6-2024

Policy design for biodiversity: How problem conception drift undermines "fit-for-purpose" Peatland conservation

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OXFORD

Policy and Society, 2024, **43(3)**, 351–380
DOI: https://doi.org/10.1093/polsoc/puae019
Advance access publication date 14 June 2024
Original Research Article

Policy design for biodiversity: How problem conception drift undermines "fit-for-purpose" Peatland conservation

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Abstract

For over two decades, scientists have documented the alarming decline of global Peatland ecosystems, regarded as the planet's most crucial carbon sinks. The deterioration of these unique wetlands alongside their policy attention presents a puzzle for policy scientists and for students of anticipatory policy design. Two contrasting explanations have emerged. Some argue that pressures from economic globalization compel governments to relax environmental standards, while others point to deficiencies in policy design and implementation. Our paper applies Cashore's Four Problem Types framework to assess a more nuanced explanation: that failure of global and local policies to curb ecosystem degradation is owing to a misalignment between how the problem is currently conceived of, and what conception is required for, effective environmental management. We find overwhelming evidence that reversing Peatland degradation necessitates a fundamental shift in applied policy analysis—from treating the crisis as a Type 3 (Compromise), Type 2 (Optimization), or even Type 1 (Commons) problem, to conceiving it as a Type 4 (Prioritization) challenge. Achieving this requires undertaking four essential policy design tasks: engaging sequentialist/lexical ordering processes; identifying key features of the problem that any solution would need to incorporate to effectively overcome; applying path dependency analysis to uncover policy mix innovations capable of "locking-in" sustainability trajectories that can fend off pressures for policy conception drift; and organizing multistakeholder "policy design learning" exercises that integrate complex sources of knowledge produced within, and across, the ecological and policy sciences.

Keywords: policy design; problem framing; policy drift; biodiversity; peatland conservation

"Relying on metaphors as the foundation for policy advice can lead to results substantially different from those presumed to be likely" Ostrom (1990: p. 23).

Over the past two decades, scientists have documented the startling decline of global Peatland ecosystems. Alarm bells have been rung because these unique wetlands provide numerous benefits including acting as homes to rich biodiversity and long-standing local cultural practices, as well as being

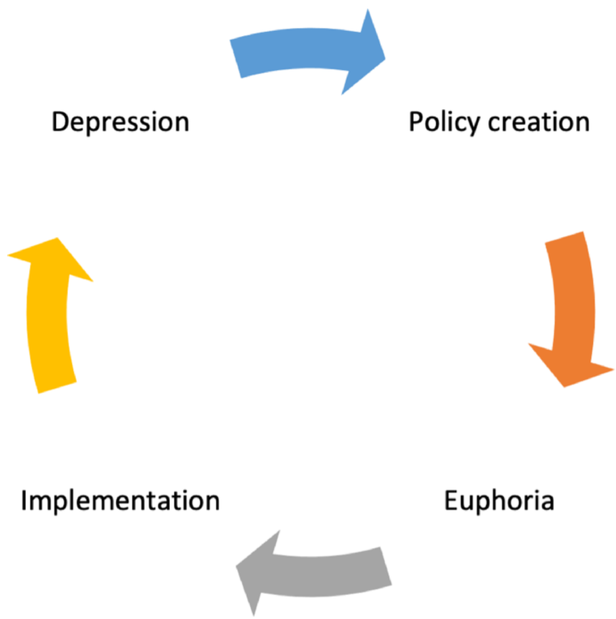

Figure 1. Policy creation, euphoria, implementation, and depression cycle.
Source: Adapted from Cashore et al. (2016).

critical sources of carbon sequestration. These trends are consistent with broader global patterns in which sustained policy attention to managing critical environmental challenges highlighted by the twin climate and biodiversity challenges coincides with their ongoing degradation (IPBES, 2019; IPCC, 2018). Historically, two competing accounts have been offered to explain these conflicting patterns (Bernstein & Cashore, 2012). Some argue that accelerating economic globalization places pressure on governments to relax environmental standards in an effort to attract and maintain capital (Berger & Dore 1996). In contrast, others, noting widespread domestic and global support in improving domestic and global environmental problems, argue that the culprit is poor policy design and implementation (Peters et al., 2018). Our paper assesses the plausibility of a more nuanced explanation: that failure of global and local policies to curb ecosystem degradation is owing to a misalignment between how the problem is currently conceived of, and what conception is required for its effective management (Visseren-Hamakers et al., 2023; Cashore & Bernstein, 2022; Cashore, 2023). We apply Cashore's Four Problem Types (4PT) framework developed and applied through several interdisciplinary collaborations[1], to find overwhelming evidence that if degradation is to be reversed, the Peatland crisis must shift from being treated as a Type 3 (Compromise), Type 2 (Optimization), or even Type 1 (Commons) problem to being conceived of, and tackled, as a Type 4 (Prioritization) challenge.

We elaborate our assessment, and its implications, in the following analytical steps. First, we review a generation old paradox: ongoing degradation of Peatland ecosystems alongside a myriad of global and local policy initiatives designed to ameliorate its decline. For analytic traction, we direct attention to Southeast Asia and Indonesia—a country that is at the epicenter of Peatland degradation as well as the target of novel efforts to reverse these trends. Second, we review, and third, we apply, the analytical framework to explain the paradox. Fourth, we show how averting irreversible collapse of Peatland ecosystems in Indonesia and beyond requires the immediate engagement of critical "fit-for-purpose" Type 4 reinforcing policy design tasks. We argue that failure to do so is likely to reproduce a "policy creation, euphoria, implementation, and depression" cycle (Figure 1) that has vexed efforts to improve climate and biodiversity in general, and Peatland ecosystems in particular, over the last three decades (Cashore et al., 2016).

[1] These include Visseren-Hamakers et al. (2023); Cashore & Bernstein (2022); Cashore (2023, 2013); Humphreys et al. (2017); B. Cashore et al. (2021); Sun et al. (2024); Auld et al. (2021); Cashore & Bernstein (2020); Cashore et al. (2019); Yona et al. (2019); Cashore (2022).

The puzzle: policy focus on Peatland restoration amid accelerating Peatland degradation

The degradation of Peatland ecosystems

Peatland ecosystems are characterized by two related processes: their "wet" status that causes much slower decomposition of plant matter relative to dryland systems, which, in turn, leads to the accumulation of carbon rich "peat soils." Ongoing soil build-up as carbon explains why, for instance, over decades, some coastal areas of Indonesia, the Netherlands, and the United Kingdom have risen above sea levels (Wijedasa, Jaafar, et al., 2018). It is hard to overstate the importance of these ecosystems: Scientists have found that global Peatlands store 10% of the world's nonglacial freshwater and 30% of global terrestrial carbon despite covering just 3% of global land surface (IUCN, 2017). Their soil generating processes also mean that Peatlands are constant sources of natural land reclamation. The vast majority of Peatland degradation has occurred within temperate and tropical forests (Figures 2 and 3). The largest amount of corresponding carbon emissions has originated from tropical Peatlands (Figures 4 and 5), with Indonesia being a particularly notable contributor (Figure 6). If these emissions continue at their current pace, they are projected to consume 41% of the carbon budget associated with the Paris Accord's objective of limiting warming to <+1.5°C above preindustrial levels (Humpenöder et al., 2020).

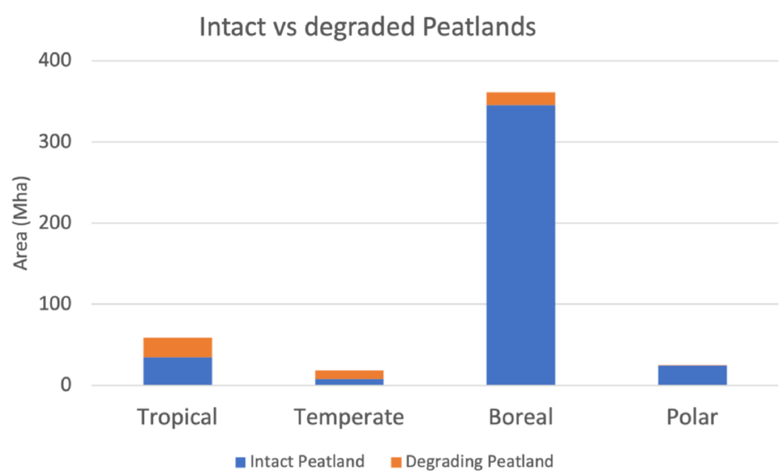

Figure 2. Intact vs degraded Peatlands.
Source: Authors' own creation based on Leifeld and Menichetti (2018).

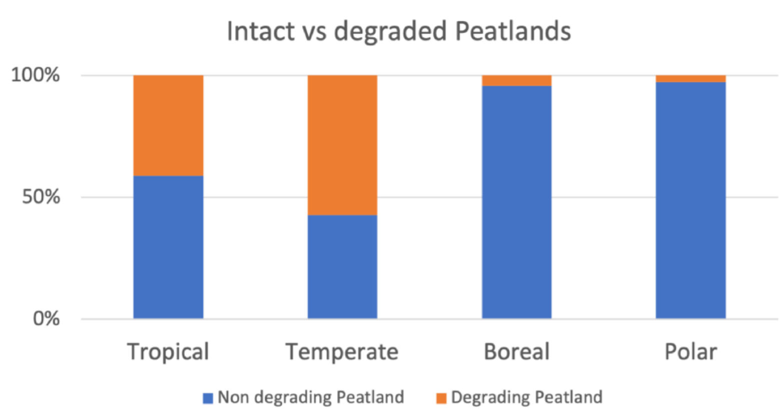

Figure 3. Intact vs degraded Peatlands.
Source: Authors' own creation based on Leifeld and Menichetti (2018).

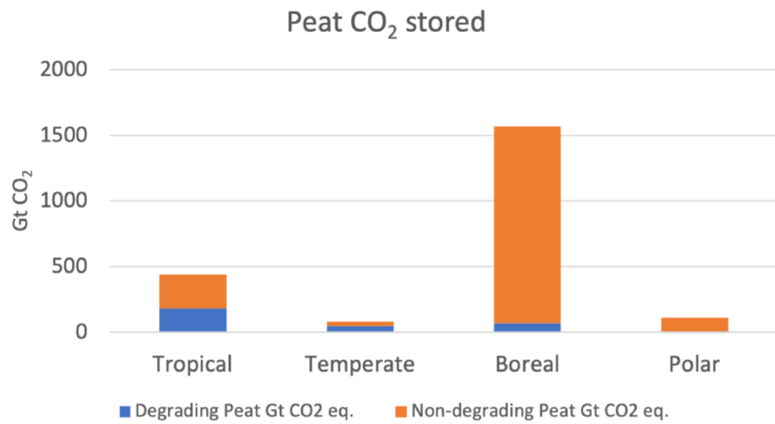

Figure 4. Peat CO_2 stored.
Source: Authors' own creation based on Leifeld and Menichetti (2018).

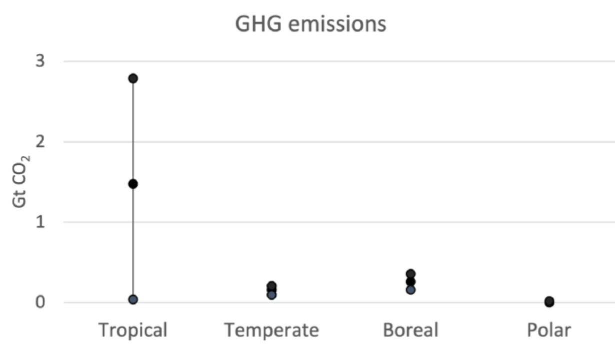

Figure 5. Greenhouse Gas (GHG) emissions of peat forests.
Source: Authors' own creation based on Leifeld and Menichetti (2018).

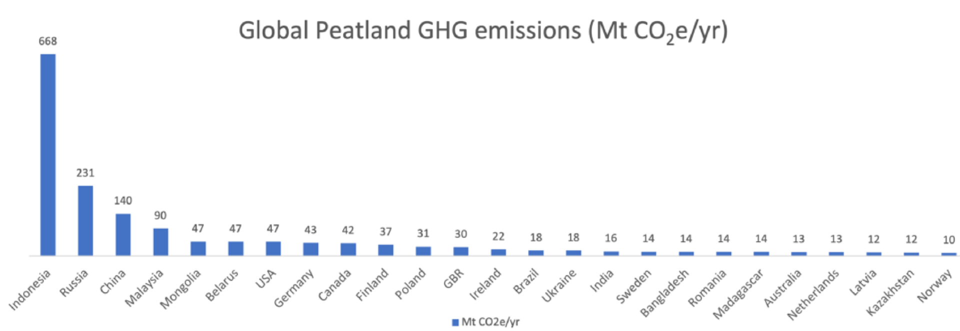

Figure 6. Global Peatland Greenhouse Gas emissions.
Source: Global Peatlands Assessment data derived from the Global Peatland Database (IMCG, 2024).

The proliferation of global and local policy efforts to address the problem

Recognition of these trends has produced a plethora of policy tools that were justified in whole, or in part, on their ability to preserve tropical Peatland ecosystems in general and in Indonesia in particular. These include a range of transnational initiatives that increasingly turned to finance and market–driven (FMD) tools as a way to find and accelerate economic incentives to ameliorate ecological challenges (Table 1). These coincided with Indonesia policy officials enacting over a 130 major regulations or

Table 1. Transnational interventions targeting Southeast Asia biodiversity conservation.

Transnational interventions targeting Southeast Asia biodiversity conservation	Emergence
Firm-level forest sustainability initiatives • Corporate social responsibility • Corporate sustainability • Social license to operate	Late 1980s
Certification of a firm's internal sustainability procedures • Environmental management systems	Late 1980s
Certification of forest environmental and social standards • Nongovernment Organization (NGO) backed Forest Stewardship Council	1993
• Industry and forest owner-initiated program for the Endorsement of Forest Certification	1999
Certification of palm oil environmental and social practices • Roundtable on Sustainable Palm Oil	2002
Legality verification • The European Union Forest Legality ("Voluntary Partnership Agreements") • The US Lacey Act • The European Union Timber Regulation	2001-2010
Carbon Markets and land management • Reduced Emissions from Deforestation and degradation (REDD+)	2005 (formalized at Bali, COP 2007)
Firm-level environmental and social governance • No deforestation commitments • Net zero climate pledges	2012
Nature-based solutions • Glasgow finance commitment on forests • Paris Accord's Article 6 and Carbon credits	2021
Trade-based land conservation • The European Union No Deforestation Regulation	2023

Source: Authors' own creation.

amendments related specifically to Peatland management and conservation (Widyatmanti et al., 2022) (Table 2).

The 4PT framework

The 4PT framework focuses analytic attention on different ways to conceive of the problem of Peatland degradation. The framework identifies four distinct schools that reinforce competing ways to conceive of, empirically measure, and manage, sustainability challenges: Commons (Type 1), Optimization (Type 2), Compromise (Type 3), and Prioritization (Type 4). The four types are distinguished in two dimensions (Table 3): Whether applied policy analysis and corresponding solutions are justified based on "key features" of a clearly specified "on-the-ground" problem (Types 1 and 4) and whether problem framing emphasizes enhancing some kind of anthropocentric utility or satisfying outcome (Types 1 and 2). These distinctions lead to the recognition that all four schools are motivated by deeply entrenched, but competing, ethical foundations (Cashore & Bernstein, 2022) that underpin each school's transformative policy design project (Visseren-Hamakers et al., 2023). These ethics, in turn, carry profound implications for how to think about, and address, inevitable synergies and "whack-a-mole"[2] effects (Levin et al., 2012), which can result from a highly effective policy design. Notably, the Compromise, Optimization, and Commons schools narrow the ability to address problems conceived of through a Type 4 lens to those that are synergistic with Types 3, 2, and 1 conceptions (Cashore & Bernstein, 2022). The framework has been applied to show how these (often) unconscious biases, and the metaphors they produce, can

[2] A children's arcade game denoted by a cycle in which successfully whacking a mole that pops up through one of six holes results in a mole pop-up in another hole.

Table 2. Select examples of domestic Peatland policy interventions in Indonesia.

Domestic Peatland policy interventions in Indonesia	Emergence
• Protected Peatland zones identified as those with thicknesses of 3 m or more. Cultivation allowable in areas <3 m (and complying with acid sulfate standards) • *Reiterated in 1999 Presidential Decree No. 80*	1990
• Government of Indonesia Regulation No. 4/2001 on fire management and mitigation	2001
• Ministry of the Environment Regulation No. 11/2006 • Business entities obliged to issue environmental impact reports for activities surrounding protected areas (including Peatlands)	2006
• Ministry of Forestry Regulation No. 55/2008 • Masterplan for conservation and rehabilitation of Peatlands in Central Kalimantan	2008
• Government of Indonesia Regulation No. 71/2014 • Regulatory guidance on protection of Peatland ecosystems • *Revised by GOI Regulation No. 57/2016 mandating Peatland protection based on level of water table (any areas with water table deeper than 40 cm from the ground classified as degraded)*	2014
• Peatland Restoration Agency (Badan Restorasi Gambut) created to coordinate Peatland restoration activities as specified by Presidential Decree No. 1/2016	2016
• *Presidential Decree No. 120/2020 in 2020 issued to add mangrove rehabilitation to Peatland restoration activities of BRG*	2020

Significant amendments are given in *italics*.
Source: Widyatmanti et al. (2022).

Table 3. Four types of sustainability problem framing and their reinforcing schools.

		Does utility dominate?	
		Yes	**No**
Analysis based on key features of “on-the-ground” problem?	Yes	Type 1 (Commons)	Type 4 (Prioritization)
	No	Type 2 (Optimization)	Type 3 (Compromise)

Source: Cashore and Bernstein (2022).

result in policies that are inconsistent with the scientific evidence about behavioral changes necessary for effectively managing critical problems including the climate and biodiversity crises.

The Commons School

(Type 1 reinforcing) is focused on designing “collective action” institutions capable of avoiding “tragedies of the commons” in which overharvesting causes catastrophic resource collapse. Ostrom made a profoundly important contribution to this school by showing how “nonexcludability”, which was found to be a key feature of a subset of commons tragedies, such as fish that swim, would require different “fit-for-purpose” solutions than those in which excludability was possible (Ostrom, 1990). While policies designed to foster private property were the dominant solution for the latter, Ostrom posited that community-based resource governance was required for the former cases (Gibson et al., 2000).

Implicit biases

This school’s prescriptive project is focused not on ecological, but economic outcomes. As Ostrom made clear, “The issue in this case—and many others—is how best to limit the use of natural resources so as to ensure their long-term *economic* viability” (Ostrom, 1990: p. 1).

Synergies and moles

While this school is sophisticated about what to do to solve a collective action challenge, it does not provide intellectual guidance about which problem, sustained yields of timber, to exotic crops from soy to palm to eucalyptus, to fisheries to local water management, ought to be given attention. This means that any synergies and moles that result are “accidental.” For example, managing fisheries as a

Type 1 problem may, depending on the reproduction logic of the resource in question, require maintaining the entire structure and function of the ecosystem itself—even though that is not the concern of Type 1 problem frames. However, the reverse can also be true, such as when successfully managing for the highest Type 1, sustained yields are found to undermine ecosystem system structure and function and/or render extinct particular species (Cashore & Howlett, 2007). Likewise, the Commons school is largely silent on what to do when successfully designing institutional arrangements for managing a particular good in the long run might undermine an ability to convert the land to a more lucrative crop, such as palm oil or soy plantations, that would have provided even higher utility enhancing benefit (Cashore & Bernstein, 2022).

The optimization school

(Type 2 reinforcing) directly incorporates these synergistic and mole effects through its normative belief that policy and institutional designs ought to champion “aggregate economic utility” across the economy as a whole (Thomas & Chindarkar, 2019). The implicit moral frame is that a particular problem “at hand” can only be ameliorated (Lippke et al., 1990) if policy officials are able to find a solution that maximizes utility not for the specific problem (like Type 1), but for society as a whole. The answer is provided through cost–benefit analysis in which environmental and social outcomes are given “utility enhancing” values often through “willingness-to-pay” surveys. This school has been credited with generating effective policy designs that have lifted millions out of poverty (Hasan, 2021).

Implicit biases

Adherents to the optimization school relay on utility maximization to assess not only how, but whether, it is rational to any particular problem that comes across the desk of a policy official, including climate and biodiversity.

Synergies and moles

This schools’ approach most certainly creates synergies—such as greater community stability, lower levels of violence, and greater access to education and health care that often result from increasing income. This thinking can create Type 4 moles—as illustrated by (Type 2 reinforcing) economist William Nordhaus’ conclusion that the most optimal or “economically rational” future is the world temperature at 3.2°C warming above natural levels (Nordhaus, 201) despite (Type 4 reinforcing) scientific evidence produced by the world’s leading scientists that 1.5/2°C is the maximum warming possible without risking catastrophic ecological changes (Cashore & Bernstein, 2022; IPCC, 2018).

The compromise school

(Type 3 reinforcing) incorporates, but expands, an emphasis on utility to include, in their own right, environmental, social, and cultural goals (Cashore & Bernstein, 2022). Its ethical foundations, highlighted by the Brundtland Report, are aimed at promoting balance among competing goals and interests through principles of inclusiveness, transparency, accountability, and empowerment (Cashore & Nathan, 2020). This school emphasizes the creation of deliberative processes with which to take appropriate decisions (Scharpf, 2000) and is highly transformative in achieving consensus outcomes (Risse, 2000). Researchers from this school have found, or posited, that depending on how they are constituted, inclusionary approaches can help foster political legitimacy (Bodansky, 1999), public support, and improve policy-making (Bernstein, 2017; Dryzek, 2005; Eckersley, 2004).

Implicit biases

Adherents to the Compromise school assess success as creating some kind of stakeholder inclusionary process that would be required to balance economic, environmental, social, and cultural values in ways that produced evaluations of trust, legitimacy, and appropriateness of the process (Overdevest & Zeitlin, 2016).

Synergies and moles

This school produces a number of synergies and moles that sit outside of ontological orientation. For instance, a deliberative approach to a range of interests can produce greater feelings of trust and inclusion that create “peace dividends” that extend far beyond a particular compromise process (Bunse &

McAllister, 2022). However, this school risks producing, and even supporting, solutions that are inconsistent with the science of what is required to address a particular "on-the-ground" problem (Cashore et al., 2019).

For instance, Victor (2015), thinking about the agreement rather than its effectiveness, adjudicated the Paris Accord as "transformative" for generating support while simultaneously declaring the 1.5/2°C objectives as "ridiculous." Similarly, the Canadian province of Newfoundland invoked a Type 3 reinforcing compromise dialogue to address biologists' warning that its cod fish were being overharvested. These transparent, trustworthy, and legitimate deliberations led to an agreement on catch levels that were *higher than* what biologists projected would be required to maintain long-term sustained yields. The result was the catastrophic collapse of Type 1g cod fishery, further degrading those concerned about Type 4 ocean ecosystem degradation (Cashore & Bernstein, 2022).

The prioritization school

school (Type 4 reinforcing) confronts "commensurability" biases (Tribe, 1972) inherent in the approach of the Commons and Optimization schools to instead, arguing that some problems must be ranked in order of importance to policy-makers and society, rather than turning to cost–benefit or multigoal policy analysis to make these choices for them (Cashore & Bernstein, 2022).

A classic example concerns antislavery as a policy objective that trumps utility calculations or compromise solutions (Cashore & Bernstein, 2022). Tribe pointed out that the same logic applies to species extinctions: i.e., policy-makers have no choice but to take decisions that are projected by scientists as likely to maintain their viability. To do otherwise is to risk extinction (Cashore & Bernstein, 2022). The Prioritization school helps shape sweeping legislation in the United States including the Endangered Species Act, participated in creating the 1972 Stockholm conference and help design the United Nations Environment Program (Ivanova, 2021). Cashore has argued that the school has dramatically declined in importance over the last half century in favor of the other schools (Cashore, 2023; Cashore & Bernstein, 2022).

Implicit biases

The Prioritization school's ethical philosophy is based on explicitly recognizing hidden conceptions inherent in all policy analyses and then to consciously, rather than inadvertently, design policies consistent with preferred biases.

Synergies and moles

For these reasons, the inherent moral philosophy behind the Prioritization school is that lower-ranked problems—including moles caused by effectively managing higher-ranked problems—can only be managed in ways that do not undermine lexical priorities.

A critical case of policy drift: the proliferation of Type 2 and Type 3 policy tools to manage Type 4 challenges

This 4PT framework offers a novel way to characterize a sweeping overview of transnational and domestic initiatives to curb deforestation in general and Peatland in particular. Given the scope of an individual article, we present a pithy but representative review by drawing on several years of individual and collaborative research, including, but not limited to, Cashore (2022: pp. 14–16); Cashore et al. (2004); Mukherjee and Sovacool (2014); van der Ven et al. (2018); (Grabs Auld & Cashore 2021); McDermott et al. (2010); Cashore and Nathan (2020); Sun et al. (2024); Judge-Lord et al. (2020); and Visseren-Hamakers et al. (2023).[3] We find strong prima facie evidence that global and local policy tools have drifted away from conceiving of the degradation of Peatland ecosystem as a Type 4 Prioritization challenge, to instead developing tools and approaches that largely emphasized Type 2 and 3 problem conceptions.

[3] This type of review is consistent with "historical narrative" approaches that are applied to inductively generate, and then deductively weave, an explanation for broad patterns of change over decades that are often missed by those championing ahistorical quantitative methods aimed at uncovering "statistical significance" (Büthe, 2002) that have been criticized for chasing precision over accuracy (Bernstein et al., 2000). The space constraints of a single journal article mean that our analysis paves the way for, rather than replaces, more in-depth "process tracing" (Collier, 2011) efforts.

Transnational biodiversity conservation initiatives: drifting away from Type 4

Since the early 1980s, and accelerating following the 1993 Rio Earth Summit, transnational actors have designed a range of private governance and private/public initiatives whose emphasis focused on land use conservation, forest sustainability, and deforestation, all of which included attention to Peatland sustainability and conservation either directly or as part of a broader suite of sustainability objectives. The bulk of these efforts turned to designing FMD policy interventions as a means to ameliorate a range of "on-the-ground" sustainability challenges including climate change and biodiversity (Table 4). Their origins can be traced back, in part, out of criticisms of two related intergovernmental efforts. The first was the International Tropical Timber Agreement (Gale, 1998), whose designers expected Type 3 outcomes integrating economic growth, social responsibility, and environmental stewardship through trade liberalization. Their design and effects were ultimately criticized by environmental groups as reinforcing a Type 2 "logging charter" (Humphreys, 2006). The second were unsuccessful efforts to achieve a global forest convention at the Rio Earth Summit that environmental groups had hoped would achieve meaningful Type 4 "on-the-ground" reforms (Cashore et al., 2004).

These led, someone ironically, to environmental groups from Greenpeace and the World Wide Fund for Nature to turning to global supply chains and a range of corporate social responsibility initiatives to achieve Type 4 outcomes that they hoped would be more effective and efficient than intergovernmental processes (Auld et al., 2008). Initial efforts included boycotts of tropical timber (Brody, 1987; El Eris, 2000) and the promotion of firm-level "environmental management systems" that focused on procedures for achieving sustainability outcomes (Kollman & Prakash, 2001).

Concerns about these efforts being too abstract and/or that reinforced Type 2 utility-oriented problems and Type 3 compromise among environmental, social, and economic goals over Type 4 environmental problems led to the creation of the Forest Stewardship Council global certification system that contained several principles, criteria, and standards governing the maintenance of forest ecosystems and conservation of biodiversity (Cashore et al., 2004).

However, by the 2000s, scholars noted mixed results, with limited uptake in developing countries (van der Ven et al., 2018). This instance of "implementation depression" led to strong debates within and across ecolabeling systems about how to better design to achieving Type 4 impacts (Auld & Cashore, 2012) (Judge-Lord et al., 2020; van der Ven & Cashore, 2018). It also led many to turn to new problems, such as "illegal logging", and new tools including forest legality verification in which forest products would be tracked for their compliance with domestic forest policies (Winkel et al., 2012). These trends subtly worked to downplay stringent standards associated with Type 4 conceptions, to instead reinforce Type 1 forest practices and sustained yields, as well as explicitly advancing Type 2 utility incentives do to so (Nathan et al., 2014; Cashore & Stone, 2014; 2012).

Similar trends occurred in the mid-2000s with the application of public and private "financing" tools through "Reduced Emissions from Deforestation and Forest Degradation" (REDD+) initiatives (Kanowski et al., 2011). The original idea was sparked by scientific evidence that forest degradation and deforestation were contributing to climate change—especially in the tropics (Santilli et al., 2005). The tool itself focused on creating economic incentives to avoid deforestation and manage forests to sequester carbon. Initial supporters engaged in rhetorical causal claims that reinforced Type 4 conceptions, including the World Bank President asserting that REDD+ "will end deforestation" in the tropics in general and in Indonesia in particular (World Bank, 2011). Others argued that such effects would require carefully assessing, and designing, these policies to achieve clearly identified environmental outcomes (McDermott et al., 2011). However, the design and impact quickly drifted toward Type 3 and 2 outcomes. For example, scholars found that despite limited effects in curbing deforestation, the dialogues that emerged over REDD+ dramatically improved Type 3 deliberative stakeholder engagements, which were further reinforced by the European Union's efforts to promote Type 2 legal compliance Voluntary Partnership Agreements (Villanueva et al., 2023) that mandated inclusion of marginalized and disempowered communities (Jodoin, 2017). To be sure, concerns about Type 2 producing moles led to "safeguard" efforts through both REDD+ (Visseren-Hamakers et al., 2012) and legality compliance; most responses tended to reinforce Type 3 empowerment concerns through procedural mechanisms (McPhail et al., 2016) including "free prior and informed consent" (Hanna & Vanclay, 2013) and fairness in stakeholder participation (Villanueva et al., 2023). To be sure, some Type 4 thinking was prevalent in these efforts, including efforts to ensure "rights to resources" of indigenous communities (Andersson et al.,

Table 4. Global and transnational policy drift from the Type 4 land conservation problem.

Type 4: Priority	Type 2: Optimization	Type 3: Compromise	Type 1: Commons
• Policy goal: Identify policy solutions based on key features of a clearly specified ecological and social problem • Ensure that solving lower-ranked problems do not undermine higher-ranked problems	• Policy goal: Improve aggregate utility (social welfare) • Policy design orientation: Incentivize conservation through market and economic gains	• Policy goal: Achieve balance and consensus across environmental, social, and economic goals	• Policy goal: Achieve long-term economic sustainability of a specified resource
1908s-1993 Rio Earth Summit: • Public governance emphasis on land use conservation, curbing deforestation and stopping illegal logging • Failure to reach agreement	Turn towards finance and market driven policy tools to improve forest conservation by improving economic incentives. Examples: • International Tropical Timber Agreement (1998) • Trade liberalization Private governance seen as more efficient than government processes Examples: • Corporate Social Responsibility • Private certification of organizational sustainability Non-State Market Driven (NSMD) Governance and eco-labels for private stakeholders to gain market access Examples: • Forest Stewardship Council (FSC) • Roundtable for Sustainable Palm Oil (RSPO) Legality Compliance Example: • Forest Law Enforcement, Governance and Trade (FLEGT) Climate Finance Tools Example: • REDD+		

Source: Authors' own creation.

2014), but these tended to be crowded out, or share the stage with, other competing conceptions, failing to produce and incorporate lexical reasoning advanced by the Prioritization school.

The emphasis on financing to conserve forests has recently accelerated following the Paris Climate Accord commitments, including commitments at Glasgow to raise $130 trillion for these efforts (Seymour et al., 2022). These private sector efforts have been justified, in part, on their potential to stop deforestation and promote responsible Peatland stewardship (Kusumaningtyas & van Gelder, 2017). However, these efforts implicitly conceive of Peatland as Type 2 or 3 problems in which it is hoped that Type 2 economic incentives and/or Type 3 dialogues aimed at environmental, social, and economic objectives will be synergistic with efforts to improve or reverse "on-the-ground" degradation (Hill, 2020). To be sure, attempts improve effectiveness through which "better designed" solutions continue. These include corporate commitments to achieve "net zero" climate emission and purchase "deforestation-free" products. They also encompass the European Union's "no deforestation regulation" (Sotirov et al., 2021), which was preceded by 30 years of policy experimentation, and frustration, over attempts to meaningfully conserve tropical forests. Yet, it seems clear from this review that without a fundamental conceptual U-turn (Panwar, 2021), the most likely outcome of these latest "better designed" efforts (Ou et al., 2021) will be to reinforce the "policy creation, euphoria, implementation, and depression" cycle that is so common within global environmental governance.

In sum, despite Type 4 origins, our collaborative research has discerned an incremental and often unconscious drift in which FMD tools largely reinforced Type 3 and 2 problem conceptions (Cashore & Bernstein, 2022; Sun et al., 2024; Cashore & Nathan, 2020) away from prioritizing the objective of maintaining Peatland ecosystems over other goals (Grabs & Garrett, 2023). Recent environmental and social governance efforts (O'Connor, 2022), though often well intended, seem unlikely to perform any better than those they replaced (Barnett et al., 2021; Panwar et al., 2023).

Policies targeting Peatland management in Indonesia: drifting away from Type 4

These broad approaches to forest and land use conservation efforts that included, but were not limited to, sustainable Peatland management have coincided with two decades of transnational and regional and efforts specifically targeting Peatland conservation in Southeast Asia in general and Indonesia in particular (Macdonald et al., 2023). These too have followed similar patterns of both conceiving of, but then drifting away from, thinking Peatland ecosystem management as a Type 4 problem (Table 5).

An implicit Type 4 emphasis can certainly be gleaned from the International Union for Conservation of Nature (IUCN)'s efforts to encouraging their member countries to include Peatland restoration as part of their Paris Climate Agreement commitments (IUCN, 2017). Type 4 conceptions were also reflected in, and justified the creation of, Indonesia's Peatland Restoration Agency (PRA) in 2016, which was given the official mandate to maintain and conserve Peatland ecosystems[4] in order to mitigate future ecological catastrophe. Indeed, the PRA's explicit mandate includes restoring and rehabilitating the hydrological functions of damaged Peatland ecosystems through rewetting and regeneration practices. These efforts were also justified for their synergies with reducing forest fires and help Indonesia meet its (Type 4) emission targets. In a similar vein, the Association of Southeast Asian Nations (ASEAN)-wide Peatland Management Strategy was created to foster regional cooperation for promoting conservation and restoration, which was expected to curtail pollution from peat clearing fires (Environment Division, and ASEAN Secretariat, 2021). Likewise, there are calls to generate novel private and public interactions to ratchet up Type 4 effects (Macdonald et al., 2024).

Despite these cases of Type 4 responses, other overlapping international and domestic agencies and legislative frameworks domestically have meant that most policies and on-the-ground practices continue to promote Type 2 and 3 conceptions of land use change in general and peat management in particular (Environment Division, and ASEAN Secretariat, 2021), with some going so far as to call for the PRA to be dissolved (Ibnu Aqil, 2020). Likewise, domestic and local policies designed to foster increased job creation caused further drifting away from Type 4 thinking. For example, Indonesia's "Omnibus Law on Job Creation" diluted strict provisions on fixing liability of corporations for forest fire cases in Peatland areas under the existing environmental and forestry law, as part of an economic reforms package for revitalizing Indonesia's economy post-COVID-19 (Sembiring et al., 2020). Likewise, there are worries that Indonesia's "food estate" program, launched as a national strategic project to address a possible

[4] The agency, which would later include Mangrove forests, is known as the Badan Restorasi Gambut dan Mangrove.

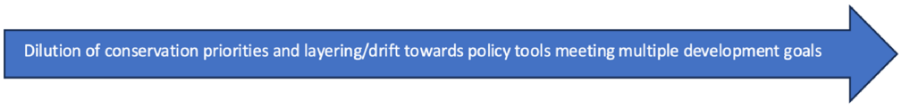

Table 5. Domestic and local policy drift from the Type 4 Peatland protection/restoration problem.

Type 4: Priority	Type 2: Optimization	Type 3: Compromise	Type 1: Commons
• Policy goal: Identify policy solutions based on key features of a clearly specified ecological and social problem • Ensure that solving lower-ranked problems do not undermine higher-ranked problems	• Policy goal: Improve aggregate utility (social welfare) • Policy design orientation: Incentivize conservation through market and economic gains	• Policy goal: Achieve balance and consensus across environmental, social, and economic goals	• Policy goal: Achieve long-term economic sustainability of a specified resource
Creation of peat and mangrove restoration agency Badan Restorasi Gambut dan Mangrove (MRGM) in response to 2015 Southeast Asian Haze Crisis	Regional cooperation on haze pollution and Peatland conservation		
Peatland restoration centered on preservation of hydrological functions in Indonesia's national commitments made to the Paris Agreement. Example: • Protection of peat domes, protection of peat content above minimum soil thickness, unified peat hydrology	(Inter)national regulation of land use and Peatland management; Sustainable logging. Expansion of drainage-based agriculture Rezoning of Peatland hydrological units into multiuse zones, separating areas for conservation and agriculture in the same ecosystem	Regulations for protection of peat domes Designation of Peatland-protected areas vs. those for sustainable harvesting Establishment of rules and institutions to reduce overexploitation	
ASEAN Peatland Management Strategy (APMS) aimed specifically at Peatland fire threats	Drainage-based agriculture such as oil palm and Acacia for paper pulp; Land sparing; Land use zoning		
	Omnibus law on job creation to revitalize economy post-COVID-19 Food estate program on food security issues	Land sharing; Paludiculture to serve both productive and protecting functions Controlled agriculture on peat soils	

Source: Authors' own creation.

food security crisis in the wake of the pandemic, could result in massive conversion of Peatland forests (Loasana, 2020).

Overall, we conclude that there is evidence that successful policies reinforcing Type 2 and 3 conceptions have not, to date, created synergies with Peatland conservation, but even larger moles. The question remains: how then, given these trends, might Peatland degradation be curbed? This question is increasingly being raised by most domestic and transnational stakeholders who recognize that avoiding collapse of Peatland ecosystem structure and function may undermine short-term economic benefits, but it will, ironically, produce higher economic and social benefits in the long term. Achieving these outcomes, however, requires, given our earlier review, conceiving of Peatland degradation as a Type 4 problem.

Policy design principles for treating a Type 4 policy challenge: the Peatland case

The 4PT framework will be useful for any policy analysis exercise seeking to overcome unconscious bias by focusing explicit attention on whether to conceive of any particular challenge at hand as a Type 1, 2, 3, or 4 problem. Once this decision is made, including acknowledging the implications for whack-a-mole effects, policy analysts can then turn to relevant school with which to design "fit-for-purpose" policy solutions.

The problem for those seeking to manage Peatland ecosystems as Type 4 problems is that while there are widespread policy capacity and expertise across scholarly and practitioner to advance policy solutions advocated by the Commons, Optimization, and Compromise schools, there is only limited knowledge, let alone policy capacity, required to advance solutions consistent with the Prioritization school. Drawing on two decades of work, his review of the Prioritization school, Cashore has identified four design tasks, and the corresponding policy capacities, that would need to be engaged to effectively manage Peatlands as a Type 4 problem: engaging sequentialist/lexical ordering processes; identifying key features of the problem that any solution would need to incorporate to overcome; applying path dependency analysis to uncover policy mix innovations capable of "locking-in" sustainability trajectories that can fend off pressures for policy conception drift; and organizing multistakeholder "policy design learning" exercises that integrate complex sources of knowledge produced within, and across, ecological and policy sciences. To be sure, our purpose here is not to conduct, but pave the way for, application of these tasks—the end result of which is expected to produce an effective and durable policy lever, a lengthy multiple-step action plan, and corresponding peer reviewed article.

Engage in sequentialist/lexical ordering

The first task of "fit-for-purpose" Type 4 policy analysis is to engage, following Tribe (1972), in a lexical or "sequentialist" ordering process in which policy officials need to be explicit about which clearly specified, measurable "on-the-ground" problems must be effectively managed "no matter what" and those that can only be addressed after higher-ranked problems are resolved. Implementing this task is relatively straightforward in certain cases, such as the problem of slavery, in which antislavery outcomes have been determined by most policy officials in most countries as being important to achieve irrespective of, and not conditional upon, cost–benefit or compromise solutions. However, Cashore' analysis of 30 years of scholarship on environmental problems found that the complicated task of sequentialist ordering when it comes to managing the environment has not, to date, received significant attention by the prioritization school. There are two ways that policy designers must overcome this gap.

The first is to directly address, rather than "wish away" through abstract causal beliefs in synergies, the perennial discussion about environment and development. Currently, these issues are generally advanced through two competing causal beliefs. One group posits that advancing Type 4 long-standing historical cultural practices is almost always synergistic with Type 4 ecological outcomes (Reytar & Veit, 2016; Yeung, 2023), while others argue that self-determination of local peoples ought to determine whether, and how, to advance whatever Type 1, 2, 3, or 4 conceptions they deem most important (Colchester, 2010). In the first, case sequentialist reasoning is bypassed; in the second case, communities are given priority over the environment, but often with little attention as to the whack-a-mole implications. To effectively engage in ranking of outcome objectives, both communities must generate more information on, and also disentangle, their moral beliefs from their causal beliefs.

Table 6. Four lexical orientations for treating biodiversity as a Type 4 problem.

		Ecosystem wide	
		Yes	**No**
Absolutist	Yes	**Holitic** • Species dispersed across ecological systems For example, managing vertebrate species such as wolfs and owls viable in boreal and temperate forests	**Targeted** • Species within narrow habitats For example, avoiding extinctions of invertebrates such as spiders in tropical forests
	No	**Comprehensive** • The science of maintaining ecological systems in the midst of species decline For example, management within Borneo's Peatlands, US grasslands	**Technocratic** • The science of maintaining select species in the midst of ecosystem decline For example, seed banks, bird feeding stations, planting trees in nontree ecosystems, zoos

Source: Table created by Cashore and first published in Cashore and Bernstein (2022).

The second task is to disentangle, and decide, which of four ways to think about Type 4 environmental problems will guide the lexical process. Just as Ostrom did for Type 1 commons tragedies, Cashore has identified four distinct ways to conceive of, measure, and manage, Type 4 problems, that lexical reasoning processes would need to decide upon (Table 6). A *holistic orientation* results when, given scientific evidence, effective efforts to save as specific individual species—such as the Northern Spotted Owl, require that an entire ecosystem must be maintained (Spies et al., 2018). In contrast, a *comprehensive orientation* places lexical reasoning not on saving all species but rather on an ecosystem's overall structure and function. The inverse is a *targeting orientation in which the emphasis is on* maintaining a specific species rather than its ecosystem (Grove, 2002; Wijedasa et al., 2017; Nair, 2007). This implicit framing was behind successful efforts to bring back Bald eagles in California and Wild Turkey's in Connecticut. Finally, a *technocratic approach* targets the conservation of species that are saved by removing them from their wild state. These include those promoting seed banks or zoos as conservation tools.

Policy designers focusing on Type 4 problems have no choice but to undertake these tasks for two reasons. First, it will be impossible to conduct empirical impacts and effectiveness evaluations without knowing what kind of "success" is expected to occur. Notably, a comprehensive approach—which is where the Paris Accord's objective of limiting emissions to 1.5/2°C above preindustrial levels is located (Cashore & Bernstein, 2022)—will most certainly, and by definition, lead to species extinctions (Baker et al., 2009). This is because species heterogeneity is so prevalent in tropical and subtropical forests that even small amounts of extractive activity can produce extinctions, especially for invertebrate species (Grove & Forster, 2011). This is important. The rationale for a comprehensive orientation is that by maintaining ecosystem structure and function, a far greater number of species will be rescued from extinction than if ecosystem structure and function had not been maintained. Without making this conception explicit, it is impossible to assess success from studies that simply show species decline following a policy intervention.

Identify key features of the problem at hand

Once a lexical or sequentialist ordering process is undertaken, the next analytical step, following Ostrom's approach to Type 1 sustainability challenges, is to identify the most salient or "key features" of the problem in question that any solution would need to incorporate to be effectively managed.

To elaborate how this would work, let us assume that a sequentialist or lexical ordering process led policy designers to treat Peatland ecosystems in Indonesia led as Type 4 "Comprehensive." Certainly, given the number of species already rendered extinct from extractive processes to date, this would seem a plausible outcome. But how, given the complexity governing ecosystem structure and function, might policy-makers identify "key features" relevant for problem-solving? Auld, Bernstein, Cashore, and Levin's work on distinguishing "super-wicked" problems provides analytical guidance.

Table 7. Problems and their key features.

	Climate	COVID-19	Peat	Haze
Those causing problem also want to solve	Yes People locked into, and benefit from, high carbon economy	Yes People benefit from disease spreading social and economic networks	Yes Consumers and companies are now looking to stop further degradation	No Those who suffer from asthma through transboundary haze are not generally causing the problem
Time is running out	Yes Years and decades	Yes Hours and days	Yes Years and decades	No Time takes care of the problem
Irrational discounting	Yes Weak commitments: pushed off as future nears	Possible Strong commitments: risk of near-term bias, moral hazard	Yes Overlapping institutions reinforce short-term approaches	Yes Clearing of forests through fires to not take into account costs of Haz
No central authority	Yes Emissions from anywhere have the same global effect	Yes and no Diseases spread across borders Countries shut down to exercise authority	Yes and No Indonesia has authority, but economic globalization and consumers limit what is possible	Yes Transboundary haze requires global cooperation

Source: Adapted and expanded from Auld et al. (2021).

While their approach first applied to and derived from the climate (Levin et al., 2007, 2012; Cashore et al., 2016), and COVID-19 crises (Auld et al., 2021), their distinctions can also be used to generate systematic deliberations over the salient features of managing Peatland as a Type 4 comprehensive problem (Table 7).

Degree to which those seeking to end the problem are also causing it

Auld, Bernstein, Cashore, and Levin noted that unlike problems with clear supporters and opponents, such as gun control or abortion, some problems like climate change are characterized by those seeking to solve the problem also contributing to it: i.e., we are battling our collective selves. They noted that virtually, no one wants climate change, "but the current political system, technologies, availability of energy sources, and patterns of production and consumption among other economic and cultural factors lead to us all individually and collectively contributing to the problem" (Levin et al., 2012). They also noted that similar dynamics were also at play during COVID, where the benefits of global travel, trade, and integration also led to swift diffusion of the disease (Auld et al., 2021).

The degree to which this feature characterizes Peatland management depends on the underlying analytical frames, and temporal location, of the myriad of researchers on this space. Some point to the historical role of large-scale global companies in accelerating swift logging processes in Southeast Asia in general and Borneo in particular (Dauvergne, 2001). These accounts are consistent with traditional interest-based account, in which some favor the policy decisions to permit extraction to continue, while others favor conservation policies to reverse these trends. However, others have conceived of responsibilities differently, pointing to the demand from (relatively wealthy) consumers in the North (Micheletti & Stolle, 2007). Certainly, these conceptions are behind those transnational processes designed to promote responsible stewardship along global value chain (Auld, 2014; Cashore et al., 2004; Mukherjee & Sovacool, 2014; Sun, 2022; Van der Ven et al., 2021).

We also know that, like the climate and COVID-19 cases, no one wanted to cause peat ecosystems to become degraded, produce and threaten species extinctions, and release carbon into the atmosphere. Instead, we know that expansion of agricultural practices on Peatlands from 17,000 km^2 to 78,000 km^2 between 1990 and 2015 was the result of successful Type 2 policies seeking to lift the incomes of millions to levels beyond the poverty line (Figures 7 and 8).

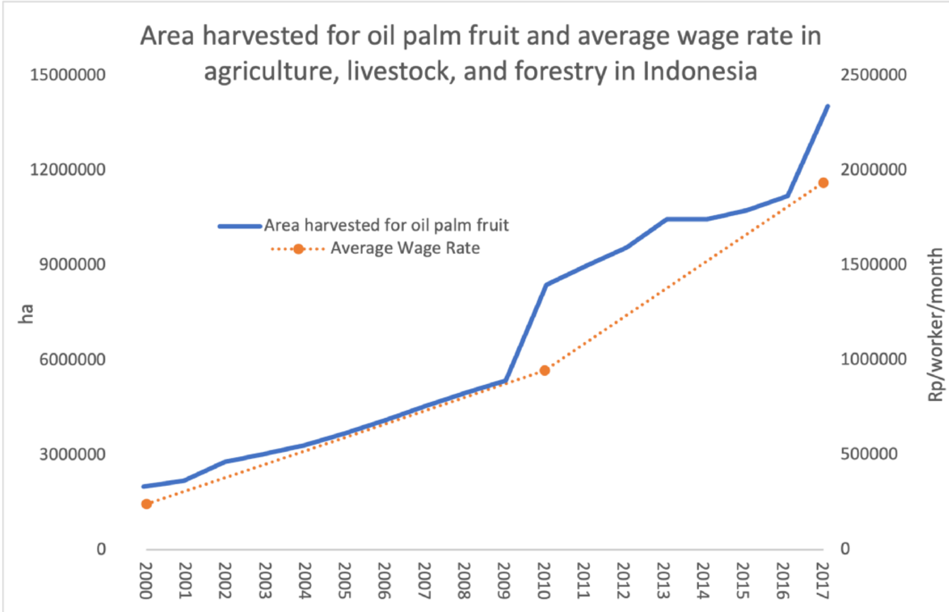

Figure 7. Palm oil expansion and wages.

Source: Authors' own creation. Expansion of the palm oil industry was estimated using the annual area harvested for oil palm fruit from the Food and Agriculture Organization's Corporate Statistical Database (FAOSTAT) (FAO, 2024). Average wage rates in the agriculture sector were obtained from Arifin et al. (2019).

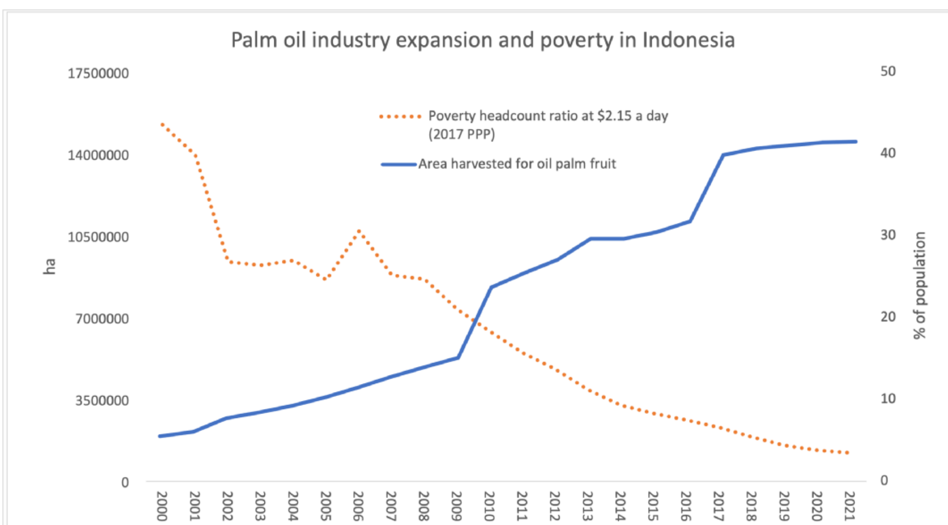

Figure 8. Palm oil expansion and poverty.

Source: Authors' own creation. Expansion of the palm oil industry was estimated using the annual area harvested for oil palm fruit from FAOSTAT (FAO, 2024). General poverty headcount ratio was obtained from The World Bank databank (The World Bank, 2024).

It was the resulting moles, including declines of intact peat swamp forests in peninsular Malaysia, Borneo, and Sumatra from 119,000 km^2 to 46,000 km^2 as of 2015 (Miettinen et al., 2017; Page et al., 2022) and 10,000 km^2 remaining by 2023, rather than explicit policy objectives, that created today's Peatland crisis. We also note that in the peat case, many of those who have been criticized by nongovernmental organizations and sustainability scholars as causing the crisis are now finding, or positing, that the same

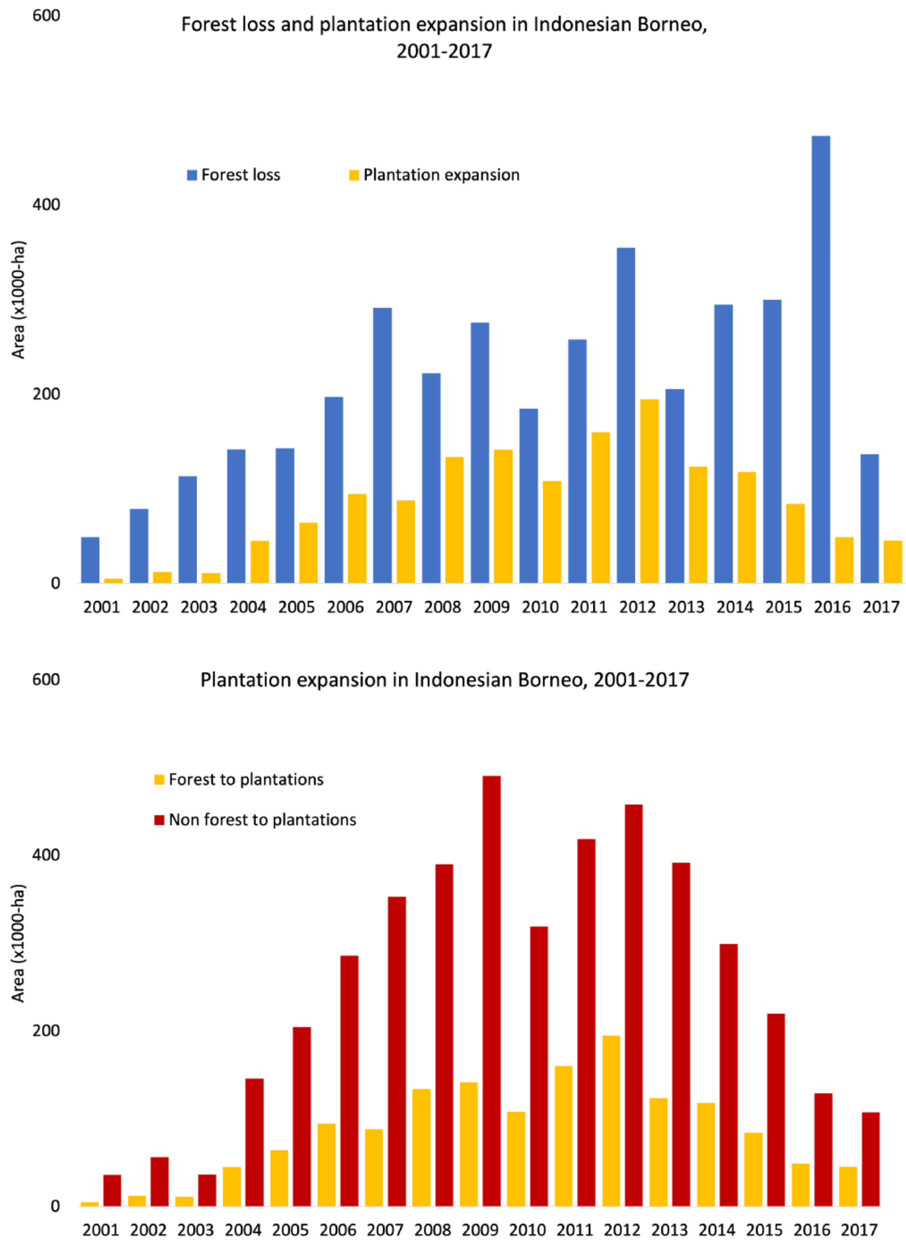

Figure 9. Conversion of natural forests to palm oil plantations.
Source: Authors' own creation based on estimates derived from Gaveau et al. (2019).

organizations are now seeking ways to avoid further degradation and collapse of Peatland ecosystems (FAO, 2005; Macdonald, 2020; Pirard et al., 2015). To be sure, skepticism remains especially among some environmental nongovernmental organizations about the extent of these efforts. We do note that these trends in efforts involving supply chains and corporate actors in solving the problem (Macdonald et al., 2023) also coincide with a dramatic decline in the conversion of natural forests to palm oil plantations in Borneo (Figure 9). They also coincide with research collaborations and publications from paper and palm oil companies and firms documenting the importance of maintaining peat ecosystems (Deshmukh et al., 2023).

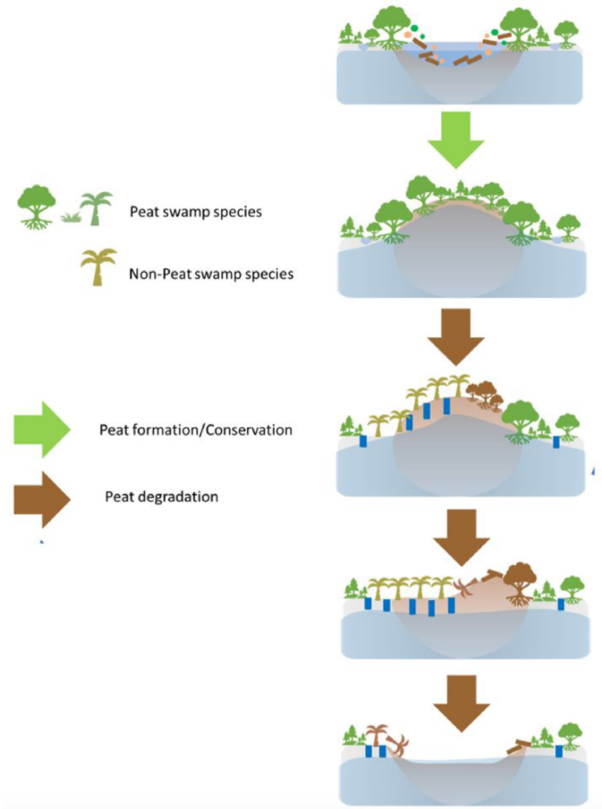

Figure 10. Drainage and Peatland ecosystem collapse.
Source: Authors' own creation.

Attention to this feature is also important for distinguishing "root cause" problems from those that result from their inattention. For instance, much of the Haze challenges in Southeast Asia are associated with clearing of Peatland for agricultural expansion. However, the "key features" shift if the problem is framed as a Haze challenge. For example, many individual Singaporeans experience Type 1 utility and Type 4 health losses associated with this pollution, but are not directly involved in causing its problem (Kheng-Lian, 2012).

Likewise, the Peatland problem can be framed first as a climate challenge, but policy designers would need to be explicit about whether climate or peat ecosystems are higher on the lexical ranking. If not, there is a risk, environmentalists feared back during the Bali climate Conference of Parties (COP), that an ability to manage tropical forests becomes inadvertently narrowed to those that have climate benefits and/or Type 2 reinforcing financial incentives (Karsenty, 2008; REDD-Monitor, 2018).

Degree to which time is running out

A second dimension focuses attention on the degree to which time is running out (Levin et al., 2012). We know that the science of the climate crisis and the epidemiology of pandemics mean that failure to act within years and decades in the case of climate, and hours and days in the case of pandemics, will cause catastrophic tipping points (Auld et al., 2020).

Attention to the Peatland as a Type 4 comprehensive problem reveals similar conditions. Notably, scientists have found that as a wetland system, drainage agricultural practices, if permitted to continue, will produce irreversible collapse of the structure and function of Peatland systems (Figure 10)—ironically, just like climate, leading to declines in long-term Type 2 outcomes as well. Hence, any and all effective policy interventions will have to be consistent with, and maintain, practices that do not result in wetland drainage or catastrophic and permanent collapse will eventually occur.

Curiously, the temporal dimension when conceiving of the problem as Haze issue is quite different because, ironically, once a Peatland conversion project is completed—whether that occurs before or after Type 4 tipping points—there will be no need for Peatland converting fires.

Degree to which policies discount the future irrationally

A third set of deliberations concerns the extent to which extant policies "discount the future" irrationally (Auld et al., 2020; Levin et al., 2012). This question focuses attention on those cases in which many policies are prone to punting, identifying commitments in the future, and then reneging as the salience of short-term costs confronts the intended or required behavioral change. Within policy studies, this question is usually applied to Type 2 utility undermining outcomes. However, the 4PT framework focused Type 4 irrationality towards an assessment as to whether policies do not reflect the scientific knowledge about what is required today to avoid tomorrow's ecological catastrophe's—which we know is present in the Peatland ecosystem case today. That is, policy interventions at global and local scales have produced a myriad of policies that, while often well intended, fall short of the required behavioral changes needed to avert catastrophic tipping points (Evers et al., 2017; Wijedasa et al., 2017).

Degree to which there is no central authority

Finally, Auld et al. focus attention on the degree to which there is a "central authority" to manage the problem (Auld et al., 2021). We know that when it comes to climate change, the system of state-based authority undermines a global effort to collectively manage the crisis—which is problematic given that a CO_2 emission anywhere in the world has the same effect. When limited central authority exists, policy-makers must advance some kind of transnational or multilevel process that would be expected to diffuse over time even in the absence of say, an international agreement. A similar dynamic played out with COVID-19, but in these cases, countries closed border to reinforce state authority. In the case of Peatland management in Indonesia, this feature presents a mixed bag: on the one hand, Indonesia does have sovereign authority to address the Peatland crisis, but the effects of economic globalization, and the role of transnational supply chains, not only act as a check on domestic authority but also provide the seeds for their potential resolution as well.

Yet, a different response occurs when considering reducing Haze as the higher-ranked lexical objective, which does require transnational cooperation given that the impacts extend beyond Indonesia's borders. In fact, recognition of this has the Haze issue to emerge as one of the most significant transboundary governance challenges in the ASEAN region (Jones, 2006) that have produced domestic and transnational regulatory mechanisms (Lee et al., 2016), including green growth partnerships, to overcome the challenge of no central authority. This boundary-spanning cooperation over Haze has indeed helped to place Peatland conservation on the agenda (Tomich et al., 1998), but even here, regional measures to enforce compliance with legal norms on transboundary pollution through state responsibility and civil liability have had limited effectiveness, prevention, and cooperation (Alam & Nurhidayah, 2017; Wijedasa, Sloan et al., 2018).

Applying path dependency analysis

A third step for developing effective policy designs to manage Type 4 problems is to formally apply "path dependency analysis" that identifies a policy mix capable of producing a multiple-step trajectory (Cashore & Howlett, 2004; Levin et al., 2012). There are two reasons for this. First, policy designers must overcome the tendency to "put off" Type 4 problems by finding ways to trigger policy lock-in innovations. Second, path dependency analysis helps guard against inevitable pressures for policy conception drift (Cashore & Bernstein, 2022).

Developing the potential for Type 4 Peatland management requires an ability to understand, and apply, three components necessary for policy design innovation. The first is to understand how previous "locked-in" policies and systems have entrenched the problem at hand (Unruh, 2000). In other words, policy designers must understand the current state of policy lock-in such as, for example, highway systems in the United States that locked-in high carbon behaviors—if they are to be overcome. This requires careful attention to understanding lock-in processes that occur within policy and ecology systems and also across them (Yona et al., 2019). In the case of Peatland, we know that drainage practices resulting from Type 2 conceptions have created some degree of path dependency because they produced investment and local jobs that reinforced support for the initial practice. Likewise, "eko-hidro" behaviors that resulted from Type 3 conceptions were subject to some degree of path dependency as

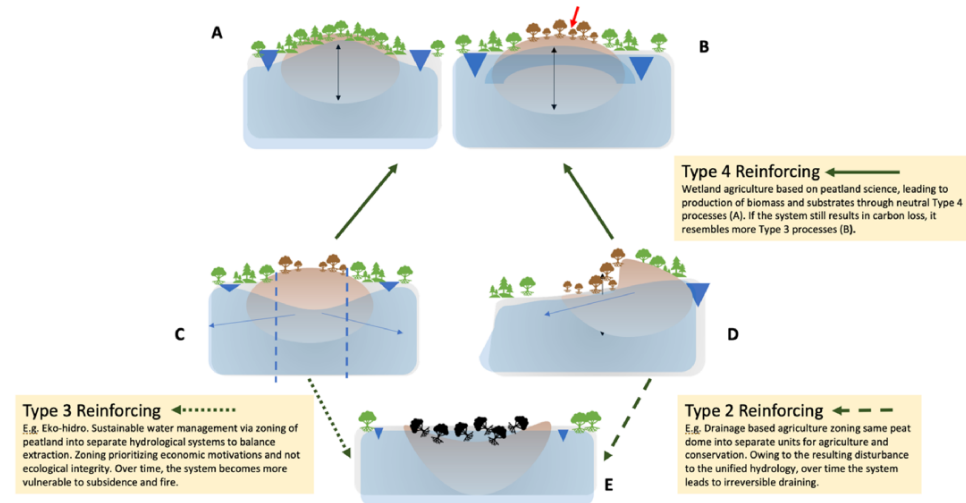

Figure 11. Competing policy conceptions behind Peatland ecosystems management interventions.
Source: Authors' own creation.

multistakeholder exercises that generated long-lasting trust among participants (Figure 11). However, such strategies often end up emphasizing economic considerations over ecosystem knowledge, undermining the structure and function of the Peatland ecosystem (Wetlands International, and Tropenbos International, 2016). We also know that the conversion of dryland forests to promote Type 2 reinforcing agricultural crops ultimately led the introduction of drainage canals to create dry conditions. This, in turn, led to Type 2 reinforcing lime and fertilizers that, in the short term, expanded productivity and associated economic benefits (Figure 12) (Miettinen et al., 2017; Wijedasa, Sloan, et al., 2018).

What we do know from the scientific research is that both Type 2 drainage on the entire Peatland Forest and Type 3 "eko-hidro" compromise approaches lead to path-dependent processes in the natural environment that will, at some point, become irreversible. This is because even if drainage only occurs on part of the land, it will lead to unintentional water draining through cleared areas. These path-dependent processes are also accelerated by two carbon-releasing phenomenon: microbial degradation of peat soils and rapid release by wild and human caused fires associated with these land conversions (Page et al., 2022). Together, these pathways will, over time, lead to the "locking-in" of degradation and sinking of the entire Peatland ecosystem and its hydrological functions.

Given that both Type 3 eko-hidro and Type 2 drainage are expected to produce Newfoundlandesque collapse in Peatlands, biologists have been conducting research and experiments to assess how nondrainage "paludiculture" (Budiman et al., 2020) might allow for some extractive activity without undermining ecosystem collapse. Paludification itself refers to the natural formation of swampy land with peat accumulation in wet areas, resulting from the build-up of organic matter surpassing decomposition rates, leading to the creation of Peatlands. Paludiculture, in turn, draws on this knowledge to assess how to cultivate wetlands in general, and Peatlands, in particular, that maintain the ecological functions of the wetland ecosystems. This orientation, which mirrors Lindenmeier and Franklin's (2003) work in old growth forests, allows for some degree of "residual" harvesting but only when consistent with the ecosystem structure and function (Uda et al., 2020).

Uncovering policy mix "levers"

However, it is not enough though to identify a practice that might be consistent with maintaining Peatland ecosystem structure and function and then call for, as has been the practice for the last 20 years, a "policy to do so" that has frustrated so many biologists, activists, and policy officials working in this space (Tan et al., 2021). Rather, advancing nondrainage "paludiculture" systems requires taking one step back to identify the most plausible policy mix lever for creating durable policy pathways. While

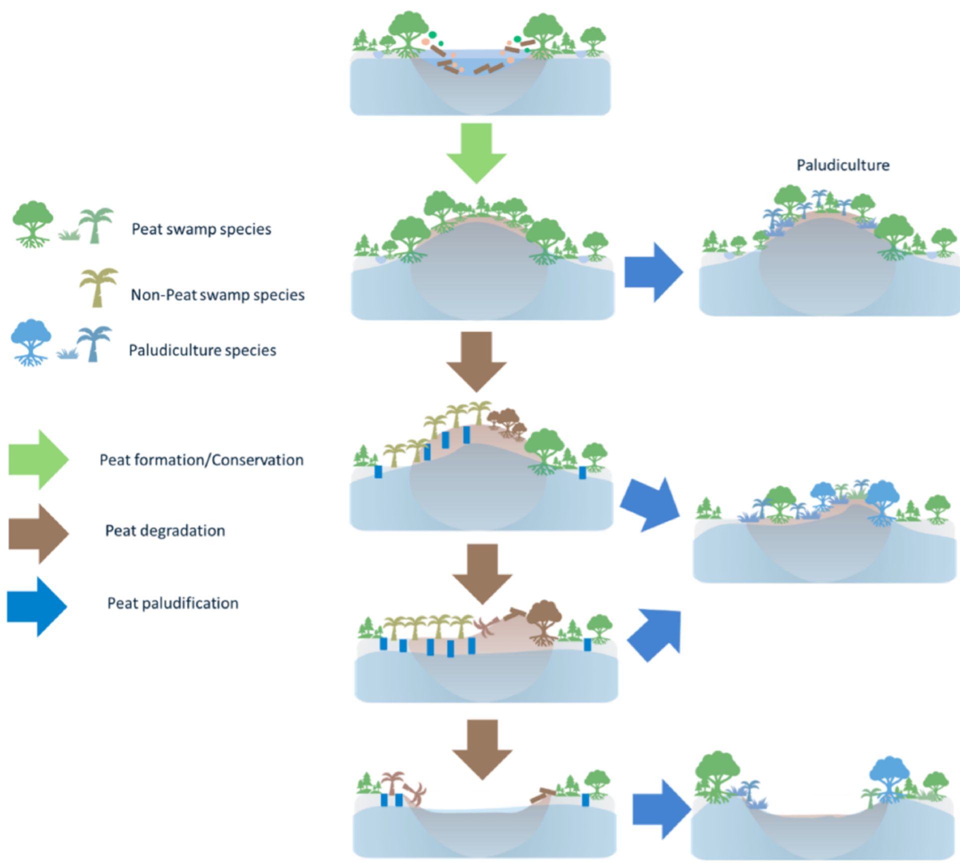

Figure 12. Possible behavioral techniques for avoiding Peatland collapse through paludification.
Source: Authors' own creation.

this is an incredibly difficult and time-intensive task involving the integration of analytic, managerial, and technical policy capacities (Howlett & Ramesh, 2016), we know from several years of research that doing so can uncover "easy-to-pull" policy levers that are hard to reverse. Relevant examples include forward looking policy design mixes behind the impact of the German government's solar photovoltaic feed-in tariff program (Busch & Joergens, 2005), designing carbon taxes for enhancing political support (Cashore & Goyal, 2019), to identifying hunting licenses as a way to lock-in decarbonization punctuations in the Canadian boreal forest (Yona et al., 2019).

This second step requires incorporating applied insights from the policy sciences on the ways that policy mixes might trigger desired transformations that are consistent with scientific understanding of both the problem and the required changes in behaviors. A great number of scholars operating within and across policy relevant sciences have targeted analytical and practical attention to uncovering, and triggering, these types of multiple-step path-dependent trajectories that seem to hold promise in generating desired transformative outcomes (Hacker, 1998; Pierson, 2000).

Much of this has been placed on efforts to achieve biodiversity and climate transformations (Lockwood et al., 2017; Roberts et al., 2018; Rosenbloom et al., 2019; Unruh, 2002). Advances in anticipatory design have specifically devoted considerable attention to identifying innovative policy mixes capable of producing these trajectories (Howlett & Mukherjee, 2018). Much of this work draws on understanding how "microlevel" policy settings and calibrations (Hall, 1993; Cashore & Howlett, 2007) are often fruitful grounds for uncovering "easy-to-pull" levers for multiple-step change.

The ultimate goal is to purposely trigger historically contingent "critical junctures" (Capoccia & Kelemen, 2007) capable of fostering multiple-step causal processes that would be expected, over time, to shape future politics and institutional authority and foster thinking about their role in shaping social

Table 8. Diagnostic questions and super-wicked features.

	Time is running out	No central authority	Those causing wanting to solve	Irrational discounting
DQ1: Immediate stickiness	✓		✓	
DQ2: Entrenched over time	✓		✓	✓
DQ3: Expanding population		✓	✓	
DQ4: Required outcome	✓			✓

Source: Auld et al. (2021).

movements, political parties, and norms that define appropriate policies or processes. These policy design processes promise much value in generating novel solutions to render durable and effective Type 4 Peatland management.

To facilitate these policy design exercises, Auld, Cashore, Bernstein, and Levin have identified four diagnostic questions related to different dimension of problem features (Auld et al., 2021; Levin et al., 2012) that can be applied to assist in the discovery of Type 4 Peatland policy levers (Table 8): What has or can be done to create immediate policy stickiness or irreversibility (*DQ1*); what has or can be done to entrench support over time (*DQ2*); what has or can be done to expand populations that support the policy over time (*DQ3*); and what has or can be done to ensure that lock-in, entrenchment, and expansion initiatives are in line with desired outcomes? **(***DQ4*).

Policy learning design dialogues

Finally, the development of policy mix innovations must include, for both instrumental and knowledge integration reasons, the convening of policy design dialogues among relevant stakeholders who will be needed to pull the initial policy lever and help support, and nurture, the unfolding multiple-step pathways (Humphreys et al., 2017). Indeed, research on policy learning demonstrates that when development and environment coalitions come together to cogenerate design innovations for problem-solving, rather than focusing on compromise, greater political support can and does occur (Sabatier & Jenkins-Smith, 1993; Weible & Sabatier, 2009). This literature also finds that policy learning dialogues are most likely to be effective when targeting the role of calibrations and settings—even though the vast majority of stakeholder dialogues target goals and macrolevel tools. These learning dialogues also require policy design action plans to institutionalize the plan for traveling the causal pathways, including relevant strategies within, and across, each step (Cashore et al., 2019). Recognition of this is particularly critical given the complexities of the political economy of Peatlands, the contested and politically sensitive nature of policy-making in this arena, resistance to state intervention, and powerful stakeholders (Astuti et al., 2020) who must be engaged without causing policy conception drift.

Conclusion: designing for the right problem

Our paper highlights that well-intentioned policy officials often juggle numerous policy goals and objectives, each rooted in different problem conception frames and representing legitimate policy pursuits in their own right, and that they are often successful in addressing them through effective policy designs. However, these endeavors give rise to whack-a-mole effects, which conflict with Type 4 Peatland conservation efforts.

These findings offer novel explanation and corresponding ways to engage in innovative anticipatory policy design exercises than those provided in the extant literature. Our contributions provide a more nuanced way to engage long-standing debates about whether economic globalization or poor policy implementation explains the paradox of concurrently heightened policy attention and problem acceleration: i.e., that failure of global and local policies to curb Peatland ecosystem degradation is owing to a misalignment between how the Peatland problem is currently conceived of and what conception is actually required for its effective management. Our findings caution against applying widespread analytical approaches of cost–benefit and multigoal policy analyses if policy-makers are to escape the "policy creation, euphoria, implementation, and depression" cycles characterizing so much of biodiversity and climate governance globally and in Asia.

To be sure, what we are offering will be challenging, given the abundance of policy capacity for fostering Types 1, 2, and 3 policy analyses, but little for Type 4 within academic or practitioner circles, despite its potential benefits. It is notable that few policy schools formally teach policy design for path dependency and there are no known cases of proactive application of path dependency by policy practitioners in Southeast Asia. Consequently, there is potential, if such capacity can be swiftly built, to facilitate the acceleration of climate and biodiversity policy transitions.

This is important. It is clear from our analysis that the impact of today's latest policy metaphors that emphasize nature-based solutions, green finance, and technology is not preordained. If these policies are designed as part of an effort to create a "critical juncture" policy mix, they could indeed have the potential to create durable and effective outcomes for biodiversity and climate goals in general and Peatland objectives in particular.

To achieve this, and somewhat counterintuitively, these efforts can benefit from incorporating insights from those trained in all four schools of thought. For example, the Optimization school played a crucial role in developing cost-effective cap and trade systems to meet Type 4 environmental regulations governing the Great Lakes' acid rain problem (Burtraw & Swift, 1996), while the Compromise school was instrumental in developing and implementing the US National Environmental Policy Act, which established procedures for stakeholder involvement (Cortner & Moote, 1993). However, this integration must only occur in ways that reinforce, rather than divert from, the Type 4 problem at hand. Such an exercise will require constant conversations across policy and ecology officials as more is learned about how to engage in Peatland ecosystem friendly practices including the potential of nondrainage "paludiculture."

The task then for those seeking to ameliorate Peatland as a Type 4 problem is how to unleash policy designs that integrate both the ecological knowledge of the risk of resource collapse and historical work on the way in which policy designs, mixes, and patches might trigger path-dependent processes for bringing the environment back in (Cashore & Bernstein, 2022). What we do know is that successfully engaging effective and durable policy design innovations in general, and for Peatland in particular, require much more systematic integration of knowledge generated within and across ecology and policy studies.

Acknowledgements

The authors gratefully acknowledge Susan E. Page for her feedback on the manuscript. We extend our sincere appreciation to Beatrice Riingen, Shao Huizhen, Wesley Ng, and Ashwath Dasarathy for their invaluable research assistance. Additionally, we would like to express our gratitude to the coauthors of related projects: I. J. Visseren-Hamakers, Graeme Auld, Kelly Levin, Steven Bernstein, Hamish van der Ven, Yixian Sun, Devin Judge-Lord, Sebastian Sewerin, Janina Grabs, and Katharina Rietig. We also thank the editor and anonymous reviewers for their helpful comments and suggestions on the manuscript.

Funding

Support for this research was provided by a National University of Singapore Start Up Grant through the Lee Kuan Yew School of Public Policy.

Conflict of interest

None declared.

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