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"Doing more good": Exploring the multidisciplinary landscape of regeneration as a boundary object for paradigm change

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Abstract

The concept of regeneration is gaining traction across diverse disciplines, from agriculture and engineering to business and the social sciences. More than just a buzzword, regeneration is emerging as a pivotal boundary object in a paradigm shift that is redefining design principles and transforming humanity's relationship with the environment. This narrative review explores regeneration's journey from its literal origins in biology and engineering to its metaphorical applications in areas such as regenerative economics, agriculture, and culture. We argue that regeneration's conceptual fluidity allows it to adapt and resonate across domains while maintaining a core ethos of holistic, proactive care and stewardship. Central to regeneration is the notion of generativity—a principle that champions giving back more than what is taken, fostering reciprocity, and co-creating a thriving world for all. As regeneration gains prominence, there are risks that it will be misappropriated or diluted by greenwashers; however, its power lies in its ability to facilitate interdisciplinary dialogue and place-based solutions. Rather than limiting regeneration through strict definitions, we propose nurturing its development through collaborative social agreements like covenants and treaties that enshrine its core tenets of generativity, diversity, and care. We believe that regeneration's emergence across disciplines heralds

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a new era of environmental thought and action—one where humanity moves beyond harm reduction to actively healing and enriching the social and ecological systems that we are part of. This review provides a foundation for scholars and practitioners to engage critically with regeneration and collaborate across boundaries to address pressing socio-ecological challenges.

Keywords
agroecology, boundary concepts, boundary objects, food production, food systems transformation, regeneration, regenerative design, regenerative farming

Introduction

In recent years, the concept of regeneration has taken center stage in discussions of how we can transform our relationships with nature to address issues such as biodiversity loss and climate change (Gibbons, 2020; Loring, 2021; Wahl, 2016). The readers of this journal will no doubt recognize regeneration as a hot topic in the world of alternative agricultural systems (Loring, 2021). Regeneration actually predates this usage in other areas of practice, including medicine and engineering (Cole, 2012; Mao & Mooney, 2015). Likewise, regeneration is popping up in unlikely new areas, such as fisheries, tourism, education, fashion, and landscape architecture (Anu, 2021; France, 2019; Kumar & Howarth, 2022; Loring, 2023b). As such, some have argued that the concept is becoming little more than a buzzword that businesses can use to greenwash business as usual. While there are no doubt risks of greenwashing (as there have been with concepts such as sustainability), we propose here that the concept of regeneration is actually emerging as a central concept in an ongoing cultural shift, both with respect to the design principles and values we apply to food systems and other technological aspects of society, and also more deeply, in terms of how we think about the basic nature of humanity's relationship with the environment.

To understand where regeneration might be going and recognize why its rise is such an important societal development, we need to first look at the concepts and values that precede it, starting with sustainability movement of the late 20th century. There is no doubt that the concept of sustainability has had a tremendous impact on the social, economic, and technological aspirations of communities and governments around the world (Edwards, 2005). Indeed, the widespread uptake of sustainability as a valorous societal pursuit was a noteworthy turn for western civilization, away from treating nature as an endless supply of capital and toward valuing the success and well-being of future generations (Sneddon et al., 2006). With sustainability, we were starting to articulate and acknowledge our own hand in creating the world that future generations will inherit.

And yet, critics of sustainability have pointed out many of its shortcomings as a societal narrative for change: that it is not sufficiently aspirational, for example, and has been limited by a mindset of doing less harm—shrinking our footprints, if you will—while missing opportunities to explore futures that involve improved outcomes for both nature and people (Agyeman, 2008; Gibbons, 2020; Loring, 2020). We believe that the rise of regeneration in myriad sectors is a response to these criticize, because with regeneration proponents are now advocating that we move on from the posture of minimizing harm and instead approach our relationships with nature from an intention of "doing more good" (Brown et al., 2018, p. 5).

The paper is structured as a narrative review (Paré et al., 2015). In the pages that follow, we begin with a short overview of the concept of sustainability and how it has developed and changed over time, from its origins in poverty reduction and then evolving through such forms as sustainable development, natural resource optimization, and resilience. Then, we introduce regeneration and offer a scan of how it has emerged or is emerging in a variety of disparate fields. As we discuss, regeneration takes on notably different forms from one field to the next, but still maintains a recognizable character. We believe that this makes regeneration a *boundary concept*: a term or concept that resonates in multiple fields of practice and allows people to think collaboratively and communicate conceptually among and across them (Mollinga, 2008; Sajtos et al., 2018).

As a narrative review, our approach is curated

rather than systematic (Paré et al., 2015). That is to say, we did not implement a systematic, database-driven review of regeneration as used in all academic literature. That method that would be more appropriate if we aimed to make broad and generalizable claims or identify areas of consensus. Our approach, the narrative review, is intentionally selective and opportunistic, which allows us to bring our own expertise to bear and explore trends and points of potential convergence that may not otherwise be evident (Paré et al., 2015).

With this review, we offer insights for the future of research and practice on regenerative systems. Given the conceptual murkiness and disagreements that often accompany paradigm changes (Sandri, 2013), it is possible that regeneration can be used a shroud for greenwashing (Giller et al., 2021). Currently, for example, actors in the agricultural sector face pressure to define and regulate the concept with definitions and certifications. Our argument here is that the flexibility of regeneration as a concept is part and parcel of its power to inform social change; this flexibility could be undermined by too-rigid approaches to standardization and certification. As an alternative, we conclude by discussing collaborative social efforts such as covenants or treaties that could enshrine regeneration's shared values and provide a more robust basis for effectively reorienting our communities and economies.

From Sustainability to Resilience and Stewardship

In this section, we review some of the important developments and trends in the recent history of sustainability and related concepts. Our goal is not to provide a comprehensive history (for that, see Edwards, 2005), but to draw out important features that help us see how regeneration both builds on and diverges from this historical precedent.

Since its rise in the second half of the 20th century, sustainability has undergone an interesting arc. Its origins can be traced back to efforts in the international development community to bring alleviation of poverty and mitigation of environmental harms and degradation under the same roof (Edwards, 2005). Published in 1987, the influential Brundtland Report remains a pivotal and foundational document, defining sustainability as development that "[meets] the needs of the present without compromising the ability of future generations to meet their own needs} (Brundtland, 1987, p. 39). This framing of sustainability aimed to address social disparities and environmental degradation (see also Rodale, 1983), and in many ways, this inaugural era of sustainability as a western idea was a response to the radical environmentalism of the late 1960s and 1970s, from which emerged concerns about limits to growth and growing public awareness of environmental issues like water and air pollution, chemical toxicants like DDT, and environmental racism.

Opinions on sustainability split with the rise of its popularity in economic development circles (Neumayer, 2004; Sneddon et al., 2006). Some critics argued that "sustainable development," is an oxymoron—that continued economic growth could not fully coexist with environmental preservation. This debate exposed an often-unspoken assumption that there will always be a tension between human prosperity and environmental conservation—that gains for people must come at the expense of nature, or vice versa. Two camps of sustainability thinking emerged around this debate, one which came to be known as strong sustainability and another known as weak sustainability (Ang & Van Passel, 2012; Neumayer, 2004). Strong sustainability advocates argued for a recognition of hard and fast limits to growth, and weak sustainability advocates emphasized the role of technological innovation and the need to eventually decouple human society from environmental limits entirely (United Nations Environment Programme International Resource Panel, 2011).

In areas such as fisheries, food, and timber, a strong sustainability approach became quickly institutionalized. Concepts such as carrying capacity and maximum sustainable yield (MSY) were adopted as a relatively policy-friendly way of optimizing resource extraction in light of ecological limits (Finley, 2011). This approach has been incredibly successful in terms of its uptake by societies around the world, in part because it is highly compatible with mainstream economic sensibilities. With clearly demarcated limits to extractive activities in place, those harvests can be privatized, par-

celled, and traded in the same way as land. However, at the core of this framing of sustainability remains the familiar, zero-sum posture of optimizing economic benefits in light of ecological harms. As such, strong sustainability in practice was regularly criticized for obscuring solutions that might seem less than economically optimal but still provide co-benefits for ecological health and human well-being. Fisheries in Alaska are one example, where purportedly sustainable approaches to management have given rise to conflict and eroded the rights of Indigenous Peoples (Loring, 2013).

In the early 21st century, the spotlight shifted from sustainability to resilience (Yanarella & Levine, 2014). This turn came about because of the observation that sustainability was perhaps too focused on the matter of stability; ecosystems are always in flux, and together with ongoing issues like climate change, the notion of managing systems only for stability was rightly supplanted by discussions of how to navigate systems undergoing constant change. Resilience thinking, which emphasizes the ability of systems to "bounce back" from disturbances (Walker & Salt, 2006), was at the center of this shift. For many people, resilience provided a valuable alternative framing for how to maintain the desired features of ecosystems while adapting to changes outside of their control (Worstell, 2020). However, it also faced criticism, primarily from social scientists, for its exclusive focus on reaction and recovery, neglecting the questions of equity and compensation for harm, and lacking aspirational values such as agency and justice (Davidson, 2010; Yanarella & Levine, 2014). In response, some resilience literature adopted the notion of resilience as "bouncing forward," meaning to respond to some harm or surprise through actions that create positive change (Manyena et al., 2011).

More recently, resilience and sustainability are increasingly subsumed within the conceptual toolkit of stewardship, which emphasizes a proactive approach to responsible management and care for the Earth (Chapin et al., 2011). Stewardship encapsulates the idea that humans, as custodians of the planet, have a moral and ethical obligation to protect and nurture the environment for future generations. This shift marks an important departure from purely exploitative attitudes toward nature, encouraging a sense of guardianship that aligns with Indigenous approaches to human-environment relations (Artelle et al., 2019; Moola & Roth, 2019).

A critical feature of stewardship that contrasts notably with earlier, more instrumental interpretations of sustainability is its emphasis on relationships and relational care (West et al., 2020). Recognizing the intricate web of connections between humans and the rest of the natural world, the relational perspective rejects the simplistic, win-or-lose assumptions common to early approaches to sustainability. Instead, it attends to the well-being of communities and the environment as being inherently intertwined. For stewardship, sustainability transcends a mere balance between ecological integrity and economic development; it is a holistic approach rooted in nurturing robust relationships between humans and the natural world and prioritizing social justice, diversity, solidarity, and empowerment (Jennings, 2018).

Enter Regeneration

In the most general sense, regeneration describes a pattern of behavior through which a system returns energy and matter from used to usable forms (Ikerd, 2021). Most widely known perhaps for its recent appearance in area of food systems and agriculture, regeneration embodies a philosophy of healing and renewal that is similar to resilience. It also shares features with stewardship: discussions of regeneration often attend to the quality of relationships, care, resilience, and overall well-being.

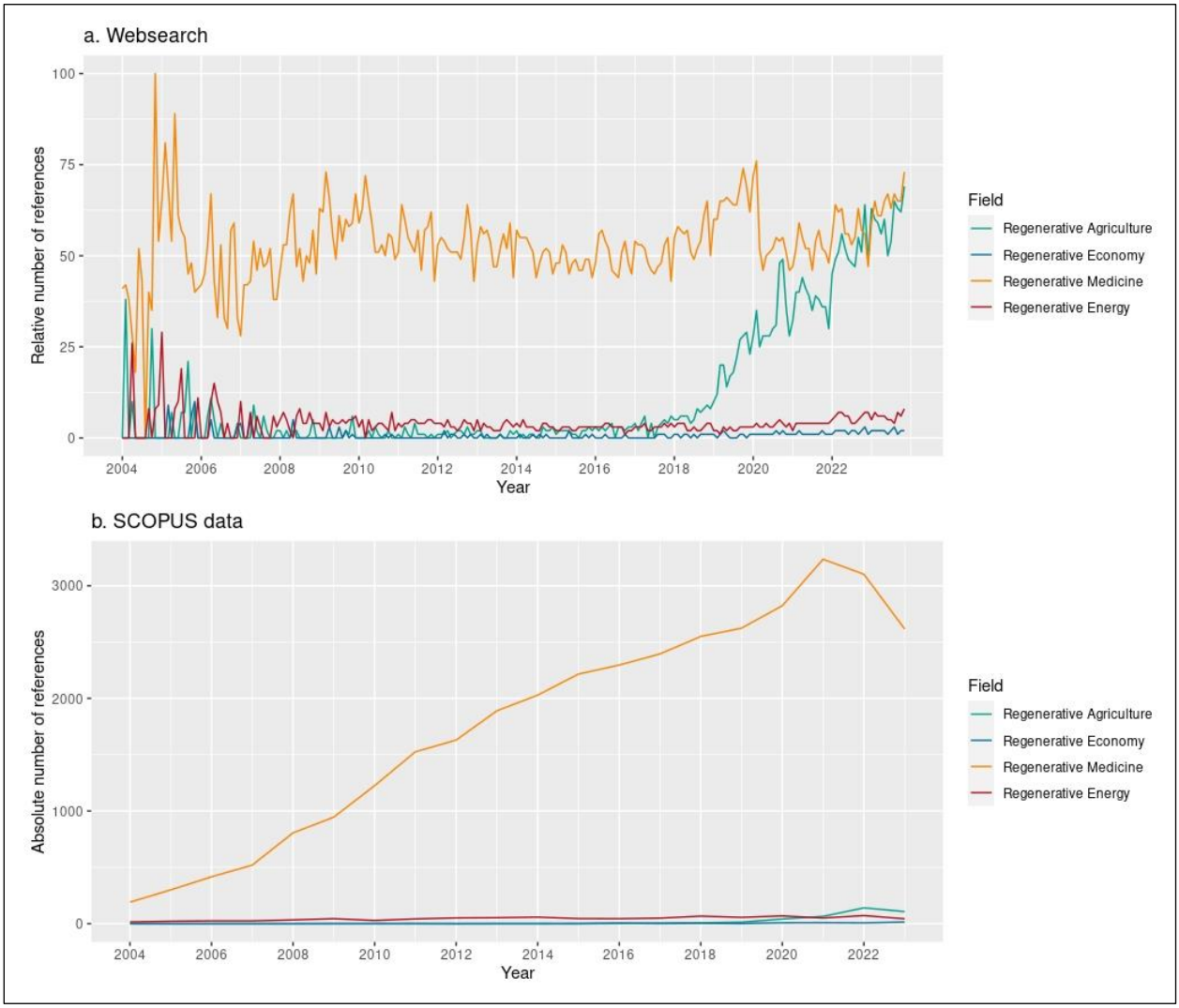
Regeneration's influences are varied and widespread. Reference to and interest in "regeneration" in have grown and diversified over time in both public and academic spheres (Figure 1). Based on our read of the early literature, 'regeneration' originally took on very literal meanings, referring in biology. for example. to an organism's ability to regrow lost body structures (Stocum, 2012). In the technological realm, regeneration referred to a built system's ability to harness and reuse energy, e.g., in regenerative braking systems common to hybrid and electric passenger vehicles (Potrč et al., 2022). Early uses of the term in writings on energy and power use 'regenerative' to describe systems that

shift away from one-time-use energy sources and toward the recycling or reuse of energy trapped within these systems (Potrč et al., 2022). Today, although regenerative energy and regenerative power systems are often used synonymously, regenerative energy typically includes solar, wind, hydropower, and geothermal energy sources (essentially, it is synonymous with renewable energy), while regenerative power typically refers to technological systems such as regenerative brakes, pumps, circuits, and furnaces (Cook-Chennault et al., 2008).

In the 20th century, the field of regenerative biology also gained scholarly recognition, and regenerative medicine took shape as a field of study. Regenerative biology focuses on understanding how cells, tissues, and/or complex structures naturally regenerate in living organisms (Stocum, 2012). By studying regenerative biology, scientists seek insights into the mechanisms involved in regeneration and then apply this knowledge to engineer therapies or technologies to treat injuries and diseases (Stocum, 2012). Regenerative medi-

Figure 1. Trends in Usage of 'Regeneration' Over Time

a. Number of Google searches containing the terms 'Regenerative agriculture,' 'Regenerative farming' (data combined with 'Regenerative agriculture'), 'Regenerative economy,' 'Regenerative medicine,' and 'Regenerative Energy.' Data were retrieved on November 14, 2023, and standardized to the highest value automatically prior to downloading.
b. Total number of articles with the terms listed in (a) present in the title, abstract, or keywords, listed by Scopus.



cine, for example, uses these treatments to promote tissue healing (Mao & Mooney, 2015). Within the last decade or so, specialized branches of regenerative medicine have emerged; endodontics, dermatology, cardiology, and orthopedics are just some examples of fields that now incorporate concepts developed from regenerative biology (Arbatli et al., 2018; Kim et al., 2018; Moioli et al., 2017).

So far in the 21st century, the uses of regeneration have further diversified. In addition to the literal uses noted above, the concept is also used metaphorically by several additional areas of research and practice (Table 1, especially column 3). Examples include the regenerative economy, regenerative society, regenerative food systems, and the regenerative built environment. Regenerative design, as a sort of catch-all or umbrella concept, describes any kind of system, process, or product that works by restoring or enhancing social, ecological, or economic systems (Gibbons, 2020). In the built environment, for example, regenerative refers to the design, development, and/or manage-

Table 1. Variants of Regeneration Explored in Our Narrative Review

Variant	Definition	Examples	Example References
Sustainability	complex adaptive systems that restore and regenerate ecosystems and human well-being	holistic learning and/or thinking, circular economies, ecological restoration	Gibbons, 2020
Design	approach to designing systems, products, and processes that restore and enhance ecological, social, and economic systems	permaculture, green infrastructure, closed-loop fashion, energy systems	Cole, 2012
Development	use of technologies and/or strategies that aim to restore and revitalize ecological, social, and economic systems	renewable energy projects, regenerative agriculture, power technologies	Mang & Reed, 2020
Cultures	set of values, beliefs, and practices that support human well-being and promote the co-evolution of humans and the natural world	collective wellness, regenerative education, eco-villages	Wahl, 2022
Economy	system that seeks to create a harmonious relationship between humans and the planet by investing in human, social, natural, and physical capital	circular business practices, commonwealth infrastructure, finance, and investment	Fath et al., 2019
Business	enterprise that incorporates regenerative principles and practices into its operations to promote net-positive impacts	impact measurement and reporting, stakeholder engagement, product circularity	Hahn & Tampe, 2021
Food Systems	approach to food production that aims to enhance soil health, promote biodiversity, sequester carbon, reduce waste, and create social equity	regenerative agriculture, Indigenous/traditional food systems	Loring, 2021
Biology	aims to elucidate how organisms naturally repair and replace missing cells, tissues, organs, and structures	limb regeneration, stem cell biology, wound healing, tissue homeostasis	Tsonis, 2002
Medicine	using treatments, technologies, and/or therapies to stimulate tissue regeneration and promote the healing of damaged or diseased tissues	tissue engineering, stem-cell therapy, artificial organs	Mao & Mooney, 2015
Energy Systems	energy sources and systems that are renewable and capable of being replenished by natural processes	solar power, wind power, hydropower	Potrč et al., 2022
Power Systems	energy systems or technologies that can harness, recover, and reuse energy that would typically dissipate as heat	brakes, heat exchangers, fuel cells, turbines	Cook-Chennault et al., 2008

ment of human-constructed environments that take part in aiding ecological and social restoration (Mang & Reed, 2012). It encapsulates concepts such as regenerative infrastructure, architecture, and urban development, and simultaneously considers how humans can design landscapes to mirror that of healthy/regenerative natural ecosystems (du Plessis, 2012). For example, a regenerative city may employ renewable energy or incorporate green infrastructure into the urban landscape as a way to both shrink its environmental footprint and promote urban biodiversity (du Plessis, 2012).

In ecology, regenerative ecosystem management has been described as a blending of sustainability and resilience as discussed earlier (Schreefel et al., 2020). That is, the ability of ecosystems to persist over time is understood as a function of their ability to pass through an ongoing process of release and renewal at multiple scales, from the life and death of individual creatures to the successional processes that follow wildfire. Schreefel and colleagues (2020) argue that ecosystem management needs to be organized around improving or renewing the health of natural ecosystems, for example through active restoration efforts to restore degraded lands or reintroduce critical extirpated species like predators, preventing nutrient runoff from human activities to keep water bodies clean, and managing species and plant diversity to rebuild soils.

As already noted, discussions of regeneration in the context of agriculture have erupted in recent years (Ikerd, 2021; Lal, 2020; Loring, 2021). Generally, the literature describes regenerative agricultural practices as those that increase soil fertility, biodiversity, and carbon capture; improve watersheds; and increase yields with fewer inputs. Some uses of regeneration in agriculture are extremely discrete and specific, focusing for example on the management of soil nutrient cycles. Others adopt a more holistic, social-ecological systems perspective and incorporate social-justice goals such as workers rights and food sovereignty alongside the ecological benefits of the approach. In the latter regard, regeneration draws directly from agroecology, a well-established area of science and practice in agriculture that treats ecological, technological, and societal considerations as inherently intertwined (Tittonell et al., 2022). Other sectors of food production and natural resources are also now picking up and adapting the regenerative concept, such as fisheries and aquaculture, viticulture, and forestry (Mizuta et al., 2023; reNature, 2020; Villat, 2021).

An important detail about regeneration in agriculture is that it is widely contested and for several reasons. Some criticize regenerative agriculture for lacking the aspirations for political reform and social justice that are inherent to agroecology (Tittonell et al., 2022). Whereas agroecology, as noted above, incorporates explicit values about food sovereignty, the right to food, and workers' rights, regenerative agriculture does appear in many instances to be stripped of these concerns, limited only to a handful of alternative cropping and ranching practices (Institute of Development Studies [IDS] & IPES-Food, 2022). Others question regenerative agriculture from a more instrumental perspective, arguing that the term is being appropriated for corporate gain and greenwashing, specifically with respect to regenerative agriculture's purported potential to increase carbon sequestration and create a climate-friendly narrative for livestock. That is, many are skeptical that regenerative practices can in fact deliver the carbon savings and storage that it promises (Rehberger et al., 2023). And finally, because regenerative approaches in food systems share a character with peasant agroecology and Indigenous food systems and ecological stewardship (Haslett-Marroquin, 2016), additional concerns have been raised about whether emerging corporate agendas for regenerative agriculture are guilty of cultural appropriation and perpetuating the disempowerment of already marginalized peoples around the world (IDS & IPES-Food, 2022).

Beyond agriculture, regeneration is appearing in literature on fisheries and seafood and food systems, as well as alternative approaches to economics and business. Loring (2021), for example, argues that for food systems to be regenerative, they must do more than simply incorporate purportedly regenerative practices and instead need to reorient how they account for and accommodate environmental variability and change at multiple scales. This framing mirrors new uses of the term in economics, where the concept of a regenerative economy has been proposed as an evolution of the

notion of circular economies to describe adaptive, circular, self-renewing socio-economic systems that shift away from extractive models and toward creating an overall positive impact on society and nature (Fath et al., 2019; Fullerton, 2015). Regenerative business, also an emerging concept, draws from these principles of regenerative economics in the sense that these businesses aim to create positive social and environmental impacts, rather than only minimize their negative impacts (Hahn & Tampe, 2021). A business can do this by promoting circularity, minimizing waste, and prioritizing the well-being of its employees and stakeholders (Caldera et al., 2022). Concepts such as regenerative entrepreneurship, leadership, and finance are likewise emerging that mirror and adapt these same values for generating social benefit (Hutchins & Storm, 2019).

And finally, the most holistic framing of regeneration we have encountered is that of regenerative cultures and societies (Wahl, 2016). To move our collective cultures toward a regenerative paradigm, Wahl argues that we must alter our value systems, change our daily practices in favor of care and stewardship, and actively support the co-evolution of humans and the natural world. According to Wahl, a regenerative culture prioritizes social justice, inclusivity, environmental stewardship, collaborative governance, economic circularity, and, most importantly, individual well-being and mindset growth. Wahl situates the goals of regenerative culture as a holistic design challenge, and argues for solutions that span finance, agriculture, economics, leadership, and broad cultural narratives in society at large. Likewise, Holliday (2016) argues that across all these domains, a common goal should be to adopt a set of perspectives, intentions, and practices that regard organizations and communities as dynamic living systems. In a somewhat related vein, regeneration is also emerging as a concept in writing on lifestyle, self-help, and leadership (Hutchins & Storm, 2019; Pullen, 2021).

Discussion

In working our way through this conceptual landscape of regeneration, what we see are both convergences and divergences of meaning. In some fields, such as medicine and engineering, the concept is used quite literally—to mean replenishment or regrowth; in others, the concept takes on a more metaphorical role, serving as more of an ethos than a blueprint. In agriculture, we see a little of both, with some people using the term literally while others apply the notion more abstractly and as an ethical aspiration. Our goal here is not to conflate the two, and there are clearly important differences in how the concept is used in medicine and engineering from how it informs design thinking in areas like landscape architecture and agriculture. This flexibility, we argue, is the concept's greatest strength, because it makes it an effective boundary object or concept (Sajtos et al., 2018): an idea that transcends the confines of traditional disciplines and, as such, can foster cross-sector and interdisciplinary dialogues.

Biodiversity loss, climate change, poverty, and other global social-ecological challenges manifest in complex and unique ways from place to place, which means that solutions must also reflect myriad social, cultural, and ecological circumstances and needs. In the face of these multifaceted crises, interdisciplinary collaboration and innovative thinking are paramount. Boundary concepts are critical for translating big problems to place-based action because they act as bridges between diverse disciplines, ideologies, and cultures, facilitating crucial dialogues that transcend traditional silos of knowledge. In the words of Mollinga (2008),

> Boundary concepts are words that operate as concepts in different disciplines or perspectives, refer to the same object, phenomenon, process, or quality of these, but carry (sometimes very) different meanings in those different disciplines or perspectives. In other words, they are different abstractions from the same 'thing.' (p. 25)

We believe that regeneration fits this definition. It offers a language that is sufficiently flexible to unite fields as varied as ecology, economics, social sciences, and Indigenous wisdom under a common umbrella, creating the possibility of shared understanding and collaborative problem-solving while not undermining or watering down

the important nuances the concept carries from field to field to a lowest common denominator. By embracing regeneration as a boundary concept, we can access the collective wisdom of different perspectives and nurture a holistic approach for tackling not only environmental challenges but also social issues where resilience and health are urgently needed.

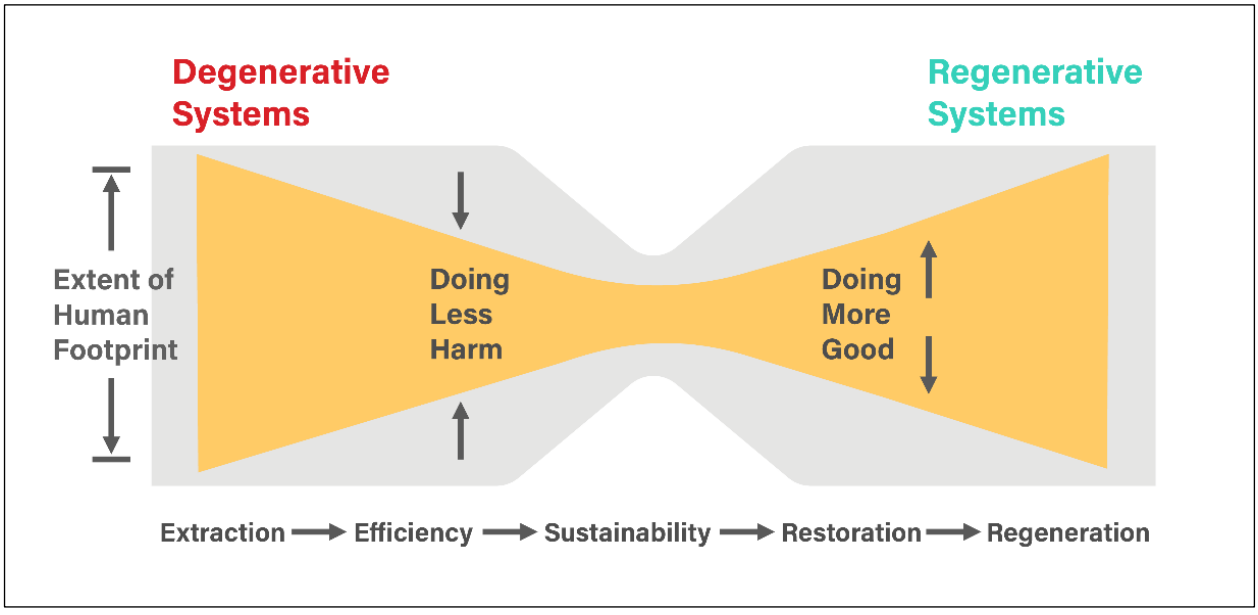
Variations on a Theme

Across the diversity of its uses, we do see a handful of emerging similarities or touchpoints that we think are important for continued discussion of regeneration. First is the concept of generativity, a central principle in regeneration that contrasts with the industrial design value of efficiency. In the most basic sense, generativity describes the ability of a system to produce and create. Generativity has long been used in fields such as child development and business management (Thomas & Tee, 2022), though any cross-pollination between these uses and how it is now emerging in the literatures on regenerative ecology and regenerative food systems—at least beyond the obvious metaphorical parallels—is not clear.

To understand generativity as it is emerging in the regeneration literature, it is helpful to contrast it with the notion of efficiency, especially as used in industrial contexts. Whereas efficiency generally hinges on the idea of maximizing output while minimizing input—a formula that mirrors exploitation—generativity embodies a spirit of giving back more than what is taken, which is a fundamental tenet of care and justice (White, 2020). As an alternative to efficiency, generativity also prompts us to view our relationship with the environment and society through the lens of reciprocity and abundance. Instead of depleting resources and exploiting ecosystems, regenerative practices guided by generativity foster a symbiotic relationship where human activities enrich rather than deplete natural and social capital. This shift from exploitation to care encapsulates the essence of regeneration—it emphasizes the responsibility to "do more good": to leave the world in a better state than we found it (Figure 2).

Figure 2. Regeneration as a Paradigm Change that Involves Two Critical Transitions

The pathway from degenerative, industrial social system and technologies to regenerative systems and technologies can be seen as a paradigm change that involves two distinct transitions: doing less harm (the shift to sustainability) and doing more good (the shift to regeneration). As shown here, the first transition focuses on technologies and practices for reducing the human footprint in the environment, with the assumption being that the entirety of that footprint is harmful or undesirable. The second transition, to regeneration, opens the possibility of an expanded but generative human footprint in which human societies actively contribute to the health and well-being of the world around us.



The shift from "doing less harm" to "doing more good" is part of what sets regeneration apart so fully from the concepts that have come before it. Consider resilience; as discussed above, resilience is a fundamentally reactive design principle, oriented to how systems respond to some external pressure. Resilience is no doubt important (Worstell, 2020), but even with the attempts to make the concept more proactive with the language of "bouncing forward," the agency and goals of resilience thinking remain subordinated to outside initiating forces (e.g., disasters) (Sarkar et al., 2023). In embracing generativity, however, regenerative design encourages proactive innovations that not only prepare a system for potential harms, but also contribute to aspirational trajectories for ecosystem health and human well-being and development.

In addition to generativity, we see a handful of other principles that are emerging as common features of regeneration across multiple fields. We offer the list below as just a starting point, and we encourage researchers and practitioners to engage with and expand these to advance the movement.

- Holism: Regeneration requires a holistic understanding, acknowledging the intricate connections between ecological, social, and economic systems. Solutions must address the interdependencies among these elements to promote genuine regeneration.
- Respect for diversity: A regenerative approach celebrates diversity, both in natural ecosystems and human communities. Recognizing and preserving diverse cultures, species, and perspectives is essential for regenerative practices to thrive.
- Adaptability and resilience: Regenerative design must be adaptable, capable of responding to changing environmental and social contexts. Building resilience into systems ensures they can withstand shocks and disturbances, fostering long-term sustainability.
- Ethical stewardship: Practitioners of regenerative design must adhere to ethical standards, ensuring fair and just practices. This includes equitable resource distribution, social justice, and respect for the rights and dignity of all individuals.
- Transparency and accountability: Transparency in decision-making processes and accountability for actions are crucial. Regenerative initiatives must be transparent in their goals, methodologies, and outcomes, fostering trust among stakeholders.

Transformation Without the Politics?

The transformative potential of regeneration as a design principle notwithstanding, there are also risks in how the concept is being used and abused that future research and scholarship need to confront. As we alluded to in the previous section, the first risk relates to the apparent trend of regeneration being used in some circles in ways that are stripped of any commitment to social change. As Tittonell and colleagues (2022) note, regenerative agriculture as used in some communities of practice appears to be a much-watered-down version of agroecology—"agroecology without the politics," in their words. The technical aspects such as the focus on soil health and biodiversity and soil carbon management are being retained, while the linked societal issues such as smallholder empowerment, land rights and tenure, and food sovereignty are marginalized or absent. Indeed, much of what currently composes regenerative agriculture builds on long-standing wisdom and practices from Indigenous and peasant communities, while corporate entities seeking to implement and benefit from the approach are not necessarily doing so in partnership with these communities. Whether or not it is intentional, this corporate appropriation of cultural practices and wisdom has significant ethical issues and will no doubt continue to contribute to ongoing colonial and economic harms and exploitation for these communities (Or, 2021; Tuck & Yang, 2012).

The second risk is the potential for greenwashing, where the concept of regeneration, even in the most literal sense, is exploited without genuine commitment. Large agribusinesses such as Bayer and financial institutions such as Royal Bank of Canada (RBC) are actively deploying large-scale ini-

tiatives under the banner of regenerative agriculture, but it is unclear how much of the regeneration ethos we describe above is being maintained; Bayer, for example, continues to develop and promote new chemical pesticides, herbicides, and genetically modified seeds, all of which are arguably incompatible with the ethos of regeneration (Koman et al., 2021). Entities like RBC, meanwhile, seem heavily focused on regeneration as a way to monetize soil carbon as an investment and growth vehicle (RBC Economics, 2023), which is driving effort and resources not toward system-level change but to much more narrow matters regarding soil carbon monitoring, reporting, and verification. The challenge as we see it is to maintain the concept's conceptual flexibility while at the same time safeguarding the concept's integrity—keeping it from meaning everything and, hence, nothing.

A Treaty Before a Standard?

To meet this challenge, it is critical to have an open discussion around standards and definitions, including not just their possible benefits but also unintended consequences. Standards, generally, are meant to ensure conformity and consistency within a set of preestablished parameters. Yet, ecological regeneration is a highly contextual phenomenon, linked in myriad ways to place-based biogeographic and biocultural circumstances. That is, the practices and approaches that would be required in a regenerative agricultural system in the Canadian Prairies would necessarily have to function at different spatial and temporal scales than in, say, the forest gardens of Ecuador. The soils are different, the ecological communities are different, and the longer-term patterns of cultural presence and practice and ecological succession are different. But standards are inherently reductive and can be restrictive or even harmful as vehicles for social innovation, as was seen with the impacts of certification on the organic farming movement and fair trade certification on Global South–oriented supply chain reform (Jaffee & Howard, 2010). Other standards, such as Marine Stewardship Council, Forest Stewardship Council, and Fair Trade, have all had mixed outcomes at best (Brosius, 1999; Le Manach et al., 2020). Indeed, it may well be that the concept of standardization itself needs to be adapted or replaced as a part of exiting the industrial paradigm for human-nature relations and entering a regenerative one (Loring, 2023a).

Movements that have eschewed standardization, by comparison, such as alternative seafood networks and food sovereignty movements, have instead chosen to focus on building alliances around shared sets of values and discussions around difference (Matties, 2016; Witter & Stoll, 2017). To that end, approaches such as covenants or treaties may hold more promise than standards for advancing shared social narratives around regeneration. Whereas standards are often secured and implemented by central authorities, treaties and covenants are negotiated and implemented collectively by all involved parties. Treaties are both binding and empowering; rather than forcing conformity, they create shared ethical spaces that allow pluralism to coexist within mutually agreed upon boundaries, criteria, and responsibilities (Tupper, 2012). Two Indigenous treaties, the Two-row Wampum and the Dish With One Spoon Covenant (McGregor, 2002; Stevenson, 2006; Williams, 2021), are poignant examples of how treaties can serve to facilitate the ethical coexistence of plurality as both a right and a responsibility while still holding true to people's mutually shared interests in one another and in the rest of the natural world.

Treaties are examples of boundary objects, which are related to, but also different from, boundary concepts. Whereas boundary concepts help people to think across difference, boundary objects, which are more formalized, help people work across difference. Leigh Star (2010) and Star and Bowker (2007) discuss how boundary objects can create a sort of collaborative infrastructure that allows a variety of groups to work together or in a shared space without consensus. Three prominent international treaties serve such a role that are worth noting in the current conversation: the Montreal Protocol for ozone-depleting substances, the Paris Climate Agreement, and the Rio de Janiero Convention on Biodiversity. All of these started as treaties to mobilize action around shared values, and then proceeded to provide a necessary foundation for the establishment and implementation of frameworks, standards, and governance processes. A regeneration treaty could play a similar role: as a

tangible boundary object that enables parties to collaboratively define and realize the transformative potential of regeneration in multiple sectors of society.

A treaty- or covenant-making process for regeneration would have to be led or co-created by the original Indigenous stewards who continue to steward the land and speak for the rights and well-being of their traditional territories. Any such process would also have to be explicitly oriented around an anticolonial commitment to explicitly addressing and compensating for past harms and takings. Arguably, any sort of certification or standard for regeneration that benefits from the ecological heritage and legacy of Indigenous peoples but does not take such an approach would merely be a continuance of settler appropriation and capitalization on Indigenous lands, knowledge, and heritage (Jacobs & Lytwyn, 2020). We encourage those engaged in discussions around emergent standards and coalitions for regeneration to pause and consider the deep ethical implications and baggage of their initiatives and to lean into rather than away from the emancipatory and restorative justice potential of the emerging regeneration paradigm.

Conclusion

In the face of the escalating crises of biodiversity loss, climate change, and human suffering, the imperative to do more than merely sustain human systems is clear. Regeneration invites us to reimagine our relationship with the planet and each other, urging us to become not just stewards but active co-creators of thriving ecosystems and equitable societies. As we have explored above, regeneration can be more than a buzzword if we commit to making it more than a buzzword. It offers a paradigm shift from mitigating harm to actively fostering well-being and abundance. Embracing principles of generativity, ethical stewardship, and interconnectedness, we believe that regeneration is a powerful boundary concept and holds great potential to unite disparate fields under a common purpose. Its significance lies not just in technological changes to how we grow food or design urban centers, but in the profound social and cultural transformations that are intertwined with these efforts.

Additionally, we feel compelled to again raise the challenge of greenwashing and settler colonial takings, where the genuine essence of regeneration can be diluted or exploited for superficial gains. Future research endeavors must focus on delineating and codifying the core values of regeneration while actively resisting attempts to coopt, regulate, or diminish its transformative potential. More support for collaborative, community-led research with Indigenous Peoples and other local communities will be critical here to help define the field, ensure that marginalized voices are not further exploited, and as a prerequisite to maintaining pluralism and avoiding a scenario where regeneration becomes an exclusive or exclusionary concept. We do not necessarily oppose the creation of standards or guidelines but believe that covenants or treaties may be critical to establishing a shared ethical space for regenerative standards and practices to inhabit. As we venture into this still-uncharted terrain, the commitment to authentic regeneration, rooted in respect, care, and generativity, offers a vision and a touchstone that can keep us on track toward a world where "doing more good" becomes not just a vision for change but a shared reality.

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