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Reshaping the operation of the Committee on Science and Technology in line with the 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018)
Report of the UNCCD 1st Scientific Conference

UNCCD 1st Scientific Conference: Synthesis and recommendations

Note by the secretariat

1. A summary of the synthesis and recommendations of the UNCCD 1st Scientific Conference was reported in document ICCD/COP(9)/CST/INF.2.

2. The full text of the synthesis and recommendations of the UNCCD 1st Scientific Conference is attached as an annex to the current document.

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Annex

Synthesis and recommendations

1. The eighth Conference of the Parties (COP 8) of the United Nations Conference to Combat Desertification (UNCCD) decided to strengthen the scientific basis underpinning the Convention and instructed the Committee on Science and Technology (CST) to conduct its future sessions in a predominantly Conference format, addressing specified themes.

2. The theme *"bio-physical and socio-economic monitoring and assessment of desertification and land degradation, to support decision-making in land and water management"* was chosen as the first priority theme. The UNCCD 10-year strategic plan and framework to enhance the implementation of the Convention (2008–2018) (The Strategy) (2008–2009 biennium) highlights the importance given to the development and implementation of scientifically-based and sound methods for monitoring and assessing desertification, and underlines the need for a holistic view.

3. In order to prepare for the Conference, the Dryland Science for Development (DSD) consortium convened three global working groups of scientists to analyse and summarize the leading scientific knowledge on the priority theme in order to generate practical recommendations.

4. This document provides the key findings of the three Working Groups, after taking into consideration the input received during the Conference, organized into 11 key messages/recommendations.

1. 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.

5. The text of the United Nations Convention to Combat Desertification 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 insecurity"* and other factors. The Strategy of the UNCCD reconfirms this mission orientation as reflected in its science-related Strategic Objectives (1-3) and their associated expected impacts.

6. To meet UNCCD expectations, therefore, monitoring and assessment of DLDD must effectively address complex human-environment interactions. This is a formidable challenge. The analysis of complex systems lies at the frontier of earth systems science and global change science.

7. Monitoring and assessment procedures have so far been largely empirical and focused on the symptoms of DLDD rather than on the underlying drivers and processes. Only since the late

1990s have interactions between human and climatic drivers, as well as the temporal and spatial scales of the phenomenon, been integrated into these concepts and frameworks, building on the interrelationships within coupled human-environmental (H-E) systems that cause DLDD.

8. Innovative assessment and monitoring concepts are required in order to translate these frameworks into concrete action. Building on recent advances in monitoring the state (condition) of land surfaces and its temporal trends (for instance in the analysis of indicators of ecosystem health, in social, economic, policy and knowledge dynamics, and in restoration and preservation methods), advanced integration concepts and tools are needed in order to develop efficient adaptation and mitigation strategies.

9. Leading conceptual frameworks for analysing complex DLDD information proposed in recent years include DPSIR (driving-force, pressure, state, impact, response, initiated by the Organisation for Economic Co-operation and Development and *the persistent reduction in the capacity of ecosystems to supply services* (Millennium Ecosystem Assessment 2005). The recent Dryland Development Paradigm (DDP) (Reynolds et al. 2007) attempts to synthesize this conceptual progress into an integrated framework centered on the coupling between human and environment systems as they co-adapt to each other in a dynamic fashion in drylands.

10. Following Reynolds et al. (2007), research and practice in these fields have increasingly converged into a set of general lessons concerning the condition and dynamics of human-environment systems that can form conceptual guidelines for more effective monitoring and assessment:

(a) Both researchers and practitioners need to adopt an integrated approach; ecological and social issues are fundamentally interwoven, as are the options for livelihood support and ecological management;

(b) There needs to be heightened awareness of slowly evolving conditions; short-term measures tend to be superficial and neither resolve persistent problems nor deal with continual change;

(c) Nonlinear processes need to be recognized. Dryland systems are often not in equilibrium, have multiple thresholds, and thus often exhibit multiple ecological and social states;

(d) Cross-scale interactions must be anticipated; problems and solutions at one scale influence, and are influenced by, those at other scales;

(e) A much greater value must be placed on local environmental knowledge.

11. This progress in framing complexity in addressable ways is helping guide the development of holistic yet scientifically-sound monitoring and assessment strategies and methods. While much more progress is needed, a number of tools and methods are already available which can significantly enrich the insights obtained from knowledge-driven monitoring and assessment.

12. The foregoing discussion leads to the conclusion that DLDD cannot be measured in terms of a single numerical value, nor by an index value calculated from mathematical combinations of qualitatively different parameters (for example, soil erosion, human well-being or ecosystem resilience), because these combine “apples and oranges” without reflecting the context-specificity and dynamism of each component.

2. To be sufficiently realistic and insightful in light of this complexity, monitoring and assessment must make use of a wide range of analytical methodologies, and distil their lessons into forms useful for decision makers through integrated assessment modelling.

13. People-centered monitoring and assessment of DLDD must deal with the reality that different stakeholders have different perceptions of land degradation. From an environmentalist perspective, the clearance of land for agriculture may represent degradation, whereas from a land-user perspective it may represent an improvement, because it changes the land in ways that yield more immediately-valuable agro-ecosystem services. Assessment of the biophysical condition of land must be complemented, therefore, by assessment of what that condition means to stakeholders.

14. Simple indicators reveal only a small part of the complex DLDD picture, and do not reflect the dynamic nature of human-environment systems’ co-adaptation and stakeholders’ perception of land condition. To reduce the costs of data collection, institutions sometimes seek indicators from readily-available non-DLDD databases (such as water, environment, agriculture, health), but a consequence is that these only partially and indirectly relate to DLDD.

15. Due to these limitations, monitoring and assessment based on a minimum indicator set may be only a starting point for assessing the broad impacts of UNCCD implementation. Rather than using fixed indicator sets alone, the UNCCD community should make progressively greater use of the full range of analytical methods that are available, within the framework of a carefully-planned, holistic, multi-scalar monitoring and assessment regime. This will enable the more flexible and insightful use of indicators attuned to the aims of the UNCCD.

16. Proven techniques exist already within the methodological areas of field research and case studies, modelling, mapping, diagnostics, scenario analysis, participatory analysis, cost-benefit analysis, trend analysis, development pathway analysis, knowledge systems analysis, stakeholder analysis, sustainability analysis and many others. The application of multiple knowledge sources also helps to ”triangulate” the investigation in order to more accurately and fully characterize the entity that is being monitored and assessed.

17. Given the complexity of DLDD, the use of expert knowledge (including that of land users) will remain a valuable component of monitoring and assessment. Expert knowledge can integrate and compare complex information in ways that lie beyond the capabilities of analytical instruments, but it needs to be addressed using commonly-agreed criteria and judgement procedures. Furthermore, expert knowledge needs to be incorporated into analytical methods. Several systematic methods are available, and experience in their use has been gained in the field of DLDD. When stakeholders and decision-makers with diverse backgrounds participate in the conceptual stage of formulating a model, this tends to reduce ambiguities and logical

inconsistencies and to focus attention on the main processes and state variables most crucial to the DLDD problem at hand.

18. Through the analytical methods listed above, a wide range of complementary information can be generated, which then needs to be integrated. "Integrated assessment models" serve this purpose, particularly linking the human and biophysical dimensions of DLDD in ways that generate useful knowledge for decision makers. Integrated assessment models improve the quality of discussions in support of decision-making because they allow scientific exploration of the complex interactions that occur in H-E systems. They reveal information such as policy and decision trade-offs and consequences, stakeholder negotiation outcomes, risks, uncertainties and vulnerabilities, and they enable the ranking of choices among competing priorities.

19. Practical examples of first steps towards implementing these concepts at larger, quasi-operational scales are initiatives such as World Overview of Conservation Approaches and Technologies (WOCAT), Land Degradation Assessment in Drylands (LADA) and the Australian Collaborative Rangeland Information System (ACRIS), which are described further in item 3 below.

3. Public land-use and land-management decisions are mainly taken at national and subnational levels, and so a United Nations Conference to Combat Desertification global monitoring and assessment strategy should be designed to be compatible and synergistic with these levels.

20. Decision makers at all scale levels need to know, but in differing degrees of detail and focus:

(a) The nature (for instance, erosion, productivity decline or bush encroachment), spatial distribution, severity and extent of DLDD and the trends over time. This requires a baseline against which to monitor change, and periodic re-observation and assessment to determine the direction and rate of change;

(b) The causes of DLDD. Both social and environmental causes need to be considered, as do influences arising from activity at other levels;

(c) The risk of DLDD occurring in areas currently not affected;

(d) Actions that can counter DLDD, and their outcomes and impacts;

(e) The benefits/costs (both monetary and non-monetary) of doing nothing, versus those of preventing or correcting DLDD problems.

21. Since policy and institutional decision-making authority is usually concentrated at national and subnational levels in most areas of the world, DLDD monitoring and assessment information needs especially to provide the degree of detail needed by decision makers at these levels.

22. Much of the global-level DLDD information desired by the UNCCD can be built from careful analysis of such national and subnational information, as long as compatible protocols and standards are used. Efforts are needed, therefore, to ensure compatible, useful and scientifically-valid standards and protocols for monitoring and assessment across national and subnational levels. This harmonization is a contribution that can be made by the scientific partners to the UNCCD, with UNCCD endorsement.

23. The DDP conceptual framework described earlier asserts, *"Coupled H-E systems are hierarchical, nested, and networked across multiple scales."* While bearing level-specific characteristics, dryland social, economic and ecological systems are also linked through social networks, communications and infrastructures to other scalar domains (Stafford-Smith et al. 2009). Cross-scale linkages of stakeholders require particular attention not only at the institutional level but also for data and information transfer across other scale dimensions.

24. Building on these social implications, this DDP principle recognizes that the issue of scale is crucial for monitoring and assessment strategy. Key ecosystem services offer a consistent set of themes across scale, eventually emphasized differently at the various scales, for nesting key variables in order to up-scale data meaningfully. Based on scoping local knowledge and integrated assessment models, conceptualized knowledge on the particular DLDD situations and H-E processes for each scale and location can determine the most important variables to monitor.

25. These variables comprise internal controlling drivers, such as water availability and stocking rates at household or communal level ─ at this scale these are often perceived as "fast" changing – and external drivers resulting from processes on a wider scale, such as landscape function, land use and climate change at national and global scales; these are usually perceived as "slow" at the household level. Nesting "slow" variables in consistent themes permits some data and information to be scaled up in a diagnostic and coherent way that relates to persistent changes in ecosystem function. This architecture should best be designed using insights provided by the syndrome approach.

26. At the global level Geist and Lambin (2004) surveyed 132 desertification case studies and identified typical repeating causal patterns, resolving into four major proximate causes explained by six major underlying drivers. In a similar, albeit broader, concept, Schellnhuber et al. (1997) hypothesized that a mere sixteen syndromes (bundles of interactive processes and symptoms) might explain all major global environmental change phenomena, including those relating to DLDD.

27. The effect of cross-scale interactions on dryland systems down to the local level, and the need to focus on appropriate slow variables to determine the state of co-evolutionary systems, has been described in several studies in Niger, China and Australia (Stafford-Smith et al. 2009). Numerous studies of smallholder farming systems in Africa have observed that the great diversity of soil conditions can often be resolved for purposes of analysis into a small number of land states and trends, for example resulting from patterns of transferring scarce nutrients from outer fields to those near the household in order to increase the yields of the most important food crops ─ although the story does not end there. Influences at other scales, such as global trade and development policies, affect decision-making for such small-scale farmers (Scoones 2001).

28. It is this conceptual description of scalar influences on H-E processes, hierarchically linked through a consistent set of themes that provides strategies for designing monitoring needs and for scaling the assessment information. Such strategies can greatly increase the power and cost-effectiveness of monitoring and assessment activities. Rather than collecting large, comprehensive sets of indicator data in all locations, including many variables that are relevant only to a subset of locations, monitoring and assessment teams can focus on the key nested variables, patterns and syndromes that can be meaningfully linked at all levels.

29. A number of recent, pilot-level monitoring initiatives are currently establishing multi-scale systems for knowledge gathering, monitoring and analysis. Multi-temporal analysis of remote sensing data is increasingly integrated with interpretation schemes based on conceptual models of H-E systems (Hill et al. 2008). The ARIDnet network is exploring the application of H-E system principles in several Latin American countries. The challenge of linking local approaches to those at national and international levels is addressed by Reed et al. (2008).

30. WOCAT has developed methods and tools for documenting and evaluating sustainable land management (SLM) technologies and approaches at local levels and to assess their dissemination to subnational or national levels. Recently, these case studies have been incorporated into a participatory process of identifying and selecting best-suited implementation measures. The WOCAT mapping method has been further developed and tested together with the LADA project coordinated by the Food and Agriculture Organization of the United Nations (FAO). Similarly, Australia has launched ACRIS which addresses H-E interactions in the assessment of national rangeland states and trends.

31. These frontline applied research initiatives provide excellent building blocks that can be blended with emerging advances on integrated assessment models and novel knowledge management techniques.

4. Sustainable land management (SLM) is imperative to address the UNCCD core mission to combat desertification; therefore SLM monitoring and assessment should be fully integrated into DLDD monitoring and assessment.

32. Historically, monitoring and assessment emphasis has been placed on delineating the nature and extent of the *problem* of DLDD. Noting that the title of the UNCCD expresses a mission to ***combat*** desertification, it would also be appropriate and desirable to place a strong emphasis on the monitoring and assessment of *solutions*. LADA for example has drawn heavily on WOCAT and DESIRE methodologies to broaden its monitoring and assessment regime to include SLM solutions, as mentioned in item 3 above.

33. Information on the progress of solutions to DLDD will be valuable to those who are investing in such solutions or are considering doing so, and could spark greater support for the UNCCD. It will also enable them to identify corrective actions, if needed, to improve progress. SLM solutions, for example, form the core strategy of the Land Degradation Focal Area of the Global Environment Facility (GEF). Since its inception, the GEF has invested US$ 792 million in projects and programmes supporting SLM to combat DLDD and deforestation. The GEF is developing monitoring and assessment procedures to track SLM gains and benefits resulting from these investments (KM: Land Project).

34. A working definition of SLM suited to the UNCCD human-environment interactions perspective might be *"Land managed in such a way as to maintain or improve ecosystem services for human well-being, as negotiated by all stakeholders"*. Observations of land cover, land-use and land-management systems provide entry points for monitoring and assessing the sustainability of land management, that is, determining whether soil, water, nutrients, vegetation and other sustainability-determining assets are being managed in ways likely to support their continued viability. Rapidly advancing geospatial methodologies hold much promise for linking a wide range of data, socio-economic as well as biophysical, across scales that provide insight into SLM trends. The short-term nature of most project funding hampers the monitoring and assessment of long-term phenomena such as sustainability, but principles and practices known to contribute to sustainability can be useful proxies (practice-based approaches), such as maintaining land cover, controlling surface water flows, increasing biodiversity and many others.

35. The judgments of stakeholders, however, may differ on the preferred configuration and magnitude of the different assets and services that ecosystems produce; for example, some may benefit more from farmland, others from rangelands, and still others from wild lands. Each land-use system can be managed sustainably or unsustainably within its own context; thus contexts must be considered in SLM monitoring and assessment. Participatory monitoring and assessment involving a representative range of stakeholders is therefore required. Socio-economic and policy dynamics strongly influence SLM adoption and impacts. Policy changes can quickly drive systems towards either more or less sustainable land states. Factors such as land tenure, labour, access to inputs and markets, among others, must be monitored and assessed.

36. Water is a major constraint for SLM in drylands, and SLM can improve water management. The potential for irrigation development is hampered by many issues (cost, secondary impacts, etc.). Distant mountain ranges act as 'water towers' supplying the drylands, along with other watershed landforms (basins, catchments etc.) but climate change and deforestation are degrading these resources. SLM monitoring and assessment must take these dynamics into account. Local knowledge is a rich source of ingenious water-harvesting solutions. Adaptation of agricultural species and management practices is often the only feasible solution, but it is only a partial one. Drought can erase hard-won development gains and make land users risk-averse, inhibiting SLM investment. SLM monitoring and assessment should be designed to inform drought early warning systems and include parameters related to drought resilience. Social safety nets and alternative livelihoods have an important role to play in reducing drought vulnerability.

37. SLM requires a balancing of system inputs and outputs, such as nutrients needed for vegetative growth. Purchased inputs can replace those exported from the farm but in a long-term global perspective this strategy creates concern, and so this issue should be monitored and assessed. Economic forces may push purchased inputs beyond the reach of many dryland poor; prices of key fertilizers are likely to climb steeply in the coming decades due to the high cost of energy used in nitrogen production and diminishing global supplies of high-quality phosphorus. Strongly negative continental nutrient balances have been estimated for sub-Saharan Africa. Nutrient losses also create pollution problems in downstream ecosystems.

38. Nutrient monitoring and assessment, however, can be costly and is plagued by spatial variability. Infrared spectroscopy is an important advance; providing rapid, low-cost

measurement of several nutrients, it is now being applied in continental-scale soil health surveillance through the Africa Soil Information Service. Strong interactions exist among soils, water, nutrients and vegetation that should be monitored and assessed through systems modeling to reveal ways to increase nutrient recycling for more sustainable land management.

39. Low soil carbon content is a widespread constraint in drylands, limiting productivity through a number of biophysical mechanisms. Models available today can provide valuable indications of carbon states, trends and impacts, but continued improvements are needed to calibrate them for different dryland settings. SLM practices can increase soil carbon content, but scarcities of nutrients and water as well as economic drivers tend to constrain the achievement of this potential.

40. Additions of carbon to dryland soils in the form of “biochar” may hold potential for improving productivity in sustainable ways. This hypothesis urgently needs further testing to resolve uncertainties.. Additions of biochar could simultaneously combat climate change and generate renewable energy. Its economical viability needs to be considered and precautions taken to avoid its becoming a driver of deforestation. Biochar can be easily monitored, since known quantities would be added to known areas of land.

5. DLDD/SLM monitoring and assessment should include the collection of information relating it to climate change and biodiversity, and to other land-related issues that are the focus of multilateral environmental agreements.

41. The global environment is deteriorating in a number of interrelated ways that have triggered international action through multilateral environmental agreements (MEA). While the UNCCD brings focus to the issues of DLDD and SLM, land dynamics also impact the concerns of its sister Rio Summit MEAs, the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). Land issues also impact the topical areas of the Ramsar Convention on Wetlands (1971), the World Heritage Convention (1972) and the Convention on Migratory Species (1979).

42. The interconnections between DLDD, climate change and biodiversity loss were highlighted by the Millennium Ecosystem Assessment (MA) Desertification Synthesis 2005. MA notes that drylands, which cover a third of the earth’s land surface, hold more than one-quarter of the world’s organic carbon stores and that DLDD causes the release of an estimated 300 million tons of carbon into the atmosphere annually. The loss of vegetation due to DLDD exposes the soil to erosion and disables the recycling of nutrients, further degrading biomass productivity. These effects also degrade habitats and adaptation conditions needed to support diverse plant and animal species. Less vegetation results in increased surface albedo (reflection) and dust, which may affect climate at the local and global scales. Dust can also affect other ecosystems and human health.

43. These interconnections also imply that strong positive synergies are achievable from actions that counteract DLDD, such as SLM. For example, increases in carbon sequestered in soil also increase crop yields and therefore food supplies and food security, while also increasing land cover and reducing soil erosion. Thus SLM contributes to both adaptation and mitigation strategies against climate change.

44. The future adoption of carbon-enhancing and sequestering SLM practices is likely to be strongly driven by economic incentives such as carbon credit policies currently under global discussion. These social forces should also be monitored and assessed in order to inform DLDD decision-making so that effective carbon policies are devised and implemented.

45. Natural biodiversity supports crucial ecosystem services that counter DLDD and improve human well-being such as nutrient cycling, erosion control, water flow moderation and purification, pollination, pest control, energy (fuelwood), structural materials, medicines, herbs, foods, ecotourism and aesthetic value, among others. Agricultural biodiversity particularly supports food and animal feed supplies, livelihoods and income, pest and disease management, and the sustainability of land-use systems. Wild species relating to cultivated crops serve as a source of valuable genetic variation for plant breeding. The loss of habitat and migratory pathways and services for fauna degrades ecotourism value. In-situ and gene bank strategies are complementary ways to preserve these assets and should be supported by monitoring and assessment information.

46. The clearance of land for agriculture can be considered as a DLDD dynamic that usually results in a large reduction in biodiversity. Agricultural development strategies need to be designed in ways that minimize that damage, for example via the 'eco-agriculture' concept. Local knowledge can often reveal the value of biodiversity components that are not familiar to commercial market channels. Even when value is uncertain, the extinction of biodiversity components would be irreversible and so a precautionary approach should be taken in adherence to Principle 15 of the Rio Earth Summit (United Nations Conference on Environment and Development, 1992) and other international agreements.

47. Monitoring and assessment data is essential for biodiversity conservation. The 2010 Biodiversity Indicators Partnership, for example, is producing global-scale, DLDD-relevant indicators aiming to reduce the rate of biodiversity loss significantly by 2010, many of which are also applicable at the regional, national and subnational scales.

48. Climate change and human activities will alter habitats resulting in shifts in species and in gene frequencies for adaptive traits (such as heat, pest and disease resistance). Some changes may be too rapid for evolutionary adaptation, causing thresholds to be crossed that can destabilize ecosystems in disastrous ways, such as by causing massive pest/disease epidemics, fires and shifts in dominant species. Such disasters can debilitate carbon sequestration, nutrient recycling and other ecosystem functions, generating feedback loops that further aggravate climate change and DLDD. An example that has degraded many dryland areas is the encroachment of woody shrubs into rangelands. Monitoring and assessment tools are needed that can foresee such risks and thresholds to provide early warnings for decision makers.

6. To aid decision makers in setting priorities, monitoring and assessment should collect information on the economic, social and environmental costs of DLDD, and the benefits of SLM. The potential role of economic modelling should be explored to develop policy mechanisms that can facilitate sustainable land management decisions.

49. National decision makers are flooded with urgent demands for action on a wide range of issues, and must make choices among them. A major factor influencing such decisions is the prospective return on investment, as demonstrated by the impressive impacts of the Stern Review on the Economics of Climate Change and the highly anticipated impacts of the Economics of Ecosystems and Biodiversity on decision-making by governments. Long-term benefits need to be considered to ensure sustainability, enable wise land use planning and reveal the true costs of short-term land exploitation and “land grabs”.

50. Due to insufficient data, DLDD-related benefit/cost analyses are few and based on coarse assumptions. This shortcoming is unfortunate, because combating DLDD should in principle yield very significant returns on investment. The benefits/costs of monitoring and assessing itself (as advocated in item 1 above) should also be delineated, so that Parties gain a clear rationale for engaging in this activity.

51. SLM interventions can transform DLDD losses into gains by raising incomes, reducing vulnerability to climatic fluctuations, and extending the productive use of land well into the future. Other means of combating desertification and sustaining livelihoods can also deliver important benefits (land rehabilitation, carbon sequestration, ecotourism, off-farm employment, for instance).

52. An accurate benefit/cost analysis must consider the value of environmental services, whether or not a mechanism exists for actual monetary payment for their use. Not all values (benefits or costs) are monetary; the land provides a range of ecosystem services that benefit humans in both tangible and intangible ways (such as culturally and spiritually).

53. Much research is under way globally to establish values of ecosystem assets, goods and services (and their loss, due to DLDD for example), including both monetary and non-monetary values. The valuation of biodiversity has made particular progress. The principles can be extended in a straightforward manner to other DLDD assets, goods and services.

54. Even when no fees are paid for ecosystem services, the revealed preferences of economic agents can be observed in order to estimate values. Such methods include public pricing, avoided-damage values, replacement/substitution costs, travel expenses to a site to gain ecosystem services, mitigation costs, hedonic pricing, contingent valuation (willingness to pay for a service), and local group evaluations, amongst others.

55. Where economic agents cannot be directly observed, indirect valuation is used. This approach assigns a monetary value to the damage caused by land degradation using dose-response and replacement cost methods. For example, the cost of fertilizer is a way of estimating the value of the loss of soil fertility that it replaces.

56. A benefit/cost analysis leads naturally to an examination of the potential for payment for environmental services (PES). Candidate ecosystem services most frequently mentioned for potential PES are (a) watershed protection, (b) biodiversity conservation, (c) landscape aesthetics, and (d) carbon sequestration. More than 400 PES schemes are currently under operation in many countries with public-private partnerships (not only in drylands).

57. International payments for carbon sequestration linked to the proposed United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD Programme) mechanism under the UNFCCC could generate financial resources for dryland countries. The cancellation of debt by lending nations in exchange for the protection of ecosystems by developing countries (debt-for-nature swaps) and microcredit to stimulate sustainable livelihoods are related opportunities for financing efforts to combat DLDD.

7. Monitoring and assessment should capitalize on knowledge management to stimulate valuable synergies between different sources of expertise across different spatial and temporal scales and levels, social settings, institutions, scientific disciplines and development sectors.

58. The complexity of DLDD demands monitoring and assessment approaches that are richly based in knowledge. Since many diverse interests (people, governments and institutions) hold stakes in land issues, monitoring and assessment must utilize multiple knowledge sources at different scales. Knowledge management (KM) addresses access to, and the conservation and sharing of, knowledge.

59. KM requires an understanding of how people learn in different settings (institutional, cultural, social) and how they overcome barriers to that sharing and learning. A vast literature has developed on how learning occurs or fails to occur in various settings. Much is known about the role of social networks, communities of practice, knowledge brokering and the role of intermediaries in the sharing of knowledge. Agent-based models have been developed which explain how knowledge flows (or becomes sequestered) within social networks depending on behavioural characteristics.

60. As societies develop, the erosion of local knowledge is an especially urgent concern, particularly with respect to land management. Attempts to conserve local knowledge in databases have led to disappointment; knowledge tends to be preserved, developed and shared only when it is used. In practice, much knowledge exchange takes place during knowledge generation itself, dissolving the boundaries between knowledge production, transfer and application. Research in Namibia, for example, found that land users had a deeper understanding of the causes and effects of environmental change, and a richer set of indicators, compared to those monitored by the formal sector. In Australia, Aboriginal knowledge has repeatedly exposed the limitations of short-term ecological research paradigms. However, care must be taken to properly attribute intellectual property rights to local communities.

61. By hybridizing local and scientific knowledge, more effective monitoring and assessment can be achieved. In Namibia, indicators identified by local farmers based on their information needs are monitored by the famers themselves; experts from the formal sector help to analyse

and interpret their data and work with them to identify options for dealing with rangeland problems. This approach is captured within a systematic framework for DLDD monitoring, assessment and remediation by Reed et al. (2006).

62. A variety of methods exist for evaluating, combining and integrating local and scientific knowledge. However, the use of these tools is often inhibited by institutional, cultural, scale, level, language and other boundaries that inhibit knowledge flows. “Boundary organizations” have emerged in an attempt to straddle these barriers.

63. For example, the global Drynet network acts as knowledge broker between organizations interested in dryland degradation and SLM. In Namibia, the Forum for Integrated Resource Management fosters knowledge exchange between farmers and those who provide services to them. The European Commission’s Northern Mediterranean Regional Action Programme (MEDRAP) Concerted Action (2001–2004) promotes knowledge exchange between the UNCCD institutional community and the scientific research community in Greece, Italy, Portugal, Spain and Turkey. WOCAT (described earlier) performs a clearing-house function for sustainable land management approaches while at the same time serving as a network of experts and practitioners at the national, regional and international levels, facilitating expert knowledge exchanges through direct contacts.

64. The effective storage and dissemination of knowledge requires bodies that carry out knowledge clearing-house functions. The Sahara and the Sahel Observatory (OSS) launched an initiative in 2000 called Desertification Information Systems – Environmental Information (DIS-EISI). DIVERSITAS carries out such a role in the field of biodiversity as well as utilizing that knowledge to develop scientific plans for decision makers, and to communicate policy implications to them.

65. The use of monitoring and assessment knowledge within the UNCCD and related bodies poses challenges. The implementation of MEA obligations by national governments has been constrained by limited financial and human resources. Although there is wide agreement on the need for more coherence in the implementation of the Rio MEAs, this has been difficult to put into practice. Within the United Nations system, numerous organizations and specialized agencies work on different aspects of DLDD, including FAO, the United Nations Development Programme, the United Nations Environment Programme, the World Meteorological Organization, the World Food Programme, the United Nations Educational, Scientific and Cultural Organization, the Committee on Sustainable Development, the United Nations Forum on Forests, and the General Assembly of the United Nations, as well as the donor agencies that support their work such as the International Fund for Agricultural Development, the World Bank, GEF and the regional development banks. Knowledge-sharing amongst these institutions needs to be improved. Similar improvements are needed in knowledge-sharing between institutions at the national level.

66. The seventh Millennium Development Goal requires countries to integrate (mainstream) the principles of sustainable development into their policies and programmes — a knowledge flow gap confounded by many institutional obstacles. However the national action programmes (NAPs) developed by many Parties to the UNCCD have yet to be mainstreamed in most cases. Tunisia is an exception; its efforts to combat desertification are now embedded in the country’s

social and economic development plans. Swaziland has also established its NAP within the National Development Strategy, the Swaziland Environment Action Plan and the Poverty Reduction Strategy and Action Plan as well as in other strategies.

8. Sharing of local and scientific knowledge, tools and methods will enhance monitoring and assessment and strengthen human and institutional capacities.

67. The overarching constraint reported by ministries, agencies, non-governmental organizations, scientists, research projects and others in developing countries, and identified by virtually all studies and reports on the implementation of MEAs, is a lack of institutional, financial and human capacity to address physical and human resources and skills requirements adequately. Capacity affects responses to, and the effectiveness of, monitoring and knowledge exchange, along with the ability to implement treaties effectively.

68. Knowledge management can help to overcome this constraint if barriers to knowledge sharing and knowledge management between local, national, regional and international levels are eased. Capacity-building needs to be cross-sectoral to overcome past shortcomings in addressing the complexities of DLDD, including the need to incorporate actions into government agendas, analyses, frameworks and policies.

69. In addition, capacity-building needs to foster greater collaboration and coordination of activities at regional, national and local levels. A prerequisite to such capacity-building would involve strengthening national/regional academic curricula on dryland science for development, thus training the decision makers of tomorrow and supporting strong ties between research and policy communities on sustainable dryland development.

70. The monitoring and assessment process itself acts as a capacity-building function, as diverse stakeholders share their expertise and knowledge about the conditions and trends of land. Knowledge from different scale levels, including local knowledge, brings new and enlightening perspectives to the other stakeholders. The integration of monitoring and assessing both the problem of DLDD and its solutions, as discussed earlier, provides a mechanism for not only building capacities but also for converting them into action to solve DLDD problems.

71. Capacities should be built in a way that strengthens existing institutions in affected countries, increasing acceptance of the continuing need for monitoring and assessment activity. For example, the BIOdiversity Monitoring Transect Analysis in Africa (BIOTA) project has trained local “para-ecologists” to carry out degradation assessment and monitoring using knowledge-sharing methods that inform local management decisions; they become key knowledge-sharers in their communities. LADA is strengthening monitoring and assessment agencies in major dryland zones on three continents by developing regional training centres within national institutions.

9. Coordination and dissemination of new knowledge and methodologies for integrated approaches to DLDD/SLM require the establishment of an independent, international, interdisciplinary scientific advisory mechanism which would include (but not be limited to) monitoring and assessment, with clear channels for consideration of its advice in Convention decision-making.

72. The breadth of scientific studies on DLDD is rapidly expanding the knowledge resources and toolkits available to make fresh progress against this difficult problem. These emerging opportunities need to be identified, evaluated and utilized on a continuing basis in ways that best support the mission of the UNCCD.

73. The UNCCD has taken an important first step in this direction through the organization of its 1st Scientific Conference. However, conferences may not be the optimum vehicles for providing ongoing scientific advice, building scientific knowledge bases, and carrying out in-depth assessments and analyses. To provide the continuity, breadth and depth of support that the UNCCD mission requires, an ongoing, independent, scientifically-credible mechanism is needed.

74. Such a mechanism should be policy-relevant but not policy-prescriptive. It should allow decision makers to be objectively informed about the likely consequences of different policy and implementation choices they might make.

75. The value of such a mechanism will depend on the degree to which it is perceived by the world as scientifically credible. To be credible, it must be transparently free of non-scientific influences, and thus managerially independent from the political process of the UNCCD. It must base its analyses on evidence that is verifiable, and subject its conclusions to widely-recognized scientific quality control processes such as peer review.

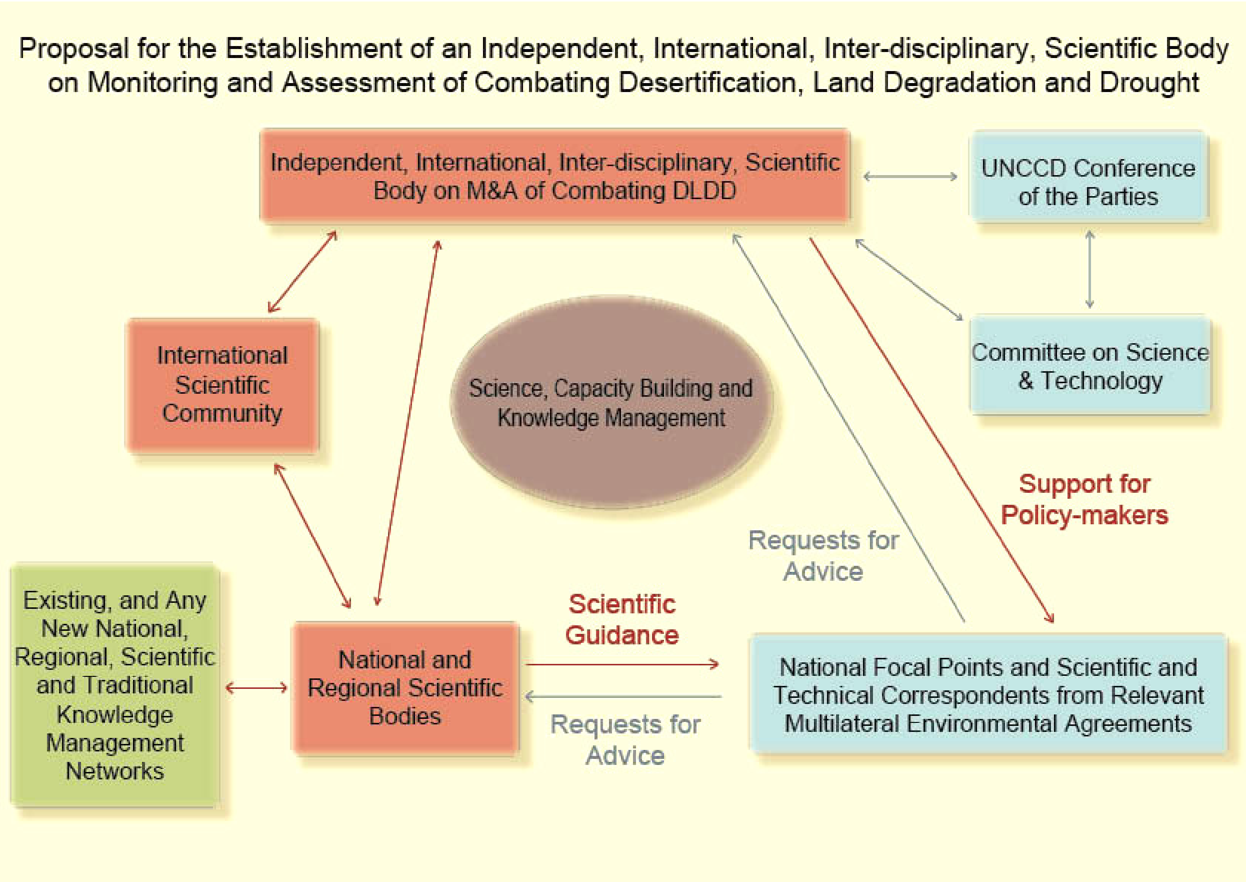
76. The mechanism should not conduct research itself, but should draw on scientific knowledge and research findings that are continually emerging from the thousands of institutions and agencies worldwide which address different aspects of DLDD by tapping organized knowledge sources, where these exist (see item 11), and should link this knowledge to capacity-building efforts (see item 8). The mechanism should interact closely with national and regional science mechanisms that tackle DLDD.

10. In order to propel principles into action, regular global DLDD/SLM monitoring and assessment and early warning mechanisms should be organized and implemented based on agreed standard protocols and open data access policies, to harmonize with other efforts worldwide and to minimize duplication of effort.

77. A mechanism is needed to implement the modern principles of DLDD/SLM monitoring and assessment described in this document. The UNCCD is the only one of the three Rio conventions that is not supported by a dedicated observation system. The UNFCCC benefits from the Global Climate Observing System and the CBD is supported by the Group on Earth Observations Biodiversity Observation Network (GEO BON) system within the Global Earth Observation System of Systems. These systems facilitate the integration and interoperability of existing observation networks and enhance the credibility of the two conventions. The two

systems were launched in response to the 2002 World Summit on Sustainable Development and given impetus by the G-8 group of leading industrialized nations.

78. In similar fashion, many DLDD scientists have urged the establishment of a Global Drylands Observation System, or GDOS, to support the UNCCD. The GDOS concept would avoid replicating or duplicating existing monitoring and assessment systems. Instead, it would integrate and harmonize them, developing agreed standards and protocols which, as is discussed above, are essential for an integrated global assessment. A GDOS-type mechanism would synthesize and build on learning gained from pioneering DLDD/SLM monitoring and assessment initiatives such as ACRIS, ARIDnet, Agro Hydro-Meteorology (AGRYMET), the Asian Regional Network for Desertification Monitoring and Assessment (Asia-TPN1), BIOTA AFRICA, DESIRE, DISMED, the Global Assessment of Human-induced Soil Degradation (GLASOD), the Global Land Project (GLP), the Global Terrestrial Observation System (GTOS), LADA, Long Term Ecological Monitoring Observatories Network/Sahel-Sahara Observatory (ROSELT/OSS, WOCAT, among others, as well as famine early warning systems that operate in many of the world's drylands, such as the Famine Early Warning System Network (FEWSNET) and the Global Information and Early Warning System (GIEWS). It would provide a platform for the continuing evolution of monitoring and assessment systems, for example, through the testing and implementation of emerging scientific concepts and techniques such as the DDP synthetic framework described in item 1.



11. The United Nations Convention to Combat Desertification community would benefit from a science networking mechanism so that the large yet dispersed body of DLDD/SLM knowledge and expertise worldwide could be more effectively accessed, used and shared.

79. Due to its complex nature, DLDD research cuts across many scientific disciplines and also intersects with other knowledge bases (such as development practitioners' and land users' knowledge). As a consequence, DLDD research and related knowledge is highly dispersed across thousands of universities, institutes, agencies and organizations around the world. For example, identifying and mobilizing this dispersed community in a short time frame emerged as a major challenge in organizing the UNCCD 1st Scientific Conference.

80. This dispersion significantly impedes the flow of coherent scientific information to the UNCCD as well as synergies with other multilateral environmental agreements such as the CBD and UNFCCC. It also impedes the development of integrated scientific approaches, and allows inefficiencies resulting from duplication and constrained knowledge flows.

81. In order to provide more comprehensive and responsive scientific input to the UNCCD, a networking and coordination mechanism for the global DLDD science community is needed which would feed into the science advisory mechanism recommended in item 10, improving the efficiency and effectiveness of that advisory mechanism. In this way the UNCCD could benefit from valuable services such as:

(a) Determining the prevailing views of scientists worldwide on pressing DLDD questions;

(b) Mobilizing scientific expertise to address specific questions and issues in more depth;

(c) Formulating widely-supported scientific plans requiring global cooperation and donor backing;

(d) Providing a clearing house and platform for exchanging scientific knowledge and stimulating discussion about DLDD;

(e) Providing a mechanism for forming scientific partnerships to tackle high-priority DLDD research challenges;

(f) Providing a referral mechanism for scientific capacity-building and mentoring opportunities with regard to DLDD.

82. DLDD scientists have begun organizing themselves through networks such as DesertNet International and the Global Network of Dryland Research Institutes. This good start should be given more support and impetus. It should tap the Earth Science System Partnership framework which already contributes substantially to the knowledge bases of sister environmental conventions through the Intergovernmental Panel on Climate Change and the CBD. Other arrangements could also be envisioned. UNCCD endorsement of the need would provide support

for the initiation of discussion by a range of scientific bodies on institutional formats for such a "network of networks" mechanism.

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