POSSIBILITIES TO USE THE "LAND DEGRADATION NEUTRALITY" APPROACH FOR SUSTAINABLE LAND MANAGEMENT MEASURING AND MONITORING

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Introductory lectures UDK 631.452(470)

BSTRACT

Key messages of the paper include the following: (i) Land Degradation Neutrality (LDN) is a new paradigm reflecting the cross-linked aspirations and demands of land-related sustainable development goals; (ii) LDN is politically sounding and attractive, it has a good background to be economically evaluated; (iii) LDN is a part of "Land-based approach" and might be considered as an operational platform for overlapping issues of 3 Rio conventions; (iv) LDN state can serve as a SLM target and overall criteria at different levels (local, subnational, national); (v) Spatial and temporal changes in land cover are measurable by indicators of land quality balance; (vi) LDN is not equally measured and is a site-specific (national-specific) matter, although global indicators of land quality can be considered as common platform for coordination; (vii) LDN concept needs advanced scientific development

Keywords: *Land Degradation Neutrality, Sustainable Land Management, Climate Change Adaptation*

INTRODUCTION

Present land degradation processes are growing globally, so that soil degradation is even named as a "silent crisis of the planet" (Dobrovolskiy and Kust, 1995). The sustainable land management (SLM) concept is widely considered to be the main approach to prevent, avoid, mitigate and restore land degradation. In spite of SLM became a strong-advocated basic idea for many land use projects in different countries, it is still a big gap between announcement of the need for SLM and real SLM practices, because the SLM targets are very different, mostly site- and national-specific, and indicators are not well defined and case-sensitive in many cases.

The possible decision can be discovered through application of the idea of the Land Degradation Neutrality, which grew up from the concept of Zero Net Land Degradation

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(so-called Changwon initiative), has been already promoted by the UNCCD (2012) and adopted as an overall UNCCD target in 2015 (COP12) and was widely discussed in recent scientific literature (Chasek *et al*., 2013; Tal, 2015, Stavi and Lal, 2015; EC JRC, 2014).

The will to 'strive towards a Land Degradation Neutral World" was expressed in the resulting document of the Rio+20 conference (The Future We Want, 2012). Land degradation neutrality was also addressed in the discussions held on formulating the post-2015 Sustainable Development Goals (SDGs) in the goal 15.3: "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss". The target of this goal sounds as: "by 2030, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world".

In spite of all these discussions, it is however felt by many that this is still a vague target with inherently lots of unknown aspects of land degradation neutrality. Thus it is necessary to explore the links of the LDN and SLM concepts and possible solutions for the application of the LDN target to reach SLM objectives.

SLM AS AN EVOLVING KEY APPROACH. SLM VERSUS LAND DEGRADATION

SLM as a concept appeared in late 90-s and was not "sustainable" at the beginning. It grew from the matters of "effective" land management and/or "rational" or "efficient" land management used in different countries at national level. In turn a brief history of the SLM concept development at global level which can be traced clearly throughout its definitions shows its development from the Land Management as a process to sustain land resources and people well-being, to the key investment area for strengthening resilience to environmental changes and disasters, including changes of climate. The definitions provided below show that the SLM can be considered either as a "concept", or "approach", or "method and procedure", either "process", "goal", "successful story/good practice", or even as an investment.

*SLM is **the use of land** resources, including soils, water, animals and plants, **for the production of goods** to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions (UN Earth Summit, **1992**).*

*Land management is the **process** by which the resources of land are put **to good effect**. It covers all activities concerned with the management of land as a resource both from an environmental and from an economic perspective (UNECE, **1996**).*

*The GEF **mandate to combat land degradation** focuses on sustainable land management (SLM) as it relates primarily to desertification and deforestation (as a result of unsustainable practices (GEF, **2003**).*

*SLM is a knowledge-based **procedure** that helps integrate land, water, biodiversity and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods (World Bank, **2005**).*

*SLM is the **adoption of land use systems** that, through **appropriate management practices**, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources" (TerrAfrica, **2005**).*

*WOCAT (**2007**) for its platform selected the definition suggested by the UN Earth Summit (1992), and underlined that "SLM" is the better thinking than Land Degradation, as it shifts the concept from "bad news" to "good news"*

*SLM has been recognized as **a key investment area** for strengthening resilience to the impacts of climate change under the Pilot Programme for Climate Resilience, paving the **way for** the integration of SLM into **core development planning** and implementation (PPCR, **2009**).*

*SLM is land managed in such a **way** as to maintain or improve ecosystem services **for human well-being**, as negotiated by all stakeholders (UNCCD, **2009**).*

During last decades a soil science made a big input in the development of the concept of SLM. Having no possibilities to discuss this in small paper, we need to emphasize a number of ideas conceived by soil scientists. There are: the idea of soil functions in biosphere and human life, which in turn developed into the concept of ecosystem services, the idea of "soil health", the global assessment of land a soil degradation, and some others, which are based on the platform that soils are the basis for many productive biophysical terrestrial systems of the globe. It is so, because in comparison to living organisms soil is a product of biophysical interactions of hundreds and even thousands years, and its recovery needs much more time than the recovery of communities of plants and animals in case of their loss.

The modern SLM concept in this connection considers the difference between land (as a piece of territory) and land/soil (as a biophysical productive system performing important environmental functions/ ecosystem services). Considering some good agronomic practices as SLM at local level, one should not forget the indirect links within watersheds, or that the use of fertilizers supports the productivity but can promote the loss of the overall soil fertility, etc.

The land and its healthy soils allow agricultural production and contribute to poverty reduction and food security. Land's and soil's functional aspects include vegetation cover providing nutrient regulation and physical protection from e.g. erosion; natural drainage or water retention providing water regulation services including prevention from flash and mud floods; biodiversity habitat protection; land / surface interactions (gas, water and energy exchange) as part of the climate and meteorological systems. A

healthy well-structured soil is the nutrient engine of the land; it can regulate vast amounts of carbon and provides an incredible amount of biodiversity. Preserving the good condition of land and all its functional structures, with soil as a main component, is required to continue to provide ecosystem services in a sustainable way and to avoid land degradation (EC JRC, 2014).

METHODS AND BASIC APPROACHES

Here we present the results of the study and understanding the concept of LDN for its scientific development and practical application, basing on our experience in the East Europe, Central Asia, the development of the Russian "Healthy Soil" initiative for the Group of Eight presented in 2014 (which unfortunately was not realized due to certain political circumstances), and also preliminary results of the discussion of this concept in the UNCCD Intergovernmental Working Group on the follow-up to Rio+20 (IWG) which worked on the elaboration of the internationally recognized science-based definition of the land degradation neutrality (LDN).

PARADIGM SHIFT?

THE VARIETY IN CONSIDERATIONS OF THE LAND DEGRADATION NEUTRALITY (LDN) CONCEPT

In practical terms the LDN concept is clear enough: SLM actions should not allow reducing the existing balance between "not yet degraded" and "already degraded" lands with persistent desire for the restoration of the last. Thus, the LDN can be considered as a practical tool to balance processes of land degradation and restoration/rehabilitation/recovering at global, regional, national and local levels.

It is also transparent, that according this common practical understanding the LDN has two linked dimensions: (i) reducing the rate of degradation of non-degraded land; (ii) increasing the rate of restoration of degraded land. Various fora have highlighted the risk of using one dimension to offset the other in the form of a trade system – this offsetting is to be avoided.

Also, rather than a global equilibration, global neutrality should be considered the sum of neutrality achieved by local communities and nations around the globe.

Other views and opinions on "What is the LDN about?" differ, but we tried to collect the various opinions from different sources on what the LDN should address for. Consequently, the basic vision and bedrock of the LDN concept consider the following matters:

- *changes in the LDN state has two co-linked dimensions: available land quantity/quality up and down alterations*
- *scattered effects related to both dimensions/directions can occur in synergy*

- *consequently, LDN promotes an ecosystem-based approach with two umbrella pathways of action: (i) addressing current and future LD (avoiding/preventing /minimizing LD): e.g. transition to SLM; (ii) redressing past LD: e.g. rehabilitate working landscapes and restore natural ecosystems*
- *the LDN concept considers spatial and temporal scales of actual manifestations and changes in land quantity/quality pari-passu with increase and mitigation of DLDD risks/threats*
- *land quality (both natural inherited and man-made artificial) is a multilateral term, which could mean productivity, functions, ecosystem services and their resilience, regeneration capacity, soil and ecosystem health, land potential, etc., or their combinations*
- *LDN recognizes the different uses of land and considers various approaches and methodologies to reach the LDN target, and as such it is about negotiating trade-offs and taking advantage of synergies in the management of these resources for multiple benefits*
- *recording changes in the LDN state needs baseline for its assessment and evaluation*
- *key LDN indicators should be easily monitored*
- *each country can declare their level of ambition*
- *the LDN should address links to biodiversity and climate change, poverty eradication and food security issues*
- *LDN requires an enabling environment in which all stakeholders participate and accept responsibility and voluntary commitments. This may include new legal frameworks that foster improved governance; technical and institutional capacity building for communities and individuals; increased investments and other incentives; etc.*

The scientific study of different explanations of the LDN concept withdrew three main constituents of the issue that let us emphasizing three approaches available to define the LDN:

- as a concept of land use/land management contributing/favouring to sustainable development at global/regional/national/local levels to meet the needs of future generations,
- as a phenomenon of equilibrium/homeostasis/constancy of land system in terms of the balance between deterioration and improvement of terrestrial ecosystems' qualities, functions and services; LDN occurs when ecosystem services are balanced artificially or naturally,
- as an SLM target to be adopted at national, sub-national or local level to sustain and improve natural resources for economic, social and environmental benefits, and food security.

The discussion of the term at various fora shows there is still a lack of commonly agreed scientific approaches to address the LDN definition. Scientists are still requiring the

following answers: *What is the scientific base behind the concept? What science do we need to develop the concept (incl. social, economic, natural sciences, others)? What scientific studies and methods should be developed/undertaken to support policy decisions, and on the nexus of Rio conventions, in particular? What encouragement efforts ought to be undertaken in this case?* (Global Soil Week, 2015)

In spite of this a few of political solutions are already in place. For example, it is not strongly debatable already, that LDN strategy is not a "license to degrade" or a grand compensation scheme to restore the productivity of one area of land to offset degradation that has taken place elsewhere. It was also mutually agreed that while addressing achieving LDN each country can declare their own level of ambition and the steps undertaken depending on available national resources and/or international assistance. LDN is not a global target which requires a new protocol or international agreement.

Basing of these fundamental agreements, and taking into account the variety of approaches addressing LDN, the UNCCD recommended the following definition of the LDN as a consensus of policy makers, civil society, business, land users and scientists approaches:

Land Degradation Neutrality is a state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales, and ecosystems.

LDN AS AN INDICATIVE TOOL

Being defined as a "state", the LDN is likely to serve as a universal indicator for different modern concepts, such as SLM, either Climate Change (or disaster risk) Adaptation, ecosystem resilience and/or vulnerability, or some others, which are not clear enough, and sound mostly as slogans without concrete and simple content. The application is obvious and could be interpreted as the achieving LDN within specified spatial and temporal limits means that this land is managed in "sustainable" way or "adapted" to any possible environmental changes within the same limits.

The upcoming issue in this case is **what are the indicators for LDN itself**?! Some ideas can be realized from a conceptual definition of LDN suggested by us (Kust, Andreeva, 2014): LDN is an ecosystem-based target when healthy land resources remain environmentally, socially and economically available and sustainable, and provide raising opportunities for application of sustainable land and water management practices and their dissemination through mitigating degradation risks and land rehabilitation measures.

Anyway, it must be noted that there are different approaches to indicate LDN state, existing at present time, which needs coherent harmonization.

One is what we name as an "Anti-Degradation call", which sounds in general like "(Eco) system(s) overall harmony needs safety". This call is coming from the "environmental" community, and mainly corresponds to the global environmental issues and ecosystem services. Another is a "Production-defensive call" sounding like "Sustainability of resources and bioproductivity required", and it is coming mainly from "food security", agricultural, and "natural resource management" communities. If the first is oriented on the environmental safety, another is oriented on the production and economic matters.

This means in general, that to the moment there are two main groups of indicators to be considered as possible indicators for LDN as a state. Both groups relate to the issue of "***What matters do we measure for LDN?"*** First of them is "measuring land degradation", which contains different possible options discovered and developed to different degrees: land quality, land quantity, scores of "relative fertility", land availability, soil/environmental health, etc. Second group explore the possibilities of measuring what the land produces, and consist of different and numerous biophysical and also economic and social parameters, such as bio-productivity, yield, vegetation cover, NDVI, income, economic and social benefits, ecosystem services, and others.

In view of the current and expected global pressures on the land to keep feeding an increasing world population, the "second group" is a bit more developed as a significant aspect is pointed to the importance of land productivity, its preservation or sustainable increase, and the knowledge on the current rates of land productivity. This has three key consequences (EC JRC, 2014): (i) a baseline has to be established against which to measure changes in land productivity; (ii) commitment to specified targets have to be agreed, (iii) mechanisms to monitor and assess the state of the land, and land productivity, at all scales have to be realized. It was emphasized, that although the targets can be set, but progress can only be measured against a baseline. Indicators need to be agreed that represent land productivity and/or related aspects that can be measured in a consistent, uniform and transparent manner. Also understanding of the interaction and the underlying drivers of land productivity change needs to be expanded if degradation has to be reduced or restoration has to be done successfully.

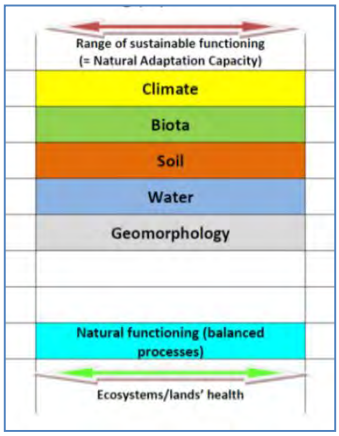
It is likely to note that all these aspects related to land productivity indicators fully correspond to other indicators including those from the "first group", that provides a good operational platform for their harmonization, taking into account the different traditions and approaches used in different countries and regions. It is essential to note, that probably the areal assessments (evaluations based on areal measures) will be a priority at the first steps of the LDN practical application, but further development for a qualitative assessment, and here the concept of soil health, ecosystem services, food security, social stress, water stress, etc. will be essential.

Another operational platform to harmonize the indicators system in different countries is the shortlist of internationally agreed land and soil indicators, which follow a tiered approach (see graphic below) and can be enriched at the national and sub-national level.

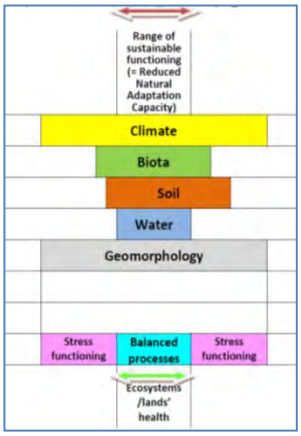
The list of global land and soil indicators encompasses: 1) land cover/land use change, 2) land productivity change and 3) soil organic carbon change (GLII, 2015). These indicators are measurable and essential in capturing a minimum of land characteristics that are globally comparable. Land cover/land use serves as an 'umbrella indicator' that allows stratification/disaggregation of the land productivity and soil organic carbon indicators. Land cover classes (e.g. forestry, agriculture, urban) will vary in importance depending on the context. Changes in land cover/land use give a first indication of the loss or degradation and restoration of land and soil quality. Land productivity addresses the net primary production per unit of area and time. Changes in land productivity, interpreted together with additional data, may give an indication on the loss or degradation, as well as on the restoration of land and soil quality. Soil organic carbon is relevant to estimate carbon fluxes and can be an important indicator of overall soil quality. The same set of three biophysical indicators were proposed by the UNCCD Secretariat for reporting on land-based adaptation, within a monitoring and evaluation framework (UNCCD, 2015).

One more issue of the application of LDN as an indicator addresses the question on "***What balance do we measure for LDN?***" To answer this question, the following points are critical.

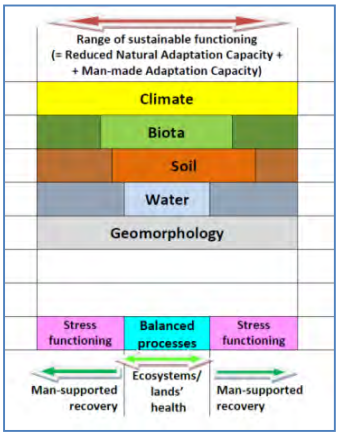
As it has been mentioned earlier, the LDN dynamics can be measures as a balance, which in turn requires a baseline for further monitoring. There are almost no doubts that for this purpose the state of the land and degradation/restoration processes (in terms of national- and site-specific indicators selected from the options described above) to the date of the last evaluation within a specific spatial scale can be determined as a necessary baseline.



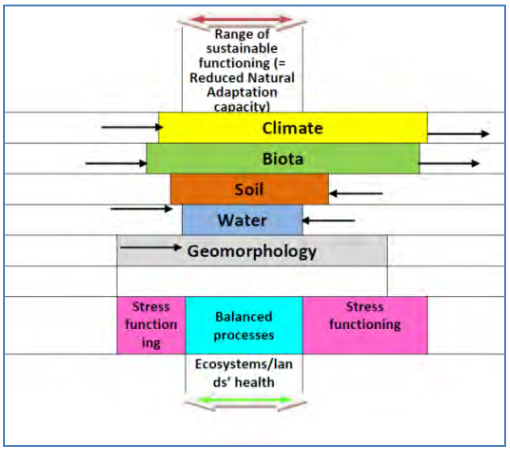
Natural sustainable functioning (equilibrium in constituents)



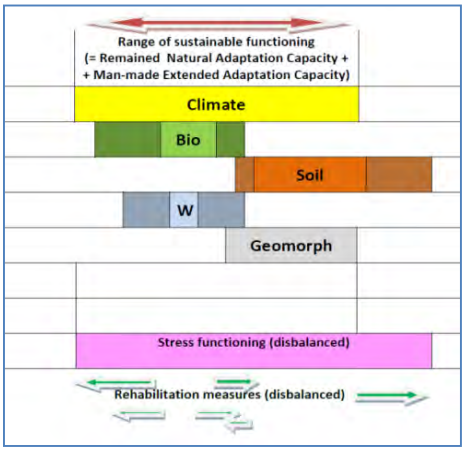
"Consumption-style" land use/management (e.g. traditional agro cosystems)



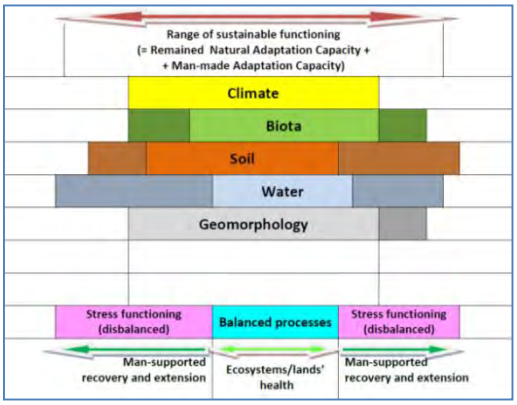
SLM functioning (adequate compensations required)



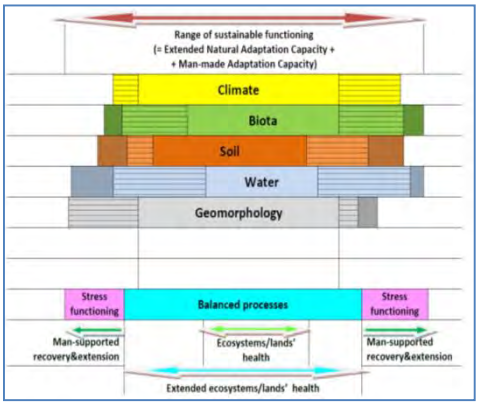
Stress affected functioning in traditional land use/management



Land/ecosystem degradation



Extended land use/management (man-made extension of resources/capacities)



Environmental land management (man-supportive extension of environmental services/externalities: new crops, artificial soils, irrigation, etc.)

In this case evaluation of the LDN progress can be measured by the ratio between land degradation (or risk of) and restoration (or avoiding/ preventing), which should not exceed '1' temporarily and spatially in terms of their areas. Indicators and/or metrics to reflect this ratio/balances can include different approaches based on the comprehensive assessment of available land quantity, land qualities and land degradation risks adaptive to various countries and areas, e.g.: between degraded/restored, destroyed (or alienated)/rehabilitated, between productive/unproductive, contaminated/recovered, etc. It can include not only the indicators of land and soil quality, but also indicators of land

grabbing, soil contamination, land availability, changes in land use/land cover, economic and social benefits, etc.

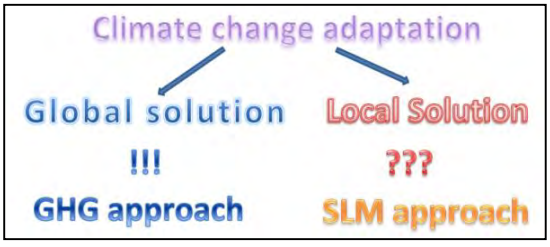
Another perspective approach, which can be practically more useful for monitoring LDN because of possibility to merge different indicators an assessment of the homeostasis of the soil/land cover is: a state when a set of components and ratio between them in terms of their areas remains constant within the ecosystem although internal mutual replacements can occur. The scientific basis for the development of this approach was discovered earlier and can rely on the ideas of the dynamics of soil cover in desertification affected areas (Kust, 1999) and of the invariants of soil cover changes (Goryachkin, 2006).

Some additional ideas on the understanding land dynamics and degradation states as well as the methodological approaches to achieve equilibrium and homeostasis in land degradation (=LDN) are reflected in a set of pictures above.

SLM, LDN AND CLIMATE CHANGE ADAPTATION ISSUES

A number of new concepts and paradigms appeared during last decades, such as sustainable land management (SLM), climate change (CC) adaptation, environmental services, ecosystem health, and others. All of these initiatives still not having the common scientific platform although some agreements in terminology were reached, schemes of links and feedback loops created, and some models developed. Nevertheless, in spite of all these scientific achievements, the land related issues are still not in the focus of CC adaptation and mitigation. The last did not grow much beyond the "greenhouse gases" (GHG) concept, which makes land degradation as the "forgotten side of climate change".

The possible decision to integrate concepts of climate and desertification/land degradation could be the considering of GHG" approach as providing global solution, and "land" approach as providing local solution covering other "locally manifesting" issues of global importance (biodiversity conservation, food security, disasters and risks, etc.) to serve as a central concept among those.



SLM concept is a land-based approach, which includes the concepts of both ecosystem-based approach (EbA) and community-based approach (CbA). SLM can serve as in integral CC adaptation strategy, being based on the statement "the healthier and resilient the system is, the less vulnerable and more adaptive it will be to any external changes and forces, including climate".

For these reasons the land-based approach using the LDN indicator and a tier of land-based indicators can serve as an operational tool for climate change adaptation assessment, as it was stated above in relation to the SLM assessment.

KEY MESSAGES:

- LDN is a new paradigm reflecting the cross-linked aspirations and demands of land-related SDG
- LDN is politically sounding and attractive, it has a good background to be economically evaluated
- LDN is a part of "Land-based approach" and might be considered as an operational platform for overlapping issues of 3 Rio conventions
- LDN state can serve as a SLM target and overall criteria at different levels (local, subnational, national)
- Spatial and temporal changes in land cover are measurable by indicators of land quality balance
- LDN is not equally measured and is a site-specific (national-specific) matter, although global indicators of land quality can be considered as common platform for coordination
- LDN concept needs advanced scientific development

Acknowledgements

Authors are thankful to the IWG members and UNCCD secretariat for cooperation and common discussions.

REFERENCES

Chasek P., Shikongo S., Safriel U. and Futran V. Zero Net Land Degradation. Outcome of "Operational zing the Zero Net Land Degradation (ZNLD) Target" session, at the SedeBoqer 4 th International Conference on Dry lands Deserts and Desertification. 8 January 2013. 14 p. http://www.unccd.int/Lists/SiteDocument Library/Rio+20/DLDD_SedeBoquer_ZNLD_outcome.pdf

Dobrovolskiy G.V., Kust G.S. Soil degradation – threat of ecological crisis worse and economic destabilization. Materials of the IGBP conference, Moscow, 1995, pp. 17-25.

EC JRC (European Commission Joint Research Centre). Institute for Environment and Sustainability (IES). Land Resource Management Unit. Note on defining and addressing "land-degradation neutral world" (LDNW). 2014. Preprint. 8 pages.

Global Land Indicators Initiative (GLII). Proposal for land and soil indicators to monitor the achievement of the Sustainable Development Goals (SDGs). Copenhagen, 2015. 6 p

Global Soil Week Bulletin - Vol. 206 No. 3 - Global Soil Week 2015 - Final Summary.

Goriachkin S.V. Study of the structures of soil cover in modern soil science. Eurasian Soil Science.2005, 12. (In Russian)

IWG (2014) Terms of Reference and Programme of Work.

Kust G., Andreeva O. Soils and desertification issue: methodological aspects. The 1st International Conference on "Desertification of Central Asia: Assessment, Forecast and Management". Nazarbayev University in Astana. September 25-27, 2014.

Kust G.S. Desertification: principles of ecological and genetic assessment and mapping. Moscow, 1999, 362 p. (in Russian).

Open Working Group on Sustainable Development Goals. July 2014. Outcome Document - http://sustainabledevelopment.un.org/focussdgs.html

Pilot Programme for Climate Resilience (PPCR). Web-site. http://www.climateinvestmentfunds.org/cif/node/4

Stavi, I., Lal, R., Achieving Zero Net Land Degradation: Challenges and opportunities, Journal of Arid Environments. Volume 112, Part A, January 2015, Pages 44-51.

Tal, A. The implications of environmental trading mechanisms on a future Zero Net Land Degradation protocol, Journal of Arid Environments. V. 112, Part A, January 2015, Pages 25–32.

Terrafrica. Sustainable Land Management in Practice: Guidelines and Best Practices for Sub-Saharan Africa. 2005.

The Future We Want: Outcome document adopted at Rio+20. 49 p.

The World Bank (2006): Sustainable Land Management. Challenges, Opportunities, and Trade-offs. Washington, DC.

UNCCD (2015). Proposal for the development of common indicators or a framework for monitoring and evaluating land-based adaptation policies and practices. 4 p.

UNCCD (May 2012). Zero Net Land Degradation. UNCCD secretariat Recommendations for Policymakers. A Sustainable Development Goal for Rio+20.

UNECE.ECE/HBP/96. Land administration guidelines. With Special Reference to Countries in Transition. New York and Geneva, 1996. 112 p.

United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 3-14 June 1992.

WOCAT (World Overview of Conservation Approaches and Technologies). Web-site. https://www.wocat.net/