

## Social innovation for biodiversity: A literature review and research challenges

Prepublication version. A later version has been published as Ziegler, R., Balzac-Arroyo, J., Holsgens, R., Holzgreve, S., Lyon, F., Spangenberg, J.H., Thapa, P (2022) Social innovation for biodiversity: A literature review and research challenges, *Ecological Economics*, 193.

<https://doi.org/10.1016/j.ecolecon.2021.107336>

Rafael Ziegler (corresponding author), Department of Management, HEC Montreal, 3000 chemin de la Côte-Sainte-Catherine, Montreal, Canada, H3T 2A7. [rafael.ziegler@hec.ca](mailto:rafael.ziegler@hec.ca)

Josephine Balzac, Department of Social Entrepreneurship, Rollins College, 1000 Holt Avenue - 2781, Winter Park, FL 32789, USA

Rick Holsgens, Social Research Centre Dortmund, Faculty for Social Sciences, TU Dortmund University, Evinger Platz 17, 44339 Dortmund, Germany

Sarah Holzgreve, GETIDOS Social Ecology, IKEM – Institute for Climate Protection, Energy and Mobility, Domstr. 20a, 17489 Greifswald, Germany

Fergus Lyon, Centre for the Understanding of Sustainable Prosperity and Centre for Enterprise and Economic Development Research, Middlesex University, London & The Burroughs, Hendon, London NW4 4BT

Joachim H. Spangenberg, Sustainable Europe Research Institute Germany e.V., Vorsterstr. 97-99, 51103 Köln, Germany

Philipp P. Thapa, GETIDOS Social Ecology, IKEM – Institute for Climate Protection, Energy and Mobility, Domstr. 20a, 17489 Greifswald, Germany

*Abstract:* There are calls for social innovation to help with the effort to halt biodiversity loss. However, research on social innovation and biodiversity is dispersed and covers a multitude of disciplines. A systematic overview of research on social innovation and biodiversity is missing and this paper contributes by focusing on social innovation to tackle the drivers of biodiversity loss and unsustainability. The paper reviews research on social innovation in changing land use (agriculture, forestry, aquatic ecosystems and cities), in tackling exploitation of organisms (fishing, hunting, harvesting), and in addressing threats of climate change, pollution and invasive species. Across these drivers, we find a) a strong emphasis on social innovation as civic action for changing practices in addressing unsustainability, b) that social innovation research tends to focus on local experimentation although there are bodies of literature on policy-driven innovations and consumer/producer-driven innovations, and c) that there is very little research taking a critical perspective to explore negative or unintended consequences of social innovation. Drawing on the review, we propose three cross cutting issues that can be a focus for future

research, practice and supportive policy: social innovation for nature-based solutions, social innovation for participatory governance, and social innovation for technology that tackles biodiversity loss.

Key words: social innovation, biodiversity, sustainability, participation, transformation

## 1. Introduction

The ecological emergency facing the world has led to calls for social innovation (SI) to support transformations so as to find rapid solutions to the crisis (Leach et al. 2012, Olsson et al. 2017). In 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) published the first major global assessment of current knowledge on biodiversity risks and called for SI to support the necessary sustainability transformation. There are many definitions of SI (Edwards-Schachter and Wallace 2017). In this paper, we adopt a broad understanding of SI as new ideas meeting social needs with intentional change of social practices (Howaldt and Schwartz 2017) that are inherently part of political processes (Ayob et al, 2016).

Most research on SI has focussed on human flourishing without a systematic focus on nature and human-environment relations. This paper fills a gap in our understanding and contributes to the subject by showing how SI is needed to tackle biodiversity loss. This has required a systematic review of the literature dispersed over a range of disciplines.

SI for tackling biodiversity loss are shown to occur in a wide range of contexts beyond wildlife protected areas. By bringing the literature from diverse disciplines in a state-of-the-art review, we are able to show how SI can be found tackling biodiversity loss not just through novel social practices to tackle exploitation of organisms but also through more sustainable changes in land use and tackling climate change and pollution. The paper identifies emerging research trends and gaps in these areas. It also identifies cross cutting themes that demonstrate further avenues for research, policy and practice.

The research is guided by three central questions: 1) We adopt the IPBES driver framework, itself the result of a large peer-review effort to structure our research with a focus on major drivers of biodiversity loss (Díaz et al. 2019): *How is SI reported to be tackling drivers of biodiversity loss and unsustainability?* 2) Since there is no canonical definition of SI (van der Have and Rubalcaba 2016), we focus on how SI is conceptualized in research on SI and biodiversity: *How is social innovation conceptualized in this literature?* 3) Since the absence of a definition is due to controversies over SI and innovation as such (Godin and Vinck 2017, Ziegler 2017), we ask: *How is the concept of social innovation contested or questioned?*

Sections 2 and 3 introduce the IPBES Biodiversity framework and SI research respectively. Following the presentation of our method in section 4, we turn to results regarding our three questions in section 5. We propose three transversal themes for SI and biodiversity research for discussion in section 6 and make suggestions towards a research agenda for biodiversity and SI scholars in section 7.

For researchers on biodiversity and sustainability, the review provides the state of the art in SI research. For SI researchers, it identifies major links between this emerging research field and drivers of biodiversity loss and unsustainability.

## **2. Biodiversity, sustainability and two faces of innovation**

According to the 2019 IPBES report, “nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide” (Díaz et al. 2019, 10). Moreover, the “direct and indirect drivers of change have accelerated during the past 50 years” (ibid. 12). The biodiversity and ecosystem services supporting and securing the needs of current and future generations, especially marginalized populations, such as indigenous peoples around the world, continue to deteriorate. Therefore, the IPBES report calls for a transformation towards sustainability, and highlights the importance of biodiversity conservation for achieving sustainability and sustainable development goals.

The IPBES report identifies five direct drivers of biodiversity loss and unsustainability (ibid. 12ff): 1) Changes in the use of land and aquatic ecosystems, 2) the direct exploitation of organisms in agriculture and fisheries, 3) climate change, 4) pollution, and 5) invasive alien species. These direct drivers result in turn from underlying causes such as systems of production and consumption, population growth, and types of governance.

There are two faces of innovation in the IPBES report. First, innovation as technological innovation is portrayed as one of the underlying causes of continued and accelerated unsustainability and biodiversity loss (ibid. 12). Examples of technological innovation include large dams as well as fertilisers and pesticides for intensive agriculture.

Second, there is the positive face of innovation as a “key leverage point” of “transformation towards sustainability”, more specifically “ensuring environmentally friendly technological and social innovation” (ibid. 17). While the IPBES report introduces SI explicitly as a solution, it offers no definition. In addition, SI is implicitly advanced as a solution in the context of a family of approaches, notably social learning and adaptive governance.<sup>1</sup> The report suggests some ways in which (social) innovation could become part of the solutions:

- Recognizing the innovations of indigenous peoples and local communities (ibid. 18)
- Recognizing locally developed innovation and experimentation (ibid. 43)
- Changes in production and consumption, especially among the affluent (ibid. 41)
- Piloting and testing policy innovations (ibid. 44).

Thus, innovation as part of the solution for a sustainability transformation points both to bottom-up options and to more top-down, macro-changes in production and consumption policy. However, research on SI and biodiversity loss is dispersed with gaps identified

---

<sup>1</sup> See <https://ipbes.net/policy-tools-methodologies>, accessed 17.12.2020.

through this systematic review. Furthermore, both the practice of SI and associated research has focussed on SI as a source of positive change without attention to potential negative effects it might have on biodiversity and sustainability.

### 3. Social Innovation Research

The positive face of SI in the IPBES report is in line with the current use of SI as a buzzword of policy discourse, and a perception of SI as a welcome and fresh approach for dealing with systemic crises of our time (Jenson and Harrison 2013). This normative understanding of SI is expected in the context of research related to sustainable development, which is itself a normative concept focused on development “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987).

A review of SI points to a long running thread since the 1970s linking SI to “unmet social needs [...] narratives about our survival (the current ‘grand challenges’) and the construction of a more sustainable world” (Edwards-Schachter and Wallace 2017, 73). The term itself was already used in the 19<sup>th</sup> century, but in contrast to the current, appreciative use, public debates tended to identify social innovators negatively as socialists: utopian schemers with societal visions and little consideration for their (disruptive) political consequences (Godin 2012). The contrast between the use of SI then and now points to contested uses of SI and suggests some caution regarding the alleged novelty of SI. It also points to a historical reservoir of thinking about SI that can inform current uses of the term.

In line with this historical perspective, the more recent SI scholarship emphasizes contestation and controversy (Ziegler 2017). Rather, than expecting “one definition”, we ought to pay attention to the different uses of SI. Ayob et al. (2017) identify two current streams of SI research. The first has a focus on outcomes and social value production, for example in terms of improvements to the quality and quantity of life. The second focuses on structural changes in power relations that emphasize new social processes and relations aiming at inequality reduction and human flourishing. Their analysis also suggests that there is less contestation between the two streams in the second decade of the new millennium as both the outcome and process dimensions tend to be accepted as common elements of SI definitions together. For example, a European Union report defines SI as: “Innovations that are social in both their ends and their means. Specifically, we define social innovations as new ideas (products, services and models) that simultaneously meet social needs (more effectively than alternatives) and create new social relationships or collaborations” (BEPA 2010).

The emphasis on new relationships and collaborations highlights a further element of relevance for this paper: moving beyond a focus on technological novelty for commercial use, SI involves a variety of actors from civil society, communities, public sector and private sector working together (Vickers et al 2017, Ziegler 2017, Anheier et al. 2018). A diversity of actors is also apparent in SI-research, which is not a scientific discipline, but

rather evolves via the contributions of various scholarly communities (van der Have and Rubalcaba 2016).

In this paper, we adopt a focus on SI as intentional change of social practices (Howaldt and Schwarz 2017). Such an approach overcomes the still prevailing focus on innovation as technological novelty for commercial use. SI is found in all aspects of societal change, i.e. in communities, civil society, business, and public administrations, as well as collaborations across these sectors (Lyon 2012, Nicholls and Ziegler 2019). We examine SI research in each of these modes or sectors as well as across them. We focus on SI as intentional change of social practices with relevance for biodiversity and sustainability. We define relevance as tackling or re-enforcing the five major direct drivers of biodiversity loss as well as their underlying causes.

Our approach conceptualizes SI as good for biodiversity and sustainability, but also with potential for negative consequences (Ziegler 2020). We question pro-innovation bias, which holds that more and faster innovation is always good (Rogers 1983). As the other face of innovation in the IPBES report reveals, some innovation might have to be slowed down, avoided altogether or eliminated again. This can be initiated by public policy, or by the choice of an organization divesting itself of an innovation in which it had previously invested as a process of *exnovation* (Heyen et al. 2017).

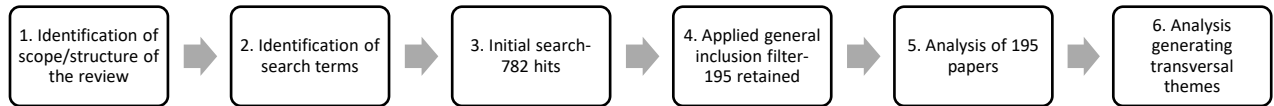
In conclusion of these introductory sections, we thus propose the following research questions to fill the research gap identified: 1) *How is SI reported to be tackling drivers of biodiversity loss and unsustainability?* Questions that drive our exploration of the IPBES driver framework: are there patterns in the way SI tackles direct drivers? Are there patterns in which the respective SI solution is linked to indirect causes? Are all drivers equally considered in the literature? Are there knowledge gaps? Since the IPBES report does not define SI but advances it as a solution in the context of a family of approaches for transformation, we ask: 2) *How is SI conceptualized in this literature?* Finally, taking a lesson from the history of SI and critical innovation studies, we are interested in problematic and contested aspects of SI: 3) *How is SI contested or questioned?* This question includes attention to negative and unintended consequences of innovation.

#### 4. Method

Since we hold the topic to be significant but could not find prior research on this important and complex topic, we opted for a systematic, explicit and replicable review (Fink 1998) of peer-reviewed publications. Systematic reviews seek to minimize biases that might result from the specific interests and disciplinary foci of scholars (Tranfield et al. 2003). The categories of a review can be used deductively with categories selected prior to the analysis, they can be derived inductively via generalisation from the material, or both approaches can be combined (Mayring 2014). We chose the combination. Since the IPBES assessment already provides a framework of drivers of biodiversity loss, we built on the peer-reviewed body of knowledge for a deductive analysis of SI and biodiversity. Based

on this, we proceeded inductively, generating three transversal themes for discussion on SI and biodiversity. We now explain this mixed approach in more detail.

Figure 1. Flow chart of the literature review methodology



In the first phase of identification of the scope of the review, we drew on the IPBES report to identify the central categories of our review. This established the focus on direct drivers as well as solution types. This deductive, realist aspect of our review explores drivers of unsustainability as causal mechanisms (Rousseau et al. 2008) and then reviews literature on SI that is tackling each mechanism. We subdivided the first two IPBES drivers into further subcategories to facilitate the analysis, and following the terminology used in the IPBES report. General systematic reviews of SI (Edwards-Schachter and Wallace 2017, Have and Rubalcaba 2017, Ayob et al. 2017) as well as SI-research on socio-economic dynamics (Nicholls and Ziegler 2019) showed the need to take a comprehensive, long-view of SI contestations across sectors (market, community, public administration/politics, or collaborative/hybrid). The scope of the study also included the valence of SI positive or negative effects and a symmetrical focus on both innovation and exnovation (discontinuation of innovation).

The second phase involved identifying search terms for the research on peer-reviewed literature on drivers and SI and, in the third phase, these were applied to all articles published from 1945 (beginning of the Web of Science record) until March 2020 in the Web of Science (Social Science Citation Index). We conducted Boolean searches for “social innov\*” AND the respective driver topics (see Table 1). For example, to find articles addressing invasive species and SI, we searched for combinations of “social innov\*” and “invasive species”. When this failed to return relevant results, we widened the search to include synonyms and likely co-occurring terms from the semantic field of “invasive species”, such as “alien species”, “endemic” or “extinc\*” (search expression: *ALL=("social innov\*") AND (ALL=("invasive species") OR ALL=("alien species") OR ALL=("non-native species") OR (ALL=(invasion) AND ALL=(species)) OR ALL=(endemic) OR ALL=(extinc\*))*). Our searches used all fields of the Web of Science core collection. We ran the search for drivers and both innovation and exnovation, and we also added a general search on biodiversity and SI to ensure key references were not missed. In total, we found 782 individual articles. Of these, 128 articles appeared more than once across drivers, indicating the comprehensiveness of the review.

In a fourth phase, at least two co-authors reviewed materials obtained for each driver. They applied a general inclusion filter: 1) Does the article address the respective driver? 2) Is SI a central topic of the work? The latter required as a minimum a mentioning in the title,

abstract or keywords (whereas a mere mentioning of the word in the text or as a source of funding was judged insufficient). This reduced the number of retained articles to 195.

Table 1 Overview number of articles

<b><i>IPBES Direct Drivers</i></b>	<b><i>Subcategories (where applicable)</i></b>	<b><i>Overall No. Articles</i></b>	<b><i>Articles retained</i></b>
<i>1. Change in Land Use</i>	<i>Agriculture</i>	67	38
	<i>Cities</i>	471	80
	<i>Forestry</i>	75	26
	<i>Aquatic Ecosystems</i>	55	8
<i>2. Exploitation of Organisms</i>	<i>Fishery</i>	20	6
	<i>Hunting &amp; Harvesting</i>	40	2
<i>3. Climate Change</i>		100	45
<i>4. Pollution</i>		33	10
<i>5. Invasive Species</i>		0	
<b><i>Complementary search</i></b>			
<i>6. Biodiversity</i>		24	5
<i>7. Exnovation</i>		31	4
	<i>Total</i>	782	195

The papers are scattered across a very large range of journals with only five having more than three papers selected in this review (Sustainability, Forest Policy and Economics, Agriculture and Human Values, Ecology and Society and Design Journal). There has been a significant growth in publications and citations since 2005, especially for agriculture, climate and cities. Appendix 1 provides further information as well as a list of all articles collected, retained and selected for in-depth reading.

In the fifth phase at least 2 of the co-authors read and analysed the papers using a template developed in phase one to respond to the research questions and also including space for free note taking. Results of this work are presented in section 5.

The sixth stage of analysis added an inductive element for generating themes from the literature. We introduced a feedback loop for revisiting thematic categories and dimensions based on the analysis of the material (Mayring 2014). The discussion of reports and rereading of papers generated three transversal relations of SI and biodiversity: technology, nature-based solutions and governance. We discuss these in section 6.

There are several limitations and caveats to this systematic review and the danger of mistaking the map for the territory (Gond et al. 2020). 1) Language: Our database has a bias towards scholarly work published in English (strongly in evidence in our review with only some results in French, Spanish and German – due to our diverse author team we could read these contributions). 2) Peer-review: Our review covers peer-reviewed publications as a standard of quality. In a practice-oriented field such as SI there is a large grey literature, with insightful contributions from foundations, policy makers and civil society. 3) Indirect drivers: This review focuses on the direct drivers of biodiversity loss. Further research could focus on the even larger topic of indirect drivers, and we make suggestions in this direction in our discussion section. 4) The review only includes literature explicitly using SI terminology. This excludes other literature on sustainability transformations. We return to this point in section 7.

## 5. Results

### 5.1. SI tackling drivers of biodiversity loss

This subsection addresses the research question 1) *How is social innovation reported to be tackling drivers of biodiversity loss and unsustainability?* We discuss each driver in turn (overview see Table 1).

#### 5.1.1. Agriculture

“Agricultural expansion is the most widespread form of land-use change, with over one third of the terrestrial land surface being used for cropping or animal husbandry” (Díaz et al 2019, 12). The literature on SI in this category mainly referred to reducing impacts of agriculture via ecological informed “working with nature” and less intensive approaches in rural areas. Examples are agro-ecological approaches (Prasad 2016, Garcia-Llorente 2019, Lopez-Garcia 2019) and varieties of community-supported agriculture where groups of consumers and producers come together for food production and other community activities for wellbeing (Blaettel-Mink 2017, Diekmann et al. 2019). These aim to change values of production and consumption and a shift to sustainable practices as proposed by the agro-food movements for organic/regenerative agriculture, food sovereignty and slow food (El Bilali 2018). This approach is linked to the goal of changing consumption patterns thereby reducing the pressure from food production on biodiversity.

Complementing the search for rural, alternative agricultures is a focus on urban (guerrilla) gardening and the participatory design and management of urban agriculture and communal gardens (Nemoto et al. 2017, Krikser et al. 2016, Spijker et al. 2018; Tornaghi 2015). Of importance for SI both urban and rural is the role of networks that facilitate learning and validate practices.



In contrast to the large body of literature on organic and community supported agriculture, there is also a sizeable body of literature exploring SI in terms of ‘sustainable intensification’ via technological innovation: sufficient food, grown at affordable price, leaving space for nature conservation areas and rewilding. In this spirit, the introduction of genetically modified crops and precision farming are discussed as bioeconomy innovations (Sasson et al. 2018), with SI a somewhat unspecified complement for the regional and participatory development of the bioeconomy (but see Moraine et al. 2014).

### *5.1.2. Cities and urbanisation*

The growth of cities and a “doubling of urban areas since 1992” is a major driver of unsustainability (Díaz et al. 2019, 12). While our research did not identify articles directly on urban expansion and urban sprawl, SI in cities is one of the most active areas of SI research. A focus on multi-actor governance and collaboration prevails, often with a focus on citizen and grassroots initiative inclusion, with both bottom-up, top-down processes and their combination (Wolfram 2018). Research consists mostly of case studies from Europe, and especially from Spain, Netherlands and UK. However, articles with a focus on China, Unites States, Korea and Japan underscore that SI research is a global phenomenon.

A substantial part of the research is on smart cities (102 articles or over 20% of the initial sample within the cities cluster). While the term “smart city” is used in different ways, a focus on ICT and their role in urban development is at the heart of the discussion. A recurring idea is that urban infrastructures for communication but also transportation, water provision, recreation etc – can be rendered more efficient and participatory with the help of digital technology, for example allowing citizens to be informed about pollution levels, measuring pollution, reporting problems etc. (Angelidou et al. 2017).

Throughout these themes, much research focuses on participation. Intermediaries, such as living labs, urban labs, hubs, or transition town movement alliances play an important role for the facilitation of participation. Much of the focus is on local adaption rather than on large-scale transformation, e.g., participatory improvement of digitization, coping with climate and capitalism, or contributing and achieving local sustainable development agendas. However, there is also a stream of critical urbanists who view local niches as expression of discontent with capitalism and top-down planning, and as potential alternatives or real utopias (Houston et al. 2018, Schaefer et al. 2018). This in turn invites an openness for “dissensus politics” and a more political SI stance (Kaika 2017).

### *5.1.3. Forestry*

The research points to three important topics of SI research in relation to forestry, and especially forest-dependent communities in rural areas (Nijnik et al. 2019). Firstly, SI is found in examples of woodland social enterprise. Examples of these include social mission-oriented enterprises, with democratic governance and a constraint on profit distribution that own or manage forested areas with income from sustainable timber harvesting, tourism and therapeutic services (Lawrence et al, 2020). Secondly, there is research on SI with a focus

on governance (Nijnik et al. 2019), especially the voluntary engagement of civil society in communal enterprise, but also in emergencies such as managing forest wildfires (Gorriz-Mifsud et al. 2019). Thirdly, research examines the innovation ecosystem and in particular the role of investment. Gnych et al. (2020) note that different actors come in at different stages of a SI with government and international donors important at early, risky stages, and private donors as SIs are scaled up. Trust and a perception of equal partnership facilitate collaborations between communities and investors (Gnych et al. 2020).

Forestry is also the only cluster that included explicit research on the inclusion of indigenous communities (Gnych et al. 2020, Sarmiento et al. 2017). Indigenous peoples play an important role for the protection of biodiversity, and the formal and information management of common property resources is a critical issue. However, even in examples granting them full communal property rights and income flow from carbon accounting, research suggests that there remain significant tensions so as to achieve cultural, social and economic rights (van Kooten et al. 2019). While values play an important role for catalysing indigenous and other local management, the SI focus on marginalized groups suggests that this is only constructive “if/when basic material needs, and ‘instrumental’ values of forest-dependent people are satisfied” (Sarkki et al. 2019, 210).

#### *5.1.4. Aquatic ecosystems and infrastructure*

Species worldwide are most at risk in aquatic ecosystems, where infrastructure expansion is also a critical driver of unsustainability, such as hydropower dams in rivers and coastal development for oceans. On the one hand, there is a focus on SI as a factor for mitigating the negative social and environmental effects of human expansion (such as hydropower dams, see Nordensvard et al. 2015). SI here complements and refines multi-functional engineering systems (Jordan et al. 2018). On the other hand, there are place-based (Baker et al. 2015), communal approaches that seek to restore or develop alternative, ecosystem-based approaches to the use of water and watersheds. These may result in direct confrontation with technological innovation, such as anti-dam construction and dam-decommissioning campaigns (Ziegler 2019). The European Rivers Network seeks to change the relation of citizens to their rivers via an annual European “Big Jump” day that invites citizens to reconnect with their rivers by swimming in them together (ibid.). Civil society networks play an important role for social learning and validation of alternative land and water uses. Local traditions are invoked to contest hegemonic notions of economy driving infrastructure development. An example is the Scandinavian tradition of “everyone’s right (and responsibility) to enjoy lakes and forests” (Ahen 2019, 10).

These two ways of thinking about SI and aquatic freshwater systems yield two different perspectives on transformation. From an ecological modernization perspective, SI contributes to changes within the existing system, such as improved corporate social responsibility potentially yielding less social and environmental negative impacts in hydropower construction (Nordensvard et al. 2015). From a place-based perspective, transformation rather calls for recognition of communal values and traditions along with creative ways of adapting them to the present. “Adaptation” accordingly becomes a central,

even if ambivalent concept. SI is said to increase adaptive processes and improve social and ecological resilience due to a capacity to respond to external shocks and to include vulnerable groups (Biggs et al. 2010).

#### *5.1.5. Exploitation of organisms and fisheries*

Our research did not yield results specifically related to hunting and harvesting on land although these issues are touched on in SI research related to forestry and agriculture. However, there was a small selection of articles on fisheries with a focus on markets and value chains. There is literature on livelihoods, work quality and well-being and other actors operating in local and global fisheries production chains (Mendez-Medina et al. 2015, van Holt et al 2016, Mazigo 2017, Pineiro-Antelo 2019). It is unclear if SI in this context will contribute to a transformation of unsustainability, or if it will further advance the exploitation of organisms (Soma et al 2019).

Local SI can face challenges of balancing social and ecological objectives especially where fishery-dependent livelihoods structurally re-enforce overfishing (Cole et al. 2018). SI research suggests a need to focus on the whole production chain and the changes elsewhere within it, such as improved processing to reduce food loss or responsible consumption. Such an expanded focus can point to escape routes from a socio-ecological trap (Cole et al. 2018). In a related manner for the global sea-food industry, research suggests that production chain system-mapping can help address persistent socio-ecological problems in small to large-scale fishery systems (van Holt et al. 2016).

#### *5.1.6. Climate change*

Climate change is a major driver of unsustainability as well as affecting changes in land use. IPCC scenarios mobilize SI to lower energy demand so as to achieve the 1.5°C global warming limit (IPCC 2018). At a local/micro scale social enterprise play a role in encouraging SI for reducing emissions and energy transitions (Hillman et al. 2018; Hoppe et al. 2019). Articles on SI and climate change also focus on global and national climate governance, and especially the role of civil society in relation to this (Tosun et al. 2017). An example is REScoop.eu, the European federation of renewable energy cooperatives. Much of the research focus is at the level of (mostly European) cities, with research on SI in relation to topics such as housing and nature-based solutions for zero-carbon goals (Schäfer et al 2018, Frantzeskaki 2019, Nerini et al. 2019).

Much research on SI and climate change is on adaptation and coping with climate change. It includes transformative adaptation, which seeks to draw on adaptive capacity of communities for the “reconfiguration of local economies. . . when transformation of some ecosystems under climate change is inevitable, pro-active management and governance can facilitate the creation of new benefits for people” (Lavorel et al. 2019, 88). The focus on adaptation complements a focus on global climate and sustainability goals and transformation as the process of actually reaching them. This includes a focus on intentional communities that “foster everyday low-carbon practices and discourage carbon-intensive ones” (Schäfer et al. 2018)

### 5.1.7. Pollution

SI research in this field addresses air and climate pollution (Jerneck et al. 2013, Lambe et al 2019), and water pollution via fertilizers and pesticides from agriculture (Ziegler 2019). There were no journal papers on SI related to marine plastic pollution found using our search criteria. A positive focus on SI prevails throughout, mainly as a kind of complement to technological innovation.

SI can change how problems are framed. Jerneck et al. (2013) were looking for ways to reduce indoor smoke pollution from cooking stoves in Africa. Rather than focussing on technical improvements, they realised that “technology is embedded in socio-ecological relations and exists in the gendered micro-processes of everyday lives” (ibid.). They initiated a co-production project with cooking stoves users in a community-based effort to tackle indoor smoke. At its core was symbolically reconfiguring the kitchen from a cooking area (a mainly feminine space) into an experimental arena for smoke-free cooking on improved stoves with flue pipes as a gender-neutral space.

A frequent supply-side, technological starting point, also echoing the “smart” city topic above, might explain a focus on citizen science in this cluster: SI is identified with citizens gathering data on pollution issues and (usually) delivering the information to the authorities. However, there was no discussion of the corresponding SI among decision-makers regarding how such data were used to improve decisions, nor discussions of changing practices of the citizen science participants.

### 5.1.8. Invasive Species

While the IPBES report identifies invasive species as a key driver of biodiversity loss, our search for the combination of the terms “social innov\*” and “invasive species” did not yield any publications that make an explicit link between the two topics. This result remained unchanged for synonyms and likely co-occurring terms (as reported in section 4). Within the limits of our systematic literature review method, we are therefore forced to report a blank.

## 5.2 Conceptualising SI

Our second research question explores the conceptualisation of SI by asking: *How is SI conceptualized in this literature?* A large number of articles were not retained for further analysis (see Table 1). One reason for this is the frequent use of SI as a mere buzzword but without any analytical use. For articles retained, our review explores the extent to which they are focussed on markets, government or civil society (see Table 2). While it is hard to attribute a sector in some cases, the overall trend is evident: the collaborative modes combining at least two of these sectors clearly prevails, with the remaining literature divided equally between market approaches to SI, community/civil society approaches and government/policy approaches.

Table 2 SI activity in and across modes

Modes*	Agri-culture	Cities	Forestry	Acquatic Ecosyst.	Fishery	Hunt & Harvest	Climate	Pollution	Biodi-versity	Total
Market	14	9	4	3	3	2	9	4	0	34
Community	7	17	2	1	0	0	7	3	0	30
Public	0	12	1	1	0	0	13	0	0	27
Collaboration across modes	17	33	17	3	3	0	16	3	5	80

*\*for some articles, no attribution was possible; some articles might deal with more than one mode in parallel.*

Research tends to conceptualize SI as a meso-level phenomenon focused on specific regions and places (especially cities), with some macro links in relation to the societal trends that SI is said to address and micro-links to specific actors and networks. These micro-links are especially important for the involvement of citizens as informants, users, and participants of grassroots SI. Seyfang and Smith (2007:585) conceptualise grassroots SI as “[N]etworks of activists and organizations generating novel bottom-up solutions for sustainable development....grassroots initiatives operate in civil society and involve committed activists experimenting with SIs as well as using greener technologies”.

“Bottom-up solutions” tend to be small initiatives, with an emphasis on the empowerment of communities or specific workers, for example fishermen (Mazigo 2017). Willingness to participate is shown to be shaped by the extent to which citizens feel that they are “heard”, and that their participation counts (Tosun et al. 2017).

The IPBES report conceptualises SI as providing different solutions for tackling unsustainability through local experimentation, producer/consumer driven solutions, policy driven innovations and recognition of indigenous solutions. Our review shows that local experimentation is the most frequently researched (see Table 3), though one that includes exchange and learning via networks. This is followed by a roughly equal focus on producer/consumer-driven solutions and policy-driven innovation. The review suggested that SI, with its frequent basis in affluent cities around the world, addresses underlying causes of these drivers, in particular hegemonic ideas of production and consumption. SI is shown to play a role in critiquing unsustainable consumption and exploring alternatives. However, there was a gap regarding research recognizing and respecting indigenous people and their communities.

Table 3: IPBES identified solutions found in the literature review

Solutions*	Agri-culture	Cities	Forestry	Acquatic Ecosyst.	Fishery	Hunt & Harvest	Climate	Pollution	Biodi-versity	Total
Local experimentation	17	47	13	4	3	0	15	3	2	87
Producer/consumer	17	14	6	1	1	2	8	5	0	37
Policy Innovation	7	12	6	3	2	0	11	2	3	39
Recognition of indigenous solutions	0	0	2	0	0	0	0	0	0	2

*\*In each article more than one solution approach might be important*

### 5.3 Contesting SI

For our third research question, *how is the concept of SI contested or questioned?* we explored whether SI is presented as a positive, neutral or negative activity. While all innovation can have both positive and negative impacts, we found that the research on SI for tackling biodiversity loss is overwhelmingly focussed on positive impacts (90% of papers).

Critical research identifying challenges and trade-offs between different sustainability objectives were marginal. This is despite a wider set of literature on the issue of trade-offs and conflicts, where one objective (such as wildlife conservation) is presented as a priority over other objectives such as indigenous hunting rights.

In many articles, SI is just a buzzword without delivering change, perhaps more a result of research proposals paying lip service to the language of funding calls. Elsewhere there is evidence of biodiversity and sustainability research using the term to elaborate an issue but with no particular interest in the SI discourse as such. Many papers use SI to lend a positive air to something but neither define SI nor put it to analytical use. While terminological vagueness can be valuable in helping various actors find common ground, even a deliberately vague term requires a minimum of substance to be of practical use (Ziegler 2017). Papers that use SI without substance add little to our understanding of SI in the transformation to sustainability and can be labelled the “included irrelevant” in our literature search. Conversely, there is the “excluded relevant” literature: research streams that deal with SI in all but name and deserve the attention of SI for biodiversity and sustainability research. We return to the latter in section 7.

We further explored a more critical take via a search on exnovation, here understood as the active discontinuation and termination of policies, products and practices. We found this to be marginal and understudied in SI research (Heyen 2019, Ziegler 2020, see also Table 1).

We also explored contestation at a macro-level via a focus on transformation. The IPBES 2019 assessment underlines the urgent need for a transformation in direction of sustainability. However, we found that much of the SI-research uses the word “transformation” to relate to other changes such as industrialization, urbanisation, or the neoliberalisation of nature. Rather than taking a more critical role, SI is reported to be operating to meet short term social needs but within these unsustainable trajectories.

More specifically, we found three ways in which the term SI was being used in relation to “transformation”. Firstly there is a strand of SI research that focuses on structural alternatives with more radical change to systems of production and consumption. Such alternatives struggle to reach out to wider societal groups and stakeholders (Seyfang et al. 2012). Secondly “transformation” can be interpreted as transitions towards sustainability while accepting and reconfiguring rather than substituting existing sociotechnical structures (Hodson et al. 2017, Wolfram 2017). This can be found in the development paths of specific industries as they seek a zero-carbon transition (Nerini 2019). Thirdly, there is transformative adaption (Lavorel et al. 2019) with medium and long-term social-ecological

adaption options also operating within the constraints of existing systems. For example, communities in a changing alpine ecosystem identify adaptation options; interestingly such identification can resurface more traditional practices that were marginalized (ibid.). These latter two interpretations of transformation help explain a perception of SI as a neo-liberal phenomenon that does not challenge the status quo and is open to neo-liberal capture (Rivaud et al. 2018, Kaika 2017).

## 6. Discussion

The last stage of the review was dedicated to inductive analysis of the SI and biodiversity literature. The analysis generated three transversal core themes in research on SI that is tackling biodiversity loss: SI for nature-based solutions, SI for technology and SI for participatory governance. We propose that their consideration provides better understanding of how SI can contribute to biodiversity conservation and sustainability. For each of these core elements, we present analysis based on the three research questions: *How is SI reported to be tackling drivers of biodiversity loss and unsustainability? How is social innovation conceptualized in this literature? How is the concept of social innovation contested or questioned?*

Table 4 Three transversal themes of SI and biodiversity research

	<b>How tackling drivers of biodiversity loss</b>	<b>How SI is conceptualised</b>	<b>How SI is contested and questioned</b>
SI for NBS	Actions to protect and restore ecosystems while addressing societal challenges.	Grassroots and top down approaches. Biodiversity value in terms of human wellbeing.	Focus on payment for ecosystem services or intrinsic value of nature. Questions of who is accessing and benefiting. Short-term or long-term time horizons.
SI for Technology	Radical alternatives such agro-ecology Reducing negative impacts of technology. Allows technology to have greater impacts.	SI to complement existing technology or as a radical counterforce. Grassroots experimentation or scaling up society-wide change	Questions of sustaining radical change or capture by existing structures/greenwash.
SI for participatory governance	Governance of protected areas. New roles for individuals and groups in decision making and benefits	Community level work. Networks of individuals, civil society organisations and public sector	Power and participation. Who is included and who is excluded?

### *6.1. SI and nature-based solutions*

Nature-based solutions (NBS) are defined as actions to protect, manage and restore natural ecosystems, while addressing societal challenges (e.g., climate change, food and water security, human well-being) (Cohen-Sahcham 2016). The focus on natural or modified ecosystems opens a rich field, in particular for grassroots innovations at the centre of so much SI research. This can occur in protected areas, through rewilding and through encouraging biodiversity alongside other land uses.

In modern cities, there is an emergence of third natures (Sassen et al. 2011). Neither pristine nature, nor the pure resource to be conquered. Rather, the focus is on the rediscovery, promotion and even acceleration of approaches that draw on the multiple benefits provided by nature as ecosystems and its multi-species urban entanglements (Houston et al. 2015).

In terms of how SI for NBS is conceptualised, there has been a focus in the literature on micro and meso scale activities for grassroots SI. At the level of citizens, such approaches speak to the search for improved quality of life of dissatisfied citizens (Nemoto et al. 2017), including aesthetic value (Frantzeskaki 2019) and an experience of self-efficacy and validation via participation in urban or rural experiments (Spijker et al. 2018). At the group level, they point to the (re)transformation and (re)appropriation of public spaces via stewardship and place keeping (ibid.). SI research is also exploring the management and governance of NBS engaging communities in decisions about where such nature-based solutions are promoted, and who has a say in them (Frantzeskaki 2019, Sarkki et al. 2019). SI for NBS also occurs at a macro scale with innovation in policies driving changes in land use. However, this has not been covered by the existing research analysed in the review.

SI for NBS also face numerous challenges although there has been very little research questioning or contesting the positive and negative impacts of SI. There is a risk that the focus on NBS results in a prioritisation of biodiversity activities to support human needs and where there can be a payment for ecosystem services. Furthermore, it might not be high-level biodiversity and justice values that drive initiatives but rather convenience and material need (Sarkki et al 2019). Beyond the charm of the new initiative, there is a need to explore how SI shapes *sustained* place-keeping and a long-term responsible governance of places (Radywyl et al. 2013). Questions remain concerning who the SI benefits with lack of research on equality, diversity and inclusion issues. The relative absence of research on indigenous community SI suggests a need to pay attention to the protection and sustaining of places and traditions against one dimensional modernist transformation (Ahen 2019, Prasad 2016, Rivaud et al. 2018).

### *6.2. SI and technology*

While technology is a driver for unsustainability and biodiversity loss, it can also be a part of the solution. There are at least two different SI-technology relations in the literature, each facing their own challenges for sustainability. Firstly SI for technology can be found in some radical alternatives, for example acro-ecology (Prasad 2016), regenerative or organic agriculture (Cumming et al 2020). Secondly SI for technology also tackles



biodiversity loss through playing a complementary role alongside existing technology, or supporting clean tech that reduces pollution.

SI can be conceptualised as local experimentation and grassroots activity when the technology being used is locally adapted along the lines of agro-ecological principles. There is an important role of governance and of government to generate long term support for the development and fostering of the respective niche (Prasad 2016, Gordon et al. 2017). Research also shows a role for network building, expectation management and social learning to support radical transitions (Seyfang et al. 2012).

Where SI is conceptualised as a complement to technical innovation and as something co-evolving in sustainability transitions (Schäfer et al. 2018, Hoppe 2019), it can be operating at the meso and macro scale, making large scale changes. Taking an ecological modernization perspective, SI can help change how problems are framed and allowing a technological solution to have a greater impact. This is the view taken by the Joint Workshop of IPBES and IPCC (Pörtner et al. 2021).

There has been limited research exploring how SI for technology is contested and questioned (Bolz et al. 2019). Our review suggests that there is a danger of technical change dominating the process with SI simply responding and mitigating impact on biodiversity (for example dam constructions). Where there are more radical alternatives, there is a risk that existing structures capture such niches.

### *6.3. SI and participatory governance*

A large body of SI research explores collaborative processes as ways to tackle drivers of biodiversity loss, and in particular the role of citizens in those processes (Moore et al 2014). Spijker et al (2018) speak of a “bottom-linked governance that is centred on the reconfiguration of relations between authorities at the top and grassroots individuals and groups at the bottom.” This requires innovation in governance. There is literature on SI in relation to the governance of protected areas (Martini et al. 2017, Rivaud et al. 2018) as a cross-cutting topic of relevance for tackling agricultural and urban expansion, forestry clear-cutting etc. Against the background of the marketization of nature and the expansion of industrial agriculture, these articles point to a positively connoted research on SI as improved participatory governance of nature-protection areas that better considers alternative interests in the design and development of such areas, or even conceives of them as a space for alternative pathways of sustainable development (Rivaud et al. 2018).

The conceptualisation of SI in participatory governance is focused on new ways of organising with networks of individuals, civil society organisations, business and the public sector. Angelidou et al. (2017) explore the different social roles of citizens in such processes. They identify the citizen sensor, the sharing citizen, the collaborative citizen, and the entrepreneurial citizen. Frantzeskaki et al. (2016) identify roles of civil society organisations and networks as pioneers, as filling the void, and as disconnected innovators.

We suggest that the identification of such roles of individuals and groups is important for encouraging participation in governance (Tosun et al. 2017; Biggs et al 2017), and for public policy to support local experimentation (Gordon et al. 2017) for biodiversity and sustainability.

Critical perspectives of participatory governance are needed in order to understand how SI is contested. While much SI research explores consensus, Kaika (2017) calls for a focus on dissensus as real SI, and Wolfram (2018) defines SI in terms of social struggle. There is a need for research on who is really included in such processes, and who is marginalized by collaboration.

## **7. Towards a Research Agenda**

This systematic review on SI-research for tackling biodiversity loss has identified several gaps in knowledge in relation to nature-based solutions, technology, as well as participatory governance. Building on the review we identify areas for further research at societal, community, organisational and individual levels. At each level there is a need for research to examine local and regional, culturally specific difference. Beyond the realm of explicit SI research in focus here, this also requires interdisciplinary approaches recognising the large number of related research fields, analysing the emergence, effects, dissemination, conditions and impacts of SI.

- 1) At the level of societal change theories, our review pointed to transition theory for thinking about biodiversity and sustainability transformation more generally, even if much of this technology-inspired research tradition does not use SI explicitly. Recently, transition research has moved from a discussion of specific transitions to deep transition across sectors (Schot et al. 2018). This system shift is important, where existing institutions are biased against rapid transition, are not able to look beyond market-based innovation (Hausknost and Haas 2019), and overlook the source of innovation in communities and civil society as well as associated ways of thinking beyond the “marketable” (von Hippel 2016, Ziegler 2020). The IPBES report problematized the dedication to high consumption, economic growth at any cost and global free trade. Our review highlighted a need for more critical innovation research (Godin and Vinck 2017) and an improved focus on exnovating, decommissioning, discontinuation, removal and termination across sectors (Heyen 2019, Ziegler 2020) for sustainability transformation and sustainable economy.
- 2) At the level of communities, common pool research provides an important theory perspective to study and validate initiatives that defend, creatively, their tradition and practices, adapting “old” commons to new realities or creating new commons (Gnych 2019). Indigenous communities and the solutions they propose can be central to tackling biodiversity loss in many contexts. This is especially important in those contexts where there has been an abuse of their rights and discrimination in the name of conservation.

- 3) At the level of organisations, research on change management is needed to offer insights into coalition building, campaign formation, and collaborative policymaking so that sustainability solutions do not stay in the niche (Kristof 2010). The review suggests that the link between change management and participatory methods for improved civic inclusion is particularly important. SI for biodiversity can be driven by business participation but there is a need for research to explore whether this is part of transformational change or whether short term profit motives are using innovation as a form of greenwash. There is also lack of research on temporality and the role of short term and long-term thinking in all types of organisation.
- 4) At the level of individual change, research in social practice theory and social psychology on individual motivation and self-efficacy provides important insights into educational, motivational and normative determinants for participation in collective action for biodiversity (Tosun et al 2017, Spijker et al. 2018). Norms in turn lead to values and visions of the good life as a lever point of transformative change (Chan et al 2020). Research is needed on how people participate, who is included in decision making, who benefits and who is excluded. These power relations in participatory governance are shaped by ethnicity, gender, class and age.

## 8. Conclusion

This paper shows the diverse ways in which SI can tackle biodiversity loss by a systematic review of the literature across different disciplines. It also identifies gaps in the literature. Based on our review, we arrived at the following responses to our guiding questions: 1. *How is SI reported to be tackling drivers of biodiversity loss and unsustainability?* Examples of SI are found in the literature relating to changing land use (agriculture, forestry, aquatic ecosystems and cities), tackling exploitation of organisms (fishing, hunting, harvesting), and in addressing climate change and pollution. We found that the amount and quality of papers on SI and specific drivers of biodiversity loss varies. Across drivers, there was a particular gap regarding research recognizing and respecting indigenous people and their communities. 2. *How is social innovation conceptualized in this literature?* We find that SI for biodiversity and sustainability cuts across markets, civil society and government and specifically focuses collaboration between these sectors. Within the field of SI research, research on grassroots innovation is particularly important alongside research on civic action at the regional/meso level. 3. *How is the concept of social innovation contested or questioned?* We found little critical discussion of SI and or recognition of SI as a contested concept with positive and negative impacts. Much SI-research remains situated within current economic and social contexts. This opens the opportunity for SI research to be critiqued as seemingly reinforcing the status quo via merely incremental, local change.

While there is a risk of SI being considered simply a buzzword, it can be used to describe novel approaches of bringing about positive change. It also can be useful for exploring alternative ways of tackling biodiversity loss that are SI in all but name. Our analysis

generated three cross-cutting themes of SI for tackling biodiversity loss: SI for nature based solutions, for technology and for participatory governance. Beyond explicit SI research we identified societal, communal, organisational and individual levels where future research could fruitfully explore insights provided by other strands of sustainability research.

This review also provides insights of what is possible for practice and policy, and where SI can be supported. The use of the concept of SI in IPBES reports is seen as a welcome approach for transformation and rethinking of systems of production and consumption (Diaz et al. 2019). SI is focused on place-based civic action and network exchange. It suggests the value of a “thousand flowers” that is not captured by the search for regime disrupting technological uber-innovators. The more common use of the term innovation, as technical novelty for commercial use, problematically pushes for a discourse on scaling and replication with a view to capturing market monopolies. This use implies that the term SI is contested in political discussion and indeed is currently omitted from the more recent drafts of the Global Biodiversity Framework (Pörtner et al. 2021). A better understanding of SI can promote a more comprehensive conception of innovation processes for tackling biodiversity loss and transformation in direction of sustainability.

## References

- Ahen, F. (2019). Making Resource Democracy Radically Meaningful for Stakeowners: Our World, Our Rules? *Sustainability*, 11(19), 23. doi:10.3390/su11195150
- Angelidou, M., & Psaltoglou, A. (2017). An empirical investigation of social innovation initiatives for sustainable urban development. *Sustainable Cities and Society*, 33, 113-125.
- Anheier, H., Krlev, G., & Mildenberger, G. (2018). *Social Innovation: Comparative Perspectives*. London: Routledge.
- Ayob, N., Teasale, S., & Fagan, K. (2016). How Social Innovation ‘Came to Be’: Tracing the Evolution of a Contested Concept. *Journal of Social Policy*, 45(04), 635–653.
- Baker, S., & Mehmood, A. (2015). Social innovation and the governance of sustainable places. *Local Environment*, 20(3), 321-334.
- Biggs, R., Westley, F. R., & Carpenter, S. R. (2010). Navigating the Back Loop: Fostering Social Innovation and Transformation in Ecosystem Management. *Ecology and Society*, 15(2), 25.
- Blattel-Mink, B., Boddenberg, M., Gunkel, L., Schmitz, S., & Vaessen, F. (2017). Beyond the market: New practices of supply in times of crisis: The example community-supported agriculture. *International Journal of Consumer Studies*, 41(4), 415-421.
- Bolz, K., & de Bruin, A. (2019). Responsible innovation and social innovation: toward an integrative research framework. *International Journal of Social Economics*, 46 (7), 742-755
- Chan, K. M., Boyd, D. R., Gould, R. K., Jetzkowitz, J., Liu, J., Muraca, B., . . . Selomane, O. (2020). Levers and leverage points for pathways to sustainability. *People and Nature*, 2(3), 693-717.
- Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). *Nature-based solutions to address global societal challenges*. Gland: IUCN.

- Cole, S. M., McDougall, C., Kaminski, A. M., Kefi, A. S., Chilala, A., & Chisule, G. (2018). Postharvest fish losses and unequal gender relations: drivers of the social-ecological trap in the Barotse Floodplain fishery, Zambia. *Ecology and Society*, 23(2), 13. doi:10.5751/es-09950-230218
- Cumming, D., Johan, S., Oberst, C., & Uzuegbunam, I (2020). The unintended consequences of biotechnology innovation adoption. *Industry and Innovation*, 27 (10), 1089-1109,
- Díaz, S., Settele, J., & Brondízio, E. et al. (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*: Bonn: IPBES.
- Diekmann, M., & Theuvsen, L. (2019). Non-participants interest in CSA - Insights from Germany. *Journal of Rural Studies*, 69, 1-10. doi:10.1016/j.jrurstud.2019.04.006
- Edwards-Schachter, M., & Wallace, M. L. (2017). 'Shaken, but not stirred': Sixty years of defining social innovation. *Technological Forecasting and Social Change*, 119, 64–79.
- El Bilali, H. (2018). Relation between innovation and sustainability in the agro-food system. *Italian Journal of Food Science*, 30(2), 200-225.
- Fink, A. (1998). *Conducting research literature reviews: from paper to the internet*. Thousand Oaks: Sage.
- Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy*, 93, 101-111.
- Garcia-Llorente, M., Perez-Ramirez, I., de la Portilla, C. S., Haro, C., & Benito, A. (2019). Agroecological Strategies for Reactivating the Agrarian Sector: The Case of Agrolab in Madrid. *Sustainability*, 11(4), 19.
- Gnych, S., Lawry, S., McLain, R., Monterroso, I., & Adhikary, A. (2020). Is community tenure facilitating investment in the commons for inclusive and sustainable development? *Forest Policy and Economics*, 111, 19.
- Godin, B. (2012). *Social Innovation: Utopias of Innovation from c.1830 to the Present*. Project on the Intellectual History of Innovation. Montreal: INRS.
- Godin, B., & Vinck, D. (Eds.). (2017). *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias*. Cheltenham: Edward Elgar.
- Gond, J.-P., Mena, S., & Mosonyi, S. (2020). The Performativity of Literature Reviewing: Constituting the Corporate Social Responsibility Literature Through Re-presentation and Intervention. *Organizational Research Methods*, First published online doi:10.1177/1094428120935494
- Gordon, A., Becerra, L. D., & Fressoli, M. (2017). Potentialities and constraints in the relation between social innovation and public policies: some lessons from South America. *Ecology and Society*, 22(4), 7.
- Gorriiz-Mifsud, E., Burns, M., & Govigli, V. M. (2019). Civil society engaged in wildfires: Mediterranean forest fire volunteer groupings. *Forest Policy and Economics*, 102, 119-29
- Hamann, M., Biggs, R., Pereira, L., Preiser, R., Hichert, T., Blanchard, R., . . . Ziervogel, G. (2020). Scenarios of Good Anthropocenes in southern Africa. *Futures*, 118, 16. doi:10.1016/j.futures.2020.102526
- Hausknot, D., & Haas, W. (2019). The Politics of Selection: Towards a Transformative Model of Environmental Innovation. *Sustainability*, 11(2), 506.
- Have, R. P. v. d., & Rubalcaba, L. (2016). Social innovation research: An emerging area of innovation studies? *Research Policy*, 45(9), 1923–1935.
- Heyen, D., Hermwille, L., & Wehnert, T. (2017). Out of the Comfort Zone! Governing the Exnovation of Unsustainable Technologies and Practices. *Gaia-Ecological Perspectives for Science and Society*, 26(4), 326-331.

- Hillman, J., Axon, S., & Morrissey, J. (2018). Social enterprise as a potential niche innovation breakout for low carbon transition. *Energy Policy*, *117*, 445-456.
- Hippel, E. (2016). *Free Innovation*. Massachusetts: MIT Press.
- Hoppe, T., & de Vries, G. (2019) Social Innovation and the Energy Transition. *Sustainability*, *11*(1), 13
- Houston, D., Hillier, J., MacCallum, D., Steele, W., & Byrne, J. (2018). Make kin, not cities! Multispecies entanglements and 'becoming-world' in planning theory. *Planning Theory*, *17*(2), 190-212.
- Howaldt, J., & Schwarz, M. (2017). Social Innovation and Human Development—How the Capabilities Approach and Social Innovation Theory Mutually Support Each Other. *Journal of Human Development and Capabilities*, *18*(2), 163–180.
- IPCC. (2018). *Global Warming of 1.5°C. An IPCC Special Report*. Geneva: IPCC.
- Jenson, J., & Harrison, D. (2013). *Social innovation research in the European Union: Approaches, findings and future directions*. Brussels: European Commission.
- Jordan, N. R., Mulla, D. J., Slotterback, C., Runck, B., & Hays, C. (2018). Multifunctional agricultural watersheds for climate adaptation in Midwest USA: commentary. *Renewable Agriculture and Food Systems*, *33*(3), 292-296.
- Kaika, M. (2017). "Don't call me resilient again!": the New Urban Agenda as immunology ... or ... what happens when communities refuse to be vaccinated with "smart cities" and indicators. *Environment and Urbanization*, *29*(1), 89-102.
- Krikser, T., Piorr, A., Berges, R., & Opitz, I. (2016). Urban Agriculture Oriented towards Self-Supply, Social and Commercial Purpose: A Typology. *Land*, *5*(3), 19.
- Kristof, K. (2010). *Wege zum Wandel: Wie wir gesellschaftliche Veränderungen erfolgreicher gestalten können*. München: oekom.
- Lambe, F., Johnson, O., Ochieng, C., Diaz, L., & Lee, K. (2019). What's health got to do with it? Influencing cookstove uptake in Cambodia through behaviour change communication. *Journal of Social Marketing*, *9*(1), 94-110.
- Lavorel, S., Colloff, M. J., Locatelli, B., Gorddard, R., Prober, S. M., Gabillet, M., Peyrache-Gadeau, V. (2019). Mustering the power of ecosystems for adaptation to climate change. *Environmental Science & Policy*, *92*, 87-97.
- Lawrence, A., Wong, J. L. G., & Molteno, S. (2020). Fostering social enterprise in woodlands: Challenges for partnerships supporting social innovation. *Forest Policy and Economics*, *118*, 14.
- Leach, M., Rockström, J., Raskin, P., Scoones, I., Stirling, A. C., Smith, A., . . . Olsson, P. (2012). Transforming Innovation for Sustainability. *Ecology and Society*, *17*(2). doi:10.5751/es-04933-170211
- Lopez-Garcia, D., Calvet-Mir, L., Di Masso, M., & Espluga, J. (2019). Multi-actor networks and innovation niches: university training for local Agroecological Dynamization. *Agriculture and Human Values*, *36*(3), 567-579.
- Lyon, F. (2012). Social innovation, co-operation and competition: inter-organizational relations for social enterprises in the delivery of public services. In Nicholls, A and Murdock, A, (2012) *Social Innovation*. London: Palgrave MacMillan
- Martini, U., Buffa, F., & Notaro, S. (2017). Community Participation, Natural Resource Management and the Creation of Innovative Tourism Products: Evidence from Italian Networks of Reserves in the Alps. *Sustainability*, *9*(12).
- Mayring, P. (2014). *Qualitative content analysis: theoretical foundation, basic procedures and software solution* Klagenfurt.

- Mazigo, A. F. (2017). Promoting Social Innovation Through Action Research: Evidence from an Empirical Study in the Fisheries Sector of Ukerewe District in Tanzania. *Journal of Human Development and Capabilities*, 18(2), 239-257.
- Mendez-Medina, C., Schmook, B., & McCandless, S. R. (2015). The Punta Allen cooperative as an emblematic example of a sustainable small-scale fishery in the Mexican Caribbean. *Maritime Studies*, 14, 19
- Moore, M. L., von der Porten, S., Plummer, R., Brandes, O., & Baird, J. (2014). Water policy reform and innovation: A systematic review. *Environmental Science & Policy*, 38, 263-271.
- Moraine, M., Duru, M., Nicholas, P., Leterme, P., & Therond, O. (2014). Farming system design for innovative crop-livestock integration in Europe. *Animal*, 8(8), 1204-1217.
- Nemoto, E. H., & Biazoti, A. R. (2017). Urban agriculture: How bottom-up initiatives are impacting space and policies in Sao Paulo. *Future of Food-Journal on Food Agriculture and Society*, 5(3), 21-34.
- Nerini, F. F., Slob, A., Engstrom, R. E., & Trutnevycyte, E. (2019). A Research and Innovation Agenda for Zero-Emission European Cities. *Sustainability*, 11(6), 13.
- Nicholls, A., & Ziegler, R. (Eds.). (2019). *Creating economic space for social innovation*. Oxford: Oxford University Press.
- Nijnik, M., Secco, L., Miller, D., & Melnykovych, M. (2019). Can social innovation make a difference to forest-dependent communities? *Forest Policy and Economics*, 100, 207-213.
- Nordensvard, J., Urban, F., & Mang, G. (2015). Social Innovation and Chinese Overseas Hydropower Dams: The Nexus of National Social Policy and Corporate Social Responsibility. *Sustainable Development*, 23(4), 245-256.
- Olsson, P., Moore, M.-L., Westley, F. R., & McCarthy, D. (2017). The concept of the Anthropocene as a game-changer: a new context for social innovation and transformations to sustainability. *Ecology and Society*, 22(2), 31.
- Pineiro-Antelo, M. A., & Lois-Gonzalez, R. C. (2019). The role of European fisheries funds for innovation and regional development in Galicia (Spain). *European Planning Studies*, 27(12), 2394-2410.
- Pörtner, H. O., Scholes, R. J., Agard, J., Archer, E., Arneth, A., Bai, X., . . . Ngo, H. T. (2021). *IPBES-IPCC co-sponsored workshop report on biodiversity and climate change*. Bonn: IPBES and IPCC. DOI:10.5281/zenodo.4782538.
- Prasad, S. C. (2016). Innovating at the margins: the System of Rice Intensification in India and transformative social innovation. *Ecology and Society*, 21(4), 9.
- Radywyl, N., & Biggs, C. (2013). Reclaiming the commons for urban transformation. *Journal of Cleaner Production*, 50, 159-170. doi:10.1016/j.jclepro.2012.12.020
- Rivaud, A., & Prevost, B. (2018). Land stewardship : an alternative to neoliberal governance for the conservation of biodiversity in natural areas ? *Developpement Durable & Territoires*, 9(3). doi:10.4000/developpementdurable.13051
- Rogers, E. M. (1983). *Diffusion of innovations* (3 ed.). New York: Free Press of Glencoe.
- Rousseau, D. M., Manning, J., & Denyer, D. (2008). Evidence in Management and Organizational Science: Assembling the Field's Full Weight of Scientific Knowledge Through Syntheses. *The Academy of Management Annals*, 2(1), 475-515.
- Sarmiento, F., & Moura, M. (2017). Material Resignification in the Amazon. A way to construct sustainability scenarios. *Design Journal*, 20, S1852-S1868.
- Sassen, S., & Dotan, N. (2011). Delegating, not returning, to the biosphere: How to use the multi-scalar and ecological properties of cities. *Global Environmental Change-Human and Policy Dimensions*, 21(3), 823-834.

- Sasson, A., & Malpica, C. (2018). Bioeconomy in Latin America. *New Biotechnology*, 40, 40-45. doi:10.1016/j.nbt.2017.07.007
- Schäfer, M., Hielscher, S., Haas, W., Hausknot, D., Leitner, M., Kunze, I., & Mandl, S. (2018). Facilitating Low-Carbon Living? A Comparison of Intervention Measures in Different Community-Based Initiatives. *Sustainability*, 10(4), 23. doi:10.3390/su10041047
- Schot, J., & Kanger, L. (2018). Deep transitions: Emergence, acceleration, stabilization and directionality. *Research Policy*, 47(6), 1045–1059.
- Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C-Government and Policy*, 30(3), 381-400.
- Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics*, 16(4), 584–603.
- Soma, K., van den Burg, S. W. K., Selnes, T., & van der Heide, C. M. (2019). Assessing social innovation across offshore sectors in the Dutch North Sea. *Ocean & Coastal Management*, 167, 42-51.
- Spijker, S. N., & Parra, C. (2018). Knitting green spaces with the threads of social innovation in Groningen and London. *Journal of Environmental Planning and Management*, 61(5-6), 1011-1032.
- Tornaghi, C., & Van Dyck, B. (2015). Research-informed gardening activism: steering the public food and land agenda. *Local Environment*, 20(10), 1247-1264.
- Tosun, J., & Schoenefeld, J. J. (2017). Collective climate action and networked climate governance. *Wiley Interdisciplinary Reviews-Climate Change*, 8(1), 17.
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14(3), 207-222.
- van Holt, T., & Weisman, W. (2016). Global production network mapping for transforming socio-ecological systems. *Current Opinion in Environmental Sustainability*, 20, 61-66.
- van Kooten, G. C., Nijnik, M., & Bradford, K. (2019). Can carbon accounting promote economic development in forest-dependent, indigenous communities? *Forest Policy and Economics*, 100, 68-74. doi:10.1016/j.forpol.2018.10.012
- Vickers, I., Lyon, F., Sepulveda, L., & McMullin, C. Public service innovation and multiple institutional logics: The case of hybrid social enterprise providers of health and wellbeing. *Research Policy*, 46(10), 1755–1768.
- Wolfram, M. (2018). Cities shaping grassroots niches for sustainability transitions: Conceptual reflections and an exploratory case study. *Journal of Cleaner Production*, 173, 11-23. doi:10.1016/j.jclepro.2016.08.044
- World Commission on, E., & Development. (1987). *Our Common Future*. Oxford: OUP
- Ziegler, R. (2017). Social innovation as a collaborative concept. *Innovation-the European Journal of Social Science Research*, 30(4), 388-405.
- Ziegler, R. (2019). Viewpoint - Water Innovation for a Circular Economy: The Contribution of Grassroots Actors. *Water Alternatives-an Interdisciplinary Journal on Water Politics and Development*, 12(2), 774-787.
- Ziegler, R. (2020). *Innovation, Ethics and Our Common Futures: A Collaborative Philosophy*. Cheltenham: Edward Elgar.