



Classification of farmland ownership fragmentation as a cause of land degradation: A review on typology, consequences, and remedies



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ABSTRACT

Farmland ownership fragmentation is one of the important drivers of land-use changes. It is a process that in its extreme form can essentially limit land management sustainability. Based on a typology of land degradation and its causes, this process is here classified for the first time as an underlying cause which through tenure insecurity causes land degradation in five types (water erosion, wind erosion, soil compaction, reduction of organic matter, and nutrient depletion). A review of relevant literature enables the further presentation of a list of 21 types of land degradation and another extensive list of the 37 most common causes of land degradation. This work further presents an overview of harmful consequences of high farmland ownership fragmentation, and possibilities for remedying the effects. These possibilities consist of eliminating or mitigating those causes accelerating the fragmentation process, defragmenting current land ownership, and remedying the effects brought by this process.

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1. Introduction

There is no definitive list of land degradation (LD) types or causes, and it is very possible that there never will be. To date, the list of types is dominated by processes reflecting the degradation of all physical, chemical, and biological properties of ecosystem sub-components. Similarly incomplete is the list of the causes of LD, which is, in contrast, dominated by, in addition to natural causes, items of a socioeconomic character that have the end result of reducing the primary production services of ecosystems. In this regard, this work offers the most detailed overview to date of LD types and causes.

This study focuses on a process with the end result of LD that has not yet been described in sufficient detail, namely farmland ownership fragmentation. A review of the literature enables a description of the negative effects of this phenomenon on agricultural land use as well as arguments supporting the conclusion that high farmland ownership fragmentation is a cause of LD. The work goes on to describe methods for mitigating the causes and negative consequences of this process.

The paper is organized as follows: Section 2 introduces various definitions of LD and discusses their consequences for the classi-

fication of LD types (Section 2.1) and causes (Section 2.2). Section 3 outlines the farmland ownership fragmentation issue, classifying this phenomenon as an underlying cause of LD (Section 3.1) and describing its possible remedies (Section 3.2). The conclusions of this review are presented in Section 4.

2. Land degradation

Lists of various LD types differ depending on the author, the further use for the typology, and primarily the definition of this term. It can generally be said that there is presently no universal agreement on a single definition. The term itself was coined quite recently, and as of 1994 did not even exist as an independent category in the U.S. Library of Congress Classification (Johnson and Lewis, 2007). Differences in currently used definitions consist primarily in two main issues. The first is broad interpretations of the term “land” from the all-encompassing (umbrella) term embracing degradation of all elements of the environment, including their interactions (Stocking and Murnaghan, 2001), through the single-purpose or absolute limitation of the topic within “soil degradation” (Oldeman, 1994), to the entirely inappropriate simplification of the problem in the interest of popularization, such as when Lomborg (2001) used the term LD exclusively for soil erosion. The second essential difference arises from whether the definition covers natural processes as causes of LD. In this area, authors are divided into two groups, with one considering LD as a phenomenon or process that arises only as a result of human activities (e.g., Norbu et al., 2003; Johnson and

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Lewis, 2007), while the other, larger group expands the definition to include among causes such natural processes as rainfall, wind, temperature, and earthquakes under conditions without human influence (e.g., Blaikie and Brookfield, 1987; Sarukhán et al., 2005; Nachtergaele et al., 2011; Nkonya et al., 2011). In addition to these two main areas within which the definition of LD diverges, there are a number of other differences affecting the form of the definition and therefore the typology of LD. These include such differences as whether the effects of degradation are understood exclusively in relation to humans or at a general level, and also whether degradation is expressed only as reductions in primary production or in a much broader sense to include such measures as biodiversity indicators. Moreover, Blaikie and Brookfield (1987) had emphasized the socioeconomic dimension in stating that LD decreases the yields of labor and capital inputs into production. However, these authors did not offer any corresponding socioeconomic LD type.

This review will employ a concise but substantively broad definition thoughtfully compiled from several sources (Blaikie and Brookfield, 1987; Sarukhán et al., 2005; Nkonya et al., 2011): “land degradation is the reduction or loss of natural beneficial goods and services, notably primary production services, derived from terrestrial ecosystems”. This results in a definition embracing both human and natural causes and emphasizing primary production services but considering them within the context of all components of the land (soil, water, vegetation, and other components of the ecosystem). The consequences of the process are not limited exclusively to human needs, although these are emphasized. Degradation thus includes more types and affects soils, biomass, water, and socioeconomic services derived from ecosystems. I personally added to the definition the word “natural,” which thus incorporates within LD cases wherein all beneficial goods and services may remain at the previous level but at the cost of a higher input of additional energy (fertilizer, irrigation, human work, etc.). Even such cases in which the natural potential of ecosystems is decreased should properly be considered as LD.

2.1. Types of land degradation

This broad definition is suitable for the subsequent consideration of LD typology. However, it leads to several complications for further use. Above all, there is no consensus on how to assess ecosystem goods and services. All authors who discuss LD in general and who offer their own definitions or apply a certain point of view to specific cases fail to present a comprehensive accounting of LD types. Similarly as with most other typologies, accounting for individual LD types is influenced primarily by the way in which the problem is defined and the purpose of its further use, which affects in particular the need for detail. The required level at which to assess these processes is derived from the purpose of the typology (global, regional, or local; Wiebe, 2003), which helps substantially in deciding the suitability and measurability of individual types. Another important factor determining the form of LD types relates to the local characteristics of the study area, particularly in endeavoring to reflect the causes and processes which are dominant or decisive in the given region or, in contrast, to suppress or exclude from the assessment those types which are less important or are not present.

In terms of the distribution of individual LD types, water and wind erosion together with loss of biodiversity most frequently occur in less populated areas, while in agricultural areas the dominant types are water shortages, soil depletion, and soil pollution (Nachtergaele et al., 2011). Bai et al. (2008) stated that almost one-fifth of degraded land comprised cropland, while 23% was deciduous forest, 19% coniferous forest, and 20–25% rangeland.

Currently used typologies emphasize physical, chemical, or biological processes caused by both natural factors and human use

of the land and/or ecosystem. Socioeconomic characteristics are not presented as types of LD but exclusively as factors influencing LD. Table 1 presents an overview of the LD types used in relevant typological and case studies. Individual types are divided into LD subcomponents, with the commonly used term soil degradation also split into soil physics and soil chemistry. The list of types is not definitive. The list can be expected to expand in the area of biodiversity, just as the tendency has recently been strengthening for the definition of LD to be expanded further from its previous narrow meaning of soil degradation to include other land components.

Compiling a general typology is no easy task in as much as LD must be judged in its spatial, temporal, economic, and cultural context (Warren, 2002). It generally holds that changes at the local level affect global processes just as they are affected by these processes (Wilbanks and Kates, 1999), and vice versa. Some types are measurable only at the finest scales, while others are regional or global. Most of the types are, however, identifiable across scales.

2.2. Causes of land degradation

The causes of LD have not been comprehensively deliberated in terms of their typology, interrelationships, or possible effects. Not even the terminology is unified, as in addition to the frequently used term “cause” (e.g., Stocking and Murnaghan, 2001; Nachtergaele et al., 2011; Nkonya et al., 2011), some authors (e.g., Barbier, 1997) have used the term “determinant”, and others (e.g., Meadows and Hoffman, 2002) have used “factor.” Tefera et al. (2002) used the two terms cause and factor, while Nachtergaele et al. (2011) used both cause and driver, without detailing any differences in their interpretation. It is necessary, however, to acknowledge one essential difference between the term cause and the terms factor, determinant, and driver. The term “causes” carries with it a negative connotation of agency, while “factors”, “determinants”, and “drivers” simply indicate the occurrence of the phenomenon, without raising the issue of an agent responsible for the negative effects of what has happened. For this reason, it is not appropriate to denote as causes of LD such aspects as tenure security, ability to defend rights, and enforcement of rules, but rather tenure insecurity, inability to defend rights, and weak enforcement of rules, respectively. As many authors do not take these nuances into account, Table 2 presents an overview of causes as well as factors, determinants, and drivers.

To date, causes of LD have been mentioned only in an incomplete form or in the context of a specific LD type or research location. Nkonya et al. (2011) distinguished immediate (proximate) and underlying causes, which helps to clarify complicated causal relationships for further study. These authors expressed the complexity of the relationship between these two levels in which some underlying causes appear in other cases as immediate causes and vice versa. An example can be seen in tenure insecurity, which most often appears as an immediate cause of LD but in some cases may be classified as an underlying cause of poverty (Clerc, 2012). Specific causes may in certain cases even be consequences of Nkonya et al. (2011) gave as an example those causes of poverty that lead to insufficient investment in land management practices and to loss of natural fertility. Similarly, degradation of land fertility can also conversely establish or accelerate poverty. Cases where one LD type causes another LD type are also possible, as for example loss of vegetation cover (e.g., deforestation) may be a cause of water erosion. These are further reasons why a general relationship scheme at the level of individual LD causes has not yet been exhaustively described and seemingly never can be.

Authors who include natural processes among causes of LD (see Section 2) essentially agree on the basic division of causes into natural (biophysical) and human-induced causes (Nachtergaele et al., 2011; Nkonya et al., 2011). A number of causes may seem to be

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