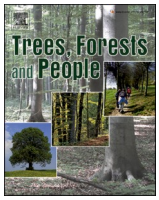
Trees, Forests and People 8 (2022) 100253

Contents lists available at ScienceDirect

Trees, Forests and People

journal homepage: www.sciencedirect.com/journal/trees-forests-and-people



Review Article

Sustainable development or developmental sustainability: Two cases of indigenous knowledge and practices for sustainable sourcing for wood-based design-solutions

Julia Bello-Bravo [a,*], Anne Namatsi Lutomia [b]

[a] Department of Agricultural Sciences Education and Communication, Purdue University, West Lafayette, IN, United States
[b] Department of Entomology, The Urban Center, Purdue University, West Lafayette, IN, United States

ARTICLE INFO

Keywords:
Wood-based
Design-solutions
Value chain
Indigenous
Forests
Sustainable

ABSTRACT

Sustainable wood-based design solutions necessarily presuppose economically, socially, and environmentally reliable sources of wood use for any future designs. However, increasingly unsustainable effects from climate extremity are now prompting the search for alternative forms of use that avoid or forestall those effects. To that end, this paper reviews the notion of sustainability and qualitatively explores two cases of contemporary-indigenous forest use illustrative of better sustainable wood-sourcing use practices. Results from the case analyses yield recommendations for (1) an explicitly holistic and long-term, even generational, scale of planning, (2) human-nonhuman collaborations rooted in an integration of the life patterns of all involved actors, and (3) a change of attitude or stance that integrates sustainability values and practices across the full extent of any wood-based solutions supply- or value-chains.

1. Introduction

Sustainable wood-based design-solutions necessarily presuppose economically, socially, and environmentally reliable sources of wood for any of its future designs. However, no consensus yet exists around the meaning of sustainability in theory and especially not in practice. A general paraphrase of sustainability's goals, drawing from the headwaters of its original formulation (Brundtland et al., 1987), is meeting the needs of the present without compromising the future ability of others to meet their needs as well, especially by meeting "the essential needs of the world's poor, *to which overriding priority should be given*" (Brundtland et al., 1987, p. 41, emphasis added). In this context, the world's poor are those who are globally more vulnerable, less advantaged, or otherwise have less access to essential needs in any given context; they are the world's *poorer*. Ensuring that global and local efforts actually achieve sustainability's goal of prioritizing the essential needs of those with less access to meet them is critical for the survival of not just the human species but all life on the planet, especially in light of ongoing and anticipated future impacts on forests due to worsening climate extremity (Augustynczik et al., 2020; Canadell and Raupach, 2008; Hou et al., 2020). Throughout this paper, the urgent and looming menace of the effects of worsening climate change, especially for the world's poor, are the continuous prompt and goad for taking to heart and undertaking the needed changes for achieving genuine sustainability.

For sustainability in wood-based solutions more narrowly, one self-evident and practical aspect of this is simply ensuring a *reliably indefinite (renewable and resilient) source of wood*. In one sense, this is the most basic sense of sustainability. However, the core sustainability value of granting overriding priority to meeting the needs of less advantaged stakeholders must also apply at every link of a value-chain (from solution-design to production to distribution to receipt). For example, at the production link, this means prioritizing and meeting the needs of workers performing the production; at the solution-design level, this means prioritizing and meeting the needs of those who physically transform conceptual designs into blueprints, design images, and so forth. In all cases, the actual balance or triple-bottom line of environmental, social, and economic priorities at each link will vary significantly in terms of maintaining it sustainably.

These link-differences of emphasis will have dramatic consequences for sustainability depending on where they fall in the chain. What is meant by sustainability at the production-side link of design-solutions has tended to prioritize economic sustainability (i.e., the design-solution's production cost-effectiveness and ROI) over any social and

* Corresponding author.
E-mail address: mbellobr@purdue.edu (J. Bello-Bravo).

https://doi.org/10.1016/j.tfp.2022.100253
Received 23 August 2021; Received in revised form 3 April 2022; Accepted 7 April 2022
Available online 9 April 2022

environmental sustainability. As such, the emphasis on triple-bottom-line sustainability affects and applies not simply to value-chain end-recipients or economics (Cashore and Vertinsky, 2000; Gulbrandsen, 2004; Schepers, 2010) but also to the workplace *environment* and longer-term *social* supports for employees in the value-chain (including benefits and pensions). Similarly, while the end-recipient link of the design-solution value-chain is often critically shaped by economic sustainability (the cost of the solution for end-recipients), the solution itself can often have social and environmental costs that unsustainably outstrip or negate any economic gains (Corntassel, 2008; Martínez-Alier et al., 2010; Mather et al., 1999; Rudel and Horowitz, 1993; Schneider et al., 2010).

An objection to this call for integral sustainability at *every* link of a value-chain from source to producer to recipient is that wood-based design-solution producers can simply assume or assure sustainability of wood-sourcing *upstream*. However, even producers (who are seemingly at the front of a value-chain) are already a recipient (at the end of another one). Equally, solution recipients (seemingly at the end of a value-chain) will often become new headwaters for subsequent design changes or innovations (at the front of a value-chain). This suggests that a value "chain" more resembles a mutually dependent circle than a linear chain (Frandy, 2018).

For wood-based design producers specifically, this situation leaves them liable to unsustainable (or even harmful) upstream social, environmental, or economic effects from non-sustainable wood sourcing by suppliers. This is not only the basic problem that wood suppliers may openly or secretly engage in expressly non-sustainable, possibly illegal, or purely economically driven and environmentally harmful extraction from forests or protected reserves (Brack, 2003; Vasco et al., 2017). It also includes more indirect issues for solution-designers, including but not limited to

- suppliers" unsustainable pricing decisions, large-scale shifts in markets, and bad PR optics (c.f., the child slavery lawsuits facing major chocolate producers due to their suppliers' labor practices, Balch, 2021)
- Non-renewability or non-resiliency in suppliers that cut off a wood source and negatively impact or preclude long-term sustainability and viability of wood-based solution designing (Hajmohammad and Vachon, 2016; Ridwan Kurniawan and Nuraeny, 2018; c.f., the short-term vs. long-term discussion in Turnnidge and Kelly, 2021), and
- An inability to get good partners for sourcing, absent the (contractually unlikely) premise of making *their* long-term sustainability explicitly a part of *your* long-term sustainability also (Hessels and Terjesen, 2010; Pfeffer and Salancik, 2003; Sherer and Lee, 2002).

The foregoing suggests that sustainable wood-based design solutions might advocate for and adopt a stance toward design sustainability based more on prioritizing end-user criteria over the producer's (Barnaud et al., 2014; Barreteau et al., 2014). This would also more align with the Brundtland Report's (1987) criterion to grant overriding priority to meeting the needs of less advantaged stakeholders' in any sustainable design scenario. However, because being a "recipient" does not automatically or inherently make a stakeholder the less advantaged one in some given scenario, achieving sustainability will at times require producers (as supply-recipients) to meet the essential needs of their supplier-links upstream of them. An instance of this is visible in wood-sourcing forest certification regimes that can distribute more benefits to developed countries than the developing countries where the wood originates (Schepers, 2010). Consequently, Frandy (2018) speaks explicitly of "indigenizing sustainabilities" (p. 1) as a way to more holistically frame and operationalize sustainability—to make sustainability itself more sustainable. This paper's two cases explore that suggestion. At its broadest, the findings apply indigenized sustainability to (how we think about) global sustainability efforts, while also more "narrowly" or "practically" framing this for wood-based solution-designs specifically.

2. Method

2.1. Case study selection

Motivated by Bello-Bravo (2020b), which explored local tensions and negotiations around multispecies sustainable stewardship efforts to restore a sacred forest in Benin under local people's traditional (indigenous) use, this paper qualitatively explores other contemporary indigenous forest use practices that support sustainable wood-sourcing practices against a background of the revisited sustainability concept generally. The research question was, "What aspects of forest use practices support reliably indefinite (renewable and resilient) wood--sourcing" for wood generally and wood-based solutions specifically. As will be seen, although much research on sustainable forest management exists, when narrowed to indigenized sustainability practices for forests, the number of relevant studies plummets.

Initially, a combined search including Google Scholar and BASE specifically for journal-published, intitle-delimited "wood sourcing practices" studies since 2017 counterintuitively yielded only two results: Kittler et al. (2020), which assesses the US wood pellet industry's sourcing practices, and Sikkema et al. (2017), which discusses the EU's energy policy and wood. Notably, even without the title delimiter, "wood sourcing practices" yielded only 46 results for the search period; when further delimited by "indigenous," the number of results drops to 15. None of the studies were relevant to the focus of this paper.

Another initial search for "sustainable forest management" + "wood sourcing" yielded only 75 results for the search period; when further narrowed by ~indigenous, this yielded 19 studies, but none provided sufficiently "thick descriptions" (Geertz, 1973) for qualitative analysis. Trosper (2007) has also noted that a framework of "forest management" may analogize with, but does not accurately capture, indigenous wood-sourcing patterns or forest use.

Taking a cue from the emphasis on "indigenous stewardship" in Schang et al. (2020), a search for intitle:"indigenous stewardship" during the same period yielded 18 results. Adding the further limiters ~wood and ~wood ~forest yielded 6 and 5 results, respectively. Of these last, two (one a thesis) explored the discourses around environmental justice and biodiversity vis-à-vis indigenous stewardship (Holm, 2021; Mulrennan and Bussières, 2020), two (one a thesis) explored indigenous stewardship related to waters (Hewitt, 2019; Lee et al., 2019), and one explored indigenous stewardship of forests specifically (Waller and Reo, 2018). Upon review of these studies, Waller and Reo (2018) met the search criteria.

For the sake of completeness, we note that since originally conducting this paper's literature searches in 2021, two more studies have been published: one on the archeological history of indigenous stewardship on the Santa Cruz coast (Lightfoot et al., 2021) and a second on plant stewardship by the Wolastoqiyik and Mi'kmaq communities in North America (Baumflek et al., 2021). While the focus on "indigenous plant stewardship" in the latter is closely related to the specific focus of this paper, because it fell outside of the search period, it was not included in this paper's data or analysis. Also of note, an original element of this research intended to focus on multispecies sustainability specifically, but the paucity of studies overall discouraged adding that delimiter. Nevertheless, Waller and Reo (2018) include multispecies themes in the forest sustainability investigated.

2.2. Data analysis

Using the theoretical frameworks of *sustainability* and *use* below, both researchers independently coded the two studies (Bello-Bravo, 2020b; Waller and Reo, 2018) that matched the research question and conferenced to resolve any coding discrepancies until a >95% inter-rater

agreement was reached (Gwet, 2014). Codes were then further clumped for emergent themes.

2.3. Theoretical framework

Sustainability. While Circular Ecology (2021) tallies at least 200 definitions for sustainability and sustainable development, a majority emphasize that initial and oft-cited formulation for sustainability and sustainable development from *Our Common Future* (e.g., the Brundtland Report) (1987); namely, that sustainable projects must "meet the needs of the present without compromising the ability of future generations to meet their own needs" (p. 41). Less frequently emphasized from this formulation are "two key concepts" that *Our Common Future* explicitly highlights; namely,

- The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs (p. 41).

Out of this initial formulation has gradually emerged a general notion that the design-solutions of sustainable developmental should maximally balance a triple bottom line of economic, social, and environmental benefits while also minimizing any harmful impacts from the design-solution in the milieu where it is intended to be used (Afful et al., 2019; Luetz and Walid, 2019; United Nations, 2020). This principle echoes the medical sense of *outcomes* and *impacts*, where the intention is to intervene into a problem or condition with the most effective (short-term) procedure that also has the least disruptive (long-term) impacts (Bello-Bravo, 2019).

At the heart of this insight are two additional criteria that ultimately constrain sustainable design-solutions as well: the notion of "first, do no harm" and the mandate that interventions be minimally invasive. Although scholarship differs about the origin or exact wording of the mandate *first, do no harm* (Aring, 1965; Inman, 1861; Markel, 2004; c.f., Smith, 2005, for a thorough historical discussion; Sokol, 2013), Inman (1861) captures its core value: "We believe that the principle of doing evil to the constitution that good may come is as false in medicine as it is in theology" (p. 244). Usually attributed to Hippocrates, Smith (2005) notes, "According to medical historians, the only known relevant Hippocratic sayings are found in Epidemics (Book I, Chapter XI): 'As to diseases, make a habit of two things—to help, or at least to do no harm' (p. 371). Part of doing no harm suggests the second implied criterion: that interventions will be *minimally invasive* (Brooks, 1998). Thus, while always striving to do the least harm (if harm must be done at all), then one must also apply the smallest intervention possible that is still effective (Bratt et al., 1997; Brooks, 1998).

Taken together, these two criteria underscore what sustainability for design-solution *outcomes* and *impacts* could look like—namely, a minimally invasive but still effective (short-term) intervention that has the least disruptive (long-term) impacts in the milieus where the design-solutions are implemented (Bello-Bravo, 2019). Not integrating these criteria at all points along the value chain or circle risks doing more harm than good with design-solutions.

Remembering "in particular the essential needs of the world's poor, to which overriding priority should be given" (Brundtland et al., 1987, p. 41), the criteria and approach described above require a genuine disavowal of "business as usual"—for example, not practicing production-side climate-smart agriculture efforts toward sustainability that merely "greenwash the status quo" (Zundel, 2017, p. 80) and fail to foster short-term-effective, long-term-nondisruptive sustainability locally. While even more stark differences can be seen between corporate and non-corporate sustainability (In and Schumacher, 2021; Kalra, 2019; McIntyre et al., 2018; Pjevovic, 2017), some of the most prominent governance structures for sustainability may not be adequately giving, operationalizing, or supporting an overriding priority to meeting the needs of the world's poorer with respect to forests, especially given that

- Forest Stewardship Council (FSC) efforts have "seen more success *in developed than developing countries* in terms of amount of forest certified and number of chain-of-custody certificates issued" (Schepers, 2010, p. 279, emphasis added),
- The corporatist nature of the PEFC (Cashore and Vertinsky, 2000; Gulbrandsen, 2004) is directly opposed to the notion of the sustainability of a commons (in this case forests)(Schepers, 2010, p. 280), and
- Certification processes in general function (by design or by accident) to *exclude* access by the world's poorer to economic opportunity and its concomitant social wellbeing (Arthur, 2014; Bello-Bravo and Amoa-Mensa, 2019; Biyase and Zwane, 2018; Counsell and Loraas, 2002; Currie, 2018; Onwuegbuchulam, 2018; Taylor, 1978).

These challenge for sustainability occur within academic and scientific design-solutions research as well (emphasizing again the need for integral sustainability across an entire value-chain). In their recent review of sustainable supply-chain management research, Sánchez-Flores et al. (2020) note that "a clear research gap is the global integration of the three dimensions of sustainability in emerging economies" (p. 19). More broadly, Holmgren et al. (2020) analyzed 59 studies on forest-based "bioeconomy transformations and pathways" and found that "much of the research tends to replicate a bioeconomy imaginary articulated in EU and national bioeconomy policies and strategies. Accordingly, the research primarily reproduces *a weak approach to sustainability, which prioritize economic growth and competitiveness*" (Holmgren et al., 2020, p. 1860, emphasis added). This echoes the criticism raised by Schepers (2010) for forest certification specifically but also work by other researchers that identifies a prevailing tendency to prioritize the economic pillar of sustainability over (or at the expense of) the social and environmental pillars (Afful et al., 2019; Luetz and Walid, 2019).

Efforts likely to achieve actual sustainability goals in the world—efforts that meets the needs of the present without sacrificing the future's capacity, while giving overriding priority to meeting the needs of the world's poorer—requires a change of perspective. This change of perspectives involves a committed *stance,* as a reorientation within solutions-design work as well, out of which changes of practice will follow in a new repertoire for sustainability (Barnaud et al., 2014; Étienne, 2014). Obviously, such a call for a change of stance will seem the most challenging aspect, because it specifically requires not just that *others* change how they do things, but that *we* must as well.

Nevertheless, without some pragmatic or concrete guideposts and insights into what those changes might be—above and beyond the perennial obstacles to change that occur due to institutional inertia, a lack of solidarity or consensus about any needed changes of direction, and resistance by stakeholders who already benefit from the current arrangement (Farrell, 2019; Jankó et al., 2020; Munck af Rosenschöld et al., 2014; Walther et al., 2005)—it may seem difficult if not impossible to decide what direction to take. Fortunately, a growing literature already documents indigenous patterns of sustainability that disclose what that stance and change of practice might look like (Bangura, 2005; Baumflek et al., 2021; Karsten and Illa, 2005; Kimmerer, 2002; Tsosie, 2019; Waller and Reo, 2018). At its deepest roots, the needed change of stance is not so difficult in practice but does hinge on a fundamental change of worldview regarding *use*. Briefly, we must turn to that.

Two Worldviews around 'Use': Modernist and Traditional. There can be no question that sustainable wood-based solutions require the *use* of an in-principle indefinite (renewable and resilient) source of wood, whether through (1) repurposing or waste recycling, including wood ash (Shahidul et al., 2018; Stupak et al., 2008), (2) stewardship or management of existing stands of forests and other woody materials

(Baumflek et al., 2021; Bello-Bravo, 2020b; Canadell and Raupach, 2008; Posey, 1985; Waller and Reo, 2018; Wiersum, 1997), (3) conversion of existing ecologies to or from sources of wood (whether as deforestation, conservation, restoration of sacred forests, or attempts to balance of these forces) (Aggestam et al., 2020; Bello-Bravo, 2020b; Köhl et al., 2015; Sun et al., 2004), or (4) artificially engineering or creating wood-like materials (Ueitele et al., 2021; Zafar and Siddiqui, 2017; Zaman et al., 2014). Arguably, some of these approaches may no longer fall within the ambit of wood-based solutions; for example, Binhussain and El-Tonsy (2013) engineered a wood-like building material out of plastic and date palm waste.

Such *use* constitutes "any activity that has a manifest effect in the world, whether physical, psychological, or socioeconomic" (Bello-Bravo, 2020b, p. 3). That human beings (not alone among animals) use the world's materials is not just inevitable but unavoidable (Kimmerer, 2013). However, this notion of use also includes prohibitions and restrictions on use, whether private or public, or for scientific, humanitarian, conservationist, or political ends (Beissinger et al., 2017; Bendix, 2000; Frandy, 2018; Singh et al., 2017). The shared assumption across all of these examples (in both indigenous and non-indigenous settings) is that the "purpose" of Nature (in this case forests and other woody plants) is to be used by human beings (Bello-Bravo, 2020b; White, 1967).

However, because human beings (in common with other heterotrophic species) must and will consume the things of the world to persist (Kimmerer, 2012; Mangena, 2013), the question is not *if* we consume but *how* we choose to do so, along with the narratives we spin around those choices (Mangena, 2016). Accordingly, our species has a breadth and scale of choice—even a duty (Kimmerer, 2012)—unrivaled among others to assess the consequences of those choices and narratives. For example, do we (1) describe and treat a forest instrumentally as "nothing but" a commodity, wood, which we can freely use (sustainably or not) without constraint and without consideration of anything else, including other species, or do we (2) address forests as a living and communal entity whose help in the preservation of all species generally (both now and into the future, as also throughout the entirety of our existence as a species) is as critical and vital as the help of other people?

Merely for the sake of having a distinction to refer to, these two ways of viewing the use of forests (or Nature generally) are *modernist* and *traditional*. Notwithstanding the perils and inadequacies of all seemingly binary dichotomies (Goulden, 2009; Perea, 1998), this distinction turns back to the previous criteria above requiring a choice of the most effective (short-term) intervention-solutions with the least economically, socially, and environmentally disruptive (long-term) impacts. Acknowledging the global socioeconomic gains from the modernist worldview over the last three centuries (Williams, 1983), these also have now self-evidently led to unsustainable long-term (and still longer-term) impacts from technological industrialization (White, 1967; Williams, 1989)—both directly and indirectly, and in their consequences as pollution, environmental degradation, and effects from industrialization of food production, especially hoofed meat animals (Bondu 2017; Bondu et al., 2016; Henry et al., 2018; IPCC, 2014; Khalid and Shahid, 2017; Osborne, Bellante, and von Hedemann, 2014; Rayan, 2020).

This situation is not a result of technology per se but rather its current industrialized socioeconomic form. Every human society from the beginning has been technological (culture and language being the most fundamental human inventions of all) (Maturana and Varela, 1987). It may well be that impacts from pre-industrial technologies (both currently and in the past) were simply smaller-scale and less disruptive over the long-term, when not explicitly sustainable (Magni, 2017; Reynolds and Stafford-Smith, 2002; Taylor, 2010). However, in the current face of looming climate extinction, better sustainable forms of use are called for to avoid that outcome, especially for the sake of the world's poorer who face steeper consequences from the primary and secondary aspects of worsening climate extremity (Dervis, 2007; Farbotko, 2020). What Frandy (2018) refers to as "indigenized sustainabilities" represent one instance of better sustainable forms of use—as illustrated in the case studies matching this study's research parameters below.

3. Results & discussion: case studies in indigenous wood-based sustainability

Summarizing the findings from the data analysis of the relevant articles in advance, these include three themes within indigenized practices: (1) longer-term timeframes of planning and action that achieve the most short-term effective interventions or outcomes with the least long-term disruptive effects, (2) a more holistic or systems-view of the economic, social, and environmental actualities of a setting that take account of human and nonhuman stakeholders, and (3) a stance, attitude, or worldview that narrates forest use not in instrumental terms. We address these themes separately for each case study below.

3.1. Forest stewardship in northern Wisconsin

Waller and Reo (2018) report on present-day indigenous forest management practices among the Menominee and Ojibwe peoples (in northern Wisconsin). For context, these communities practice selective logging and harvest rotation (as a traditional use) in these forests (Trosper, 2007), yet also exhibit higher biodiversity and tree regeneration (Waller and Reo, 2018). Comparing the adjacent and similar state and federal forests, indigenously managed forests held larger carbon reserves in more mature trees, maintained greater or increased biodiversity, had fewer invasive species, and lower deer density per acre (Waller and Reo, 2018).

Holistic (Multispecies) Perspectives. Waller and Reo (2018) particularly highlight indigenous hunting of deer (specifically, white-tailed deer, *Odocoileus virginianus*) as a keystone to these observed forest patterns. Grazing deer affect tree regeneration by eating or damaging new tree saplings but also have multiple downstream effects on other forest ecologies (Côté et al., 2004; Waller, 2014). Culling deer populations becomes essential for achieving the healthier qualities of indigenously managed forests (Waller and Reo, 2018).

This approach contrasts with recreational or individualistic non-indigenous deer hunting on nontribal lands (Waller and Reo, 2018). Equally, the observed practices in Wisconsin reflect the broader, more community- or communally-oriented valuation placed by indigenous peoples on hunting (McCorquodale, 1997; Sayles and Mulrennan, 2010). More significantly, culled venison is also shared with other nonhuman living beings in the forest—eagles and bears, but especially wolves (*ma'iingan*), who are treated by the Ojibwe as family members integrally involved in the fate of the community generally (Usik, 2015). Specifically, the human culling of deer reduces the means of livelihoods and survival for other populations within the forest. Thus it follows, both morally and practically, that those otherwise harmful human effects should be offset by more sustainable activities toward other stakeholders in the forest who would not otherwise have access to the essential need of food. This personification and extension of moral status to a nonhuman Other in a world where humans live (Mangena, 2013) also informs indigenous decision-making around the selective logging of trees (Yazzie, 2007).

Indeed, forests offer much more besides wood (Baumflek et al., 2021). The indigenous "systems look" understands not only its many economic gifts (Kimmerer, 2013)—including food, medicine, materials for culture-building or trading, and homes for other living beings and spirits (Bello-Bravo, 2019) as well as genetic biodiversity, carbon sequestration, and species restoration (Mäder et al., 2002; Neuenschwander et al., 2003; Pimentel et al., 1995)—but also its social role in the formation of multi-community organizations to maintain them (Gilmour, 2016; Muttaqin et al., 2019). All of this depends foremost on woods as the keystone of land itself. As such, much in the same way that channeling investments to women can have a multiplicative benefit effect compared to similar investments in men (Anderson et al., 2021;

Ashby et al., 2009), centering woods as a keystone for sustainability also has multiplicative, holistic, and system-wide effects.

The moral argument for including nonhuman actors in our human calculations is not easily dismissed or intractable (Kimmerer, 2012, 2017; Mangena, 2013) but can seem weak or readily fall to the wayside under the pressure of survival (see the topic of hunting endangered monkeys in the case study below). However, the argument here is not only moral. The now-present and worsening long-term effects of industrialized instrumental-only use of environments has brought the entire globe, along with our own species to the brink of mass extinction (Fears, 2019; Strona and Bradshaw, 2018). In contrast, the collaboration between the Ojibwe and *ma'iingan* communities illustrates how we (as a species) can benefit from the indigenized social habit of extending moral status (Mangena, 2013) to all other living beings (Kimmerer, 2012). As such, treating Nature as instrumental-only causes short-term harms with long-term detrimental effects and denies us the benefit of collaborative action.

Long-term Perspectives. Especially characteristic of this indigenous "systems look" approach to forest stewardship is a long horizon of planning, sometimes even generations ahead (Davis, 2000). This embraces completely the notion of meeting the needs of today without sacrificing tomorrow's and contrasts starkly with short-term corporate profit-taking (Wright and Nyberg, 2017) and decision-maker tenures based in four- and six-year political cycles (Mändmaa et al., 2020; Schulze, 2021). It also implicitly aligns with problems of climate, which operate at very long time-scales already (Barfuss et al., 2020).

Nevertheless, Trosper (2007) cautions that while this indigenous future-vision of sustainability could be likened to non-indigenous notions of "sustained yield," its underlying rationale (among the Menominee specifically) is not rooted in a "sourcing" or "management" narrative but, rather, in an origin narrative and its accompanying values that contextualize human beings as part of Nature generally, as one among many in a "democracy of species" (Kimmerer, 2017, p. 133) with other nonhuman flora and fauna. The constraints this strategy of "origin narrative" places on human use of forests is resultantly less invasive, as measured in the greater health of indigenous forests compared to nearby similar state and federal land (Waller and Reo, 2018). As such, this "origin narrative" approach better aligns with applying a least-invasive but most-effective (short-term) intervention with the least-disruptive (long-term) impacts.

Narrative perspectives. As Mangena (2016) convincingly argues, if the prevailing mood of postmodernism asserts a situation and opportunity (if not a mandate) to choose between competing narratives about life, culture, and how to live, then as "fanciful" and anthropomorphic as the indigenous narratives about forests may seem, it is clear that they have a greater power to elicit, foster, support, and perpetuate commitments to sustainability among human cultures; Kimmerer (2012) and Waller and Reo (2018), in any case, demonstrate the relevance and applicability of indigenous criteria even for national-level decision-making.

In these ways, sustainability around "respecting" (rather than "sourcing") woods will better ground environmentally sustainable future prospects for wood-based design-solutions generally. Such an approach also more broadly and socioeconomically benefits all living beings through its manifold "downstream" effects. Through these more holistic, long-term, and empirically supported narratives, it becomes more apparent how to achieve maximally effective (short-term) benefits with the least disruptive (long-term) impacts (Bello-Bravo, 2019). The hybrid modernist-traditionalist forest use in this case represents an instance of what Frandy (2018) calls indigenized sustainability, as an adaptation of traditional practices and values re-contextualized within the contemporary era. Here again, we are reminded by Trosper (2007) that this continuity is not some romantic holdover from days gone by, but emerged from, and was shaped by, intense socio-legal opposition from the surrounding non-indigenous State and culture.

3.2. Restoring a sacred forest in Benin

Bello-Bravo (2020b) analyses the fruits of a more than two-decade project to restore a neglected sacred forest in Benin within a context forest use by several classes of human and nonhuman actors. Originally purchased by a European, the long-term vision was to restore the biodiversity of the sacred forest and provide a habitat for endangered species of flora and fauna, especially the red-bellied monkey (*Cercopithecus erythrogaster*). While the sustainability goals of this project were explicitly environmental, it required extensive interplay between the social (and, to a lesser extent, the economic) aspects of the nearby village community to achieve its success. In particular, local villagers' traditional use of the forest for food, medicine, and (fire) wood regularly threatened or impacted efforts to restore species. Depredation of wood reserves, more often due to population increases than conversion to farmland, is a characteristic problem for sustainability, especially in Benin (Tola, 2010) despite national effort for the sustainable protection of forests (ADBG, 2017; Government of Benin, 2012; Rombolli, 2008).

Narrative perspectives. Attempts by the sacred forest owner to redirect or change local harvesting and hunting practices found little traction with locals until he became an initiate of the *zan-gbeto*, a Beninese men's society that traditionally guards villages. This membership afforded him the socio-legal standing to create and enforce policies within the forest under his supervision (Bello-Bravo, 2020b, p. 5). More exactly, such initiation is the preeminently traditional cultural form by which someone becomes *recognized as having attained* the status of a person with real access to participation within social life (Eliade, 2009).

Effectively, this meant that he was seen differently by local villagers, and thus the identity and story told about him locally changed. From Mangena (2013), initiation confers and extends moral status. Moreover, while many narratives about encounters between modernist and traditional peoples rightly emphasize an arbitrary or harmful colonializing imposition of alien values on pre-existing cultural forms (Bello-Bravo, 2020a; Desai, 2017; Sanya et al., 2018), in this case the social power was almost entirely on the side of the villagers, such that the forest owner was the one required to assimilate. As such, this captures an instance of what Frandy (2018) calls indigenizing sustainabilities.

Consequently, the forest owner's change of social identity also socially mandated that he distribute largesse and donations to people in the village for help with medical expenses, tuition, and other costs, as is traditional for forest stewards. "Few people in the village outside the small circle of immediate friends would tolerate the forest if it were not for this assistance" (Neuenschwander et al., 2015, p. 35). Subsequent attempts to redirect or change wood foraging practices also received implicit support from the national legislation for the protection of sacred forests (Government of Benin, 2012). This law specified and included "buffers" around the perimeters of protected areas specifically for traditional uses, including farming, medicinal plant growth, and wood sourcing. Unlike in the first case above, where harvesting wood is an integral part of the picture, wood preservation in the present case precluded any harvesting whatsoever; for that reason, the provision of buffers affording alternative sources of wood were integral to enabling and maximizing the environmental and social aspects of sustainability in this case.

Further social and economic negotiations were still required and took a long time. Initially, the owner hired villagers to guard the forest against human incursions (thereby transforming the traditional village role of village guards to forest guards). However, village elders demanded to be kept in the loop for that new income stream. An *ad hoc* committee was subsequently established and eventually became permanent, a new institution within social life. Its purpose was partly to oversee money, but it also formalized the airing of grievances related to the forest (as an actor). These were often raised by farmers against inhabitants of the forest (usually monkeys foraging from surrounding farmers' crops, whether actually or purely by accusation). But local offenses by humans against the forest (e.g., prohibited hunting or

foraging) were also adjudicated.

In particular because this project of forest restoration arose as a new practice within the long-existing context of village life, shifts in narrative, identity, and purpose are more prominent here than in the first case. Thus, the identity of the "on-paper legal" owner of the land to be restored had to undergo a change (through his initiations) to become socially accepted as an "off-paper recognized" steward of the sacred forest. Similarly, the local populace gradually changed its narrative about the edibility of (endangered) red-bellied monkeys, which the forest owner wanted to protect, while the zan-gbeto (as traditional protectors of the village only) transformed into protectors of the sacred forest as well. Inescapably, these and still other cultural shifts and negotiations necessary to make the restoration of the sacred forest sustainable and successful took a long time, sometimes years.

Long-term perspectives. The ongoing sustainability of this project required a long-term vision that could successfully mediate and meet short-term needs (i.e., otherwise destructive foraging of newly restored plant and animal species) without long-term disruptions to the forest. This required a provision of viable alternatives to those short-term needs. For example, buffers around the sacred reserve itself afforded flora otherwise foraged from the forest to be cultivated in the buffers instead. The forest itself also offered an alternative to hunting red-bellied monkeys, after another species of abundant and not endangered green-bellied monkeys took up residence in the forest and became an alternative source of meat.

Critically, these changes of practice were not necessarily accompanied by a change of understanding across actors. This will prove essential for multispecies sustainability. For example, the motivations for the forest owner's scientific project to promote biodiversity and species restoration—while requiring local people *not* to use the gods-given local bounty of the forest to meet their needs for food and medicine—did not (and may never) make sense to local people, and understandably so. As mentioned in the previous case study, this is an instance case where a moral (or scientific) rationale can fall by the wayside in the face of survival. Conversely, from a scientifically materialist perspective, that the national law in Benin protects sacred forests explicitly, in part, because they are a "home to several gods" (Government of Benin, 2012) may not (and may never) be ideologically untenable. That local people claimed evil spirits had had a hand in an instance of severe forest vandalism demonstrated, in the owner's opinion, "the possible negative effects of local beliefs" (Neuenschwander et al., 2015, p. 34). These are irreconcilably divergent worldviews.

Nevertheless, over a long period of time, both the forest owner and the villagers arrived at forms of interaction that supported sustainability within the restoration of the forest despite their incommensurable difference of values about the rationale for protecting the forest. So also between the incommensurable realities of *ma'iingan* (wolves) and humans in Wisconsin, where over a long period of time, forms of interaction were negotiated that support the long-term sustainability of a sacred space of forest.

Holistic perspectives. In this case, the sustainability of the forest (economically, socially, and environmentally) required interactions between actors consisting of insider and outsider (or transitioning) humans, nonhuman other species (including red- and green-bellied monkeys, and restored or newly introduced flora), and the forest itself. Economically, a possible burgeoning ecotourism to the sacred forest may offset some villagers' opinions that maintaining such an enclave makes them look backward (Bello-Bravo, 2020b). Socially, new institutions have emerged while existing ones (including forms of identity) have changed. Notably, this includes a committee to assess the legal culpability for impacts on farmers' crops by the forest itself (represented by the spokesperson of the forest steward himself). Environmentally, the health of the forest is vastly improved, its biodiversity has increased dramatically, and it now serves as a refuge for threatened animal and plant species (Neuenschwander and Adomou, 2017). More broadly still, this system of indigenized sustainability itself is further enmeshed in the immediately surrounding region—which at one point attracted outside hunters threatening predation in the forest and prompted the transformation of zan-gbeto men from village to forest protectors—and national-level sacred forest protection.

What especially emerges in this case of sustainability, with its capacity (as also in Wisconsin) to include in its activities the needs of nonhuman actors (other flora and fauna inhabiting the forest), are the *edges* along boundaries where this happens. These can be quite distinct, i.e., the buffers between the forest and village, or more ambiguous, i.e., the ways that the identity of the forest owner (who is simultaneously a European outsider and an initiated insider) straddles both; similarly, the zan-gbeto, who no longer protect only the village but the forest as well. Negotiating these edges across incommensurable value-differences requires an especially capacious and holistic perspective, along with sufficient time to sort out how to act.

3.3. Recommendations

Findings from the data analysis and discussion highlight indigenized practices for sustainability that include (1) longer-term timeframes of planning and action that achieve the most short-term effective interventions or outcomes with the least long-term disruptive effects, (2) a more holistic or systems-view of the economic, social, and environmental actualities of a setting that includes human and nonhuman stakeholders, and (3) a stance, attitude, or worldview that narrates forest use not in instrumental terms. Above all, this change of worldview or perspective is the most needed, and, as already noted, its argument is not only moral. Treating Nature as instrumental-only has self-evidently caused unsustainable short-term harms with long-term detrimental effects while also denying us the benefit of collaborative action with other members of the world's "democracy of species" (Kimmerer, 2017).

More narrowly and pragmatically for wood-based solutions, ensuring reliably indefinite (renewable and resilient) wood-sourcing addresses only the economic pillar of sustainability both for organizations and across the arc of design processes overall (from production to receipt). As such, implementing design processes and products under the criterion of maximizing short-term solution effectiveness with the least long-term disruptions would better support an organization's social and ecological pillars of sustainability. Similarly, making provisions for alternative ways to meet short-term needs (especially economic ones), while utilizing the design criterion above at every point over the process of solution-production, also better reflects social and environmentally sustainable action, e.g., prioritizing longer-term capacity building over short-term profit-taking.

Further, wood-based solution designers can recognize that collaborative design processes (and solution-design circles) can sustainably occur even when incommensurable differences of worldview otherwise seem to get in the way. Pragmatically, this means it may only be necessary to establish among stakeholders *what* an outcome should be without enforcing, utilizing time and resources, or attempting to generate a consensus around a rationale for attempting the effort. It is clear in the cases of wolves and humans in Wisconsin (or humans and a sacred forest in Benin) that otherwise incommensurable value-systems need not preclude collaborations that result in more economically, socially, and environmentally reliable, renewable, and resilient wood-sourcing outcomes now and into the future.

4. Conclusion

This paper asked the question, "What aspects of forest use practices support reliably indefinite (renewable and resilient) wood-sourcing." The core of the answer consists of narratives, perspectives, and criteria that incorporate longer-term, more holistic approaches to support human *and* nonhuman worlds. In postmodern terms of competing ideas, this is a rejection of the use of Nature as instrumental only and a recognition of the co-participation in life of nonhuman actors. While the

indigenized sustainabilities of this paper proactively argue in favor of this possibility, the increasingly looming and ongoing effects of worsening climate change actively argue against continuing business as usual. It is the case that human beings have no choice but to be consumers—including consumers of wood for wood-based solutions—but how we choose to consume still remains open.

Whether applied to wood-sourcing for wood-based solutions themselves, as part of the complete arc of design-solutions practices from production to recipient, or in the course of acting as one among the many of the world's democracy of species, the perspectives, criteria, and narratives of indigenized sustainabilities in this paper illustrate a use of Nature that is not instrumental-only and which achieves more sustainable results. The committed stance of these perspectives and criteria incorporate meeting the essential needs of the least advantaged, both now and in the future, whether these are trees, forests, or other human and nonhuman people. Doing so gains us the benefit collaborative effort and force amongst all species on the planet and co-implicates meeting the needs of them all as well.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

ADBG, 2017. Benin Community Forest Management Support Project – Phase II (PAGEFCOM-II) Appraisal Report. African Development Bank Group, Abidjan, Côte d'Ivoire.

A. Afful, G.K. Kumi-Acquah, & K. Agyekum (2019). Level of knowledge of design professionals on the principles of social sustainability in Ghana. Retrieved 27 April 2020, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3511538.

Aggestam, F., Konczal, A., Sotirov, M., Wallin, I., Paillet, Y., Spinelli, R., Lindner, M., Derks, J., Hanewinkel, M., Winkel, G., 2020. Can nature conservation and wood production be reconciled in managed forests? A review of driving factors for integrated forest management in Europe. J. Environ. Manag. 268, 110670 https://doi.org/10.1016/j.jenvman.2020.110670.

Anderson, C.L., Reynolds, T.W., Biscaye, P., Patwardhan, V., Schmidt, C., 2021. Economic benefits of empowering women in agriculture: assumptions and evidence. J. Dev. Stud. 57 (2), 193–208. https://doi.org/10.1080/00220388.2020.1769071.

Aring, C., 1965. Primum non nocere. Arch. Intern. Med. 115, 345–350.

Arthur, J.A., 2014. Class Formations and Inequality Structures in Contemporary African Migration: Evidence from Ghana. Lexington Books, Lanham, MD.

Ashby, J., Hartl, M., Lambrou, Y., Larson, G., Lubbock, A., Pehu, E., Ragasa, C., 2009. Investing in Women as Drivers of Agricultural Growth Gender in Agriculture Sourcebook. IFAD, Washington, DC, pp. 1–8. The Agriculture and Rural Development Department of the World Bank, the UN Food and Agriculture Organization (FAO), and the International Fund for Agricultural Development.

Augustynczik, A.L.D., Gutsch, M., Basile, M., Suckow, F., Lasch, P., Yousefpour, R., Hanewinkel, M., 2020. Socially optimal forest management and biodiversity conservation in temperate forests under climate change. Ecol. Econ. 169, 106504 https://doi.org/10.1016/j.ecolecon.2019.106504.

O. Balch (2021). Mars, Nestlé and Hershey to face child slavery lawsuit in US. Retrieved 15 February 2021, from https://www.theguardian.com/global-development/2021/feb/12/mars-nestle-and-hershey-to-face-landmark-child-slavery-lawsuit-in-us?CMP=Share_AndroidApp_Other.

Bangura, A.K., 2005. Ubuntugogy: an African educational paradigm that transcends pedagogy, andragogy, ergonagy and heutagogy. J. Third World Stud. 22 (2), 13–53.

Barfuss, W., Donges, J.F., Vasconcelos, V.V., Kurths, J., Levin, S.A., 2020. Caring for the future can turn tragedy into comedy for long-term collective action under risk of collapse. Proc. Natl. Acad. Sci. 117 (23), 12915–12922. https://doi.org/10.1073/pnas.1916545117.

Barnaud, C., d'Aquino, P., Daré, W.s., Fourage, C., Mathevet, R., Trébuil, G., 2014. Power asymmetries in companion modelling processes. In: Étienne, M. (Ed.), Companion Modelling: A participatory Approach to Support Sustainable Development. Springer, Dordrecht, Netherlands, pp. 127–153.

Barreteau, O., Bousquet, F., Étienne, M., Souchère, V., d'Aquino, P., Étienne, M., 2014. Companion modelling: a method of adaptive and participatory research. In: Étienne, M. (Ed.), Companion Modelling: A Participatory Approach to Support Sustainable Development. Springer, Dordrecht, Netherlands, pp. 13–40.

Baumflek, M., Kassam, K.A., Ginger, C., Emery, M.R., 2021. Incorporating biocultural approaches in forest management: insights from a case study of indigenous plant stewardship in Maine, USA and New Brunswick, Canada. Soc. Nat. Resour. 34 (9), 1155–1173. https://doi.org/10.1080/08941920.2021.1944411.

Beissinger, S.R., Ackerly, D.D., Doremus, H., Machlis, G.E., 2017. Science, Conservation, and National Parks. University of Chicago Press, Chicago, IL.

Bello-Bravo, J., 2019. The (S)pace of change and practices shaping rural communities. Environ. Space Place, 11 (1), 102–125. https://doi.org/10.5749/envispacplac.11.1.0102.

Bello-Bravo, J., 2020a. Getting the message across: characterizing a need to bridge public health messaging for tuberculosis across a rural/urban and CHW/traditional healer divide in Madagascar (A Review). Sci. Afr. e00321. https://doi.org/10.1016/j.sciaf.2020.e00321.

Bello-Bravo, J., 2020b. Managing biodiversity & divinities: case study of one twenty-year humanitarian forest restoration project in Benin. World Dev. 126, 104707 https://doi.org/10.1016/j.worlddev.2019.104707.

Bello-Bravo, J., Amoa-Mensa, S., 2019. Scaffolding entrepreneurship: a local SME-NGO partnership to enable cocoa production in Ghana. J. Small Bus. Entrep. 31 (4), 297–321. https://doi.org/10.1080/08276331.2018.1528138.

Bendix, R., 2000. Heredity, hybridity and heritage from one fin-de-siècle to the next. In: Antonnen, P.J., Siikala, A.-L., Magnusson, L. (Eds.), Folklore, Heritage Politics, and Ethnic Diversity: A Festschrift for Barbro Klein. Multicultural Centre, Botkyrka, Sweden, pp. 37–54.

Binhussain, M.A., El-Tonsy, M.M., 2013. Palm leave and plastic waste wood composite for out-door structures. Construction and Building Materials 47, 1431–1435. https://doi.org/10.1016/j.conbuildmat.2013.06.031.

Biyase, M., Zwane, T., 2018. An empirical analysis of the determinants of poverty and household welfare in South Africa. J. Dev. Areas 52 (1), 115–130. https://doi.org/10.1353/jda.2018.0008.

Bondu, R., 2017. Origine Et Distribution De L'arsenic Dans L'eau Souterraine De L'aquifère Rocheux Fracturé Du Bouclier Canadien En abitibi-témiscamingue. l'Université du Québec en AbitibiTémiscamingue, Québec, Canada (PhD).

Bondu, R., Cloutier, V., Rosa, E., Benzaazoua, M., 2016. A review and evaluation of the impacts of climate change on geogenic arsenic in groundwater from fractured bedrock aquifers. Water Air Soil Pollut. 27 (9), 296. https://doi.org/10.1007/s11270-016-2936-6.

Brack, D., 2003. Illegal logging and the illegal trade in forest and timber products. Int. For. Rev. 5 (3), 195–198. https://doi.org/10.1505/IFOR.5.3.195.19148.

Bratt, G.M., Evenden, J., Spencer, C., 1997. Estimating Costs For Army Material Health Hazards. Logistics Management Institute, McLean, VA.

Brooks, D.C. (Ed.), 1998. Current Review of Minimally Invasive Surgery, ed. Springer-Verlag, New York City, NY.

Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., Hauff, V., Lang, I., Shijun, M., de Botero, M.M., 1987. Report of the World Commission on Environment and Development: Our Common Future. Our Common Future: Report of the World Commission on Environment and Development, O. U. Press Ed. World Commission on Environment and Development, London, UK. edWorld Commission on Environment and Developmen.

Canadell, J.G., Raupach, M.R., 2008. Managing forests for climate change mitigation. Science 320 (5882), 1456–1457. https://doi.org/10.1126/science.1155458.

Cashore, B., Vertinsky, I., 2000. Policy networks and firm behaviours: governance systems and firm reponses to external demands for sustainable forest management. Policy Sci. 33 (1), 1–30. https://doi.org/10.1023/A:1004728206505.

Circular Ecology. (2021). Sustainability and sustainable development - what is sustainability and what is sustainable development? Retrieved 22 July 2021, from https://circularecology.com/sustainability-and-sustainable-development.html.

Corntassel, J., 2008. Toward sustainable self-determination: rethinking the contemporary Indigenous-rights discourse. Alternatives 33 (1), 105–132. https://doi.org/10.1177/030437540803300106.

Côté, S.D., Rooney, T.P., Tremblay, J.P., Dussault, C., Waller, D.M., 2004. Ecological impacts of deer overabundance. Ann. Rev. Ecol. Evol. Syst. 35, 113–147. https://doi.org/10.1146/annurev.ecolsys.35.021103.105725.

Counsell, S., Loraas, K.T., 2002. Trading in credibility: The myth and Reality of the Forest Stewardship Council. Trading in Credibility: The Myth and Reality of the Forest Stewardship Council. Rainforest Foundation UK, London, UK.

Currie, E., 2018. Confronting the North's South: on race and violence in the United States. In: Carrington, K., Hogg, R., Scott, J., Sozzo, M. (Eds.), The Palgrave Handbook of Criminology and the Global South. Palgrave Macmillan, Cham, CH, pp. 43–59.

Davis, T., 2000. Sustaining the Forest, the People, and the Spirit. State University of New York Press, Albany, NY.

K. Dervis (2007). Devastating for the world's poor: climate change threatens the development gains already achieved. Retrieved 15 February 2021, from https://www.un.org/en/chronicle/article/devastating-worlds-poor-climate-change-threatens-development-gains-already-achieved.

Desai, K., 2017. Girlscape: Transnational Productions of Neoliberal Girlhoods. Teachers College, New York City, NY (PhD).

Eliade, M., 2009. Rites and Symbols of Initiation: The Mysteires of Birth and Rebirth. Spring, Putnam, CT.

Étienne, M., 2014. Companion Modelling: A participatory Approach to Support Sustainable Development. Springer, Dordrecht, Netherlands.

Farbotko, C., 2020. Is it too late to prevent systemic danger to the world's poor?. In: Wiley Interdiscip. Rev. Clim. Chang., 11, p. e609. https://doi.org/10.1002/wcc.609.

Farrell, J., 2019. The growth of climate change misinformation in US philanthropy: evidence from natural language processing. Environ. Res. Lett. 14 (3), 034013 https://doi.org/10.1088/1748-9326/aaf939.

D. Fears (2019). One million species face extinction, UN report says. And humans will suffer as a result. Retrieved 27 September 2020, from https://www.washingtonpost.com/climate-environment/2019/05/06/one-million-species-face-extinction-un-panel-says-humans-will-suffer-result.

Frandy, T., 2018. Indigenizing sustainabilities, sustaining indigeneities: decolonization, sustainability, and education. J. Sustain. Educ. 18 (March), 1–8.

Geertz, C., 1973. The Interpretation of Cultures. Basic Books, New York City, NY.
Gilmour, D., 2016. Forty Years of Community-Based forestry: A review of Its Extent and Effectiveness. Forty Years of Community-Based Forestry: A Review of Its Extent and Effectiveness. FAO, Rome, IT.
Goulden, M., 2009. Boundary-work and the human—animal binary: piltdown man, science and the media. Public Understand. Sci. 18 (3), 275–291. https://doi.org/10.1177/0963662507081239.
Government of Benin. (2012). Setting the conditions for the sustainable management of sacred forests in the Republic of Benin [English Translation] (A. Cauchois, Trans.). Porto-Novo, Benin: Ministry of Decentralisation, Local Governance, Administration and Country Planning Cabinets.
Gulbrandsen, L.H., 2004. Overlapping public and private governance: can forest certification fill the gaps in the global forest regime? Global Environ. Politics 4 (2), 75–99. https://doi.org/10.1162/152638004323074200.
Gwet, K.L., 2014. Handbook of Inter-Rater reliability: The definitive Guide to Measuring the Extent of Agreement Among Raters. Handbook of Inter-Rater reliability: The Definitive Guide to Measuring the Extent of Agreement among Raters, 4th ed. Advanced Analytics, Gaithersburg, MD. LLC.
Hajmohammad, S., Vachon, S., 2016. Mitigation, avoidance, or acceptance? Managing supplier sustainability risk. J. Supply Chain Manag. 52 (2), 48–65. https://doi.org/10.1111/jscm.12099.
Henry, B., Eckard, R., Beauchemin, K., 2018. Review: adaptation of ruminant livestock production systems to climate changes. Animal 12 (s2), s445–s456. https://doi.org/10.1017/S1751731118001301.
Hessels, J., Terjesen, S., 2010. Resource dependency and institutional theory perspectives on direct and indirect export choices. Small Bus. Econ. 34 (2), 203–220. https://doi.org/10.1007/s11187-008-9156-4.
Hewitt, K., 2019. Exploring Indigenous-Led Collaborative Stewardship in a Watershed context: Prespectives from the Nechako Headwaters. (PhD). University of Northern British Columbia, Prince George, CN.
Holm, M., 2021. Indigenous Rights in Changing Forest Landscapes in South-East Asia: How Narratives in Science and Practice Frame Indigenous Environmental Justice and Stewardship. Indigenous Rights in Changing Forest Landscapes in South-East Asia: How Narratives in Science and Practice Frame Indigenous Environmental Justice and Stewardship. Stockholm University, Stockholm, SW.
Holmgren, S., D'Amato, D., Giurca, A., 2020. Bioeconomy imaginaries: a review of forest-related social science literature. Ambio 49 (12), 1860–1877. https://doi.org/10.1007/s13280-020-01398-6.
Hou, M., Venäläinen, A.K., Wang, L., Pirinen, P., Gao, Y., Jin, S., Zhu, Y., Qin, F., Hu, Y., 2020. Spatio-temporal divergence in the responses of Finland's boreal forests to climate variables. Int. J. Appl. Earth Obs. Geoinf. 92, 102186 https://doi.org/10.1016/j.jag.2020.102186.
S.Y. In, & K. Schumacher (2021). Carbonwashing: a new type of ESG greenwashing in a post-Paris climate agreement world [Abstract]. Retrieved 26 July 2021, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3833668.
Inman, T., 1861. Foundation for a New Theory and Practice of Medicine. John Churchill, Londnon, UK.
IPCC. (2014). AR5 synthesis report: climate change 2014. Retrieved 3 March 2021, from https://www.ipcc.ch/report/ar5/syr/.
Jankó, F., Drüszler, Á., Gálos, B., Móricz, N., Papp-Vancsó, J., Pieczka, I., Pongrácz, R., Rasztovits, E., Dezső, Z.S., Szabó, O., 2020. Recalculating climate change consensus: the question of position and rhetoric. J. Clean. Prod. 254, 120127 https://doi.org/10.1016/j.jclepro.2020.120127.
Kalra, K., 2019. Climate Change mitigation: Understanding through the Lens of Corporate Social Responsibility (CSR) in India. National Law School of India University, Bengaluru, India.
Karsten, L., Illa, H., 2005. Ubuntu as a key African management concept: contextual background and practical insights for knowledge application. J. Manag. Psychol. 20 (7), 607–620. https://doi.org/10.1108/02683940510623416.
Khalid, M.A., Shahid, S.M.A., 2017. Environmental pollution and climate change impacts on human health with particular reference to Brain: a review. In: Subhan, S., Bagchi, M. (Eds.), Phytopharmaceuticals for Brain Health. CRC, New York City, NY, pp. 39–68.
Kimmerer, R.W., 2002. Weaving traditional ecological knowledge into biological education: a call to action. Bioscience 52 (5), 432–438. https://doi.org/10.1641/0006-3568(2002)052-0432:WTEKIB-2.0.CO;2.
R.W. Kimmerer (2012). Reclaiming the honorable harvest. Retrieved 26 July 2021, from https://www.youtube.com/watch?v=Lz1vgfZ3etE&t=1s&ab_channel=TEDxTalks.
Kimmerer, R.W., 2013. Braiding Sweetgrass: Indigenous wisdom, Scientific Knowledge and the Teachings of Plants. Milkweed Editions, Minneapolis, MN.
Kimmerer, R.W., 2017. Learning the grammar of animacy. Anthropol. Conscious. 28 (2), 128–134. https://doi.org/10.1111/anoc.12081.
Kittler, B., Stupak, I., Smith, C.T., 2020. Assessing the wood sourcing practices of the US industrial wood pellet industry supplying European energy demand. Energy Sustain. Soc. 10 (1), 1–17. https://doi.org/10.1186/s13705-020-00255-4.
Köhl, M., Lasco, R., Cifuentes, M., Jonsson, Ö., Korhonen, K.T., Mundhenk, P., de Jesus Navar, J., Stinson, G., 2015. Changes in forest production, biomass and carbon: results from the 2015 UN FAO global forest resource assessment. For. Ecol. Manag. 352, 21–34. https://doi.org/10.1016/j.foreco.2015.05.036.
Lee, L.C., Reid, M., Jones, R., Winbourne, J., Rutherford, M., Salomon, A.K., 2019. Drawing on indigenous governance and stewardship to build resilient coastal fisheries: people and abalone along Canada's northwest coast. Mar. Policy 109, 103701. https://doi.org/10.1016/j.marpol.2019.103701.
Lightfoot, K.G., Cuthrell, R., Hylkema, M.G., Lopez, V., Gifford-Gonzalez, D., Jewett, R. A., Grone, M.A., Sanchez, G.M., Nelson, P.A., Apodaca, A.J., 2021. The eco-archaeological investigation of indigenous stewardship practices on the Santa Cruz Coast. J. Calif. Gt. Basin Anthropol. 41 (2), 187–205.
Luetz, J.M., Walid, M., 2019. Social responsibility versus sustainable development in United Nations policy documents: a meta-analytical review of key terms in human development reports. In: Filho, W.L. (Ed.), Social Responsibility and Sustainability. Springer, Cham, CH, pp. 301–334.
Mäder, P., Fliessbach, A., Dubois, D., Gunst, L., Fried, P., Niggli, U., 2002. Soil fertility and biodiversity in organic farming. Science 296 (5573), 1694–1697. https://doi.org/10.1126/science.1071148.
Magni, G., 2017. Indigenous knowledge and implications for the sustainable development agenda. Eur. J. Educ. 52 (4), 437–447. https://doi.org/10.1111/ejed.12238.
Mändmaa, P., Hakala, E., Janeliūnas, T., Ozoliņš, J., Kowalewski, K., 2020. Winds of change, or More of the same?: Impact of the 2018-19 Election Cycle On Energy Security and Climate Policies in the Baltic states, Poland and Finland. Rahvusvahelise Kaitseuuringute Keskuse, Tallinn, Estonia.
Mangena, F., 2013. Discerning moral status in the African environment. Phronimon 14 (2), 25–44.
Mangena, F., 2016. African ethics through Ubuntu: a postmodern exposition. Africology J. Pan Afr. Stud. 9 (2), 66–80.
Markel, H., 2004. I swear by Apollo"—on taking the Hippocratic oath. N. Engl. J. Med. 350 (20), 2026–2029. https://doi.org/10.1056/NEJMp048092.
Martínez-Alier, J., Pascual, U., Vivien, F.D., Zaccai, E., 2010. Sustainable de-growth: mapping the context, criticisms and future prospects of an emergent paradigm. Ecol. Econ. 69 (9), 1741–1747. https://doi.org/10.1016/j.ecolecon.2010.04.017.
Mather, A.S., Fairbairn, J., Needle, C.L., 1999. The course and drivers of the forest transition: the case of France. J. Rural Stud. 15 (1), 65–90. https://doi.org/10.1016/S0743-0167(98)00023-0.
Maturana, H.R., Varela, F.J., 1987. The Tree of knowledge: The Biological Roots of Human Understanding. Shambhala, Boston, MA.
McCorquodale, S.M., 1997. Cultural Contexts of Recreational Hunting and Native Subsistence and Ceremonial hunting: Their significance For Wildlife Management, 25. Wildlife Society Bulletin, pp. 568–573, 1973-2006.
McIntyre, J.R., Ivanaj, S., Ivanaj, V., 2018. CSR and Climate Change Implications for Multinational Enterprises. Edward Elgar Publishing, Cheltenham, UK.
Mulrennan, M.E., Bussières, V., 2020. Indigenous environmental stewardship: do mechanisms of biodiversity conservation align with or undermine it. In: Turner, N.J. (Ed.), Plants, People, and Places: The Roles of Ethnobotany and Ethnoecology in Indigenous Peoples' Land Rights in Canada and Beyond. CN: McGill-Queen's University Press, Montreal, pp. 282–312.
Munck af Rosenschöld, J., Rozema, J.G., Frye-Levine, L.A., 2014. Institutional inertia and climate change: a review of the new institutionalist literature. Wiley Interdiscip. Rev. Clim. Chang. 5 (5), 639–648. https://doi.org/10.1002/wcc.292.
Muttaqin, M.Z., Alviya, I., Lugina, M., Hamdani, F.A.U., 2019. Developing community-based forest ecosystem service management to reduce emissions from deforestation and forest degradation. For. Policy Econ. 108, 101938 https://doi.org/10.1016/j.forpol.2019.05.024.
Neuenschwander, P., Adomou, A.C., 2017. Reconstituting a rainforest patch in southern Benin for the protection of threatened plants. Nat. Conserv. 21, 57–82. https://doi.org/10.3897/natureconservation.21.13906.
Neuenschwander, P., Bown, D., Hèdégbètan, G.C., Adomou, A., 2015. Long-term conservation and rehabilitation of threatened rain forest patches under different human population pressures in West Africa. Nat. Conserv. 13, 21–46. https://doi.org/10.3897/natureconservation.13.6539.
P. Neuenschwander Neuenschwander, P., Langewald, J., Borgemeister, C., James, B., Neuenschwander, P., Borgemeister, C., Langewald, J., 2003. Biological control for increased agricultural productivity, poverty reduction and environmental protection in Africa. In: Neuenschwander, P., Borgemeister, C., Langewald, J. (Eds.), Biological Control in Integrated Pest Management Systems in Africa. CABI Publishing, Wallingford, UK, pp. 377–406. Wallingford, UK: CABI.
Onwuegbuchulam, S.P.C., 2018. A capability approach assessment of poverty in the sociopolitical history of South Africa/KwaZulu-Natal. J. Poverty 22 (4), 287–309. https://doi.org/10.1080/10875549.2017.1419529.
T. Osborne, L. Bellante, & N. von Hedemann (2014). Indigenous Peoples and REDD+: A Critical Perspective - Indigenous People's Biocultural Climate Change Assessment Initiative. Cusco, Peru: IPCCA.
Perea, J., 1998. The black/white binary paradigm of race. In: Delgado, R., Stefancic, J. (Eds.), The Latino/a Condition: A critical Reader. New York Unviersity Press, New York City, NY, pp. 359–368.
Pfeffer, J., Salancik, G.R., 2003. The External Control of Organizations: A Resource Dependence Perspective. Stanford University Press, Palo Alto, CA.
Pimentel, D., Harvey, C., Resosudarmo, P., Sinclair, K., Kurz, D., McNair, M., Crist, S., Shpritz, L., Fitton, L., Saffouri, R., 1995. Environmental and economic costs of soil erosion and conservation benefits. Science 267 (5201), 1117–1122. https://doi.org/10.1126/science.267.5201.1117.
Pjevovic, D., 2017. Cities and Climate change: Power games and Greenwashing Through Transnational Urban Networks. University of British Columbia, Vancouver, Canada (MA).
Posey, D.A., 1985. Indigenous management of tropical forest ecosystems: the case of the Kayapo Indians of the Brazilian Amazon. Agrofor. Syst. 3 (2), 139–158. https://doi.org/10.1007/BF00122640.
Rayan, R., 2020. Review on the burger effect: beef industry and climate change. Glob. J. Public Health Med. 2 (SP1), 164–167. https://doi.org/10.37557/gjphm.v2iSP1.39.
Reynolds, J., Stafford-Smith, M., 2002. Global Desertification: Do Humans Cause Deserts? Dahlem University Press, Berlin, DE.

Ridwan Kurniawan, K., Nuraeny, E., 2018. Understanding genius loci to sustain Ume Bangka's traditional architecture based on intangible material culture. IOP Conf. Ser. Earth Environ. Sci. 213 (1), 012024 https://doi.org/10.1088/1755-1315/213/1/012024.
Rombolli, S., 2008. Global Environmental Facility (GEF) Country Portfolio Evaluation. World Bank, Washington, DC. Benin1991-2007.
Rudel, T.K., Horowitz, B., 1993. Tropical deforestation: Small Farmers and Land Clearing in the Ecuadorian Amazon. Columbia University Press, New York City, NY.
Sánchez-Flores, R.B., Cruz-Sotelo, S.E., Ojeda-Benitez, S., Ramírez-Barreto, M., 2020. Sustainable supply chain management-a literature review on emerging economies. Sustainability 12 (17), 6972. https://doi.org/10.3390/su12176972.
Sanya, B.N., Desai, K., Callier, D.M., McCarthy, C., 2018. Desirable and disposable: educative practices and the making of (non) citizens. Curric. Inq. 48 (1), 1–15. https://doi.org/10.1080/03626784.2017.1421308.
Sayles, J.S., Mulrennan, M.E., 2010. Securing a future: cree hunters' resistance and flexibility to environmental changes, Wemindji, James Bay. Ecol. Soc. 15 (4), 22.
Schang, K.A., Trant, A.J., Bohnert, S.A., Closs, A.M., Humchitt, M., McIntosh, K.P., Way, R.G., Wickham, S.B., 2020. Ecological research should consider Indigenous peoples and stewardship. FACETS 5 (1), 534–537. https://doi.org/10.1139/facets-2019-0041.
Schepers, D.H., 2010. Challenges to legitimacy at the forest stewardship council. J. Bus. Ethics 92 (2), 279–290. https://doi.org/10.1007/s10551-009-0154-5.
Schneider, F., Kallis, G., Martinez-Alier, J., 2010. Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. J. Clean. Prod. 18 (6), 511–518. https://doi.org/10.1016/j.jclepro.2010.01.014.
Schulze, K., 2021. Policy characteristics, electoral cycles, and the partisan politics of climate change. Glob. Environ. Politics 21 (2), 44–72. https://doi.org/10.1162/glep_a_00593.
M. Shahidul, M.L. Malcolm, M.S. Hashmi, & M.H. Alhaji (2018). Waste resources recycling in achieving economic and environmental sustainability: review on wood waste industry. In S. Hashmi & I. A. Choudhury (Eds.), Encyclopedia of Renewable and Sustainable Materials (Vol. 1, pp. 965–974). Amsterdam, Netherlands: Elsevier.
Sherer, P.D., Lee, K., 2002. Institutional change in large law firms: a resource dependency and institutional perspective. Acad. Manag. J. 45 (1), 102–119. https://doi.org/10.5465/3069287.
Sikkema, R., Dallemand, J.F., Matos, C.T., van der Velde, M., San-Miguel-Ayanz, J., 2017. How can the ambitious goals for the EU's future bioeconomy be supported by sustainable and efficient wood sourcing practices? Scand. J. For. Res. 32 (7), 551–558. https://doi.org/10.1080/02827581.2016.1240228.
Singh, S., Youssouf, M., Malik, Z.A., Bussmann, R.W., 2017. Sacred groves: myths, beliefs, and biodiversity conservation—a case study from western Himalaya, India. Int. J. Ecol. https://doi.org/10.1155/2017/3828609, 2017.
Smith, C.M., 2005. Origin and uses of primum non nocere—above all, do no harm! J. Clin. Pharmacol. 45 (4), 371–377. https://doi.org/10.1177/0091270004273680.
Sokol, D.K., 2013. "First do no harm" revisited. BMJ 347. https://doi.org/10.1136/bmj.f6426.
Strona, G., Bradshaw, C.J., 2018. Co-extinctions annihilate planetary life during extreme environmental change. Sci. Rep. 8 (1), 16724. https://doi.org/10.1038/s41598-018-35068-1.
Stupak, I., Asikainen, A., Röser, D., Pasanen, K., Röser, D., Asikainen, A., Raulund-Rasmussen, K., Stupak, I., 2008. Review of recommendations for forest energy harvesting and wood ash recycling. In: Sustainable Use of Forest Biomass For Energy, 12. Springer, Dordrecht, Netherlands, pp. 155–196.
Sun, X., Wang, L., Gu, Z., 2004. A brief overview of China's timber market system. Int. For. Rev. 6 (3–4), 221–226. https://doi.org/10.1505/ifor.6.3.221.59973.
Taylor, D.A., 1978. Implications of licensure, certification and credentialling for minority providers. In Interamerica Research Associates National Conference on Minority Group Alcohol, Drug Abuse and Mental Health Issues. Inter America Research Associates, Washington, DC, pp. 22–43.
Taylor, P.J., 2010. Unruly Complexity: Ecology, Interpretation, Engagement. University of Chicago Press, Chicago, IL.
E. Tola (2010). The vanishing forests of Benin. Retrieved 9 December 2017, from http://www.africareview.com/special-reports/The-vanishing-forests-of-Benin/979182-1156120-hd0ghtz/index.html.
Trosper, R.L., 2007. Indigenous influence on forest management on the Menominee Indian reservation. For. Ecol. Manag. 249 (1–2), 134–139. https://doi.org/10.1016/j.foreco.2007.04.037.
Tsosie, R., 2019. Indigenous sustainability and resilience to climate extremes: traditional knowledge and the systems of survival. Conn. Law Rev. 51 (4), 1009–1042.
Turnnidge, J., Kelly, A.L, 2021. Organizational structures: looking back and looking ahead. In: Kelly, A.L., Côté, J., Jeffreys, M., Turnnidge, J. (Eds.), Birth Advantages and Relative Age Effects in Sport. Routledge, New York City, NY, pp. 239–246.
Ueitele, I., Horn, L., Kadhila, N., 2021. Ganoderma research activities and development in Namibia: a review. Asian J. Mycol. 4 (1), 29–39. https://doi.org/10.5943/ajom/4/1/4.
Usik, K.A., 2015. The Hunt For Ma'iingan: Ojibwe Ecological Knowledge and Wolf Hunting in the Great Lakes. The University of Iowa, Iowa City, IA (MA). MA.
Vasco, C., Torres, B., Pacheco, P., Griess, V., 2017. The socioeconomic determinants of legal and illegal smallholder logging: evidence from the Ecuadorian amazon. For. Policy Econ. 78, 133–140. https://doi.org/10.1016/j.forpol.2017.01.015.
Waller, D.M., 2014. Effects of deer on forest herb layers. In: Gilliam, F. (Ed.), The Herbaceous Layer in Forests of Eastern North America. Oxford University Press, Oxford, UK, pp. 369–399.
Waller, D.M., Reo, N.J., 2018. First stewards: ecological outcomes of forest and wildlife stewardship by indigenous peoples of Wisconsin, USA. Ecol. Soc. 23 (1), 45. https://doi.org/10.5751/ES-09865-230145.
Walther, G.R., Hughes, L., Vitousek, P., Stenseth, N.C., 2005. Consensus on climate change. Trends Ecol. Evol. 20 (12), 648–649. https://doi.org/10.1016/j.tree.2005.10.008. Amst.
White, L., 1967. The historical roots of our ecologic crisis. Science 155 (3767), 1203–1207. https://doi.org/10.1126/science.155.3767.1203.
Wiersum, K.F., 1997. Indigenous exploitation and management of tropical forest resources: an evolutionary continuum in forest-people interactions. Agric. Ecosyst. Environ. 63 (1), 1–16. https://doi.org/10.1016/S0167-8809(96)01124-3.
Williams, R., 1983. Culture and Society: 1780-1950. Columbia University Press, New York City, NY, 1780-1950.
Williams, R., 1989. Metropolitan perceptions and the emergence of modernism. In: Pinkney, T. (Ed.), The Politics of Modernism: Against the New Conformists. Verso, New York City, NY, pp. 37–48.
Wright, C., Nyberg, D., 2017. An inconvenient truth: how organizations translate climate change into business as usual. Acad. Manag. J. 60 (5), 1633–1661. https://doi.org/10.5465/amj.2015.0718.
Yazzie, V., 2007. The tribal perspective of old growth in frequent-fire forests—its history. Ecol. Soc. 12 (2), 21.
Zafar, M.F., Siddiqui, M.A., 2017. Natural filler based composites: a review. Int. J. Adv. Prod. Ind. Eng. 505, 27–33, 2017.
Zaman, A.U., Gutub, S.A., Soliman, M.F., Wafa, M.A., 2014. Sustainability and human health issues pertinent to fibre reinforced polymer composites usage: a review. J. Reinf. Plast. Compos. 33 (11), 1069–1084. https://doi.org/10.1177/0731684414521087.
Zundel, T., 2017. Climate-smart agriculture as a development buzzword: framework for flexible development, or greenwashing the status quo? Insights from Northern Ghana. University of Guelph, Guelph, Ontario, Canada (MA).
United Nations. (2020). The sustainable development goals report 2020. Retrieved 12-25-2020, 2020, from https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf.