



## Meeting global land restoration and protection targets: What would the world look like in 2050?



Sarah Wolff<sup>a,\*</sup>, Elizabeth A. Schrammeijer<sup>a</sup>, Catharina J.E. Schulp<sup>a</sup>, Peter H. Verburg<sup>a,b</sup>

<sup>a</sup> Institute for Environmental Studies, Vrije Universiteit Amsterdam, 1081 HV Amsterdam, The Netherlands

<sup>b</sup> Swiss Federal Institute for Forest Snow and Landscape Research, WSL Zürcherstrasse 111, CH-8903, Birmensdorf, Switzerland

### ARTICLE INFO

#### Keywords:

Sustainable development goals  
Land restoration  
Ecosystem services demand  
Scenarios  
Land change modelling

### ABSTRACT

Land restoration has received increased attention recently as a tool to counteract negative externalities of unsustainable land management on human well-being. This is reflected in targets of the Sustainable Development Goals (SDGs), the Convention on Biological Diversity (CBD), the United Nations Framework of the Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD). However, the implications of these targets for land use, especially considering their potential conflict with growing food production demands, are largely unexplored. We study the potential and aggregated consequences of meeting these targets on land cover and land system change. We do so by analyzing targets originating from these global commitments towards land restoration and protection and implement them in a global land system change model. We compare this Restoration and Protection scenario with simulation results of two plausible pathways of socio-economic development in the absence of these targets, following the Shared Socio-Economic Pathway (SSP) storylines. We find that meeting global land restoration and protection targets would increase global tree cover by 4 million km<sup>2</sup>, increasing forest carbon stocks by 50 Gt and protecting 28% of the terrestrial area with the highest value of both biodiversity and carbon storage. Gains in tree cover and natural land systems would cause a contraction of crop, pasture- and bare land. This results in further cropland intensification and the expansion of land systems that are combining land use demands in mosaics of forest and agriculture. Without these targets, land system architecture tends to become more specialized, while many carbon and biodiversity hotspots, such as in the Americas, India, and Indonesia would be lost. Grassland-agriculture mosaics were threatened by land use change under all scenarios, requiring greater consideration in research and environmental policy. Our results emphasize the need for targeted land management in line with the analyzed policy targets if global restoration and protection targets are to be achieved.

### 1. Introduction

Human activity has become the major cause of earth system change. Unsustainable land management, exacerbated by climate change, has led to land degradation and desertification, the alteration of carbon, nitrogen and water cycles, and to changes in biodiversity and soil productivity (Steffen et al., 2015). Land degradation is a major driver of ecosystem function and services loss. Vegetation cover and soil nutrient losses reduce soil productive capacity, impacting food-security, health, and other components of human well-being (Lal, 2015; Rojas et al., 2016). During the last century, land degradation has been accelerating through land use pressures such as agricultural expansion and intensification, unsustainable livestock production and urban expansion (WHO, 2017).

Projected increases in world population, lifestyle changes and associated changes in consumption demands will pose additional pressures on land. This has raised awareness about the need to increase land use efficiency and to adopt sustainable land management practices to ensure the provision of food, water, and other ES to future generations (FAO, 2017; Godfray et al., 2010). The central role of land use in achieving sustainable development has been highlighted by the United Nations Sustainable Development Goals (SDGs) that prioritize environmental sustainability as a way to achieve other development goals, such as the alleviation of poverty and hunger (UN, 2015). In particular target 15 “Life on Land” has been devoted to the protection, restoration and sustainable use of terrestrial ecosystems.

The implementation of this target is supported by several international conventions and their commitments including the Convention on

\* Corresponding author.

E-mail address: [sarah.wolff@vu.nl](mailto:sarah.wolff@vu.nl) (S. Wolff).

Biological Diversity (CBD) Aichi Biodiversity Targets (CBD, 2011), the United Nations Framework Convention on Climate Change (UNFCCC) target to Reduce Emissions from Deforestation and Forest Degradation (REDD+) (UN-REDD, 2015), as well as the United Nations Convention to Combat Desertification (UNCCD) Land Degradation Neutral target (UNCCD, 2012). These commitments aim to enhance food security, biodiversity conservation, and climate change mitigation through the sustainable management of forests, combating desertification, and halting and reversing land degradation.

As a means of implementing these international commitments at national and regional scales, the Bonn Challenge has been established by the Global Partnership on Forest Landscape Restoration (GPFLR). This Global Restoration Initiative, together with the New York Declaration on Forests, has set the target to restore 350 million ha of deforested and degraded land in the process of agroforestry and forest landscape restoration by 2030 (IUCN, 2017b; UN, 2014). The main rationale of this initiative is to simultaneously improve ecological integrity and human well-being through multi-functional landscapes (GPFLR, 2016a). To support countries in identifying potential areas that would help to meet this aspiration a global map of forest landscape restoration opportunities has been developed (Laestadius et al., 2011). According to this study, more than 2 billion ha of land offer opportunities for forest and landscape restoration, while 156 million ha are already being restored (IUCN, 2017b).

Increased prominence of land restoration and protection in the policy arena (Chazdon, 2008; Chazdon et al., 2017; Aronson and Alexander, 2013) and ongoing interventions across the world (e.g. Afr100, 2017; GPFLR, 2016b) suggest that land restoration and protection will become more important drivers of land use change in the future. This includes the restoration of degraded forest and dryland, and the protection of areas for biodiversity conservation, carbon sequestration and other ecosystem services (ES). These claims will put additional demand on land use that need to be aligned with increasing demand for agricultural production and housing.

While the influence of demand for biodiversity conservation and carbon sequestration on global land use has been assessed (Eitelberg et al., 2016) the relative influence of land restoration and protection targets on land system change and potential impacts of these targets on ES provision has so far remained unexplored. In this context we pose the following questions:

- How could the implementation of restoration and protection targets drive land system change until 2050?
- What is the importance of these targets for the conservation of biodiversity and carbon hotspots until 2050?

To answer these questions, we first synthesize and cluster global policy targets that focus on land restoration and protection (Section 2.1). We then translate these targets (Section 3.2) into a global scale land system change model (CLUMondo, Section 2.2). Using the SSP1: “Sustainability” storyline as a basis, we build a Restoration and Protection scenario and compare it with two reference scenarios that do not consider the implementation of these targets; the SSP1, and the SSP2 “Middle of the Road” scenario (O’Neill et al., 2014). We discuss potential implications of meeting global land restoration and protection targets and illustrate the challenges when translated into action on land use (Section 5).

## 2. Material and models

### 2.1. Review, synthesis and clustering of targets

#### Review and synthesis

We first identified global policy targets that focus on the restoration and protection of land-based ES (up to July 2016). Most important in this context is the United Nations Sustainable Development Goal 15

(UN, 2015), that is translated into more explicit policy targets by the three main Rio conventions: the CBD (Aichi target 5, 11, 14, 15) (CBD, 2011), UNCCD (Rio land degradation neutral goal) (UNCCD, 2012), and the UNFCCC (REDD + goal). Next to these commitments, the Bonn Challenge was considered. This global policy initiative is the largest action-oriented platform for forest restoration and has been recognized as a key driver in forest landscape restoration (IUCN, 2017a).

Secondly, we disassembled and interpreted the individual targets by studying their definitions of terms, such as land degradation or restoration, to evaluate the implications of the targets for land use and management [Appendix A]. We then checked if technical rationales and indicators for the individual targets were specified by the conventions. If these were available, we gathered spatial and statistical data which best suited the conventions’ definitions or recommended indicators. If targets were not specific enough, we made assumptions in alignment with their description to allow their implementation into land change modelling [Appendix A, Table A. 2]. In case there was neither sufficient data nor specification possible, targets were excluded from further analysis. Similarly, we evaluated the possibility of translating these targets into model settings. Targets that could not be accurately accounted for by adapting model settings were excluded from consideration (Fig. 1).

#### Clustering

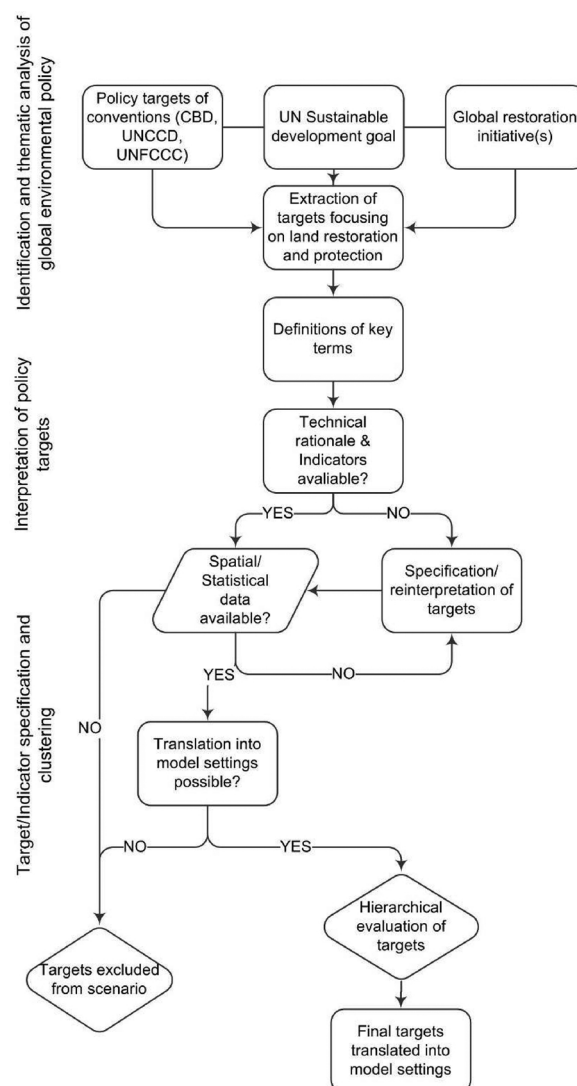


Fig. 1. Decision tree for including the global policy targets in the land system change model.

Download English Version:

<https://daneshyari.com/en/article/11005289>

Download Persian Version:

<https://daneshyari.com/article/11005289>

[Daneshyari.com](https://daneshyari.com)