

LAND DEGRADATION – AN OVERVIEW

HALBAC-COTOARA-ZAMFIR R.¹

¹ Politehnica University of Timisoara, Faculty of Civil Engineering, Str. Traian Lalescu No. 2,
Timisoara, 300223, Timis County, Romania
raresh_81@yahoo.com

ABSTRACT

On a planet with more than 7 billion people land and soil health are more than essential in order to cover the necessary quantities of food. Meanwhile we need to sustain land and soil health in order to be able to response properly at the climatic changes and to maintain the so much necessary hydrological flows.

Land degradation is a very complex system involving different types of interactions and links between processes, generated by causes and affected by factors.

If we want to reduce the extent of land degradation, scientifically robust and accurate information is needed for a consistent monitoring, for establishing priorities in land restoration and for adopting appropriate solutions.

During the last decades, the scientific community in special and the humanity in general agreed that topics like land degradation and desertification are “hot” topics and they are surrounded by many, again, hot questions.

Perhaps the most 5 important questions (which were raised by Stafford Smith and Reynolds in 2002) on these two concepts are the following:

- Which are the causes and the consequences of land degradation?
- Which is the border between natural land changes and anthropogenic land changes?
- The observed changes are reversible or not?
- Which is the amount of land affected or at risk?
- Which is the role and success of various abatement efforts?

In addition to these questions, Ellis *et al* (2002) raised another 3 questions:

- The deserts are expanding?
- Which is the extension of this phenomenon?
- What are the causes (natural or anthropogenic)?

Actual statistics are presenting alarming values. 25% of Europe and 40% of the world lands are drylands. 30% of semiarid Mediterranean drylands are affected by desertification and more than 30% of the region’s population suffer from severe land degradation (Rubio and Recatala, 2006; Safriel, 2009).

Desertification is the most severe form of land degradation – the wasteland. Desertification doesn’t mean that land is turn to desert because typical desert land forms in the geomorphic sense do not usually form in sub-humid or semi-arid zones due to land degradation.

Even if exists a lot of information about the issues that have lead to the loss of land quality and desertification, this information is dispersed, diffuse and largely unavailable to users.

The paper will present some key conclusions on what land degradation means, how to perceive this phenomenon and which solutions can be approached for land restoration.

Keywords: land degradation, soil, interactions, land restoration, phenomenon, causes

1. Introduction

Land degradation is a theme which was debated from ancient times. Ancient writers were aware about the influence of humans on landscape degradation. Some clues can be found in the Bible, Jeremiah 12:10-11: "Many shepherds will ruin my vineyard and trample down my field; they will turn my pleasant field into a desolate desert. It will be made a wasteland, parched and desolate before me; the whole land will be laid because there is no one who cares". Even from that times, a definition of land degradation included economical aspects (in this case references to a vineyard). Columella, in his great work *De Re Rustica*, emphasizes human's carelessness on natural factors leading to agricultural degradation.

Even the science was at the beginning, the main source of land degradation was identified in humanity. In the first century, it was estimated that our world had a population of about 200 millions while now we are more than 7 billions . Using this comparison can be land degradation considered as an entirely humans fault? Hardly to say in our days but probably no.

2. Defining land degradation

According to United Nations Convention to Combat Desertification (UNCCD), over 250 million people are directly affected by land degradation. Unfortunately, and degradation is increasing in severity and extent in many parts of the world. Bai *et al.* (2008) states that more than 20% of all cultivated areas, 30% of forests and 10% of grasslands undergoing degradation. Millions of hectares of land per year are being degraded in all climatic regions. Adams and Eswaran (2000) estimated that 2.6 billion people are affected by land degradation and desertification in more than a hundred countries, influencing over 33% of the earth's land surface.

Probably the most authorized institution in this field, UNCCD defines land degradation as a "reduction or loss, in arid, semi-arid, and dry subhumid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation." It is just one of the too many definitions for land degradation. These definitions of land degradation are ranging from "all processes which cause bush encroachment, soil erosion and ultimately result in desertification" (Arntzen and Veenendaal, 1986) to "a global-scale, ongoing, and relentless problem that poses a major long-term challenge to humans in terms of its adverse impact on biomass productivity, food security, biodiversity and environmental sustainability" (Mueller *et al.*, 2014). Despite this passion of finding new and new definitions, land degradation (according to the same Mueller *et al.*, 2014) is difficult to be defined because land can be considered degraded in relation to a potential benefit from it. In this case, it is land degradation a purely economic problem?

Barrow (1994) states that land degradation involve two interlocking, complex systems: the natural ecosystem and the human social system. The main feature of land degradation – agreed by most of the researchers – is diminishing land quality and productivity. We discuss here about "an action" which may take us to a preliminary conclusion: land degradation is not a state but a process. However, applying modern techniques for land works and considering the state-of-art in land use, can be considered this progress degradation? On the other side land development works may have both positive of negative effects. In the last case, can we discuss about negative land development? If we will analyze deeper the meaning of „degradation“, we will see that degradation is not meaning „removing“ but „not having“ or „acting in opposite to“. In this way, land degradation will not mean the loss or decreasing some of its qualities but a land without necessary (requested) qualities or with qualities which are not in concordance with the expectances from this land. A better option will be to use the expression of land declassing instead of land degradation. Land declassing can be defined as a lowering of land services delivering due to some causes, factures and pressures (natural of human induces).

Millennium Ecosystem Assessment document (2005) defines land degradation as being “a persistent reduction of biological and economic productivity” so, in conclusion, the reduction of ecosystem services. We find here a problem of “expectancy”. What do we expect from an ecosystem and what do we get. The state of “degradation” is very subjective considering that is influenced by human expectations regarding ecosystem performance as well as by humans experience in knowing and understanding the system (Davis, 2005; Roba and Oba, 2009; Mueller *et al.*, 2014).

Gabriels and Cornelis (2009) prefer an approach in which they link land degradation to loss of resilience (the land’s ability to recover from a shock). Unfortunately, the resilience is highly challenged by unison action of natural forces (extreme and persistent climatic events) and human use (through abusing land ecosystems).

3. Land degradation drivers, causes, factors, processes, indicators

Land degradation as is understands it today can be natural or human induced. Looking at the previous paragraphs, land degradation due to natural causes can be expressed as land declassing while land degradation due to human causes (and considering that we are leaving in a world dominated by selfish financial purposes) can be understand as land despoiling. According to Lal R. (2011) land degradation implies replacement of climax vegetation with secondary vegetation, alteration of humus quantity and composition and adverse changes in soil quality and related ecosystem services. Concluding, we are discussing about different processes affecting land (mechanism) leading to a state (degradation). Land as concept can be reduced to “terrestrial ecosystem”, in this way, land degradation being a “reduction or loss of ecosystem services, notably the primary production services” (UNCCD, 1999; MEA, 2005). Causes of land degradation can be divided into proximate causes and root causes. Geist and Lambin (2004), basing on the results obtained from 132 study cases, identified 4 groups of proximate causes (agricultural activities, increasing on infrastructure, deforestation, fire and droughts) and 6 groups of root causes (demographic, economic, technological, climatic, institutional and cultural).



Figure 1: Proximate causes and underlying drivers for land degradation

Currently, the highest pressures on land leading to land degradation are mostly of anthropic nature. The continuous increasing of Earth’s population, the need for more food and energy, wrong policies adopted for land management as well as climate events like droughts and floods created the necessary framework for setting up a vicious cycle of land degradation.

Mueller *et al* (2014) identify a set of “interlocking” socio-economic drivers of land degradation including industrial and transgenic farming, the globalized economy, the speculations in commodities, migration, pollution, the use of arable land for fuel production as well as the lack (or the fall) of environmental standards. From social-economic point of view, Geist and Lambin (2004) added the following series of land degradation drivers: poverty, labour availability, input availability, road access, and education.

Which is the genesis of land degradation? According to a study realized in 2009 for the European Parliament, there are at least 5 macro-pressures driving land management changes: Demography, Economy; Policy; Technology; Climate changes.

A clear difference between processes, causes and factors is made by Lal R. (2011). Lal R. states that “processes are the mechanisms, drivers, source of required energy, and the principal controls which lead to perturbations through disturbing the delicate and dynamic equilibrium and set-in-motion the land/soil degradation process which adversely affects ecosystem functions and services.” These processes are characterized by a direction and a magnitude which can be altered by factors (environmental parameters) like climate and terrain. In their turn, the factors have effects which can be altered and moderated by causes of land degradation like deforestation farming systems, land use, and specific management of soil, crops, plants, water, and animals.

According to UNCCD, land restoration means “reversing land degradation processes by applying soil amendments to enhance land resilience and restoring soil functions and ecosystem services” (UNCCD, 2012). But what does it mean “land restoration”? The Society for Ecological Restoration (SER) defines restoration as “the intentional alteration of a site to establish a defined indigenous, historic ecosystem”. While restoration focuses more on a return to a previous indigenous ecosystem, rehabilitation offers an alternative steady-state or an intermediate simplified ecosystem (Aronson *et al.*, 1993). From other perspective, rehabilitation seems to have a lower value than restoration because will lead only to an improvement of the ecosystem without searching to aim the original form (Francis *et al.*, 1979; Box, 1978; Wali, 1982). Briefly speaking, the followed aim in restoration and rehabilitation projects is to regain the so much needed ecosystem services largely through revegetation efforts.

4. Conclusions

Both natural and anthropic factors are inducing land degradation processes even human factors remains the most important. There is a huge amount of research on land degradation but still persists a gap in obtaining updated and, very important, comparable data. The knowledge is dispersed, focused on local/ regional experiments and without links to a general framework analysis and interpretation.

The definition of land degradation adopted by UNCCD assigns a major importance to climatic factors contributing to land degradation. However, identifying a problem is not enough and more efforts are needed in monitoring land degradation processes and in establishing the impact of different climatic factors on land degradation. Implementing sustainable land management is critical to minimizing and rehabilitating the effects of land degradation by resolving the conflicts between ecosystem function and the pressures on them.

Future researches are necessary for a better understanding of land degradation and desertification mainly on the links between social and economic factors. We also must better understand the factors affecting the ecosystem services and we must involve all the stakeholders bridging together the people with know-why and those with know-how.

REFERENCES

1. Adams C.R. and Eswaran H. (2000), Global land resources in the context of food and environmental security. Pp.35-50. In: Gawande SP, eds. *Advances in Land Resources Management for the 20th Century*. New Delhi: Soil Conservation Society of India. 655 pp.
2. Arntzen J.W., Veenendaal E.M. (1986), *A profile of environment and development in Botswana*. NIR, Gaborone, Botswana, 172p;
3. Aronson, J., Floret, C., Le Floc'h, E., Ovalle, C. and Pontanier, R. (1993), *Restoration and Rehabilitation of Degraded Ecosystems in Arid and Semi-Arid Lands. I. A View from the South*. *Restoration Ecology*, 1: 8–17. doi: 10.1111/j.1526-100X.1993.tb00004.x;
4. Bai Z.G., Dent D.L., Olsson L. and Schaepman M.E. (2008), *Global assessment of land degradation and improvement 1. Identification by remote sensing*. Report 2008/01, ISRIC, Wageningen;

5. Barrow C.J. (1994), *Land degradation. Development and breakdown of terrestrial environments.* Cambridge University Press, New York, NY, USA;
6. Box, T.W. (1978), The significance and responsibility of rehabilitating drastically disturbed land. In *Reclamation of Drastically Disturbed Lands*, eds. F.W. Schaller, P. Sutton, pp. 1-10, Madison WI, American Society of Agronomy;
7. Davis D.K. (2005), Indigenous knowledge and the desertification debate: problematising expert knowledge in North Africa. *Geoforum* 36:509-524;
8. Ellis J. E., Price K., Yu F., Christensen L. and Yu M. (2002), Dimensions of desertification in the drylands of northern China. In *Global Desertification: Do Humans Cause Deserts?* (J. F. Reynolds and D. M. Stafford Smith, eds.), Dahlem University Press, Berlin, pp. 167–180;
9. Francis G.R., Magnuson J.R., Regier H.A., Talhelm D.R. (1979), *Rehabilitating Great Lakes Ecosystems.* Ann Arbor, MI: Great Lakes Fishery Commission;
10. Gabriels D. and Cornelis W.M. (2009), *Human-Induced Land Degradation. Land Use, Land Cover and Soil -Volume 3.* ISBN: 978-1-84826-237-9;
11. Geist, H.J.; Lambin E.F. (2004), Dynamic Causal Patterns of Desertification. In: *BioScience*, 54(9): 817-829
12. Lal R. (2011), Land degradation and pedological processes in a changing climate. *Pedologist* 315-325.
13. Millennium Ecosystem Assessment. (2005), *Ecosystems and Human Well-Being: Desertification Synthesis.* World Resources Institute, Washington D.C.
14. Mueller E.N., Wainwright J., Parsons A.J. and Turnbull L. (ed.), *Patterns of Land Degradation in Drylands. Understanding Self-Organized Ecogeomorphic Systems*, Springer, 2014;
15. Roba H.G. and Oba G. (2009), Efficacy of integrating herder knowledge and ecological methods for monitoring rangeland degradation in northern Kenya. *Hum Ecol* 37:589-612;
16. Rubio J.L. and Recatala L (2006), The relevance and consequences of Mediterranean desertification including security aspects. In: Kepner WG, Rubio JL, Mouat DA, Pedrazzini F (eds) *Desertification in the mediterranean region: a security issue.* Springer, Valencia, pp 133–165;
17. Safriel U.N. (2009), Status of desertification in the Mediterranean region In Rubio, J. L.; Safriel, U. N.; Daussa, R.; Blum, W. E. H.; and Pedrazzini, F. (eds.). *Water Scarcity, Land Degradation and Desertification in the Mediterranean Region.* NATO Science for Peace and Security Series C: Environmental Security, Springer Science+ Business Media B.V., p. 33-73, 2009.
18. Stafford Smith D. M. and Reynolds J. F. (2002), The Dahlem desertification paradigm: a new approach to an old problem. In *Global Desertification: Do Humans Cause Deserts?* (J. F. Reynolds and D. M. Stafford Smith, eds.), Dahlem University Press, Berlin, pp. 403–424;
19. UNCCD (1999), *United Nations Convention to Combat Desertification in those countries experiencing serious drought and/or desertification, particularly in Africa. Text with Annexes.* Secretariat of the Convention to Combat Desertification. Bonn, Germany.
20. UNCCD (2012), *Zero Net Land Degradation. A Sustainable Development Goal for Rio+20 to secure the contribution of our planet's land and soil to sustainable development, including food security and poverty eradication, UNCCD Secretariat policy brief;*
21. Wali, M. (1992), *Ecology of the Rehabilitation Process*, In *Ecosystem Rehabilitation*, ed. M. Wali, vol. 1, pp 3-26, The Hague: SPB Academic Publishing.