and plant biomass) in affected areas.</p> <p>Component of ecosystem restoration and impact of SLM</p>	Status: Indicator to be developed in conjunction with IPCC process

Indicator

Name: National carbon stocks above and below ground

Brief Definition: Amount of carbon held above and below ground.

Unit of Measurement: tons/ha

Relevance

Purpose: To encourage countries to take note of their carbon stocks and to record changes in above and below ground stocks as a global benefit.

Relevance to UNCCD: One purpose of the UNCCD is to reduce land degradation and to combat drought. A measure of success in this regard is the increase in carbon stocks held by both above ground and in ground carbon. Carbon sequestration as a result of the UNCCD has global significance in climate change. It is likely that the UNFCCC will require carbon stock measurement from the parties and it now appears possible to provide countries with adequate estimates.

Methodological Description

Basing UNFCCC (United Nations Framework Convention on Climate Change) REDD (Reduced Emissions from Deforestation and Degradation) policies on a carbon stock mapping approach would have a number of benefits relative to approaches based solely on field sampling and forest inventories. This is true not only in terms of improving estimates of carbon stored in forests for the emerging carbon markets, by providing spatially explicit information on the location of carbon stocks, but also with respect to avoiding the ambiguities, uncertainties and outright differences among land cover type classifications (Houghton & Goetz, 2008). A carbon stock approach could allow countries to report at a higher IPCC (Intergovernmental Panel on Climate Change) reporting tier by providing country-specific data and advanced methods and data for

land conversions, even at a Tier 3 level which is defined in the Good Practice Guidance (GPG) as including "models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national to fine grid scales (GPG 3.17)" (IPCC Guidelines for National Greenhouse Gas Inventories, 2006). A carbon stock monitoring approach is directly linked with biomass dynamics.

This approach could be used to obtain estimates for above-ground biomass (AGB) in all of the categories of LULUCF (Land Use, Land Use Change and Forestry) reporting, including categories where land classification remains the same (i.e. Forest Land Remaining Forest Land) and in categories defining changes in land use (i.e. Land Converted to Forest Land). Additionally, this approach would also allow a Tier 2 key category analysis (GPG 5.30), as it can provide specific uncertainty estimates for each category measured with this approach.

Direct Remote Sensing (DR) Approach: A spatially consistent way to produce carbon stock maps is to extend the satellite measurements directly to maps by calibrating them to field estimates of AGB using any of a number of statistical or so-called "machine learning" techniques, such as neural networks or regression trees (Breiman, 2001; Baccini & Friedl, 2004). For example, maps have been produced at 1 km resolution using MODIS imagery across all of Africa, a continent of particular importance in the global carbon cycle (Williams et al, 2007), and validated using independent lidar data sets (Baccini et al, 2008). Related analyses have been done for the Amazon basin (Saatchi et al, 2007), Russia (Houghton et al, 2007) and the United States (Blackard et al, 2008) using a similar approach. Multi-sensor synergy has also been used with a network of forest inventory data to produce ca. 1 hectare resolution biomass maps for tropical Costa Rica and is in progress for the conterminous U.S. (National Carbon and Biomass Database). Once the optimized rules are established for the training data, they are then applied to the satellite images to produce wall-to-wall maps with continuous values of AGB for each cell (pixel) of the image (or map). A key advantage of this approach is that the rules, once established, are easy to understand and can potentially be adapted to a monitoring framework.

Data Assessment

Well documented techniques and satellite data enable reliable mapping of carbon stocks over large areas. Although a number of relatively simple methods exist for assigning field estimates of AGB to categories defined by vegetation type classes or weighted data layers in geographic information system models, the most spatially consistent maps are produced using models that derive continuous values (e.g. between 0 and 500+ tons per hectare) from statistically optimized decision rules. The techniques and data sources described herein are published in the refereed scientific literature and are progressing rapidly as new "data mining" techniques are advanced (Breiman, 2001) and improved satellite remote sensing data become available (Houghton & Goetz, 2008). This situation will improve further as new satellite missions come online in the next few years, several of which are designed specifically with the intent of improving estimates of the standing stock of carbon in biomass, and changes in those stocks through time. The UNFCCC process would benefit from refinement and application of these approaches and from improved data in developing policies designed to reduce emissions from deforestation and forest degradation.

Agencies Involved in the Development of the Indicator

Lead Agency: UNFCCC and UNCCD

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XI. Lands under Sustainable Land Management	
Category:	Country Coverage: National and Global
<p style="text-align: center;">Placement Within 10YSP:</p> <p>Objective 3: To generate global benefits through effective implementation of the UNCCD</p> <p style="text-align: center;">Core Indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management</p>	Status:

Indicator

Name: Land under Sustainable Land Management (SLM)

Brief Definition: Sustainable land management (SLM) can be defined as the use of land resources such as soils, water, animals and plants for the production of goods - to meet changing human needs – while assuring the long-term productive potential of these resources, and the maintenance of their environmental functions.

Unit of Measurement: Variable measures of continual productivity. The indicator will be area of land under SLM in ha. This should be compared with a similar assessment at the beginning of the 10 year plan.

Rationale

Purpose: Land under Sustainable Land Management (SLM) is an important surrogate for a number of global benefits. Sustainable land management affects albedo, evapotranspiration, vegetation cover and carbon sequestration all of which have climate change implications. SLM seeks to harmonize the complementary but often conflicting goals of production and environmental protection. The aim must be an agreed trade-off from farm level and community level to the international level. The central question is not how to preserve nature in a pristine state but how to co-exist with nature in order to maintain the functions of the land resources for the benefit of society in a sustainable manner (World Bank 2006).

Relevance to UNCCD: Sustainable land management impacts vegetation cover and composition which is globally important for biodiversity. Sustainable land management also reduces soil erosion and stream and lake sedimentation which is important for water retention and the regional hydrologic balance. SLM is thus an effective measure of a number of global benefits.

Components of Sustainable Land Management

Land under SLM can be calculated in a combination of direct and indirect ways.

In lay terms, SLM involves these activities³⁶:

- Preserving and enhancing the productive capabilities of cropland, forestland, and grazing land (such as upland areas, down-slope areas, flatlands, and bottomlands)
- Sustaining productive forest areas and potentially commercial and noncommercial forest reserves
- Maintaining the integrity of watersheds for water supply and hydropower-generation needs and water conservation zones
- Maintaining the ability of aquifers to serve the needs of farm and other productive activities.

In addition, SLM includes actions to stop and reverse degradation—or at least to mitigate the adverse effects of earlier misuse. Such actions are increasingly important in uplands and watersheds—especially those where pressures from the resident populations are severe and where the destructive consequences of upland degradation are being felt in far more densely populated areas downstream.

The indicator can be considered the sum of these components or as a ratio of this sum against the total affected land area.

Assessment of Data

Data Needed to Compile the Indicator: The data required includes updated statistics and remote sensing coverage, dependable agricultural census data on land uses, and dependable land use maps, all updated at regular intervals. In the absence of databases at national level, available global databases can be used.

National and International Data Availability and Sources: Broad land use statistics are available for most countries. However, variable definitions and the lack of consistent land use change data which is spatially referenced are serious impediments to, for example, temporal analysis and international comparisons.

Land Cover: The Global Land Cover 2000 (GLC2000) map, realized by the Joint Research Centre (JRC, 2006, FAO, 2005), was simplified by reclassification (6 versus 11 original classes: forests, Shrub and herbaceous sparse shrub, cropland and mosaic cropland, wetlands, artificial and bare areas, and open water).

Irrigation: Global map of irrigated areas (version 4.0.1, February 2007). Center for Environmental Systems Research, University of Kassel, and Land and Water Development Division (FAO). Original resolution: 3 arc min.

³⁶Sustainable Land Management: Challenges and Opportunities

worldbank.org/EXTARD/Resources/336681-1215724937571/PART1.pdf

Protected areas: WCMC and UNEP have prepared a geographic coverage of protected areas worldwide that includes National sites known boundary, national sites without IUCN category, sites within other International Conventions and agreements with known boundary, wetlands with international importance (Ramsar), World Heritage Sites and UNESCO-MAB Biosphere Reserves. The data are originally given at 1:1 000 000 scale.

Data References: Data are available from national governments and regional and international programmes which focus on land use information. <http://sedac.ciesin.columbia.edu/>; <http://www.landcover.org/data/gimms/>; <http://www-gvm.jrc.it/glc2000/>; <http://www.wdpa.org/>.

Agencies Involved in the Development of the Indicator

Lead Agency: The lead agencies for the development of this indicator are GEF and FAO.

Other Contributing Organizations: The United Nations Environment Program is a partner in the development of this indicator.

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