Scientific review of the UNCCD provisionally accepted set of impact indicators to measure the implementation of strategic objectives 1, 2 and 3

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Summary

Development of this white paper follows Decision 17/COP.9 [1] of the ninth session of the Conference of the Parties (COP 9), requesting the CST to develop proposals, for consideration at COP 11, for the refinement of the set of the provisionally accepted impact indicators [2] being developed 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 (The Strategy)" [3]. It responds to the Synthesis and Recommendations resulting from the UNCCD 1st Scientific Conference [4], primarily to provide a scientific foundation for this refinement process and maximize possible synergies with other programmes pursuing related goals. It is a synthesis of a participatory, formative, and iterative process involving over 64 technical experts from the scientific community from September 2010 to January 2011.

"This white paper was prepared for the UNCCD secretariat, with the financial assistance of the European Commission, in the framework of the scientific peer review for the refinement of the UNCCD set of impact indicators led by the CST Bureau. The contents of this document are the sole responsibility of the author and can in no way be taken to reflect the views of the secretariat and or the Parties to the UNCCD."

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List of abbreviations

AQUASTAT	FAO's global information system on water and agriculture
CBD	UN Convention on Biological Diversity
CBP	Carbon Benefits Project (a GEF/UNEP focal area)
CIESIN	Center for International Earth Sciences Information Network
COP	Conference of the Parties
CSD	UN Commission on Sustainable Development
CSDF	Comité Scientifique Français de la Désertification (French Scientific Committee on Desertification)
CST	Committee on Science and Technology
DLDD	desertification, land degradation and drought
DPSIR	Driving Force-Pressure-State-Impact-Response framework
DSR	Driving Force-State Response framework
DSD	Dryland Science for Development Consortium
EEA	European Environment Agency
ECV	Essential Climate Variables (of the UNFCCC)
EDN	European DesertNet: European Network for Global Desertification Research
FAO	Food and Agriculture Organization
FDES	Framework for the Development of Environment Statistics
GDOS	Global Drylands Observation System
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GIMMS	Global Inventory Modeling and Mapping Studies
GLADA	Global Assessment of Land Degradation and Improvement
GLADIS	Global Land Degradation Information System
GLC 2000	Global Land Cover 2000 dataset
GOSIC	Global Observing Systems Information Center
HANTS	Harmonic Analysis of NDVI Time Series
HDI	Human Development Index
H-E	coupled human-environmental (H-E) systems
IGO	intergovernmental organization
JMP	WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation
JRC	Joint Research Center
KM:Land	The GEF Land Degradation Focal Area
KMST	Knowledge Management, Science and Technology (of the UNCCD)
LADA	Land Degradation Assessment in Drylands
LCCS	Land Cover Classification System (developed by FAO)
LPI	Living Planet Index
LUS	Land Use System
MA	Millennium Ecosystem Assessment
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
MSP	Medium scale project
NAP	National Action Plans to combat desertification
NDVI	Normalized Difference Vegetation Index
NPP	Net Primary Productivity
NRD	Nucleo Ricerca Desertificazione (University of Sassari)
OECD	Organisation for Economic Cooperation and Development
OSS	Observatoire du Sahara et du Sahel (Sahara and Sahel Observatory)
PSR	Pressure-State-Response framework
PSURC	Pressure-State-Use-Response-Capacity framework

ROSELT	Réseau d'Observatoires de Surveillance Ecologique à Long Terme (Long-term Ecological Monitoring Observatories Network) (part of OSS)
RSPB	Royal Society for the Protection of Birds
RUE	Rain Use Efficiency
QM	LADA QM pressure indicators (semi-quantitative indicators derived in part from a questionnaire for mapping)
SEDAC	Socio-economic Data and Applications Center
SLM	Sustainable Land Management
SPI	Standardized Precipitation Index
STAP	Scientific and Technical Advisory Panel (of the GEF)
The Strategy	10-year strategic plan and framework to enhance the implementation of the Convention (2008-2018)
TPN	UNCCD Thematic Programme Network
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNH WSAG	University of New Hampshire Water Systems Analysis Group
UNICEF	United Nations Children's Fund
UNU	United Nations University
UNU-INWEH	UNU Institute for Water, Environment & Health
WBI	Global Wild Bird Index
WHO	World Health Organization
WMO	World Meteorological Organization
WOCAT	World Overview of Conservation Approaches and Technologies
WWF	World Wildlife Fund
ZSL	Zoological Society of London
WAD	World Atlas of Desertification

I. Background

1. The UNCCD Conference of the Parties (COP) during its eighth session in Madrid in September 2007 adopted a ten-year strategic plan and framework to enhance the implementation of the Convention (2008–2018) (The Strategy).

2. As by decision 3/COP 8 [5], the CST was requested to advise COP 9 on how best to measure progress on the achievement of strategic objectives 1, 2, and 3 of The Strategy:

- Strategic Objective 1: To improve living conditions of affected populations;
- Strategic Objective 2: To improve the conditions of the ecosystems;
- Strategic Objective 3: To generate global benefits through effective implementation of the Convention.

3. The Strategy contains 7 Core indicators that are indicative of the types of indicators to be established to provide information on the trends in affected areas. The CST was requested to further refine these Core indicators capitalizing on existing sources of data.

4. As a first step towards carrying out the assignment of the COP, a framework document [3], "Elements for provision of 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 (The Strategy)", was presented and discussed at the first special session of the Committee on Science and Technology (CST S-1), held in Istanbul in November 2008. These

5. The document, together with the outputs of the CST deliberations, provided inputs for the preparation of an in-session document [6] which outlined the concrete steps to be taken and activities to be carried out for the selection of a minimum set of impact indicators that are coherent with the seven Core indicators related to strategic objectives 1, 2 and 3 as outlined in The Strategy.

6. Three sets of studies were carried out to achieve the selection of a minimum set of impact indicators and identify the short- to medium-term capacity-building needs of the Parties: (a) global consultations of affected Parties on currently utilized impact indicators of relevance to the three strategic objectives [7]; (b) regional consultations on methodologies for collecting and using the required data as well as capacity-building needs to ensure an effective utilization of the identified minimum set of impact indicators [8]; and (c) identification of United Nations agencies and intergovernmental organizations (IGOs) that have the existing information and data required to effectively use the identified minimum set of indicators on either a default or a complementary basis [9]. The findings of these three studies were synthesized in a comprehensive document [2] that was presented at COP 9.

7. Furthermore, the UNCCD 1st Scientific Conference, organized at the occasion of COP 9, tackled issues and made recommendations regarding the biophysical and socio-economic monitoring and assessment of desertification and land degradation [4,10].

8. In Decision 17/COP.9, the COP decided to provisionally accept the proposed, minimum but not exclusive, set of eleven impact indicators. The indicators were organized in a matrix in the Annex of Decision 17/COP.9 (Table 1), which links them to both the Core indicators and the strategic objectives of The Strategy and shows their suitability for use at the national and/or the global level.

9. In Decision 17/COP.9, a sub-set of two impact indicators (i.e., III Proportion of the population in affected areas living above the poverty line; IX Land cover status) was

identified as the minimum required for reporting by affected countries beginning in 2012. The remaining nine impact indicators, while recommended, were considered optional for inclusion in reports by affected countries.

Table 1 **Set of impact indicators recommended to the UNCCD for refinement.**
* Source: Decision 17/COP.9 (UNCCD 2009a) [1].

Recommended set of impact indicators		
	National level	**Global level**
Objective 1: To improve the living conditions of affected populations		
Core indicator S-1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought	• I. Water availability per capita in affected areas • II. Change in land use	• I. Water availability per capita in affected areas
Core indicator S-2: Increase in the proportion of households living above the poverty line in affected areas.	• **III. Proportion of the population in affected areas living above the poverty line**[a]	• III. Proportion of population in affected areas living above the poverty line
Core indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.	• IV. Childhood malnutrition and/or food consumption/ calorie intake per capita in affected areas	• V. The Human Development Index as defined by UNDP
Objective 2: To improve the condition of ecosystems		
Core indicator S-4: Reduction in the total area affected by desertification/land degradation and drought	• II. Change in land use • VI. Level of land degradation (including salinization, water and wind erosion, etc.)	•
Core indicator S-5: Increases in net primary productivity in affected areas.	• VII. Plant and animal biodiversity • VIII. The aridity index • **IX. Land cover status**	• IX. Land cover status
Objective 3: To generate global benefits through effective implementation of UNCCD		
	• VII. Plant and animal biodiversity • III. Proportion of the population in affected areas living above the poverty line	• III. Proportion of the population in affected areas living above the poverty line
Core indicator S-6: Increases in carbon stocks (soil and plant biomass) in affected areas.	• X. Carbon stocks above and below ground	
Core indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management	• XI. Land under SLM	• XI. Land under SLM

[a] The two impact indicators highlighted constitute the minimum required for reporting by affected countries beginning in 2012: **i) Proportion of the population in affected areas living above the poverty line; ii) Land cover status**. The remaining impact indicators in the list, while recommended, are optional for inclusion in reports by affected countries.

10. Annex 1 of Decision 17/COP.9 [1] is drawn directly from the report of the Berry et al. (2009) [7], which also includes, proposed metrics or proxies for each indicator. Table 2 is a summary of this information.

Table 2. **Brief technical definitions of the 11 provisionally recommended impact indicators provided in the "UNCCD Minimum set of Impact Indicators" report** [7,11]**.**

Provisional Impact Indicators	*Stated Purpose*	*Metric/Proxy Definition*
I. Water availability per capita in affected areas	Monitor the progress in the access of the population to improved water sources.	Population with water stress - UN Sustainable Development Indicators. [Percent - %]
II. Change in land use	Highlight changes in the productive or protective uses of the land resource.	Proportion of change of each land use category to another per unit of time. [Percent - %]
III. Proportion of the population in affected areas living above the poverty line	Monitor poverty as the most important defining characteristic of underdevelopment and as a root cause & consequence, of desertification.	The percentage of the affected population with a standard of living above the poverty line [Percent - %]
IV. Childhood malnutrition and/or food consumption/ calorie intake per capita in affected areas	Measure long term nutritional imbalance and malnutrition. Nutritional status is the best global indicator of well-being in children and an indicator of the availability of ecosystem services.	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. [Percent - %]
V. The Human Development Index as defined by UNDP	Approximate the status and change in the well being of populations. Applied in affected areas it will be an effective surrogate for the impact of the efforts to combat desertification on the livelihood of peoples.	UNDP's HDI, based on 4 basic indicators: life expectancy at birth; adult literacy; combined gross enrolment in primary, secondary and tertiary level education; gross domestic product (GDP) per capita in Purchasing Power Parity US dollars (PPP US$) [Parametric index]
VI. Level of land degradation (including salinization, water and wind erosion, etc.)	Measure the extent of land degradation at the national level. It also measures the impact of agreements and programs to address land degradation and to reclaim degraded lands.	The amount of land affected by degradation and its proportion of national territory, LADA . [Area (km^2) and Percent (%) of land area affected]
VII. Plant and animal biodiversity	Approximate overall biodiversity condition of a region relative to a 'pristine' state. The current condition in protected areas is used as a surrogate measure of this pristine state.	Biodiversity intactness index (BII) [Rate of change of BII in percentage (%)]

Provisional Impact Indicators	*Stated Purpose*	*Metric/Proxy Definition*
VIII. The aridity index	Use as base indicator for characterizing sensitive and desertification-affected areas.	UNEP Aridity Index (Bioclimatic Index), defined as the ratio between mean annual precipitation (P) and mean annual evapotranspiration: (ETP) $I_a = P_a / Et_o$ [Indicative value of the ratio P_a / Et_o]
IX. Land cover status	Monitor land degradation in terms of long-term loss of ecosystem primary productivity and taking into account effects of rainfall on NPP.	GLADA - Land cover status -in both cultivated and non-cultivated lands- based on NPP and RUE trends as obtained through long term series NDVI data. [kgC ha-1 year-1% (NPP) and mm-1 (RUE)]
X. Carbon stocks above and below ground	Encourage countries to monitor their carbon stocks and to record changes in above and below ground stocks as a global benefit.	Indicator to be developed in conjunction with IPCC process [tons/ha]
XI. Land under SLM	Land under Sustainable Land Management (SLM) is an important surrogate for a number of global benefits.	Area of land under SLM (World Bank) [ha]

*Source: Adapted from Zucca and Biancalani (2010) [11] summary drawn from Berry et al. (2009) [7].

II. Aim and scope

A. Foundation

11. The foundation for this document involves a considerable body of work on desertification indicator development conducted over the past three decades, the origin of which has been attributed to Barry and Ford (1977) and Reining (1978) [12-14]. The UNCCD began to formally address the challenge of indicator development and selection in 1998, when, in accordance with decision 22/COP.1 of the first session of the Conference of the Parties [15], the first Ad Hoc Panel on Benchmarks and Indicators was convened in Beijing, China [16]. Subsequent work led to a list of indicators for governments to use in preparing their national reports. This in turn led to contributions to the indicator development process from individual country Parties, particularly through UNCCD "country profile" reporting and monitoring [17]. Since that time there has been extensive work carried out by numerous subgroups of scientists that were appointed by the CST as members of the Group of Experts working towards a minimum set of national/global indicators for monitoring Desertification, Land Degradation and Drought (DLDD). This work resulted in a number of highly relevant reports and peer-reviewed publications (e.g., [18-20]). The work continues today: in early 2011, a special issue of *Land Degradation & Development* will focus on indicators [21].

12. This report builds on several recent steps taken to identify and define suitable indicators for the monitoring and assessment of the implementation of the Convention, the impact of National Action Plans (NAPs), and processes and impacts of desertification [22].

In support of UNCCD requests to enhance consistency and coherence, these steps have included (a) determining what benchmarks and indicators country Parties were already using to monitor and assess desertification and its mitigation and identifying synergies (especially commonly used basic indicators) across countries and regions [7], (b) identifying methodologies for measuring those provisional indicators [8], (c) identifying relevant data sources [9]. These efforts formed the basis for the preliminary list of provisional impact indicators currently under refinement (Table 1).

13. This report responds to the evaluation of the outcomes of the UNCCD 1st Scientific Conference. These include a synthesis and recommendations provided by the Dryland Science for Development Consortium [4], guidance on developing a baseline survey for monitoring DLDD [23], and guidance on refinement of the proposed impact indicators, which was provided by the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF) [24]. Annex I provides a synthesis of those recommendations related to the refinement of the provisional impact indicator set.

14. This report also makes use of the relevant work of several parallel, synergistic activities. These include indicator development work of the UN Convention on Biological Diversity (CBD) [25,26], the UN Framework Convention on Climate Change (UNFCCC) Essential Climate Variables (ECV) [27,28], the GEF-UNDP KM:Land "Ensuring Impacts from SLM - Development of a Global Indicator System" medium scale project (MSP) [29], the Land Degradation Assessment in Drylands (LADA) indicator toolbox development effort [30], a joint French Scientific Committee on Desertification (CSDF) - European DesertNet (EDN) indicator development effort [31], and the work of Réseau d'Observatoires de Surveillance Ecologique à Long Terme/Observatoire du Sahara et du Sahel (ROSELT/OSS) [32], the World Atlas on Desertification (WAD) [33], and efforts to promote a Global Drylands Observing System [34].

B. Objectives

15. Based on the decision 17/COP.9 by which the Parties required the UNCCD secretariat, under guidance of the CST Bureau, to develop proposals to refine the provisionally accepted set of impact indicators, the aim is to review the relevance, accuracy and cost-effectiveness of the set of the eleven provisional impact indicators and develop proposals and alternatives for their refinement, revision and improvement [1]. The review should be participatory, formative, and iterative, involving input from the scientific community. It should be representative geographically and across disciplines. The review should build on past and current indicator development work (e.g., a thorough document review), and maximize possible synergies with regional UNCCD efforts, as well as parallel relevant programmes, projects and institutions, including those associated with the other Rio conventions.

16. This review should result in:

(a) A scientifically grounded conceptual framework for the indicator set relative to the complexity of DLDD issues and coherence with the UNCCD ten-year strategic plan and framework to enhance the implementation of the Convention (The Strategy);

(b) Scientifically justifiable indicator evaluation criteria to assess relevance and interpretation of each indicator relative to DLDD, The Strategy, policymakers, managers and other stakeholders, and what we know from science. These criteria should include:

(i) Scientific validity, including being based on well-understood and generally accepted approaches, the capacity to provide information about changes in important processes, sensitivity to change/variability without being overwhelmed by natural variability, applicability at the appropriate temporal and spatial scale;

(ii) Feasibility, including accepted and cost-effective approaches for measurement, availability of appropriate monitoring systems and reliable data (or the future potential these of these), and utility to decision makers;

(c) A hierarchical approach to defining the interrelationship of the indicator set and corresponding objectives. Using Decision 17/COP.9-Annex 1 (Table 1) as the starting point, this should clarify the relationship between UNCCD Strategic Objectives (SO1-3), their corresponding Core indicators (S1-7), the underlying General indicators (refinements on the list of provisional indicators I-XI), and potential Metrics/proxies for measuring the General indicators (based proposals from scientists involved in on-going, long-term indicator development and testing work);

(d) A proposal, based on this hierarchy, for the refinement in the naming and organization of the General indicators (based on refinements of the provisional indicators) and proposals for corresponding Metrics/proxies, retained for further consideration based on a high level of agreement among scientists contributing the to review; this should also include an operational "readiness" assessment rating the development and potential implementation status of the Metrics/proxies (e.g, readiness for testing or further development);

(e) A set of proposals designed to provide guidance on the scientific and operational issues identified during the review as necessary to be addressed in order to have a viable, scientifically valid, and operationally effective impact indicator set.

III. Approach

A. Participatory, formative and iterative evaluation

17. Before, during and after COP 9, the scientific community expressed a strong interest in contributing to the UNCCD impact indicator refinement process. To maximize this diverse technical knowledge and expertise, the refinement approach was designed to be participatory and formative. It is participatory in that scientists from around the world and across disciplines were invited to contribute. It is formative in that multiple avenues of communication and engagement with technical experts were pursued, and at three junctures, what was learned in previous stages became the basis of the next discussion.

18. Formative research attempts to contextualize and incorporate what a population thinks, does, and says about some domain of experience, in this case indicator development in support of monitoring DLDD and the impact of The Strategy of the UNCCD. After each stage/iteration in the process, feedback from the participants is used to adapt the findings to reflect what was learned. The feedback can influence not only the objective (in this case, refinement of the impact indicators), but the overall approach, so that the outcome addresses not only the needs expressed at the outset, but also how those needs are perceived following interaction among the participating scientists.

19. A participatory and formative evaluation can be logistically challenging in that it requires hands-on engagement with the target population. But it has an added benefit that is essential for the UNCCD impact indicator refinement process. Through individual and social learning, knowledge is co-produced instead of a unilateral flow of information. Self-reflection is made possible through open and responsive discourse and interaction among diverse participants to develop a common framework of understanding and basis for joint action. While total consensus on any scientific issue is unlikely, this approach encourages engagement, sharing, learning, a sense of ownership, consensus, and ideally, better information.

B. Major steps in the evaluation/refinement process

(a) Development of a "Zero Draft" of this white paper based on the results of a through review of technical documents and the scientific literature. The Zero Draft included (i) background and objectives, (ii) a candidate conceptual scientific framework, (iii) a summary of recent scientific evaluations of the 11 provisional impact indicators, (iv) a detailed description proposed refinement Metrics/proxies for each of the 11 provisional indicators (obtained from two major parallel indicator development activities conducted by scientists working with LADA and GEF KM:Land, and one contributed by CBD), (v) indicator evaluation criteria, and (vi) an approach to evaluation of the alternative Metrics/proxies based on an evaluation matrix incorporating the criteria. (August – October 2010)

(b) Identification of a broad set of candidate technical experts from each region and across disciplines who would be invited to review the Zero Draft and conduct an evaluation of the 22 Metrics/proxies using the evaluation matrix. The UNCCD conducted the identification and invitation process, using chain referral (asking those identified early on for other candidate scientists) in order identify those with appropriate expert technical knowledge, and to be as representative as possible.

(c) Presentation of the Zero Draft to the CST Bureau and approval to move to the next iteration. (November 2010)

(d) Initial Expert Review. This was the first technical expert review of the white paper and the proposed refinements to the provisional impact indicators. This involved the engagement (via email) of ~70 scientists for the initial review of the white paper and the evaluation of the 22 Metrics/proxies proposed as candidates for refinement of the 11 provisional indicators. Of the ~70 scientists invited, 37 provided detailed written reviews of the white paper and the Metrics/proxies under consideration (Annex III); of these, 17 also completed the evaluation matrix (Annex IV). This was followed by analysis and compilation of their feedback, which was shared back to the participants. (November-December 2010)

(e) Technical Workshop on Impact Indicators Refinement hosted at the UNCCD headquarters in Bonn, Germany (http://www.unccd.int/science/announce/ImpactIndicators.php). Participants included 41 scientists, including representatives of the major synergistic activities and one of the other Rio Conventions, the CBD. Among those attending were 14 who had provided reviews of the Zero Draft and the indicators. Presentations were made on the white paper and indicator evaluation results to date, the role and potential contributions of synergist efforts, and several key discussion topics (e.g., conceptual framework, indicator testing). Four working groups met, discussed, and evaluated the current linkages between UNCCD Strategic Objectives, Core indicators and the provisional indicators. They also assessed the 22 Metrics/proxies. Outcomes included a draft of proposals for consideration by the CST which are incorporated into this white paper. (18–19 December 2010)

(f) Integration of the Technical Workshop results. The workshop results and feedback along with information from the previous stages in the formative evaluation were used to produce (i) a refined conceptual framework, (ii) a refinement of the indicator set hierarchy, (iii) proposals (with varying levels of agreement among the scientists) among the Metrics/proxies reviewed for those that could be considered for testing or further development, (iv) a final version of associated workshop conclusions, framed as proposals for consideration by the CST, and (v) a final draft of this white paper. (January 2011).

(g) Presentation of the process and results at the Second Special Session of the Committee on Science and Technology (CST/S-2) (http://www.unccd.int/cop/cric9/menu.php) in Bonn, Germany. (16-18 February 2011).

(h) Public comment. The final draft of the white paper will be subjected to a global, public consultation through an e-forum facilitated by the UNCCD secretariat (http://eforum.unccd). It is expected that scientists and other stakeholders interested in developing and monitoring impact indicators related to the DLDD issue provide feedback and suggestions for further fine tuning of the white paper. As this process is formative and iterative, those comments will ultimately be incorporated in the final version of the white paper. The public discussion and continued the scientific peer review of the UNCCD impact indicators will last six weeks, starting in February 2011.

C. Indicator evaluation criteria

20. After reviewing a variety of approaches toward indicator evaluation, the decision was made to use the evaluation criteria developed by the U.S. National Research Council in 2000 [35] and the Millennium Ecosystem Assessment (MA) [36]. In addition these prior endorsements, the approach was selected for pragmatic considerations: it is less burdensome on reviewers (only seven questions), and has been used by several synergistic activities for their own indicator development, as well as a review of the 11 provisional indicators conducted by GEF-STAP. The indicator evaluation criteria questions are:

- 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?
- 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?

21. This aspect of the evaluation was facilitated by a matrix (within an Excel spreadsheet) where the columns represented the above criteria and the rows were those indicators (Metrics/proxies) under review. The evaluation matrix also included guidance on the rating scale, consideration of the conceptual framework, and space for comments.

IV. Conceptual framework

A. The need for a conceptual framework

22. The general purpose of monitoring and assessment is to provide the capacity for a formal synthesis and quantitative analysis of information related to specified goals.

Indicators should reflect (1) what a project/program/policy was intended to achieve, and (2) how it was to be achieved. Indicators must therefore be explained in the context of an understanding of the processes involved, and an explanation of how interventions will affect those processes. In this approach, if indicators do not perform as predicted in response to a prescribed intervention, it is possible to return to these basic understandings and adjust/redesign/reconceptualize what is being done. Without this context all that can be done is to make an assessment that has little diagnostic or prescriptive value.

23. Indicators have the capacity to provide the necessary information, but only if, when taken in combination, they consider the full complexity of the system (attributes and stressors), remain simple enough to be regularly and systematically monitored, reflect clear long-term management and policy goals, and can be linked to the decision process [37]. A defined protocol for identifying, developing and refining indicators can provide scientific rigor to the process and help ensure the indicators capture the complexities of the system and provide the information needed for decision making, ideally so that when they are taken together, they can capture the causality in the system among driving forces, state of the environment, and impacts of changes [38]. This in turn can help decision makers connect the underlying processes with impacts, make linkages to related assessment areas, and ultimately more directly support decision making [39]. This approach suggests the need for a causality-based conceptual framework as a foundation for monitoring and assessment and the development, organization and communication of associated indicators.

24. A second and equally important facet in determining the most appropriate conceptual framework for the development, refinement and use of an indicator set for the monitoring and assessment of desertification, its impacts, and its remedies through the implementation of the Convention is the capacity to encompass human-environment interactions. This issue is the first of eleven key messages in the Synthesis and Recommendations from the UNCCD 1st Scientific Conference COP 9 [4]:

> *Desertification, land degradation and drought as defined by the United Nations Convention to Combat Desertification results from dynamic, interconnected, human-environment interactions in land systems, where land includes water, soil, vegetation and humans -- requiring a rigorous scientific framework for monitoring and assessment, which has heretofore been lacking...The text of the United Nations Convention to Combat Desertification [40] places humans "at the centre of concerns to combat desertification and mitigate the effects of drought". It notes that desertification/land degradation and drought (DLDD) "is caused by complex interactions among physical, biological, political, social, cultural and economic factors", and is interrelated with "social problems such as poverty, poor health and nutrition, lack of food security" and other factors.*

25. The Millennium Ecosystem Assessment provides a mechanism for integrating human and environmental systems through the concept of ecosystem services, defined as "the benefits people obtain from ecosystems [41]" The MA Desertification Synthesis describes desertification as being "…a result of a long-term failure to balance demand for and supply of ecosystem services in drylands [42]." This suggests that the conceptual framework adopted for the development, refinement, selection and ultimate use of desertification indicators should also include the ecosystems services approach to linking environmental change and human well-being.

B. Stress, response and causality within a conceptual framework

26. Rapport and Friend (1979) are credited with introducing the concept of framing environmental statistics on the basis of stress and response, the foundation for what are now termed causal chain conceptual frameworks [43,44].The United Nations (UN) moved in

this direction, starting with an extensive survey of the wide variety of methods available for the compilation of environmental statistics, followed by the development of the UN's Framework for the Development of Environment Statistics (FDES) in 1984, which was ultimately endorsed by the Statistical Commission in 1995 [45]. FDES is a combined media (information categories based on system components) and stress-response approach [46].

27. Since that time, several stress and response frameworks have been developed and widely implemented for environmental assessment which emphasize the causal relationships between forces acting on the environment, associated consequences, and societal response through a set of interlinked indicators (hence the descriptor of "causal chain" conceptual frameworks coined by Niemeijer and de Groot) [39]. The most commonly used for environmental monitoring and assessment include (a) the Pressure-State-Response (PSR) framework developed by the Organisation for Economic Cooperation and Development (OECD) [47] and work of the Canadian government and UNEP [48], which led to variations, including (b) the Driving Force-State Response framework (DSR) developed by the UN Commission on Sustainable Development (CSD) [49][1] and used for agri-environmental assessment by OECD [50], (c) the Driving Force-Pressure-State-Impact-Response (DPSIR) framework introduced by the European Environment Agency [38,51,52],and more recently, (d) the Pressure-State-Use-Response-Capacity (PSURC) framework developed by the Convention on Biological Diversity (CBD) [53]. These conceptual frameworks are similar in that each addresses both the origins and consequences of whatever issue is being conceptualized, but differ in how each subdivides the causal chain [39].

C. Driving Force-Pressure-State-Impact-Response (DPSIR) framework

28. The DPSIR framework, depicted in Figure 1, is explained in more detail in Table 3. This framework in particular has been singled out because it (a) incorporates most of the elements of the others mentioned thus far, (b) includes feedback responses (and thus is more dynamic than simple chains from input to impact), and (c) has been adopted or adapted by most of the groups working to develop indicators of desertification, and its mitigation through sustainable land management.

29. Among the major ongoing initiatives to derive desertification indicators that employ the DPSIR conceptual framework are:

- The GEF-UNDP KM:Land "Ensuring Impacts from SLM - Development of a Global Indicator System" medium scale project (MSP) [29]
- The Land Degradation Assessment in Drylands (LADA) indicator toolbox development [30]
- The desertification monitoring and assessment Thematic Programme Network (TPN) for the Asia Region (TPN-1) [54]
- The benchmarks and indicators for the Latin America and Caribbean RAC (TPN-1) [55]
- The joint French Scientific Committee on Desertification (CSDF) - European DesertNet (EDN) indicator development effort [31]

[1] The UN CSD shifted to a Millennium Development Goals (MGD)-based monitoring framework in 2001.

- The Sahara and Sahel Observatory's (OSS) Long-term Ecological Monitoring Observatories Network (ROSELT) local environments indicator development effort [56]
- The GEF Carbon Benefits Project
- The World Atlas of Desertification (WAD) project [33]

Figure 1. **DPSIR framework. (Source: Niemeijer and de Groot 2008 [39])**

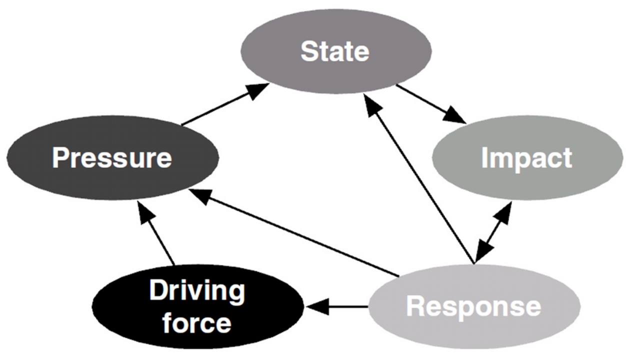


Table 3. **Elements of the DPSIR framework [57-59].**

Driving forces are indirect or underlying factors that result in pressures that in turn cause changes in the quality and quantity or state of the resources. Drivers can involve both anthropogenic and natural forces. Socio-economic and socio-cultural forcing factors can drive human activities, which increase or mitigate pressures on the environment. Human drivers can be subject to policy and management interventions, or responses. Natural driving forces such as climate variability cannot be controlled but must be accounted for in policy development and management.
Pressures are direct drivers (stresses) that human activities place on the environment. Pressures include factors that lead to soil or vegetation loss and degradation, such as land use pressure. Pressure indictors ideally should be linkable to specific drivers. For example, demographic change (a driving force) such as urban and exurban population increases may lead to land use change, land fragmentation (pressures), and the loss of wildlife habitat (a change in system state).
State variables are indicators of the condition of the system (including bio-physical and socio-economic factors/processes). State variables also include trends, often referred to as environmental change, which could be both naturally and human induced. State variables may be interrelated, where a change in one may influence another.
Impacts are the measure of the effects on human well-being and the environment induced by state changes. Impacts are measured with respect to policy/management objectives and the risks associated with exceeding or falling below these targets and limits. Impacts are the consequences of environmental degradation. Environmental change may positively or negatively influence human wellbeing (as reflected in international goals and targets) through changes in ecosystem services and environmental stress. ***Responses*** are the actions or interventions (regulatory and otherwise) that are taken in response to predicted impacts. Forcing factors under human control trigger management responses when target values are not met as indicated by risk assessments. In land degradation, mitigation is the response to impact, while the response to drivers and

pressures is prevention, and the response to changes in status/processes is adaptation. Changes in the core characteristics of a system may also require changes in ecosystem reference points that reflect the shifting environmental states. Responses are subject to feedbacks and intentional or un-intentional by-products (i.e., job creation can increase human well-being, but also lead to further pressure on the land).

* Source: Adapted from Levin et al. (2008-NOAA) [57], UNEP/GRID-Arendal (2002) [58], and UNEP-IEA (2008) [59]

D. Ecosystem services and drylands: The MA framework

30. Ecosystem services are defined as the conditions and processes through which natural systems support, sustain, and enrich human life [60,61]. Reduction in these services in drylands, where more people are dependent on agro-ecological productivity for basic needs than any other system, leads to loss of human well-being. These services are organized into four interrelated categories: provisioning, supporting, regulating and cultural services. (Table 4).

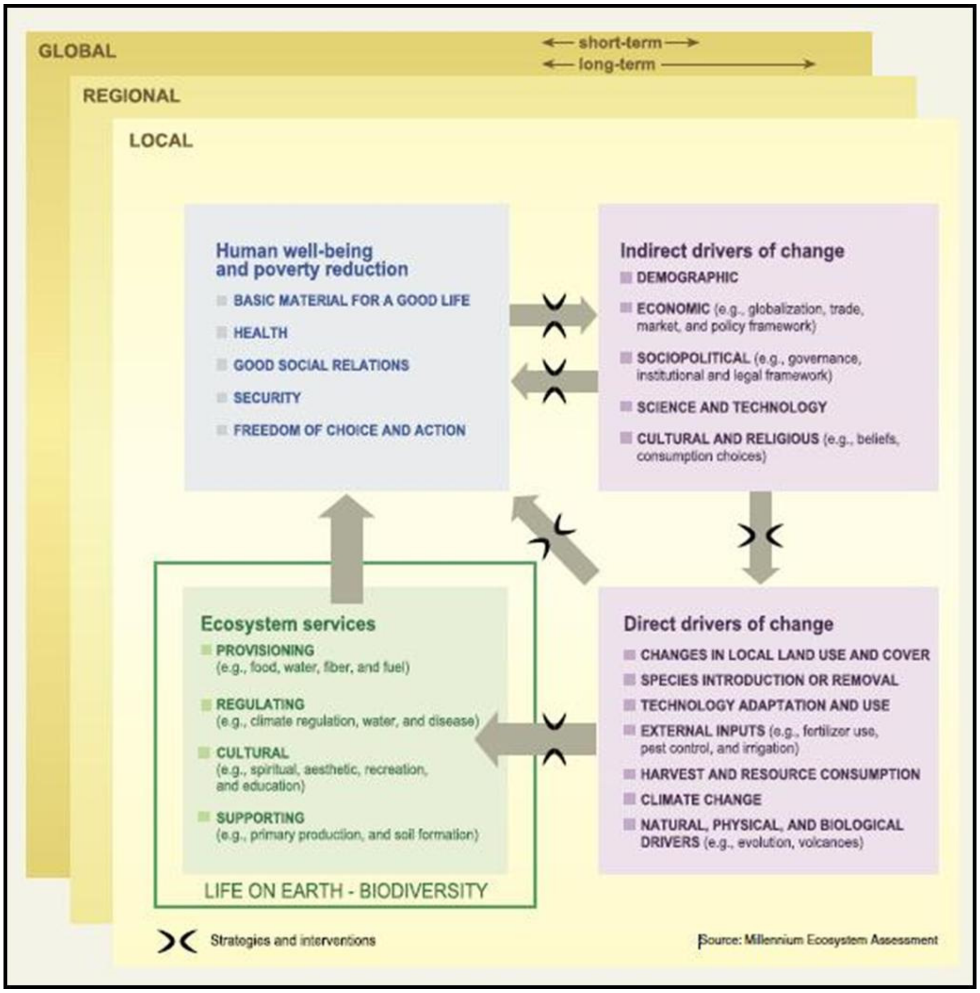
Table 4. **Ecosystem services from drylands categorised in accordance with the MA framework.**

Provisioning Service	Goods produced or provided by ecosystems	• Provisions derived from biological productivity: food, fibre, forage, fuelwood, and biochemicals • Fresh water
Regulating Service	Benefits obtained from regulation of ecosystem processes	• Water purification and regulation • Pollination and seed dispersal • Climate regulation (local through vegetation cover and global through carbon sequestration)
Cultural Service	Nonmaterial benefits obtained from ecosystems	• Recreation and tourism • Cultural identity and diversity • Cultural landscapes and heritage values • Indigenous knowledge systems • Spiritual, aesthetic, and inspirational services
Supporting Service	Services that maintain the conditions for life on Earth	• Soil development (conservation, formation) • Primary production • Nutrient cycling

* Source: Millennium Ecosystem Assessment (2005b) [42]

31. Interactions between biodiversity, ecosystem services, human well-being, and drivers of change form the basis of the MA conceptual framework (Figure 3) [36].

Figure 2. **Millennium Assessment conceptual framework. (Source: MA 2005a [41])**



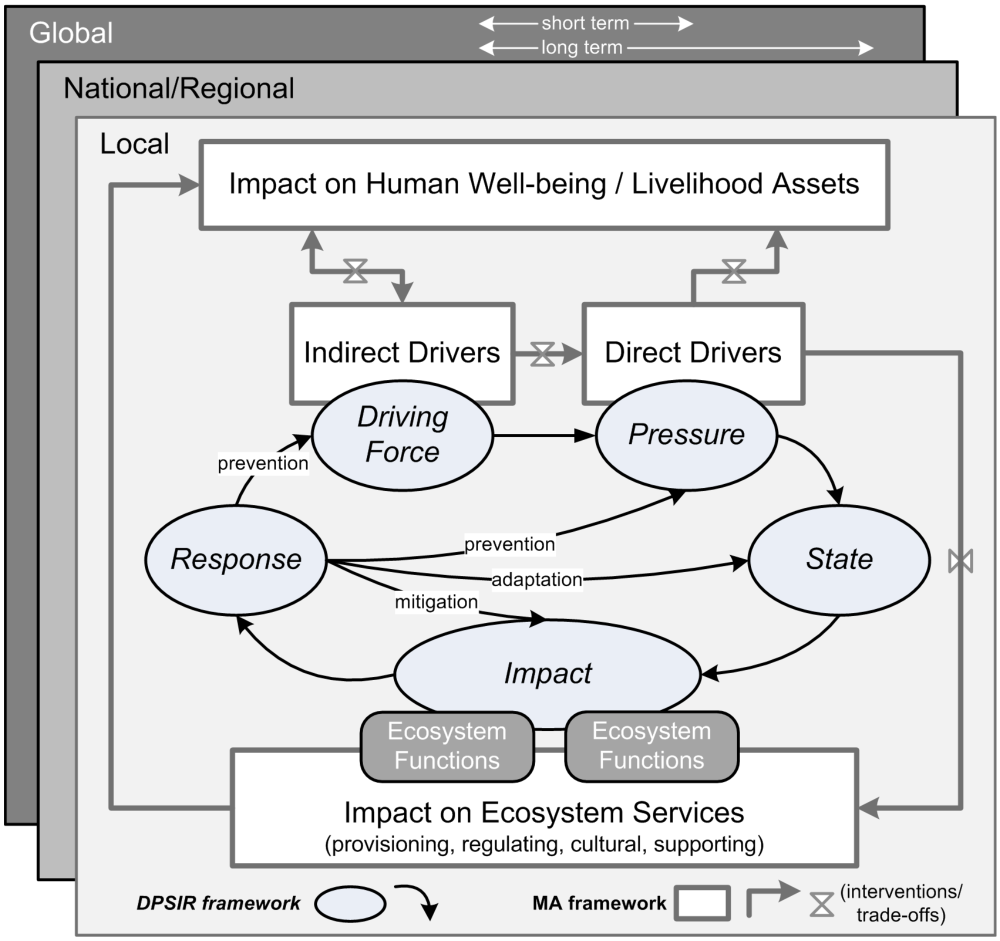
32. The MA conceptual framework includes characteristics that are central to the DPSIR conceptual framework. It accounts for indirect (driving force) and direct (pressure) drivers of change, and captures response. It differs in that it couches impacts from the perspective of human well-being – which is core to the mission of the Convention. It also visually accounts for interactions at more than one spatial and temporal scale and those that occur across scales.

33. Like DPSIR, the MA framework is commonly used in desertification research and practice. For example, the Drylands Development Paradigm (DDP), a synthetic approach to addressing the livelihoods of human populations in drylands, via the study of coupled human-ecological (H-E) systems, employs this framework [62], as do GEF KM:Land and LADA.

E. Proposed amended DPSIR framework integrated with ecosystem services provisions

34. The conceptual framework proposed for consideration by the UNCCD employs a combination of DPSIR and ecosystem services approaches to conceptualizing the indicator set and includes a MA-like visualization of the different spatial temporal scales of concern (Figure 4).

Figure 3. **Amended DPSIR framework integrated with ecosystem services provisions**



* (Source: Adapted from GEF KM:Land 2010 & FAO LADA 2009)

35. The proposed framework is a refinement of the one used in the Initial Expert Review, with contributions from participants in the Technical Expert Workshop which followed. Those present proposed the framework be considered by the CST, as reflected in proposal (g) in section VII.B.

36. The proposed framework is similar in approach to that taken by two important synergistic efforts supporting the mission and objectives of the UNCCD, KM:Land and LADA. In the case of KM:Land, UNU-INWEH, together with the GEF Land Degradation Task Force developed what they call the "SLM framework," where DPSIR operates at

different scale levels with the impact assessment focused on benefits to society and biodiversity [63]. LADA integrates different parts of its land degradation assessment approach through DPSIR and ecosystem services frameworks, as well as a sustainable livelihoods framework. Together, these focus on the benefits people obtain from the environment in support of their livelihoods [30].

37. The amended DPSIR framework integrated with ecosystem services provisions can guide and facilitate indicator set organization, use and communication. It has the potential to support the strategic objectives of the UNCCD and provides the opportunity to account for causality, interactions and trade-offs that are always present in land management, and that have to be taken into account if proper and feasible responses have to be identified in support of decision making. This provides a first approximation of how well the causal chain associated with DLDD will be captured by the selected indicator set, helping highlight gaps and cross-indicator interactions. While it is recognized that the UNCCD mandate for indicator development is focused on the national and global scales, it is important that the conceptual framework also highlights the need for eventual synergy between global, national and local information, and be amenable to a future mechanism that could support the use of locally-derived indicators in support of the global monitoring effort, such at that proposed by Oba et al., 2008 [64]. In addition, the proposed framework provides specific emphasis on a number of monitoring and assessment priorities that the UNCCD is working to support in its approach to indicator refinement: (a) emphasis on impact on human well-being, (b) accommodation of an ecosystem services approach to integrated assessment, (c) consideration of spatial and temporal scalar issues, (d) emphasis on “response” indicators to help monitor policy and management influences ranging from implementation of the Convention to specific SLM or desertification mitigation efforts.

38. This approach has some weaknesses. Participants in the UNU-INWEH KM:Land effort have pointed out that changes in ecosystem services due to strategies or interventions (as measured by response indicators) may impact human well-being, but on a longer time frame than typical observation periods of 1-5 years. This can be in part mitigated through assessment of changes in state indicators [29]. While the approach highlights the issues of scale, it does not, resolve them (e.g., in many cases local-scale indicator data cannot be aggregated to national levels without risking exaggerated results). The approach also offers the opportunity to incorporate locally-derived indicators into the global monitoring effort, but it does not, as of yet, define the mechanism that would make this operationally feasible.

39. Another challenge is in how the framework is used to support reporting. Environmental assessments that are conducted using causal chain frameworks frequently do not capitalize on the entire set of indicators (interactions), but rather report on an indicator-by-indicator basis, with some comparisons across indicators [39]. This practice of compartmentalization of indicator data essentially defeats the purpose of having an indicator set working in concert. One solution to this is to make the framework itself part of the indicator development process so that it evolves with the decisions to embrace or adapt indicators and measurement methodologies into the future.

40. This could also include a more in depth assessment of the interrelationships among the indicators in the set through casual network analysis, in a stepwise process corresponding to progress on indicator selection, development and testing. Casual networks visually resemble a process-based simulation model flowchart used in environmental systems analysis to depict interconnections between components and processes (but with less detail and less quantification of the relationships) [65]. The causal network approach has an additional advantage in that it is even more flexible to regional variation, so that locally derived indicators could be more readily incorporated, and more directly contribute to global assessment. Niemeijer and de Groot (2008b [65]) document the steps necessary to build a causal network conceptual framework, something that could be conducted by

representatives of the major synergistic efforts working towards an integrated global monitoring and assessment approach to DLDD.

V. Provisional impact indicators: prior review results

41. Following the COP 9 request of the CST to review the set of UNCCD-COP provisionally accepted set of eleven impact indicators (in Decision 17/COP.9) [1], the UNCCD requested input which was provided in four parallel studies focused on the original provisional indictor set. Two of these, the GEF-STAP report (2009) [24] and a methods integration study by LADA (2010) [11] addressed all eleven provisional impact indicators relative to parallel indicator development work underway by KM:Land and LADA, respectively. Two others addressed, individually, the sub-set of two impact indicators that were identified in Decision 17/COP.9 as the minimum required for reporting by affected countries beginning in 2012 (III. Proportion of the population in affected areas living above the poverty line [66]; IX. Land cover status [67]).

A. GEF-STAP review

42. In late 2009, the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF) completed a review [24] of the 11 impact indicators provisionally approved by the UNCCD for refinement (Table 1). This review was focused primarily on the International Group of Experts Report "UNCCD Minimum Set of Impact Indicators [7]". The GEF-STAP review applied MA evaluation criteria [36] (which were originally developed by the U.S. National Research Council in 2000 [35]) for identifying strengths and weaknesses in the eleven provisional indicators (see section III.C above). The review included a brief summary of the answers to each of these questions for all 11 indicators. The degree to which each indicator met these criteria (yes, no, partly or unknown) was then summarized, and is reproduced here in Table 5.

Table 5. **Results of the GEF-STAP indicator assessment using the MA indicator criteria**.

*Indicator**	*Info about important process*	*Sensitive enough to detect change*	*Detect change at appropriate scale*	*Generally accepted and understood*	*Reliable data available*	*Monitor system in place*	*Easily under-stood by policy makers*
I. Water availability per capita	±	±	–	+	+	+	+
II. Change in land use	–	–	–	–	–	–	–
III. Population above poverty line	+	±	–	+	+	+	+
IV. Childhood malnutrition	±	±	±	+	+	+	+
V. The Human Development Index	±	±	?	+	+	+	±
VI. Level of land	±	–	–	±	–	–	±

*Indicator**	*Info about important process*	*Sensitive enough to detect change*	*Detect change at appropriate scale*	*Generally accepted and understood*	*Reliable data available*	*Monitor system in place*	*Easily under-stood by policy makers*
degradation							
VII. Plant and animal biodiversity	**+**	**+**	**?**	**+**	**+**	**±**	**+**
VIII. The aridity index	**+**	**±**	**±**	**+**	**+**	**+**	**+**
IX. Land cover status	**±**	**±**	**?**	**±**	**+**	**+**	**?**
X. Carbon stocks	**+**	**±**	**–**	**+**	**–**	**±**	**+**
XI. Land under SLM	**±**	**–**	**–**	**–**	**–**	**–**	**–**

* For full indicator name see Table 1. Guide*:* **+** = *Yes;* **–** = *No;* **±** = *partly;* **?** = *unknown* Source: GEF-STAP 2009 [24]

43. All eleven indicators were determined to need refinement. The GEF-STAP [24] summarized their findings as follows:

> *In summary, none of the discussed eleven impact indicators meet all the requirements as proposed by the MA. Overall, the human oriented indicators (I, III, IV, V) are more suitable than the others. Their main limitation is their applicability at the national to global level. However, most environmental indicators have severe conceptual and/or data limitations (especially II, VI, IX, X, XI). The short-comings of these indicators include: insensitivity to detection of change, the lack of an appropriate scale for detecting change and various uncertainties about the nature of the indicator. The indicators on plant biodiversity and aridity are potentially the most robust of the proposed environmental indicators.*
>
> *… Only large impacts at national to global level over decades can be measured. Many of the proposed indicators are not sensitive enough to measure relevant impact.*
>
> *… It is clear…that there is a structural mismatch of the scale properties of the proposed indicators. There is no unifying resolution of the indicators though all can be reported at a resolution of country with a global extent. This is unfortunately far too coarse to approach the multi-scale levels where the actual land degradation and desertification processes take place [68,69]. This scalar mismatch severely limits the value of the proposed indicators. Additionally, the users of the proposed indicators are not discussed, nor are the scales that are used matched to the governance levels involved [70].*
>
> *…When we map the UNCCD "core" indicators against the suggested impact indicators…Some Core indicators are served by three proposed indicators while others are served by one indicator. What could be done to improve the understanding of the relationship is to make a causal tracking diagram linking them. The current mapping suggests that there are too many overlapping biophysical indicators, such as indicators VII, VIII and IX. On the other hand, indicators II, IX, and XI seem to overlap and could potentially be merged. This clearly indicates the*

need for a general systemic framework first from where processes and impacts are derived yielding, preferably, one impact indicator for each UNCCD "core" indicator.

B. LADA-NRD review

44. A second study, conducted by LADA members from Nucleo Ricerca Desertificazione (NRD) at the University of Sassari focused mostly on exploring ways to use LADA data and methods to make the provisional set of indicators operational [11]. LADA was encouraged to provide this input as it is currently the only project working to produce an integrated assessment of dryland desertification at different scales, globally. As part of that effort, the authors conducted a brief analysis of the operability, specificity, and data availability of each of the eleven indicators (Table 6).

Table 6. **A brief analysis on the present operability and specificity of the 11 UNCCD provisional indicators. Source: Zucca and Biancalani, 2010**

Impact Indicator	*Still need definition*	*Need greater Specification**	*Operational***	*Datasets complete and available at sub-national level****
I. Water availability per capita in affected areas	N	Y	Y	N
II. Change in land use	N	N	N	
III. Proportion of the population in affected areas living above the poverty line	N	N	Y	N
IV. Childhood malnutrition and/or food consumption/ calorie intake per capita in affected areas	N	N	Y	Y/N
V. The Human Development Index as defined by UNDP	N	N	Y	N
VI. Level of land degradation (including salinization, water and wind erosion, etc.)	Y	Y	N	
VII. Plant and animal biodiversity	N	N	N	
VIII. The aridity index	N	N	Y	Y
IX. Land cover status	N	Y	N	
X. Carbon stocks above and below ground	Y	Y	N	
XI. Land under SLM	Y	Y	N	

*In principle all indicators making reference to the affected areas would need better specification.
**Operational = datasets are already collected (and updated) with standard and common formats at the global level.
***Only applies to "operational" indicators.

45. The report concluded that some of the indicators can be satisfied by LADA products, but further refinement is necessary on all eleven indicators in how they are defined, specified and made operational for future implementation.

46. It is important to note that both studies point out that time and direct experience with the indicators had an influence on the assessment, particularly with more complex indicators such as II. Change in land use and XI. Land under SLM. In addition, three indicators were essentially "placeholders" in the original report, as they were specifically requested but at the time of the report not defined at a higher operational level of detail (VI, X and XI).

VI. Indicator refinement: candidate metrics/proxies

Source and technical descriptions

47. Candidate Metrics/proxies – how an indicator might be measured – have been proposed to the UNCCD for each of the provisional indicator categories by a number of synergistic activities. In particular, taken together, GEF KM:Land, LADA and CBD have 22 Metrics/proxies for indicators under development that corresponded to the provisional indicator list. Their development efforts over the past few years involved considerable input from the scientific community, and a considerable amount of documentation was available for each metric or proxy. Based on this background information, consistent technical descriptions for each were developed to provide to the Initial Expert Review Annex III. They are ordered in Annex III according to UNCCD strategic objectives 1, 2 and 3 and associated Core indicators (S-1 through S-7). They are numbered to correspond with the original UNCCD provisional indicator (I–XI) they most suited, with the addition of a letter code (e.g., KM:Land = KM; LADA = LA; CBD = CBD) to make it easier to track the source. Each refinement metric/proxy retains the name given by those how proposed it. A generalized reference to scale is also provided next to the indicator name. The information for each metric/proxy provided includes: purpose, description, source, spatial and temporal refinement, and noted strengths and weaknesses. Similar Metrics/proxies of indicators related to the same original UNCCD indicator were placed side by side in Annex III.

48. The Metrics/proxies which were evaluated are listed in Table 7. Table 8 maps these proposed Metrics/proxies against the Strategic Objectives, Core indicators, and the corresponding Provisional indicator as originally defined in Decision 17/COP.9-Annex 1 (see Table 1).

Table 7. **The proposed Metrics/proxies evaluated in support of the indicator refinement effort.**

1. **I-KM-a.** Water stress
2. **I-LA-a.** Pressure on water resources
3. **I-KM-b.** Water availability
4. **I-LA-b.** Water availability and use
5. **I-KM-c.** Percentage of rural population with access to (safe) drinking water
6. **I.LA-c.** Access to improved drinking water based on change in water quality
7. **II-KM.** (see XI-KM below). Land Use System (LUS) and Sustainable Land Management (SLM) practices
8. **II-LA.** Land Use System (LUS) and change in land use
9. **III-KM.** Rural Poverty Rate
10. **IV-KM.** Proportion of chronically undernourished children under the age of 5 in rural areas
11. **V-KM.** Maternal mortality ratio (or rate) (MMR)
12. **VI-LA-a.** Level of land degradation (via ecosystem-services provision capacity)
13. **VI-LA-b.** Level of land degradation
14. **VII-KM.** Crop and livestock diversity (agro-biodiversity)

15. **VII-CBD.** Trends in abundance and distribution of selected species
16. **VIII-KM.** Trends in seasonal precipitation
17. **VIII-LA.** Aridity trend and rainfall variability
18. **IX-KM.** Land cover
19. **IX-KM&LA.** Land productivity
20. **X-LA.** Above and below ground organic carbon stocks
21. **XI-KM.** (see II-KM above) Land use system (LUS) and Sustainable Land Management (SLM) practices
22. **XI-LA.** Land under Sustainable Land Management (SLM)

KM:Land = KM; LADA = LA; Convention on Biological Diversity = CBD

Table 8. Schematic of UNCCD objectives, core indicators, provisional indicators, and revision metrics/proxies under consideration (part 1)

UNCCD Objective 1: To improve the living conditions of affected populations										
UNCCD Core indicator S-1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought.								UNCCD Core indicator S-2: Increase in the proportion of households living above the poverty line in affected areas.	UNCCD Core indicator S-3: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.	
UNCCD Provisional indicator names:										
I. Water availability per capita in affected areas						II. Change in land use		III. Proportion of the population in affected areas living above the poverty line	IV. Childhood malnutrition and/or food consumption/ calorie intake per capita in affected areas	V. The Human Development Index (HDI) as defined by UNDP
Revision metric/proxy names:										
#1 I-KM-a Water stress	#2 I-LA-a Pressure on water resources	#3 I-KM-b Water availability	#4 I-LA-b Water availability and use	#5 I-KM-c Percentage of rural population with access to (safe) drinking water	#6 I.LA-c Access to improved drinking water based on change in water quality	#7 II&XI-KM Land Use System (LUS) and Sustainable Land Management (SLM) practices	#8 II-LA Land Use System (LUS) and change in land use	#9 III-KM Rural Poverty Rate	#10 IV-KM Proportion of chronically undernourished children under the age of 5 in rural areas	#11 V-KM Maternal mortality ratio (or rate) (MMR)

(part 2)

UNCCD Objective 2: To improve the condition of ecosystems								UNCCD Objective 3: To generate global benefits through effective implementation of UNCCD		
Core indicator S-4		UNCCD Core indicator S-5						UNCCD Core indicator S-6		
UNCCD Provisional indicator names:										
VI. Level of land degradation (including salinization, water and wind erosion, etc.)		VII. Plant and animal biodiversity		VIII. The aridity index		IX. Land cover status		X. Carbon stocks above and below ground	XI. Land under Sustainable Land Management (SLM)	
Revision metric/proxy names:										
#12 VI-LA-a Level of land degradation (via ecosystem-services provision capacity)	#13 VI-LA-b Level of land degradation	#14 VII-KM Crop and livestock diversity (agro-biodiversity)	#15 VII-CBD Trends in abundance and distribution of selected species	#16 VIII-KM Trends in seasonal precipitation	#17 VIII-LA Aridity trend and rainfall variability	#18 IX-KM Land cover	#19 X-KM&LA Land productivity	#20 X-LA Above and below ground organic carbon stocks	#21 XI&II-KM Land use system (LUS) and Sustainable Land Management (SLM) practices	#22 XI-LA Land under Sustainable Land Management (SLM)

VII. Conclusions

Refinement of the indicator set hierarchy

49. One of the critical needs identified in the both reviews conducted prior to this effort and by the Initial Expert Review for this report was how the underlying logic (and in some cases, language) of the indicator set hierarchy needed to be fine-tuned in order to maximize the potential for the indicator set to meet the strategic objectives of the UNCCD. These issues were taken up in the Technical Workshop and led to proposals on (a) enhancing the linkages between the strategic objectives and Core indicators, (b) distinguishing between necessary General indicators and the Metrics/proxies and associated methodologies that might be used represent them, and (c) suggestions on Metrics/proxies that are ready for testing or further development.

50. It is important to note that these suggested refinements detailed below are *not* intended to change the purpose and target of the indicators, but to simplify them in order to ease the selection of the specific and operational indicators needed to allow for clear and effective reporting.

51. The next sections describe, step by step, these refinements. (To see the combined results of these steps, see Table 12.)

1. Refine the indicator set hierarchical structure

52. The indicator set hierarchy as provided in Decision 17/COP.9-Annex 1 (Table 1) involves three levels:

I. Strategic Objectives
  a. Core indicators
    i. Provisional Indicators

53. The proposed refinement to the *structure* of this hierarchy is to divide level 3 (Provisional Indicators) into two parts, namely General indicators (what should be measured) and Metrics/proxies (methodologically defined measures to make the General indicators operational), so that the refined hierarchy would be as follows:

I. Strategic Objectives
  a. Core indicators
    ii. General indicators
      1. Metrics/proxies

54. This refinement essentially splits apart two, often confounding aspects of the debate in indicator development and selection: what the indicator should measure, and the metric or proxy that should be used to measure it.

2. Refine the core indicator descriptions

55. The experts endorsed the approach defined by the Core indicators and their relationship to the Strategic Objectives as listed in Decision 17/COP.9-Annex 1 (Table 1), and suggested one aggregation and some minor refinements in wording to make them more effective.

56. The introduced changes depicted in *italic* and ~~strikethrough~~ in Table 9 are:

- Merging and generalization of former Core indicators S-1, S-2, S-3 to allow for a more flexible and effective selection of the best indicators related to poverty, nutrition, access to water, based on the most updated methods
- Elimination of the repeated reference to "affected areas" in the Core indicators definition, in conjunction with the proposal that the context of application of the indicators should be defined and clarified as a separate by parallel task, in order to avoid possible confusion and different interpretations by the UNCCD and affected country Parties (see proposal (g) in section VII.B).

Table 9 Proposed refinements to Core indicators.

OBJECTIVE 1: TO IMPROVE THE LIVING CONDITIONS OF AFFECTED POPULATIONS	
Core indicator S-1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought **Core indicator S-2**: Increase in the proportion of households living above the poverty line in affected areas. **Core indicator S-3**: Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.	**Core indicator S-1/2/3**: *Improvement in the livelihoods of people potentially* impacted by the process of desertification/land degradation and drought
OBJECTIVE 2: TO IMPROVE THE CONDITION OF ECOSYSTEMS	
Core indicator S-4: Reduction in the total area affected by desertification/land degradation and drought	**Core indicator S-4:** Reduction in the total area affected by desertification/land degradation and drought
Core indicator S-5: Increases in net primary productivity in affected areas.	**Core indicator S-5**: *Maintenance of or* increases in ecosystem function, including net primary productivity ~~*in affected areas*~~
OBJECTIVE 3: TO GENERATE GLOBAL BENEFITS THROUGH EFFECTIVE IMPLEMENTATION OF UNCCD	
Core indicator S-6: Increases in carbon stocks (soil and plant biomass) in affected areas	**Core indicator S-6**: Increases in carbon stocks (soil and plant biomass) ~~*in affected areas*~~
Core indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management	**Core indicator S-7**: Areas of forest, agricultural and aquaculture ecosystems under sustainable management

* The introduced changes depicted in *italic* and ~~strikethrough~~

3. Generalize the provisional indicator system level, and refine the list

57. The convened experts are aware of the criticism raised in relation to the 11 provisionally accepted indicators. They are also aware that some of the 11 indicators were defined (by the original "minimum set" report) at a sufficient degree of operational specificity, but many others were just left open, to be intended as General indicators (or

information categories, a sort of information need statement) to be implemented by means of specific indicators to be defined in a later refinement phase. This aspect has been often neglected by those criticisms.

58. Having this in mind, the experts suggested that the provisional indicator list could serve an essential function of "General Indicator" for what is determined must be measured in order to assess impact. (And, as noted in Step 1 above, they operational definitions of these indicators would reside in the fourth level of the hierarchy, called "Metrics/proxies"). Based on this, the experts proposed the name/definitions changes in the General indicators list as shown in Table 10.

59. And, in the same way done for the Core indicators, the experts suggested elimination of the repeated reference to "affected areas" in the General indicators definition, in conjunction with the recommendation that the context of application of the indicators should be defined and clarified as a separate by parallel task, in order to avoid possible confusion and different interpretations by the UNCCD and affected country Parties (see proposal (g) in section VII.B).

60. Next, the experts analyzed the provisional indicator list for their relevance to the related to the Core indicators. As far as they are considered as General indicators (as defined above) all the Provisional indicators were considered as relevant to at least one of the Core indicators and endorsed, with two exceptions:

- "V. HUMAN DEVELOPMENT INDEX" was *not* endorsed because it was determined to be redundant because it overlaps the other specific indicators proposed in relation to livelihood (indicators I-IV), and because of its complexity (it involves multiple underlying measures in its calculation), would be the least sensitive to DLDD.
- "VIII. ARIDITY INDEX" was *not* endorsed as a General Indicator relevant to the three Core indicators in the sense that it must be used in conjunction with all the others to define the dryland areas, and thus will be used in support of their analysis rather than as an independent indicator (See proposal (g) in section VII.B).

Table 10. Proposed revisions to the indicator short names/definitions.

The original 11 Provisional Indicators	*The retained General indicators*
I. Water availability per capita in the affected areas	I. Water availability per capita ~~*in the affected areas*~~
II. Change in land use	II. Change in land use
III. Proportion of population in affected areas above poverty level	III. Proportion of population ~~*in affected areas*~~ above *the relative* poverty ~~*level*~~ *line*
IV. Childhood malnutrition and/or food consumption/caloric intake per capita	IV. ~~*Childhood malnutrition and/or*~~ Food consumption~~*/caloric intake*~~ per capita
V. Human Development Index (HDI)	~~*V. Human Development Index (HDI)*~~
VI. Level of land degradation	*New V.: Capacity of soils to sustain agro-pastoral use*
VII. Plant and animal biodiversity	VI. ~~*Level*~~ *Degree* of land degradation
VIII. Aridity index	VII. Plant and animal biodiversity
IX. Land cover status	

The original 11 Provisional Indicators	*The retained General indicators*
X. Carbon stocks above and below ground	VIII. ~~*Aridity*~~ *Drought* index
XI. Lands under Sustainable Land Management (SLM)	IX. Land cover status
	X. Carbon stocks above and below ground
	XI. Lands under Sustainable Land Management (SLM)

* The introduced changes depicted in *italic* and ~~strikethrough~~

4. Refine the relationship between core and General indicators

61. For some of General indicators it was suggested to change the association with the specific Core indicators to ensure each Core indicator and its associated General indicators have a direct relationship, and that taken together, they address the corresponding Strategic Objective. This is summarized in Table 11 below (and it is also reflected in the final results of the refinement process in Table 12).

62. Specifically, two gaps were identified by the experts:

- A “DROUGHT INDEX” indicator (e.g., Standard Precipitation Index, SPI) is necessary to fully cover the definition of Core indicator S-4. In the refined hierarchy, this indicator was given the name “**VIII. Drought index**”.
- A “CAPACITY OF SOILS TO SUSTAIN AGRO-PASTORAL USE” indicator (e.g., GLADIS “Soil Health Status) is needed in relation to both SO-2 (ecosystem provisioning services capacity) S-4 and SO-3 (sustainability of land use) S-7. In the refined hierarchy, this indicator was given the name “**V. Capacity of soils to sustain agro-pastoral use**”.

63. The experts also noted that some indicators would play support roles for other indicators.

- The proposed “Drought index” (new VII.) was also considered necessary to for a) the assessment of drought, b) the derivation of VI. Degree of land degradation.
- The proposed “Capacity of soils to sustain agro-pastoral use indicator” (new V.) (e.g., GLADIS “Soil Health Status”) was considered necessary for the derivation and interpretation of VI. Degree of land degradation and for assessing sustainable land management and XI. Land under Sustainable Land Management (SLM).

64. The experts noted that some indicators would serve as secondary indicators under a second core objective. One such example was:

> VII. Plant and animal biodiversity is the primary General indicator under Core indicator S-5. However, in relation to Core indicator S-7, it should be considered as a secondary indicator because the relationship between biodiversity and SLM are not univocal.

65. In one case, an indicator originally addressed two strategic objectives, but with a Core indicator associated with the second. Specifically, Decision 17/COP.9-Annex 1 (Table 1) placed III. Proportion of the population living above the relative poverty line, under SO-1, but also under SO-3 with no corresponding Core indicator. This latter placement was deemed redundant and removed.

5. Refine the implementation scale

66. Because the provisional indicators listed in Decision 17/COP.9-Annex I (Table 1) were both what was to be measured, and in some cases, the specific metric or proxy of how to measure that indicator, an attempt was made to reference the appropriate implementation scale (national, global, or both), which subsequently engendered considerable debate. The proposed change in the structure of the indicator set hierarchy makes this no longer relevant at the General indicator level (as methodology and data set scale dependency is primarily an issue when the metric/proxy is defined) (Table 11). However, clearly, the implementation scale issue will remain of concern when selecting Metrics/proxies for testing or further development. To ensure clear guidance on this issue, and to document major concerns related to scale, please see proposals (e) and (f) in section VII.B.

Table 11 Proposed revisions to the relationship between the Core indicators and the underlying General indicators.

	Original (Provisional)		*Refined (General)*
	National	Global	National & Global
STRATEGIC OBJECTIVE 1:			
Core indicator S-1/2/3:	I, II, III, IV	I, III, V	I, III, IV
STRATEGIC OBJECTIVE 2:			
Core indicator S-4:	II, VI		II, VI, New VIII, New V
Core indicator S-5:	VII, VIII, IX	IX	VII, IX
STRATEGIC OBJECTIVE 3:			
Core indicator S-6:	X		X
Core indicator S-7:	XI	XI	XI, New V, VII*
Not linked to a core objective	VII, III	III	

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); New VIII. Drought index; New V. Capacity of soils to sustain agro-pastoral use

*Note: VIII. Biodiversity in relation to Core indicator S-7 should be considered as a secondary indicator because the relationship between biodiversity and SLM are not univocal.

6. Refine the Metrics/proxies level

67. In all, 22 different "Metrics/proxies", the methodologically defined measures to make the General indicators operational, were evaluated. During the Initial Expert Review, 37 scientists provided comments on these measures, and of these, 17 completed an evaluation using the criteria (described in section III.C). The results, including all the comments, are compiled in Annex IV. The summary of the ratings for each indicator/criteria is available in Annex V. The reviewers were also asked for their opinion on the role each metric/proxy under evaluation might play, with respect to the DPSIR and MA framework. The summary of that assessment is in Annex VI.

68. These results were discussed in both plenary and by the four working groups during the Technical Workshop. The Metrics/proxies were then reassessed by the working groups of 10 scientists from different regions and disciplines (not all groups had time to address all Metrics/proxies, but each was assessed in detail by at least two working groups). The working groups also rated these Metrics/proxies on their "readiness" for testing as a separate issue, so that indicators deemed necessary, but not yet ready to implement would remain under consideration (see proposal (n) in section VII.B).

69. All Metrics/proxies that were recommended to be moved forward for further consideration by both working groups, as well as those with less agreement, are listed in Table 12. There were several Metrics/proxies that did not receive conclusive support as "independent" metrics or proxies within the indicator set. However, when considered in conjunction with another indicator or metric, they were considered essential. These included:

- #3 I-KM-b and #4 I-LA-b Water availability and use (in support of #5 I-KM-c Percentage of population with access to (safe) drinking water
- #7 II-KM/XI-KM and #8 II-LA Land use (in support of deriving a) VI. Land degradation and b) XI. SLW, and also in interpreting c) IX. Land cover status)

70. Finally, three new Metrics/proxies were proposed and received strong support from the 10 scientists in the working group making the proposal. These included:

- Standardized Precipitation Index (SPI) (under New VII. "Drought index"), proposed because it was considered necessary for a) the assessment of drought, b) the derivation of VI. Degree of land degradation, and the recent decision by the World Meteorological Organization (WMO) and other organizations to endorse SPI as a universal standard drought index [71].
- GLADIS "Soil Health Status" (under New V. "Capacity of soils to sustain agro-pastoral use") was considered necessary for the derivation and interpretation of VI. Degree of land degradation and for assessing sustainable land management and XI. Land under Sustainable Land Management (SLM).
- Soil biodiversity (under VII. Plant and animal biodiversity) was considered not ready for implementation today, but something which would be valuable, even essential in the future. To ensure full consideration and to create a "place holder" this Metric/Proxy was proposed by the working group assessing this indicator.

71. These refinements are a culmination of the participatory, formative review process. The level of agreement among the experts varied point to point, and this has been noted throughout the white paper and in Table 12. In this way we hope to have reflected the views of the Technical Expert Workshop participants.

72. The refinements to Decision 17/COP.9-Annex I are based on the combined sources of technical expert feedback obtained throughout formative, participatory evaluation process.

Table 12 Proposed refinements to Decision 17/COP.9-Annex I [1] (see Table 1 in this document).

Proposed revisions to Decision 17/COP 9-Annex 1, including metrics/proxies to be considered for testing and/or further assessment/development

Core Indicators *(with proposed revisions)*	**General Indicators** *(revisions of 11 provisional indicators)*	**Metrics/Proxies** *(operational approaches proposed for testing, where ready, and further assessment/development where not)*	**Degree of Expert Agreement**	**Readiness for Testing**
Strategic Objective 1: To improve the living conditions of affected populations				
Core indicator S-(1/2/3): Improvement in the livelihoods of people potentially impacted by the process of desertification/land degradation and drought	**III. Proportion of the population living above the relative poverty line**	#9 III-KM Rural Poverty Rate*	High	Green
	I. Water availability per capita	#5 I-KM-c Percentage of population with access to (safe) drinking water	Medium	Yellow
		#3 I-KM-b and #4 I-LA-b Water availability and use (in support of #5 I-KM-c)	Low**	Yellow
	IV. Food consumption per capita	#10 IV-KM Proportion of chronically undernourished children under the age of 5 in rural areas*	High	Yellow
Strategic Objective 2: To improve the condition of ecosystems				
Core indicator S-4: Reduction in the total area affected by desertification/landdegradation and drought	VI. Degree of land degradation	A less complex version of #13 VI-LA-b Level of land degradation + 16 VIII-KM. Trends in seasonal precipitation	High	Red
	VIII. Drought index	Standardized Precipitation Index (SPI)	(new)	Green
	V. Capacity of soils to sustain agro-pastoral use	GLADIS "Soil Health Status"	(new)	Green
	II. Change in land use	#7 II-KM/XI-KM and #8 II-LA Land use (in support of deriving a) VI. Land degradation and b) XI. SLW, and also in interpreting c) IX. Land cover status)	Low**	Yellow
Core indicator S-5: Maintenance of or increases in ecosystem function, including net primary productivity	**IX. Land cover status**	#18 IX-KM. Land cover	High	Green
		#19 IX-KM&LA. Land productivity*	Medium	Green
	VII. Plant and animal biodiversity***	#14 VII-KM. Crop and livestock diversity (agro-biodiversity)	High	Yellow
		#15 VII-CBD. Trends in abundance and distribution of selected species	High	Yellow
		Soil biodiversity	(new)	Red
Strategic Objective 3: To generate global benefits through effective implementation of UNCCD				
Core indicator S-6: Increases in carbon stocks (soil and plant biomass)	X. Carbon stocks above and below ground	#20a X-LA Above ground organic carbon stocks	High	Yellow
		#20b X-LA Below ground organic carbon stocks	High	Red
Core indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management	XI. Land under Sustainable Land Management (SLM)	#22 XI-LA Land under Sustainable Land Management (SLM) + General Indicator VII. Plant and animal biodiversity (secondary role) + II. Change in Land Use	High	Yellow
	V. Capacity of soils to sustain agro-pastoral use	GLADIS "Soil Health Status"	(new)	Green

* Though named slightly differently, the operational definition of this indicator is very similar to that given by Berry et al., 2009 [7].

** As a stand-alone metric/proxy, there was limited or divided support for this metric/proxy. However, if used in support of another indicator, the agreement was much higher.

*** Also a secondary indicator under Core indicator S-7.

B. Proposals

73. In addition to updated the proposed conceptual framework (Figure 4) and the indicator set refinements proposed in section VII.A, the participants in the Technical Experts Workshop also debated and then drafted a set of proposals for consideration by the CST designed to overcome barriers in the current approach to indicator set refinement, and suggest where future emphasis may have greater impact. The proposals were debated and redrafted. After the meeting, most of the experts submitted additional feedback, helping resolve remaining those points of discussion that were still open at the end of the meeting.

Proposals

(a) We propose a clarification in the use of the term “impact indicators” to suggest that the complete set of indicators, when taken together, should provide insights on the progress made towards the achievement of the strategic objectives 1, 2 and 3 of the 10-year Strategic Plan of the Convention. In this sense, some of the indicators in the set may not be, strictly speaking, “impact” indicators (e.g., might be a driver). However, when considered with the other indicators, they are recommended for inclusion in the set as they would aid in understanding impact. This is particularly important for future efforts to measure the real impact of the UNCCD and associated interventions.

(b) We propose that a decision be taken concerning the use of the terms ‘harmonization’ and ‘standardization’ (as was done by GTOS). Harmonization means to make comparable (harmonize) the same variable measured in different ways. Standardization means to agree and use only one single common methodology for the same variable or indicator. Causes and consequences of dryland degradation have multiple characteristics and vary within space and scale. Hence, the indicator selection needs to accommodate these particularities while following coherent principles and criteria. We propose that the UNCCD pursue harmonization, with the potential for standardization when appropriate and feasible.

(c) We propose a clarification in the intent behind proposing a “minimum” or “limited” set of indicators. There is a demonstrable need for harmonized measures that are comparable across countries and regions. For reasons of practicality, feasibility, verifiability, and capacity, these should be no more in number than is necessary to report impacts, so that each indicator contributes essential information, and that duplication (internal auto-correlation) among the indicators is minimized. However, it should be underscored that this approach is not meant to limit monitoring, evaluation and assessment. To functionally address this concern, we propose the UNCCD initiate the development of a mechanism where the minimum set of globally harmonized indicators can be systematically complemented by regionally, nationally, and/or locally-relevant and developed indicators, that, when combined with the global set, more comprehensively communicate impact and can provide support to the decision making and planning processes.

(d) We support prior recommendations to UNCCD that it is essential to have a scientific framework to support indicator set organization, use and communication. We propose that the framework selected help support the strategic objectives of the UNCCD and provide the opportunity to capture causality, interactions and tradeoffs, so that the indicator set would further support decision making. We propose as the initial framework an amended Driver-Pressure-State-Impact-Response (DPSIR) framework integrated with ecosystem services provisions. We propose that the framework selected initially be regularly re-evaluated for appropriateness as monitoring and evaluation efforts mature, for its usefulness for the decision making processes, and because needs may change.

(e) We propose that the UNCCD, in preparing reporting guidelines for the parties, engages stakeholders (the scientific community, data providers and end users) in more clearly specifying their needs; determine the desired data output resolution, particularly where the term "national monitoring*" is concerned (e.g., to distinguish between single number national statistics versus measurements that would provide a sense of the variability within a nation).

(f) Indicators of land degradation and desertification are scale-dependent; that is, the resultant measurement depends on the area being considered and the process of land degradation being assessed. This is a particular concern when aggregating field, local, and district information in support of national monitoring where exaggerated results could arise when an indicator is used at a small-scale (detailed assessment) for estimating degradation at a large-scale. In the UNCCD's reporting guidelines, indicators and their scale of operation as measurements need to be carefully noted and precautions taken if indicator measurements are aggregated to a wider landscape.

(g) In order to provide for effective use of the indicator set we propose the UNCCD clarify the term "in affected areas," specifically where used in the definition of the core and provisional indicators. It is suggested that all the proposed indicators be measured in affected country Parties countries (as already mandated by the Convention), thus this term is not required in indicator definitions. However, the operational use of the term "affected areas" should be refined through input of the scientific community (determining how to delineate these areas in a scientifically sound manner) and used to interpret the impact indicator measurements (e.g., percentage of affected area). In this approach the related but different challenges of a) defining, measuring and monitoring the indicators, and b) defining and delineating affected areas would be distinct and therefore more operationally viable.

(h) We propose that the UNCCD seek to further develop with other relevant conventions and organizations synergies on the identification, development and use of indicators.

(i) We propose that the UNCCD establish, and dedicate appropriate resources towards an *Ad hoc* Technical Expert Group (AHTEG) along the lines of a similar approach adopted by the CBD. Such an AHTEG would be tasked with continuing the iterative, participatory contribution from the science and technology community to the indicator selection, development and refinement process, the subsequent monitoring and evaluation, and efforts to manage and make use of the information collected from the indicator set and contributions made locally and regionally. This technical group would be small and flexible enough to support the CST and UNCCD, and yet be regionally and functionally representative, including participation by representatives of major synergistic efforts, and relevant conventions and organizations. Examples of topics this group (or appointed *ad hoc* technical sub-working groups) would address include a) indicator specifications in terms of underlying functions, explicit capacity to link with other indictors to increase effectiveness, reproducibility and understandability by users, b) operational definition and measurement methodology refinements for the selected indicators, c) indicator data requirements on quality, availability and cost, d) indicator testing, e) data harmonization and standardization, f) developing a mechanism for the framework and indicator approach to accommodate regionally or locally specific inputs, g) developing an operational definition of and an approach to identifying affected areas, h) exploring ways to improve "readiness" of selected indicators, including their sensitivity to DLDD, i) developing a communication strategy and associated information products for the outputs of the indicator set, etc.

(j) We propose that the UNCCD encourage the establishment of, and dedicate appropriate resources towards the creation of an institutional partners group, along the lines of the Biodiversity Indicators Partnership (BIP). It should be made up of the organizations that would be contributing to the generation and management of the data sets underlying the indicators of DLDD and the success of remedies to address it.

(k) We propose the UNCCD dedicate appropriate resources towards encouraging the production/availability of statistical data at the sub-national level to make possible an effective integration of biophysical and socio-economic information, and most importantly, to ensure that the socio-economic information be given proper weight to ensure that human well-being assessments (and associated indicators) are capable of determining the influence of DLDD. This process could be linked with efforts of the United Nations Statistics Division (UNSD) and national accounting.

(l) We propose that the UNCCD encourage the realization of tests in order to assess the feasibility of the proposed refinement impact indicators in meeting the objectives of the indicator set under the proposed hierarchy. The tests should include the review of available data, baselines and monitoring system existing at national and local levels to use the UNCCD set of impact indicators currently under scientific peer review process. Analysis of the gaps and review of capacities should be part of the testing. Testing should be part of both local engagement in the indicator development process and capacity building. Testing should also evaluate whether the set of indicators, when taken together, are covering all requirements for information necessary to assess impact. The results of the tests should be presented to the CST before the next session of the COP (COP 10).

(m) We propose the UNCCD (with input from the scientific community) carefully consider the sensitivity of indicators, particularly essential socio-economic measures of impact, where the contributive influence of DLDD and its remedies are, at least at present, difficult to distinguish. It is quite challenging, and in some cases impossible, to define the contribution of DLDD to some indicators (e.g., GNP), however for others, the degree of sensitivity to DLDD may improve as our capacity to define and delineate affected areas improves and the spatial resolution of corresponding indicator data sets is enhanced. This issue could be addressed by the 2nd UNCCD Scientific Conference on “Economic assessment of desertification, sustainable land management and resilience of arid, semi-arid and dry sub-humid areas”.

(n) We propose that the UNCCD consider adopting a scheme for categorizing indicators based on their “readiness” for operational use (something like this was embraced by CBD and FCCC). Such a scheme would ensure a place for indicators that are currently challenging to measure, but are viewed as essential to monitoring impact. We propose, as an initial approach, the scheme used during the Technical Workshop: Green = ready for testing, Yellow = requires fine tuning, Red = requires further development. Using such a scheme will prevent the elimination of essential indicators solely on the basis of our current capacity to operationally monitor them.

(o) We propose that the UNCCD (with input from the scientific community) reach commonly agreed definitions for terms used for impact indicators and the potential associated metrics or proxies used to measure those indicators. For example, Sustainable Land Management (SLM) is viewed by many technical and policy experts as a necessary indicator, but without a proper, consistent definition agreed upon in collaboration with major synergistic activities undertaking SLM activities locally, there will be confusion and disagreement that could be avoided with a consistent definition (as shown in the evaluation and subsequent discussion by experts on this indicator).

(p) It is important that the realities of indicator development need to be fully acknowledged, including time and financial resources required. It is an evolutionary process at the global, national and local levels, and thus the UNCCD should provide guidance on alternative approaches that may be adopted, encouragement of horizontal and inter-agency collaboration and data sharing, as well as procedures for sufficient contextualization and a reporting review process (including the link between UNCCD performance and impact indicators).

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Annex I

Synthesis of recommendations from the scientific community made to UNCCD prior to the refinement process [1-3]

This list synthesizes the past recommendations from the science community to the UNCCD for consideration during the impact indicator refinement process:

(a) Ensure that the refinement of the indicator suite being developed to support monitoring and assessment of DLDD solicits and uses input from the science community;

(b) Ensure that the indicator refinement process is as representative as possible geographically and across disciplines, to ease achieving a final representative outcome, in terms of the complexity (geographical, perceptions…) it captures;

(c) Maximize possible synergies with regional UNCCD efforts, and parallel relevant programmes, projects and institutions, including those associated with the other Rio conventions;

(d) Identify a scientifically grounded, and systematically applied conceptual framework that can be used to support indicator organization, communication and use, has the capacity for supporting analysis of and decision based upon complex DLDD information, and addresses not only the symptoms of DLDD (state, condition, impacts), but also the underlying drivers and processes;

(e) Employ an accepted, scientifically grounded, and rigorous application set of criteria for refinement of the indicators;

(f) Ensure that the proposed conceptual framework has the capacity to support an operational link between the suite of indicators and the primary applications envisioned (i.e., monitoring the impacts of the UNCCD, and supporting management actions and policy decisions) in a way that ecological and social issues are fundamentally interwoven, as are the options for livelihood support and ecological management. This would facilitate subsequent use of the data gathered in one or more accepted integrated assessment approaches (processes meant to treat complex issues through various scientific disciplines while incorporating local, regional and/or national social actors);

(g) Recognizing that a fixed "common denominator" indicator suite may be only a starting point for assessing the broad impacts of UNCCD implementation, select a conceptual framework that has the potential to be enhanced so the common denominator of "standard" indicators can be readily augmented with indicators identified through participatory approaches involving all the actors affected in order to capture the variation among regions, countries, sites, and even among different socio-environmental units within the sites. This would involve identifying a mechanism within or linkable to the conceptual framework so that such participatory processes that capture the variety of local perspectives and expertise (i.e., land users, managers, decision makers, researchers) in the development of locally identified indicators can contribute to global assessment and monitoring in a way that encourages stakeholder engagement and captures of essential local environmental knowledge;

(h) Provide a mechanism, within or connected to the refined indicator suite, for ensemble assessment ("triangulation" of information from multiple lines of evidence), recognizing the wide variety and disparity of information used to monitor and assess

DLDD, as well as the range of proven techniques for monitoring and assessment, and the variation in these at the regional and national levels;

(i) Refine the indicators in a way the helps ensure they are attributable to (correlate with) the primary processes of concern, DLDD and the performance of associated remedies;

(j) Anticipate and work to enhance the capacity for the refined indicator suite to account for the fundamental interrelationships within coupled human-environmental (H-E) systems that cause DLDD, which includes scalar issues (multiple temporal and spatial scales, cross-scale links and hierarchical interactions, nesting vs. independence, slow vs. fast variables, etc.), recognizing that problems and solutions at one scale influence are influenced by those at other scales;

(k) Consider that many DLDD processes are nonlinear, that dryland systems are often not in equilibrium, have multiple thresholds, and thus often exhibit multiple ecological and social states;

(l) Work towards ensuring the global measurability of the indicators where possible, and document where further development of the science, monitoring methods, and/or data capture-management-reporting will be necessary;

(m) Consider the need for setting targets and reflecting progress through benchmarks based on a refined indicator suite that has the capacity to be assessed relative to socio-economic and biophysical baseline information;

(n) Ensure the link between the refined indicator suite and policy/governance is established by providing the capacity within the conceptual framework and refined indicator suite to incorporate information necessary to aid in priority setting, including socio-economic factors (i.e., economic, social and environmental costs of DLDD, the benefits of Sustainable Land Management (SLM), return on investment (ROI), pricing of ecosystem services provided/protected by successfully combating desertification) that are challenging to capture today, but will be vital in the longer term UNCCD objectives;

(o) Address the UNCCD request that monitoring and assessment meet both the needs of affected country Parties and global information needs by acknowledging that policy and institutional decision-making authority associated with DLDD is usually concentrated at national and subnational levels in most areas of the world. Thus the level of detail provided by the refined indicator suite must be commensurate with this need;

(p) Distinguish between indicator sets and scale of operation. While some of the global-level DLDD information desired by the UNCCD can be built from careful analysis of such national and subnational information, it is essential that compatible protocols and standards are used. Moreover, in many cases “scaling up” is not possible because levels of detail are different, measurement requirements vary and the users/uses of the information also vary. For this reason, it is necessary to distinguish between indicator sets and scale of operation;

(q) Capture the interconnections between DLDD, climate change and biodiversity loss to maximize (and leverage) the work of other multilateral environmental agreements (particularly the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC)) in the refinement of the indicator suite for DLDD assessment and monitoring;

(r) Encourage an approach to indicator development and use that maximizes multiple parallel efforts and the capacity to benefit from a common information repository and knowledge management system, such at the proposed Global Drylands Observation System (GDOS);

(s) Ensure that sustainable land management (SLM) is carefully defined in collaboration with ongoing SLM initiatives, and that it is fully integrated into DLDD monitoring and assessment;

(t) Address the concern that monitoring and assessment should not only provide information about the risk of desertification and desertification impacts, but also about that performance of measures to combat desertification;

(u) Ensure that the conceptual framework proposed has the potential to be enhanced so that future indicator development, refinement and selection can be based on the analytical logic of behind the interconnectedness of the indicators via a causal network / model of the functioning of the system (developed in a participatory manner) rather than on individual indicator characteristics alone;

(v) Promote the endorsement of harmonization through compatible, scientifically-valid standards and protocols for monitoring and assessment across national and subnational levels, which will not only enhance the utility of the indicator suite, but permit appropriate analysis of national and subnational information at the global scale.

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Annex II

Initial Expert Review: General Comments

This is a compilation of comments from the Initial Expert Review on the "zero draft" of the white paper made by 37 expert reviewers, organized in categories design to correspond to key issues noted. Most of the comments were taken verbatim, however some were compiled or paraphrased (e.g., multiple, related comments by one reviewer were combined).

Table of Contents

A. Overall UNCCD Indicators, Goal, structure, process

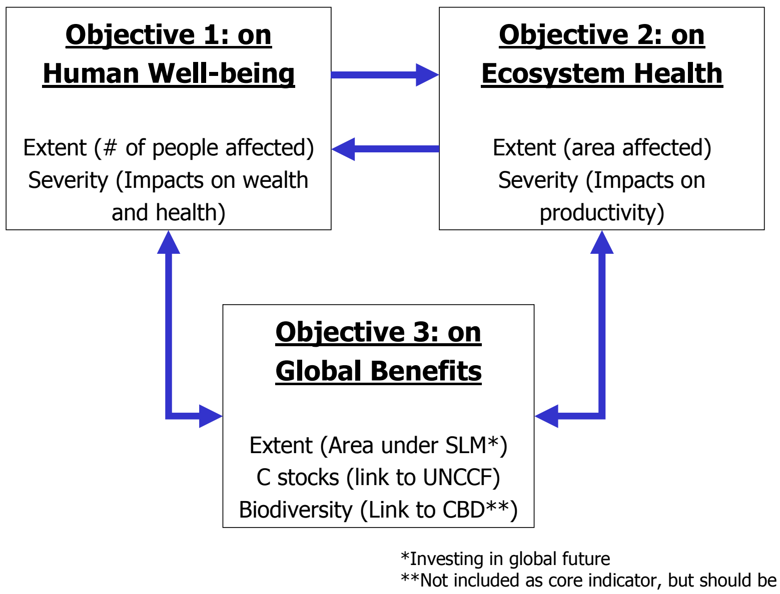
1. A number of reviewers: A conclusion reached by GEF STAP about the relationship among the provisional 11 impact indicators, the core indicators, and the strategic objectives, was endorsed. That quote (bold emphasis added): *Some core indicators are served by three proposed indicators while others are served by one indicator. What could be done to improve the understanding of the relationship is to make a causal tracking diagram linking them. The current mapping suggests that there are too many overlapping biophysical indicators, such as indicators VII, VIII and IX. On the other hand, indicators II, IX, and XI seem to overlap and could potentially be merged.* ***This clearly indicates the need for a general systemic framework first from where processes and impacts are derived yielding, preferably, one impact indicator for each UNCCD "core" indicator****.*

2. Expert1: When considering the whole process and associated outcomes (The Strategy and its three Objectives and Core Indicators; the eleven indicators; and the refinement process and indicators provided by a number of initiatives and summarized in the White paper), there seem to be a background lack of consistency and logic, probably due to the fact that the 11 indicators (and further refinement) were not derived from the Objectives and Core Indicators, but from different sources. Given this disconnection in origin, the attempt to –a posteriori– make the selected indicators to relate to the objectives and core indicators is not succeeding. Actually it hardly could. Similarly, the –a posteriori– allocation of a conceptual framework to the already proposed indicators will certainly serve for identifying gaps but is not a real provision of the very much needed framework.

3. Expert1: I also have the feeling that by trying to refine further the 11 indicators, or the refinement indicators, or the framework proposed, without fixing first the above-mentioned lack of consistency, i.e., without following the logic path: Objectives → Framework → indicators, we won't succeed.

4. Expert1: The Objectives and Core Indicators (actually formulate as objectives as well) are well thought and structured (though they only refer to Impacts, with the exception perhaps of the last one that can be seen also as Response indicator). Actually, there is an implicit framework behind them that can be outlined as follows (Figure 1):

Figure 1.



Next steps forward should have been (and still can be):

a) Decide and clearly state if (a) not only impact indicators but also indicators on other processes and elements related to causes and responses to desertification should equally be considering when monitoring progress on the achievement of strategic objectives, or (b) following the model provided by the Core Indicators, the refined suite of indicators will focus on Impacts, though a complementary assessment on the Driving Forces and Pressures (the causes) behind the impacts, and the responses already in place must be considered to properly interpret the results and design new responses.

- If options were (a), then the conceptual framework could be a DPSIR-wise one (hybrid with MA or not); a well balanced suite of indicators representing each element in the global process (D, P, S, I, and R) should be proposed; and further refinement in indicator selection that considers a causal network framework should be encouraged.

- If option were (b), the central suite of indicators should be Impact indicators (as it seemed to be the intention of the designers of The Strategy), though the identification and trend assessment of the site/country/region-specific driving forces and related pressures should be mandatory (as the reports on the actions/responses applied) in order to interpret the impact assessment results. Even if focusing only on Impact indicators, a conceptual framework is still very much needed to support the selection of the actual indicators (what is the theoretical basis for assuming that impact indicator X is properly informing about desertification trends regarding Objective 1, 2 and/or 3?). In this regard, probably MA framework is the best option available.

b) Decide on an approach and criteria for selecting an applicable and scientifically-sound suite of indicators (in agreement with the selected framework). This includes (among other issues):

- To define the selection criteria. The criteria suggested by the White paper, based on the GEF-STAP review (in turn based on U.S. National Research Council), seems to be good, though the core criterion (are there clear theoretical basis for assuming that impact indicator X is properly informing about desertification trends regarding Objective 1, 2 and/or 3?) should be stressed.

- To decide and clearly state if the assessment will be based entirely on common indicators and metrics or if it will (also) include site/country/region-specific indicators (selected through participatory approaches) on common criteria. This second approach is being tested within the European project PRACTICE, and preliminary outcomes are promising. If this second approach is followed, those criteria that are meant to be addressed to site/country/region specific indicators should be clearly identified. If the first approach is followed, indicators cannot always be very specific.

c) To actually select and propose a suite of indicators. Of course, this step should consider and take advantage of what is already available and is being implemented, but selection should be entirely driven by the previous points, and room should be given for new indicators that can be developed in the future (being very clear about the criteria and open about the metrics). Current selection, based on what is being (more or less) commonly implemented, and the further (backward) allocation of these all-kind-of-indicators (impact, driving force, response, state indicators) into the categories defined by the objectives and core (impact) indicators simply does not work.

The suite of indicators selected should be balanced regarding both form (a suite that includes indicators that can be assessed through a single metric –e.g., Rural Poverty rate– and indicators that require a whole multi-metric complex assessment protocol themselves –e.g., "level of land degradation" proposed by LADA– is not a balanced one) and substance (e.g, a balanced basket of ecosystem services).

5. Expert 2: The clear implication of this review is that refining existing individual indicators, e.g. by "definition" or "greater specification", without revising the overarching framework will serve no useful purpose. Consequently, the "evaluation criteria" listed in Section 2.4 are only partially relevant. Instead, the structure of the set of indicators needs refinement, with indicators selected after what GEF-STAP calls "a general systemic framework" has been identified.

6. A number of reviewers: The original 11 provisional impact indicators do not address core indicators 8 and 9. Why not?

7. Expert 3: Are they all really impact indicators? I find it interesting that there have apparently been few concerns raised about whether or not all of the indicators are truly impact indicators. Specifically, from the perspective of the UNCCD, the Aridity Index would seem to be an indicator of a 'Driver', while my understanding is that impact indicators should primarily reflect 'States' and 'Impacts' in the DPSIR framework. The Aridity Index is a good example of an indicator that meets cost and most MA criteria, but ultimately seems to be of little value to the UNCCD.

8. Expert 4: Given all that has been done on the development of indicators over the past 35 years – and particularly the last 5 – this is paper faces a daunting task. The diversity of effort devoted to developing indicators by UNCCD is not explained here. The author was not asked to explain this but, at some point, it would be worthwhile to everyone who is

concerned about the topic for UNCCD – or better another independent entity – to provide some explanation. That would be fascinating. Putting this complaint aside, the paper does an exceptional job of weaving together a framework that brings all the diverse efforts for developing indicators that is consistent and rational.

9. Expert 4: This observation reflects more on how UNCCD conceives the indicator problem. From my perspective, the continuing failure in the conceptualization of most indicators is that they are conceived in a context-and-outcomes-free environment. Originally, desertification indicators were intended to help us understand and differentiate what was going on in different places and how bad it might be. In the 35 years since this was undertaken, the emphasis should have evolved to be what impacts are being achieved through the projects being implemented (the basic question put the GEF). As is pointed out in 2.1.24 (recommendations that led to the white paper), indicators should reflect (1) what a project/program/policy was intended to achieve, and (2) how it was to be achieved. While this was the last recommendation mentioned in section 2.1, it is key to the first recommendation in 2.2.7 that relates to causality. My point is that indicators must be explained in the context of (a) an understanding of the processes involved, and (2) an explanation of how interventions will affect those processes. As a result, if indicators do not perform as predicted in response to a prescribed intervention, it is possible to return to these basic understandings and adjust/redesign/reconceptualize what is being done. Without this context all that can be done is to make an assessment that has little diagnostic or prescriptive value.

10. Expert 5: The white paper builds of the recommendation "Ensure that the proposed conceptual framework is not only useful for the refinement of the indicator suite, but has the capacity to support an operational link between the suite of indicators and the primary applications envisioned (i.e., management actions and policy decisions) in a way that ecological and social issues are fundamentally interwoven, as are the options for livelihood support and ecological management." I strongly believe the scientific community deserves an explanation on why this was not done in the first place. This could have been one of the tasks of the Group of Experts, many years ago. So much time would have been saved.

11. Expert 6: It all starts with the definition of desertification, of land degradation, and even of drought. If there is not clear, agreed-upon definition of something, how can you monitor it and how can you have indicators for it??? One way is to circumvent it is to create an acronym, like DLDD. Once there is DLDD there is a clear answer. What is DLDD? One may ask. And the answer will be – it is Desertification, Land Degradation and Drought. Now the one who posed the question will not dare to ask more, because it is enough he did not know what DLDD is… The MA, in its desertification synthesis, defined desertification as a PERSISTENT reduction in productivity, meaning – reduced productivity irrespective of climate. Yet, this definition is totally forgotten when one reads all these indicators and all the literature around them. When definitions are not clear or agreed, a mountain of interpretations for DLDD starts to build up around the indicators of those things we can not define. So there are now layers upon layers of indicators and their "refinements", and you were asked to add one more layer.

12. Expert 6: Same thing is with SLM. I never got a clear answer what sustainable land management is. What is sustainable? The land? The management? Nevertheless, there is an acronym, and now no one will dare ask more disturbing questions.

13. Expert 7: SLM is proposed by the UNCCD, and it is very much needed, but without proper definition there will be confusion (as shown in the testing results).

14. Expert 7: Very often it looks like the assessment is still mainly concentrating on the effect of LD, too few times it is mentioned that we also look at remediation measures (SLM).

15. Expert 8: I do not know how much room for maneuver there is, but I am not sure that trying to further refine the existing core indicators or the 11 minimum indicators is the best way to get a useful set of indicators. There are serious flaws with a number of these indicators and as a set they are not very strong either. If there is one thing this white paper shows it is the serious limitations and issues with this set. Some of that can be fixed by finding appropriate refinement indicators or measurements, but in some cases a completely different indicator might be more appropriate as well as removing some of the existing ones. Additionally, some of the proposed refinement indicators are still as subjective, not measurable in practice, not responsive within relevant time and spatial scales as the originals. It is my experience that really useful indicators require a much more radical approach.

16. Expert 8: I very much agree with some of the concerns expressed in various reports and mentioned in this white paper concerned both the 7 core indicators and the more detailed 11 indicators. There are some issues that I feel may not have been sufficiently mentioned :

a) S1 is a very risky indicator in political terms because a decrease in the number of people negatively affected could be achieved in many other ways (on purpose or as an indirect consequence of other processes): forced migration of population outside impacted areas, mass starvation, war casualties, rural to urban migration, international migration. All of these processes would reduce the number of affected people without any reduction in degradation.

b) Regarding S1 I am not happy with the fact that it refers to both drought and degradation. These are often confused and if both are covered in the same indicator it does not gain in clarity or power.

c) There is likely to be a significant correlation between S2 and S3, making one of them redundant.

17. Expert 6: S1 = Decrease in numbers of people negatively impacted by the processes of desertification/land degradation and drought. Can someone be positively impacted, or not impacted by desertification?

18. Expert 9: Are we looking for indicators that are amenable to statistical analysis? If that is so, we have indicators that are measured in numerical and nominal indices each of which would require different types of statistics. There is therefore not one form of statistics that is suited for analyses of all indicators. How would one analyze compound indicators-often perceptional in nature?

19. Expert 6: All in all, this is admirable work, having been charged with an impossible mission, that has become more and more intangible as time goes by, and more and more committee and organizations are commission to devise indicators for processes that are ill-defined and not agreed upon. May be I am totally wrong, but I am afraid that when serious policy makers on the one hand, and land users on the other hand, will see one day all that amount of paper we produced, will have some thoughts of how we people do our business… Still, wishing for success in somehow getting out of all this mess!

20. Expert 10: The indicator development process for UNCCD is moving in the right direction, and this document represents a significant step forward: it is pragmatic, reasonably constrained, and problem-focused. Most of the indicators need further refinement and practical ‘bedding down’ before we have a truly operation system. Moreover, this is not yet really a ‘system’, taking maximum advantage of the potential links and interactions between variables. They each seem to have been independently derived, with their own input datasets. This not only increases the work involved, but potentially leads to problems of incompatibilities. Each of the top-level indicators actually depends on a network of underpinning variables. These need to be revealed, and specified in as much

detail as the final reporting variables. It is also very useful to have access to them, since they are causal indicators in their own right, and can be used in new combinations.

21. Expert 10: I have a preference for defining the conceptually-correct indicator, even if it is not yet currently fully achievable (ie you need to use a model estimate, a proxy or a coarse-scale result in the interim). The estimate needs to be accompanies by an uncertainty estimate. Then the operating rule for the indicator system is the progressive reduction in the error bar. For example, I quite like the aridity index, but why not go the whole way and make it a true water balance indicator (eg number of day-equivalents where water supply to plants is non-limiting), by including a soil and vegetation term? That way, you can link it systematically to the water yield indicators and the NPP indicators. The soil and vegetation models will start off crude, using available global datasets, but can be refined over time and can be rigorously converted into an error range. For this reason I am willing to give cautious support to products such as GLC2000, despite their many demonstrable flaws. They are on the right track, and can be improved. Similarly, it argues strongly for FAPAR rather than NDVI or similar indices.

22. Expert 11: I am somehow astonished that only the GEF KM and the LADA indicators are considered in the scoring at this stage. I personally felt that for instance Berry at al., have given quite concrete examples/recommendations for the set of 11 indicators, which from my point of view in many cases are as concrete or mature as the information provided by KM Land and LADA and would hence merit to be considered in the scoring exercise as well (in my opinion KM land and LADA do not always provide a real refinement against the set of 11). On the other hand I think that the workshop discussion will give more opportunity to discuss about additional alternatives. I also think that there is space for improvement regarding the cross-tabulation of refinement indicators and the Core-Strategic indicators (S1 to S7). I think in quite a number of cases other combinations of the given indicators (e.g. Table 8) would be needed to come to the best possible representation of the 7 strategic indicators for monitoring the impact of the convention.

23. Expert 11: For me this 0 draft of the white paper is on an excellent way to provide clear methodological guideline for iterative development and refinement of UNCCD impact indicators throughout the implementation of the 10 Years strategy (possibly/even principally beyond 2018) based on scientific state-of-the-art. While the scientific basis of the proposed hybrid concept to me appears quite clear and suitable, feasibility aspects should not be only considered at technical level (e.g. data availability and quality etc) but also in terms of necessary organizational structures needed to keep such iterative process running as part of its implementation (e.g. are current structures of UNCCD capable of doing so, etc). A suitable reference in this context may be the white paper of DSD working group 3, published by UNU and DNI.

24. Expert 12: Congratulations for making reasonably good sense of a challenging and complex issue. I haven't spent time thinking about all of the indicators but where I have looked the logic is generally coherent, and, given that I think the implementation of an improved global monitoring system of this nature will have to be an iterative process, the document is a useful step along this path. My critique however is that the document you provided do not seem, on my rapid reading, to provide a context in which to judge the purpose of the monitoring; without this (as we have found in our experience with the ACRIS system in Australia), it is impossible to assess whether these are the necessary and sufficient set (even initial set) of indicators, nor then whether the individual indicators are correctly detailed. By purpose here I mean operational purposes, which directly intersect with possible decisions: by contrast, the 'Objectives 1-3' stated on p.6, which are of course entirely legitimate, are goal-oriented aspirations. That is, it is not apparent that there is any threshold of these 3 objectives at which a specific action would be taken, whereas

operational purposes of monitoring should have such commitment to action at least potentially associated with them.

25. Expert 12: I would expect the operational purposes of this global system of monitoring to be at least 3-fold: (i) to help assess where international (and perhaps national) investment in ameliorating desertification should be applied, and to what end in these places (e.g. should it address soil nitrogen management practices or stocking rates or access to markets or regional governance?); (ii) to help assess whether past such investments have provided a useful return on investment; and (iii) to improve the scientific understanding of the causal links of drivers of both desertification and its amelioration in individual localities and more universally, in order to help better interpret data for (i) or (ii) in the future. Of course ancillary purposes may be to support more local management interventions, especially if the monitoring data is collected on ground locally and therefore needs to provide local benefit also; and also for accrediting standards of management whether for marketing sustainability or carbon sequestration or whatever. If these are indeed (at least approximately) the purposes of the monitoring, then the list of indicators provided largely omits the likely driving forces other than those in the climate domain – e.g. population, livelihood diversity, social organisation, governance, etc. I also think it would help to express the indicators more in terms of (simple) hypotheses about causal relationships (for example using the list of key patterns of desertification listed in publications such as Helmut Geist's thesis – I have pasted these in below as an example but not necessarily the one you should use).

26. Expert 12: I appreciate deeply the political realities and challenges of getting agreement on these indicators, as implied in the table on p.6 where it is evidently only realistic at this time to insist on 2 of even this list of indicators; and so I am not suggesting that a complex system needs to be forced on all parties as that will not work. But I do think it is vital that we have a clear scientific rationale for a set of indicators and then simplify from this to what is feasible, with a clear goal of what we must gradually build towards.

In my opinion the COP9 decision to revise the preliminary indicator set by means of an iterative, wide-ranging consultation process was a very positive one. I see this paper as a useful stimulation for the discussion to be held in Bonn and in the following stages.

B. Are these really impact indicators?

27. Expert 3: Are they all really impact indicators? I find it interesting that there have apparently been few concerns raised about whether or not all of the indicators are truly impact indicators. Specifically, from the perspective of the UNCCD, the Aridity Index would seem to be an indicator of a 'Driver', while my understanding is that impact indicators should primarily reflect 'States' and 'Impacts' in the DPSIR framework. The Aridity Index is a good example of an indicator that meets cost and most MA criteria, but ultimately seems to be of little value to the UNCCD.

28. Expert 7: LD/SLM Impact indicators: Having read through the document and having been involved in several indicator meetings and workshops (KM-LAND and LADA-WOCAT, and also UNCCD meetings), I still have a basic problem of understanding the purpose of these indicators. I assume that we are taking about Impact Indicators of Land Degradation (LD) and remediation practices what I call Sustainable Land management (SLM) practices:

a) A number of indicators (such as. Proportion of the population in affected areas living above the poverty line; malnutrition, child mortality, access to water, water scarcity…) are suggested to be used from national statistics (or assessed at national level) and I agree that they are import development / poverty indicators but …: How do we relate these indicators to LD/SLM??? How are they showing the impact of LD/SLM? They are just very valuable “development indicators” which might or might not be related at all to LD/SLM. If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM. We need the information about poverty, etc., but not only aggregated as a national indicator. The LADA-WOCAT national (and sub-national assessment could be the tool.

b) Furthermore there are many other factors influencing the results of these indicators. How do we isolate what the contribution of LD or SLM is??? I am very aware that this is not easy and a bit demanding but this is actually what we should be doing to prove that LD and SLM have major impacts and thus need to become national and international priorities.

c) The Aridity Index has nothing to do with impacts of LD. I fail to understand how this aridity index is showing any impacts of LD/SLM, they way it is defined, it is good for characterization of the area but nothing to do with impact.

29. Expert 13: There is a definition I need some help with…what the UNCCD means by "impact indicator". In the 20+ years that I have been working with indicators, most of the problems stem from the very concept of "indicators". I think that definition is pretty well taken care of by both you and the CCD. However, "impact indicators" have definitions that are wide ranging. With respect to the interests of the CCD, they could refer to the impacts of desertification on ... to impacts of projects and programs put together to mitigate the effects of desertification. That is to suggest an answer to the question "are these programs/projects/portfolios having their intended impacts"? In most cases "impact indicators" refer to the latter. The use of the expression by the CCD, however, seems to be ambiguous, sometimes referring to the projects to mitigate and other times to the impact of desertification itself. This needs to be clarified by the UNCCD.

30. Expert 14: Impact indicators need to be defined clearly, not only for the impacts of desertification, but also the impact of UNCCD efforts to combat it. On one side there are impacts of the phenomena, in this case desertification. On the other side are impacts of mitigation/restoration efforts. Thus, one part of the definition must focus on the consequences of the programme (in this case, the Convention) beyond its direct and immediate interaction with the beneficiaries. Tying indictors to the influences of policy can be challenging, particularly when there is high regional heterogeneity. One option is to use a “meta-indicator” that, which can be done with a cost-effectiveness indicator that relates the costs of the policy or intervention strategy to an indicator that captures its effects. Consider the cost-effectiveness indicator (CEI):

$$CEI = \frac{monetary\_\cos ts\_of\_the\_policy - monetary\_\cos ts\_of\_inaction}{effects\_of\_the\_policy - effects\_of\_inaction}$$

On the numerator there is the difference between the monetary costs of the policy (i.e. Euros transferred for planting new trees, building irrigation systems/pipelines and so on) and the monetary costs of inaction, that (obviously assume to be zero. No policy, no money transfer, no public expenditure). It is very important to highlight that in this simplified ratio we do not account for opportunity costs . The denominator is the difference between the (potential, expected) gain on the socio-economic milieu from a selected measure (GDP of the area; child mortality and many others) and the gains/losses, interpreted as the started benchmark.

31. Expert 14: Consider the issue of linking human-well being indicators with desertification, which is challenging with national development statistics. One option not in the currently list might be considered is a migration indicator. A migration indicator should

measure, across time, the percentage of people, in critical areas that had to migrate given desertification. The indicator can be easy to calculate (as a row number or a percentage over total resident population). The migration indicator can provide valuable information about poor populations' movements. Weakness refers to the difficulty to gather data and the difficulty to find a precise cause-effect relationship between desertification and migration (people can move for reasons other than desertification.

32. Expert 14: Socio-economic impact indicators for market and non-market values

- land productivity per squared meter/ha for the selected products cultivated in the land at desertification risk (e.g. x kg/corn/ha);
- domestic prices of selected products cultivated in the land at desertification risk (e.g. y euro/kg corn);
- land use patterns/composition in the land area at desertification risk, including forestry, grassland and the intensity of grazing activities, when applicable (e.g. for the case study Y we have a total of land area of Z ha, distributed in z1 for crop1, z2 crop2 and so on, or preferably a GIS map);
- labour, water and land costs/prices for the production of selected products cultivated in the land at desertification risk (e.g. irrigation costs);
- employment data regarding the areas of study, including the contribution of the cultivated land at desertification risk on the creation of jobs/employment
- governance structure of the land at risk of desertification (long or short term contracts; commons; public vs private property, ownership vs leasing of the land);
- real GDP per capita / income of relevant population;
- relevant population in and near the study-site;
- local biodiversity data(e.g. mammal diversity, bird diversity, etc.), natura2000 when it refers to an EU area;
- level of human development (e.g., GLOBIO study);
- anthropogenic pressure (e.g., some index of pollution);
- climatic data (e.g., temperature, precipitation);
- type and intensity of economic activity taking place in the area under consideration, including tourism;
- data on tourism (annual flows of visitors, characterization of the supply side, including the number and type of hotels and restaurants);
- the presence of sites of cultural, environmental or esthetic value (e.g. unesco sites, national protected sites, natural 2000 network sites, iucn sites);
- data on constructed/engineering based water streams/water pipelines or other water infrastructure possibilities;

33. Expert 6: Calling the Aridity Index an impact indicator is like saying that rainfall and temperature are indicators of desertification, which is a great fallacy.

C. Relevance to the affected parties & decision making

34. Expert 3: I am hopeful that the final report will address the 'relevance' concern of the GEF-STAP group (quoted on page 20): "… the users of the proposed indicators are not discussed…", but will go beyond simply considering whether "the scales that are used

match to the governance levels involved". If we're really serious about using the Convention to promote changes in the way Parties address LDD, we need to consider the fact that the primary interaction of many Parties with the Convention is through the reporting process. The reporting process can serve to increase recognition of LDD challenges and opportunities through (a) acquisition, (b) analysis, and (c) reporting itself. In some cases, a scale disconnect may be OK (if a desired outcome is simply to have greater awareness of an issue and/or data need to be collected at a more useful scale to be addressed at a national scale). In conclusion, a strategic (and necessarily qualitative) analysis of how the reporting process itself contributes to awareness, willingness and ability to address the problem could help with final indicator selection. More closely linking the 1a country evaluation with this White Paper could help, particularly if 1a includes asking the Parties how helpful the indicators are for increasing national and sub-national awareness, willingness and ability to address LDD.

35. Expert 5: I would insist that a greater attention needs to be paid to social, economic, and institutional aspects linked to the DLDD process, for this to support the affected parties and decision making.

36. Expert 5: We must keep in mind that many countries have no monitoring system through which assess the DLDD process.

37. Expert 7: The paper suggests the UNCCD should "ensure the indicators capture the complexities of the system and provide the information needed for decision making": Crucial challenge: Yes the indicators and the information gathered through the assessment must help in decision making. Therefore, a general basic requirement must be to get the feedback of what decision makers need and will use. How do we evaluate and include it in the indicator selection??? This is a great challenge and I have not seen how to tackle it. In collaboration between the EU-DESIRE and the WOCAT programme a decision support tool has been developed on how to support projects in selecting the best SLM strategies. This has now been incorporated in the WOCAT program and will be further developed for the national level as a follow-up activity of the LADA-WOCAT national assessment.

38. Expert 15: Political sensitivities of the Impact indicator system. Assessment of implementation of UNCCD are related to national situation in DLDD and control of desertification.

D. Cost and feasibility

39. Expert 3: When we emphasized the importance of an iterative process taking into account the four bullets on page 7 [(a) application by affected countries, (b) scientific review, (c) synergies, and (d) UNCCD conference contributions], there was a hope that these would not occur in isolation. The White Paper integrates b-d, with an emphasis (through application of the MA criteria) on (b), but is much weaker on issues frequently raised by (a), including cost and feasibility. While I understand that team has not been tasked with addressing (a), I am concerned that the ultimate recommendations of this paper (e.g. one impact indicator per core indicator) could end up compromised if an indicator is selected based on MA criteria that is perceived by the affected countries to have a high cost. While I have a strong belief in the value of monitoring, I also share their concern that the ultimate benefit/cost ratio of the reporting process exceed that of other investments. The key will be making it simple and transparent enough to be used by and useful for the parties as well as the UNCCD.

40. Expert 15: Assessment of Core indicators should be focused on high cost-effectiveness, because most of countries affected by DLDD are the developing counties, including some of the least undeveloped countries in the world.

41. Expert 15: Feasibility is related, in part, to local capacity for data collection and management. Data and information related to the indicators should be easily obtained and accessed. .

E. What are the "affected areas"?

42. Expert 11: Clear guidelines or agreement how to define affected areas remain a point which requires clarification. This has also been mentioned by Berry et al.. I think that the proposed framework is in principle also suitable for this task in the future so still being a major challenge; but in the first instance simpler criteria may be acceptable. In any case parties should be encouraged to distinguish between affected and non-affected as much as possible.

43. Expert 7: The UNCCD often mentions "in affected areas". Therefore, we need to define: (1) what are affected areas (affected by LD, type and severity???, (2) what about not affected areas (under SLM!)???. Only if we compare we have a chance to see the impact of LD/SLM.

F. Conceptual framework

44. Expert 16: This conceptual framework seems universal; everything can be filled in without criticisms. The question is how to get the framework operational?

45. Expert 17: Since STAP is familiar in its operational work on GEF projects with both the DPSIR framework (as used, for example, in LADA) and the Millennium Ecosystem Assessment (MA) conceptual framework, it has focused most of its attention in this review to the development of what the consultants call a hybrid DPSIR-MA framework for use by the UNCCD (pp.10-16 of the draft paper).

a) STAP understands the apparent logic of trying to combine the DPSIR framework with the MA conceptual framework, into what is presented as a hybrid conceptual framework. Both are implied in the White Paper to be expressions of the 'causal chain' leading to land degradation (p.11). It is also said that they are similar. We beg to differ on both counts.

b) A causal chain is an ordered sequence of events in which any one event in the chain causes the next. The importance of the DPSIR is that it is not a linear causal chain but rather it is an open framework. It encourages and supports iteration, and focuses its users on how there is a network of Drivers, leading to different States, varying Responses and hence to changing Drivers. Causal chain analysis can be done within such a network model. The Global International Waters Assessment is a good example of where causal chain analysis picks up on important parts of the network where interventions may be contemplated (see http://www.unep.org/dewa/giwa/publications/articles/ambio/article_2.pdf). STAP encourages greater clarity in the use of modeling terms and greater rigor in describing how and why the chosen conceptual model will be useful and an advance on current models.

c) The DPSIR is a general framework for organizing information and reporting about state of the environment. It is *not* a conceptual model. It was first developed by the OECD in the mid-1980s and has subsequently been extended into a number of fields, including those of interest to UNCCD, and to a number of GEF projects, including the Carbon Benefits Project (not listed in the White Paper). As a 'framework' it is good at organizing, describing and discriminating between aspects of the environment which cause different states of land degradation. What it is less good at is identifying between what is a 'driver' and what is a 'pressure', and between an 'impact' and a 'response'. The authors of the

White Paper are encouraged to read a critique of the application of DPSIR by Svarstad and colleagues in the journal *Land Use Policy* Volume 25 (2008, pp. 116-125), where it is concluded that, “The problem with the framework is the lack, so far, of efforts to find a satisfactory way of dealing with the multiple attitudes and definitions of issues by stakeholders and the general public.” Indeed, DPSIR as a generalized framework needs to be very carefully populated in its components (D, P, S, I & R) according to the discourse being employed, the audience being addressed and the stakeholders being consulted. The UNCCD indicators are this ‘population’, each of which needs to be carefully located in its appropriate part of the framework, reflecting the attitudes, views and perspectives of each stakeholder. An ‘impact’ for one stakeholder could very well be a ‘response’ for another.

d) The MA conceptual framework is very different. It has some fundamental weaknesses for the purposes for which the UNCCD needs indicators. It was purposely designed to link human well-being with environmental and ecosystem parameters, and to create a *circular* chain of links expressly to show how the state of critical ecosystems change over time. As a critique of the MA published in 2006 by the UK House of Parliament[2] describes, the MA suffers from a lack of stakeholder-specific guidelines. The MA is also weak on assessing the economic implications of changes to ecosystems consequent upon environmental degradation. So, for example, [quoting the above parliamentary report], “the Poverty and Environment Partnership (PEP) has shown that the returns on environmental investments are multifaceted and extremely significant. For example, investment in soil conservation greatly enhances sustainable agricultural practices, especially in dry-land regions. A 15-year programme to combat land degradation, costed at between £9 billion and £21 billion, is estimated to yield benefits 1.5 to 3.3 times higher in terms of avoided agricultural production losses alone (Martin-Hurtado, 2002). Further benefits have also been shown - improved food security, education, environment and access to finance. A specific challenge for the international community is to assist developing countries to integrate environmental and ecosystem issues into their national development plans such as Poverty Reduction Strategies.” These two key weaknesses – lack of stakeholder-specificity and inability to handle the economic and complex interconnections between human development and environment – mean that the MA will (1) exaggerate the impacts of land degradation; (2) fail to identify synergistic benefits from interventions; and (3) ignore the most important driver, economic impact.

e) STAP would like to see the DPSIR and MA models both employed but is concerned that a simple bolting of the two together is done uncritically and without understanding of the fundamental purposes and weaknesses of the original models. The hybrid model developed by the consultants seems designed only to limit the scope of the generalized framework (DPSIR) to the issues being addressed by the MA.

f) Further, STAP questions whether a conceptual model is needed simply to present sets of potential candidate indicators for use to measure the impact of measures undertaken under the auspices of the UNCCD. All that is really needed is a careful consideration of *scale* of operation of the indicator, the *synergies* being captured by an indicator, and the *sources* of information for each indicator. Annex III of the White Paper seems to be doing much of this already. The hybrid conceptual framework does not appear to be adding any value to our understanding of the processes and the utility of using indicators.

g) STAP started to try to complete the indicator assessment matrix. However, for the reasons outlined above, especially in respect of the DPSIR column J of the matrix, we feel unable to proceed without much clearer specification of scale, stakeholders and desired

[2] http://www.publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/77/77.pdf

synergies. This is an exercise, the judgement for which is dependent on at least these three aspects.

h) The depiction of this as a 'merged' DPSIR and MA model framework is disingenuous. What KM: Land proposed is merely DPSIR operating at different scale levels, with the Impact assessment being primarily the impact on society, but also for GEF purposes the impact on GEBs such as biodiversity.

i) The so-called hybrid misses one of the key impact indicators identified by UNCCD (as well as by the GEF4 and GEF5 strategies), the change in land cover.

j) DPSIR is more a network than a chain – and so is the MA model, but rather more simply. DPSIR is not a simple chain, and can cope with some of the limitations described below through iterative operations of the feedback loops. DPSIR is better described as a network – you use this term below yourselves. The conceptual framework is not the problem – it is the limitations imposed upon DPSIR by the design of the hybrid. Projects such as LADA use DPSIR and include impacts on other environmental goods in their use of the framework. And they do so at multiple scales – e.g. GLADA as well as local-level field assessment of land degradation. So the statement here [chain/network discussion] is misleading and actually not true. The recommendation of the "hybrid" framework, which is based upon a false premise and which introduces limitations that then raise further problems such as the interaction between global environmental issues as linked impacts.

46. Expert 2: The Proposed DPSIR-MA Framework is an improvement over the DPSIR Framework. However, the scientific deficiencies of the DPSIR Framework are so serious (and so well catalogued in the literature) that even this improvement cannot overcome them. For example, the lack of treatment of societal factors (identified in political science) between State and Response, and between Response and Driving Force.

47. Expert 2: The entire set of indicators requires a conceptual model, as GEF-STAP argued.

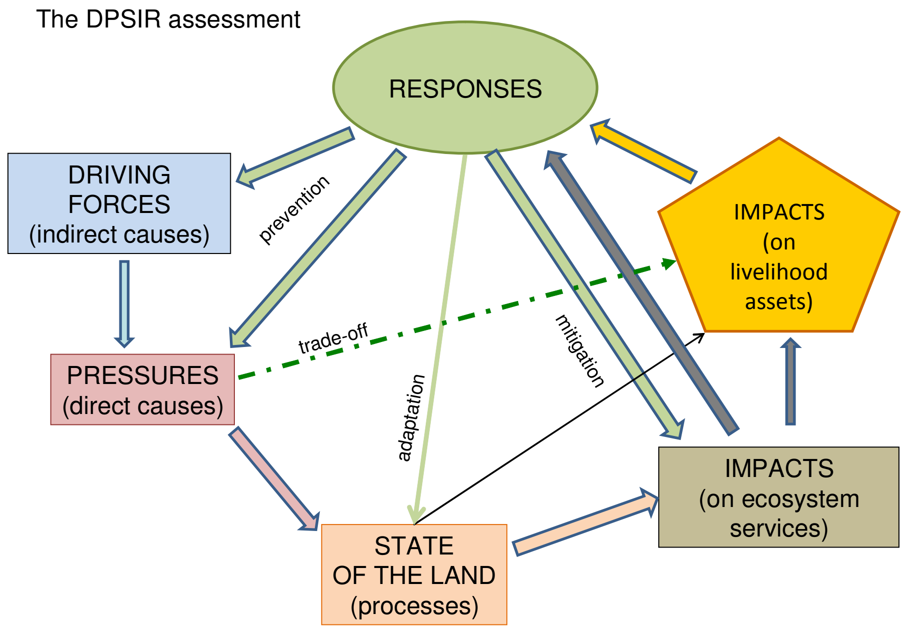
48. Definition of pressures as indirect drivers (p 12) contradicts the statement in the following page, where pressures are defined direct drivers (which I agree). On the same page, On the same page, impacts definition should include impacts on the environment.

49. Expert 19: The proposed "Hybrid DPSIR-MA" scheme presented in the zero draft of the white paper is interesting, but it lacks of an interpretation, illustration of the trade-offs that are always present in land management, and that have to be taken into account if proper and feasible responses have to be identified. Also one has to consider that different groups of stakeholders may act in the same territory/land.

50. Expert 19: A revision of the adopted DPSIR scheme would be needed. The LADA team is preparing a paper on it.

51. Expert 19: In the definition of responses (p 12), the terms adaptation and mitigation seem to be taken from climate change jargon. In that case, adaptation is a response to impact, while mitigation is a response to pressures/drivers. In land degradation, mitigation is a response to impacts, while the response to drivers/pressures should be prevention, and the response to status/processes should be adaptation. I attach a revised DPSIR scheme in this sense (Figure 2).

Figure 2



52. Expert 5: The transition from a causal chain to causal network approach sounds, overall, extremely ambitious, since the parties would be forced to jump from no indicator use, to a rather complex mechanism that has not been tried. Why not design a stepwise process that increases complexity little by little?? If this system is to be used by the parties, then we can be sure it won't be used at all.

53. Expert 5: What does the author bears in mind when he recommends a "collaborative construction" of a causal network....”?

54. Expert 7: The decision on which framework to use is very much supported and within the WOCAT program, we also came to the same conclusion.

55. Expert 8: The white paper misses one key point made in the Niemeijer papers related to causal networks, which is that there is a tendency to focus on criteria for individual indicators and to pay too little attention to set-level criteria. The MA criteria are at indicator level. The use of the hybrid framework as a way to help selecting indicators is set level, but there are more set-level aspects that should be highlighted as a formal criterion, such as keeping internal correlation low.

56. Expert 9: The frameworks are important but then they must be amenable to the applications of different indicators. In the discussions there should be attempts to see how composite indicators: both scientific and indigenous indicators can be applied.

57. Expert 9: Concerning the MA framework, mention the specific ecosystem services for which indicators will be sought, but briefly.

58. Expert 9: Concerning the DPSIR framework, could the arrow from Response to Driving force be reversed? Since response is the product of the impact it might influence

the Pressure Points (lessens or increases) but cannot be the driver unless we are describing a system which is in a positive feedback mode.

59. Expert 9: These frameworks are neat in organizing the inter-linkages across different causal drivers but in themselves are not statistical in any sense. They merely help in organizations of ideas that might have causal relationships without being able to show how the different stressors or drivers can be measured.

60. Expert 14: In applying the MA framework, what needs to be assessed is whether or not there are thresholds in the provision of services that either independently or together with the exogenous factors cause human well-being to drop to a level that crosses the poverty threshold. The information/data required for Cultural Services valuation are mostly data on Human Capital.

61. Expert 20: The WP recommends an hybrid DPSIR-MA conceptual framework for the suite of impact indicators needed to deal with desertification. It is clear that some kind of conceptual framework is needed and any one has advantages and limitations. Lets provide some comments on these in the case of the proposed option.

a) DPSIR and MA intend to provide a very generic frame to Human / Environment (H/E) interactions, which is justified by their planetary perspective but may be not so much when applied to a particular set of processes as desertification, which even if their impact is global, its conceptual frame isn't (i.e. climatic range, land use systems, cultural backgrounds etc). If we remain too generic in the conceptual framework, we will fail at identifying explicitly what we expect from indicators.

b) The very concepts of 'ecosystem's services' and DPSIR causality chain are rooted in an anthropocentric view of that puts Man as a consumer and manager of the Ecosystem rather than being itself a part of it. I don't recommend rejecting the proposed option but only warning of its deficiencies to better adapt our needs concerning desertification.

c) H/E systems threatened by desertification share common properties that could enrich the DPSIR-MA framework, for example:

- They are more adapted to mobility in the use of resources (i.e. nomadism).

- They know how to use spatial and temporal refuges to survive draughts and other fluctuations, etc).

- They have a lot of relevant cultural factors that influence decisions of people often above the economical ones.

- They are particularly adapted to survive in fluctuating environments but they have difficulties in adapting this inherited knowledge to climatic and socio-economic out of range never experienced changes.

- Land degradation appears long behind the increase of pressure on resources, and often as hotspots of intensification that export chaos and land degradation in the surrounding areas.

d) The DPSIR-MA framework should 'downscaled' to meet the reality of desertification. As it was shown at the 'International Conference on Advanced Scientific Tools for Desertification Policy' held recently in Rome, today, the ideas and huge data bases of documented desertification story cases to support this work are already available.

e) This would fortify the starting choice of the suite of indicators, but also would provide ground to simple functions and models of the H/E behaviour to support indicators. This would help one of the recommendations of the review report concerning the conceptual frame.

62. Expert 6: In DPSIR, it is difficult to distinguish between driving force and pressure, because you know there is a driving force only when you feel the pressure. Also difficult to distinguish between state and impact because you know there is impact when you see a different state.

63. Expert 6: There is no state of "human well-being", only impact, and the same for "ecosystem services". Why we need all this? The MA framework was simple and straight-forward and did not require stakeholders to remember such meaningless acronyms like DPSIR.

64. Expert 6: I may suggest that the only conceptual framework that normal stakeholders, both grassroots and policy makers can easily understand and work with, and have indicators for, is as follows:

a) Land degradation is a persistent reduction of biological productivity in drylands. The indicator is therefore the trends of yields, corrected for rainfall fluctuations, nothing more. The degree of reduction changes (but it must be persistent), and its extreme may be called desertification.

b) The direct causes of land degradation are several, and there may be indicators for each – salinization, soil erosion, nutrient depletion, etc., which are salinity (easy to measure), and the other two not so easy so may be dropped.

c) The indirect causes are human actions – over stocking, irrigation, and their indicators need to be worked out on scientific basis – what is "over", and what irrigation is "improper"

d) Desertification, of whatever direct and indirect causes, has impact on human well-being. There are so many impacts that we can have multitude of indicators that are habitually measured. But whichever one we use, it is to be meaningless unless it is matched with the indicator of (1), i.e. land degradation and its extreme – desertification.

So, all is so simple. We need at most 4 indicators, one for each of these four sections, and just two, one for (a) and one for (d) will suffice. And I want to see one "affected" country that will measure these two for at least one year ….

65. Expert 10: The MA-derived conceptual model, which shows the scales stacked up behind each other, with no details of how they actually interact, does not help with scaling problems – it indicates that you have addressed the problem, but actually it is just swept under the carpet. See Carpenter et al 2006 Science 313:257-258 for a discussion of this and other issues with the MA model.

66. Expert 11: The choice of DPSIR may be criticized as being kind of arbitrary; there has been scientific concern that it may not be not be best suited to provide an effective representation of desertification and to comply with the Dryland Development Paradigm principles considering fluctuation of and multiplicity of human-environment interactions, but I agree that it has the advantage to be already used by important actors in the UNCCD which in my opinion favors broader acceptance of the concept by parties.

67. Expert 11: I like the concept of a "hybrid DPRIR-MA" framework and think I understand its logic of connecting the Ecosystem services and the DPSIR for analyzing the cause effect relationships and expressing the impact in terms of changes in the provided ecosystem services. Both are in principle applicable "universally" to all kind of H-E systems and are as such not necessarily specific to the desertification context. This may not be a major problem from a scientific point of view, but could possibly be perceived by stakeholders/decision makers as not sufficiently specific to their problems. Often they are competent or in charge in relation to a specific sector of activity. That's why we propose for the WAD ATLAS linkage of ecosystem services to more specific dryland or desertification

issues, which are then analyzed with the hybrid conceptual framework in order to select the indicator set. I could imagine that this approach could help to illustrate the relevance of the impact indicators to actors at various levels (national-international) at a later stage. We have outlined this in a recent paper which has been accepted for the special issue of the LD&D journal related to the 1st UNCCD-CST scientific conference. Consider Figures A & B, just for illustration of this comment.

68. Expert 11: Adopting the proposed hybrid framework and proposing ongoing refinement of the approach are fine, but at the end their implementation requires clarification of organizational mechanism, in simple words, who coordinates/organizes this in practical terms to be efficient. Could this really be done in the current structure of CST and KMST, or would it not require another broader mechanism including constant peer review, capacity building etc?

69. Expert 12: The document says nothing (and of course it was probably not expected to) about the structuring of the information system within which indicators might be collected. Our experience with ACRIS is that this is as important as the headline indicators to be collected. For a range of reasons I believe it is essential to consider a structure which is nested around key themes which are themselves associated with key ecosystem services and the causal drivers of (both positive and negative) change; and that this should be done in ways which allow some local data to be upscaled to the wider national, regional and even global scales at which some decision-makers need the decision-support information noted above (2). Many of the indicators listed in this document would in fact lend themselves to this approach, such that the expression of the indicator may be different at different scales (and also at different locations at the same scale), whilst some may indeed be more universal. However, I do not see any sign of this thinking lying behind the choice of indicators, nor in explaining how some may be collected differently in different places yet be meta-analysed to provide a consistent measure at a higher scale.

70. Expert 21: Regarding the conceptual hybrid DPSIR-MA framework, I found it properly to use as such because it summarizes all the constituents of the process under the two main key elements, the productive base and the users or stresors, hey elements in this complex, timely and spatial variable process.

71. Expert 22: As far as I understand, the proposed DPSIR-MA conceptual framework is good in its capacity of generalizing. However, I would suggest more descriptions are added. My concerns are: 1) In the actual operation how to distinguish “pressures” from “driving forces” at various spatial scales? 2) How to link the proposed or candidate indicator suite to the conceptual framework, especially when DLDD processes are nonlinear and have multiple thresholds?

72. Expert 23: The DPSIR assignment of indicators should be contextual, and refer to the causal chain related to a specific (regional, local, whatever) “storyline” and each indicator can be in one box or another according to the context and perception.

73. Expert 23: The whitepaper should note that both LADA and the World Atlas of Desertification (WAD) developed their own hybrid frameworks, which should be presented and discussed as well.

74. Expert 23: The proposed hybrid framework displays the scales, however The challenge is to integrate the scales.

75. A number of reviewers: Support use of the hybrid framework, and agree with the recommendation to use it for indicator development.

Figure 3 Flowchart of main elements and principle pathway for selecting adapted indicator sets.

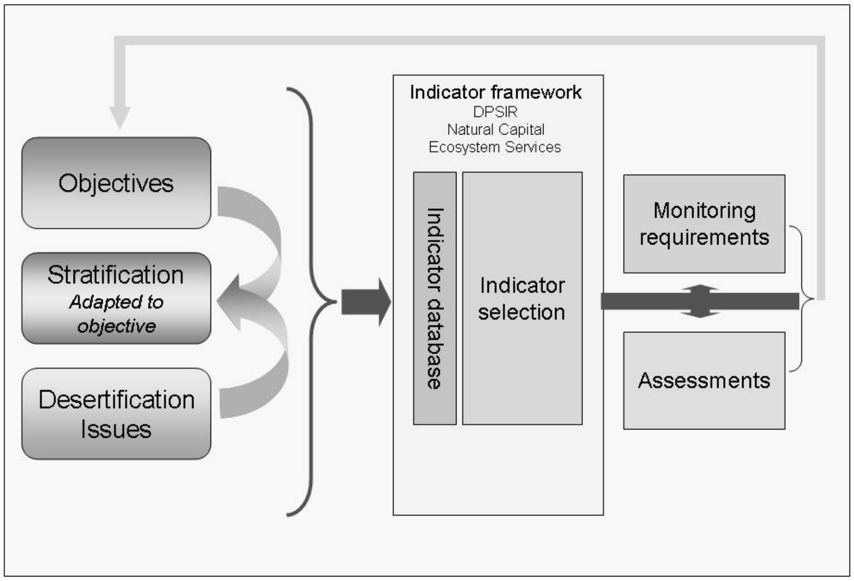
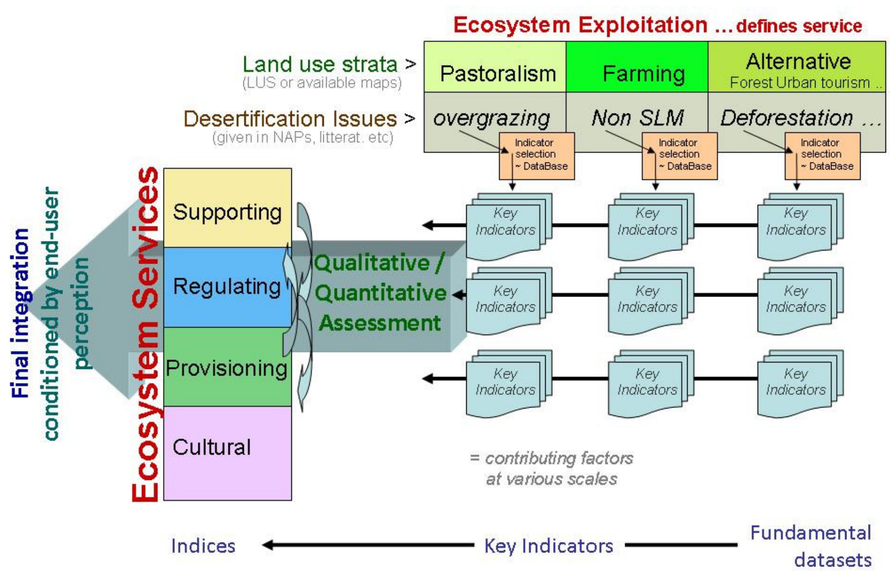


Figure 4: Schematic and simplified overview of the general concept for selecting, using and integrating key indicators, being contributive factors of DLDD, into combined indices useful for evaluating related ecosystem services



G. Indicator evaluation criteria

76. Expert 19: In terms of the first evaluation criterion, "Does the indicator provide information about changes in important processes?" -- What is important? In the scheme

below, the only indicator which is given low importance is the change in land use, that is the main driver to land degradation.

77. Expert1: The evaluation criteria ask about scale, but, what is the appropriate scale? It may vary depending on the indicator and the very scale of the assessment, which one must know before being able to evaluate any given indicator. Overall, this criterion doesn't make sense to me without being first specific about the required or appropriate scale. However, what is very important to know is the right scale of application of any suggested indicator, and the availability of cross-scaling rules, if any. Alternative formulation could be "Are the spatial and temporal scales/domains of the indicator specified and clear?. Another option could be to remove this criterion and instead, ask the experts to label each indicator with the proper scale of application (similar to the request of labeling them as D, P, S, I, R)

78. Expert1: Several of the evaluation criteria overlap. Two actually point towards current information. Being two, they give a greater importance to what is already available, reducing the potential for using "new" (recently suggested) indicators.

79. Expert 2: Because of the GEF-STAP critique I did not find the first three evaluation criteria questions relevant.

80. Expert 11: The criterion "Can policymakers easily understand the indicator?" does not make much sense. It simply depends on the policy maker and there are as many different types of policy makers as indicators. In my opinion it is often more the question if an indicator suits the current needs of a policy maker. Too often they have rather short term objectives, which do not match necessarily the longer temporal dimension required for desertification assessment and follow-up decisions. Answer can probably each time be yes and no.

81. Expert 21: I believe it's important to include in the document the criteria used in order to select these 11 indicators. One issue is now the evaluation criteria, but it's fundamental to know which were the criteria used in order to select them. That's fundamental when dealing with indicators. There is a lot of material on that, and it's our backstone when selecting indicators for assessing land degradation. There is the ideal situation and unfortunately reality is fairly different. So, I'll advise to include it.

82. Expert 23: The proposed criteria are probably suited to compare better defined, quantitative indicators, after a pre-selection based on relevance and feasibility; we are not yet at that stage.

83. Expert 23: It appears that the evaluation criteria require, to be best applied, a specific, in depth understanding of single, fully defined indicators, homologous. Most of the "indicators" we are dealing with here are not at that stage of definition.

84. Expert 23: Apart from concerns about the applicability and suitability of the proposed criteria at the present stage of review, some additional concerns:

a) comparability: the matrix includes indicators with different scales and levels of specification, quantitative and semi-quantitative ones

b) contextual meaning(1): country by country and region by region the scores may (must) be very different for some criteria (for same indicator)

c) contextual meaning(2): dpsir assignment should be contextual, and refer to the causal chain related to a specific (regional, local, …) "storyline"

d) LUS based-LADA-N indicators are extrapolated from a system and the reviewer should know very well the LADA manuals to evaluate them; they have not been formulated to be extrapolated and used (evaluated) as single

e) the sub-group of candidate indicators proposed is probably too limited and the reasons (criteria) for the related pre-selection should be introduced

H. Limited set of indicators

85. Expert 16: The more indicators are supposed to use, the lesser reliability will be. Maximum 5 indicators are recommended: high education rate, rate of income/expenditure per capita, land cover status and change, ratio of input and output of land production, and soil organic matter.

86. Expert 2: Of the UNCCD Provisional Indicators, the set should be limited to I. Water availability, III. Proportion above poverty line, VI. Level of land degradation, VIII Aridity index, X. Carbon stocks above/below ground. The rest are redundant or inappropriate. Relating this back to the strategic objectives:

- Objective 1: Overlap between indicators leaves many redundant.

- Objective 2: VI Having a single index of land degradation is good for some purposes, e.g. if one were to balance the index against a poverty indicator. But since in my view the most important priority of the UNCCD is to monitor the level of land degradation, compressing multiple indicators into a single index, alongside many other indicators of lesser importance is not beneficial. VII Plant and animal diversity is best included in Objective 3, because it generates global benefits, like carbon. IX Land cover status needs to be integrated with the level of land degradation, and so is not useful in its own right.

- Objective 3: XI SLM is not a global benefit. But affects VI.

87. Expert 8: UNCCD provisional indicators III, IV, V are highly correlated and thus lead to redundancy.

88. Expert 6: I may suggest that the only conceptual framework that normal stakeholders, both grassroots and policy makers can easily understand and work with, and have indicators for, is as follows:

a) Land degradation is a persistent reduction of biological productivity in drylands. The indicator is therefore the trends of yields, corrected for rainfall fluctuations, nothing more. The degree of reduction changes (but it must be persistent), and its extreme may be called desertification.

b) The direct causes of land degradation are several, and there may be indicators for each – salinization, soil erosion, nutrient depletion, etc., which are salinity (easy to measure), and the other two not so easy so may be dropped.

c) The indirect causes are human actions – over stocking, irrigation, and their indicators need to be worked out on scientific basis – what is "over", and what irrigation is "improper"

d) Desertification, of whatever direct and indirect causes, has impact on human well-being. There are so many impacts that we can have multitude of indicators that are habitually measured. But whichever one we use, it is to be meaningless unless it is matched with the indicator of (1), i.e. land degradation and its extreme – desertification.

So, all is so simple. We need at most 4 indicators, one for each of these four sections, and just two, one for (a) and one for (d) will suffice. And I want to see one "affected" country that will measure these two for at least one year ….

I. Participation and locally Specific/Identified indicators

89. Expert 11: On p. 8 the white paper states the need for "…identifying a mechanism within or linkable to the conceptual framework so that such participatory processes that capture the variety of local perspectives and expertise..." I agree in this point very much, but it should be mentioned more clearly that implementation of this participatory and cross-cutting approach requires at least as much novel organizational elements as scientific conceptual ones. Maybe DSD white paper 3 published by UNU-DNI can provide some input in view of this.

90. Expert 1: On p 15, the white paper states the conceptual framework will need to define/provide a mechanism for "where locally-derived indicators will be needed to support the overall monitoring and assessment effort." This is an important point, but I don't see how is this framework is highlighting where locally-derived indicators will be needed.

91. Expert 5: For the framework to accommodate locally-derived indicators and data obtained in a participatory manner from the full range of actors, local capacity must also be considered as many countries have no monitoring system through which assess the DLDD process.

92. Expert 7: Since 1992, WOCAT worked in over 50 countries worldwide and developed in collaboration with national and international programs and partners (including FAO, UNEP, …) a joint methodology such that this is useful for the countries. Our main aim was to make something useful for national, sub-national and project level, where efforts are being made to reduce land degradation and promote SLM. In this participatory process many indicators have been developed and are already applied.

93. Expert 9: The white paper is not strong on experiences with selections of indigenous indicators that local communities can widely apply. Research has been conducted in these areas but the local indicators have not been widely tried. The frameworks are important but then they must be amenable to the applications of different indicators. In the discussions there should be attempts to see how composite indicators: both scientific and indigenous indicators can be applied.

94. Expert 24: Most of these indicators are at a level that people in developed countries can use most of them to address the situation throughout the globe based on globally available data and information but not necessarily based on information available in the individual countries. It seems that this would be the best use of scarce resources. Nevertheless, the indicators are meant to be used at country level but, as KM:Land found out in Namibia, many people working on these issues at country level simply don't have access to all the UN, World Bank and other high level reports where much of this information is assembled (accurately or not).

95. Expert 24: What I am personally interested in is seeing useful local or national indicators being scaled up for overall comparative use globally. Maybe this is a tall order, and maybe this has already been considered and discarded, but I would like to hear about this if it has been done.

J. Scale issues

96. Expert 17: Indicators not only are influenced by spatial scale to be considered but also are completely scale-dependent to the extent that if one indicator is used at different scales, vastly different results are obtained. In land degradation, this is an especially vital issue affecting the type of results that can be gained from whether a field or farm or watershed or regional scale is being assessed. A typical indicator such as rate of soil

erosion by water can vary at the same location by a factor of 100 between a small plot (high estimate) and a large catchment (low). This scale issue appears not to be considered in the draft White Paper, except rather obliquely at point 17 on page 9.

97. Expert 17: Scale issues do, however, underlie the whole paper since the UNCCD is interested in national reporting and in measuring impact at the global level. The so-called hybrid conceptual model has scale levels in it borrowed from the MA – local, regional, global (see Figure 3). Most national reporting has to be undertaken by aggregating field, local and district level information. Aggregation is problematic, and some massive mistakes have been made in the past in, for example, FAO's Provisional Methodology for Soil Degradation Assessment, where a modified form of the Universal Soil Loss Equation, an empirical model used at the field/plot level, was aggregated for major regional zones. The result was a ridiculous exaggeration of net rates of soil degradation. For this reason, projects such as KM:Land have been careful to distinguish between indicator sets and scale of operation. We think UNCCD should do similarly.

98. Expert 17: Concerning recommendations leading to this white paper, point 17 (p) raises the scale issue for indicators – can national and sub-national levels be aggregated for global-level information? In most cases, the answer is 'no'. Levels of detail are different, measurement requirements vary and the users/uses of the information also vary. For this reason, projects such as KM:Land distinguished between indicator sets and scale of operation. We think UNCCD should do similarly.

99. Expert 19: Concerning the 11 provisional impact indicators, global and national levels are not well defined in terms of scale/resolution.

100. Expert1: The evaluation criteria ask about scale, but, what is the appropriate scale? It may vary depending on the indicator and the very scale of the assessment, which one must know before being able to evaluate any given indicator. Overall, this criterion doesn't make sense to me without being first specific about the required or appropriate scale. However, what is very important to know is the right scale of application of any suggested indicator, and the availability of cross-scaling rules, if any. Alternative formulation could be "Are the spatial and temporal scales/domains of the indicator specified and clear?. Another option could be to remove this criterion and instead, ask the experts to label each indicator with the proper scale of application (similar to the request of labeling them as D, P, S, I, R).

101. Expert 3: In some cases, a scale disconnect may be OK (if a desired outcome is simply to have greater awareness of an issue and/or data need to be collected at a more useful scale to be addressed at a national scale).

102. Expert 7: WOCAT has a standardized methodology to assess at the local scale and regional /national scale and this system has been harmonized to be able to link the different scales.

103. Expert 8: The issue mentioned on page 16 about changes in ecosystem services only affecting human wellbeing in longer time frames is actually a much wider issue. Even state changes typically happen in longer time frames than projects and governments tend to think. This is a major issue with most of the recommended indicators.

104. Expert 9: In the white paper, the need for different indicator levels are not well highlighted. In most cases, desertification is a local problem and local communities would have the responsibility to reverse it through changes in land use.

105. Expert 9: The issue of scaling, which has been identified in the draft paper, is most critical for any applications of the indicators. Experiences shows that scaling effects could determine the responses to any statistical analyses.

106. Expert 9: If one can assume that the impacts of indicators are to be measured at regional and local levels (there are scaling effects) then, appropriateness of indicators might vary. Quite often, indicators developed and measured lack corresponding functions at local levels even when they might appear appropriate if considered at regional levels. Scaling down indicators would therefore be important. Even such indicators as poverty index that often rely on the standardized UN values such dollars per capita might sound unrealistic in systems such as pastoralism where poverty measures use different units.

107. Expert 10: Even when the indicator is in principle scale-independent (eg water per capita), it is quite unlikely that the top-down methods will agree with the bottom-up methods, because they probably disagree about what ‘available water’ is. For most of the indicators, it will not be possible to provide sub-national resolution if global data-sources are to be the main data providers. This is really problematic, because few countries are entirely dryland, and even within dryland areas, degradation problems are typically spatially patchy. Interventions are usually local. So there is no alternative to encouraging all affected countries to put in place monitoring systems that allow subnational resolution. The countries that have done so demonstrate that it can be done.

108. Expert 12: The document says nothing (and of course it was probably not expected to) about the structuring of the information system within which indicators might be collected. Our experience with ACRIS is that this is as important as the headline indicators to be collected. For a range of reasons I believe it is essential to consider a structure which is nested around key themes which are themselves associated with key ecosystem services and the causal drivers of (both positive and negative) change; and that this should be done in ways which allow some local data to be upscaled to the wider national, regional and even global scales at which some decision-makers need the decision-support information noted above (2). Many of the indicators listed in this document would in fact lend themselves to this approach, such that the expression of the indicator may be different at different scales (and also at different locations at the same scale), whilst some may indeed be more universal. However, I do not see any sign of this thinking lying behind the choice of indicators, nor in explaining how some may be collected differently in different places yet be meta-analysed to provide a consistent measure at a higher scale.

109. Expert 15: The value of impact indicators is related to scale. Impact Indicators of UNCCD are set for national and global level assessment, but some of (or most) indicators were derived of projects (or local level), such as water availability and water pressure. Those indicators are not suited for national or global level assessment when those are scaled up from project (local) to national or global level, mainly duo to data availability in special and temporal variation.

110. Expert 15: Indicators should be monitored, measured and verified in appropriate spatial and temporal scale.

111. Expert 23: the spatial scale against which the indicators are to be assessed is not very clear and the answer would depend very much on it.

K. Testing

112. Expert 10: A lot more research and practical testing needs to be done in almost all of these indicators before the full set is foisted on an unsuspecting world. Even a lot of things that are allegedly ‘ready to go’ (such as the GLADA, or the various global NDVI analyses) are still really unvalidated research products. My personal experience is that they get things very wrong when you start drilling down into the details. [Actually, many of them have gone through a validation process, been found to be faulty, but simply proceeded with].

113. Expert 24: Indicators have been discussed by the CST since COP1. Throughout this time, it is assumed, that on the ground testing has been going on and feeding into these indicators. My suggestion is that the selected indicators for the global level simply be tested. This seems to me to be more productive than continuing to refine indicators without extensive testing. The two global indicators that have been selected are ones that actually could be done in Europe by someone behind a computer. I'm not clear on how each country is going to do their own assessment.

L. Synergies

114. Expert 17: STAP welcomes the invitation to contribute to the review of the draft 'White Paper'. It congratulates the consultants on the commencement of this comprehensive exercise, and for delivering concrete recommendations. Annex 1II is particularly useful in bringing together in a systematic way the proposed indicators from initiatives such as KM: Land and LADA, and setting them in their context of the three UNCCD Objectives. This part of the exercise enables readers to review not only the potential sources of information for the indicators but also their potential practicability for application by the UNCCD and its parties.

115. Expert 25: CSFD is gathering what is produced around desertification in France, but we are not a scientific research team developing new tools. We are currently preparing a scientific seminar for next summer on economical indicators, where French (speaking) scientists will present their findings and views. I can signal the work of OSS in which many of us are involved, even if a majority of documents is in French, some have been translated in English. I attached one of them, more can be found on their website. http://www.oss-online.org/

116. Expert 7: WOCAT has participated in several workshops and made its methodology available. Since 1992, WOCAT worked in over 50 countries worldwide and developed in collaboration with national and international programs and partners (including FAO, UNEP, …) a joint methodology such that this is useful for the countries. Our main aim was to make something useful for national, sub-national and project level, where efforts are being made to reduce land degradation and promote SLM. In this participatory process many indicators have been developed and are already applied, which are now mentioned as LADA indicators (especially the LADA-N indicators). KM-Land made proper reference but the LADA-N (National) is very much based on the WOCAT-Mapping and was further developed during a contract given by LADA to the WOCAT team, which developed it further with the inputs of the LADA partners. We in WOCAT always refer to this tool as the WOCAT-LADA or LADA WOCAT mapping tool to illustrate the joint development.

117. Expert 26: I'm attaching a paper which might help to understand how the different methods (WOCAT, LADA, DESIRE, KM-Land, etc) relate to each other, what is their role regarding impact indicators and UNCCD. This is actually the result of the DSD in preparation of to the first scientific conference in Buenos Aires last year and will be part of the special issue on UNCCD of the journal Land Degradation & Development (probably early 2011).

118. Expert 23: Basically we are asked to evaluate just a small set if indicators and many others are there of course…..even LADA will ask you why the 30 or so Gladis global indicators are completely neglected.

119. Expert 23: Suggest the effort could build more on the work of the former White Papers prepared before COP9, and to consider some missing ongoing initiatives, such as WAD (World Atlas of Desertification), as well as missing products/indicators of the

mentioned programs (such as the GLADIS system of LADA). Both LADA and WAD already tackled (and solved, their ways) the issue of the hybrid MA-DPSIR framework.

120. Expert 23: The process leading up to the proposed conceptual framework needs to include acknowledgement of the scientific work carried out by projects like DESERTLINKS and MEDACTION, as well as country based experiences, to develop indicators sets based on participatory causality based frameworks, specifically in the frame of the UNCCD. These works were well disseminated in the UNCCD context and constituted an input to several initiatives such as LADA and, more recently, WAD (World Atlas of Desertification).

M. Organization and content of the white paper

121. Expert 17: STAP also has comments aimed at improving the visibility and clarity of the objectives of the exercise, some of which have been obscured by the opening background material which is currently labelled 'introduction' and 'approach'. We also have difficulties with Section 2.1 which is a strange mix of steps in the review process and certainly not what is promised in the subtitle ('Key recommendations and concerns'). The 'process' aspects would be better relegated to an annex, while the recommendations from various forums would be better listed by number so that the reader can track how the reasons for this paper have been derived.

122. Expert1: The balance of the report, perhaps because the expert review is ongoing, is weighted towards the background information rather than the synthetic review. Once the review is complete, the initial 12 points should be simplified, prior reviews summarized, and perhaps Figure 2 may no longer be necessary. Relevant information from this figure that is further used in the white paper is already included in previous Table 3 and in next figure (Fig. 3). So, suggest deleting previous Table OR deleting this Figure 2.

123. Expert 4: The purpose of the paper is never fully articulated. In section 1.1, there needs to be one short paragraph at the very end that says exactly what is supposed to be done. The pieces are there, but there should be one clear statement of what this is about.

124. Expert 5: Previous to these decisions, there was an extensive work carried out by a numerous subgroup of scientists that were appointed by the CST as members of the Group of Experts. This group specifically worked on indicators, but their worked has never been considered in subsequent reviews after the GoE ended its mandate.....I believe it's time to include their proposal, just as a means to draw from previous experiences and activities.

125. Expert 5: This is a very interesting paper in terms of its contribution in proposing a framework for the application of indicators. However, the exact purpose of the paper should be described with more precision right at the beginning. Then, the structure followed is rather confusing, as it goes into the framework and proposing a new phase, and at the end it goes back to the actual set of indicators accepted by the parties.

126. Expert 7: Understanding the white paper and the arguments about the need for indicators: my very personal comment is that the paper should be clear and in an easy understandable language such that all the different countries involved get convinced that there is great need and a good benefit from assessing these indicators. This is especially needed when we consider that this paper might have to be translated to other languages. Having worked in WOCAT with methods and tools in several languages, I am aware of how much confusion this can cause. The indicators must me simple, measurable, … robust, … (SMART) so has to be the document. I am aware this is easier said than done but I think more efforts have to be made.

127. Expert 7: A principle of a Strategic (White) Paper should be to give reference to the main sources. Whereas KM-Land and LADA are well mentioned (rightly so), WOCAT and its efforts to standardize assessment and documentation of SLM defining methods/ tools and indicators has not been acknowledged properly (only mentioned once in the white paper).

128. Expert 7: Recommendations should be short clear sentences and statements otherwise it will not stick.

129. Expert 9: Mention the specific ecosystem services for which indicators will be sought, but briefly.

130. Expert 23: Enrich the introductory analysis, or the concern and recommendation section, with a reference to the UNCCD "country profile" reporting (and monitoring) strategy (National reporting process of affected country parties explanatory note and help guide, ICCD/CRIC(5)/INF.3, 23 December 2005) and with a brief note on its outcomes (and country feed-back/response).

131. Expert 23: State clearly and succinctly the primary goals of the white paper up front, and move "steps" list in the approach, and/or the TOR to an Annex. Be sure to give the reader/reviewer the possibility to distinguish between TORS and (eventual) self-defined goals.

132. Expert 23: The "common denominator" and "standard" aspects of the indicator needs were pointed out since 1998 by the former CST "Committee on Benchmarks and Indicators" and some countries and projects performed (and documented) this kind of work. I would suggest to develop a brief analysis of these experiences in a dedicated paragraph of the report (in chapter 2.2?)

Annex III

Technical descriptions of metrics/proxies for proposed refinement indicators (Revised 13 December 2010)

Annex III is a table of technical descriptions of proposed refinements to the metrics/proxies of the the provisional UNCCD impact indicators (see Table 1 & 4) proposed by groups of experts (KM:Land, LADA, WOCAT, and in one case, CBD) that have been working on related indicator development extensively. The indicators are ordered according to UNCCD strategic objectives 1, 2 and 3 and associated core indicators (S-1 through S-7). They are numbered to correspond with the original UNCCD indicator (I –XI), with the addition of a letter code (e.g., KM:Land = KM; LADA = LA; CBD = CBD) to make it easier to track the refinement source. Each metric or proxy retains the name given by those how proposed it. A generalized reference to scale is also provided next to the indicator name. Global/National indicators are either national statistics (sub-national data not available), or have the potential to be spatially explicit where some insight with national boundaries is possible (this is stated when relevant). Local (project) indicators listed here have the *potential*, based on input provided by KM:Land and LADA (verbal communication and reports), to be scaled-up or otherwise aggregated to be reported at the national level (scaling methods are included, or if lacking recommended). Indicators from more than one source related to the same original UNCCD indicator are placed side by side in the table. In a few cases they may be very similar to each other, but in others they are quite different. Therefore each indicator should be assessed on its own merit. Text in each cell, whenever possible, was copied verbatim directly from the primary references (listed in the first row in the table) used to generate a common technical description. However, the source documents varied considerably in format and approach, so in many cases information was summarized for this table. Please do not hesitate to correct any errors and address any omissions.

Technical descriptions of proposed metrics/proxies for the refinement indicators

Primary reference(s) used for KM:Land-proposed refinement indicator metrics/proxies: 1. KM:Land Global Indicators [1] 2. KM:Land Project Indicators [2] 3: KM:Land Indicator Measurement/Reporting [3]	*Primary reference(s) used for LADA proposed refinement indicator metrics/proxies* 1. LADA Methodology Local Manual [4] 2. LADA Tool Box Local Manual [5] 3. LADA for UNCCD Guidelines [6] 4. LADA Land Use Systems Mapping [7] 5. WOCAT-LADA Framework [8-10] 6. Global Land Degradation Information System (GLADIS) [11] 7. GLADIS Ecosystem Approach [12]
Use of primary references: Where possible, content below is taken verbatim from these reports to be as close to what the authors intended. For more detail, please access the reports directly. In other cases, the content below is a summary of information extracted across one or more reports.	
LADA Methodological Note: LADA-proposed global/national indicators listed here can be derived from GLADIS data and/or LADA-WOCAT national assessment methodology, unless otherwise stated. Project indicators follow the LADA assessment methodology, which involves 2-6 geographic assessment areas per country, with 2-3 study areas in each.	

These areas range in size from a single watershed to a region of several hundred km^2 (up to several thousand in large contiguous regions). Study areas generally involve 2 transects. In addition, for each land use type in the study area, ~3 pairs of plots are measured (depending complexity). Secondary data (maps, imagery, etc.) and key respondent interviews are also used.

KM:Land Methodological Note: KM:Land-proposed indicators vary in source in methods at the global/national as well as project level (and thus each is individually described below).

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UNCCD Core indicator S-1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought

Current UNCCD indicator name:
I. Water availability per capita in affected areas

***1.* I-KM-a. Water stress** (Global/National)

Purpose: To measure the stress/pressure on water resources

Description: The ratio of water withdrawals to availability. 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. Water withdrawals are defined as the amount of water taken out of rivers, streams or groundwater aquifers to satisfy human needs for water.

Source: University of New Hampshire Water Systems Analysis Group's (UNH WSAG) mean annual relative water stress index (unitless ratio per grid cell)

Spatial and Temporal Refinement: National and sub-national analysis possible, based on a 0.5° grid (NB: the approximate area of a 30 minute grid cell at the equator is 3600 km^2). Models run on year 2000 data, but have not (as of 2008 GEF report) been updated.

Noted Strengths and Weaknesses: Spatially explicit, and available at a sub-national level. Not currently regularly updates (costs for updates estimated at $200,000 every two years).

***2.* I-LA-a. Pressure on water resources** (Global/National)

Description: Percentage of total actual renewable freshwater resources withdrawn, as derived from the relationship between nationally reported statistics on total renewable water resources and water withdrawal (by water-user sectors and source of water). Millennium Development Goals (MDG) use this indicator, with the name "Proportion of total water resources used" [13].

Source: GLADIS includes these statistics from AQUASTAT [14], FAO's global information system on water and agriculture, collecting these national statistics since 1993.

Spatial and Temporal Refinement: National statistic only. Some inputs are spatially explicit, such as the precipitation data set, 0.5° grid, while others are regional (e.g., basin) or national aggregates. Trends can be calculated based on data back to 1993.

Noted Strengths and Weaknesses: AQUASAT has been used for global and national statistics reporting since 1993. This indicator adopted by MGD as an indicator. Sub-national data are not available, thus can only be used as a national statistic. There are AQUASTAT data quality concerns related to variation in reporting periods, variability in sources, interpolation issues, and potential over/under estimation bias. This raises concerns about accuracy, consistency and comparability.

***3.* I-KM-b. Water availability** (Local-level up to National)

***4.* I-LA-b. Water availability and use** (Local-level up to National)

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Purpose: To measure the impact of DLDD and its mitigation on water resources.

NOTE: KM:Land (I-KM-b) actually refers to LADA as a example of project-level methods (described in I-LA-b) that could be employed. They also refer to the LADA AQUASTAT approach to national statistics for national context that LADA uses in GLADIS. Thus, both the KM:L and LADA descriptions for this indicator can be considered separately or in combination.

Description: Proportion of total water resources used is defined as the total volume of groundwater and surface water withdrawn from their sources for human use (in the agricultural, domestic and industrial sectors), expressed as a percentage of the total volume of water available annually through the hydrological cycle. The terms water resources and water withdrawal are understood as freshwater resources and freshwater withdrawal.

Description: Current LADA-WOCAT indicators can be analyzed to assess trends in water availability and the proportion of total water available that is in use. Per capita water availability indicators include:
LADA-WOCAT-N: Hg Change in groundwater / aquifer level;
LADA-WOCAT-N: Hs Change in quantity of surface water.

Source: Project level based on local assessment, such as the LADA methodology (see I-LA-b.). Includes level of water resources, depth of water resources, water use, water withdrawal/ extraction obtained through local measurement and key respondent interviews. Scale up to national level may be challenging; one approach would be to link this with data based on the Millennium Development Goals (MDG) indicator "Proportion of total water resources used" (data for which is obtained through AQUASTAT – I.la.).

Source: Project level assessment of level of water resources, depth of water resources, water use, water withdrawal/extraction. Secondary information on water resources and climatic conditions and trends in the geographical assessment area are reviewed first. Local observations and measurements of water bodies (lakes, rivers, etc.) and water points (boreholes and wells) in the field, backed up by secondary data and key respondent interviews including land users/households. Tested instruments for rapid assessment of water resources degradation (observations, measurements, key respondent interviews) are available to support data collection.

Spatial and Temporal Refinement: Project-level, and thus resolution dependent on local assessment implementation.

Spatial and Temporal Refinement: Project-level, and thus resolution dependent on local assessment implementation. See general note on LADA methods at the top of this table.

Noted Strengths and Weaknesses: DLDD happens locally, so capturing sub-national variation is essential. However, scaling up from projects alone may not be spatially representative. Water quantity, especially in relation to water resources available, is difficult to assess. Care must be taken to account for inter-annual and seasonal variations in water availability. Short-term changes in water availability need to be carefully compared with longer-term trends in order to assess whether or not the observed trend is significant.

***5.* I-KM-c. Percentage of rural population with access to (safe) drinking water** (Local-level up to National)

***6.* I.LA-c. Access to improved drinking water based on change in water quality** (Local-level up to National)

Purpose: Demonstrate that mitigation efforts remove or prevent the pollution of water resources associated with DLDD and/or enhance access to safe drinking water.

Description: The percentage of the rural population with access to safe drinking water in a project's intervention area. According to the World Health Organization (WHO), basic access to safe drinking water can be defined as the availability of at least 20 litres of drinking water per person per day within a distance of not more than 1 km of the dwelling, corresponding to a maximum water-hauling round trip of 30 minutes. Access to safe drinking water is measured by WHO and UNESCO as the "proportion of the population using an improved drinking water source."

Description: The LADA-WOCAT methodology has the potential to address safe drinking water access from the perspective of changes in water quality relative to overall water supply. It also includes collection of contextual information on water allocations/access rules and arrangements, incidence and management of water conflicts, water policy, legislation and other institutional issues. Per capita water availability indicators include:
LADA-WOCAT-N: Hg Change in groundwater / aquifer level;
LADA-WOCAT-N: Hs Change in quantity of surface water. For water quality: LADA-WOCAT-N: Hp Decline

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of surface water quality; LADA-WOCAT-N: Hq Decline of groundwater quality.

Source: This indicator can be calculated by dividing the total population within a project area by the number of persons with access to an adequate amount of safe drinking water within the project area, and then multiplying this by 100 to obtain a percentage. Where available, the relevant data can be obtained through national data that is available from different sources such as WHO/UNICEF, AQUASTAT etc. The datasets of WHO/UNICEF Joint Monitoring Programme [15] (JMP) are based on national statistics but are completed with household surveys to improve the data quality. When national data are unavailable or insufficient, it will be necessary to conduct project-level assessments to obtain data. Two measurable indicators are proposed to be assessed at the project level through household surveys: an indicator in relation to water access and availability as defined by WHO, and an indicator capturing information in relation to water quality for human consumption, animal water and/or irrigation through simple categories.

Source: In the LADA methodology, the survey of water degradation is an assessment of level of water resources, depth of water resources, water use, water withdrawal/extraction, as well as groundwater and surface water quality obtained through observations and measurements of water bodies (lakes, rivers, etc.) and water points (boreholes and wells) in the field, backed up by information from key respondents and land users/households.

Spatial and Temporal Refinement: JMP data are based on national statistics. (To capture sub-national variability would require survey data at a finer spatial unit of analysis.) The data provided by JMP is updated every two years.

Spatial and Temporal Refinement: Mapping units in LADA-WOCAT products are associated with "land units" which are areas of land defined in terms of biophysical qualities and other landscape characteristics that may be demarcated on a map. They are the basis for the survey that produces the data for LADA-WOCAT indicators, which are then quantified (as an average) over each mapping unit. The resolution of spatially explicit, national level maps therefore varies from country to country, based on the landscape variation that exists and the intensity of sampling possible. However, the resolution is high enough for sub-national analysis. The frequency of LADA-WOCAT surveys has yet to be determined, but it is likely not to be more frequent than 5-10 years.

Noted Strengths and Weaknesses: DLDD happens locally, so capturing sub-national variation is essential through project-level assessments. However, scaling up from projects alone may not be spatially representative. Changes in water quality can result from activities not directly related to land degradation, which reduces the sensitivity of this indicator in terms of attribution to land degradation. Therefore, these factors need to be taken into account when relating land degradation to changes in water quality. Improved drinking water sources are more likely to be protected from external contaminants than unimproved sources, either by intervention or through their design and construction. This indicator does not take actual drinking water quality into account, nor does it reflect the time spent on getting water from improved sources which are not physically obtained on the household premises. Both these determinants though are important parameters of access.

Noted Strengths and Weaknesses: DLDD happens locally, so capturing sub-national variation is essential. However, scaling up from projects alone may not be spatially representative. Water quantity and water quality, especially in relation to water resources available, is difficult to assess. This approach is an indirect measure of drinking water access, but has the advantage that, in addition to measurements, contextual information on barriers to access is also gathered.

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Current UNCCD indicator name:
II. Change in land use

Note: Both the KM:Land and LADA approaches to change in land use involve, as a first step, assessment of land cover and/or productivity. Please see IX. Land Cover status (below) where this is detailed further. Both have approaches to obtain information on SLM from land use (see XI).

***7.* II-KM. and XI-KM. Land Use System (LUS) and Sustainable Land Management (SLM) practices** (Project level up to National)

Purpose: This indicator generated and used in conjunction with the land cover indicator (see IX). It provides information on the types of land use and SLM practices are being used in DLDD intervention areas, and provides insights into the associated impacts. Good practices conducive to SLM (see XI) can contribute to the arresting and reversing of current global trends in land degradation, while improving human well-being.

Description: This indicator shows the distribution/area coverage of land use systems including SLM practices within intervention areas, which then have the potential to be scaled up for national-level reporting. Land cover (see IX) can be mapped in further detail to obtain land use systems (categorized by cropland, grazing land, forest/woodland, mixed land, water surfaces, built/urban land, other). Further subdivision can be made on the basis of additional criteria such as physiography, administration, soil, slope, etc. The order of importance of these additional criteria depends on the local situation; for example, whether physiography or socio-economic criteria play a determining role. This is followed by mapping SLM practices in each LUS area.

Source: The mapping of LUS and SLM practices should be conducted through a participatory expert assessment. Further data for the delineation of the LUS and SLM practices can be obtained from various regional institutions involved in collecting and elaborating land management practices data. KM:Land suggests that the World Overview of Conservation Approaches and Technologies (WOCAT) [16] / LADA mapping questionnaires provide an elaborate method of assessing the area of degradation and SLM at the national level, which can also be applied at the project level. Participatory ground verification is recommended.

Spatial and Temporal Refinement: The size of the intervention area and the variability within the area will determine the scale of the mapping exercise and the size of the mapping units. Measurement units include hectares of land, and % of different land uses systems and where

***8.* II-LA. Land Use System (LUS) and change in land use** (Global/National with potential for Project-level analog) (See XI. For LADA SLM approach, which is project level)

Purpose: Measure land use change to help understand impacts of land degradation on ecosystem function.

Description: Land degradation can be defined as a long term loss of ecosystem functions over time as perceived by the beneficiaries. Its relation with land use is obvious as land use implicitly characterizes the way farmers and pastoralists use and manage the land and thereby inherently change it for the better and/or the worse. Knowledge of local conditions, both biophysical and socio-economic, are needed to explain and relate the land use to land degradation and vice versa. The approach is based on a Land Use Systems (LUS) classification scheme focused on both production systems and the environmental services rendered.

Source: The LADA-WOCAT approach to land use mapping begins with a transformation of the global land cover dataset (GLC-2000) [17] into major land use systems that make up the LADA-WOCAT LUS scheme. This scheme is based on the sequence and combination of operations designed to obtain goods and services from the land. Apart from land cover, major ecosystems are mainly characterized by climate and terrain and by type of soils. Attributes include land use and land use practices (dominant livestock and crop types, small-scale irrigation, and a crop index), biophysical aspects (temperature regime, length of growing period, dominant soil, and terrain), and socio-economic aspects (population density and poverty). Change in land use can be obtained from LADA-WOCAT indicator LADA-WOCAT-N: Area trend of LUS available in GLADIS.

Spatial and Temporal Refinement: The LADA-WOCAT methodology describes principles to map land use and inventory related ecosystems and more detailed crop or livestock information at a the global and national scales. The database provided includes all individual

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SLM practices are applied in intervention areas.	characteristics aggregated to a 5 arc minutes grid. The approach can also be used at the local scale. Refinements of this methodology are required when applied at more detailed scale, but the linkage with the overall global Land Use System can be maintained. This allows a more reliable extrapolation of results from local to national and from national to global scale.

Noted Strengths and Weaknesses: Land use is a sensitive indicator, with the potential to show an impact after a short intervention period of 2-3 years. This indicator is one of the most important factors influences land degradation, however it is difficult to evaluate the influence of land use change on land degradation (and land use change does not necessarily lead to land degradation). This indicator works within the overall set in that it requires land cover for its derivation, and it in turn contributes to measuring carbon stocks/sequestration. The LADA-WOCAT approach provides a national level indicator of land use that is spatial explicit. The methodology can be adjusted to be applied at the project level, allowing for scalar integration. The approach is being applied in current LADA-WOCAT countries, and there are plans to use it as LADA-WOCAT expands. However, both methods are dependent on the quality of land cover mapping, and the initial costs and workload for setting up land cover maps are high when compared with the assessment of other indicators. At the local level, the subsequent construction of a LUS and SLM map can be demanding of local expertise and knowledge. It is participatory, which engages stakeholders, but also requires strong organizational capacity. Getting data on land use change at the national or global levels is challenging. Initial costs are high, but once a base map is obtained, updates are less demanding. Both the LADA-WOCAT and KM-Land approaches provide an option for project-level assessment that can be scaled up. National scale up could be made feasible with this indicator, because it is spatial and intervention specific, if methods and maps have some common standards employed across interventions.

UNCCD Core indicator S-2:
Increase in the proportion of households living above the poverty line in affected areas.

Current UNCCD indicator name:
III. Proportion of the population in affected areas living above the poverty line

***9.* III-KM. Rural Poverty Rate** (Global/National) (though a different name, this is identical to UNCCD III)

Note: LADA-WOCAT has a number of indicators which could be used as a proxy for this core indicator, however since the UNCCD population/poverty indicator (which is identical in all but name to the KM:Land poverty indicator) has been approved, the LADA-WOCAT indicators are not included in this assessment.

Purpose: The rural poverty rate measures the percent of the population in rural areas living in poverty. Individuals whose consumption (or income, when consumption is unavailable) falls below the rural poverty line are considered poor.

Description: The rural poverty rate is the percentage of the rural population living below the national rural poverty line. The poverty rate is part of a suite of decomposable poverty measures referred to as the Foster, Greer, and Thorbecke (FGT) Poverty Measures, 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.

Source: National level rural poverty rates, based on national poverty lines, are in the public domain. For selected countries data are also available at the sub-national level [18]. The total population above/below the national poverty line is one of the MDG indicators [13].

Spatial and Temporal Refinement: National-level statistic, with data available for 73 countries are available from the MDG database, from 1990-2004 (approximately 2 data points per country). For selected countries data are also available at the sub-national level. In its current form, it is a non-comparable indicator based on national poverty line. However, there is an indicator in development that is comparable based on international poverty line, which, as of 2005, was set at $1.25 a day.

Noted Strengths and Weaknesses: The total population above/below the national poverty line is an MDG indicator, is freely available and has a long time series. Because the national poverty lines vary, it is currently non-comparable, though an alternative indicator based on the international poverty line is in development. Although the poverty rate is one of the most widely used indicators of poverty, it does not provide any details on how poor (i.e., how far below the poverty threshold) the poor are. The income level does not take into account the multidimensional nature of poverty; it is therefore of limited value if it is used alone. This indicator may be insensitive to DLDD mitigation because it is linked to other human well-being indicators such as net migration rate, adult literacy rate, proportion of chronic undernourished children under the age of 5 in rural areas, and maternal mortality ratio. This linkage makes the relationship between the combat of desertification and the effect of economic policies aimed at decreasing poverty difficult to determine [19].

UNCCD Core indicator S-3:
Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.

Current UNCCD indicator name:
IV. Childhood malnutrition and/or food consumption/ calorie intake per capita in affected areas

***10.* IV-KM. Proportion of chronically undernourished children under the age of 5 in rural areas** (National with some Local-level potential)

Note: There is no comparable LADA indicator.

Purpose: Measure long-term nutritional imbalance and malnutrition, as well as current under-nutrition within DLDD intervention areas.

Description: Prevalence of (moderately and severely) underweight children is defined as the percentage of children aged 0-59 months whose weights for age are less than two standard deviations below the median weight for age of the international reference population.

Source: Proportion of chronically undernourished children under 5 in rural areas is one of the indicators used within the MDG indicators. The data can be obtained through national data compiled by WHO [20], UNICEF [21] and MDG [13] indicators. The national datasets are based on the following method of computation: the weights of children under five years of age are compared with the weights given in the WHO / U.S. National Center for Health Statistics standard reference population for each age group. The percentage of children whose weights are up to two standard deviations below the median weight-for-age are then aggregated to form the total percentage of children under the age of five who are underweight.

Spatial and Temporal Refinement: National statistic, however this indicator can be calculated at the local level, allowing for cross-scale assessment [22].

Noted Strengths and Weaknesses: This is an MDG indicator, which has increased efforts to collect, publish and analyze associated statistics. National data is available in most developing countries, however, in most countries not on annual basis. Additional data is therefore needed. Each country undertakes household surveys at different intervals, which typically take place every 3-5 years. This indicator can be sensitive to short-term changes in food supply. Although income level is the most commonly used poverty indicator, a nutrition-based measure is a more appropriate measure of rural poverty it takes into account the multidimensional nature of poverty. This indicator does not have to be adjusted for inflation and would not be affected by any gaps or distortions in price data. Though it is possible to assess this locally, the process can be demanding and complex, especially if based on household surveys conducted through projects. This indicator may be insensitive to DLDD, as there are other causes of childhood malnutrition.

Current UNCCD indicator name:
V. The Human Development Index (HDI) as defined by UNDP

***11.* V-KM. Maternal mortality ratio (or rate) (MMR)**
(National with some Local-level potential)

Note: The KM:Land indicator that is most similar to HDI is “Rural Poverty Rate,” which is listed and described in III-KM. as it addresses a different UNCCD core indicator objective. KM:Land proposed MMR as a second human well-being indicator.

Purpose: MMR is a proxy indicator that demonstrates that DLDD interventions contribute equally to improvement of

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human well-being in both women and men.

Description: Maternal health refers to the health of women during pregnancy, childbirth and the postpartum period. Maternal mortality is given through the ratio of maternal mortality per 100,000 live births. MMR estimates the proportion of pregnant women who die from causes related to or aggravated by pregnancy or its management. It measures the health of women during pregnancy, childbirth and the postpartum period. The MMR is expressed as follows:

[Maternal deaths (direct and indirect) x K] / Live births, for a specified year, where K = 1,000 or 10,000 or 100,000.

Source: Improved maternal health is an MDG goal, where MMR is one of the main indicators. National data is available in most developing countries; however, in most countries it is not available on annual basis. Additional data is therefore needed from clinics, hospitals, medical service centers, etc. and household surveys through projects. Data on maternal mortality and other relevant variables are obtained through databases maintained by MDG [13], WHO [20], and UNICEF [21]. Data available from countries vary in terms of the source and methods. Primary sources of data include vital registration systems, household surveys (direct and indirect methods), reproductive age mortality studies, disease surveillance or sample registration systems, special studies on maternal mortality, and national population censuses.

Spatial and Temporal Refinement: MMR is a national, annually collected statistic from some countries, but others report less regularly. Adjusted MMR estimates are calculated every 5 years and published a year or two after the reference year to allow time for data compilation and analysis. Both the adjusted estimates from interagency work, as well as the unadjusted estimates reported by governments, are published annually by UNICEF [23,24].

Noted Strengths and Weaknesses: Maternal mortality is difficult to measure, and a large sample size is required to address variability. Vital registration and health information systems in most developing countries are weak, and thus, cannot provide an accurate assessment of maternal mortality. Even estimates derived from complete vital registration systems, such as those in developed countries; suffer from misclassification and under-reporting of maternal deaths. Because reporting of some countries is less frequent (or regular) than annual reporting, pursing this approach would require data extrapolation and or supplement by additional data from clinics, hospitals, medical service centers, etc., as well as household surveys through projects. Such local assessment is challenging and resource intensive. This indicator may not be suitable for assessing trends over time or for making comparisons between countries.

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UNCCD Core indicator S-4:
Reduction in the total area affected by desertification/land degradation and drought

Current UNCCD indicator name:
VI. Level of land degradation (including salinization, water and wind erosion, etc.)

Note: KM:Land does not have a direct proxy for this indicator. They recommend an analysis of two other indicators, Land cover (IX-KM.) and Land use (II-KM.).

***12.* VI-LA-a. Level of land degradation (via ecosystem-services provision capacity)** (National, Global)

Purpose: Measure level and trends in the change in capacity of the land to provide ecosystem goods and services over a period of time for its beneficiaries.

Description: Land degradation has been defined by LADA as the reduction in the capacity of the land to provide ecosystem goods and services over a period of time for its beneficiaries [12]. Ecosystem goods refer to

***13.* VI-LA-b. Level of land degradation** (Project level scaled up to National)

Purpose: Measure the state of primary soil, vegetation and water degradation.

Description: A second LADA solution for a “level of land degradation” indicator for UNCCD is to combine soil, vegetation, and water degradation assessments [6]. Soil degradation often impacts directly on provisioning and

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absolute quantities of land produce having an economic or social value for human beings. They include animal and vegetal production, land availability and water quality and quantity. A decline in ecosystem services corresponds with a change in state of these services due to pressures and resulting in various degradation processes. This suggests an approach to assessing the level of land degradation could involve the integration of six parameters (biomass, soil health, water quantity, biodiversity, economic and social services) to describe the status of any ecosystem service in a semi-quantitative way. To visualize the status and/or changes in any of these parameters (also termed axes), LADA uses a radar/spider diagram to visualize the strength and weaknesses of all six in combination for a given ecosystem to provide goods and services.

The value of each axis in the radar/spider diagram is determined according to parameters and indicators derived from global databases. These parameters can be displayed for each location in the world by clicking on a single pixel of the on-line map. Also, averages can be displayed for wider areas by land use system in a country or for the whole country. This allows an easy and quick comparison between different areas, by point, country or land use, for any point on earth.

Three aggregated indexes are also calculated. These are obtained by addition of the values (or the constraint classes) of each axis and divided by the maximum rating.

--The Ecosystem Services Status Index (ESSI) considers the biophysical status of biomass, soil health, water quantity, biodiversity and socio-economics. ESSI describes the actual state of the ecosystem to provide goods and services. The index is calculated by combining the 4 biophysical status axes and the 2 socio-economic ones in a single rating.

--The Land Degradation Index (LDI) considers the combined trend of all six axes including the social and economic ones. LDI describes the overall processes of declining ecosystem services by considering the combined value of each process axis in the radar trend diagram. LDI is rated on a reduced scale where 0- 50 indicates degradation and values more than 50 improvements.

--The Land Degradation Impact Index (LDII) considers that land degradation has not the same effect when it occurs in industrial relatively rich countries as compared to its effect in a poor rural society. It weighs the land degradation index according to the poverty levels and population density. To calculate LDII, poverty levels and the population class are multiplied by LDI.

other key ecosystem services. A good understanding of the condition of the soil (state) the change dynamics and the processes involved is thus required. Vegetation degradation is an important aspect of land degradation although more attention has been paid in the past to soil degradation and water shortage. Water resources, their management and degradation will be important land resource components in most dryland assessment sites. More detail is provided here on the soil and vegetation degradation assessment processes. The overall sampling strategy for a LADA assessment is described at the top of this table. The water degradation assessment is described in I.la. above. The approach includes assessment of soil biological (e.g., organic matter), chemical (nutrient or pH imbalance, salinisation etc.), physical (crusting, compaction etc.) and hydrological (e.g. water logging, aridification) properties, as well as water and wind erosion.

The LADA project-level field methodology involves visual indicators of soil properties (e.g., soil depth, texture, structure, surface crusts, colour, earthworms and other biota, roots) and erosion (e.g., root exposure, tree mounds, armour layer, barrier build up, soil depth change). Indicators for assessing vegetation degradation include:

– Reduced vegetation cover (plant and litter)

– Changes in vegetation structure and plant community composition

– Decline in species and habitat diversity

– Changes in abundance of indicator species (e.g. of high or low pasture quality or poor soil quality and invasive species).

– Reduced productivity.

Data come from key respondent interviews and focus groups, visual and imagery assessment of vegetation status and condition.

These methods are well-documented in the LADA Field Manual [4,5] and have been tested in LADA countries with success at both the project level and scaling up to a national, spatially explicit assessment.

Level of land degradation is the most complex (and the most basic and important) project-level indicator for LADA-WOCAT. Potentially, several LADA-WOCAT indicators (in principle all QM State indicators) could contribute to define it. The most relevant ones could be analyzed in order to create a “level of land degradation” index.

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In this LADA approach, the indicators used are relatively few. An effort has been made to focus on the most relevant ones and where possible to use geo-referenced indicators and therefore obtain an idea of the sub-national situation and effect, easier for the biophysical indicators (except for the water resources). However, it is difficult at this small scale level to go much beyond country statistics on the social and some specific economic parameters. Indicators that are used are quantitative or semi-quantitative. The former are those for which hard data exist, such as the greenness decline in vegetation, while the latter are secondary information derived through empirical algorithms, such as the Universal Soil Loss Equation (USLE) for the anticipated soil loss rates, or expert-based relationships such as the salinization effect in irrigated areas.	LADA-WOCAT-N: Wg Gully erosion / gullying; LADA-WOCAT-N: Wt Loss of topsoil / surface erosion (by water); LADA-WOCAT-N: Ed Deflation and deposition; LADA-WOCAT-N: Et Loss of topsoil; (by wind) LADA-WOCAT-N: Ca Acidification; LADA-WOCAT-N: Cn Fertility decline and reduced organic matter content; LADA-WOCAT-N: Cp Soil pollution; LADA-WOCAT-N: Cs Salinisation / alkalinisation; LADA-WOCAT-N: Pc Compaction; LADA-WOCAT-N: Pk Sealing and crusting; LADA-WOCAT-N: Hg Change in groundwater / aquifer LADA-WOCAT-N: Hp Decline of surface water quality; LADA-WOCAT-N: Hq Decline of groundwater quality; LADA-WOCAT-N: Hs Change in quantity of surface water; LADA-WOCAT-N: Bc Reduction of vegetation cover; LADA-WOCAT-N: Bh Loss of habitats; LADA-WOCAT-N: Bq Quantity / biomass decline; LADA-WOCAT-N: Bs Quality and species composition / diversity decline. An important feature of LADA-WOCAT pressure indicators (termed “QM” indicators because they are obtained, in part, from a questionnaire for mapping) are recorded as causal attributes in relation to state factors. For example, an area of land may be recorded as 15% degraded (the state factor), and the QM survey may reveal an underlying cause associated with poverty. This permits a clear link between pressure and state indicators.
Source: GLADIS inventories changes in ecosystem goods and services by land use system in each country. GLADIS outputs are a series of global maps on the status and trends of the main ecosystem services that can be queried and downloaded. These are supplemented by a larger range of maps and databases that document the input data used to determine individual axis parameters. Ancillary maps such as a global land use systems map with attributes are also included. These can be accessed in a beta version of the GLADIS database [11].	*Source:* At national and sub-national level, tools are available in LADA-WOCAT including QM and LUS. In addition, GLADIS provides information at sub-national level both on degradation processes and on degraded status of the land. Most general types of land degradation are covered (soil erosion by water, salinization, compaction, nutrient decline, pollution, water, biomass and biodiversity decline).
Spatial and Temporal Refinement:	*Spatial and Temporal Refinement:*
LADA, through GLADIS, provides a global assessment of land degradation at:	Mapping units for LADA-WOCAT products are associated with "land units" which are areas of land

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of land degradation at:

• per pixel on the map, at 5 ArcMin resolution

• per global Land Use System units, subdivided by country. (Note that at national level, LADA evaluates land degradation similarly in national Land Use Systems per province or district).

• per country, by averaging all pixels belonging to the country

Noted Strengths and Weaknesses: Measurement of the level of land degradation has direct relevance to UNCDD mission, and it is also very challenging to measure. The LADA approach of measuring level of land degradation from the perspective of the capacity of an ecosystem to provide services links the human and environmental aspects of DLDD. The underlying parameters and calculated indexes have been generated for LADA countries, offering a spatially explicit means to assess land degradation for each country. Like all efforts to assess land degradation in a comprehensive manner, this approach is limited by the quality and frequency of data inputs. The effort to limit the number of input parameters makes the approach more feasible for participating countries. However, this approach might be considered an assessment (rather than an indicator). Moreover, there is risk that this approach could confuse cause and effect.

defined in terms of biophysical qualities and other landscape characteristics that may be demarcated on a map. They are the basis for the survey that produces the data for LADA-WOCAT indicators, which are then quantified (as an average) over each mapping unit. The resolution of spatially explicit, national level maps therefore varies from country to country, based on the landscape variation that exists and the intensity of sampling possible. However, the resolution is high enough for sub-national analysis. The frequency of LADA-WOCAT surveys has yet to be determined, but it is likely not to be more frequent than 5-10 years.

Noted Strengths and Weaknesses: Measurement of the level of land degradation has direct relevance to UNCDD mission, and it is also very challenging to measure. The LADA-WOCAT field assessment methodology has been under development and testing in a variety of dryland environments across the globe, and there are plans to expand this significantly. The most important aspect of that assessment is directly correlated with desertification and land degradation. However, this strength brings with it some challenges. The focus of LADA-WOCAT is on drylands, while the UNCCD is also responsible for assessing impacts beyond the boundaries of drylands, particularly in this period of rising temperatures and associated environmental change. In addition, land degradation assessment is complex and the most resource intensive aspect of the LADA-WOCAT process. Although LADA's current primary focus is on drylands, its tools have the potential to be used in any other systems with amendments. LADA-WOCAT has made considerable progress in addressing local to national scalar issues in the assessment methodology. The frequency of reassessment has not been determined, but 5-10 years is a reasonable estimate. Particularly considering the expert assessment (with many not easily trained qualitative methods), it is not clear that this approach could be considered repeatable, or comparable across sites. This approach might be considered an assessment (rather than an indicator). Moreover, there is risk that this approach could confuse cause and effect.

UNCCD Core indicator S-5: Increases in net primary productivity in affected areas.

Current UNCCD indicator name:
VII. Plant and animal biodiversity

Note: LADA assesses biodiversity globally, but indirectly through a land use proxy. LADA field methods mention the need to assess biodiversity degradation/improvement, but this is not a required part of the overall assessment (see page 99 LADA Field Manual Tool Box). Therefore, LADA biodiversity indicators are not described here.

However, the CBD does provide an indicator which has been approved that may meet UNCCD needs. It is

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described here.

14. VII-KM. Crop and livestock diversity (agro-biodiversity) (Global/National)

Purpose: The purpose of this indicator is to demonstrate the impact of DLDD interventions in terms of maintaining or enhancing the diversity of crops and livestock in agricultural systems within an intervention area. Crop diversity provides the source of the world's food and fibre production, including the basis for crop and livestock genetic resources. Therefore, a monitoring and assessment of the development of agricultural diversity is of high importance for ensuring food security.

The impacts of climate change on agricultural land (including water availability) can be managed through a diversification of crops and animal species in order to enhance agro-ecosystem resilience and risk mitigation, among others.

Description: Agrobiodiversity is the variance in both crop and livestock diversity, including species and varieties. Crop diversity is the variance in genetic and phenotypic characteristics of plants used in agriculture, while livestock diversity is the number of livestock species used in the village territory and relative share in area or number of animals and plant species and varieties. The development of indicators for the genetic component of diversity is essential to obtain a clear picture of the current status of the extent and maintenance of native diversity in agricultural production systems. The following measurable indicators are recommended to be used for the assessment of crop and livestock diversity:

- Number of crop and animal species in agricultural use

- Share of main/key crop and animal varieties

- (Optional: Number and share of crop and animal varieties that are endangered per area)

The total number and share of main crop varieties are the indicators recommended for further consideration by the Convention on Biological Diversity (CBD) in relation to agricultural crop diversity.

Source: The assessment is based on the availability of national data, and needs to be broken down to the project level through one of the following methods:

- Agricultural statistics: Annual agricultural statistics for

15. VII-CBD. Trends in abundance and distribution of selected species (Global/National)

Purpose: measure trends in the abundance and distribution of indicative species to gage impacts on biodiversity, and in so doing, ecosystem services which the human race depends on for a multitude of purposes including provision of food, medicine and basic materials.

Description: This Convention on Biological Diversity (CBD) [25] indicator is made up of two indexes, the Living Planet Index (LPI) [26], and the Global Wild Bird Index (WBI) [27]. The description below is taken from the Biodiversity Indicators Partnership website on the CBD indicators [28].

The Living Planet Index (LPI) is an indicator of the state of global biological diversity, based on trends in vertebrate populations of species from around the world. It is calculated using time-series data on more than 7000 populations of over 2,300 species of mammal, bird, reptile, amphibian and fish from all around the globe. The changes in the population of each species are aggregated and shown as an index relative to 1970, which is given a value of 1. The LPI can be thought of as a biological analogue of a stock market index that tracks the value of a set of stocks and shares traded on an exchange. The results of the LPI are published biennially in the Living Planet Report.

The Global Wild Bird Index (WBI) aims to measure population trends of a representative suite of wild birds, to act as a barometer of the general health of the environment and how it is changing. The WBI measures biodiversity change in a similar fashion to the Living Planet Index, the main difference is that the WBI only incorporates trend data from formally designed breeding bird surveys to deliver scientifically robust and representative indicators.

Source: LPI data are collected by WWF [26] and maintained in the Living Planet Database (LPD) by Zoological Society of London (ZSL). WBI data are collected by BirdLife International and the Royal Society for the Protection of Birds (RSPB) [27]

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cropland

- Household surveys: Diversification of farm production, number of crop varieties, etc.

- Local Markets: number of crop varieties and shares sold at local markets

Some these data are available through FAOSTAT [29], which provides time-series and cross sectional data relating to food and agriculture for some 200 countries. The national version of FAOSTAT, CountrySTAT, is being developed and implemented in a number of target countries, primarily in sub-saharan Africa.

Spatial and Temporal Refinement: National data exist, but sub-national assessment would not be possible unless projects obtained locally specific data which was then scaled up.

Noted Strengths and Weaknesses: Crop and livestock diversity are related to net primary productivity and food security. This indicator does not address biodiversity outside of agricultural systems. The number of crop varieties might be especially difficult to assess because available national data might not be accurate. Data which are not available from FAO or country databases would have to be obtained by projects through household surveys and local market analyses.

for the Protection of Birds (RSPB) [27].

Spatial and Temporal Refinement: Though both networks aspire to be global, monitoring currently is patchy. The LPI is not only a global index but can also be calculated for selected regions, nations, biomes or taxonomic groups, provided that there are sufficient data available. WBI data are generated at the local level and are thus scalable and can be aggregated or disaggregated at the global, regional and national (sub- national) level. WBIs can also be disaggregated by the habitat or guild a bird occurs in, or by aspects of species' ecology, in order to aid interpretation. WBIs are particularly suited to tracking trends in the condition of habitats. The requirement for robust data, however, means that data coverage is currently patchy and the WBI is not presently applicable at a global scale.

Noted Strengths and Weaknesses: Biodiversity is an essential service required for the survival of

ecosystems in general. This is a CBD indicator and offers an excellent opportunity for direct collaboration between the two conventions. The indexes used to generate this indicator are not yet ideal for DLDD needs, but are moving in the right direction. Ideally, trends in diversity of selected species would cover all regions and species types evenly. However, this indicator is currently limited to vertebrate species, and of particular concern is the lack of vascular plant data. For LPI the LPD will ultimately provide greater coverage of species from underrepresented taxonomic groups and regions. ZSL and WWF have recently begun forming partnerships to develop LPIs for invertebrates and plants.

Current UNCCD indicator name:
VIII. The aridity index

***16.* VIII-KM. Trends in seasonal precipitation**
(National with Local-level potential)

Purpose: To measure rainfall water availability in project areas (or regional average) subject to drought.

Description: Lack of precipitation, irregular rainfall distribution, non-seasonal rains, etc. are the main climatic factors contributing to land degradation and

***17.* VIII-LA. Aridity trend and rainfall variability**
(Local-level scaled up to national)

Purpose: To measure changes in water balance and reliability of rainfall as driving forces of DLDD.

Description: The availability of water and the reliability of rainfall represent driving climatic forces that can result in increased pressure on resources in affected DLDD

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affecting agricultural productivity. Assessing their seasonal trends can provide vital information on this climatic driving force. Trends can be generated from the national average (if possible, project area) of monthly station rainfall, weighted by the long-term station rainfall average. Ideally this would be based on 30 years of mean monthly rainfall (for near stations/gridded). Preferred measurement units would be departure from average in standard deviations.	areas. LADA collects two indicators which could be used to capture this: LADA-G: Aridity trend LADA-G: Rainfall trend LADA defines these indicators as follows [30]: The aridity index is defined as the ratio between mean annual precipitation (P) and mean annual evapotranspiration: (ETP) $I_a = P_a / ET_o$, where ET_0: is the reference evapotranspiration in the period assessed. In the LADA approach, information for calculating the indicator is collected at local level (meteorological stations). At local level it may be possible to detect a trend (towards more aridity or less aridity) if a sufficiently long time series is available but such a trend may only be validated if more stations point into the same direction and this needs to be done by compilation at national level and beyond. The same is true for Rainfall variability. This indicator, instead of using the mere standard deviation of annual rainfall, is calculated by dividing the standard deviation of annual rainfall by the average annual rainfall (coefficient of variation); it expresses the standard deviation of annual totals as a percentage of average annual rainfall; the higher the coefficient, the more variable the rainfall is from year to year. The advantage is that the coefficient of variation allows one to compare the variability of rainfall at any location, regardless of mean precipitation. Both indicators may be linked to agro-ecological zones through stratification.
Source: In order for this contextual indicator to be relevant, it will be necessary to obtain mean monthly rainfall statistics (from national statistics, and for local interventions, from stations situated in the area) based on a series spanning at least a 30-year period. This long period is necessary for providing an indication of the trend/development of the rainfall pattern in the area. Measurements will be based on data obtained from meteorological/climate services, possibly complemented with remote sensing data.	*Source:* GLADIS provides the trends of the aridity index and rainfall trends for various periods and the statistical significance levels of these trends. The data are obtained at the project-level, through national and local databases. Data access could potentially be enhanced, in part, by supplementing the dataset from a global repository [31].
Spatial and Temporal Refinement: National statistics with the potential to be spatially interpolated for sub-national analysis. Temporal resolution involves 30 years of monthly averages.	*Spatial and Temporal Refinement:* Local-level and national data records obtained from national databases where available, for stations in affected areas (monthly data, ideally with 30 years of data for trend calculations).
Noted Strengths and Weaknesses: This indicator is a direct measure of one of the climatic driving forces related to DLDD. It is intuitively easy to understand. It is closely related to other social, economic, and environmental measures important to dryland areas (i.e., population growth rate, net migration rate, human and economic loss due to natural disasters, gross domestic product per capita,	*Noted Strengths and Weaknesses:* When assessed as trends, these are indicators of climatic driving forces related to DLDD. (They are not impact indicators, however in order to assess impacts, the context provided through information on driving forces is essential.). Their sensitivity depends strongly on the spatial density and the temporal resolution of existing meteorological stations.

groundwater reserves, land use change, land affected by desertification, and arable land per capita). Data quality and the capacity to spatially interpolate can be issues.

Current UNCCD indicator name:
IX. Land cover status

18. **IX-KM. Land cover** (Global/National)

Purpose: To measure current land cover, and especially the distribution of land cover types of greatest concern for land degradation (cropland, rangeland, etc.).

Description: This indicator shows the distribution 23 of the world's major land cover categories, as classified by the European Commission Joint Research Centre (JRC) Global Land Cover 2000 (GLC-2000) product [17]. According to the JRC, who led the effort, "the general objective was to provide for the year 2000 a harmonized land cover database over the whole globe. The year 2000 is considered as a reference year for environmental assessment in relation to various activities, in particular the United Nation's Ecosystem-related International Conventions. To achieve this objective GLC 2000 makes use of the VEGA 2000 dataset: a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite, made available through a sponsorship from members of the VEGETATION programme, including JRC."

Unlike previous global land cover mapping initiatives, creation of GLC-2000 was participatory, involving the partnership of some 30 institutions across the globe, each with a team of regional experts who classified and mapped each region independently, assuring regional appropriateness. The regionally defined classes were then aggregated into a thematically simpler global legend through the FAO's Land Cover Classification System (LCCS). LCCS that is capable of cross-referencing regional differences in land cover descriptions [32]. The GLC 2000 data were included as a core data set in the Millennium Ecosystem Assessment (MA).

Source: JRC's GLC2000 webiste [17].

Availability of complete series of temporal data at national level, lack of homogeneity in data series are challenges.

19. **IX-KM&LA. Land productivity** (Global/National)

Purpose: To identify regions with declining greenness as an early warning of possible land degradation in a particular area.

Description: The International Soil Resources Information Centre (ISRIC), under a subcontract with FAO LADA, has constructed a measure of greenness trend using the Global Inventory Modeling and Mapping Studies (GIMMS) normalized difference vegetation index (NDVI) time series (1981 to 2006) assembled by the University of Maryland. Where greenness is limited by rainfall, the index is adjusted for rainfall variability using rain-use efficiency (RUE), the ratio of NDVI to rainfall. First, correlation between annual rainfall and NDVI is calculated, pixel-by-pixel. For those pixels that show positive correlation, station-observed rainfall is used to create a rainfall surface, and annual integrated NDVI values for a given grid cell are divided by the rainfall amounts for the corresponding time-unit. Where RUE is positive, it is assumed that the greenness decline is caused by a declining trend of rainfall and those areas are screened from the other areas of declining greenness. The remaining areas of declining greenness are expressed in terms of NPP to provide a single, tangible indicator: long-term trend of declining productivity which may be summed up as loss of NPP in tones C/ha. The unit of measurement of the final product is sum NDVI, translated into absolute change in net primary productivity.

Source: All required data sets are already available from the Global Assessment of Land Degradation and (GLADA) [33]. GLADA used annual sums of NDVI from the GIMMS 16-day maximum at 8km resolution. From this it is possible to create a five year moving average (i.e. the 2005 average represents an average of the NDVI for the years 2003-2007). The Global Inventory Modeling and Mapping Studies (GIMMS) [34] data set is a normalized difference vegetation index (NDVI) derived from imagery obtained from the Advanced Very High Resolution Radiometer (AVHRR) sensor onboard National Oceanic and Atmospheric Administration (NOAA) satellites. The GIMMS dataset was corrected for

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	distortions due to instrument calibration, view geometry, volcanic aerosols, and other effects unrelated to vegetation change (University of Maryland, undated). GIMMS is available globally for a 26-year period from 1981 to 2006 and is also updated annually. Harmonic Analysis of NDVI Time Series (HANTS) algorithm has been applied in the GIMMS dataset to remove cloud interference and to eliminate the influence of phenological shift between the northern and southern hemispheres. The rainfall-adjusted greenness indicator uses the greenness trends derived from the GIMMS dataset. It takes the ratio of ΣNDVI values and sum of annual rainfall values from a global repository.
Spatial and Temporal Refinement: GLC2000 is a 1km dataset for the year 2000. Change in land cover analysis will soon be possible, because the European Space Agency (ESA), through the GlobCover initiative, is generating global land cover map for the year 2005/2006 [35] using ENVISAT MERIS Fine Resolution (300m) data. It is being designed to be compatible with GLC2000, and a thematic legend compatible with LCCS.	*Spatial and Temporal Refinement:* The spatial resolution of the resulting product is 8km. Time series are possible, for these date ranges: 2000-2007, 1981-2002; 1981-2006.
Noted Strengths and Weaknesses: The GLC2000 is global land cover product that is regionally appropriate that has been validated, and shown to be reasonably accurate (as far as land cover classifications go, the overall accuracy of 68.6% is good for a global product) [36]. That accuracy, however, suggests that sub-national use should be accompanied by higher resolution land cover products, including ground verification. Presently there are no globally comparable time series land cover data sets, but with GlobCover under development, the potential for land cover change analysis is possible. The cost of producing maps of this kind is substantial, but these GLC2000 (and GlobCover) products are (and will be) freely available.	*Noted Strengths and Weaknesses:* The parameters used to create this indicator cannot be used to definitively conclude that land degradation has taken place, but they can help to identify areas that require more fine-scaled investigation. Although the rainfall-adjusted greenness trend controls to some extent for the impact of rainfall variability, the global indicator is unable to fully distinguish between changes in NDVI resulting from land use change and those resulting from land degradation as ordinarily understood. This can only be assessed by following time series data for individual pixels, preferably at a higher resolution than the 8km GIMMS data. Another weakness is the paucity of rainfall measurement stations in some regions. Any rainfall surface derived from widely-spaced observations will not capture fine-scale variability. Nevertheless, this indicator can signal areas that require closer investigation and, as such, provides an early warning for land degradation. Beyond the trend measures, it is possible to generate state measures of current greenness (in a 5-yr moving average) for the most recent years for which NDVI data are available from MODIS or AVHRR.

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UNCCD Core indicator S-6: Increases in carbon stocks (soil and plant biomass) in affected areas.

Current UNCCD indicator name:
X. Carbon stocks above and below ground

***20.* X-LA. Above and below ground organic carbon stocks** (Global/National)

Purpose: To estimate above and below ground organic carbon as an indirect measure of desertification control success and global significance in responding to climate change.

Description: At the global/national scale, LADA-WOCAT GLADIS and GLADA have developed two indicators to track organic carbon stocks: organic carbon above ground, defined as the status of above ground biomass as a function of land cover in Tons of C /ha, and organic carbon below ground, defined as topsoil and subsoil organic carbon in T/ha. Elaborated by ISRIC [37]. GLADA uses total biomass as an indicator for above-ground organic carbon accumulation (environmental service), based on GIMMS measurements of NDVI (see IX-LA.) Trend analysis is conducted from 1981 to 2006. Topsoil and subsoil organic carbon is also estimated, based on soil type, using the Harmonized World Soil Database (HWSD) [38].

Source: GLADIS stores both above and below ground carbon data from this analysis. For above-ground organic carbon, both trends and status are available. For the subsoil only the status is available.

Spatial and Temporal Refinement: Resolution 5 arc minutes. Using this approach it is possible to assess organic carbon losses/gains per year.

Noted Strengths and Weaknesses: The proposed datasets are available, however the resolution is coarse and accuracy/validation from this indirect method is an issue. The time series of above ground estimates permits trend analysis, however the below ground data are collected over a number of years and are not good basis for monitoring.

Note: A number of methods are now available for converting ground and remote sensing-based measurement into carbon stocks through allometric relationships that should be considered for this indicator [39]. Moreover, the UNFCCC recently released their Essential Climate Variables (ECV) list [40,41] which includes above ground biomass and soil carbon, and thus further development of this indicator could be pursued collaboratively. In addition, GEF and UNEP launched (May 2009) a new focal area called “Carbon Benefits Project” (CBP) [42]. CBP aims to provide a cost-effective end-to-end estimation and support system for showing carbon benefits in GEF and other natural resource management projects. Modeling will focus on estimation and forecasting of carbon stocks, flows and GHG emissions on cropland and grazing lands. Measurement & monitoring: will focus on field measurement and monitoring of carbon changes across landscapes with emphasis on agro-forestry and forestry.

UNCCD Core indicator S-7: Areas of forest, agricultural and aquaculture ecosystems under sustainable management

Current UNCCD indicator name:
XI. Land under SLM

***21.* XI-KM. [**see II-KM above] **Land use system (LUS) and Sustainable Land Management (SLM) practices** (Global/National)

Note: This indicator, under KM:Land design, is both LUS and SLM. It is described in this table under II-KM. Thus one indicator addresses two UNCCD needs.

***22.* XI-LA. Land under Sustainable Land Management (SLM)**
(Local with the potential to be scaled up to National)

Purpose: Measure the impact of SLM on minimizing, land degradation, rehabilitating degraded areas and ensuring the optimal use of land resources for the benefit of present and future generations.

Description: SLM is based on four common principles:

- land-user-driven and participatory approaches;

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- integrated use of natural resources at ecosystem and farming systems levels;

- multilevel and multistakeholder involvement; and

- targeted policy and institutional support, including development of incentive mechanisms for SLM adoption and income generation at the local level.

LADA proposes a three level approach for measuring the impact of SLM. GLADIS provides an estimate of the present land management level for agricultural cropped areas. This provides a first approximation of SLM at the national level, but would require sub-national information for further development. Second, the land use type mapping in the LADA methodology (see II-LA. above) includes a SLM classification and mapping approach. There are 25 conversation measures tracked, including the full range of agronomic, vegetative, and management measures. This approach provides the base SLM map, which is then attributed using the same approach described for observations and interviews described in I-LA-a. and I-LA-c. above. SLM is conceptually complex, and thus several local-level LADA indicators could contribute to define it. LADA-WOCAT QM, based on a participatory methodology that addresses the four common principles, provides two different kinds of input related to sustainable land management.

Primarily, the WOCAT response indicators (LADA-WOCAT-N: Extent and trends of Land Conservation; LADA-WOCAT-N: Effectiveness of Land Conservation) can contribute directly by estimating the extent and effectiveness of conservation practices.

Well managed land can also be described as where anthropic pressure is limited or "sustainable." Thus, indirect measures may be useful on impacted landscapes. Relevant LADA-WOCAT indicators would be: (LADA-WOCAT-N: c Crop management; LADA-WOCAT-N: e Over-exploitation of vegetation for domestic use; LADA-WOCAT-N: f Deforestation and removal of natural vegetation; LADA-WOCAT-N: g Overgrazing; LADA-WOCAT-N: o Over-abstraction / excessive withdrawal of water; LADA-WOCAT-N: s Soil management; LADA-WOCAT-N: w Disturbance of the water cycle) A combination of these indicators may better match the UNCCD requirement.

Source: GLADIS, LADA-WOCAT QM, and WOCAT databases, combined with LADA field methods as described in I-LA-c. above.

Spatial and Temporal Refinement: Project-level, and thus resolution dependent on local assessment implementation. See general note on LADA methods at the top of this table.

Noted Strengths and Weaknesses: DLDD happens locally, so capturing sub-national variation is essential. However, scaling up from projects alone may not be spatially representative. SLM is difficult to assess, and while LADA collects the aforementioned indicators, further development on integrating them will be necessary.

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Annex IV

Initial expert evaluation of proposed UNCCD refinement metrics/proxies (14 December 2010)

Objective 1. To improve the living conditions of affected populations
Core Indicator S-1: Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought

I-KM-a. Water stress (#1)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	15	4.2 (0.9)	4	**100%** of respondents reported “yes” moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	13	2.9 (0.8)	3	**85%** of respondents reported “yes” moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	13	2.2 (1.4)	3	**54%** of respondents reported “yes” moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	14	3.6 (0.9)	3.5	**93%** of respondents reported “yes” moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	14	2.9 (1.4)	3	**64%** of respondents reported “yes” moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	14	2.4 (1.5)	2.5	**50%** of respondents reported “yes” moderately or mostly
Can policymakers easily understand the indicator?	15	3.5 (1.1)	3	**87%** of respondents reported “yes” moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
	✓				
	✓				
	✓				
		✓	✓	✓	
✓	✓	✓			✓
		✓			
	✓				
	✓				
	✓		✓	✓	
	✓				
✓	✓				

✓					
	✓				
3	**10**	**3**	**2**	**2**	**1**

I-KM-a. Water stress (#1)

Though expressed differently, "I-KM-a. Water stress" and "I-LA-a. Pressure on water resources" are the same indicator. It is understood easier when expressed as "Pressure on water resources". Even better if they (it) were named like MDG does: “Proportion of total water resources used”. General comment: Being a Pressure Indicator, it relates to many, if not all, Core (Impact) Indicators and Strategic Objectives. Don't see why it is placed here.

The indicator seems to be weak in terms of updating, hence in its capacity of identifying changes.

This response generally applies to the next three as well; most of the data at sub-national resolution is from hydrological models such as those run by UNH/WSAG (now at CUNY) or University of Kassel in Germany with very infrequent updates based on real hydrological data; thus they are not currently useful for change analysis. But I am aware that Vorosmarty is working on some change indicators that may be available in the future.

Would be good impact indicator but not if assessed at national and global level thus low rating unless assessed separately for areas with and without LD.

Issue of space scale

There is no monitoring system of amount of water taken out of rivers, streams or especially groundwater acquifers with open access to data. Determination of this indicator is extremely expensive for model's estimation, verification and updating.

The main problem is scale - current quite coarse globally, Could be refined, but this needs better meteorological networks and satellite-based rainfall measures. Relates rather indirectly to the res of the indicators in this cluster.

Water pressure is important factor, but cannot be easily assessed in national and global level.

D8: I think that it is necessary to link with other five indicator in relation with water (I-LA-A, K-KM-b, I-LA-b, I-KM-c, I. LA-c)

It is complicated to understand how we can measure the “amount of pressure put on water resources and aquatic ecosystems by users…”

If only national, even though it is an important indicator, it cannot be used for assessing Impacts of LS/SLM

Can we use models as impact indicators?

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

I-LA-a. Pressure on water resources (#2)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	4.1 (0.9)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.3 (1.0)	3	**92%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	12	2.8 (1.3)	3	**58%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	13	3.7 (0.9)	4	**92%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	3.1 (1.6)	3	**69%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	3.2 (1.2)	3	**69%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	13	3.3 (1.6)	4	**69%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

Driving Force (D)	Pressure (P)	State (S)	Impact: Ecosystem Services	Impact: Human Well-being	Response
			✓	✓	
	✓				
	✓	✓			
	✓				
	✓				
	✓				
	✓		✓	✓	
	✓				
✓	✓				
	✓				
	✓				
1	**10**	**1**	**2**	**2**	**0**

I-LA-a. Pressure on water resources (#2)

See comments on previous indicator [Though expressed differently, "I-KM-a. Water stress" and "I-LA-a. Pressure on water resources" are the same indicator. It is understood easier when expressed as "Pressure on water resources". Even better if they (it) were named like MDG does: "Proportion of total water resources used". General comment: Being an Pressure Indicator, it relates to many, if not all, Core (Impact) Indicators and Strategic Objectives. Don't see why it is placed here.]

The indicator seems to be weak in terms of updating, hence in its capacity of identifying changes, It is however based on well-recognized datasets (AQUASTAT)

This response generally applies to the next three as well; most of the data at sub-national resolution is from hydrological models such as those run by UNH/WSAG (now at CUNY) or University of Kassel in Germany with very infrequent updates based on real hydrological data; thus they are not currently useful for change analysis. But I am aware that Vorosmarty is working on some change indicators that may be available in the future.

Would be good impact indicator but not if assessed at national and global level thus low rating unless assessed separately for areas with and without LD.

The national-level resolution is problematic. It could be assessed locally, but that is a lot of work.

If the MDG use this indicator named "Proportion of total water resources used" why we have to change the name? Would be better if we use the original indicator with the original name. Because is an indicator known by all the countries.

AQUASTAT data issues raise concerns about accuracy, consistency and comparability.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

Water per capita is a strange indicator of desertification. Surely the amount of water depends on the dryland type, arid areas have less water than semiarid areas, and the amount per capita depends on number of people. Surely with more people there is less water. So how this indicates desertification? The usual answer is that "lack of water is very important in drylands". This is to say that ice is very important in Antarctica. It is true, so what?

I-KM-b. Water availability (#3)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	3.4 (1.0)	3	**85%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	2.8 (1.5)	3	**67%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	12	2.5 (1.1)	3	**67%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	13	3.6 (0.9)	4	**92%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	2.5(1.2)	2	**46%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	2.4 (1.4)	3	**62%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	13	3.4 (0.9)	3	**92%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

Driving Force (D)	**Pressure (P)**	**State (S)**	**Impact: Ecosystem Services**	**Impact: Human Well-being**	**Response**
		✓			
	✓				
		✓	✓	✓	
	✓				✓
	✓				
	✓		✓		
		✓			
	✓				
		✓			
✓	✓				
		✓			
	✓				
1	**7**	**5**	**2**	**1**	**1**

I-KM-b. Water availability (#3)

This indicator, as it is described, is measuring the same than the previous two, but at a local-up-to-national scale. Why a different name then? General comment on previous indicator also applies here.

The indicators seem to be strong in terms of acceptance. On the other hand, there are little monitoring and databases in place.

This response generally applies to the next three as well; most of the data at sub-national resolution is from hydrological models such as those run by UNH/WSAG (now at CUNY) or University of Kassel in Germany with very infrequent updates based on real hydrological data; thus they are not currently useful for change analysis. But I am aware that Vorosmarty is working on some change indicators that may be available in the future.

Good if intervention areas are compared with non-intervention (affected areas)

Obtaining data by local observation and interviews is subjective and depends strongly from local implementation.

The measure mixes a pool (groundwater) with a flux (surface water). Will be very sensitive to errors in estimates of both, which are typically large.

This indicator depends on many issues (natural and human induced), therefore it needs a complex process in order to generate it and assess it.

For this assessment the national statistics database should be used.

There is a need to compare areas with land degradation and those with interventions to see impacts.

This indicator refers to both the availability and the pressure on the resources; hence there is a lack of precision.

For water availability, I would use water availability per capita. Safe water access reflects development policy rather than desertification policy.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Drylands are where land productivity is limited by water resource. So water is a vital indicator for DLDD, and thus water availability (or a similar indicator) should be core indicator.

I-LA-b. Water availability and use (#4)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	4.0 (0.8)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.3 (1.6)	3.5	**83%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	12	2.9 (1.1)	3	**83%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	13	3.9 (0.8)	4	**100%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	2.7 (1.4)	3	**54%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	2.8 (1.1)	3	**69%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	13	3.5 (0.9)	3	**92%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
	✓	✓			
	✓				
		✓	✓	✓	
	✓		✓		
		✓	✓	✓	
	✓		✓		
	✓				
✓	✓	✓			
✓	✓		✓	✓	✓
		✓			
	✓				
2	**8**	**5**	**5**	**3**	**1**

I-LA-b. Water availability and use (#4)

Comments on previous indicator apply to this one as well. However, it seems that the intention here is to focus on trends in use instead of trends in proportion between used and available. It would be better just to use a single indicator "Proportion of total water resources used", and adapt its monitoring to each of the various scales used. [Comments from previous indicator: This indicator, as it is described, is measuring the same than the previous two, but at a local-up-to-national scale. Why a different name then? General comment on previous indicator also applies here. See comments on previous indicator [Though expressed differently, "I-KM-a. Water stress" and "I-LA-a. Pressure on water resources" are the same indicator. It is understood easier when expressed as "Pressure on water resources". Even better if they (it) were named like MDG does: "Proportion of total water resources used". General comment: Being an Pressure Indicator, it relates to many, if not all, Core (Impact) Indicators and Strategic Objectives. Don't see why it is placed here.]

This response generally applies to the next three as well; most of the data at sub-national resolution is from hydrological models such as those run by UNH/WSAG (now at CUNY) or University of Kassel in Germany with very infrequent updates based on real hydrological data; thus they are not currently useful for change analysis. But I am aware that Vorosmarty is working on some change indicators that may be available in the future.

Good if intervention areas are compared with non-intervention (affected areas)

Changes in groundwater levels and surface water volumes are not widely measured.

The problem is that this is not one indicator, but a whole swarm of things, which will be very hard to standardize and quantify in a way that can be aggregated to other scales or used comparatively.

This indicator depends on many issues (natural and human induced), therefore it needs a complex process in order to generate it and assess it.

This indicator consider the change in groundwater/aquifer level and change in quantity of surface water in the last 10 years. The analysis period for this kind of resources should be longer than 10 years. On the other hand, the use of the resources change country by country. The analysis of this indicator could be more complex than the analysis of the water availability.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

I-KM-c. Percentage of rural population with access to (safe) drinking water (#5)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	12	3.3 (1.2)	3	**75%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	10	2.7 (1.8)	2	**40%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	11	2.5 (1.4)	3	**55%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	12	3.3 (1.3)	3.5	**83%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	12	2.6 (1.4)	3	**67%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	12	2.7 (1.6)	3	**67%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	12	3.8 (1.4)	4	**92%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

Driving Force (D)	Pressure (P)	State (S)	Impact: Ecosystem Services	Impact: Human Well-being	Response
	✓	✓			
	✓				
		✓	✓	✓	
	✓		✓		
		✓	✓	✓	
	✓		✓		
		✓		✓	
	✓				
✓	✓	✓			
✓	✓	✓	✓	✓	
		✓			
2	**7**	**7**	**5**	**4**	**0**

I-KM-c. Percentage of rural population with access to (safe) drinking water (#5)

Among the water-related indicators, this type of indicator is the most closely related to Core Indicator S-1 and Objective 1, as it is an impact Indicator and focuses on human well-being (living conditions). However, as many other I-HB indicators, its changes may result from many other processes and forces in isolation or combined with desertification.

Good if intervention areas are compared with non-intervention (affected areas)

Rural population has access to uncertain volume of underground water.

The key issue here is the access to safe drinking water is most controlled by engineering and social issues, and is rather insensitive to land management.

Little information available due to lack of adequate monitoring of quality.

Conceptually the best under S-1, because it crosses bio-physical with population, question is availability of reliable data; would expect more economic and human candidate indicators under S-1

In this case we have to define which are the "project's intervention areas." Again, if already exist and indicator (proportion of the population using an improved drinking water source") why we do not use this indicator?

This indicator has potential where data are available. For example, a database exists for this indicator assessment at the Direction of Rural Water particular at the Millenium Safe Water and Sanitation Program (PEPAM) and other projects and programs.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

I.LA-c. Access to improved drinking water based on change in water quality (#6)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	3.6 (1.1)	4	**92%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.0 (1.8)	3	**58%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	12	2.6 (1.7)	2.5	**50%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	12	3.1 (1.2)	3	**58%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	2.0 (0.9)	2	**100%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	1.3 (0.9)	1	**8%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	12	3.8 (1.4)	4	**92%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

Driving Force (D)	Pressure (P)	State (S)	Impact: Ecosystem Services	Impact: Human Well-being	Response
				✓	
		✓	✓	✓	
		✓			
				✓	
			✓		
✓		✓		✓	
	✓				
		✓		✓	
				✓	✓
		✓			
				✓	
1	**1**	**5**	**2**	**7**	**1**

I.LA-c. Access to improved drinking water based on change in water quality (#6)

See comments on previous indicator. Also, why "improved"? Should be "Access to safe drinking water". Proposed monitoring overlaps with I-LA-b. How the monitoring variables are used to assess pressures and impacts at the same time should be clarified. [Comments from previous indicator - Among the water-related indicators, this type of indicator is the most closely related to Core Indicator S-1 and Objective 1, as it is an impact Indicator and focuses on human well-being (living conditions). However, as many other I-HB indicators, its changes may result from many other processes and forces in isolation or combined with desertification.]

Lack of data and monitoring are the main constraints for this indicator.

up-to-date comparable data difficult to obtain; monitoring networks are sparse; we've done work with GEMS to create indicators, but it has proven difficult to track progress (see http://sedac.ciesin.columbia.edu/es/epi/ for 2008 and 2010 WQIs as part of the EPIs)

Good if intervention areas are compared with non-intervention (affected areas)

There is no measurements and access to data about water quality in many countries.

Same problem as I-LS-b a complex indicator requiring many different input data sources.

Scarce information available in countries on this.

Would be necessary define the baseline to assess the change in water quality.

In some countries, actions to improve the quality of safe water are being conducted and water quality monitoring data may exist, however models and data are not well shared.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

II-KM. and XI-KM. Land Use System (LUS) and Sustainable Land Management (SLM) practices (#7)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	12	3.6 (1.2)	3.5	**92%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.3 (1.7)	3.5	**67%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	12	3.9 (0.9)	4	**92%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	12	3.1 (1.6)	3.5	**67%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	12	2.8 (1.5)	3	**67%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	12	2.6 (1.2)	3	**67%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	12	3.0 (1.6)	3	**67%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td></tr>
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<tr><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td></tr>
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<tr><td>✓</td><td>✓</td><td>✓</td><td colspan="2">✓</td><td>✓</td></tr>
<tr><td></td><td>✓(LUS)</td><td>✓(LUS)</td><td></td><td></td><td>✓ (SLM and LUS)</td></tr>
<tr><td>5</td><td>6</td><td>5</td><td>1-2</td><td>1-2</td><td>6</td></tr>
</table>

II-KM. and XI-KM. Land Use System (LUS) and Sustainable Land Management (SLM) practices (#7)

It's hard to evaluate this indicator if mixing 2 things "Change in lad use" and "Area under SLM". While the Area under SLM is easy to understand (though hard to measure) and could be a good Response Indicator (mostly at National and Global scales), related to Core Indicators 4 and 7 (mainly), and indirectly related to S-1, the "Land Use System" per se is telling nothing about degradation or succeeding in combating desertification. It provides useful background information, and through its monitoring it is possible to assess key indicators such as Area under SLM, but its sensitivity to important changes, though pretty high (see scores) tells very little by its own.

Although the indicator looks quite robust, it seems to be focused on land cover rather than land use. So, it will not catch changes in land use, and would become more an indicator of impact rather than pressure.

Very important information, important also to have a good categorization system such that links to land degradation can be made.

SLM is locally determined and depends strongly from stat agriculture policy.

Deciding what practices are sustainable, and combining multiple practices in one areas into a single indicator, are near insuperable problems. The actual mapping is hard - it would need to be done parcel by parcel, and across many seasons since land management is time-varying.

It is mixed, LUS is not an indicator important at such but SLM is a Response indicator that is very

Too indirect to be a good indicator in this context

The SLM indicator is some not easily to understand for policymakers.

Land use change is indeed, critical to assess land degradation. However getting data/info on land use change at national or global levels is not easy. More difficult is to evaluate influence of land use change on land degradation, e.g, land use change doesn’t necessarily lead to land degradation. Land cover and change can be an option or an alternative for land use and change.

This indicator can be monitored through remote sensing satellite survey analysis. Some countries will have this capacity available in services provided by a monitoring center, but not all countries have this capacity.

This indicator is not closely connected to the decrease in the number of people negatively impacted by the process of desertification/land degradation and drought.

This indicator is valuable, not always assessed with full information. A solid theoretical background of the land use change based indicators in the frame of LDD is essential to provide a proper review.

II-LA. Land Use System (LUS) and change in land use (#8)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	3.8 (1.2)	4	**92%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	13	3.8 (1.7)	3.5	**77%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	13	3.6 (1.3)	4	**77%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	13	3.1 (1.7)	3	**77%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	3.3 (1.5)	4	**77%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	3.0 (1.5)	3	**69%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	13	3.6 (1.1)	3	**85%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
✓					
✓	✓				
		✓			✓
	✓	✓		✓	✓
	✓		✓		
	✓	✓			
		✓			✓
	✓				✓
✓					
	✓	✓			
✓	✓				✓
✓		✓			
	✓ **(LUS)**	✓ **(LUS)**			✓ **(LUS)**
5	**8**	**7**	**1-2**	**1**	**6**

II-LA. Land Use System (LUS) and change in land use (#8)

"Land Use System" per se is telling nothing about degradation or succeeding in combating desertification. It provides useful background information, and through its monitoring it is possible to assess key indicators such as Area under SLM, but its sensitivity to important changes, though pretty high (see scores) tells very little by its own.

This has more land use components. The construction of the LUS map may be not intuitive and needs training.

As above but depends very much on the LUS categories that are considered, if very broad then less valuable.

Notoriously high variability between land cover products which has nothing to do with change.

Important indicator to assess and monitor human indices land degradation (especially from the change point of view)

Too indirect to be a good indicator in this context

This indicator considers the change in groundwater/aquifer level and change in quantity of surface water in the last 10 years. The analysis period for this kind of resources should be longer than 10 years.

There may be a temporal data sensitivity issue with this indicator. Changes in land use are not always easily identified in a very short period of time, nor are they easily distinguished from land cover change where land use has not changed.

Changes in land use is not a very useful indicator by itself as depending on people's perspectives changes can be good or bad. Even rate of change can be considered good or bad. It is hard to define objective criteria for the interpretation of this indicator.

This indicator is valuable, not always assessed with full information. A solid theoretical background of the land use change based indicators in the frame of LDD is essential to provide a proper review.

Core indicator S-2:
Increase in the proportion of households living above the poverty line in affected areas

III-KM. Rural Poverty Rate (#9)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	3.8 (0.8)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	13	3.5 (1.0)	3	**85%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	11	3.1 (1.4)	4	**64%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	13	3.5 (1.5)	4	**77%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	13	3.1 (1.4)	4	**69%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	2.9 (1.3)	3	**62%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	13	4.2 (1.0)	5	**92%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
✓				✓	
				✓	
✓		✓		✓	
✓	✓	✓	✓		✓
				✓	
				✓	
				✓	
✓		✓		✓	
	✓				
✓		✓			
	✓			✓	
✓	✓	✓			
				✓	
6	**4**	**5**	**0-1**	**9-10**	**1**

III-KM. Rural Poverty Rate (#9)

Lack of personal expertise to properly evaluate this and next two indicators, though I'm concerned about certain degree of overlapping.

Would be good impact indicator but not if assessed at national and global level thus low rating unless assessed separately for areas with and without LD

National poverty line is politically subservient.

There are distributional issues (see general comments) and some technical issues relating to defining poverty in non-wage economies. Quite a lot of work to collect the data, but worthwhile.

Not sensitive enough to detect changes due to SLM interventions, data not collected frequently enough.

Land degradation is a process on time, therefore baseline information is important to understand that could be naturally poor drylands in which this rate is low and even with some development remains low. So, it could indicate us degradation status but not full pictures.

I think here the initial indicator "poverty line" of Berry et al, is better, or would you say just rural areas can be affected?

This indicator, as a proxy for UNCCDIII, has a major flaw in its spatial resolution. According to description, it is available at sub-national level only for selected countries. This creates problems for its assessment “in affected areas”, as stated by the UNCCDIII.

This indicator could be controversial, because the parameters consider calculating this variation from one country to other one, because many times the rural poverty rates does not consider the same variables for each country.

Difficult to link to DLDD: the proportion would be increasing but absolute number of the poor people would be also increasing in affected areas.

In some countries this is a well monitored Indicator [e.g., within the Strategic document of Poverty Reduction (PRSP1 and 2)].

Reliable data are generally available, and monitoring systems in place.

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

Changes in land use is not a very useful indicator by itself as depending on people's perspectives changes can be good or bad. Even rate of change can be considered good or bad. It is hard to define objective criteria for the interpretation of this indicator.

Proportion of the population in affected areas living above the poverty line should be core indicator for the UNCCD.

Indicators such as the poverty index that often rely on the standardized UN values such dollars per capita might sound unrealistic in systems such as pastoralism where poverty measures use different units.

Core indicator S-3:
Reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas

IV-KM. Proportion of chronically undernourished children under the age of 5 in rural areas (#10)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	12	3.5 (1.4)	4	**83%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	2.7 (1.5)	3	**58%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	11	2.2 (1.5)	3	**55%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	11	3.3 (1.8)	4	**73%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	11	2.5 (1.6)	3	**64%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	11	2.1 (1.3)	2.5	**55%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	11	3.7 (1.8)	4.5	**82%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>✓</td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>2</td><td>0</td><td>5</td><td>0-1</td><td>10-11</td><td>2</td></tr>
</table>

IV-KM. Proportion of chronically undernourished children under the age of 5 in rural areas (#10)

See comment on previous indicator III-KM [Lack of personal expertise to properly evaluate this and next two indicators, though I'm concerned about certain degree of overlapping.]

up-to-date comparable data difficult to obtain; monitoring networks are sparse; we've done work with GEMS to create indicators, but it has proven difficult to track progress (see http://sedac.ciesin.columbia.edu/es/epi/ for 2008 and 2010 WQIs as part of the EPIs)

Would be good impact indicator but not if assessed at national and global level thus low rating unless assessed separately for areas with and without LD

Issue of space scale

A sensitive integrating indicator of several factors (poverty, food security)

Land degradation is a process on time, therefore baseline information is important to understand that could be naturally poor drylands in which this rate is low and even with some development remains low. So, it could indicate us degradation status but not full pictures.

This is an indicator very sensible for policymakers but is not always easy to obtain the data

The main issue here is survey frequency and reporting resolution; if DHS/MICS then it may be possible to geolocate sample survey cluster points to get a better sense of spatial variability.

The interpretation of this indicator should be clarified, because many times the causes are structural and not regarding DLDD, which are a consequence of the socioeconomical and political issues.

In some countries this indicator is already regularly followed through national and local level structures [e.g., Reinforcement Nutrition Program (PRN)].

Though valuable as a "development" indicator, how do we relate this indicator to LD/SLM? If we want to show the impact of LD/SLM we need to have this information differentiated for areas where there is LD / SLM and where not. National statistics integrate both areas with LD and SLM.

V-KM. Maternal mortality ratio (or rate) (MMR) (#11)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	10	2.5 (1.8)	2.5	**50%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	10	2.0 (1.6)	2	**30%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	9	1.7 (1.3)	1	**44%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	9	3.1 (1.8)	3.5	**67%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	9	3.1 (1.8)	3.5	**78%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	9	2.6 (1.6)	2.5	**56%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	9	3.8 (1.6)	4	**89%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

Driving Force (D)	Pressure (P)	State (S)	Impact: Ecosystem Services	Impact: Human Well-being	Response
		✓		✓	
		✓	✓		✓
				✓	
				✓	
				✓	✓
✓				✓	
				✓	
		✓			
✓				✓	
				✓	
2	**0**	**3**	**0-1**	**8-9**	**2**

V-KM. Maternal mortality ratio (or rate) (MMR) (#11)

See comment on previous indicator III-KM [Lack of personal expertise to properly evaluate this and next two indicators, though I'm concerned about certain degree of overlapping.]

Would be good impact indicator but not if assessed at national and global level thus low rating unless assessed separately for areas with and without LD

Issue of spatial scale.

Indicator is sensitive and important in its own right, but tied to may causal factors, only some of which relate to land degradation.

Land degradation is a process on time, therefore baseline information is important to understand that could be naturally poor drylands in which this rate is low and even with some development remains low. So, it could indicate us degradation status but not full pictures.

This is an indicator very sensible for policymakers but is not always easy to obtain the data

This indicator it is not necessary a consequence of DLDD, could be a geographical and/or a healthy problem. For that reason it is not a stable indicator to assess DLDD.

This Indicator is less relevant to the issue of desertification.

This indicator is closely relevant with the reduction in the proportion of the population below the minimum level of dietary energy consumption in affected areas.

Objective 2: To improve the condition of ecosystems
Core indicator S-4:
Reduction in the total area affected by desertification/land degradation and drought

VI-LA-a. Level of land degradation (via ecosystem-services provision capacity) (#12)

	Count	Mean (Std Dev)	Median	Percent Frequency
Does the indicator provide information about changes in important processes?	14	4.2 (1.1)	5	**93%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	13	3.6 (1.1)	3	**85%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	13	3.5 (1.2)	3	**77%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	14	3.1 (1.0)	3	**71%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	14	2.3 (1.4)	2	**29%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	13	2.2 (1.2)	2	**46%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	14	3.1 (1.2)	3	**71%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
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<tr><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>1</td><td>3</td><td>9</td><td>8-9</td><td>4-5</td><td>2</td></tr>
</table>

VI-LA-a. Level of land degradation (via ecosystem-services provision capacity) (#12)

More than an indicator, this is a whole land-status assessment protocol. It involves tens of indicators that relate to the three Objectives. Hard to evaluate using this Indicator Assessment Matrix rates, as it is a combination of too many things. Actually "Level of Land Degradation" is equivalent to "Level of Desertification" which is the general target to be assessed in order to evaluate the achievement of the three objectives of the Strategy. I don't see this "Indicator" as a refined indicator, but as an independent methodology for assessing land degradation, which includes indicators that overlap with many of the UNCCD (and refined) indicators.

This is a status indicator, although the GLADIS system provides information also on the causality chain. The model is not yet fully recognized, although it is the only available.

Would be good impact indicator but not if assessment at national and global level thus low rating unless assessed separately for areas with and without interventions

Formulation and data requirements are precise but data collection is hugely expensive and data combination to yield the indicator values don't allow quantitative comparisons.

Conceptually sound in principle, but the addition of arbitrary indices is a deep flaw. Rather convert them to common units (natural capital) and then monitor changes.

KM:Land has land productivity which serves a similar function as LADA indicator. Not many countries can be expected to use this.

In order to have it as indicator, we shall count with standard baseline information about degradation, especially quantitative information. This is not easily achieved as land degradation is a complex process.

I consider the LADA "spiders or radar" diagram approach an attractive and interesting tool to provide a simple assessment in line with the white paper concept, problem is that without dynamic and good quality input the potential monitoring remains limited

Be careful with the period considered for the analysis. The comparison between different areas, by point, country or land use, for any point on earth it is not useful for decision makers, because the database is global and exist considerable differences at national level.

This approach confuses the effect and causes: land degradation is a consequence resulting from various factors: both natural and human interventions. Biomass, as an effect, is an integration of all causing actors including soil health (erosion, salinization, pollution etc), water quality, human activities and so on; decline in biodiversity is a by-product of land degradation. Therefore, combining the cause and effect is not an option.

This has the potential to reflect some good changes in processes. There are structures for monitoring of ecosystem services in come countries, but the models are not well developed to determine the level of degradation.

An indicator on the level of land degradation should be needed in any case where the definition of "affected areas" is needed.

Considerations: a. Wind action - you could choose erosion rate in non-dune areas, and have an additional index for dune expansion. b. Water erosion - this requires an area features indicator, not erosion rate. c. Salinization and alkalinization and waterlogging.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Measuring land degradation cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring this. Estimates of the amount of degraded land in particular countries or regions vary widely.

Lacking good objective definitions and measurement methods.

Multi-scale and multi-indicator assessment is required.

Two approaches, i) via changes of the land capacity to goods and services ii) via estimates of soil, vegetation and water degradation. Both are explicit in using attributes related to land condition and in this sense they are easy to understand. However, estimates are based on ground measures or proxys that are expensive to obtain, with the uncertainty associated to expert judgement and with difficult to integrate them into robust quantitative values.

Measuring land degradation cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring these. Estimates of the amount of degraded land in particular countries or regions vary widely.

VI-LA-b. Level of land degradation (#13)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	13	4.4 (1.0)	5	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	13	4.0 (1.2)	4	**85%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	13	3.7 (1.1)	4	**85%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	14	3.5 (1.3)	4	**86%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	14	2.4 (0.9)	3	**57%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	14	2.2 (1.0)	2	**43%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	14	3.4 (0.9)	3	**86%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
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</table>

VI-LA-b. Level of land degradation (#13)

More than an indicator, this is a whole land-status assessment protocol. It involves tens of indicators that relate to the three Objectives. Hard to evaluate using this Indicator Assessment Matrix rates, as it is a combination of too many things. Actually "Level of Land Degradation" is equivalent to "Level of Desertification" which is the general target to be assessed in order to evaluate the achievement of the three objectives of the Strategy. I don't see this "Indicator" as a refined indicator, but as an independent methodology for assessing land degradation, which includes indicators that overlap with many of the UNCCD (and refined) indicators.

It is unlikely this approach would be accepted. The reasons are 1) the criteria are complex and some cannot be quantified, experts judgments vary due to different experiences; 2) QM doers are often familiar with local situation rather than national, they are also different from country to country, how to compare and judge the results? 3) not repeatable: after 10 years, surveyors will change, possibly some criteria have to change as well 4) Technically, some specifications or criteria are not clearly defined; the answer to a same QM for a mapping unit could be quite different from different so-called experts. To be sure, UNCCD would interview the people of LADA partner countries who were involved in the land degradation assessment by using QM.

Being an assessment, it is not affected by natural variability, and it is sensitive enough for being effective every 5-10 years. The main issues are related to the availability of data, useful to further increase the robustness of the expert assessment.

Good if assessed per LUS and differentiated into areas with LD and those with SLM (the LADA-WOCAT national / Sub-national mapping approach.

It seems the LADA indicators are the most relevant for land degradation assessment. However, LADA project covers only selected countries. The other countries will face serious difficulties with regular assessment of land degradation bases on LADA approaches.

Very detailed work, expensive and relatively high-skill, prone to observer bias.

In order to have it as indicator, we shall count with standard baseline information about degradation, especially quantitative information. This is not easily achieved as land degradation is a complex process.

LADA country evaluation of level of land degradation is well developed, but it is a major cumbersome effort to do it, most parties will have difficulties to do it once every 10 years. Going through this approach were possible is useful probably it is not ideal in a regular reporting scheme for the current UNCCD impact reporting. Where feasible it could provide important validation data for other more dynamic indicators.

Be careful with the period considered for the analysis. The comparison between different areas, by point, country or land use, for any point on earth it is not useful for decision makers, because the database is global and exist considerable differences at national level.

This approach confuses the effect and causes: land degradation is a consequence resulting from various factors: both natural and human interventions. Biomass, as an effect, is an integration of all causing actors including soil health (erosion, salinization, pollution etc), water quality, human activities and so on; decline in biodiversity is a by-product of land degradation. Therefore, combining the cause and effect is not an option.

An indicator on the level of land degradation should be needed in any case where the definition of "affected areas" is needed

Considerations: a. Wind action - you could choose erosion rate in non-dune areas, and have an additional index for dune expansion. b. Water erosion - this requires an area features indicator, not erosion rate. c. Salinization and alkalinization and waterlogging.

Reliable data are currently not generally available, and/or monitoring systems are not in place.

Measuring land degradation cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring this. Estimates of the amount of degraded land in particular countries or regions vary widely.

Lacking good objective definitions and measurement methods.

Two approaches, i) via changes of the land capacity to goods and services ii) via estimates of soil, vegetation and water degradation. Both are explicit in using attributes related to land condition and in this sense they are easy to understand. However, estimates are based on ground measures or proxies that are expensive to obtain, with the uncertainty associated to expert judgment and with difficult to integrate them into robust quantitative values.

Measuring land degradation cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring these. Estimates of the amount of degraded land in particular countries or regions vary widely.

Core indicator S-5:
Increases in net primary productivity in affected areas

VII-KM. Crop and livestock diversity (agro-biodiversity) (#14)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	11	3.4 (0.9)	4	**91%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	10	2.8 (1.0)	3	**70%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	9	3.0 (1.1)	3	**78%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	10	3.3 (1.6)	4	**60%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	10	3.0 (1.9)	3	**60%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	10	3.1 (1.8)	3	**60%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	10	3.3 (1.3)	3	**80%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td></tr>
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<tr><td></td><td></td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>1</td><td>8</td><td>3-4</td><td>1-2</td><td>1</td></tr>
</table>

VII-KM. Crop and livestock diversity (agro-biodiversity) (#14)

Though this indicator could be a good State indicator, related to Objective 2 and 3, its relationship with productivity (and desertification) is not so straightforward. This indicator could better relate to Objective 3

Would be good impact indicator but not is assessed at national and global level thus low rating unless assessed separately for areas with and without LD.

Nice idea, but if based simply on richness (the number of species) is rather insensitive. I would go for a Simpson's Index-type indicator where variety is weighted by contribution.

Surprising lack of easily accessible data limits use of this.

Not as such, it should talk about trends, from baseline to a monitoring framework

The group VII are easily of understand, but is necessary do assessment to obtain the data

Choices associated with livestock diversification are either from individual or from manager or policy choices or strategies. Accommodations are sometimes slow (e.g., short cycle varieties of peanut still in use when precipitation increased and winter period extended).

VII-CBD. Trends in abundance and distribution of selected species (#15)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	10	3.3 (1.0)	3.5	**80%** of respondents reported “yes” moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	9	2.6 (1.0)	3	**67%** of respondents reported “yes” moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	9	2.9 (1.5)	3	**67%** of respondents reported “yes” moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	10	3.0 (1.5)	3	**70%** of respondents reported “yes” moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	10	3.0 (1.9)	4	**60%** of respondents reported “yes” moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	9	2.3 (1.9)	2	**44%** of respondents reported “yes” moderately or mostly
Can policymakers easily understand the indicator?	10	3.1 (1.5)	3.5	**70%** of respondents reported “yes” moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

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<tr><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
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</table>

VII-CBD. Trends in abundance and distribution of selected species (#15)

See comments on previous indicator VII-KM [Though this indicator could be a good State indicator, related to Objective 2 and 3, its relationship with productivity (and desertification) is not so straightforward. This indicator could better relate to Objective 3]

Would be good impact indicator but not is assessed at national and global level thus low rating unless assessed separately for areas with and without LD.

This indicator does not reflect the local for agriculture.

The key issue here is which species, you need enough to not be driven purely by noise, but they should also be ecologically or socially important. Allows links to CBD 2020 indicator system.

Would need incentives to measure these data.

Very good indicator, better than VII-KM as we should count with indicators that represents the dynamic content of the process; land degradation

Plant and animal diversity - relying on animal diversity alone is data-dependent and not advisable.

Not clear how biodiversity is linked to the increases in net primary productivity in affected areas.

Plant biodiversity says nothing about desertification, because the relations between individual species and services that if provided desertification does not occur, are not known in most cases.

VIII-KM. Trends in seasonal precipitation (#16)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	15	4.1 (1.2)	4	**93%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	16	3.5 (1.0)	3	**88%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	15	3.5 (1.1)	3	**80%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	16	4.0 (1.5)	5	**88%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	16	4.0 (1.0)	4	**94%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	16	4.1 (1.0)	4.5	**94%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	16	3.9 (1.4)	4.5	**88%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
✓					
	✓				
✓					
✓					
	✓	✓			
✓		✓			
✓					
✓					
✓	✓				
✓	✓		✓		
✓		✓			
✓					
		✓	✓	✓	
✓					
11	**4**	**4**	**2**	**1**	**0**

VIII-KM. Trends in seasonal precipitation (#16)

Changes in precipitation regime can certainly affect land degradation (as a driving force). Furthermore, this information is needed to interpret other indicators correctly. However, the impact of management actions on precipitation is too weak, and therefore it doesn't make sense to include this type of indicators within a suite of indicators aimed at assessing the achievement of The Strategy goals. Aridity and trends in precipitation should be part of other indicators, such as changes in land productivity (to make them relative to changes in precipitation)

This is straightforward, with all the limitations of rainfalls series and network.

Rainfall monitoring networks are often spares in arid and semi-arid regions, especially in Africa, but it should be possible to construct a trend from limited areas.

Not an impact indicator III.

It is a Driver, not an indicator.

Very fundamental and straightforward, but the existing observing systems are generally inadequate. Trend detection is hard unless you use very sophisticated methods which are hard to make transparent.

Essential contextual indicator.

Long term time series analysis required

Which is the “project area” defined? Which is the source data use?

Refinement of Aridity index - any standard index would do.

Reliable data are generally available, and monitoring systems in place.

Lack of precipitation, irregular rainfall etc. are the normal behavior of drylands, so why is this indicator being considered? Certainly not for impacts.

This is as saying that the rainfall and the temperature are indicators of desertification, which is a great fallacy.

Aridity index simply tells us that we are in a dryland, but says nothing regarding whether the dryland is desertified or not.

I fail to understand how this aridity index is showing any impacts of LD/SLM, they way it is defined, it is good for characterization of the area but nothing to do with impact.

VIII-LA. Aridity trend and rainfall variability (#17)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if 0 75%)
Does the indicator provide information about changes in important processes?	15	4.2 (1.2)	4	**87%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	16	3.6 (1.1)	4	**88%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	16	3.5 (1.2)	4	**80%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	16	3.8 (1.5)	4	**88%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	16	3.9 (1.0)	4	**94%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	16	3.8 (0.9)	4	**94%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	16	3.6 ((1.5)	4	**88%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
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<tr><td></td><td>✓</td><td></td><td></td><td></td><td></td></tr>
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<tr><td>7</td><td>5</td><td>4</td><td>3-4</td><td>1-2</td><td>1</td></tr>
</table>

VIII-LA. Aridity trend and rainfall variability (#17)

See comments on previous indicator VIII-KM. All the values given apply only for aridity trend. Rainfall variability, albeit important regarding desertification, is not as well understood and supported by a conceptual framework that establishes well defined linkages with desertification [Changes in precipitation regime can certainly affect land degradation (as a driving force). Furthermore, this information is needed to interpret other indicators correctly. However, the impact of management actions on precipitation is too weak, and therefore it doesn't make sense to include this type of indicators within a suite of indicators aimed at assessing the achievement of The Strategy goals. Aridity and trends in precipitation should be part of other indicators, such as changes in land productivity (to make them relative to changes in precipitation)]

The limitations are similar to the VIII-KM, but the aridity index trend makes this indicator more respondent to climate change influence.

I may be wrong, but I think data on evapotranspiration is often lacking.

Not an impact indicator III.

It is a Driver, not an indicator.

More robust than VII-MK (which it requires for input, therefore above comments on data apply). See my general comments on taking this one step further.

Yet a good indicator.

Long term time series analysis required.

The trend should be validated through national databases.

Refinement of Aridity index - any standard index would do.

Reliable data are generally available, and monitoring systems in place.

I quite like the aridity index, but why not go the whole way and make it a true water balance indicator (eg number of day-equivalents where water supply to plants is non-limiting), by including a soil and vegetation term? That way, you can link it systematically to the water yield indicators and the NPP indicators.

Lack of precipitation, irregular rainfall etc.are the normal behavior of drylands, so why is this indicator being considered? Certainly not for impacts.

Aridity index is an index of a driver intensity, but not yet an indicator because its functional link to land degradation processes are not worked out.

This indicator is very specific and very complex to calculate; the (many) necessary data are not globally available and will not easily be in future; furthermore, it requires land use data to be calculated.

IX-KM. Land cover (#18)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	15	3.7 (1.2)	4	**87%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	14	3.9 (1.0)	4	**86%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	14	3.9 (1.1)	4	**86%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	15	3.8 (1.1)	4	**93%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	15	3.8 (1.1)	4	**87%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	15	3.3 (1.2)	3	**73%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	15	3.7 (0.9)	4	**93%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

			Impact		
Driving Force (D)	**Pressure (P)**	**State (S)**	**Ecosystem Services**	**Human Well-being**	**Response**
		✓			✓
		✓	✓		
		✓	✓		
		✓	✓	✓	
		✓			✓
		✓			
		✓			
		✓			✓
✓		✓			
✓					
		✓			
✓	✓	✓	✓		✓
✓	✓	✓			
		✓			
4	**2**	**13**	**4**	**1**	**4**

IX-KM. Land Cover (#18)

Land cover per se is telling very little.

At global level, this has little comparability in time at low level, as the technology, resolution and classification change over time. Updating are however irregular and very costly. Better usability at national level, although the issue of cost remains.

Land cover data are difficult to produce (requiring specialized expertise and costly data and software/hardware inputs) and to collect over time (owing to changes in satellite sensors) Land cover change analysis is fraught with difficulties over larger areas but may be accomplished over smaller areas without too much difficulty (e.g. if your study area is in contained in one medium resolution scene).

Good if differentiated at the sub-national level

Data are in general available and the formulation is consistent

This is a descriptive rather than process-oriented indicator, very subject to classification error (which is currently greater than the trend)

An essential contextual indicator as well as a change indicator.

Changes in land cover could be more important than just this, besides its use and applications is more uniform.

Important and needed for stratification, cut change only reliably measureable and understandable at local level; rather an important key variable than a good indicator, since change is not per se indicative for specific processes and causes.

Land cover status and productivity/change can be simply employed as an integration of other factors (water items, poverty items, human well-being etc.)

Land cover status and productivity/change can be measured timely, consistently, even more precise by remote sensing with ground validation.

The existence of several anthropogenic factors can influence the state of vegetation. Example of illicit cutting, so there is lack of sensitivity with respect to the process.

Land cover status is an integral indicator of both biophysical factors (atmosphere, water, soil, vegetation) and socio-economic components including humans; changes in land cover status could indicate or predict directions of DLDD. Land cover status and change can be measured consistently, timely, frequently, remotely (Remote Sensing) at all scale levels; it can standardize the measurement of DLDD for the Parties; also, importantly, the outcome of the measurement can be used to ‘monitor’ the reported results from the Parties whether their reports are scientifically based or politically intentional!

Land cover should be core indicator for the UNCCD.

The soil and vegetation models will start of crude, using available global datasets, but can be refined over time and can be rigorously converted into an error range. For this reason I am willing to give cautious support to products such as GLC2000, despite their many demonstrable flaws. They are on the right track, and can be improved. Similarly, it argues strongly for FAPAR rather than NDVI or similar indices.

Two approaches i) measuring spatial distribution of land cover type; ii) identifying regions with declining greenness as an early warning of possible land degradation in a particular area. The first is clearly feasible and helpful to build up several other indicators of the list. The second is a preliminary approach using basically remotely sensed data to identify losses of vegetation density. This is a topic which is being intensively worked out in the last years, particularly in the EU DeSurvey project . A detailed review of these approaches, by V.R. Squires, also commissioned by UNCCD is open to public review these days. These approaches are cost efficient and flexible enough to be repeated in time by any country. They are in advanced stage to provide consistent assessment and monitoring procedures of land degradation status and trend in large areas. It is suggested to call all the scientific and technical efforts made in this topic to choose the best way for an indicator useful to the UNCCD objectives.

IX-KM&LA. Land productivity (#19)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	15	4.1 (0.8)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	15	3.2 (1.1)	3	**80%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	14	3.0 (1.8)	3	**71%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	15	3.2 (1.4)	3	**80%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	15	3.2 (1.2)	3	**87%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	15	3.2 (1.3)	3	**73%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	15	3.3(1.2)	3	**73%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td></tr>
<tr><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td></tr>
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<tr><td>✓</td><td>✓</td><td>✓</td><td colspan="2">✓</td><td>✓</td></tr>
<tr><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>1</td><td>3</td><td>10</td><td>5-6</td><td>2-3</td><td>3</td></tr>
</table>

IX-KM&LA. Land productivity (#19)

This is a key indicator, but monitoring should not be only based on RS sources

On the contrary, this can be easily and cheaply updated regularly. The main issue is the statistical significance, as the natural variability is very high.

Land cover data are difficult to produce (requiring specialized expertise and costly data and software/hardware inputs) and to collect over time (owing to changes in satellite sensors) Land cover change analysis is fraught with difficulties over larger areas but may be accomplished over smaller areas without too much difficulty (e.g. if your study area is in contained in one medium resolution scene).

The formulation is too simple for offering a spatially consistent assessment. Other initiatives working in this line should be invited to participate.

The bracketed values are the potential using best available techniques the un-bracketed are the current state, using the GIMMS AVHRR data as assessed by ISRIC.

Pilot testing revealed surprising lack of data on this indicator.

Can we find standard figures for land productivity under different context around the world? Could land productivity in USA be compared or standardize with one in Mali or Bolivia? Difficult to set global standards.

Research suggest that the indicator needs to be applied in a more stratified approach as e.g. proposed by G. del Barrio et al, /Remote Sensing of Environment 114 (2010) 1817-1832.

The FLADA indicator has some issues that need to be resolved. We experimented with a national level metrix in Box 4.7 of the EPI report, with mixed results (web link provided)

In this case, vegetation indices based on distance such as Perpendicular Vegetation Index (PVI) work better in drylands ecosystem, where land cover is low and species are usually xerophytic and of low vegetation vigor.

Land cover status and productivity/change can be simply employed as an integration of other factors (water items, poverty items, human well-being etc.)

Land cover status and productivity/change can be measured timely, consistently, even more precise by remote sensing with ground validation.

Relevant indicator. Annual collection of production and yields and information available at the local level.

Land productivity is proposed as an indicator, which is valid. However, it is listed next to the "Land cover status" provisional indicator, as a "revision". The idea of it being an indicator in its own right is fine, but it should be clear that land productivity is not land cover, and NPP (which was proposed to be used to help calcualte the original provisional "land cover status" indicator is not land cover.

Objective 3: To generate global benefits through effective implementation of UNCCD
Core indicator S-6:
Increases in carbon stocks (soil and plant biomass) in affected areas

X-LA. Above and below ground organic carbon stocks (#20)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if 0 75%)
Does the indicator provide information about changes in important processes?	14	4.4 (0.8)	5	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	14	3.6 (1.2)	4	**86%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	13	3.2 (1.6)	3	**69%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	14	3.5 (1.5)	4	**79%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	14	2.2 (1.3)	2	**43%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	14	2.1 (1.3)	2	**43%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	14	3.4 (1.3)	4	**86%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
<tr><th rowspan="2">Driving Force (D)</th><th rowspan="2">Pressure (P)</th><th rowspan="2">State (S)</th><th colspan="2">Impact</th><th rowspan="2">Response</th></tr>
<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
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<tr><td>3</td><td>2</td><td>5</td><td>3-4</td><td>2-3</td><td>7</td></tr>
</table>

X-LA. Above and below ground organic carbon stocks (#20)

As in other case, an indicator describing the State of an ecosystem is, to some extent, describing the State of the provision of Ecosystem Services, and therefore the Impacts on these Services.

This is a combination of several parameters, indicating status and impacts, and measured in various ways. Pros and cons apply as per indicators IX above.

Ground organic stocks difficult to measure and monitor.

A good integrating variable, quite slow to change (which is good), very spatially variable, technically demanding to measure accurately.

Difficult to measure, lack of monitoring limits use of this indicator.

Key indicator but shall be expressed in the temporal domain as degradation is. Could be changes in organic carbon stocks. The role of soils here is fundamental.

For obtain this indicator is need do investigation in different places

We have to be careful with the database used. Because global database doesn't show what really happened at national level.

Carbon stocks above/below ground - I would not trust AVHRR satellite estimates of above-ground biomass. Field measurements of this could be used to estimate below-ground biomass using IPCC conversion factors.

This is a suitable indicator.

Carbon stocks is an indicator which is intended to be developed in conjunction with the IPCC process. Indicators VI and IX could provide the most of the necessary information. It seems feasible in a consistent way. The error of the estimates may be large but controlled.

Core indicator S-7:
Areas of forest, agricultural and aquaculture ecosystems under sustainable management

XI-KM. [see II-KM above] Land use system (LUS) and Sustainable Land Management (SLM) practices (#21)

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	12	3.9 (0.8)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.3 (1.2)	3	**83%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	11	3.6 (1.0)	4	**82%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	12	3.1 (1.4)	3.5	**75%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	12	2.5 (1.4)	3	**67%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	12	2.3 (1.0)	2.5	**50%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	12	2.6 (1.2)	3	**58%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

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<tr><td></td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>3</td><td>2</td><td>5</td><td>3-4</td><td>2-3</td><td>7</td></tr>
</table>

XI-KM. [see II-KM above] Land use system (LUS) and Sustainable Land Management (SLM) practices (#21)

See II-KM. Although the indicator looks quite robust, it seems to be focused on landcover rather than land use. So, it will not catch changes in land use, become more an indicator of impact rather than pressure.

One of the most important indicators, the basis for all assessment according to the LADA-WOCAT mapping.

The need is there and the formulation of precise but the development is starting.

There is the need to set up concrete and quantitative criteria for assessment of Land Management to identify if it is SLM.

Difficult to verify.

The problem is in the concept of SLM because many people have different concepts. I think that first is necessary to define it clearly.

This indicator can be monitored through remote sensing satellite survey analysis. Some countries will have this capacity available in services provided by a monitoring center, but not all countries have this capacity.

Measuring land under SLM cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring this. SLM tends to be either defined too narrowly or too broadly, or in most cases not defined well at all.

This seems still far to be operational. The information needed is basically obtained through participatory procedures and expert opinion. Another optional approach would be using stability analysis techniques to assess vulnerability rather than sustainability. The former is likely easier and more precise. Operational developments are already available from the DeSurvey project.

SLM is proposed by the UNCCD, and it is very much needed, but without proper definition there will be confusion (as shown in the testing results).

Lacking good objective definitions and measurement methods.

This indicator is not closely connected to the decrease in the number of people negatively impacted by the process of desertification/land degradation and drought.

How to define SLM is a problem.

This indicator is valuable, not always assessed with full information. A solid theoretical background of the land use change based indicators in the frame of LDD is essential to provide a proper review.

Who decides what is SLM, and if what one does is indeed SLM?

SLM is very much needed but without proper definition there will be confusion (as shown in the testing results).

XI-LA. Land under Sustainable Land Management (SLM) #22

	Count	Mean (Std Dev)	Median	Percent Frequency (Highlighted if ≥ 75%)
Does the indicator provide information about changes in important processes?	12	3.8 (0.7)	4	**100%** of respondents reported "yes" moderately or mostly
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	12	3.1 (1.4)	3	**75%** of respondents reported "yes" moderately or mostly
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	11	3.4 (2.3)	3	**73%** of respondents reported "yes" moderately or mostly
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	12	2.8 (1.4)	3	**67%** of respondents reported "yes" moderately or mostly
Are reliable data available to assess trends and is data collection a relatively straightforward process?	12	2.2 (1.0)	2.5	**50%** of respondents reported "yes" moderately or mostly
Are monitoring systems in place for the underlying data needed to calculate the indicator?	12	1.9 (0.9)	2	**25%** of respondents reported "yes" moderately or mostly
Can policymakers easily understand the indicator?	12	2.5 (1.2)	3	**58%** of respondents reported "yes" moderately or mostly

Framework (Respondent details by line item, and total number of respondents)

<table>
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<tr><th>Ecosystem Services</th><th>Human Well-being</th></tr>
<tr><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td></tr>
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<tr><td>2</td><td>1</td><td>5</td><td>2-3</td><td>1-2</td><td>8</td></tr>
</table>

XI-LA. Land under Sustainable Land Management (SLM) (#22)

At global level, GLADIS provides updatable information on the present sustainability. At national level, the LADA QM gives indications on both existing and recommended SLM measures.

As above but more at the local level.

The need is there and the formulation precise but the development is still starting

There is the need to set up concrete and quantitative criteria for assessment of Land Management to identify if it is SLM

Real issues of definitions, methods, comparability, consistency over time.

Difficult to verify

This indicator is based on DPSIR conceptual framework, measuring the impact of SLM. But doesn't show how the impact of SLM on the resources measure. GLADIS not only provides an estimate on the present land management level for agricultural cropped areas, also present for livestock areas, but should be validated at national level, because the database use is at global level, and is usual that the real impact of SLM on the resources should not be appropriate or real.

This indicator focuses on qualitative aspects; objective measurement is not always easy.

SLM is proposed by the UNCCD, and it is very much needed, but without proper definition there will be confusion (as shown in the testing results).

Measuring land under SLM cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring this. SLM tends to be either defined too narrowly or too broadly, or in most cases not defined well at all.

Lacking good objective definitions and measurement methods.

SLM is proposed by the UNCCD, and it is very much needed, but without proper definition there will be confusion (as shown in the testing results).

This indicator is not closely connected to the decrease in the number of people negatively impacted by the process of desertification/land degradation and drought.

How to define SLM is a problem.

This seems still far to be operational. The information needed is basically obtained through participatory procedures and expert opinion. Another optional approach would be using stability analysis techniques to assess vulnerability rather than sustainability. The former is likely easier and more precise. Operational developments are already available from the DeSurvey project.

Measuring and under SLM cannot (yet) be done objectively. There are no generally accepted measurable criteria for measuring these. SLM tends to be either defined too narrowly or too broadly, or in most cases not defined well at all.

This indicator is valuable, not always assessed with full information. A solid theoretical background of the land use change based indicators in the frame of LDD is essential to provide a proper review.

Who decides what is SLM, and if what one does is indeed SLM?

SLM is very much needed but without proper definition there will be confusion (as shown in the testing results).

Annex V

Summary frequencies of the 22 revision indicators (metrics/proxies) under evaluation (first 11) (n=17)

	UNCCD Objective 1: To improve the living conditions of affected populations										
						UNCCD Core indicator S-1			UNCCD Core indicator S-2	UNCCD Core indicator S-3	
Indicator Evaluation Criteria (NRC 2000; MA 2003)	#1 I-KM-a	#2 I-LA-a	#3 I-KM-b	#4 I-LA-b	#5 I-KM-c	#6 I.LA-c	#7 II&XI-KM	#8 II-LA	#9 III-KM	#10 IV-KM	#11 V-KM
Does the indicator provide information about changes in important processes?	**100%**	**100%**	**85%**	**100%**	**75%**	**92%**	**92%**	**92%**	**100%**	**83%**	**50%**
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	**85%**	**92%**	**67%**	**83%**	**40%**	**58%**	**67%**	**77%**	**85%**	**58%**	**30%**
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	**54%**	**58%**	**67%**	**83%**	**55%**	**50%**	**92%**	**77%**	**64%**	**55%**	**44%**
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	**93%**	**92%**	**92%**	**100%**	**83%**	**58%**	**67%**	**77%**	**77%**	**73%**	**67%**
Are reliable data available to assess trends and is data collection a relatively straightforward process?	**64%**	**69%**	**46%**	**54%**	**67%**	**100%**	**67%**	**77%**	**69%**	**64%**	**78%**
Are monitoring systems in place for the underlying data needed to calculate the indicator?	**50%**	**69%**	**62%**	**69%**	**67%**	**8%**	**67%**	**69%**	**62%**	**55%**	**56%**
Can policymakers easily understand the indicator?	**87%**	**69%**	**92%**	**92%**	**92%**	**92%**	**67%**	**85%**	**92%**	**82%**	**89%**

Figures in shaded boxes: ≥ 75% of Respondents Reported “Yes” Moderately to Mostly

NOTE: See last page for assessment rating scale and considerations for interpreting this table.

Summary frequencies of the 22 revision indicators (metrics/proxies) under evaluation (last 11) (n=17)

	UNCCD Objective 2: To improve the condition of ecosystems								*UNCCD Objective 3: To generate global benefits through effective implementation of UNCCD*		
	Core indicator S-4						UNCCD Core indicator S-5		UNCCD Core indicator S-6		
Indicator Evaluation Criteria (NRC 2000 [1]; MA 2003 [2])	#12 VI-LA-a	#13 VI-LA-b	#14 VII-KM	#15 VII-CBD	#16 VIII-KM	#17 VIII-LA	#18 IX-KM	#19 X-KM&LA	#20 X-LA	#21 XI&II-KM	#22 XI-LA
Does the indicator provide information about changes in important processes?	**93%**	**100%**	**91%**	**80%**	**93%**	**87%**	**87%**	**100%**	**100%**	**100%**	**100%**
Is the indicator sensitive enough to detect impact changes but not so sensitive that signals are masked by natural variability?	**85%**	**85%**	**70%**	**67%**	**88%**	**88%**	**86%**	**80%**	**86%**	**83%**	**75%**
Can the indicator detect changes at the appropriate temporal and spatial scale without being overwhelmed by variability?	**77%**	**85%**	**78%**	**67%**	**80%**	**80%**	**86%**	**71%**	**69%**	**82%**	**73%**
Is the indicator based on well-understood and generally accepted conceptual models of the system to which it is applied?	**71%**	**86%**	**60%**	**70%**	**88%**	**88%**	**93%**	**80%**	**79%**	**75%**	**67%**
Are reliable data available to assess trends and is data collection a relatively straightforward process?	**29%**	**57%**	**60%**	**60%**	**94%**	**94%**	**87%**	**87%**	**43%**	**67%**	**50%**
Are monitoring systems in place for the underlying data needed to calculate the indicator?	**46%**	**43%**	**60%**	**44%**	**94%**	**94%**	**73%**	**73%**	**43%**	**50%**	**25%**
Can policymakers easily understand the indicator?	**71%**	**86%**	**80%**	**70%**	**88%**	**88%**	**93%**	**73%**	**86%**	**58%**	**58%**

Figures in shaded boxes: ≥ 75% of Respondents Reported "Yes" Moderately to Mostly

NOTE: See last page for assessment rating scale and considerations for interpreting this table.

Assessment rating scale:

- Sixteen reviewers contributed scores on indicators (metrics/proxies) where they felt they had sufficient knowledge/expertise to do so.
- Scoring was based on a Likert scale: (no, not at all) 0 <------> 5 (yes, very much)
- To create a summary (and help interpret the findings), the rating scale was collapsed into two over-arching levels of agreement with the assessment statements.

0 – 5 Rating Scale	*Interpretation Key*
0 "No, not at all"	
1	
2	**Not at all to weakly**
3	
4	
5 "Yes, very much"	**Moderately to mostly**

This is an aggregated summary of the evaluation of these metrics/proxies.

Considerations:

- The reviewers were asked to assess the indicators individually, not relative to their role in a set or overall monitoring system.*
- These numbers encourage thinking and help to understand the ranges of and concurrence in perspectives of the reviewers. The original scores and these percentages are illustrative and instructive, but do not, in-and-of-themselves, dictate an answer. Overall values indicate the 'desirability' of the alternatives with respect to the preference information given by the respondents.
- Questions to consider what reviewing these results include:

  (a) What was a realistic expectation for the above percentages?

  (b) Should the tangible versus intangible nature of the 22 indicators above affect our expectations in terms of consensus and interpretation of the above feedback?

(c) Which of the above 7 criteria are critical (go-no-go variables) versus “preferable if they are present”?

(d) Where is the threshold for decision-making (e.g., how do we proceed knowing that “perfect is the enemy of good enough”?)

(e) Which categorization (UNCCD strategic objectives, UNCCD core indicators, framework categories D, P, S, I-HWB, I-ES, R, etc.) are priorities, do the strong performing variables above line-up with these priorities?

* Some reviewers, in their comments (see did discuss the issue of how the indicators would (or would not) function in a set.

Annex V References

[1] NRC (U.S. National Research Council). 2000. Ecological Indicators for the Nation. Chapter 3: A Framework for Indicator Selection. Washington D.C.: The National Academies Press. 180 pp. Available Online: http://www.nap.edu/openbook.php?record_id=9720&page=51

[2] MA (Millennium Assessment). 2003. Millennium Ecosystem Assessment: Ecosystems and Human Well-being – A Framework for Assessment. Available Online: http://www.maweb.org/en/Framework.aspx Chapter 1: Introduction and Conceptual Framework. Washington DC: World Resources Institute. Available Online: http://www.maweb.org/documents/document.299.aspx.pdf.

Annex VI

Summary of the Initial Expert Review perspectives on the role each metric/proxy under evaluation might play in the updated DPSIR-MA framework

				Impact		
Indicator	*D*	*P*	*S*	**I-ES**	**I-HB**	*R*
Objective 1: To improve the living conditions of affected populations						
Core Indicator S-1: *Decrease in the number of people negatively impacted by the process of desertification/land degradation and drought*						
I-KM-a. Water stress (#1)	3	10	3	2	2	1
I-LA-a. Pressure on water resources (#2)	1	10	1	2	2	0
I-KM-b. Water availability (#3)	1	7	5	2	1	1
I-LA-b. Water availability and use (#4)	2	8	5	5	3	1
I-KM-c. Percentage of rural population with access to (safe) drinking water (#5)	2	7	7	5	4	0
I-LA-c. Access to improved drinking water based on change in water quality (#6)	1	1	5	2	7	1
II-KM. and IX-KM. Land Use System (LUS) and Sustainable Land Management (SLM) Practices (#7)	5	6	5	1-2	1-2	6
II-LA. Land Use System (LUS) and change in land use (#8)	5	8	7	1-2	1	6
Core Indicator S-2: *Increase in proportion of households living above poverty line in affected areas*						
III.KM. Rural Poverty Rate (#9)	6	4	5	0	9-10	1
Core Indicator S-3: Reduction in the proportion of households living above the poverty line in affected areas						
IV-KM. Proportion of chronically undernourished children under the age of 5 in rural areas (#10)	2	0	5	0-1	10-11	2
V-KM. Maternal mortality ratio (or rate)(MMR) (#11)	2	0	3	0-1	9	2
Objective 2: To improve the condition of ecosystems						
Core Indicator S-4: Reduction in the total area affected by desertification/land degradation and drought						
VI-LA-a. Level of land degradation (via ecosystem-services provision capacity) (#12)	1	3	9	8-9	4-5	2
VI-LA-b. Level of land degradation (#13)	2	3	12	8-9	5-6	4
Core Indicator S-5: Increase in net primary productivity in affected areas						
VII-KM. Crop and livestock diversity (agro-biodiversity) (#14)	2	1	8	3-4	1-2	1
VII-CBD. Trends in abundance and distribution of selected species (#15)	2	1	9	5-6	1-2	1
VIII-KM. Trends in seasonal precipitation (#16)	11	4	4	2	1	0

Indicator	D	P	S	Impact I-ES	I-HB	R
VIII-LA. Aridity trend and rainfall variability (#17)	7	5	4	3-4	1-2	1
IX.KM. Land cover (#18)	4	2	13	4	1	4
IX-KM&LA. Land productivity (#19)	1	3	10	5-6	2-3	3
<u>Objective 3:</u> To generate global benefits through effective implementation of UNCCD						
Core indicator S-6: Increase in carbon stocks (soil and plant biomass) in affected areas						
X-LA. Above and below ground organic carbon stocks (#20)	3	2	5	3-4	2-3	7
Core Indicator S-7: Areas of forest, agriculture and aquaculture ecosystems under sustainable management						
XI-KM (seeII-KM above] Land use system (LUS) and Sustainable Land Management (SLM) practices (#21)	3	2	5	3-4	2-3	7
XI-LA. Land under Sustainable Land Management (SLM) (#22)	2	1	5	2-3	1-2	8

Driving Force (D); Pressure (P); State (S); Impact (I); Response (R)
Impact on Ecosystem Services (ES); Impact on Human Well-being (HB)