



Food and Agriculture  
Organization of the  
United Nations

# Transformational change to reduce deforestation and climate change impacts

A review of definitions, concepts and drivers in scientific  
and grey literature





# **Transformational change to reduce deforestation and climate change impacts**

A review of definitions, concepts and drivers in scientific and grey literature

Stibniati Atmadja, Christopher Martius, Stephen Leonard  
Center for International Forestry Research (CIFOR)

and

Maria José Sanz Sanchez,  
Basque Centre for Climate Change (BC3)

Required citation:

Atmadja, S., Martius, C., Leonard, S. and Sanz Sanchez, M.J. 2021. *Transformational change to reduce deforestation and climate change impacts – A review of definitions, concepts and drivers in scientific and grey literature*. Rome, FAO. <https://doi.org/10.4060/cb7314en>

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

ISBN 978-92-5-135167-3

© FAO, 2021



Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode>).

Under the terms of this licence, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that FAO endorses any specific organization, products or services. The use of the FAO logo is not permitted. If the work is adapted, then it must be licensed under the same or equivalent Creative Commons licence. If a translation of this work is created, it must include the following disclaimer along with the required citation: "This translation was not created by the Food and Agriculture Organization of the United Nations (FAO). FAO is not responsible for the content or accuracy of this translation. The original [Language] edition shall be the authoritative edition."

Disputes arising under the licence that cannot be settled amicably will be resolved by mediation and arbitration as described in Article 8 of the licence except as otherwise provided herein. The applicable mediation rules will be the mediation rules of the World Intellectual Property Organization <http://www.wipo.int/amc/en/mediation/rules> and any arbitration will be conducted in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL).

Third-party materials. Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

Sales, rights and licensing. FAO information products are available on the FAO website ([www.fao.org/publications](http://www.fao.org/publications)) and can be purchased through [publications-sales@fao.org](mailto:publications-sales@fao.org). Requests for commercial use should be submitted via: [www.fao.org/contact-us/licence-request](http://www.fao.org/contact-us/licence-request). Queries regarding rights and licensing should be submitted to: [copyright@fao.org](mailto:copyright@fao.org).

Cover photograph: ©CIFOR

# Contents

<b>Acknowledgements</b>	<b>iv</b>
<b>Executive summary</b>	<b>v</b>
<b>Summary points</b>	<b>viii</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Scope of the paper	1
1.2 The need for transformational change in land use and climate change	1
1.3 Global discourses and efforts on transformational change in the context of climate change, forestry and agriculture	2
1.4 Land use, climate change and the need for transformation	3
<b>2 The scientific literature on transformational change</b>	<b>5</b>
2.1 Publication trends and authorship of scientific articles on transformational change	5
2.2 Definition of transformational change and related concepts	5
2.3 Influential theoretical and empirical frameworks for transformational change	8
2.4 Similarities, differences and lessons across multiple sectors	12
2.5 Drivers of transformational change	15
2.6 Indicators of transformational change identified in the literature review	17
<b>3 Conclusions</b>	<b>19</b>
3.1 Highlights and reflections from reviewing the literature	19
3.2 Issues for further exploration	21
<b>References</b>	<b>25</b>
<b>Glossary</b>	<b>31</b>
<b>Annexes</b>	<b>33</b>
1 Method used to select academic literature for review	33
2 List of articles selected for review	34
3 Learning from the land-use sector (agriculture, forestry and other land uses): Transformational change definitions and concepts that relate to climate change and other disciplines	43
4 Summary of the drivers of transformational change found in academic literature	44
5 Indicators of transformational change by context and scale of action	48

# Acknowledgements

We are grateful for the financial support, intellectual contribution and time that the FAO has invested in this report. We especially thank Malgorzata Buszko Briggs, Katherine Clyne, Kristin DeValue, Serena Fortuna, Loreto Sanz Herrera and Thomas Woolnough for their contributions. We also would like to acknowledge additional financial assistance of the CGIAR Research Program on Forests, Trees and Agroforestry (CRP-FTA), with financial support from the donors contributing to the CGIAR Fund. We are grateful to Anne Larson and Maria Brockhaus for reviewing an early version of this report, and to Sarah Oakes for language editing.

# Executive summary

Humanity is facing a series of critical challenges related to global environmental and climate change. Global development and climate objectives, as enshrined in the Sustainable Development Goals (SDGs), the Paris Agreement and other international efforts, require swift, deep and encompassing action. Climate change must be kept far below the current global average warming trajectory of 3.5 degrees. Evidence is rapidly mounting that, while this may be a herculean task, it is one essential for humanity's survival. There is additional moral and ethical pressure to address large and widening inequalities in income, livelihoods, human health and access to food. Truly 'transformational' change is required that leads to 'paradigm shifts' underpinning the sweeping changes that are needed before 2030, just a few years from now.

In this study, the Food and Agriculture Organization of the United Nations (FAO) and the Center for International Forestry Research (CIFOR) teamed up to investigate how transformational change (transformational change) is understood in the scientific literature. The study, the first of its kind to review academic studies on transformational change, focuses on two main questions: **(i) What does 'transformational change' mean? and (ii) What drives it?**

We identified and analyzed 111 scientific articles on transformational change in health and business, as well as land use, natural resources and climate change', reviewing articles with the search term 'transformational change' in their titles. This approach ensures articles are representative of the breadth of scientific knowledge directly relevant to discussions on transformational change. We acknowledge that this search could be broadened in the future using related concepts, like 'social change' and 'institutional reform'.

Transformational change is reasonably well articulated and analyzed in health, education and business management literature; likewise, understanding on how transformational change manifests itself in the very long term (e.g. decades and beyond) can be found in the archaeological literature. In comparison, with just 22 papers, **literature on transformational change relating to the land-use sector (i.e. agriculture, forestry and other land uses) and climate change remains scarce.** The scientific literature published between 2000 and 2018 on transformational change and forestry mostly relates to reducing emissions from deforestation and forest degradation (REDD+).

Scholarship on transformational change specifically within REDD+ and within agriculture (related to climate change adaptation) is relatively new, and substantial contributions have been made from researchers based in developing countries. Overall, however, **authors writing about transformational change are mostly affiliated to organizations in just a handful of developed countries** (i.e. Australia, Canada, the United Kingdom and the United States.). A broader and better understanding of transformational change requires a broader base of scholarship on the subject; including case studies and analysis of how institutions understand and implement a transformational change-driven agenda.

Other sectors teach us that transformational change is related to **human agency** – the capacity of humans to act to change a given human or natural environment; either unconsciously and involuntarily, or purposefully and in a goal-oriented manner. The 'how to' literature that deals with organizational change assumes human agency, emphasizing the importance of leadership, political support and cultural/behavioral change.

Fundamental differences emerge between the various definitions of transformational change, specifically around the type of transformations sought, the *unit* of transformation, the *direction* of transformation, time scales and expected leader(s) of transformational change.

**Definitions** of transformational change have the following in common:

- Transformational change represents a movement **away from the current state of affairs**, business-as-usual regime or behaviors, and an opening of new pathways;
- **Transformation should be sustained**, either through institutionalization within systems, or changes in behavior, cultures, beliefs and power relations;
- Transformational action should **focus on root causes and relationships between dimensions of change** (e.g. organizations, markets, technologies, power and social relations, and ideas);
- **Knowledge** plays a key role, both as driver and indicator of change.

Theoretical frameworks used to analyze transformational change similarly identify some **critical elements** of successful transformations:

- **Collective learning and reflection:** learning to inform action, and learning from actions
- **Taking and managing risks and expectations:** space for innovation, trial and error, and flexibility in program design
- **Non-linear thinking** that integrates complexity, interconnectedness across multiple dimensions, temporal and spatial scales, and real-time feedback mechanisms
- **Consultation and participation:** engaging, and consulting with, a wide variety of stakeholders through mechanisms for inclusive, meaningful and enduring participation
- **Ownership:** e.g. country- or jurisdiction-led approaches; sufficient, flexible and predictable finance

Development interventions are complex, resulting in a dynamic not completely controlled by any one person or institution. As such, **interdisciplinary and transdisciplinary** learning and collaboration are required, and it is important for actors to recognize that silver-bullet solutions are rare. Instead, it is preferable to embrace a diversity and multiplicity of approaches.

**Definitions of transformational change also diverge** in several ways. For example, on whether transformational change can be achieved through continuous processes and a series of incremental steps, or whether it instead needs discontinuous/disruptive processes. Some definitions put emphasis on the results of particular actions or investments, or on the process; others put more emphasis on national or large-scale change, as opposed to one-off changes across scales. Many definitions of transformational change do not explicitly highlight multi-level interactions and interdependencies; yet addressing these could be key in transformational change, if it is to address complexity.

**Three dimensions of transformational change** include the **scale**, **speed** and **depth** of change. Achieving all three dimensions at the same time will inevitably encounter trade-offs among them. It is particularly important that development practitioners and donors understand the time requirements for bringing lasting change. Project lifetimes of less than five years are often too short to have any impact. Projects still need to build on and learn from each other. Since some authors believe speed and urgency to be important elements in transformational change, it is necessary to understand what kind and level of change can be realistically expected under different sets of circumstances.

Transformational change is influenced by drivers; i.e. the short- and long-term forces behind lasting change. **Four groups of drivers** for transformational change emerged from our literature review: (i) **resources:** factors that provide the energy needed to push for change; (ii) **legitimacy:** factors that help change to be accepted by society and its decision makers as an objective that merits the allocation of resources; (iii) **processes:** actions that harmonize efforts and values across different levels and actors; and (iv) **norms:** values that guide processes to result in sustainable and transformational collaborations.



**Indicators of transformational change** found in scientific articles **have a wider scope than those used in monitoring and evaluation practices.** Indicators in scientific articles monitor changes across the diverse drivers of transformational change (i.e. resources, legitimacy, processes and norms). These indicators are both level-dependent (i.e. only apply to outcomes at one level), level-independent (i.e. apply to outcomes at multiple levels) and multi-level (i.e. apply to interactions across levels) indicators. In contrast, monitoring and evaluation practices tend to focus only on level-dependent and impact-oriented indicators attributable to one specific actor or action, and not on level-independent and multi-level indicators, or on processes and norms.

**Further reflections and scientific analysis are needed on the drivers of transformational change at the intersection between land use and climate change;** particularly analysis which focuses on long-term multi-decade impacts. Such analysis will need to account for many unpredictable changes in factors like technology, political and market regimes, demography and ecosystem functions. Guidance is needed on aspects such as: identifying drivers for achieving transformational change at spatial scales that are unique to land uses, like landscapes and watersheds; understanding the financial, human and institutional resources needed to sustain transformational change efforts over very long periods; the practicalities of sustaining the momentum and vision of transformational change across political cycles; and institutional measures to facilitate sustained long-term efforts. Nature-based units of transformation (e.g. landscapes, watersheds, ecosystems) are often challenging and costly to monitor and evaluate. Likewise, multi-level and multi-sectoral stakeholder coordination and land tenure challenges are unique to land use and climate change.

The literature review presented in this technical paper revealed several issues that need to be further explored, but that were beyond the scope of the present study:

- **Transformational change is driven by norms and processes that can either be aligned with, or have trade-offs with, human rights issues.** For example, several articles identified that addressing inequalities can drive transformational change. This includes seeking wide participation, empowering marginalized groups, correcting injustices, improving access to information and decision-making processes, and forming a common vision negotiated by all parties. On the other hand – while recognizing the importance of technical knowledge, innovation, and technology – relying on highly technical knowledge can alienate groups who do not have access to that knowledge, limiting their ability to effectively participate in decision making. Transformational change needs to be defined more broadly beyond climate change, and consider the needs of developing countries. Issues of rights are associated with the depth of change as it is concerned with how change is done, by who and for whom; such rights could thus be jeopardized if quick change at scale is the goal. The literature on transformational change supports local ownership in the change process, but does not define ‘local ownership’ well. There is limited analysis on the trade-offs between processes and norms aligned with improving human rights conditions, and the need to attain resources and legitimacy to drive change. The political economy underlying drivers of transformational changes at the intersection between land use and climate change also needs to be analyzed more deeply and widely.
- **Monitoring and measuring transformational change will require new or unconventional methods and indicators that can better deal with complexity and uncertainty.** The drivers and dimensions of transformational changes are complex and are often not considered in current monitoring and evaluation (M&E) approaches. An alternative M&E approach is needed – one that is applied on multiple scales and depths where transformational change is expected. By identifying transformational change as a dynamic process that needs to remain in motion, impacts can be measured along the way; but only multi-level analysis will allow us to see whether the entire system and all its parts are moving in the right direction. Different types of drivers of transformational change (resources, legitimacy, processes and norms) need to be monitored and are often difficult to measure. Apart from these technical difficulties, there is the issue of legitimacy – i.e. who is considered to be a legitimate actor or entity when it comes to monitoring, evaluation and creating a space to learn from lessons.

# Summary points

- **Use of the term "transformational change", and the science around this term specific to land use and climate change, is still limited.** Within the limited literature that exists on transformational change in land use and climate change, work on transformational change in relation to REDD+ appears relatively advanced.
- **Existing definitions of transformational change demonstrate similarities** in terms of: movement away from the current equilibrium to new pathways, sustained and deep changes, and learning as a driver or indicator of change. However, there are differences of thought in terms of how transformational change can be achieved (i.e. through a continuous process or through incremental steps), what exactly drives transformational change (i.e. particular actions/investments or the process itself), and the necessary scale of change (i.e. national/large-scale or across scales).
- **From the literature, drivers of transformational change can be divided into four groups:** (i) *resources*, which provide the energy to push for change; (ii) *legitimacy*, which helps the change to be accepted; (iii) *processes*, which harmonize efforts and values across levels and actors; and (iv) *norms*, which guide processes for sustainable and transformational collaborations.
- **Transformational change in the context of land use and climate change is expected to be large-scale, fast and in-depth; but these are arguably unachievable simultaneously.** Trade-offs between these three outcomes are likely. Drivers of transformational change in this context require further exploration and analysis.
- **What is considered speedy change in climate change and forestry – years and decades – would be considered too slow to be transformational in other disciplines.** These lessons need to account for differences in human relationships both within societies and with the natural environment. Both aspects have changed in scale and scope across time.
- Despite academic discussions around the importance of **linking different levels to achieve transformational change**, most multilateral institutions' definitions do not explicitly highlight multi-level interactions and interdependencies. Such gaps need to be bridged.
- **The direction of transformation can be both bottom-up and top-down.** Forestry (notably REDD+) literature demonstrates that the engagement of actors at all levels of governance is crucial, and that lack of this engagement has become a barrier for transformational change.
- **Stakeholder coalitions** that empower and enable transformational change are particularly vital according to land-use and climate change literature, as actors are often fragmented across generations, sector, levels and politics. Conflicts at the policy to local level still dominate, particularly in the land-use sector.

- Two **theoretical frameworks** for analyzing transformational change stand out in the area of forestry and sustainability: (i) the 4I framework, which provides theoretical underpinnings for monitoring and strategizing transformational change in forest policy within developing countries; and (ii) the transition management framework, which was developed in the context of addressing sustainability issues in developed countries.
- **New monitoring and evaluation approaches must be developed** to account for groups of drivers, since current approaches mostly focus on resource-related outcomes, and rarely on processes, norms or legitimacy. These approaches need to be an integrated part of governance processes to be effective.

# 1 Introduction

## 1.1 Scope of the paper

Given the urgent need for true transformation to achieve long-term and sustainable reduction in deforestation, and to reach the goals set out in the Paris Agreement, the Food and Agriculture Organization of the United Nations (FAO) and the Center for International Forestry Research (CIFOR) partnered up to generate new knowledge to inform approaches to transformational change. This technical report presents the results of a literature review which aims to answer two fundamental questions: **1. What does ‘transformational change’ mean? and 2. What drives it?**

The review draws on a broad Transformational Change literature but focuses its reflections and analysis on climate change mitigation and adaptation in the context of forestry, natural resources and agriculture (for ease of reference referred to as ‘land use<sup>1</sup> and climate change’ in this document). Agriculture and forestry can provide important nature-based climate solutions; these two sectors alone could contribute over a third of the climate mitigation needed to stabilize global warming to below 2°C by 2030 (Griscom *et al.* 2017).

This review analyzes academic literature, both to capture the most up-to-date theoretical and analytical thinking on transformational change, and to understand how transformational change is defined both within and outside the theme of land use and climate change. To do so, we reviewed 111 scientific journal articles using the term ‘transformational change’ in their titles. This keyword-based approach is not exhaustive, as many alternative keywords associated with transformational change exist, such as ‘social

change’, ‘paradigm shift’, ‘transformational leadership’ or ‘institutional reform’. As it leads to a narrow and targeted group of articles, this approach also risks missing relevant work, such as that produced by [Tabara](#) and [Feola](#). This targeted approach does however provide a starting point to understand a phrase that is becoming increasingly popular in global climate discourses, with the aim of understanding how transformational change is analyzed, defined and brought about.

Of the 111 journal articles reviewed, 22 were specific to agriculture, forestry and climate change. A description of the methods used to identify the scientific articles included in this review can be found in Annex 1, while the list of reviewed articles is found in Annex 2. This academic literature review was then complemented by a review of the ‘grey’ literature, published by donors (including the Green Climate Fund and the World Bank), development organizations and practitioners in the field of land use and climate change.

## 1.2 The need for transformational change in land use and climate change

One of the most profound challenges of our time is achieving a sustainable world in a changing climate. The Intergovernmental Panel on Climate Change (IPCC) unequivocally warned of the risks of global warming beyond 1.5°C above pre-industrial levels, and identified many of the challenges associated with achieving the Paris Agreement targets (IPCC, 2018b, 2019b). Additionally, lags in the global climate system make warming of more than 2.0°C highly likely, at least for some time, if emissions do not peak soon.

---

<sup>1</sup> In UNFCCC terminology, land use refers to “Agriculture, Forestry and Other Land Use” (AFOU); however this technical paper presents reflections only in the context of agriculture, forestry and natural resources.

Calls for deep changes abound (Klein, 2015; Wallace-Wells, 2019). Unprecedented, rapid and far-reaching transformations are needed in all sectors to achieve a 40–50 percent reduction in

emissions by 2030 and a completely carbon-neutral world by 2050 (IPCC, 2018b). Massive worldwide youth demonstrations are drawing attention to the need for bold action, pointing out that they are the ones who will suffer from lack of action by their parents' generation (350.org 2019; Al Jazeera, 2019; Fridays for Future, n.d.). These calls are starting to be heard at high levels. For example, the European Union (EU) is investing in a Green Deal that envisions no net emissions of greenhouse gases by 2050, economic growth decoupled from resource use, and that no person and no place is left behind (EC, n.d.).

Many global efforts attempt to tackle these issues, yet each requires a profound shift in our socio-economic systems, away from business-as-usual. Linking knowledge to action is essential for this transformation. Successfully addressing the challenges to achieving global sustainability in a complex, intertwined world requires transformative, open knowledge systems and processes. Agendas need to be set collectively, taking into account different perspectives, norms, uncertainties and values. Outcomes need to be evaluated transparently and discussed openly, with participation from a wide range of stakeholders (Cornell *et al.*, 2013).

Notably, discussions on what constitutes transformational change precede the recent advent of the term itself. There have always been attempts to elucidate and operationalize the elements of sustainable transformations. Some examples are still relevant to the discussion, e.g. related to global agriculture (Chapin *et al.*, 2000), dryland development (Reynolds *et al.*, 2007) and environmental conservation (Schindler and Hilborn, 2015).

### 1.3 Global discourses and efforts on transformational change in the context of climate change, forestry and agriculture

Global-level discourses have been echoing the phrase 'transformational change'<sup>2</sup> in the context of land use and climate change. The IPCC's '1.5-degree' report increased the emphasis on the speed of change, by stating with high confidence that "Global warming is likely to reach 1.5°C between 2030 and 2052 if

it continues to increase at the current rate." (IPCC, 2018a ). Paris Agreement pledges, even if they are met, would result in warming by a catastrophic 3.2°C above pre-industrial levels (UNEP, 2019). The depth and speed of the required change implies the need for transformational change. As such, transformational change is given much importance, but it is still a vague concept when applied to climate change and land use.

Differing assumptions, on how climate governance can bring about change and how change should look like, are represented by three streams of global discourse: 'Green governmentality', "Ecological modernization" and "Climate justice" (Bäckstrand and Lövbrand, 2016). Each discourse focuses on different governance problems and beliefs that shape which objectives are selected, and which investments will be made, with very diverse implications for actual transformational change outcomes. Tensions across differing discourses will underlie the way transformational change is realized. Bäckstrand and Lövbrand concluded that there is a discursive compromise between 'Green governmentality' and 'Ecological modernization'. Both discourses largely continue current climate governance and economic regimes, with slight changes. This is contested by the 'Climate justice' discourse, the most critical of the status quo among the three.

Global institutions working on climate change and land use have begun learning about transformational change through several means. The United Nations Development Programme (UNDP) and Climate Investment Funds (CIF) conducted **introspective studies** to learn from their past activities and examine how transformation change looks within their respective institutional frameworks, as well as what conditions and actions could enable a general movement towards transformational change (UNDP, 2011; Bird *et al.*, 2019; Itad, 2019; CIF and Itad, 2020). These studies have helped institutions conceptualize transformational change more clearly, leading to tools that can be used in practice. For example, CIF's work led to the concept of transformational change 'signals' flagging whether current actions are helping or hindering progress towards transformational change (CIF and Itad, 2020). These signals are not context-specific but can be used to identify more context-specific indicators. Researchers and

<sup>2</sup> The terms 'paradigm shift', 'step change', and 'transitions' are also sometimes being used.

practitioners have also started collaborating on transformational change; for example, CIFOR and FAO began **collaborative research** into transformational change in the land-use sector and climate change in 2017<sup>3</sup>.

Some initiatives **engage with a wide variety of stakeholders** to share ideas, knowledge and information about transformational change. The Transformational Change Learning Partnership (TCLP), hosted by the CIF, brings together experts and non-experts alike in guided, online, monthly discussion [webinars](#). FAO and CIFOR, through their research collaboration, have organized expert meetings that bring together forestry and climate change experts to exchange views and learn from experiences.

Some institutions have made progress in operationalizing transformational change by **establishing practical guidelines** that align with their institutional objectives and contexts. Some of these guidelines come from introspective learning processes (e.g. CIF). Germany's Federal Ministry for Economic Cooperation and Development, BMZ, has commissioned guidance documents that use a scientific understanding of transformational change to enhance the impact of capacity-development activities and identify activities for investment (Mersmann *et al.* 2014), and to design climate finance programs and climate adaptation/mitigation actions (Mersmann and Wehnert, 2015). GIZ has produced a guidance document for designing 'transformational projects', which elaborates the concept of transformational change and outlines project design principles that lead to transformational change (GIZ, 2020).

Donors have started supporting initiatives specifically to catalyze transformational change. For example, BMZ have launched the 2030 Agenda Transformation Fund (2018) to support short-term (4 - 12 months) and small-scale (EUR 50,000 - 125 000) innovative projects in partner countries. This program aims to create impetus for the transformation needed to achieve the SDGs. As of April 2019, 12 projects were selected, contributing

<sup>3</sup> The collaboration from which this technical paper, 'Exploring guiding elements of transformational change in integrated landscape management' and an upcoming information brief originate.

to the following areas: (i) aligning policies and processes with the 2030 Agenda; (ii) mobilizing domestic resources and private investments for sustainable development; and (iii) capacity building for monitoring and reviewing the 2030 Agenda.

The **Green Climate Fund** (GCF) has an investment framework that includes six 'initial investment criteria' upon which funding proposals are assessed. One of the six criteria is paradigm shift potential:

"Project proposals should **identify a vision for paradigm shift** as it relates to the subject of the project. The vision for paradigm shift should outline how the proposed project can **catalyze impact beyond a one-off investment**. This vision for longer-term change should be **accompanied by a robust and convincing theory of change for replication and/or scaling up** of the project results, including the **long-term sustainability** of the results, or by **a description of the most binding constraint(s) to change and how it/they will be addressed** through the project." (GCF, 2018a)

The GCF also has a Results Monitoring Framework, with four core indicators at the fund level to measure performance against the GCF's paradigm shift objectives to "shift to low-emission, sustainable development pathways" and "increase climate-resilient sustainable development" (GCF, 2018b).

## 1.4 Land use, climate change and the need for transformation

Overall, land use is a significant net contributor to greenhouse gas emissions and climate change (Tubiello *et al.*, 2015; Le Quéré *et al.*, 2018), but it is also a large part of the solution. By 2050, forests and land use will have the potential to mitigate an estimated 13 Gt CO<sub>2</sub>/year, of which 10 Gt CO<sub>2</sub>/year are in developing countries (Griscom *et al.* 2017, 2020; IPCC 2018a, 2019; Dinerstein *et al.* 2019). Different land-based climate change mitigation options are being debated, along with their environmental and societal implications

(Griscom *et al.*, 2017; Sanz *et al.*, 2017; Rogelj *et al.*, 2018; Dinerstein *et al.*, 2019). Worldwide, land-based mitigation activities are relied upon for a quarter of the greenhouse gas emission reductions planned by 2030 (Forsell *et al.* 2016; Grassi *et al.* 2017; IPCC 2019).<sup>4</sup>

A strategic vision to guide actions is needed, particularly in the land-use sector, with its longer time lags between policy decisions and the materialization of their impacts. This requires a reconsideration of the way we use land, including the planting of crops, using soils, and managing forests and grasslands. Worryingly, even simple technical innovations often take a long time to permeate (IPCC, 2019; Douthwaite, 2002).

Land-based solutions for mitigation of and adaptation to climate change require local to global processes. Markets for land, commodities and labor are interconnected at all levels and in all time frames. Scholars of the subject maintain that such multi-scale changes need to be ‘transformational’ rather than ‘incremental’, by changing power relations, discourses, attitudes, policies and practices from global to local levels (Bäckstrand and Lövbrand, 2016; Biermann *et al.* 2012; Brockhaus *et al.* 2014b). The complexities of climate change and changes in the global socio-economic environment require ‘systems thinking’ that includes aspects beyond land-use management itself, like political and economic interests, power structures, and beliefs.

---

<sup>4</sup> Based on the information provided in the Intended Nationally Determined Contributions (NDCs) submitted to the UNFCCC

# 2 The scientific literature on transformational change

## 2.1 Publication trends and authorship of scientific articles on transformational change

**The number of scientific articles using the title ‘transformational change’ has been increasing since 2000** (Figure 1). We identified and analyzed 111 scientific articles published before 31 December 2018. Very few were related to agriculture (Jacobs *et al.*, 2017; Mapfumo *et al.*, 2017; Derner *et al.*, 2018), while articles in forestry are mostly on REDD+, and are included within the general environmental science category. Prominent research themes are business and economics (specifically business management), environmental sciences, health, education and public administration. Very few (five) authors are specialists, having contributed more than two articles to this literature (i.e. Babon, Boodoo, Brockhaus, Di Gregorio and Olsen). One author, Valerie Brown, published several books not included in the list of scientific articles (e.g. Brown and Lambert, 2013; Brown and Harris, 2014; Brown and Lambert, 2015).

**More work is needed to increase the diversity of authorship in transformational change and increase representation among scholars from developing countries.** When considering the overall transformational change literature, most (129 of 166) contributing authors were from 19 high-income countries, notably the United States (46 authors), United Kingdom (24 authors), Australia (16) and Canada (14). These four countries account for 61 percent of the authorship in the studied publications. In contrast, 20 authors from 16 low and low-middle income countries account for 9 percent of the authorship. We conclude that the distribution of co-authorship in the transformational change literature is highly skewed against authors in developing countries. The science of transformational change is not yet

participatory enough to reflect the voice of authors in developing countries.

**While speaking of collaboration, most transformational change research has not been conducted collaboratively.** Very few publications are the result of large, collaborative efforts. Most (58 percent) have one or two authors (Figure 2). Only two papers in fields related to land use and climate change have been written by numerous authors; these are both affiliated to institutions based in developing countries: 20 authors in Brockhaus *et al.* 2017, and 12 authors in Mapfumo *et al.* 2017. These two articles represent nearly all the developing country authors active in the study of transformational change.

## 2.2 Definition of transformational change and related concepts

We reviewed the definitions of transformational change found in scientific articles and grey literature, so as to identify similarities and differences (Annex 3)<sup>5</sup>. In most cases, these are texts that describe – rather than define – transformational change or related phrases like ‘paradigm shift’ and ‘transformation’. They are nevertheless useful to extract commonalities and differences in the way transformational change is conceptualized.

**Definitions of transformational change share the following common features:**

- movement away from the current regime, equilibrium or business-as-usual situation, and opening of new pathways

---

<sup>5</sup> Many of the definitions from the grey literature were identified from Puri (2018)



- sustained changes, either through institutionalization within systems, or changes in cultures, beliefs and power relations
- focus on root causes and on relationships between dimensions of change (e.g. organizations, markets, technologies, power and social relations, and ideas), i.e. deep change
- emphasis on learning, either as a driver or indicator of change.

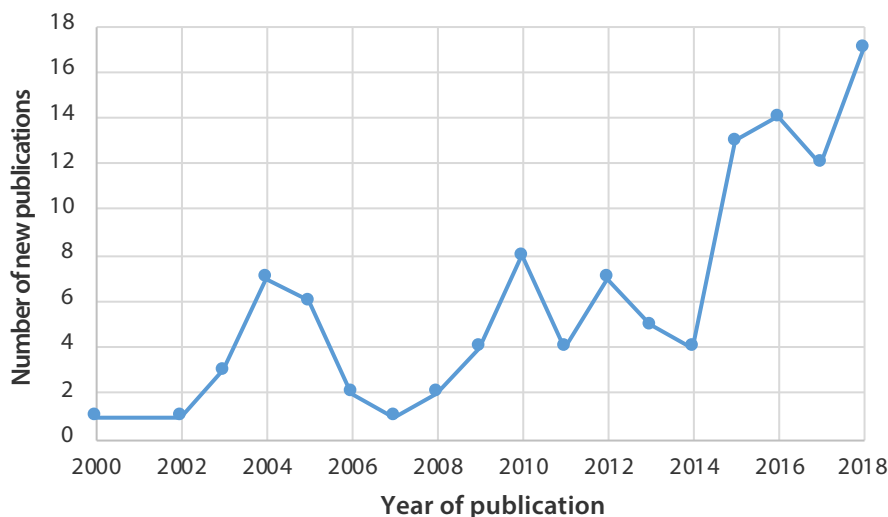
**Some definitions diverge from each other, and we need to work with this diversity.** Divergence may be due either to an underlying disagreement of what is transformational and how it is achieved for any goal or context, or to the fact that the goals and contexts require that definitions need to be adjusted. Given the diversity of the literature examined, it is difficult to ascertain the reason for divergence. Examples of divergences are:

- The idea that transformational change can be achieved through continuous processes and a series of incremental steps (Jacobs *et al.*, 2017; Boodoo and Olsen 2018), versus the idea that it can be achieved through discontinuous or disruptive processes (Brown n.d.; Mapfumo *et al.*, 2017).
- Emphasis on the results of particular actions or investments (UNDP, 2011), versus emphasis on

the process (Brown n.d.; Holland 2017; Jacobs *et al.* 2017; Mapfumo *et al.* 2017).

- Emphasis on national or large-scale change (CIPD, 2015; FAO, 2019; GCF, 2016; GEF, 2018; UNDP, 2011) versus emphasis on changes across scales (Brown, n.d.; Jacobs *et al.*, 2017).

**Despite academic discussion around the importance of linking different levels to achieve transformational change<sup>6</sup>, most definitions by multilateral institutions do not explicitly highlight** multi-level interactions and interdependencies. Multilateral institutions, typically working in the area of international development, focus on large-scale transformational changes. They set objectives at the higher level based on global agendas, which are used to selectively support action on the ground. It is therefore sufficient to define transformational change based on higher-level changes. Some definitions include country ownership, while others acknowledge heterogeneity among countries; some others set national objectives with national stakeholders. Yet the flow of influence is assumed to be largely limited between national and global scales, with national stakeholders being considered

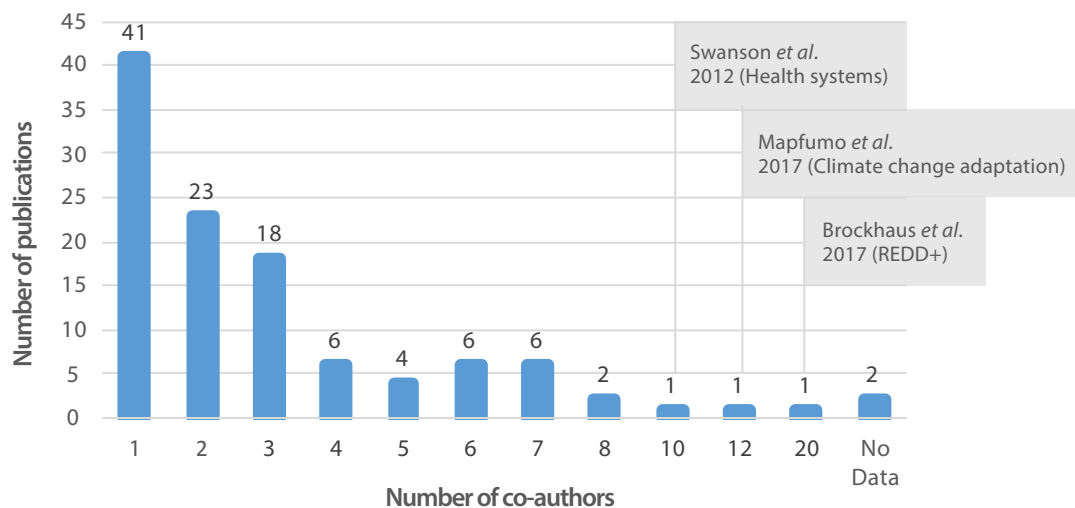


**Figure 1. Number of new publications with "transformational change" in their title.**

Note: As of 31 December 2018, a total of 111 articles were observed

Source: Authors' own elaboration.

<sup>6</sup> For example, see the transition management literature, summarized in Section 2.3.1



**Figure 2. Number of authors listed in publications.**

Note: As of 31 December 2018, 111 articles were observed to have ‘transformational change’ in their titles. There is no data on two of the publications as authors were listed as ‘Anonymus’.

Source: Authors’ own elaboration.

as representing local perspectives<sup>7</sup>. Interactions and interdependencies with and among subnational levels, like local governments and community members, are rarely considered. This results in definitions that are top-down from the perspective of subnational actors.

**The gap between multilevel approaches promoted in scientific literature and top-down approaches espoused by global multilateral institutions needs to be bridged.** The scientific literature focuses on the importance of processes, where each scale is an important part of the whole system driving transformational change. Here, every scale matters; there is greater emphasis on animating and managing the non-linear interrelations between scales. This reflects the extensive use of transition management or similar frameworks in the scientific literature, and the desire to find alternatives to the top-down governance systems that often dominate large multilateral institutions (Termeer *et al.*, 2017; Boodoo *et al.*, 2018). On the other hand, the international institutions that we reviewed focus more on results at one (large) scale. They are interested in attributing how resources provided by their institution can result in

transformational change. Some scientific articles (e.g. Termeer *et al.*, 2017; Boodoo *et al.*, 2018) argue that pursuing transformational change is not compatible with top-down governance structures. Others instead acknowledge a discrepancy between ideal transition management approaches to transformational change – which focus on adaptable and participatory management and need easy-to-monitor hierarchical impact pathways for donor accountability on one hand – and the high cost and impracticalities of long-term stakeholder engagement across levels, on the other hand.

**By striving to achieve scale, speed and depth simultaneously in transformational change, attempts at transformational change are set to fail.** Transformational change in the context of land use and climate change is expected to be large-scale (the whole system instead of isolated parts; inherently multi-dimensional, multi-component, multi-aspectual and multi-level), fast (including jumps and discontinuous processes) and in-depth (fundamental, truly new, revolutionary; with altered values, frames and logics underlying the system). This trifecta was questioned by Termeer *et al.* (2017): “Although this might be an attractive proposition for people with a change agenda, organization science suggests that achieving all three simultaneously is virtually impossible because of the inherent

<sup>7</sup> With some exceptions, e.g. Mersmann *et al.* (2014)

trade-offs between them.” (Termeer *et al.* 2017). As these authors explain, “in-depth change requires people to challenge existing cultures, dominant rationalities and habitual practices, which cannot be enabled through rolling out a large-scale intervention over the whole organization in a standardized way” (Termeer *et al.* 2017). In the end, achieving two of these goals simultaneously may be possible, but at the expense of the third.

**Based on the common features of transformational change, supplemented by suggestions from the scientific literature, we found the following common elements that characterize transformational change in land use and climate change:**

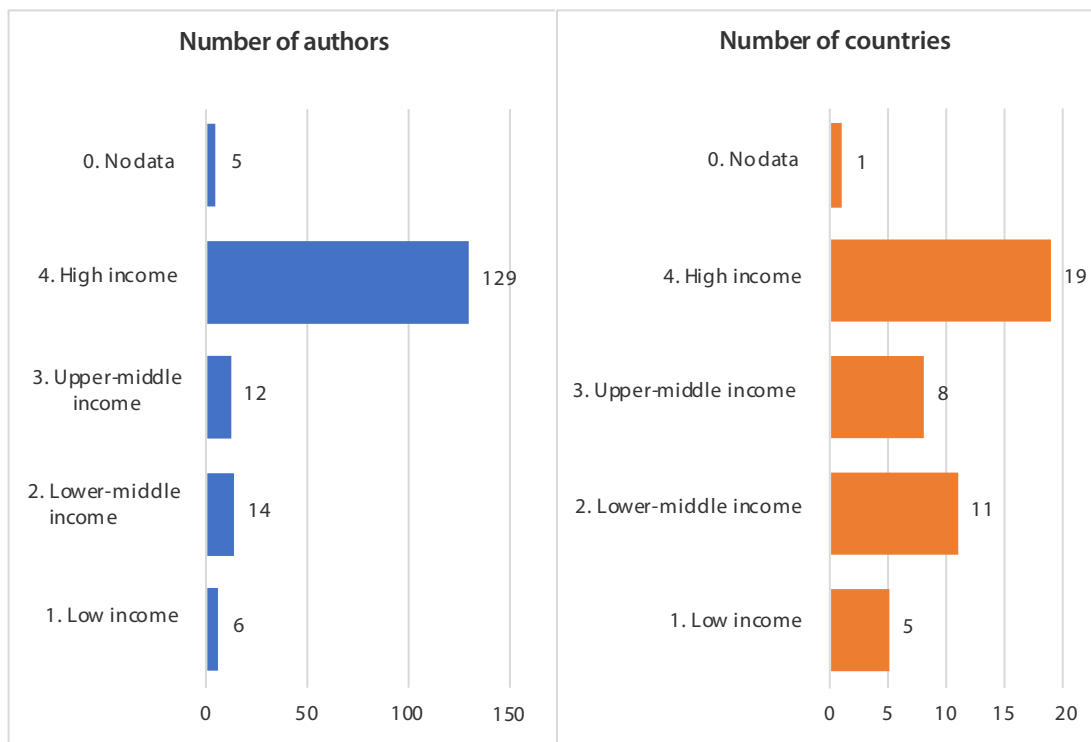
Transformational change in land use and climate change is characterized by:

- (i) processes that moves away from the current regime of unsustainable land use, maladaptation and unmitigated greenhouse gas emissions, opening pathways to reverse these outcomes and work towards a sustainable planet

- (ii) being achieved through sustained changes that accept complexity and uncertainty
- (iii) a focus on root causes and nurturing relationships between scales and dimensions of change (e.g. organizations, markets, technologies, power and social relations, and ideas)
- (iv) being based on participation, equity and transparency
- (v) being supported by knowledge and data used for understanding, evaluation and course corrections

**2.3 Influential theoretical and empirical frameworks for transformational change**

Of the 111 articles identified, we focused on a subset of 22 articles on topics related to land use and climate change to understand how transformational change is being analyzed and understood specifically in this context. These 22 articles draw upon several theoretical frameworks from different sciences and apply



**Figure 3. Number of authors by country income classification.**

Note: Total number of authors: 166. Total number of countries: 44. Country income classification taken from <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>, accessed 15 September 2020. Countries represent authors' affiliations, not their citizenship. Source: Authors' own elaboration.

different analytical frameworks and definitions to analyze transformational change. Within this heterogeneity, there is general agreement about the critical elements of moving towards transformational change:

- Importance of creating space for innovation (either technical or institutional), trial and error, and flexibility in program design.
- Moving away from linear cause-and-effect logical frameworks towards non-linear thinking that integrates complexity, interconnectedness across multiple dimensions, temporal scales and spatial scales, and feedback mechanisms (i.e. systems thinking).
- Engaging a wide variety of stakeholders, with emphasis on meaningful participation and the inclusion of marginal stakeholders and connecting traditionally disconnected groups of stakeholders.
- Emphasizing the use of learning to inform action and learning from actions by monitoring processes and outcomes and using feedback mechanisms, as well as collective learning and reflection.

We detected influential theoretical and empirical frameworks of transformational change by identifying large (i.e. three or more) clusters of studies that adopt the same framework or set of methods. Two clusters of studies emerged. The first cluster of studies adopt the transition management framework (see Annex 4), described in Loorbach (2010). This transition management cluster of studies includes articles by McAlpine *et al.* (2015), Fridahl and Johansson (2017), Jacobs *et al.* (2017), Mapfumo *et al.* (2017), Boodoo and Olsen (2018) and Boodoo *et al.* (2018).

The second cluster of studies focuses on REDD+ (Babon *et al.*, 2014; Korhonen-Kurki *et al.*, 2014; Moeliono *et al.*, 2014; Di Gregorio *et al.*, 2015; Brockhaus *et al.*, 2017) and – more recently – Moeliono *et al.* (2020). The REDD+ cluster of studies adopted a consistent analytical framework and methods to study transformational change developed under the [Global Comparative Study on REDD+](#) led by CIFOR. These studies focus on same key elements, which are transformational change as a change in discursive practices, incentive structures and power relations. They also follow the same definition of transformational change described in Brockhaus and Angelsen (2012). These methods and definition were used almost exclusively in the context of REDD+ and forest

governance, and influenced the work of other researchers (e.g. Ngendakumana *et al.* 2014; Glover and Schroeder 2017; Chia *et al.* 2019).

Transition management was developed for a wide range of sustainability issues across a range of natural resources (e.g. water, minerals, and soil health), whereas the REDD+ studies took a political economy perspective on change (or lack thereof) to the underlying drivers of deforestation and forest degradation, with REDD+ as a case study. The underlying frameworks used by these two clusters of studies are complementary, as the transition management framework offers concrete 'how-to' guidelines, while the REDD+ studies focus on the underlying (political economy) conditions that determine the direction and likelihood of change away from the business-as-usual state of deforestation and forest degradation.

### 2.3.1 Transition management framework

Transition management is a governance approach for sustainable development based on complexity theory, in particular two theories of how societies and technologies transition: (i) the multilevel perspective (Rip and Kemp 1998; Geels 2002) that distinguishes innovations at three levels: niches, regimes and landscapes; and (ii) the multiphase or S-curve model (Rotmans *et al.* 2001) that distinguishes between phases of innovation: predevelopment, take-off, acceleration and stabilization phases. Transition management is rooted in the transition sustainability literature (reviewed in Markard *et al.* 2012), which in turn builds on complexity science (Boodoo *et al.* 2018). Complexity science has been used to design programs for transformational change at various levels, including at the community level (e.g. Brown and Lambert 2013; Durie and Wyatt 2013). The basic tenet is that changes must come from self-organization and relationships within the system.

Transition management can be used to analyze and govern societal processes. Table 1 describes the types of activities that transition management suggests for bringing about transformational change at different levels and their focus.

Activities to bring about transformational change interact and exist simultaneously at different levels and time scales. Reflexive actions are the glue that brings these levels together. Researchers play a central role in reflexive action, as they analyze

longer-term societal processes and dynamics and put these on the societal and political agenda. Reflexive actions are necessary to prevent lock-in and enable exploration of new ideas and trajectories.

Reflexive action:

- includes monitoring, assessments and evaluation of ongoing policies, and ongoing societal change,
- is found in existing institutions (e.g. monitoring and evaluation units, learning forums) or is socially embedded (e.g. media, internet),
- needs to be an integrated part of governance processes.

Transition management's advantage is that it provides a 'how to' general guide for transformational change that can be applied to a wide range of long-term societal issues (See Box 1). The approach is useful for planning and developing a theory of change (Martius *et al.* 2018) for each context, because it advocates for building a shared image of the future, establishing an agenda and pathway for transitions, and using experimentation, monitoring and evaluation to provide evidence-based decisions towards change.

Critics of the transition management approach (e.g. Shove and Walker 2016) point to several weaknesses, like the lack of consideration of the politics of managing transitions. For example, transition management proposes the establishment of a transition arena consisting of 10-15 people to structure the problem, develop a vision and organize the arena (see Box 1). However, the framework leaves gaps in the political economy of transformational change, like who decides who will participate, what makes the transition arena legitimate, the source of resources for such an enterprise, how to engineer the demise of undesirable technologies, and reliance on controlling (in reality, uncontrollable) uses of innovations to push for transformation.

### 2.3.2 REDD+ political economy framework

The REDD+ political economy framework was developed in CIFOR's Global Comparative Study on REDD+ (GCS REDD+) to understand and overcome challenges in achieving transformational change in REDD+. In this framework, REDD+ is seen both as potential game-changer (i.e. a

driver of change) and a beneficiary of up-front changes and changes in other sectors. Research on transformational change has focused on the REDD+ policy arena as the place where a network of actors come together, negotiate and influence each other (CIFOR, 2020). This REDD+ policy arena is characterized by a multitude of actors from global to local levels, and has some features that make transformational change challenging (Brockhaus and Angelsen, 2012):

- multilevel institutions and multilayered processes (e.g. funding, forest governance, REDD+ coordination, cross-sectoral coordination);
- multiple actors with different authorities, interests, discourses, beliefs and modes of thinking;
- a variety of governance structures, in the form of hierarchies, coalitions or networks, along the spectrum between markets and states;
- context dependence, implying that changes outside the forestry sector are needed to achieve REDD+ objectives.

A framework called the 4I framework was developed as part of the GCS REDD+ (see Brockhaus and Angelsen, 2012). It provides the theoretical underpinnings for investigating business-as-usual circumstances, strategizing and monitoring for transformational change in forest policy in developing countries. The framework has four components:

- **Institutions**, which form the 'rules of the game' consisting of norms, regulations and other formal and informal arrangements. Historically, institutions have enabled the current trend of forest degradation and loss. State institutions (e.g. ministries, agencies) and private companies are especially influential in the forestry sector. Institutional change is restricted by path-dependencies (i.e. 'what was' and 'what is' are shaped by 'what can be') and stickiness (i.e. resistance to change, notably among state organizations).
- **Interests** of actors in efforts to halt or continue forest loss. In the business-as-usual scenario, there are limited interests to change, although this may change over time as other factors change (e.g. institutions, incentives, ideas). One way to realize interests in change is to build coalitions among different actors to leverage their combined political and economic powers. There are conflicting interests and tradeoffs across and within actor groups, which can be conducive for progress (Brockhaus

**Table 1. Transition management levels and their focus.**

Transition management governance level	Transformational change challenge	Target of action for transformational change	Time scale	Example of activities for transformational change
Strategic	Deep, slow-changing and exogenous structural trends that exert a unidirectional influence on the regime and niche dynamics	Culture and societies	Long-term (30 years)	Establishing a transition arena; structuring problems; envisioning of futures
Tactical	Stable socio-technical configurations that depict the established way of doing things, which, in turn, hinder the development of innovative ways to fulfil societal functions termed 'niches'	Structures/institutions	Mid-term (5–15 years)	Building coalitions; developing images and transition agendas; developing transition scenarios
Operational	Protected spaces where unstable but more sustainable practices may be nurtured to challenge existing ones	Practices/projects	Short-term (0–5 years)	Mobilizing actors; executing activities
Reflexive	Lack of reflexivity prevents different levels of governance from interacting	All levels	All time scales	Monitoring of the process; evaluation and re-orientation

Source: Adapted from Loorbach 2010 and Boodoo and Olsen 2018

and Di Gregorio, 2014). The presence of a powerful 'transformational coalition' in REDD+ countries is a crucial ingredient for larger transformation (Korhonen-Kurki *et al.*, 2019).

- **Ideas** (concepts or mental constructions), ideologies (a normative set of ideas), and beliefs about how forests should be managed,

help legitimize actions for or against change. The extent to which beliefs resist change vary. In some contexts, a policy proposal can touch non-negotiable beliefs and is therefore rejected, e.g. carbon offsetting. In other contexts, the same proposal speaks to beliefs in the dominant economic framework and hence opens space for negotiation. How a problem is

### Box 1. Summary of the transition management approach

1. Organize the transition arena:
  - Create a group of 10 - 15 individuals, not representing institutions, who are willing to invest time in structuring the problem, developing a long-term sustainability vision and establishing and organizing the transition arena.
  - These individuals need to represent various perceptions of the problem, as well as possible solutions.
  - The group is a network of innovation, not an administrative platform or consultative group.
  - They should consist of an equal number of frontrunners from the government, the private sector, NGOs, knowledge institutes and intermediaries (consulting organizations, project organizations and mediators).
  - They are selected by experts on the process and the transition subject (e.g. climate change, forestry, agriculture).
2. Develop future images and a transition agenda, and derive the necessary transition paths.
3. Establish and carry out transition experiments, and mobilize the resulting transition networks.
4. Monitor, evaluate and learn from the transition experiments and, based on these lessons, make adjustments in the vision, agenda and coalitions.

Source: Adapted from Loorbach (2010)

framed limits the options of what seems to be reasonable or possible, and hence shapes policy action or justifies inaction.

- **Information** or knowledge, upon which discourses unfold. Information is diverse, can be conflicting, and can be used to justify action or non-action. There is also a political dimension in what seems to be a technical issue that is especially pertinent in forestry, as the wide variety of actors (including companies, ministries, scientists, and local communities) have different capacities to access, process and provide information. Often, facts are used to support the interests of the information provider, which is one of the reasons why there are many (often conflicting) discourses on climate change and forests. Information can either constrain or enable change, depending on who uses it, and how it is used (Myers *et al.*, 2018).

## 2.4 Similarities, differences and lessons across multiple sectors

**Given the small amount of academic literature on transformational change in land-use and climate change (22 papers), we must learn from other sectors.** Bringing about transformational change depends mainly on how it is defined, the kind of ‘change’ envisaged, and the roles and types of stakeholders involved. These are very contextual questions; hence, from the outset, opportunities to learn from other fields must be treated with great care. The first step is to identify differences and similarities. To do so, we grouped the 111 articles into six themes: three directly related to the specific interest (land-use and climate change research themes – agriculture, forestry and climate change adaptation and mitigation); and three themes that are the most prominent in the transformational change literature (i.e. health, education, business management). An additional research theme – public administration – cuts across the six themes and was not analyzed. These themes are characterized by the type of transformation sought, the scale of transformation, the time scale, the direction of transformation, and the expected leader of transformational change. This analysis is based on the information provided in the abstracts of 111 transformational change articles, summarized in Table 2. The following characteristics set land-use and climate change literature apart from other themes (education, health, business management) and can be the basis

of further research that is targeted at the land-use sector:

- topics of land tenure are more prominently discussed,
- units of transformation include those that are based on the natural environment (e.g. watershed, ecosystem, biome, landscapes),
- nature has a stronger influence on transformational change outcomes,
- time scales are longer, especially in forestry and climate change,
- the literature rarely provides hands-on practical advice on how to bring about transformational change.

There was no significant difference in the way transformational change was defined in land-use and climate change literature. All research themes are similarly cognizant of the importance of collaboration and learning across public and private actors, and across levels for transformational change. This is particularly the case in forestry.

**What is considered speedy change in climate change and forestry – years and decades – would be considered too slow to be transformational in other disciplines.** Because of this, the archaeology and history literature, especially that which analyzes transformations in human civilizations due to climate change, can offer valuable insights into how humans can cause transformational change in the long run, and the impact of undertaking transformational change for future generations (see Hassan 2009; Schoon *et al.* 2011). These lessons need to account for the difference in human relationships, both within societies and with the natural environment. Both aspects have changed in scale and scope across time.

**The direction of transformation is both bottom-up and top-down.** The forestry (notably REDD+) literature demonstrates that the engagement of actors from all levels of governance is crucial, and that lack of this engagement has become a barrier for transformational change (see, for example, Babon *et al.* 2014). Climate change adaptation literature provides examples of bottom-up transformations, like collective action by citizens and local governments to improve climate resilience (e.g. Mapfumo *et al.*, 2017; Totin *et al.* 2018). The climate change mitigation literature, excluding REDD+, provides examples of top-down processes like climate finance (e.g. Boodoo and Olsen 2018; Boodoo *et al.* 2018).

Transformational change analysis in business and management is well-developed and offers practical insights into institutional transformation; **however, many messages are lost in translation due the more complex types of stakeholders, objectives, visions, time frames and constraints in land use and climate change.** There is a wide range of management books, training courses and research papers on how to bring about, sustain and endure transformational change within organizations. This literature offers the needed 'how to' that is lacking in transformational change literature on land use and climate change, like how to cultivate leaders and an organizational culture that enables transformational change. The business management literature focuses more on transformational change within enterprises and smaller units, making its findings useful for ministries, programs, projects, departments, communities and individuals. There are increasingly more articles going beyond profit-maximization, and into social and environmental sustainability. Nonetheless, the literature lacks guidance for very long-term and global-level transformations relevant to addressing climate change, and the direction of transformation is almost exclusively top-down.

**Transformational change research in public administration, health and education offers numerous learning opportunities for transformational change in land use and climate change due to similar interests in improving the governance of systems and public institutions.**

The education literature provides a rich source of information on how to improve personal and collective learning. The health literature is interested in improving service delivery by providing integrated care from different service providers. Transformational change analysis in the public administration literature is well developed in practical and analytical terms, and applicable to a wide range of transformational change objectives in land use and climate change due to its emphasis on improving governance and on the inclusion of bottom-up transformation pathways.

**Transformational change articles in the education sector offer practical methods for learning at the personal and communal level, and analysis on the process of institutional change at the national to school level.** Compared to the land-use and climate change literature, the educational literature on transformational

change benefits to a deeper extent from the fields of psychology at the individual level. At the institutional level, it often draws from the field of management, organizational behavior and public administration (e.g. Ananthakrishnan *et al.* 2012; Kezar 2013; Boone 2015). One example of practical methods to bring change in this literature is Kezar (2013), who examined 28 universities in the United States. They found that sensemaking/sensegiving processes (e.g., activities to 'give sense' to or 'make sense' of a problem or experience) determined success in achieving transformational change objectives such as creating interdisciplinary learning environments. Previous work (Kezar and Eckel 2002) identified five core strategies facilitating sensemaking/sensegiving – support from senior administration, collaborative leadership, staff support, taking action and robust design. These strategies gave key participants the opportunity to create a new sense of the direction and priorities for the institution. Widespread conversations, cross-departmental teams, public presentations and external speakers were pivotal tools to create sensemaking.

**All fields grapple with the issue of top-down and bottom-up change processes, and multi-stakeholder linkages.** In the field of education, the multi-level relationship between ministries of education, university or school administration and faculty/staff reflects to some extent the relationship between the different levels of government and local people in the land-use and climate change context. The same is reflected in health and business management. Forming linkages across these various levels and stakeholders is important for transformational change in any field. While these insights are important, there are significant differences in the prominence and role of government, private sector and civil society, which are specific to each field. Applying approaches from other fields (e.g. sensemaking/sensegiving in Kezar and Eckel [2002]) would need to account for the different constellation of actors.

**Land-use and climate change studies focus more on learning at the institutional and communal level, rather than at the personal level, reflecting the collective nature of land use and climate change.** Some articles (e.g. Amansure and Adendorff, 2018) view education as an intervention that can lead to transformational change, in the form of formal and informal learnerships, mentorships, further education and



**Table 2. Summary of type, unit, direction and expected leader of transformational change across research areas (based on literature review).**

Research theme	Type of transformations sought	Unit of transformation	Time scale	Direction of transformation	Expected leader of transformational change
Climate change	Reduced greenhouse gas emissions, reduced impact of climate change, improved use and governance of natural resources	Countries, world  In terms of adaptation: households, communities, jurisdictions	Decades, centuries	Top-down (e.g. climate financing); bottom up (especially for adaptation)	Government, local communities, NGOs, donors, global institutions
Forestry (and natural resource management)	Increased forest cover/ quality, carbon- and non-carbon benefits (economic, social, environmental, climate change), cross-sectoral coordination	Households, communities, jurisdictions, watersheds, landscapes, ecosystems, sectors, countries, world	Decades	Top down (e.g. national or landscape programs); bottom-up (e.g. collective action)	Government, enterprises, local communities, NGOs, donors
Agriculture	Increased and sustainable agricultural production, benefits (income, health, climate change); reduced environmental impact per unit produced	Individuals, households, communities, jurisdictions, watersheds, sectors, commodity, countries, enterprises, world	Seasons, years	Top down (e.g. national or commodity programs; technology adoption programs); bottom-up (e.g. collective action)	Government, enterprises, donors, local communities
Education	Learning efficacy, suitability with job market/sectors, management efficiency, interdisciplinary learning	Individuals, enterprises (e.g. schools, service providers), communities, school systems, sectors, sub-sectors (e.g. fields of expertise), world	Months, years	Top down (e.g. education system reform), bottom up	Government, enterprises, local communities, professionals, individuals
Business management	Increased profitability and sustainability	Individual staff, leaders within enterprises, entire enterprises	Months, years	Top-down	Individuals
Health	Improved health service, reduced cost, clinical efficacy, improved coordination, evidence-based approach	Individuals, enterprises (e.g. hospital/clinic, service providers) communities, health system, health sector, world	Months, years	Top down (e.g. health system reform); bottom up (e.g. integrating parents in care of child patients)	Government, enterprises, local communities, professionals, individuals

training, educational support and resourcing. It is imposed externally, as part of the context within which actors operate. Several articles focus on collective or transformational learning processes (e.g. Brown and Lambert, 2013 and 2015), drawing heavily on theories related to education and epistemology. This body of work has identified methods and tools to encourage learning, mainly at the local level.

**Establishing links between these different stakeholders is an important aspect of transformational change in the land-use and climate change literature, because actors in the land-use sector are fragmented.** Transformational change requires coalescing power from different actors which are strewn across generations, sectors (e.g. between forestry, agriculture, land administration), levels (global to local), and political boundaries. They have asymmetric power (weak to strong) and draw from different sources of knowledge (practical, theoretical). Several types of linkages are being discussed in the literature that link some of these different pockets of actors: advocacy coalitions that can either promote or hinder transformational change in forest governance (e.g. Babon *et al.*, 2014; Brockhaus *et al.*, 2017); social, technical and political coalitions built around coordinated activities to manage a common resource (like urban water, e.g. Bos *et al.*, 2015); partnership between scientists and land managers (Dermer *et al.*, 2018); and a coalition of ‘prime movers’ built through consensus among policy makers, institutions and scientists (Jacobs *et al.*, 2017).

**Land-use and climate change studies demonstrate the importance of enabling and empowering coalitions with desire to achieve transformational change, while highlighting some challenges.** These include: conflicts at the policy level where powerful actors derive and maintain power; conflicts at the local level where ideas become action that impacts daily lives; market forces overcoming socially desirable goals through profit; the relative weakness of coalitions that demand change versus those that want to maintain the status quo; and difficulties in changing institutions, even if there is political will and consensus to do so among actors (Babon *et al.*, 2014; Brockhaus *et al.*, 2017; Jacobs *et al.*, 2017).

**Identifying appropriate stakeholders is vital in transformational change strategies due to the importance of linking stakeholders together and building coalitions.** This is particularly true in land use and climate change, where there are strong competing interests between and within land-use sectors. Studies analyzing transformational coalitions in [REDD+ policy networks](#) can be a useful starting point.

## 2.5 Drivers of transformational change

### 2.5.1 Basic concepts

The following definitions were taken from the transformational change literature.

**Drivers** are underlying and proximate conditions and the forces that influence the outcome of actions. This definition is inspired by the way this word has been used to understand the causes (‘drivers’) of deforestation. The attribution between outcome and driver is less stringent, since there can be multiple drivers operating at the same time, each pushing a system and each other to a given direction at different levels. The relative strengths of these multiple drivers determine the extent and direction of change within the system (Jacobs *et al.* 2017). Unless noted otherwise, this term is used in the positive sense, in that drivers of transformational change are conditions and forces that encourage the desired change. In the short term, drivers tend to be exogenous to (i.e. beyond the control of) the actors and actions that strive to create transformational change.

**Examples of drivers** identified in the scientific literature (see Annex 4):

- UNFCCC negotiations and agreements, particularly NDCs and the Paris Agreement.
- Global debate on climate finance, REDD+ and REDD+ results-based payments.
- Improved resources for advocacy.
- Policy and media engaging dominant actors on how to reduce pressure on forests.
- Government enhancement on policies and measures based on past failures and successes.
- Supportive structures in the country serving (e.g. law, policies) to increase the likelihood that innovation and success cases are scaled up;
- Closer interaction among sectors, including linking natural resource stewards to boost

environmentally friendly practices in agriculture and livestock.

- Development of alliances and networks for learning and co-operation.

**Barriers** are the forces opposing change that may prevent the direction, intensity or duration of events from changing. They can be groups of actors with interest in maintaining the status quo, technologies that are locked into existing production and economic systems (e.g. reliance on fossil fuels), incongruence in several related but uncoordinated parts of a system that need to be disentangled prior to embarking in change (e.g. land vs. forest laws), missing technology, funding, knowledge or other capacity deficits, and belief systems. Barriers are the opposite of triggers and drivers.

**Examples of barriers** (see Annex 4):

- Little attention and consideration from decision makers in the land-use sector and in land-use planning to the drivers of deforestation and forest degradation.
- Disparities and fragmentation of interests in the broader land-use sector.
- Difficulty reconciling accountability and an open-ended/participatory approach.

**Lock-in** is “a mode that the system does not easily get out of again due to self-stabilizing feedback” (Scheffer and Westley 2007). It is a kind of barrier, as it prevents systems from shifting in the face of drivers of change. Examples include deforested areas that cannot be restored because the topsoil is lost after the trees are removed. A more elaborate definition is provided in Annex 6 (Glossary).

The Glossary (Annex 6) includes the above and several other concepts that are often used in the transformational change literature, like human agency, paradigm shift and triggers.

### 2.5.2 Identifying drivers of transformational change

Several of the 22 analyzed land-use and climate change-related articles identified drivers and barriers to transformational change (summarized in Annex 4). We analyzed these studies and coded text identifying particular factors that authors suggest could bring about those outcomes. Some drivers were identified through empirical research, while others were part of the authors' hypotheses.

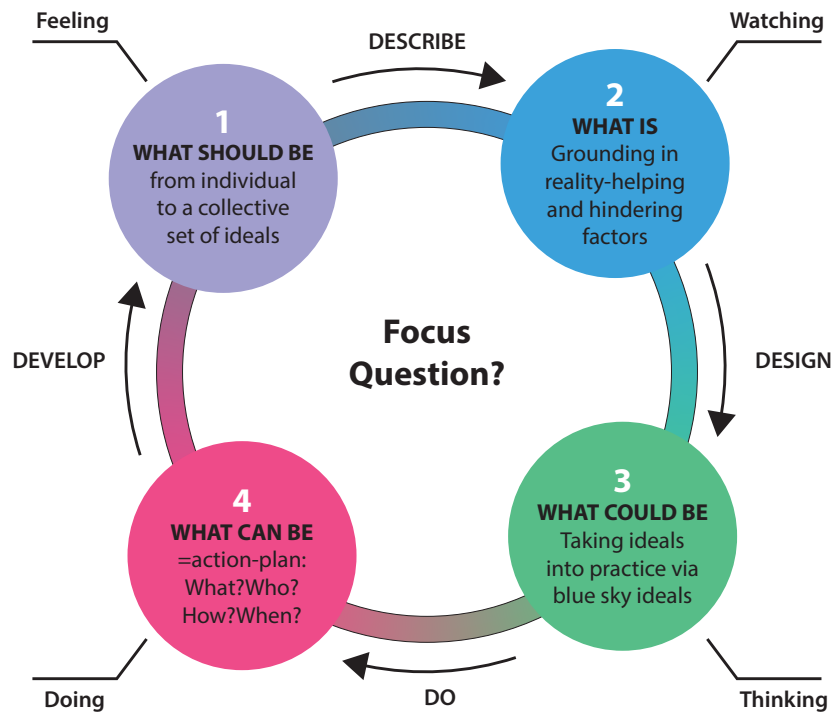
None of the identified drivers have been through rigorous impact evaluation methods. This should not reduce the value of the results, since existing impact evaluation methods are well-suited to simple interventions in simple systems, but new approaches need to be developed to evaluate complex interventions in complex systems (Shiell *et al.* 2008).

**Factors that could drive transformational change are classified into endogenous and exogenous, and barriers.**

Barriers can also be endogenous or exogenous, although we do not distinguish among them due to limited data. Note that within the same case study, multiple drivers co-exist and can diminish, strengthen or transform each other. For example, international climate finance commitment can drive change, since it affirms national climate change action. Nevertheless, if the global debates are based on norms that do not view national actors as equal partners (e.g. donor-recipient relationship), this could drive low country ownership over global climate change concerns, and possible backlash. Interactions and feedbacks between drivers make it difficult to predict the general direction of change. Nevertheless, our analysis seeks to show which driver can help achieve transformational change if viewed in isolation.

Four groups of drivers were identified from this analysis. Each group can have exogenous and endogenous elements, depending on the context:

- 1. Resources (R):** Factors that provide the energy needed to push for change. For example: information/data, knowledgeable people, funds, dedicated people, time, legal frameworks, market structures, institutions, political will.
- 2. Legitimacy (L):** Factors that help change to be accepted by society as an objective that merits allocation of resources. For example: formation of higher-level agenda, shared concern, economic and political interests, shared narratives, shared vision, heightened awareness.
- 3. Processes (P):** Actions that harmonize efforts and values across different levels and actors. For example: forming a shared vision, collective learning, updating strategies and objectives based on evidence, harmonizing processes and incentives with vision, forming a transition arena, linking and developing actors' alliances across different scales and interests, knowledge management, monitoring and evaluation, scaling up.



**Figure 4. Four stages of the collective social learning cycle.**

Source: Brown and Lambert (2015)

4. **Norms (N):** Values that guide processes to result in sustainable and transformational collaborations. For example: openness to new ideas and actors, equal voice, risk-taking, willingness to empower marginal actors, willingness to learn and share lessons from trial and error, low/no-regrets approach (actions that would be desirable regardless of climate outcomes), a focus that is more on the process.

**Authors have diverging opinions on the role of technology and science.** Some see them as resources that need to be accessed (Bos *et al.* 2015), and that generate new lessons and directions. Others see them as a barrier to transformation, when they:

- lead to an undesirable state locking us on an unsustainable path (e.g. Boodoo and Olsen, 2018);
- take away the voice of those who do not have access to them and limit their desire to join the conversation (e.g. Holland, 2017).

This divergence highlights the importance of other drivers (e.g. norms, process, legitimacy), and interactions between drivers that could influence final outcomes.

**Learning.** Many articles include learning as an essential mechanism to drive transformational change. Brown and Lambert (2015) propose a learning cycle composed of four stages designed to bring about collective social learning and change (Figure 4). Each transformational change has its own context that determines how this cycle is implemented, and whose knowledge and what kind of knowledge can contribute to the learning exercise. This learning cycle has been used at the community level, but can be adapted to other levels.

## 2.6 Indicators of transformational change identified in the literature review

Achieving transformational change requires being able to monitor progress based on specific indicators of success. Here we summarize the indicators used by researchers to monitor and assess transformational change in case studies, grouped by the level of action being monitored or assessed (Annex 5). These indicators were identified in the academic literature that uses a variety of theoretical frameworks.

Most transformational change indicators in the scientific articles we reviewed are not quantifiable and are difficult to measure, or are not meant to be measured consistently across levels, space and time. The literature focuses on detecting changes in drivers (resources, legitimacy, processes and norms). There are three types of indicators:

1. **Level-dependent indicators**, aligned to each level's objectives, timeframes, scope, resources and conditions.
2. **Level-independent indicators**, used for actions at different levels – including processes for learning, participation and decision making – and for norms that should be espoused in these various processes.
3. **Multi-level indicators**, which address how actions at different levels interact and contribute to attaining the desired transformational change, and the norms that the processes relevant for this action should espouse.

Monitoring and impact evaluation are becoming standard practice in most projects, but current monitoring and evaluation practices focus on attaining a pre-determined impact, in adherence

to a project or program log frame or theory of change. Impact monitoring tends to focus on level-specific and impact-oriented indicators, while ignoring processes, norms and level-independent and multi-level indicators. For example, theory of change is explicit in identifying 'boundary partners', which are actors that could link project-level outputs to higher-level outcomes. It does not normally, in our experience, look at the process and quality of interactions with these boundary partners, something that needs to be done. GCF's Independent Evaluation Unit published a review (Puri, 2018) that asks "What is transformational change? Can we define it? Can we measure it? If a transformational change occurred, would we notice it?" (Puri 2018). The concept of 'measurability' needs to be adapted for the purpose of monitoring transformational change and expanded to include qualitative, non-standardized, non-linear indicators.

# 3 Conclusions

This section synthesizes the major insights derived from analyzing the scientific and grey literature (Section 2), and reflects on overarching topics related to human agency, human rights and the role of measurement in transformational change.

## 3.1 Highlights and reflections from reviewing the literature

We offer some highlights from the literature review by focusing on our main questions: (i) What does 'transformational change' mean? and (ii) What drives it?

### 3.1.1 What does "transformational change" mean?

The term 'transformational change' has proliferated in academic literature over the past two decades, mostly in the fields of health, education, public administration and business management. Despite growing interest in this topic, land-use and climate change-specific literature on transformational change still is scarce (just 22 papers found, with the first dating back to 2012), notably in the field of agriculture. The transformational change literature in forestry has so far been restricted to REDD+. Transformational change is better articulated and analyzed in health, education and business management literature, compared to land use and climate change. Some insights on how transformational change manifests in the very long term (e.g. decades and beyond) can be found in the archaeological literature. Interdisciplinary and transdisciplinary learning can be beneficial to understanding transformational change in land use and climate change.

**Elements of transformational change definitions have commonalities, differences and trade-offs.** Some definitions differ on whether

transformational change is a continuous or discontinuous process, should emphasize process or results, and should focus on large/national scales or multiple scales. This could reflect differences in context, or underlying beliefs on what drives transformational change. In climate change, transformational change is characterized as large, fast and deep change. Termeer *et al.* (2017) warn that achieving transformational change in all three dimensions at the same time is not possible because of inevitable trade-offs. Defining transformational change objectives and characteristics (i.e. scale, speed and depth) are therefore a central first step for all actors.

**Definitions of transformational change often do not explicitly highlight multi-level interactions and interdependencies – in spite of those being a core element in driving and managing transformational change.** This reflects the gap between multilevel approaches promoted in the scientific literature, and the top-down approaches espoused by global multilateral institutions. This gap needs to be bridged.

**There are fundamental differences** in the type of transformations sought, the unit of transformation, the direction of transformation, time scales and expected leader(s) of transformational change. Nevertheless, all disciplines embrace common transformational change objectives, related to change within the context of institutional changes.

**Authors writing about transformational change are mostly affiliated to organizations in a handful of developed countries** (i.e. Australia, Canada, the United Kingdom and the United States). This may compromise the applicability and acceptability of current transformational change scholarship, since very few organizations (and viewpoints) in other world regions are represented. Nevertheless, scholarship on transformational change within forestry and climate change

adaptation specifically is relatively new, and has received substantial contributions from researchers based in developing countries (e.g. Brockhaus *et al.*, 2017; Mapfumo *et al.* 2017) – a good start that needs to be further encouraged.

### 3.1.2 What drives transformational change?

**Several theoretical frameworks used to analyze transformational change identify similar critical elements for moving towards transformational change.** These are:

- collective learning and reflection: learning to inform action, and learning from actions,
- taking and managing risks and expectations: space for innovation, trial and error, and flexibility in program design,
- non-linear thinking that integrates complexity, interconnectedness across multiple dimensions, temporal and spatial scales, and real-time feedback mechanisms,
- consultation and participation: engaging, and consulting with, a wide variety of stakeholders through mechanisms for inclusive, meaningful and enduring participation,
- ownership: e.g. country- or jurisdiction-led approaches; sufficient, flexible and predictable finance.

Development interventions are complex, resulting in a dynamic not completely controlled by any person or institution. Hence, **interdisciplinary and transdisciplinary learning and collaboration are required**, and it is important for actors to recognize that silver-bullet solutions are rare. It is better to embrace a diversity and multiplicity of approaches.

**Four groups of drivers for transformational change emerged from our literature review:** (i) **resources:** actors that provide the energy needed to push for change; (ii) **legitimacy:** factors that help change to be accepted by society, as an objective that merits allocation of resources; (iii) **processes:** actions that harmonize efforts and values across different levels and actors; and (iv) **norms:** values that guide processes to result in sustainable and transformational collaborations.

**Drivers of the transformational change in the land-use sector related to climate change need further exploration and analysis.**

Transformational change on long-term, multi-

decade impacts needs to account for many unpredictable changes in factors that would normally stay static over the short term, like technology, market and policy regimes, demography and ecosystem functions. It is necessary to generate knowledge to support the identification of drivers for achieving transformational change at spatial scales that are unique to the land-use sector and climate change, like landscapes and watersheds; understanding the financial, human and institutional resources needed to sustain transformational change efforts over very long periods; sustaining the momentum and vision of transformational change across political cycles; and institutional measures to facilitate sustained long-term efforts. Nature-based units of transformation (e.g. landscapes, watersheds, ecosystems, biomes) introduce challenges in monitoring and evaluation, multi-level and multi-sectoral stakeholder coordination, and governance that are unique to land-use and climate change. These could be useful for organizing stakeholder engagement and may better endure political cycles over the long term compared to political units (e.g. cities, jurisdictions). We also acknowledge the crucial role of governing institutions in transformational change (McCall, 2016).

**Reflexive actions are the glue that brings together actions at different levels and time frames, prevents lock-ins and encourages innovation and exploration.** Reflexive action (e.g. monitoring, assessments, evaluations) is found in existing institutions (e.g. monitoring and evaluation units, learning forums) or is socially embedded (e.g. media, internet) and needs to be an integrated part of governance processes to be effective. **Researchers can play a central role in reflexive action**, as researchers analyze longer-term societal processes and dynamics and can put these on the societal and political agenda.

**Institutions need to undertake an introspective ‘positioning’ exercise**, where they see themselves as part of a dynamic world of actors that have different interests and competences. Our analysis of transformational change drivers and theoretical frameworks would suggest that such an exercise would help guide partnerships and communication strategies, which are important drivers of transformational change.

### 3.1.3 How is transformational change monitored?

**Indicators of transformational change found in scientific articles have a much wider scope than those used in monitoring and evaluation practices; this gap needs to be bridged.**

Indicators in scientific articles monitor changes in drivers of transformational change of all types (resources, legitimacy, processes and norms). They include indicators that are level-dependent (i.e. only applying to outcomes at one level), level-independent (i.e. applying to outcomes at multiple levels) and multi-level (i.e. applying to interactions across levels). In contrast, monitoring and evaluation practices tend to focus only on level-dependent and impact-oriented indicators, and not on level-independent and multi-level indicators, or on processes and norms.

Indicators of transformational change are often unquantifiable, difficult to measure, or not meant to be measured consistently across levels, space and time. This makes it difficult to integrate them into current monitoring and evaluation practices that still focus on measurability. The concept of 'measurability' needs to be adapted for the purpose of monitoring transformational change and expanded to include qualitative, non-standardized, non-linear indicators.

**Understanding transformational change in terms of time requirements is essential for lasting change.** Project cycles are either short-term (1, 2 or 3–5 years) or long-term (5–10 or even 15 years). As speed and urgency are important elements attributed to transformational change by some authors (see Section 2.2.1), it is necessary to understand what kind of transformational change can be expected within these time periods, given the often-ambitious goals and underestimated complexities of policy making. The transition management framework can provide some guidance (see Loorbach, 2010 and Section 2.2.2).

## 3.2 Issues for further exploration

In conducting our literature review, we identified several issues that need to be further explored that were beyond our scope of work. We present them here, in the hope that it will trigger debate and further research.

### 3.2.1 Human rights-based approach to transformational change

A human rights-based approach (HRBA) is defined as:

A conceptual framework for the process of human development that is normatively based on international human rights standards and operationally directed to promoting and protecting human rights (UNDP-HRWG, n.d.).

This approach seeks to analyze inequalities and redress discriminatory practices and unjust distributions, which often impede development progress.

**Many of the drivers of transformational change have HRBA elements, despite not being explicitly geared towards promoting and protecting human rights.** Many aspects of achieving transformational change are related to addressing inequalities, for example by seeking to ensure wide participation, empowering marginalized groups, correcting injustices and forming a common vision negotiated by all parties. Another transformational change element relevant to HRBA is the right to access information and decision-making processes.

**In striving to achieve transformational change, some practices may have trade-offs with HRBA.** For example, relying on scientific knowledge to define a problem and find solutions may alienate groups who do not have access to that knowledge, limiting their ability to effectively participate in decision-making (Holland, 2017). The quest of transformational change, if narrowly defined in climate change terms, could become a pressure that is externally imposed on developing countries seeking broader development goals (Winkler and Dubash, 2016). Definitions of transformational change emphasize scale, speed and depth of change, which are very difficult to achieve simultaneously (Termeer *et al.*, 2017). The issues of rights are associated with the depth of change, and could be jeopardized when seeking quick change at scale.

**The academic and grey literature on transformational change has gaps relating to HRBA.** The literature strongly agrees that local ownership in the change process is one of the most important factors of success in transformational change. Yet 'local' means different things, and ranges from national governments to households.



While the literature emphasizes the significance of providing sufficient resources and incentives to allow stakeholders to undertake transformational change and overcome lock-in, it is less emphatic on the distributional aspects of such provisions. The transformational change literature we reviewed does not provide much guidance on how to design and implement mechanisms to redress discrimination, avoid unjust distribution, and generally ensure human rights are respected and promoted. Mechanisms to manage conflicts were not discussed in detail in the 22 land-use and climate change papers we reviewed. Nevertheless, these mechanisms are important for other factors that have been highlighted as important for transformational change, like attaining legitimacy for the transformations sought, and sustaining dialogue and learning across stakeholders at different levels.

### 3.2.2 Human agency to undertake transformational change

Human agency is the capacity of humans to act in a given environment. The action can be unconscious and involuntary, or purposeful and goal-oriented. The ‘how to’ literature on transformational change that deals with organizational changes assumes human agency in bringing about transformational change by emphasizing the importance of leadership, political support or cultural/behavioral change (e.g. Brown and Lambert, 2013; Young and Esau, 2016).

There is an important difference in the concept of human agency between literature on land use and climate change and other literature, in viewing humans as the main actors or facilitators of transformational change. This distinction is crucial for interpreting lessons learned from the education and health sectors so they can be applicable for the forestry and agriculture sectors. In land use and climate change, humans facilitate the provision of ecosystem services and products from other entities, like forests, seeds, soils and water bodies. In contrast, health, education and business services are provided by and for humans. For example, environmental and climatic conditions beyond human control have much more influence on agricultural and forestry processes than in education, health and business.

**The quest for transformational change in land use and climate change is in itself a result of ongoing transformational change in how**

**human beings view their agency** over what once was attributed to exogenous entities – like ‘God’, ‘chance’ or ‘Nature’ – or to authoritative figures (see Brown n.d.). From a historical perspective, the assignment of responsibility for global climate change to humans is a new phenomenon, making it hard to understand or believe (Chakrabarty 2012). Humans derive the power to bring about transformational change from the power and responsibility of causing climate change. Although climate change is occurring due to a series of unintended actions, reversing the effects of climate change requires intentional, collective action at a global scale. The sheer effort needed to reverse this problem puts human capacity in doubt. Can ‘we’ really intervene and shift technologies, practices, social arrangements and their accompanying interdependencies? Some believe, however, that the illusion of such agency is itself important, regardless of how much agency humans actually have. “[I]llusions are productive because they motivate action and repair work, and thus something (whatever) is achieved” (Rip, 2006).

**There are two narratives around human agency in climate change. The adaptation narrative** focuses on improving the human ability to adapt to a changing world (Ransan-Cooper, 2016). The story of humans adapting (successfully and unsuccessfully) to various natural and human-made disasters and climatic changes is familiar and easy to understand (Hassan, 2009). Here, the role of human agency is crucial, and not new. **The mitigation narrative** is inspired by the fighting spirit of humanity, and its new-found perception of power over environmental forces appeals to the notion of mitigating climate change. Yet the narrative of climate change mitigation in land use – and especially forestry — is about facilitating non-human entities, like trees, soils and plants, to sequester or reduce greenhouse gas emissions. Actions to produce greenhouse gas emissions can take much less effort (e.g. cutting down a tree) compared to reversing that emission (e.g. growing a tree). The service rendered (i.e. emission reduction or sequestration) is abstract. Getting public consensus on what to do, and who should do it, is thus even more challenging. As such, **the extent of human agency is likely to be higher in the adaptation narrative compared to the mitigation narrative.**

**The synergies between the adaptation and mitigation narratives needs to be exploited**, while division between the adaptation and mitigation

narratives highlights the lack of human agency in mitigation, and therefore needs to be avoided. If adaptation is more urgent and compelling in certain contexts (e.g. agriculture drought-prone areas, fisheries in coastal communities), action that has mitigation co-benefits can be prioritized and publicly highlighted. Increasing the frequency and normalcy of mitigation measures, regardless of whether they come about as a by-product of adaptation measures, will reduce the difficulties of introducing predominantly mitigation measures to the public. The opposite is also true. In areas or sectors where climate mitigation values are comparatively easier to understand than its climate adaptation values (e.g. increasing energy efficiency in the transportation sector), its adaptation values need to be highlighted and maximized. Hence, each climate action is a platform to promote the synergies between adaptation and mitigation.

### 3.2.3 Developing systems to monitor and measure transformational change

There is debate on the role and approach of measurements in efforts to bring about transformational change. Some view measurability as an important validator of transformation and as essential to bringing about change. The assumption is that change must be measurable so that it can be monitored and validated, as in Puri's questions: "What is transformational change? Can we define it? Can we measure it? If a transformational change occurred, would we notice it?" (Puri, 2018).

### **An alternative 'big picture' view needs to be used, where indicators of systemic change are more important than measurement.**

Transformational change is a dynamic process, where change only happens if processes leading to a desired outcome remain in motion (Mapfumo *et al.* 2017). Within this motion, impacts can be measured; but there is also the need to take a step back and see whether the entire system and all its parts are moving in the right direction. It is possible that, for example, if one part of the system is not changing fast enough to qualify as transformation but other parts are, the entire system is – as a whole – moving forward.

### **In practice, the 'big picture' approach to measurement is not done often.**

Most stakeholders are only responsible or concerned with one moving part and in showing how their particular part will be transformational, rather than considering how it fits into the whole system. Or, they are preoccupied with funding particular activities that have the highest likelihood of being transformational. The result is that there is a lack of attention on the larger system or landscape in which these activities are embedded, and thus the transformational process lacks the support and monitoring it needs. Synergies that can catalyze transformational change – or trade-offs that may critically endanger progress – may be overlooked. Yet, taking a big-picture view can also be time-consuming, challenging, or costly for individuals or organizations.



# References

- 350.org. 2019. Global Climate Strike → Sep. 20–27. Accessed 1 October 2019. <https://globalclimateshrike.net/>.
- Al Jazeera. 15 March 2019. Young people across globe protest against climate change inaction. *Al Jazeera*. <https://www.aljazeera.com/news/2019/03/young-people-globe-protest-climate-change-inaction-190315114657681.html>.
- Amansure R and Adendorff C. 2018. Successful transformational change in revenue management among beneficiary communities of South African renewable energy construction companies. *Acta Structilia* 25(1):71-97. doi:10.18820/24150487/as25i1.3
- Ananthakrishnan N, Arora NK, Chandy G, Gitanjali B, Sood R, Supe A and Nagarajan S. 2012. Is there need for a transformational change to overcome the current problems with postgraduate medical education in India? *National Medical Journal of India* 25(2):101-108.
- Babon A, McIntyre D, Gowae GY, Gallemore C, Carmenta R, Di Gregorio M and Brockhaus M. 2014. Advocacy coalitions, REDD+, and forest governance in Papua New Guinea: How likely is transformational change? *Ecology and Society* 19(3). doi:10.5751/es-06486-190316
- Bäckstrand K and Lövbrand E. 2016. The road to Paris: Contending climate governance discourses in the post-Copenhagen era. *Journal of Environmental Policy and Planning* 21(5):519-532. doi:10.1080/1523908x.2016.1150777
- Biermann F, Abbott K, Andresen S, Bäckstrand K, Bernstein S, Betsill MM, Bulkeley H, Cashore B, Clapp J, Folke J, *et al.* 2012. Transforming governance and institutions for global sustainability: Key insights from the Earth System Governance Project. *Current Opinion in Environmental Sustainability* 4(1):51-60. doi:10.1016/j.cosust.2012.01.014
- Bird N, Cao Y and Quevedo A. 2019. *Transformational change in the Climate Investment Funds: A Synthesis of the evidence*. ODI. <https://www.odi.org/sites/odi.org.uk/files/resource-documents/12587.pdf>.
- Boodoo Z, Mersmann F and Olsen KH. 2018. The implications of how climate funds conceptualize transformational change in developing countries. *Climate and Development* 10(8):673-686. doi:10.1080/17565529.2018.1442788
- Boodoo Z and Olsen KH. 2018. Assessing transformational change potential: The case of the Tunisian cement Nationally Appropriate Mitigation Action (NAMA). *Climate Policy* 18(6):794-812. doi:10.1080/14693062.2017.1386081
- Boone J. 2015. Leading learning organizations through transformational change: Making the case for blended learning. *International Journal of Educational Management* 29(3):275-283. doi:10.1108/ijem-06-2013-0096
- Bos JJ, Brown RR and Farrelly MA. 2015. Building networks and coalitions to promote transformational change: Insights from an Australian urban water planning case study. *Environmental Innovation and Societal Transitions* 15:11-25. doi:10.1016/j.eist.2014.10.002
- Brockhaus M and Angelsen A. 2012. Seeing REDD+ through 4Is: A political economy framework. In Angelsen A, Brockhaus M, Sunderlin WD and Verchot L, eds. *Analysing REDD+: Challenges and choices*. Bogor, Indonesia: CIFOR. 15-30.
- Brockhaus M and Di Gregorio M. 2014. National REDD+ policy networks: From cooperation to conflict. *Ecology and Society* 19(4). doi:10.5751/es-06643-190414
- Brockhaus M, Di Gregorio M and Carmenta R. 2014a. REDD+ policy networks: Exploring actors and power structures in an emerging policy domain. *Ecology and Society* 19(4). doi:10.5751/es-07098-190429

- Brockhaus M, Di Gregorio M and Mardiah S. 2014b. Governing, the design of national REDD+: An analysis of the power of agency. *Forest Policy and Economics* 49, 23-33. doi:10.1016/j.forpol.2013.07.003
- Brockhaus M, Korhonen-Kurki K, Sehring J, Di Gregorio M, Assembe-Mvondo S, Babon A, Bekele M, Gebara MF, Khatri DB, Kambire H, *et al.* 2017. REDD+, transformational change and the promise of performance-based payments: A qualitative comparative analysis. *Climate Policy* 17(6):708-730.
- Brown V. n.d. *What is transformational change?* Accessed 28 January 2019. <http://www.collectivethinking.com.au/key-issues/transformational-change/what-is-transformational-change/>
- Brown V and Lambert J. 2015. Transformational learning: Are we all playing the same 'game'? *Journal of Transformative Learning* 3(1):35-41.
- Brown VA and Harris JA. 2014. *The human capacity for transformational change: Harnessing the collective mind.* Routledge.
- Brown VA and Lambert JA. 2013. *Collective learning for transformational change: A guide to collaborative action.* New York, NY: Routledge.
- Chakrabarty D. 2012. Postcolonial studies and the challenge of climate change. *New Literary History* 43(1):1-18. doi:10.1353/nlh.2012.0007
- Chapin FS 3rd, Zavaleta ES, Eviner VT, Naylor RL, Vitousek PM, Reynolds HL, Hooper DU, Lavorel S, Sala OE, Hobbie SE, Mack MC and Diaz S. 2000. Consequences of changing biodiversity. *Nature* 405(6783):234-242. doi:10.1038/35012241
- Chia EL, Hubert D, Carudenuto S and Sene O. 2019. Evolution in the enabling factors for transformational change in forestry and land use policy processes: The case of REDD+ in Cameroon. *International Forestry Review* 21(1):62-72. doi:10.1505/146554819825863762
- [CIF and Itad] Climate Investment Funds and Itad. 2020. *Signals of transformational change: Insights from the evaluation of transformational change in the Climate Investment Funds.* [https://www.climateinvestmentfunds.org/sites/cif\\_enc/files/knowledge-documents/tc\\_signals\\_brief.pdf](https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/tc_signals_brief.pdf).
- [CIFOR] Center for International Forestry Research. 2020. *Policy network analysis: Actors and power structures.* Accessed 15 September 2020. <https://www2.cifor.org/gcs/modules/redd-policies/policy-network-analysis-actors-power-structures/>
- [CIPD] Chartered Institute of Personnel and Development. 2015. *Landing transformational change: Closing the gap between theory and practice.* London: CIPD. [https://www.cipd.co.uk/Images/landing-transformation-change\\_2015-gap-theory-practice\\_tcm18-9050.pdf](https://www.cipd.co.uk/Images/landing-transformation-change_2015-gap-theory-practice_tcm18-9050.pdf).
- Cornell S, Berkhout F, Tuinstra W, Tàbara JD, Jäger J, Chabay I, de Wit B, Langlais R, Mills D, Moll P and Otto IM. 2013. Opening up knowledge systems for better responses to global environmental change. *Environmental Science and Policy* 28(Apr 1):60-70.
- Derner JD, Smart AJ, Toombs TP, Larsen D, McCulley RL, Goodwin J, Sims S and Roche LM. 2018. Soil health as a transformational change agent for US grazing lands management. *Rangeland Ecology and Management* 71(4):403-408. doi:10.1016/j.rama.2018.03.007
- Di Gregorio M, Brockhaus M, Cronin T, Muharrom E, Mardiah S and Santoso L. 2015. Deadlock or transformational change? Exploring public discourse on REDD+ across seven countries. *Global Environmental Politics* 15(4):63-84. doi:10.1162/GLEP\_a\_00322
- Dinerstein E, Vynne C, Sala E, Joshi AR, Fernando S, Lovejoy TE, Mayorga J, Olson D, Asner GP, Baillie JEM, Burgess ND, Burkart K, Noss RF, Zhang YP, Baccini A, Birch T, Hahn N, Joppa LN and Wikramanayake E. 2019. A Global Deal For Nature: Guiding principles, milestones, and targets. *Scientific Advances* 5(4):eaaw2869. doi:10.1126/sciadv.aaw2869
- Douthwaite MB. 2002. *Enabling innovation: A practical guide to understanding and fostering technological change.* Zed Books.
- Durie R and Wyatt K. 2013. Connecting communities and complexity: A case study in creating the conditions for transformational change. *Critical Public Health* 23(2):174-187. doi:10.1080/09581596.2013.781266
- [EC] European Commission. n.d. *A European Green Deal.* Accessed 19 March 2021. [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en)
- [FAO] Food and Agriculture Organization of the United Nations. 2019. *Policy Support and Governance.* Accessed 1 October 2019. <http://www.fao.org/policy-support/vision/en/>
- Forsell N, Turkovska O, Gusti M, Obersteiner M, Elzen MD and Havlik P. 2016. Assessing the

- INDC's land use, land use change and forest emission projections. *Carbon Balance and Management* 11(1):26. doi:10.1186/s13021-016-0068-3
- Fridahl M and Johansson L. 2017. An assessment of the potential for spurring transformational change through Nationally Appropriate Mitigation Actions (NAMAs). *Environmental Innovation and Societal Transitions* 25:35-46. doi:10.1016/j.eist.2016.11.003
- Fridays for Future. n.d. Accessed 19 March 2021. <https://www.fridaysforfuture.org/>
- [GCF] Green Climate Fund. 2018a. *Investment Criteria Indicators*. GCF/B.20/Inf.14. Songdo, Republic of Korea: Green Climate Fund. [https://www.greenclimate.fund/documents/20182/1087995/GCF\\_B.20\\_Inf.14\\_-\\_Investment\\_criteria\\_indicators.pdf/69363c9f-c893-0fc7-953b-d75504bd4870](https://www.greenclimate.fund/documents/20182/1087995/GCF_B.20_Inf.14_-_Investment_criteria_indicators.pdf/69363c9f-c893-0fc7-953b-d75504bd4870).
- [GCF] Green Climate Fund. 2018b. *Results management framework: Independent Evaluation Unit recommendations to improve the Results Management Framework*. GCF/B.21/20. Incheon, Republic of Korea: Green Climate Fund. [https://www.greenclimate.fund/documents/20182/1270184/GCF\\_B.21\\_20\\_-\\_Results\\_management\\_framework\\_\\_Independent\\_Evaluation\\_Unit\\_recommendations\\_to\\_improve\\_the\\_Results\\_Management\\_Framework\\_-\\_Final\\_Report.pdf/17a4ccbb-b891-53bf-55b1-b4d4c8a7a734](https://www.greenclimate.fund/documents/20182/1270184/GCF_B.21_20_-_Results_management_framework__Independent_Evaluation_Unit_recommendations_to_improve_the_Results_Management_Framework_-_Final_Report.pdf/17a4ccbb-b891-53bf-55b1-b4d4c8a7a734).
- [GCF] Green Climate Fund. 2016. Initial strategic plan for the GCF. Sondo, South Korea: Green Climate Fund. [https://www.greenclimate.fund/documents/20182/761223/Initial\\_Strategic\\_Plan\\_for\\_the\\_GCF.pdf/bb18820e-abf0-426f-9d8b-27f5bc6fafeb](https://www.greenclimate.fund/documents/20182/761223/Initial_Strategic_Plan_for_the_GCF.pdf/bb18820e-abf0-426f-9d8b-27f5bc6fafeb).
- Geels FW. 2002. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a casestudy. *Research Policy* 31:1257-1274.
- GIZ. 2020. *Transforming our work: Getting ready for transformational projects*. Eschborn, Germany: GIZ. [https://www.giz.de/fachexpertise/downloads/Transformation%20Guidance\\_GIZ\\_02%202020.pdf](https://www.giz.de/fachexpertise/downloads/Transformation%20Guidance_GIZ_02%202020.pdf).
- Glover A and Schroeder H. 2017. Legitimacy in REDD+ governance in Indonesia. *International Environmental Agreements: Politics, Law and Economics* 17(5):695-708. doi:10.1007/s10784-016-9341-x
- Grassi G, House J, Dentener F, Federici S, den Elzen M and Penman J. 2017. The key role of forests in meeting climate targets requires science for credible mitigation. *Nature Climate Change* 7(3):220-226. doi:10.1038/nclimate3227
- Griscom BW, Busch J, Cook-Patton SC, Ellis PW, Funk J, Leavitt SM, Lomax G, Turner WR, Chapman M, Engelmann J, et al. 2020. National mitigation potential from natural climate solutions in the tropics. *Philosophical Transactions of the Royal Society B* 375(1794):20190126. doi:10.1098/rstb.2019.0126
- Griscom BW, Adams J, Ellis PW, Houghton RA, Lomax G, Miteva DA, Schlesinger WH, Shoch D, Siikamaki JV, Smith P, et al. 2017. Natural climate solutions. *Proceedings of the National Academy of Sciences of the United States of America* 114(44):11645-11650. doi:10.1073/pnas.1710465114
- Gunderson L and Folke C. 2011. Resilience 2011: Leading Transformational Change. *Ecology and Society*, 16(2).
- Hassan FA. 2009. Human agency, climate change, and culture: An archaeological perspective. In Crate SA and Nuttall M, eds. *Anthropology and climate change: From encounters to actions*. Walnut Creek, CA: Left Coast Press. 39-69.
- Hawkins J. 2018. Transformational change in environmental and natural resource management: A guideline for policy excellence. *Australian Journal of Agricultural and Resource Economics* 62(3):501-503.
- Holland B. 2017. Procedural justice in local climate adaptation: political capabilities and transformational change. *Environmental Politics* 26(3):391-412. doi:10.1080/09644016.2017.1287625
- [IPCC] Intergovernmental Panel on Climate Change. 2019. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security and Greenhouse Gas fluxes in Terrestrial Ecosystems*. Summary for Policymakers. Approved Draft. IPCC. IPCC] Intergovernmental Panel on Climate Change. 2018a. Global Warming of 1.5 Degrees - Technical Summary. WMO, UNEP.
- [IPCC] Intergovernmental Panel on Climate Change. 2018b. IPCC, 2018: Summary for Policymakers. In Masson-Delmotte V, Zhai P, Pörtner H-O, Roberts D, Skea J, Shukla

- PR, Pirani A, Moufouma-Okia W, Péan C, Pidcock R, *et al.* eds. *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty*. Geneva, Switzerland: World Meteorological Organization. 32.  
[https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM\\_Approved\\_Microsite\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf)
- [IPCC] Intergovernmental Panel on Climate Change. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge: Cambridge University Press.
- Itad. 2019. *Evaluation of Transformational Change in the Climate Investment Funds*. [https://www.climateinvestmentfunds.org/sites/cif\\_enc/files/knowledge-documents/evaluation\\_of\\_transformational\\_change\\_in\\_the\\_cif\\_final\\_w\\_mresp\\_jan\\_2019.pdf](https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/evaluation_of_transformational_change_in_the_cif_final_w_mresp_jan_2019.pdf)
- Jacobs B, Cordell D, Chin J and Rowe H. 2017. Towards phosphorus sustainability in North America: A model for transformational change. *Environmental Science and Policy* 77:151-159. doi:10.1016/j.envsci.2017.08.009
- Kezar A. 2013. Understanding sensemaking/sensegiving in transformational change processes from the bottom up. *Higher Education* 65(6):761-780. doi:10.1007/s10734-012-9575-7
- Kezar A and Eckel P. 2002. Examining the institutional transformation process: The importance of sensemaking, interrelated strategies and balance. *Research in Higher Education* 43(3):295-328. doi:10.1023/a:1014889001242
- Klein N. 2015. *This changes everything: Capitalism vs. the climate*. Simon and Schuster.
- Korhonen-Kurki K, Brockhaus M, Sehring J, Di Gregorio M, Assembe-Mvondo S, Babon A, Bekele M, Benn V, Gebara MF, Kambire HW, *et al.* 2019. What drives policy change for REDD+? A qualitative comparative analysis of the interplay between institutional and policy arena factors. *Climate Policy* 19(3):315-328. doi:10.1080/14693062.2018.1507897
- Korhonen-Kurki K, Sehring J, Brockhaus M and Di Gregorio M. 2014. Enabling factors for establishing REDD plus in a context of weak governance. *Climate Policy* 14(2):167-186. doi:10.1080/14693062.2014.852022
- Le Quéré C, Andrew RM, Friedlingstein P, Sitch S, Hauck J, Pongratz J, Pickers PA, Korsbakken JI, Peters GP, Canadell JG *et al.* 2018. Global Carbon Budget 2018. *Earth System Science Data* 10(4):2141-2194. doi:10.5194/essd-10-2141-2018
- Loorbach D. 2010. Transition management for sustainable development: A prescriptive, complexity-based governance framework. *Governance* 23(1):161-183. doi:10.1111/j.1468-0491.2009.01471.x
- Mapfumo P, Onyango M, Honkponou SK, El Mzouri EH, Githeko A, Rabeharisoa L, Obando J, Omolo N, Majule A, Denton F, Ayers J and Agrawal A. 2017. Pathways to transformational change in the face of climate impacts: An analytical framework. *Climate and Development* 9(5):439-451. doi:10.1080/17565529.2015.1040365
- Markard J, Raven R and Truffer B. 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy* 41(6):955-967.
- Martius C, Angelsen A, Larson AM, Pham TT, Sonwa DJ and Belcher B. 2018. Pathway to impact. Is REDD+ a viable theory of change? In Angelsen A, Martius C, Duchelle AE, Larson AM, de Sy V and Pham TT eds. *Transforming REDD+*. Bogor, Indonesia: CIFOR.
- McAlpine CA, Seabrook LM, Ryan JG, Feeney BJ, Ripple WJ, Ehrlich AH and Ehrlich PR. 2015. Transformational change: Creating a safe operating space for humanity. *Ecology and Society* 20(1). doi:10.5751/es-07181-200156
- McCall MK. 2016. Beyond 'landscape' in REDD+: The imperative for 'territory'. *World Development* 85(September):58-72.
- Mersmann F and Wehnert T. 2015. *Governance and Action: Design Criteria for Transformational Climate Finance*. Berlin, Germany: Wuppertal Institute for Climate, Environment and Energy GmbH. [https://wupperinst.org/uploads/tx\\_wupperinst/Governance\\_Action.pdf](https://wupperinst.org/uploads/tx_wupperinst/Governance_Action.pdf)
- Mersmann F, Wehnert T, Gopel M, Arens S and Ujj O. 2014. *Shifting Paradigms: Unpacking Transformation for Climate Action. A Guidebook for Climate Finance and Development Practitioners*. Wuppertal Institute for Climate, Environment and Energy GmbH. <https://epub.wupperinst.org/frontdoor/>

- deliver/index/docId/5518/file/5518\_Shifting\_Paradigms.pdf.
- Moeliono M, Gallemore C, Santoso L, Brockhaus M and Di Gregorio M. 2014. Information networks and power: Confronting the 'wicked problem' of REDD plus in Indonesia. *Ecology and Society* 19(2). doi:10.5751/es-06300-190209
- Moeliono, M., Brockhaus, M., Gallemore, C., Dwisatrio, B., Maharani, C. D., Muharrom, E., & Pham, T. T. (2020). REDD+ in Indonesia: A new mode of governance or just another project?. *Forest Policy and Economics*, 121: 102316. doi:10.1016/j.forpol.2020.102316
- Myers R, Larson AM, Ravikumar A, Kowler LF, Yang A and Trench T. 2018. Messiness of forest governance: How technical approaches suppress politics in REDD+ and conservation projects. *Global Environmental Change* 50:314-324. doi:10.1016/j.gloenvcha.2018.02.015
- Nam K, Oh SW, Kim SK, Goo J and Khan MS. 2016. Dynamics of enterprise architecture in the Korean public sector: Transformational change vs. transactional change. *Sustainability* 8(11):18. doi:10.3390/su8111074
- Ngendakumana S, Minang PA, Feudjio M, Speelman S, Van Damme P and Tchoundjeu Z. 2014. Institutional dimensions of the developing REDD+ process in Cameroon. *Climate Policy*, 14(6):769-787. doi:10.1080/14693062.2014.877221
- Pagoropoulos A, Maier A and McAloone TC. 2017. Assessing transformational change from institutionalising digital capabilities on implementation and development of Product-Service Systems: Learnings from the maritime industry. *Journal of Cleaner Production* 166:369-380. doi:10.1016/j.jclepro.2017.08.019
- Puri J. 2018. *Transformational Change – The Challenge of a Brave New World*. Independent Evaluation Unit Working Paper No. 001. Songdo, South Korea: Green Climate Fund.
- Ransan-Cooper H. 2016. The role of human agency in environmental change and mobility: A case study of environmental migration in Southeast Philippines. *Environmental Sociology* 2(2): 132-143. doi:10.1080/23251042.2016.1144405
- Reynolds JF, Smith DM, Lambin EF, Turner BL 2nd, Mortimore M, Batterbury SP, Downing TE, Dowlatabadi H, Fernandez RJ, Herrick JE *et al.* 2007. Global desertification: Building a science for dryland development. *Science* 316(5826):847-851. doi:10.1126/science.1131634
- Rip A. 2006. A co-evolutionary approach to reflexive governance – and its ironies. In Voss J-P, Bauknecht D and Kemp R eds. *Reflexive Governance for Sustainable Development*. Cheltenham, UK: Edward Elgar.
- Rip A and Kemp R. 1998. Technological change. In Rayner S and Malone EL, eds. *Human Choice and Climate Change* (Vol. 2). Columbus, OH: Battelle Press. 327–399
- Rogelj J, Popp A, Calvin KV, Luderer G, Emmerling J, Gernaat D, Fujimori S, Streffer J, Hasegawa T, Marangoni G *et al.* 2018. Scenarios towards limiting global mean temperature increase below 1.5°C. *Nature Climate Change* 8(4):325-332. doi:10.1038/s41558-018-0091-3
- Ross H. 2013. Collective learning for transformational change: A guide to collaborative action. *Australasian Journal of Environmental Management* 20(3):257-259. doi:10.1080/14486563.2013.826121
- Rotmans J, Kemp R and van Asselt M. 2001. More evolution than revolution: Transition management in public policy. *Foresight* 3(1):15-31. doi:10.1108/14636680110803003
- Sanz MJ, De Vente JL, Chotte JL, Bernoux M, Kust G, Ruiz I, Almagro M, Alloza JA, Vallejo R, Castillo V and Hebel A. 2017. *Sustainable Land Management contribution to successful landbased climate change adaptation and mitigation: A report of the science-policy interface*. Bonn, Germany: UNCCD. [http://horizon.documentation.ird.fr/exl-doc/pleins\\_textes/divers17-11/010071102.pdf](http://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers17-11/010071102.pdf).
- Scheffer M and Westley FR. 2007. The evolutionary basis of rigidity: Locks in cells, minds and society. *Ecology and Society* 12(2):36.
- Schindler DE and Hilborn R. 2015. Sustainability: Prediction, precaution and policy under global change. *Science* 347(6225):953-954. doi:10.1126/science.1261824
- Schoon M, Fabricius C, Anderies JM and Nelson M. 2011. Synthesis: vulnerability, traps, and transformations—long-term perspectives from archaeology. *Ecology and Society* 16(2):24.
- Scott SM. 2017. Collective learning for transformational change: A guide to collaborative action. *Journal of*



- Transformative Education* 15(1):95-97. doi:10.1177/1541344616629792
- Shiell A Hawe P and Gold L. 2008. Complex interventions or complex systems? Implications for health economic evaluation. *BMJ* 336(7656):1281-1283. doi:10.1136/bmj.39569.510521.AD
- Shove E and Walker G. 2016. Caution! Transitions ahead: Politics, practice and sustainable transition management. *Environment and Planning A: Economy and Space* 39(4):763-770. doi:10.1068/a39310
- Termeer C, Dewulf A and Biesbroek GR. 2017. Transformational change: governance interventions for climate change adaptation from a continuous change perspective. *Journal of Environmental Planning and Management* 60(4):558-576. doi:10.1080/09640568.2016.1168288
- Totin E, Butler JR, Sidibe A, Partey S, Thornton PK and Tabo R. 2018. Can scenario planning catalyse transformational change? Evaluating a climate change policy case study in Mali. *Futures* 96: 44-56. doi:10.1016/j.futures.2017.11.005
- Tubiello FN, Salvatore M, Ferrara AF, House J, Federici S, Rossi S, Biancalani R, Condor Golec RD, Jacobs H, Flammini A, *et al.* 2015. The contribution of agriculture, forestry and other land use activities to global warming, 1990-2012. *Global Change Biology* 21(7):2655-2660. doi:10.1111/gcb.12865
- [UNDP] United Nations Development Programme. 2011. *Case Studies of Sustained and Successful Development Cooperation: Supporting Transformational Change*. United Nations Development Programme. <http://www.undp.org/content/dam/undp/library/Cross-Practice%20generic%20theme/Supporting-Transformational-Change.pdf>.
- [UNDP-HRWG] United Nations Development Programme Human Rights Working Group. (n.d.). *What is a human rights-based approach?* Accessed 8 April 2019. <https://hrbaportal.org/faq/what-is-a-human-rights-based-approach>.
- [UNEP] United Nations Environment Programme. 2019. *Emissions Gap Report 2019*. Nairobi: United Nations Environment Programme. <http://www.unenvironment.org/emissionsgap>.
- Wallace-Wells D. 2019. *The Uninhabitable Earth: Life After Warming*. Tim Duggan Books.
- Well M and Carrapatoso A. 2016. REDD+ finance: policy making in the context of fragmented institutions. *Climate Policy* 17(6):687-707. doi:10.1080/14693062.2016.1202096
- Winkler H and Dubash NK. 2016. Who determines transformational change in development and climate finance? *Climate Policy* 16(6):783-791. doi:10.1080/14693062.2015.1033674
- Young MD and Esau C, eds. 2016. *Transformational Change in Environmental and Natural Resource Management. A Guidelines for Policy Excellence*. London and New York: Routledge, Earthscan.

# Glossary

**Barriers** are the forces opposing change that may prevent the direction, intensity or duration of events from changing. They can be groups of actors with interest in the status quo, technologies that are locked into existing production and economic systems (e.g. reliance on fossil fuels), incongruence in several related but uncoordinated parts of a system that need to be disentangled prior to embarking in change (e.g. land vs. forest laws), missing technology, funding, knowledge or other capacity deficits, and belief systems. Barriers are the opposite of triggers and drivers.

**Business-as-usual:** the dominant functioning of the current system (Jacobs *et al.*, 2017).

**Drivers** are underlying and proximate conditions and the forces that influence the outcome of actions. This definition is inspired by the way this word has been used to understand the causes ('drivers') of deforestation. The attribution between outcome and driver is less stringent, since there can be multiple drivers operating at the same time, each pushing a system and each other to a given direction at different levels. The relative strengths of these multiple drivers determine the extent and direction of change within the system (Jacobs *et al.* 2017). Unless noted otherwise, this term is used in the positive sense, in that drivers of transformational change are conditions and forces that encourage the desired change. In the short term, drivers tend to be exogenous to (i.e. beyond the control of) the actors and actions that strive to create transformational change.

**Human agency** is the capacity of humans to act in a given environment. The action can be unconscious and involuntary, or purposeful and goal-oriented.

**Lock-in** is a state that a system "does not easily get out of again due to self-stabilizing feedback" (Scheffer and Westley, 2007) because some kind of barrier it prevents systems from shifting in the face of triggers of change. Getting public consensus from a vast group of people (e.g. the world's citizens) to move to a new, less emitting and more resilient state is exceptionally challenging. Psychologically, groups of people tend to lock into attitudes, despite given ample information that something urgent needs to be done. Individuals, who would have acted if alone, instead decide whether to act based on others' (in)action. The result is that groups tend to be more conservative and less likely to respond compared to individuals; in times of crisis, groups tend to be even more rigid and to adhere to old structures and habits (e.g. traditions, values) (Scheffer and Westley, 2007). Attempts to bring about transformational change by using pre-existing and win-win solutions and engaging only with dominant actors in a given sector, for example, can lead to strengthening existing conditions and lead to lock-in rather than transformational change (e.g. Boodoo and Olsen, 2018).

**Paradigm shift** is the accumulation of anomalies in data collected using one perspective or set of assumptions, resulting in a sudden and radical shift in perspectives and a new theory that 'explains' the anomalies (Scheffer and Westley, 2007). It is a change in approach, underlying assumptions, philosophy or world view, with explicitly different – and possibly opposite – components compared to the current one.

**Transformational change** is defined differently according to context, and has the following common features:

- Movement away from the current regime, equilibrium or business-as-usual situation, and opening of new pathways

- Sustained changes, either through institutionalization within systems, or changes in cultures, beliefs and power relations
- Focus on root causes and on relationships between dimensions of change (e.g. organizations, markets, technologies, power and social relations, and ideas), i.e. deep change
- Emphasis on learning, either as a driver or indicator of change.
- Some definitions diverge from each other, for example:
- The idea that transformational change can be achieved through continuous processes and a series of incremental steps (Jacobs *et al.*, 2017; Boodoo and Olsen, 2018) versus the idea that it can be achieved through discontinuous or disruptive processes (Brown n.d.; Mapfumo *et al.*, 2017).
- Emphasis on results of particular actions or investments (UNDP, 2011) versus emphasis on the process (Brown, n.d.; Holland, 2017; Jacobs *et al.*, 2017; Mapfumo *et al.*, 2017)
- Emphasis on national or large-scale change (UNDP, 2011; CIPD, 2015; GCF, 2016; GEF, 2018; FAO, 2019) versus emphasis on changes across scales (Brown, n.d.; Jacobs *et al.*, 2017).

**Transformational reform** is a change in strategy, with consequences for how organizations are structured, for resource use, and for individual behavior (Young and Esau, 2016).

**Transition** is a “substantial change and movement from one state to another” (Shove and Walker, 2016); “a set of connected changes, which reinforce each other but take place in several different areas, like technology, the economy, institutions, behavior, culture, ecology and belief systems. A transition can be seen as a spiral that reinforces itself; there are multiple causality and co-evolution caused by independent developments” (Rotmans *et al.*, 2001). These changes happen at varying scales and speeds (Jacobs *et al.*, 2017).

**Transition pathways** result from the adoption of innovative technologies and practices that deviate from business-as-usual (Jacobs *et al.*, 2017). Such pathways can take place in different areas (e.g. technology, society, ecology, human behavior, beliefs) and can reinforce each other. A ‘successful’ pathway is enabled through “path constitution, the interplay of innovative technology, human agency and mindful decision making” (Jacobs *et al.*, 2017).

**Triggers** for change are short-term events that cause a shift to a new equilibrium in a system. These events open spaces for innovation to create alternative regimes (Loorbach, 2010).

**Exogenous** triggers come from outside the system. These triggers include armed conflict, disease epidemics, natural disasters, financial crises or regime changes (UNDP, 2011). It may not be possible or ethical to create external triggers, yet it is possible to time interventions to take advantage of triggers to bring about the desired transformational change.

**Endogenous** triggers are part of the system to be transformed, although they may be outside of the scope of a particular activity, project or program within the system. They can be brought about by an active transitions arena, or a defined group of actors who can identify synergies and bring together actors, lessons and resources to evolve towards the desired goal. These triggers add pressure for change led by transformational leaders, or what the REDD+ literature refers to as “transformational coalitions” (Babon *et al.*, 2014; Brockhaus *et al.*, 2014a, 2017; Moeliono *et al.*, 2014). When change is urgently needed, individual leaders or coalitions are critical in starting or hindering movements towards change. The importance of leaders is seen in the transformational change literature’s focus on guiding leaders through the steps of bringing their organizations through change (e.g. ‘change management’), or creating conditions to encourage supportive coalitions to form (e.g. through dialogue, collective learning processes).

# Annexes

## Annex 1. Method used to select academic literature for review

To capture the latest in **theoretical and analytical thinking on transformational change**, we applied specific search protocols to explore the Web of Science scientific literature database, limiting our search to full-length articles published between January 2000 and September 2018, including papers submitted to conferences.

1. Level 1 analysis: Articles with 'transformational change' in the title (TI)
  - TI='transformational change'
  - Timespan: 2000-2018. Indexes: SCI-EXPANDED, SSCI, AandHCI, ESCI

This resulted in 113 publications. Two publications were removed: (i) One publication was deleted because Web of Science erroneously listed a publication with a different title than was listed in the database, and the title did not match our search parameters (Well and Carrapatoso, 2016); (ii) The other was removed because it was a correction for a publication already included, thereby inflating the information obtained from that publication. The remaining 111 articles underwent Level 1 analysis, where they were scanned for composition by topic, number of authors per article, and country of authorship.

2. Level 2 analysis: publications related to agriculture, forestry or climate change

The 111 publications that were identified in Level 1 analysis were further filtered based on title (TI) and subject (SU) using the following search terms:

- TI='transformational change' AND (SU=(forestry OR agriculture OR ecology) OR TS='climate change')
- Timespan: 2000-2018. Indexes: SCI-EXPANDED, SSCI, AandHCI, ESCI

The filtered results included several publications outside the boundary of forestry and climate change, like urban water management and mining, but which were nevertheless relevant when we take a broader view of land use. This search yielded 23 articles. Two articles (Nam *et al.*, 2016; Pagoropoulos *et al.*, 2017) were dropped because their focus was on transforming the architecture of information technology systems, rather than socio-ecological systems. One editorial in a series of special issues (Gunderson and Folke, 2011) was replaced by a synthesis article within one of the special issues covered in this editorial (Schoon *et al.*, 2011). Three reviews of two books (Ross, 2013; Scott, 2017; Hawkins, 2018) were replaced by the books being reviewed (Brown and Lambert, 2013; Young and Esau, 2016). The final number of articles analyzed was 20. These 20 articles went through Level 2 analysis to better understand their definition, theoretical framework and drivers of transformational change.

The resulting articles and their replacements are listed in Annex 5.2.

One limitation of this method is that it only includes International Scientific Indexing (ISI) publications, which are mostly journals written in English. It also relies on the use of the term 'transformational change' in the title, which is restrictive. Nevertheless, this represents the 'cutting edge' thoughts and analysis on transformational change. Results from reviewing this body of academic literature were used as the starting point of the theoretical section of this paper. We also included literature cited in these articles, with particular attention to preceding supporting work and articles that heavily influenced the author(s)' conceptualization of transformational change in the land-use and climate change literature.

## Annex 2. List of articles selected for review

We broke our analyses into two levels – Level 1: transformational change articles from all fields, analyzed for topic, number of authors per article and country of authorship; Level 2: land-use and climate change articles, analyzed for transformational change definition, theoretical framework and drivers. After removals and replacements (see Section 5.1), the final number of articles analyzed was 20.

**Table 2. Summary of type, unit, direction and expected leader of transformational change across research areas (based on literature review)**

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Allen B.</b> 2015. Transformational change for radiology. <i>Health Affairs</i> 34(3):1. doi:10.1377/hlthaff.2015.0088 (Letter)	Yes	No
<b>Amansure R and Adendorff C.</b> 2018. Successful transformational change in revenue management among beneficiary communities of South African renewable energy construction companies. <i>Acta Structilia</i> 25(1):71–97. doi:10.18820/24150487/as25i1.3 (Article)	Yes	No
<b>Ananthkrishnan N, Arora NK, Chandy G, Gitanjali B, Sood R, Supe A and Nagarajan S.</b> 2012. Is there need for a transformational change to overcome the current problems with postgraduate medical education in India? <i>National Medical Journal of India</i> 25(2):101–108. (Article)	Yes	No
<b>[APIC] Association for Professionals in Infection Control and Epidemiology.</b> 2018. APIC's strategic partners: Committed to transformational change. <i>American Journal of Infection Control</i> 46(11):1201–1201. doi:10.1016/j.ajic.2018.09.021 (Editorial Material)	Yes	No
<b>[APIC] Association for Professionals in Infection Control and Epidemiology.</b> 2017. APIC's strategic partners: Committed to transformational change. <i>American Journal of Infection Control</i> 45(12):1297–1297. doi:10.1016/j.ajic.2017.10.010 (Editorial Material)	Yes	No
<b>Aveling W.</b> 2006. Patient-controlled epidural analgesia and transformational change – Reply. <i>International Journal of Obstetric Anesthesia</i> 15(2):170–170. doi:10.1016/j.ijoa.2005.12.004 (Letter)	Yes	No
<b>Babon A, McIntyre D, Gowae GY, Gallemore C, Carmenta R, Di Gregorio M and Brockhaus M.</b> 2014. Advocacy coalitions, REDD+, and forest governance in Papua New Guinea: How likely is transformational change? <i>Ecology and Society</i> 19(3):13. doi:10.5751/es-06486-190316 (Article)	Yes	Yes
<b>Balcinovic M.</b> 2014. Achieving transformational change in academic libraries. <i>Australian Library Journal</i> 63(1):52–52. doi:10.1080/00049670.2013.878265 (Book Review)	Yes	No
<b>Balmer D and Carraccio C.</b> 2015. Innovation in pediatric education: Promoting and undergoing transformational change. <i>Pediatrics</i> 135(3):399–402. doi:10.1542/peds.2014–2565 (Editorial Material)	Yes	No
<b>Bergh AM, Bac M, Hugo J and Sandars J.</b> 2016. “Making a difference” – Medical students' opportunities for transformational change in health care and learning through quality improvement projects. <i>BMC Medical Education</i> 16:8. doi:10.1186/s12909-016-0694-1 (Article)	Yes	No
<b>Blantern C.</b> 2015. Dialogic organization development: The theory and practice of transformational change. <i>Action Learning</i> 12(3):358–366. doi:10.1080/14767333.2015.1094622 (Book Review)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Bleijenbergh I.</b> 2018. Transformational change towards gender equality: An autobiographical reflection on resistance during participatory action research. <i>Organization</i> 25(1):131–138. doi:10.1177/1350508417726547 (Article)	Yes	No
<b>Boodoo Z and Olsen KH.</b> 2018. Assessing transformational change potential: The case of the Tunisian cement Nationally Appropriate Mitigation Action (NAMA). <i>Climate Policy</i> 18(6):794–812. doi:10.1080/14693062.2017.1386081 (Article)	Yes	Yes
<b>Boodoo Z, Mersmann F and Olsen KH.</b> 2018. The implications of how climate funds conceptualize transformational change in developing countries. <i>Climate and Development</i> 10(8):673–686. doi:10.1080/17565529.2018.1442788 (Article)	Yes	Yes
<b>Boone J.</b> 2015. Leading learning organizations through transformational change: Making the case for blended learning. <i>International Journal of Educational Management</i> 29(3):275–283. doi:10.1108/ijem-06-2013-0096 (Article)	Yes	No
<b>Borland H.</b> 2009. Conceptualising global strategic sustainability and corporate transformational change. <i>International Marketing Review</i> 26(4–5):554–572. doi:10.1108/02651330910972039 (Article)	Yes	No
<b>Bos JJ, Brown RR and Farrelly MA.</b> 2015. Building networks and coalitions to promote transformational change: Insights from an Australian urban water planning case study. <i>Environmental Innovation and Societal Transitions</i> 15:11–25. doi:10.1016/j.eist.2014.10.002 (Article)	Yes	Yes
<b>Brand MJ, Croonen EPM and Welsh DHB.</b> 2016. Successfully managing chain-wide transformational change. <i>Organizational Dynamics</i> 45(2):94–103. doi:10.1016/j.orgdyn.2016.02.003 (Article)	Yes	No
<b>Brandis S, Fisher R, McPhail R, Rice J, Eljiz K, Fitzgerald A, Gapp R and Marshall A.</b> 2016. Hospital employees' perceptions of fairness and job satisfaction at a time of transformational change. <i>Australian Health Review</i> 40(3):292–298. doi:10.1071/ah15031 (Article)	Yes	No
<b>Brockhaus M, Korhonen-Kurki K, Sehring J, Di Gregorio M, Assembe-Mvondo S, Babon A, Bekele M, Gebara MF, Khatri DB, Kambire H et al.</b> 2017. REDD+, transformational change and the promise of performance-based payments: A qualitative comparative analysis. <i>Climate Policy</i> 17(6):708–730. (Article)	Yes	Yes
<b>Brown VA and Lambert JA.</b> 2013. <i>Collective learning for transformational change: A guide to collaborative action</i> . New York: Routledge. (Book)	No	Yes – Replacement
<b>Burke AE, Guralnick S and Hicks P.</b> 2010. The Association of Pediatric Program Directors' Strategic Plan: An opportunity for transformational change. <i>Academic Pediatrics</i> 10(4):220–221. doi:10.1016/j.acap.2010.05.001 (Editorial Material)	Yes	No
<b>Celep A, Brenner S and Mosher-Williams R.</b> 2016. Internal culture, external impact: How a change-making culture positions foundations to achieve transformational change. <i>Foundation Review</i> 8(1):116–129. doi:10.9707/1944-5660.1288 (Article)	Yes	No
<b>Charlesworth K, Jamieson M, Davey R and Butler CD.</b> 2016. Transformational change in healthcare: An examination of four case studies. <i>Australian Health Review</i> 40(2):163–167. doi:10.1071/ah15041 (Article)	Yes	No
<b>Chen H, Bell RH, Larson GM, Smith RS, Prinz RA and Grosfeld JL.</b> 2004. Resident perceptions of the impact of work-hour restrictions on health care delivery and surgical education: Time for transformational change – discussion. <i>Surgery</i> 136(4):868–871. (Editorial Material)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Chumbler NR, Haggstrom D and Saleem JJ.</b> 2011. Implementation of health information technology in Veterans health administration to support transformational change telehealth and personal health records. <i>Medical Care</i> 49(12):S36–S42. doi:10.1097/MLR.0b013e3181d558f9 (Article)	Yes	No
<b>Cohen AR.</b> 2003. Transformational change at Babson College: Notes from the firing line. <i>Academy of Management Learning and Education</i> 2(2):155–166. doi:10.5465/amle.2003.9901672 (Editorial Material)	Yes	No
<b>Cummings JA.</b> 2018. Transformational change in parenting practices after child interpersonal trauma: A grounded theory examination of parental response. <i>Child Abuse and Neglect</i> 76:117–128. doi:10.1016/j.chiabu.2017.10.005 (Article)	Yes	No
<b>Derner JD, Smart AJ, Toombs TP, Larsen D, McCulley RL, Goodwin J, Sims S and Roche LM.</b> 2018. Soil health as a transformational change agent for US grazing lands management. <i>Rangeland Ecology and Management</i> 71(4):403–408. doi:10.1016/j.rama.2018.03.007 (Article)	Yes	Yes
<b>Di Gregorio M, Brockhaus M, Cronin T, Muharrom E, Mardiah S and Santoso L.</b> 2015. Deadlock or transformational change? Exploring public discourse on REDD+ across seven countries. <i>Global Environmental Politics</i> 15(4):63–84. doi:10.1162/GLEP_a_00322 (Article)	Yes	Yes
<b>Di Diodato G.</b> 2013. Just clean your hands: Measuring the effect of a patient safety initiative on driving transformational change in a health care system. <i>American Journal of Infection Control</i> 41(11):1109–1111. doi:10.1016/j.ajic.2013.01.039 (Article)	Yes	No
<b>Di Stefano R.</b> 2013. Tracking transformational change at an area agency on aging. <i>Generations – Journal of the American Society on Aging</i> 37(2):78–80. (Article)	Yes	No
<b>Douglas LN and Webster V.</b> 2015. Readiness of chief executives for transformational change across health, councils and third sector in Scotland to lead public service reform: A grounded theory approach. <i>International Journal of Integrated Care</i> 15:2. (Meeting Abstract)	Yes	No
<b>Durie R and Wyatt K.</b> 2013. Connecting communities and complexity: A case study in creating the conditions for transformational change. <i>Critical Public Health</i> 23(2):174–187. doi:10.1080/09581596.2013.781266 (Article)	Yes	No
<b>Fischer HM and Pollock TG.</b> 2004. Effects of social capital and power on surviving transformational change: The case of initial public offerings. <i>Academy of Management Journal</i> 47(4):463–481. doi:10.2307/20159597 (Article)	Yes	No
<b>Fletcher JK.</b> 2004. The paradox of postheroic leadership: An essay on gender, power, and transformational change. <i>Leadership Quarterly</i> 15(5):647–661. doi:10.1016/j.leaqua.2004.07.004 (Article)	Yes	No
<b>Forcehimes A.</b> 2005a. The relationship between transformational change and the fourth step of Alcoholics Anonymous. <i>Alcoholism – Clinical and Experimental Research</i> 29(5):72A–72A. (Meeting Abstract)	Yes	No
<b>Forcehimes A.</b> 2005b. Transformational change in recovery. <i>Alcoholism – Clinical and Experimental Research</i> 29(5):189A–189A. (Meeting Abstract)	Yes	No
<b>Fraser A, Elliott SF and Cohen D.</b> 2012. Transformational change: The Northwick Park experience. <i>International Journal of Stroke</i> 7:31–31. (Meeting Abstract)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Fridahl M and Johansson L.</b> 2017. An assessment of the potential for spurring transformational change through Nationally Appropriate Mitigation Actions (NAMAs). <i>Environmental Innovation and Societal Transitions</i> 25:35–46. doi:10.1016/j.eist.2016.11.003 (Article)	Yes	Yes
<b>Garfield RL.</b> 2009. Mental health policy development in the states: The piecemeal nature of transformational change. <i>Psychiatric Services</i> 60(10):1329–1335. (Article)	Yes	No
<b>Gerrard JA.</b> 2015. Investigator-led science: Predict the unpredictable and be ready to capture transformational change. <i>Journal of the Royal Society of New Zealand</i> 45(2):122–125. doi:10.1080/03036758.2015.1011170 (Article)	Yes	No
<b>Gillard R.</b> 2016. Questioning the diffusion of resilience discourses in pursuit of transformational change. <i>Global Environmental Politics</i> 16(1):13–20. doi:10.1162/GLEP_a_00334 (Article)	Yes	Yes
<b>Gilpin-Jackson Y.</b> 2017. Participant experiences of transformational change in large-scale organization development interventions (LODIs). <i>Leadership and Organization Development Journal</i> 38(3):419–432. doi:10.1108/lodj-12-2015-0284 (Article)	Yes	No
<b>Grant GJ and Grant AH.</b> 2006. Patient-controlled epidural analgesia and transformational change. <i>International Journal of Obstetric Anesthesia</i> 15(2):170–170. doi:10.1016/j.ijoa.2005.10.017 (Letter)	Yes	No
<b>Grant GJ, Grant AH and Lockwood CJ.</b> 2005a. Simpson, Semmelweis and transformational change – in reply. <i>Obstetrics and Gynecology</i> 106(5):1108–1108. doi:10.1097/01.AOG.0000186255.52346.e3 (Letter)	Yes	No
<b>Grant GJ, Grant AH and Lockwood CJ.</b> 2005b. Simpson, Semmelweis and transformational change. <i>Obstetrics and Gynecology</i> 106(2):384–387. doi:10.1097/01.aog.0000168452.10067.27 (Editorial Material)	Yes	No
<b>Greenhalgh L and Nasser J.</b> 2000. Ford Motor Company's CEO Jac Nasser on transformational change, e-business, and environmental responsibility. <i>Academy of Management Executive</i> 14(3):46–51. doi:10.5465/ame.2000.4468065 (Editorial Material)	Yes	No
<b>Gualandris J and Klassen RD.</b> 2018. Emerging discourse incubator: Delivering transformational change – aligning supply chains and stakeholders in non-governmental organizations. <i>Journal of Supply Chain Management</i> 54(2):34–48. (Article)	Yes	No
<b>Gunderson L and Folke C.</b> 2011. Resilience 2011: Leading transformational change. <i>Ecology and Society</i> 16(2):3. (Editorial Material)	Yes	No - Replaced
<b>Harmon RB, Fontaine D, Plews-Ogan M and Williams A.</b> 2012. Achieving transformational change: Using appreciative inquiry for strategic planning in a school of nursing. <i>Journal of Professional Nursing</i> 28(2):119–124. doi:10.1016/j.profnurs.2011.11.007 (Article)	Yes	No
<b>Hawkins J.</b> 2018. Transformational change in environmental and natural resource management: Guidelines for policy excellence. <i>Australian Journal of Agricultural and Resource Economics</i> 62(3):501–503. (Book Review)	Yes	No - Replaced
<b>Holland B.</b> 2017. Procedural justice in local climate adaptation: Political capabilities and transformational change. <i>Environmental Politics</i> 26(3):391–412. doi:10.1080/09644016.2017.1287625 (Article)	Yes	Yes



Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Horst SO and Jarventie-Thesleff R.</b> 2016. Finding an emergent way through transformational change: A narrative approach to strategy. <i>Journal of Media Business Studies</i> 13(1):3–21. doi:10.1080/16522354.2015.1123854 (Article)	Yes	No
<b>Hunter DJ, Erskine J, Small A, McGovern T, Hicks C, Whitty P and Lugsden E.</b> 2015. Doing transformational change in the English NHS in the context of 'big bang' reorganization: Findings from the North East transformation system. <i>Journal of Health Organization and Management</i> 29(1):10–24. doi:10.1108/jhom-01-2014-0019 (Article)	Yes	No
<b>Hurley C, Baum F and Eyk H.</b> 2004. 'Designing better health care in the South': A case study of unsuccessful transformational change in public sector health service reform. <i>Australian Journal of Public Administration</i> 63(2):31–41. doi:10.1111/j.1467-8500.2004.00376.x (Article)	Yes	No
<b>Jacobs B, Cordell D, Chin J and Rowe H.</b> 2017. Towards phosphorus sustainability in North America: A model for transformational change. <i>Environmental Science and Policy</i> 77:151–159. doi:10.1016/j.envsci.2017.08.009 (Article)	Yes	Yes
<b>Jadvar H and Ballas LK.</b> 2018. PSMA PET: Transformational change in prostate cancer management? <i>Journal of Nuclear Medicine</i> 59(2):228–229. doi:10.2967/jnumed.117.203604 (Editorial Material)	Yes	No
<b>Jordan G, Cowan T, Malla A and Iyer S.</b> 2018. A qualitative investigation of positive, transformational change following a first episode of psychosis. <i>International Journal of Qualitative Methods</i> 17(1):23–23. (Meeting Abstract)	Yes	No
<b>Jorm CM.</b> 2010. Patient safety: Time for a transformational change in medical education. <i>Medical Journal of Australia</i> 193(8):487–488. (Letter)	Yes	No
<b>Karunanayaka SP and Naidu S.</b> 2018. Designing capacity building of educators in open educational resources integration leads to transformational change. <i>Distance Education</i> 39(1):87–109. doi:10.1080/01587919.2017.1413933 (Article)	Yes	No
<b>Kezar A.</b> 2013. Understanding sensemaking/sensegiving in transformational change processes from the bottom up. <i>Higher Education</i> 65(6):761–780. doi:10.1007/s10734-012-9575-7 (Article)	Yes	No
<b>Kidd S, Kenny A and McKinstry C.</b> 2014. Creating transformational change in community mental health services. <i>International Journal of Qualitative Methods</i> 13:522–523. (Meeting Abstract)	Yes	No
<b>King CS and Beeby M.</b> 2008. Colleen Jollie, State Tribal Liaison: A story of transformational change. <i>Public Administration Review</i> 68(6):1142–1150. doi:10.1111/j.1540-6210.2008.00961.x (Biography)	Yes	No
<b>Kneebone R.</b> 2009. Perspective: Simulation and transformational change: The paradox of expertise. <i>Academic Medicine</i> 84(7):954–957. doi:10.1097/ACM.0b013e3181a843d6 (Article)	Yes	No
<b>Kort KC, Pavone LA, Jensen E, Haque E, Newman N and Kittur D.</b> 2004. Resident perceptions of the impact of work-hour restrictions on health care delivery and surgical education: Time for transformational change. <i>Surgery</i> 136(4):861–868. doi:10.1016/j.surg.2004.07.005 (Article)	Yes	No
<b>Kramer R.</b> 2016. Dialogic organization development: The theory and practice of transformational change. <i>Academy of Management Learning and Education</i> 15(3):639–643. doi:10.5465/amle.2016.0207 (Book Review)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Kuntz JRC and Gomes JFS.</b> 2012. Transformational change in organisations: A self-regulation approach. <i>Journal of Organizational Change Management</i> 25(1):143–162. doi:10.1108/09534811211199637 (Article)	Yes	No
<b>Langton N, Khan KM and Lusina SJ.</b> 2010. FIFA's Football for Health: Applying Kotter's eight-step program for transformational change to a mass participation activity. <i>British Journal of Sports Medicine</i> 44(8):537–539. doi:10.1136/bjism.2010.075143 (Editorial Material)	Yes	No
<b>Lee DHL and Lee WO.</b> 2018. Transformational change in instruction with professional learning communities? The influence of teacher cultural disposition in high power distance contexts. <i>Journal of Educational Change</i> 19(4):463–488. doi:10.1007/s10833-018-9328-1 (Article)	Yes	No
<b>Luce BR, Kramer JM, Goodman SN, Connor JT, Tunis S, Whicher D and Schwartz JS.</b> 2009. Rethinking randomized clinical trials for comparative effectiveness research: The need for transformational change. <i>Annals of Internal Medicine</i> 151(3):206–W245. doi:10.7326/0003-4819-151-3-200908040-00126 (Article)	Yes	No
<b>Lukas CV, Holmes SK, Cohen AB, Restuccia J, Cramer IE, Shwartz M and Charns MP.</b> 2007. Transformational change in health care systems: An organizational model. <i>Health Care Management Review</i> 32(4):309–320. doi:10.1097/01.HMR.0000296785.29718.5d (Article)	Yes	No
<b>Mapfumo P, Onyango M, Honkponou SK, El Mzouri E, Githeko A, Rabeharisoa L, Obando J, Omolo N, Majule A, Denton F, et al.</b> 2017. Pathways to transformational change in the face of climate impacts: An analytical framework. <i>Climate and Development</i> 9(5):439–451. doi:10.1080/17565529.2015.1040365 (Article)	Yes	Yes
<b>McAlpine CA, Seabrook LM, Ryan JG, Feeney BJ, Ripple WJ, Ehrlich AH and Ehrlich PR.</b> 2015. Transformational change: Creating a safe operating space for humanity. <i>Ecology and Society</i> 20(1):6. doi:10.5751/es-07181-200156 (Article)	Yes	Yes
<b>McGrath KM, Bennett DM, Ben-Tovim DI, Boyages SC, Lyons NJ and O'Connell TJ.</b> 2008. Implementing and sustaining transformational change in health care: Lessons learnt about clinical process redesign. <i>Medical Journal of Australia</i> 188(7):422–422. (Correction)	Yes	No
<b>McGrath KM, Bennett DM, Ben-Tovim DI, Boyages SC, Lyons NJ and O'Connell TJ.</b> 2008. Implementing and sustaining transformational change in health care: Lessons learnt about clinical process redesign. <i>Medical Journal of Australia</i> 188(6):S32–S35. (Article)	Yes	No
<b>McNaney N and Bradbury E.</b> 2016a. Developing systems leadership for transformational change. <i>International Journal of Integrated Care</i> 16:1. doi:10.5334/ijic.2892 (Meeting Abstract)	Yes	No
<b>McNaney N and Bradbury E.</b> 2016b. Practical tools for transformational change. <i>International Journal of Integrated Care</i> 16:2. doi:10.5334/ijic.2893 (Meeting Abstract)	Yes	No
<b>Moore TE.</b> 2003. Transformational change at Babson: Before the first shot was fired. <i>Academy of Management Learning and Education</i> 2(2):170–172. (Editorial Material)	Yes	No
<b>Nam K, Oh SW, Kim SK, Goo J and Khan MS.</b> 2016. Dynamics of enterprise architecture in the Korean public sector: Transformational change vs. transactional change. <i>Sustainability</i> 8(11):18. doi:10.3390/su8111074 (Article)	Yes	No
<b>Nicholson KP.</b> 2015. The McDonaldization of academic libraries and the values of transformational change. <i>College and Research Libraries</i> 76(3):328–338. doi:10.5860/crl.76.3.328 (Article)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Pagoropoulos A, Maier A and McAloone TC.</b> 2017. Assessing transformational change from institutionalising digital capabilities on implementation and development of Product-Service Systems: Learnings from the maritime industry. <i>Journal of Cleaner Production</i> 166:369–380. doi:10.1016/j.jclepro.2017.08.019 (Article)	Yes	No
<b>Ramberg U.</b> 2017. Transformational change and the vacuum of performance measurement: How a story of success became a failure. <i>Financial Accountability and Management</i> 33(3):249–263. doi:10.1111/faam.12123 (Article)	Yes	No
<b>Riley WJ, Parsons HM, Duffy GL, Moran JW and Henry B.</b> 2010. Realizing transformational change through quality improvement in public health. <i>Journal of Public Health Management and Practice</i> 16(1):72–78. (Article)	Yes	No
<b>Romanow RJ and Marchildon GP.</b> 2004. History, politics and transformational change in Canadian health care: A rejoinder. <i>Canadian Psychology – Psychologie Canadienne</i> 45(3):239–243. doi:10.1037/h0086994 (Article)	Yes	No
<b>Ross H.</b> 2013. Collective learning for transformational change: A guide to collaborative action. <i>Australasian Journal of Environmental Management</i> 20(3):257–259. doi:10.1080/14486563.2013.826121 (Book Review)	Yes	No - Replaced
<b>Runciman WB.</b> 2010. Patient safety: Time for a transformational change in medical education. <i>Medical Journal of Australia</i> 193(1):3–4. (Editorial Material)	Yes	No
<b>Rutty JE, Morgan B and Rutty GN.</b> 2015. Managing transformational change: Implementing cross-sectional imaging into death investigation services in the United Kingdom. <i>Journal of Forensic Radiology and Imaging</i> 3(1):57–60. doi:10.1016/j.jofri.2014.11.003 (Editorial Material)	Yes	No
<b>Sampson J.</b> 2010. Developing a strategy for the management of change which covers continuous improvement, transformational change and discontinuous innovation through consideration of double-loop learning. <i>Vox Sanguinis</i> 99:91–92. (Meeting Abstract)	Yes	No
<b>Sayles C.</b> 2002. Transformational change – Based on the model of Virginia Satir. <i>Contemporary Family Therapy</i> 24(1):93–109. doi:10.1023/a:1014325722738 (Article)	Yes	No
<b>Schoon M, Fabricius C, Anderies JM and Nelson M.</b> 2011. Synthesis: Vulnerability, traps and transformations – long-term perspectives from archaeology. <i>Ecology and Society</i> 16(2):24. (Article)	No	Yes - Replacement
<b>Scott SM.</b> 2017. Collective learning for transformational change: A guide to collaborative action. <i>Journal of Transformative Education</i> 15(1):95–97. doi:10.1177/1541344616629792 (Book Review)	Yes	No - Replaced
<b>Seijts GH and Gandz J.</b> 2018. Transformational change and leader character. <i>Business Horizons</i> 61(2):239–249. doi:10.1016/j.bushor.2017.11.005 (Article)	Yes	No
<b>Sengupta M.</b> 2018. Transformational change or tenuous wish list? A critique of SDG 1 ('End poverty in all its forms everywhere'). <i>Social Alternatives</i> 37(1):12–17. (Article)	Yes	No
<b>Shirey MR.</b> 2011. Establishing a sense of urgency for leading transformational change. <i>Journal of Nursing Administration</i> 41(4):145–148. doi:10.1097/NNA.0b013e3182118550 (Article)	Yes	No
<b>Skogland MAC.</b> 2017. A spatial approach to transformational change Strategic alignment of the spatial and cultural environment. <i>Journal of Corporate Real Estate</i> 19(4):285–299. doi:10.1108/jcre-09-2016-0030 (Article)	Yes	No

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Springer PJ, Clark CM, Strohfus P and Belcheir M.</b> 2012. Using transformational change to improve organizational culture and climate in a school of nursing. <i>Journal of Nursing Education</i> 51(2):80–87. doi:10.3928/01484834-20111230-02 (Article)	Yes	No
<b>Stotland NE and Stotland NL.</b> 2005. Simpson, Semmelweis and transformational change. <i>Obstetrics and Gynecology</i> 106(5):1107–1108. doi:10.1097/01.aog.0000186050.56229.93 (Letter)	Yes	No
<b>Sutherland JR.</b> 2010. Patient safety: Time for a transformational change in medical education. <i>Medical Journal of Australia</i> 193(8):487–487. (Letter)	Yes	No
<b>Swanson RC, Cattaneo A, Bradley E, Chunharas S, Atun R, Abbas KM, Katsaliaki K, Mustafee N, Meier B and Best A.</b> 2012. Rethinking health systems strengthening: Key systems thinking tools and strategies for transformational change. <i>Health Policy and Planning</i> 27:54–61. doi:10.1093/heapol/czs090 (Editorial Material)	Yes	No
<b>Tassabehji R, Hackney R and Popovic A.</b> 2016. Emergent digital era governance: Enacting the role of the ‘institutional entrepreneur’ in transformational change. <i>Government Information Quarterly</i> 33(2):223–236. doi:10.1016/j.giq.2016.04.003 (Article)	Yes	No
<b>Termeer C, Dewulf A and Biesbroek GR.</b> 2017. Transformational change: Governance interventions for climate change adaptation from a continuous change perspective. <i>Journal of Environmental Planning and Management</i> 60(4):558–576. doi:10.1080/09640568.2016.1168288 (Article)	Yes	Yes
<b>Totin E, Butler JR, Sidibe A, Partey S, Thornton PK and Tabo R.</b> 2018. Can scenario planning catalyze transformational change? Evaluating a climate change policy case study in Mali. <i>Futures</i> 96:44–56. doi:10.1016/j.futures.2017.11.005 (Article)	Yes	Yes
<b>Walsh CL, Glendinning S, Castan-Broto V, Dewberry E and Powell M.</b> 2015. Are wildcard events on infrastructure systems opportunities for transformational change? <i>Futures</i> 67:1–10. doi:10.1016/j.futures.2015.01.005 (Article)	Yes	No
<b>Weaver L.</b> 2016. Possible: Transformational change in collective impact. <i>Community Development</i> 47(2):274–283. doi:10.1080/15575330.2016.1138977 (Article)	Yes	No
<b>Weerakkody V, Janssen M and Dwivedi YK.</b> 2011. Transformational change and business process reengineering (BPR): Lessons from the British and Dutch public sector. <i>Government Information Quarterly</i> 28(3):320–328. doi:10.1016/j.giq.2010.07.010 (Article)	Yes	No
<b>White WL.</b> 2004. Transformational change: A historical review. <i>Journal of Clinical Psychology</i> 60(5):461–470. doi:10.1002/jclp.20001 (Article)	Yes	No
<b>Wiek A, Ness B, Schweizer-Ries P, Brand FS and Farioli F.</b> 2012. From complex systems analysis to transformational change: A comparative appraisal of sustainability science projects. <i>Sustainability Science</i> 7:5–24. doi:10.1007/s11625-011-0148-y (Article)	Yes	Yes
<b>Williamson JAH.</b> 2010. Patient safety: Time for a transformational change in medical education. <i>Medical Journal of Australia</i> 193(8):487–487. (Letter)	Yes	No
<b>Willis CD, Best A, Riley B, Herbert CP, Millar J and Howland D.</b> 2014. Systems thinking for transformational change in health. <i>Evidence and Policy</i> 10(1):113–126. doi:10.1332/174426413x662815 (Article)	Yes	No
<b>Winkler H and Dubash NK.</b> 2016. Who determines transformational change in development and climate finance? <i>Climate Policy</i> 16(6):783–791. doi:10.1080/14693062.2015.1033674 (Article)	Yes	Yes

Citation (Publication type)	Analysis	
	Level 1	Level 2
<b>Wolf G, Bradle J and Nelson G.</b> 2005. Bridging the strategic leadership gap: A model program for transformational change. <i>Journal of Nursing Administration</i> 35(2):54–60. (Article)	Yes	No
<b>Young M and Esau C,</b> eds. 2016. Transformational change in environmental and natural resource management: Guidelines for Policy Excellence. <i>Routledge.</i> (Book)	No	Yes - Replacement
<b>Zolner JP.</b> 2003. Transformational change at Babson College: A view from the outside. <i>Academy of Management Learning and Education</i> 2(2):177–180. (Editorial Material)	Yes	No

### Annex 3. Learning from the land-use sector (agriculture, forestry and other land uses): Transformational change definitions and concepts that relate to climate change and other disciplines

Note: The emphasis in this table was added by the authors of this report

Context	Definition/description of transformational change
Climate change adaptation and mitigation	<p>“What is crucial, however, is that the Board’s ambition to get the Fund off the ground and up to scale swiftly does not compromise on its ambition to <b>promote cutting-edge innovation and real transformation</b> towards the low-emission and climate-resilient future that the global community committed itself to in the Paris Agreement.” (GCF, cited in Puri 2018, 3)</p> <p>“...the GCF <b>will promote the paradigm shift</b> towards low-emission and climate-resilient development pathways <b>by providing support to developing countries</b> to limit or reduce their greenhouse gas emissions and to adapt to the impacts of climate change, taking into account the needs of those developing countries particularly vulnerable to the adverse effects of climate change.” (GCF, cited in Puri 2018, 3)</p>
Climate change adaptation	<p>“a fundamental qualitative change ... that often involves a <b>change in paradigm</b> and may include <b>shifts in perception and meaning</b>, changes in underlying <b>norms and values</b>, reconfiguration of <b>social networks and patterns of interaction</b>, changes in <b>power structures</b>, and the introduction of new <b>institutional arrangements and regulatory frameworks.</b>” (IPCC 2012, 436)</p> <p>“... adaptation is understood as an <b>ongoing process of transformation</b>, in which vulnerable populations come to <b>have voice and power</b> in the struggle among competing interests.” (Holland 2017, 8)</p> <p>“Transformation entails a <b>significant shift</b> in characteristic features and functions, resulting in a <b>fundamentally new system or process</b> whether economic, social or ecological.” (Mapfumo <i>et al.</i> 2017, 440)</p> <p>“... the size/extent and intensity of a change often characterize transformational shifts. Change that is discontinuous, qualitatively distinctive and has a broad spatial coverage is often also viewed as transformational .... Irreversibility and long duration are other characteristics sometimes attributed to transformational changes and responses.” (Mapfumo <i>et al.</i> 2017, 440)</p> <p>“However, given the relative newness of interventions to support climate change adaptation in recent years, and the short duration of many development interventions related to climate risks, it is necessary to think of transformation in ways that <b>do not only hinge on an assessment of size and scale.</b>” (Mapfumo <i>et al.</i> 2017, 440)</p>

Context	Definition/description of transformational change
Climate change mitigation	<p>“... deep, long-term, structural changes that <b>address the root causes</b> of carbon lock-in <b>through a series of incremental steps</b> ... a structural change that <b>alters the interplay</b> of institutional, cultural, technological, economic and ecological dimensions” (Boodoo <i>et al.</i> 2018, 683)</p> <p>“... occur[s] when <b>regimes are destabilized</b> under the influence of pressures from niches and landscape factors.” (Boodoo and Olsen 2018, 796)</p> <p>“... [a] <b>shift in discourse, attitudes, power relations, and deliberate policy and protest action</b> that leads policy formulation and implementation <b>away from business as usual</b> policy approaches that directly or indirectly support deforestation and forest degradation.” (Brockhaus and Angelsen 2012, 16; adopted by Babon <i>et al.</i> (2014), Di Gregorio <i>et al.</i> (2015) and Brockhaus <i>et al.</i> (2017))</p>
Natural resource management	<p>Transitions involve gradual, continuous processes of change <b>along a range of possible development paths at varying scales and speeds</b>, and can be described as a set of connected changes. These pathways may reinforce each other but take place in diverse areas, like technology, the economy, institutions, human behavior and beliefs, culture and ecology. Transformed systems are achieved through knowledge sharing of success and self-organization of the social system.” (Jacobs <i>et al.</i> 2017)</p>
International development	<p>“Transformational change is the process whereby positive development <b>results are achieved and sustained</b> over time by <b>institutionalizing</b> policies, programs and projects within national strategies. ... this embodies the concept of institutionally sustained results – consistency of achievement over time. This is in order to exclude short-term, transitory impact.” (UNDP 2011, 7)</p> <p>“GEF 2020 emphasizes the need for us to support transformational change and <b>achieve impacts on a broader scale.</b>”</p> <p>“The 2020 vision for the GEF is to be a champion of the global environment building on its role as financial mechanism of several multilateral environmental conventions (MEAs), supporting transformational change, and <b>achieving global environmental benefits on a larger scale.</b>” (Global Environment Facility (GEF), cited in Puri 2018, 3)</p> <p>“Transforming the trajectory to maintain the historical trend requires a concerted effort by the international development community to <b>bend the ‘natural arc’ of history.</b>” (World Bank, cited in Puri 2018, 3)</p> <p>“We need to move decisively beyond the remnants of a one-size-fits-all approach and <b>recognize the full extent of the diversity and complexity</b> of our client base, then tailor solutions to each client.” (World Bank, cited in Puri 2018, 3)</p> <p>“FAO is working closely with governments and their stakeholders to <b>select national targets, implement and monitor progress</b> in line with the overall vision and aspirations of the 2030 Agenda.” (FAO, cited in Puri 2018, 3)</p> <p>“A structural change that <b>alters the interplay</b> of institutional, cultural, technological, economic and ecological dimensions of a given system. It will <b>unlock new development paths</b>, including social practices and worldviews.” (Mersmann <i>et al.</i> 2014 10, commissioned by BMZ, the German Federal Ministry for Economic Cooperation and Development)</p> <p>Characteristics of transformational change processes: <b>Intense</b> (fundamental restructuring of the system, shift of predominant paradigms, complex non-linear processes, change in multiple dimensions); <b>socially dynamic</b> (driven by pioneers with a vision of change, emergence of new networks and coalitions, and conflicts as power structures change); and <b>temporally dynamic</b> (long time span, gradual changes through incremental steps, with tipping points where the stability of the former systems break). (Adapted from Table 2.1 in Mersmann <i>et al.</i> 2014)</p>
Business	<p>“Transformation involves <b>large-scale change</b> affecting <b>behaviors</b> and more fundamentally the <b>culture</b> of the organization.” (CIPD 2015, 6)</p>

Context	Definition/description of transformational change
Collective learning	“changes in a local community or involving an entire nation ... [or] the entire globe ... take place on each of these levels at the same time ... go <b>beyond incremental change</b> to changes that alter the context in which it is taking place. It is not business as usual, and tomorrow will not be the same as yesterday ... <b>a change in the way we think</b> , and especially to our understanding of the world we live in.” (Brown n.d.)

## Annex 4. Summary of the drivers of transformational change found in academic literature

Note: Twelve of 22 land-use and climate change articles are included in this analysis

Context	Scientific article and desired transformational change	Possible drivers (Exogenous, Endogenous, Barriers) <sup>a</sup>	Driver groups <sup>b</sup>			
			R	L	P	N
Climate change mitigation	Transformational change in the REDD+ policy arena in Papua New Guinea (Babon <i>et al.</i> 2014)	<i>Exogenous</i> : Global debate supporting REDD+ (L, P); emerging global carbon markets (R, L)	X	X	X	
		<i>Endogenous</i> : National REDD+ actions (R); improved resources of advocacy coalitions (R); dominance of advocacy coalition actions over status quo coalitions (L)	X	X		
	Transformational change in the REDD+ policy arenas (13 countries) (Brockhaus <i>et al.</i> 2017)	<i>Endogenous</i> : Results-based payments, when there is high national ownership (R, L); non-performance based payments, when there is no national ownership (R, L)	X	X		
	REDD+ policy reforms in 7 countries (Di Gregorio <i>et al.</i> 2015)	<i>Endogenous</i> : Reformist policy actors and the media engaging dominant policy actors on how to reduce pressure on forest (L, P)		X	X	
		<i>Barriers</i> : Predominance of win-win storylines (L); state actors lack debates on potential negative outcomes of REDD+ (P); little attention to the drivers of deforestation (L, P)		X	X	
	Improve potential of transformational change of climate finance in Tunisia (Boodoo <i>et al.</i> 2018)	<i>Exogenous</i> : Climate finance debate at the global level (R, L); climate finance from the Green Climate Fund (GCF) and Nationally Appropriate Mitigation Actions (NAMA) Facility (R)	X	X		
		<i>Barriers</i> : Disparities and fragmentation of interests (L); difficulty reconciling accountability with innovative open-ended approach (P, N); difficult to apply transition management principles in the developing-country context (N)		X	X	X

Context	Scientific article and desired transformational change	Possible drivers (Exogenous, Endogenous, Barriers) <sup>a</sup>	Driver groups <sup>b</sup>			
			R	L	P	N
	Reduce carbon emissions from the cement industry in Tunisia (Boodoo and Olsen 2018)	<i>Exogenous</i> : UNFCCC ratification, entailing (I) NDCs and the NAMA registry (R, L); donor support for Cement NAMA in Tunisia (R, L)	X	X		
		<i>Endogenous</i> : Closer interaction between regimes (energy production and waste) (P; N)			X	
		<i>Barriers</i> : Increased prices of cleaner energy sources (R); locked into landfilling and the national electric utility company (R); industry incumbents choose only win-win outcomes (L, N); industry incumbents are not reflexive (N); donors/financers were not engaged early in coalition-building (P,N); lack of social learning built into the project design (P, N); lack of learning from implementation within and across niches (P, N)	X	X	X	X
Climate change adaptation	Reduce social vulnerability, enhance systems resilience and enable targeting of actions against specific climate risks. (Mapfumo <i>et al.</i> 2017)	<i>Endogenous</i> : Learning from actions (N); development of alliances and networks for learning (P); presence of multiple reward systems (R, L, P); willingness to empower individuals/communities as change agents (e.g. by providing access to information, facilitating dialogue and collaboration) (N); actions are self-sufficient (e.g. financing, human resources) (R)	X	X	X	X
	Correct inequities, focusing on changing human agency rather than vulnerability (Holland 2017)	<i>Exogenous</i> : Beliefs among powerful actors in whether climate change is real (N)				X
		<i>Endogenous</i> : Give vulnerable populations control to shape adaptation actions (N); ensure people's preferences are well-informed (R, N); ensure vulnerable populations are free from overt forms of domination or oppression (P, N); adopt policies that communities want regardless of climate impacts occurring (L, N)	X	X	X	X
		<i>Barriers</i> : Making decisions based on climate models that may weaken claims of those without scientific proof of probable harm (L, N); reducing discussions about climate change adaptation to a series of engineering calculations (L, N); favoring 'scientific' knowledge over other forms of knowledge (L, N)		X		X



Context	Scientific article and desired transformational change	Possible drivers (Exogenous, Endogenous, Barriers) <sup>a</sup>	Driver groups <sup>b</sup>			
			R	L	P	N
Sustainable resource management	Improve water health and water management in the Cook River water catchment, Sydney (Bos <i>et al.</i> 2015)	<i>Exogenous</i> : Grant program for partnership between local government, businesses, NGOs, residents (R, P); existing groups and individuals with objectives similar to the change in question (L); access to a network of science/knowledge brokers (R)	X	X	X	
		<i>Endogenous</i> : Governance experimentation based on past policy failures (P, N); influential and visionary frontrunners (R, L); main transition arena and sub-arenas share information and make decisions (P); early investment in building transition arena that is inclusive and diverse (P, N); real-time monitoring results used to form new strategies for the whole catchment (P, N); form a political coalition in support of the transformational change (L, P)		X	X	X
Sustainable resource management	Improve commitment across a large number of people (e.g. city, region) to act and live more sustainably (Brown and Lambert 2013)	<i>Exogenous</i> : Well-educated professionals (R); a concerned citizenry; a web of local organizations with overlapping interests (R, L)	X	X		
		<i>Endogenous</i> : Working from values rather than facts (N); working in small groups (P); stirring deep wells of untapped imagination (P); series of workshops engaging the four-stages of social learning (Figure 4) (P)			X	X
		<i>Barrier</i> : Regulation and broader business interests (R, L)	X	X		
	Encourage stewardship and sustainable grazing land management (Dermer <i>et al.</i> 2018)	<i>Endogenous</i> : Linking natural resources stewardship and sustainable grazing management (P, N); reaching broader audiences (P, N); communications among producers, customers and the general public (P, N); establishing a network of living laboratories; management-science partnerships (P, N)			X	X
		<i>Barrier</i> : Actors prescribing practices assuming benefits or outcomes (N)				X

Context	Scientific article and desired transformational change	Possible drivers (Exogenous, Endogenous, Barriers) <sup>a</sup>	Driver groups <sup>b</sup>			
			R	L	P	N
	Become low-carbon societies (Fridahl and Johansson 2017)	<i>Exogenous:</i> Structures in the country serving as a support system, like policy or law (R); regulatory support systems for niches, to increase the likelihood innovations are scaled up (R, N)	X			X
		<i>Endogenous:</i> Action affecting multiple areas of the system (P, N); supporting the development or scaling up an existing niche, or developing a new one (R, N); acknowledging the need for a learning process (N); bringing together a shared positive vision among diverse actors (P, N); learning by trial and error (N); encouraging strong social networks through participatory processes (P, N); long-term financial support from donors (R,N); allowing niches to learn from errors and build networks (N); inducing change at multiple levels of socio-technical systems (P, N)	X		X	X
	Improve the sustainability of phosphorus supply to improve socio-ecological resilience (Jacobs <i>et al.</i> 2017)	<i>Exogenous:</i> Environmental catastrophe caused by too much phosphorous run-off (L); the closure of the only phosphate mine in Canada, which increased North American dependence on overseas imports and the value of phosphorous (L); government interest in food security (L)		X		
		<i>Endogenous:</i> Articulation of a 'guiding vision' (P); top-down incentives for change to overcome entrenched world views (R, N); offset the additional transaction costs of polycentric governance systems (R, N)	X		X	X

<sup>a</sup> Ex = Exogenous; En = Endogenous; Ba = Barriers.

<sup>b</sup> R = Resources; L = Legitimacy; P = Processes; N = Norms

## Annex 5. Indicators of transformational change by context and scale of action

This table provides examples of indicators of transformational change, as identified by the authors of each study. We classify these into driver groups: R (Resources), L (Legitimacy), P (Process) and N (Norms), as well as O (Outcome indicators). The theoretical basis of each study was identified from each study's methods, as described in the article.

Context and scale	Indicators	Driver groups <sup>b</sup>				O <sup>1</sup>	Theoretical basis
		R	L	P	N		
Climate change adaptation – local	Rights and responsibilities distributed fairly [ <b>N: fairness</b> ]				X		Substantive justice; procedural justice (Holland 2017)
	Decisions made through just institutional processes and procedures [ <b>N: justice</b> ]				X		
	Shift in cropping systems; farmers' efforts to cope with periodic climate fluctuations and hazards in extreme years are transformed [ <b>O: adopt new technology</b> ]					X	Systems theory; organizational theory (Mapfumo <i>et al.</i> 2017)
	Local <b>awareness</b> about limitations of current cropping systems [ <b>R: information; P: awareness raising</b> ]	X		X			
	Farmer <b>experimentation</b> with new options [ <b>P: learning; N: will to innovate and learn</b> ]			X	X		
	<b>Strength and dynamism</b> of local institutions that support ongoing change processes [ <b>R: institutions; N: participative, dynamic</b> ]	X			X		
	Extent of local <b>partnerships</b> between men and women, and traditional and local administrative leaders [ <b>L: social, political; P: partnership; N: participative</b> ]		X	X	X		
	Promotion of <b>information and knowledge sharing</b> is present [ <b>P: knowledge sharing; N: will to learn</b> ]			X			
	Adoption of new crop varieties [ <b>O: adopt new technology</b> ]					X	
	Source of driver for the change process is endogenous and local, instead of exogenous and non-local [ <b>N: endogenous change</b> ]				X		

Context and scale	Indicators	Driver groups <sup>b</sup>				O <sup>1</sup>	Theoretical basis
		R	L	P	N		
Climate change mitigation – national	Presence and influence of transformational change coalitions (e.g. influence score, availability of resources, variety and number of members) [ <b>R: supportive coalitions</b> ]	X					Advocacy coalition framework (Babon <i>et al.</i> 2014)
	Merging of transformational change coalitions [ <b>L: political</b> ]		X				
	Policy learning among business-as-usual actors [ <b>N: will to learn</b> ]				X		
	More participatory decision-making [ <b>N: participative</b> ]				X		
	Processes to resolve policy inconsistencies [ <b>P: course corrections; N: will to correct</b> ]			X	X		
Climate change mitigation – national	Means to learn within and across projects/ programs [ <b>R: learning resources; N: will to learn, cross-learning</b> ]	X			X		Transition management (Boodoo <i>et al.</i> 2018)
	Interactions with actors across scales [ <b>P: stakeholder engagement; N: participative, multi-level</b> ]			X	X		
	Accounting for non-linearity, interactions and feedbacks [ <b>P: evaluation; N: embracing complexity</b> ]			X	X		
	Collaborative policymaking: deliberate engagement of actors involved [ <b>P: stakeholder engagement; N: collaborative</b> ]			X	X		
	Long-term planning [ <b>P: planning; N: long-term vision</b> ]			X	X		
	Integration of innovation and experimentation [ <b>P: evaluation; N: will to innovate and learn</b> ]			X	X		
	Climate change mitigation – national	Addressed underlying issues: financing and flexibility in project design [ <b>R: finance, flexibility; N: embracing uncertainty</b> ]	X			X	
	Willingness to learn and mechanisms for learning are present: feedback loops and self-contemplation based on long-term vision, experimentation, social learning and information gathered during implementation [ <b>R: learning mechanism, information; P: visioning exercise, learning forums; N: will to learn and innovate, embracing uncertainty</b> ]	X	X	X			
	Extent of carbon lock-in: emissions per tonne of cement produced between 2003 to 2010 vs. values worldwide [ <b>O: avoidance of lock-ins</b> ]				X		

Context and scale	Indicators	Driver groups <sup>b</sup>				O <sup>1</sup>	Theoretical basis
		R	L	P	N		
	Sensitivity of fertilizer supply to global prices of phosphorus [ <b>L: economic</b> ]		X				Transition management; economics of increasing returns (Jacobs <i>et al.</i> 2017).
	Persistence of environmental problems associated with phosphorus [ <b>L: social, economic</b> ]		X				
	Efficiency and retention of phosphorus in food production [ <b>L: food security</b> ]		X				
	Number of years until demand for high-grade mined phosphorous exceeds supply [ <b>O: resource sustainability</b> ]					X	
	Availability of technological or biological substitute for phosphorus [ <b>R: technology</b> ]	X					
	Risk aversion in management [ <b>N: embracing uncertainty</b> ]					X	
	Connectivity across policies [ <b>N: multi-sector</b> ]					X	
	Environmental health [ <b>O: environmental quality</b> ]					X	
	Whether there is a circular phosphorus economy [ <b>O: sustainability</b> ]					X	
	The rate of phosphate rock consumption [ <b>O: sustainability</b> ]					X	
Sustainable resource management – local	Level of degradation of the water catchment [ <b>L: society; O: sustainability</b> ]		L			X	Integrated water management / transition management (Bos <i>et al.</i> 2015)
	Level of integration across stakeholders [ <b>P: multi-stakeholder processes; N: participative, multi-sector</b> ]					X	
Sustainable resource management – multi-level	Changes in perspective and knowledge; [ <b>N: will to learn; O: change in perspective and knowledge</b> ]					X X	Collective learning (Brown and Harris 2014)
	Integration of different perspectives [ <b>P: multi-stakeholder processes; N: participation, respecting diversity</b> ]					X	
	Level of scientific evidence for the importance of soil health in rangeland management [ <b>R: information; L: scientific</b> ]	X	X				[Theoretical basis not mentioned] (Derner <i>et al.</i> 2018)
	Value of the study of soil health among students oriented towards production/ maximization [ <b>L: practitioners</b> ]		X				

<sup>1</sup> R = Resources; L = Legitimacy; P = Processes; N = Norms; O = Outcome indicators



**Food and Agriculture  
Organization of the  
United Nations**

**The Food and Agriculture Organization of the United Nations (FAO)** is a specialized agency of the UN that leads international efforts to defeat hunger. The goal of FAO is to achieve food security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives. With over 194 member states, FAO works in over 130 countries worldwide.



**RESEARCH  
PROGRAM ON  
Forests, Trees and  
Agroforestry**

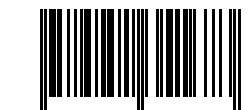
**The CGIAR Research Program on Forests, Trees and Agroforestry (FTA)** is the world's largest research for development program to enhance the role of forests, trees and agroforestry in sustainable development and food security and to address climate change. CIFOR leads FTA in partnership with Bioversity International, CATIE, CIRAD, ICRAF, INBAR and TBI.

FTA's research is supported by CGIAR Fund Donors: [cgiar.org/funders/](http://cgiar.org/funders/)



**Center for International Forestry Research (CIFOR)** advances human well-being, equity and environmental integrity by conducting innovative research, developing partners' capacity, and actively engaging in dialogue with all stakeholders to inform policies and practices that affect forests and people. CIFOR is a CGIAR Research Center, and leads the CGIAR Research Program on Forests, Trees and Agroforestry (FTA). Our headquarters are in Bogor, Indonesia, with offices in Nairobi, Kenya; Yaounde, Cameroon; Lima, Peru and Bonn, Germany.

ISBN 978-92-5-135167-3



9 789251 351673

CB7314EN/1/10.21