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Synthesis

Toward spatial fit in the governance of global commodity flows

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ABSTRACT. Global commodity flows between distally connected social-ecological systems pose important challenges to sustainability governance. These challenges are partly due to difficulties in designing and implementing governance institutions that fit or match the scale of the environmental and social problems generated in such telecoupled systems. We focus on the spatial dimension of governance fit in relation to global commodity flows and telecoupled systems. Specifically, we draw on examples from land use and global agricultural commodity governance to examine two overarching types of governance mismatches: boundary mismatches and resolution mismatches. We argue that one way to address mismatches is through governance rescaling and illustrate this approach with reference to examples of three broad types of governance approaches: trade agreements, due diligence laws, and landscape approaches to supply chain governance. No single governance approach is likely to address all mismatches, highlighting the need to align multiple governance approaches to govern telecoupled systems effectively.

Key Words: *environmental governance; human-environment interactions; scale; spatial mismatch; supply chain; telecoupling*

INTRODUCTION

Local sustainability problems are increasingly shaped by distal actors and processes through global flows of information, people, goods, and services. Demand for commodities such as palm oil, soy, meat, cocoa, and rubber produces negative social and environmental impacts, including deforestation, biodiversity loss, food insecurity, agri-chemical pollution, and consolidation of landholdings, in production regions that are often far removed from sites of consumption (Laroche et al. 2021, Cotta et al. 2022, Roux et al. 2022). Such sustainability problems often transcend traditional political boundaries, which makes it challenging to design governance institutions to fit the scale of the problems. Where governance institutions do not match the scale of the problems they are expected to address, scholars have diagnosed "problems of fit", "mismatches", or "misfits" (Young 2005, Folke et al. 2007, Galaz et al. 2008). The degree of fit may pertain to alignment between a given social-ecological problem and a governance response in spatial, temporal, or functional terms (Cumming et al. 2006, Folke et al. 2007). Issues of governance fit are well researched with regard to regionally bounded or transboundary social-ecological systems such as aquatic or riverine ecosystems (Moss 2012, Bergsten et al. 2014). However, research has not yet systematically explored solutions to spatial mismatches in social-ecological systems connected across long distances, so-called telecoupled systems (Sikor et al. 2013, Munroe et al. 2019, Newig et al. 2020).

Telecoupling denotes long-distance connections between two or more social-ecological systems that are linked through material and non-material flows (Liu et al. 2013, Eakin et al. 2014, Friis et al. 2016). The telecoupling concept supports analysis of how social-ecological changes in one place are related to social-ecological processes elsewhere. Rather than confronting globalization as a diffuse, complex, and all-pervasive phenomenon, a focus on telecoupling helps to delineate and analyze particular connections, place-specific social and environmental impacts, and their (often remote) drivers in a globalizing world (Challies et al. 2014, Friis and Nielsen 2019, Sonderegger et al. 2020).

Governance in telecoupled systems is challenging because the drivers and effects of global flows often lie beyond the reach of national governments, companies, or citizens. Existing sustainability governance initiatives that govern global flows of agricultural and forestry commodities, such as corporate pledges, voluntary sustainability standards, public-private partnerships, and multistakeholder initiatives, are not necessarily effective in driving sustainable supply chains (Garrett et al. 2019, 2021, Grabs et al. 2021, Meemken et al. 2021). Research has attributed the ineffectiveness of governance interventions in part to mismatches between the scale of the governance institution and the scale of the underlying problem (Young 2005).

Here, we explore the problem of spatial fit between governance arrangements and the social-ecological problems they address in relation to land use, as well as global agricultural commodity governance and telecoupled systems more broadly. We focus specifically on the question of spatial fit because telecoupled sustainability problems are inherently related to issues of spatial

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scale. We distinguish two overarching types of spatial mismatches: boundary mismatches and resolution mismatches, building on previous work by Cumming et al. (2006) and Bergsten et al. (2014). Whereas boundary mismatches denote situations in which social-ecological processes transcend governance boundaries, resolution mismatches refer to governance schemes designed at too coarse a spatial scale to effectively address the issue at hand (Bergsten et al. 2014).[1] We present illustrative empirical examples from land and global agricultural commodity governance to elucidate how problems of spatial fit impede the effective governance of land and land-based resources in telecoupled systems. We also examine governance approaches to address this problem. We contend that a better understanding of the types of mismatches that arise in efforts to govern global commodity flows will contribute to identification of leverage points for effective governance interventions in telecoupled systems (Carrasco et al. 2017, Munroe et al. 2019, Newig et al. 2020).

THE PROBLEM OF FIT

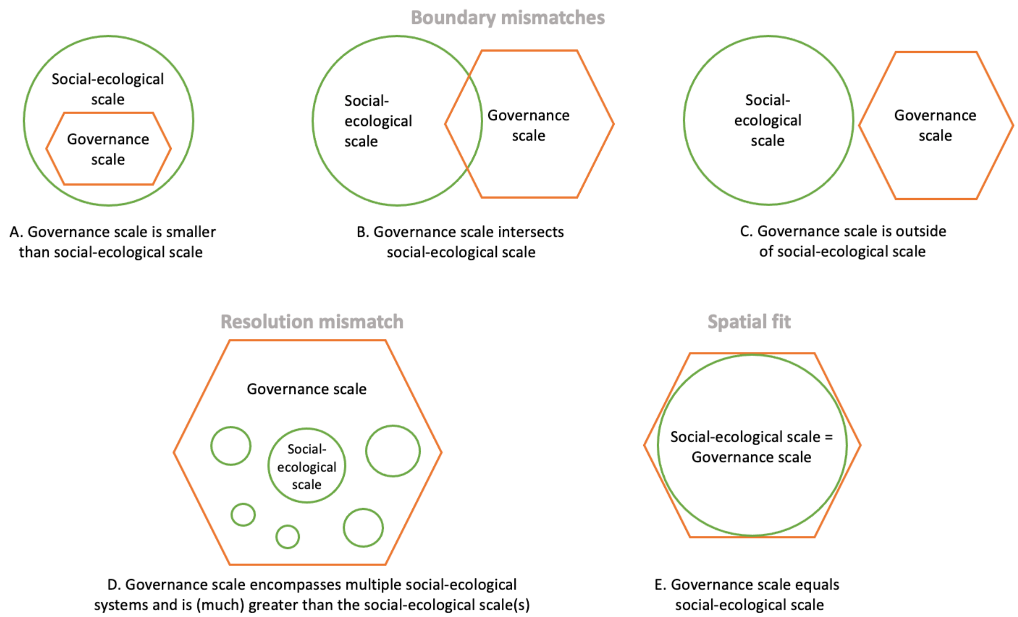
The problem of fit has been widely researched in political science and social-ecological systems literature. Scholars have examined mismatches between the spatial, temporal, and functional scales of governance institutions and the scales of social-ecological processes (Cumming et al. 2006, Folke et al. 2007, Galaz et al. 2008, Ekstrom and Young 2009, Epstein et al. 2015). Here, scale is understood as "the various levels at which a phenomenon occurs in the dimensions of space and time" (Young 2002*a:*26). Because of institutional mismatches, governance responses to environmental threats often struggle to address the full extent of the problem (Ekstrom and Crona 2017). For example, drivers of land-use change operate at multiple levels and spatial scales. International trade, regional development policies, national property rights regimes, and local people's agricultural practices are among the many factors that may lead to land conversion (Geist and Lambin 2002). However, governance mechanisms typically target a single level (e.g., national forestry laws), and thus do not provide adequate solutions to the challenge of governing wider resource systems (Nagendra and Ostrom 2012). Governance arrangements that only partially cover the resource or ecosystem in question have built-in limitations that impede their ability to fulfill their goals (Young 2005).

Various possible configurations of spatial mismatches exist (Fig. 1). The governance scale may be smaller than the social-ecological system scale (Fig. 1A). For example, a municipality may not be able to effectively address air pollution, which is caused by local factories but dispersed beyond municipal boundaries. Governance at larger scales, such as national regulations, may solve the problem (upscaling of governance). Similarly, the governance scale may only partially cover the social-ecological scale (Fig. 1B), as is often the case, for example, with governance of transboundary rivers. In such situations, upscaling may be more difficult in the absence of an authority at a higher governing level. Moreover, governance institutions and actors may have no jurisdiction at all over the social-ecological scale of an identified problem (Fig. 1C), such as in the case of a country lacking the authority to regulate illegal logging by a company domiciled in the country but operating in a neighboring country. Lastly, the governance scale may be greater than the social-ecological scale (Fig. 1D). In such cases, regulation at a (much) larger scale than that of the ecological problem may lack the regulatory specificity to "come to terms with local variations in biogeophysical conditions and [lack] sensitivity to both the knowledge and the rights and interests of local stakeholders" (Young 2002*b:*283; see also Ostrom 1990). For example, much of European Union legislation has been criticized for being too insensitive to local contexts, despite the EU's principle of subsidiarity (Article 5 Treaty on European Union), which demands that decisions should be taken at the most appropriate level of governance, and that the EU should only take action when national, regional, or local governments are unable to achieve a particular objective. The EU Water Framework Directive provides an example of governance that seeks to avoid resolution mismatches. It requires member states to develop River Basin Management Plans to guide local and context-specific implementation (Jager et al. 2016). An institutional fit emerges if the governance scale equals the social-ecological scale (Fig. 1E), as in the case of the global agreements reached in the Montreal Protocol on Substances that Deplete the Ozone Layer to address a global problem (Epstein et al. 2014).

Fundamentally, the problem of fit concerns the question of how to scale or rescale governance arrangements so that they have the best possible institutional fit with the targeted social-ecological dynamics. Establishing the most appropriate fit requires a trade-off between the advantages of better coordination at higher scales, which may reduce the risk of overlooking spatial externalities, and the risk of lacking context sensitivity and legitimacy among local actors, impeding effective implementation (Newig and Moss 2017). Importantly, problems do not occur at a single scale that is objectively given, but different actors perceive and frame problems at different scales and levels (Padt et al. 2014). For example, if state actors aim to meet forest restoration commitments made under international agreements and frame the problem solely at an ecological scale, a national afforestation program fits with the objective of forest restoration for carbon storage. However, if the problem is framed at a social-ecological scale, a single homogeneous afforestation program may suffer from a resolution mismatch and fail to address context-specific challenges related to rural livelihoods (Wiegant et al. 2020, Coleman et al. 2021). Thus, evaluations of fit depend upon how a problem is framed and by whom (Epstein et al. 2015). What is perceived as the "optimal scale" may vary among actors, and the scale at which they define a problem will influence their preferences for governance rescaling. For example, political and societal actors may strategically frame certain problems at the global scale if they perceive national governments as a possible hindrance to solving the problem, or if they want to avoid assuming responsibility and implementing domestic measures (Gupta 2014).

Here, we build on the concept of institutional fit, which is based on the underlying normative assumption that institutional scale can be optimized to avoid spatial externalities (Moss and Newig 2010). Thus, we focus on how individual institutions face this problem of fit. Nevertheless, we recognize that governance always involves the interplay of different institutions. Analysis of institutional fit is closely linked to the analysis of institutional interplay because social-ecological problems are typically governed by various institutions at different spatial scales (Young 2002*a*). Although no institution operates in a vacuum, it can be useful to assess the spatial fit of a specific institution in isolation from the broader institutional landscape. This approach simplifies

Fig. 1. Scale (mis-)matches between social-ecological (green) and governance (orange) scales. (A–C) Boundary mismatches. The institutional boundaries do not match with the spatial boundaries of the social-ecological problem, creating spatial spillover effects. (D) Resolution mismatch. The governance institution does not fit the specifics of the (local) social-ecological context that is to be addressed by governance and hence lacks sufficient spatial specificity. A single governance institution typically addresses a class of social-ecological problems that occurs in multiple distinct localities that have specific contextual features, to which a single governance institution cannot necessarily be adjusted. (E) Spatial fit. Illustration inspired by Newig et al. (2013:13).



the analysis and does not consider all interdependencies, but it enhances analytical tractability and makes it easier to identify governance weaknesses and gaps (Young 2005). The analysis of institutional mismatches can be complemented with considerations of how to create linkages and facilitate interactions among various institutions. We return to considerations of the relation between institutional fit and interplay below.

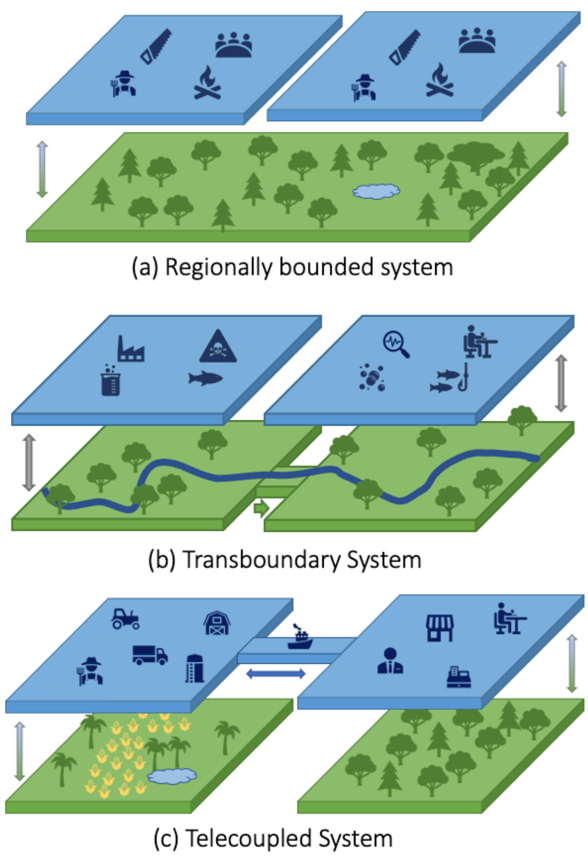
THE PROBLEM OF SPATIAL FIT IN TELECOUPLED SYSTEMS

Research on institutional fit has primarily focused on cases of natural resources in specific social-ecological systems. Studies have been conducted on forest governance (Shkaruba and Kireyeu 2013, Bodin et al. 2014, Melnykovych et al. 2018), water governance (Lebel et al. 2005, 2013, Moss 2012, Enqvist et al. 2020), and land and wildlife management (Bergsten et al. 2014, Dressel et al. 2018). Most research has focused on mismatches between local, regional, and national governance institutions and the social-ecological systems they target, but a small and growing pool of literature investigates transboundary and larger scale social-ecological problems such as depletion of the ozone layer or pollution of international watersheds (Cox et al. 2014). Challies et al. (2014) observe that social-ecological systems research itself has mostly examined small, tightly coupled systems, rather than connections and interdependencies that exist between multiple social-ecological systems linked through global production networks and supply chains (Nyström et al. 2019). Research on telecoupling is increasingly addressing this research gap by investigating the causes, drivers, and implications of globally linked social-ecological systems. Telecoupling research has referred to the problem of mismatches, but the definition and application of the concept in the context of telecoupling remains limited (Oberlack et al. 2018, Munroe et al. 2019, Zaehringer et al. 2019, Newig et al. 2020). The important question of how to align the scale of governance with the scale of the social-ecological problem at hand remains largely unaddressed in research on governing telecoupled social-ecological systems.

Telecoupling is one distinct ideal-typical configuration of interdependent social-ecological systems (Fig. 2). Telecoupled systems arise when the activities of actors in one system affect a social-ecological system elsewhere (e.g., through international trade or the displacement of extractive activities from one place to another), thereby creating social-ecological interdependencies. Consequently, feedbacks can develop, for example, when actors in one location become aware of the displaced effects of their actions and seek to mitigate them through measures such as increased conservation funding.

Telecoupled systems are characterized by geographical distance between the place where the social or environmental impacts occur and the places where underlying causes are found. The geographical distance is often associated with social and institutional distances between the socioeconomic systems (Eakin et al. 2014, Niewöhner et al. 2016, Friis and Nielsen 2017) because they tend to be governed by different, functionally independent institutional arrangements, social networks, and actors (Eakin et al. 2017). Even when distant actors are willing to work together, transaction costs of cooperating on sustainability issues are often much higher than in local or transboundary settings (Newig et al. 2020). Geographical, social, and institutional distances thus hinder the creation of appropriately scaled governance institutions in telecoupled systems in at least four ways.

Fig. 2. Ideal types of interconnected social-ecological systems and their interdependencies. Systems comprise socioeconomic building blocks (blue), ecological building blocks (green), and their interdependencies (arrows). (A) In a regionally bounded system, two socioeconomic systems share the same ecological resource base; e.g., two communities harvest wood from the same forest. (B) In a transboundary system, two socioeconomic systems rely on resources or ecosystems that are ecologically connected; e.g., pollution of a river by an upstream riparian country may affect fish populations in a downstream riparian country. (C) In telecoupled systems, the ecological systems are geographically separate but are connected through social-ecological processes such as trade in agricultural commodities.



First, the absence of manifest ecological feedbacks between telecoupled systems obscures the remote causes and effects of certain decisions and actions. In many locally bounded or closely neighboring social-ecological systems, the activities of one group of resource users will have direct effects on other users (Lebel et al. 2005, Bergsten et al. 2014, Kininmonth et al. 2015). With transboundary water resources, for example, withdrawals in one place affect downstream availability. In telecoupled systems, however, there is usually no such direct ecological feedback. For example, tropical ecosystem degradation driven by commodity production for export to European markets causes biodiversity loss in producing regions or carbon emissions, but does not directly affect European consumers in the short term. Where feedbacks are delayed or indirect, it is also difficult to attribute specific social-ecological effects to particular activities (Carlson et al. 2018). Consequently, the actors driving telecoupled interactions do not necessarily experience the negative effects of their actions or recognize the connections between past actions and subsequent negative effects (Newig et al. 2020). They may therefore have very little incentive to formulate or adapt governance responses.

Second, as a result of the above situation, recognition of and concern about specific problems may depend on social or political actors highlighting causal linkages between certain actions and distant outcomes. “Problem-brokers” or “political entrepreneurs” can play important roles in framing and problematizing unsustainable connections between telecoupled systems (Bastos Lima et al. 2019, Meyfroidt et al. 2022). Once distant ecological or social conditions attract sufficient public attention and concern, a policy window opens wherein various governance interventions may become possible (Kingdon 1984, Eakin et al. 2017). Improved transparency, through the collection and dissemination of information on flows and impacts, can enable or instigate governance responses to telecoupled issues (Gardner et al. 2019). For instance, increasing media attention on environmental issues such as deforestation has put pressure on the EU to address soybean production in the Amazon region (Mempel and Corbera 2021). Several interventions have emerged to tackle deforestation embedded in international trade and to reduce “imported deforestation” from EU consumption (Bager et al. 2021).

Third, governance mismatches arise when governance responses misdiagnose a problem or neglect its wider drivers. Interventions that target only the direct ecological effects of an activity risk merely displacing it to other social-ecological systems. For example, European demand for soy is associated with negative ecological impacts such as deforestation in producer countries (Pendrill et al. 2019, Schilling-Vacaflor et al. 2021). Addressing tropical deforestation at the scale of a single region such as the Amazon is unlikely to be effective because demand for forest-risk commodities will persist. Therefore, governance interventions such as the Brazilian Soy Moratorium, which targets the Amazon specifically, have displaced deforestation to other areas such as the Cerrado region (Dou et al. 2018).

Fourth, the places and governance institutions implicated in telecoupled systems may have very little history of prior collaboration (Newig et al. 2020). The social and institutional distance between telecoupled systems may mean that separate policies, actors, and networks govern largely independently. In the absence of joint institutional structures, governing telecoupled systems is challenging because governance actors face issues that extend beyond their jurisdiction. For example, consumption in the EU has social-ecological effects beyond EU borders (Kastner et al. 2015, Dorninger et al. 2021, Roux et al. 2021). However, the EU's ability to govern these issues has clear limitations given the national sovereignty of external countries and World Trade Organization rules.

DIFFERENT TYPES OF MISMATCHES IN TELECOUPLED SYSTEMS

We apply the concepts of boundary and resolution mismatches to telecoupled systems. We identify the underlying governance problem associated with each type of mismatch, outline two particular mechanisms of boundary mismatches and illustrate with examples from both public and private governance perspectives (Table 1). Our distinction between ideal-typical configurations of mismatches helps in elaborating how the scale of governance institutions often does not align with the scale of social-ecological problems.[2]

Boundary mismatches in telecoupled systems

Boundary mismatches arise in telecoupled systems when the spatial reach of governance structures is such that these structures do not internalize existing social-ecological externalities of activities (i.e., spillovers; Fig. 3A) or when public policies or transnational economic activities produce new externalities (i.e., leakages; Fig. 3B). Spillovers describe events or developments that are not targeted by a given governance intervention, whereas leakages are a form of spillover caused by a governance intervention (Meyfroidt et al. 2020).

Spillover

In case of spillovers (Fig. 3A), part of the problem remains unaddressed because it lies outside the domain of the governance institution. The omitted part of the problem is referred to as a spillover, which is broadly understood as an indirect effect of an activity or intervention (e.g., policy, program, or new technology) that occurs outside the targeted area (Meyfroidt et al. 2020). Spillovers emerge because governance actors may not be aware of the full scale of the social-ecological problem, may be uninterested in or unable to govern what happens beyond their jurisdictional boundaries, or may intentionally neglect parts of the problem (Bastos Lima et al. 2019). For example, voluntary sustainability standards often focus on reducing harmful on-farm effects at sites of production but tend to neglect off-farm effects such as reduced downstream water availability or air pollution from pesticide use (Zaehringer et al. 2018, Parra-Paitan and Verburg 2022, Sonderegger et al. 2022). Spillovers can also cascade to further social-ecological systems (as indicated in Fig. 3A) and have cumulative effects, which makes it difficult to identify causal connections (Busck-Lumholt et al 2022*a*).

The transnational operations of companies make it challenging to achieve institutional fit and to internalize the extra-jurisdictional social and environmental effects of global supply chains. Because multinational enterprises operate beyond the jurisdictional reach of individual states, the externalities of their activities are often not addressed by existing governance institutions. These actors are not accountable to any single authority that matches their scope of operation (Kobrin 2009).

Private actors may encounter boundary mismatches in their efforts to govern supply chains for two reasons. First, individual companies may lack oversight and influence over some or all of their suppliers and therefore lack the ability to control the environmental and socioeconomic effects of production. For example, approximately one-quarter of the solid wood furniture that IKEA sells is manufactured in Chinese factories that source their timber from other countries, in particular Russia (Newell and Simeone 2014). IKEA attempted to control the timber sourcing of its Chinese subcontractors to "green" its supply chain but was unsuccessful because of the geographical distance to upstream activities, the large number of intermediaries between timber extraction and retail, and an inability to trace timber to a specific logging permit (Goldstein and Newell 2020). Additionally, supply chain configurations change over time (dos Reis et al. 2020). China has long depended on Russian wood for the manufacture of finished wood products for export to the United States, but the specific companies within these supply chains change regularly (Goldstein and Newell 2020). Even where large, powerful retailers dictate prices and quality standards to their suppliers, their ability to control sustainability along the value chain is often limited because of the mismatch between their governance reach and the scale of the social-ecological problem. Companies are often not able to monitor their indirect suppliers, which makes it difficult to implement chain-wide sustainability policies (zu Ermgassen et al. 2022).

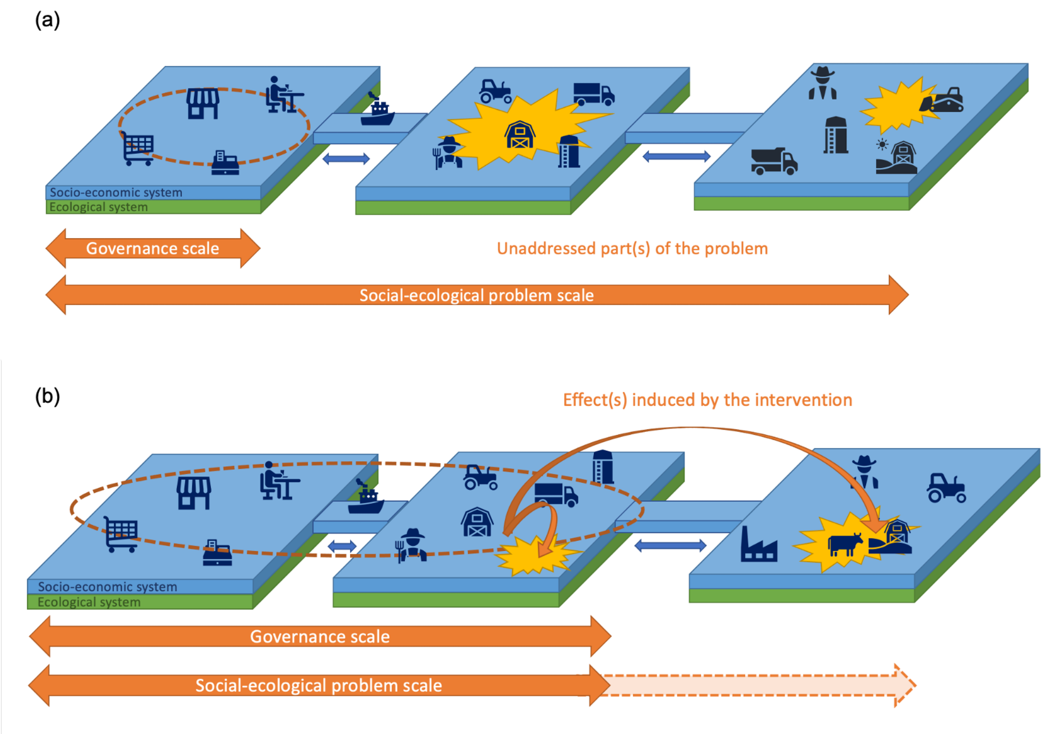
Second, companies may govern particular segments of their supply chain but neglect others, which constitutes a boundary mismatch if the goal is to create sustainable supply chains that encompass the full value chain. For example, textile certifications generally focus on either the upstream end of the supply chain (i.e., organic and fair cotton production) or the midstream section (i.e., working conditions of garment workers; Partzsch 2020), but seldom cover all segments of the supply chain.

Leakage

A leakage may emerge when a governance intervention induces externalities (Fig. 3B). The governance intervention produces effects that contradict its objectives and reduce the overall benefit of the interventions, which constitutes a leakage effect (Meyfroidt et al. 2018, Bastos Lima et al. 2019). For example, the EU's Renewable Energy Directive created additional demand for biofuel crops produced outside of the EU and thereby fuelled land-use change and deforestation in tropical countries, counteracting the goal of reducing greenhouse gas emissions (Bastos Lima 2021). This process has also been described as "governance inducing telecoupling" (Newig et al. 2019), i.e., situations in which governance initiatives themselves create new distal interactions with positive or negative outcomes. Recognition of the negative distal effects led to revision of the Renewable Energy Directive to mitigate indirect land-use change (Bastos Lima 2021). In other instances, the leakage effect does not occur across a great distance but can be in proximity to the target area. For instance, if a forest moratorium prohibits deforestation within designated areas, the activity may simply shift to nearby areas not covered by the moratorium (Meyfroidt et al. 2010, Leijten et al. 2021).

Just like public governance, private governance can have spillover effects and leakages. For instance, if private conservation actors focus their efforts on specific regions such as the Brazilian Amazon, that leaves other regions such as the Cerrado and Gran Chaco comparatively less well protected, and land conversion

Fig. 3. Boundary mismatches. Governance institutions neglect social-ecological problems that transcend established jurisdictional boundaries due to spillovers (A) or leakages (B).



may be displaced to those regions (Soterroni et al. 2019, Qin et al. 2022). In short, leakage occurs when the side effects of an intervention escape the scope of governance.

Resolution mismatches in telecoupled systems

Resolution mismatches represent a second problem of governance fit in telecoupled systems (Fig. 4). Because international or transnational governance institutions usually aim to address a social-ecological problem that occurs in more than one place, they are not specific to the social and ecological attributes of a particular social-ecological system or a particular telecoupling. If governance occurs at too coarse a scale, meaning that governance instruments are not context sensitive or flow specific, they are unlikely to be successful because “one-size-fits-all” panaceas do not exist (Ostrom et al. 2007, Meyfroidt et al. 2022).

For example, international governance schemes such as Multilateral Environmental Agreements tend to be too general to govern specific telecoupled systems because international conventions, agreements, and commitments typically involve a large number of signatories, have a general thematic scope, and are not specific to any particular flow.[3] Of approximately 250 Multilateral Environmental Agreements worldwide, only 15 explicitly include trade-related provisions for environmental protection (World Trade Organization 2021). International governance schemes cover a large spatial scale and require a broad institutional outlook that can be implemented in heterogeneous national and local contexts. Because most international institutions are not supranational, meaning that they do not have authority beyond that of their respective members, they rely on lower-level institutions for implementation, which, however, have limited abilities to govern the causes or effects of cross-border flows beyond their jurisdictional boundaries. If the implementation pathway is not defined and lower-level institutions have neither the capacity nor the experience to implement higher-level governance objectives, a spatial scale challenge emerges (Wiegant et al. 2020). Global environmental governance is often directed toward reaching global targets (e.g., Paris Agreement, Aichi Biodiversity Targets, Bonn Challenge). However, target-based governance has been criticized for the gap between international policy and national implementation, the missing linkages between national governments and on-the-ground actions, and the unclear definitions of some wording of the targets (Hagerman et al. 2021, Perino et al. 2022).

In the context of private governance, supply chain actors may set broad, blanket-coverage sustainability goals that are meant to apply across entire supply chains but are, for that reason, ambiguously defined, limited in scope, and poorly operationalized in terms of concrete and measurable targets. For example, in a sample of 513 companies in the coffee sector, only one-third reported tangible commitments to sustainability, whereas the remaining companies reported no or vague commitments (Bager and Lambin 2020). Similarly, companies may adopt zero-deforestation commitments without setting clear implementation goals, mechanisms, or deadlines, which impedes effective implementation across the contexts in which they operate (Garrett et al. 2019).

Table 1. Boundary and resolution mismatches in the governance of telecoupled social-ecological systems.

	Boundary mismatch		Resolution mismatch
Definition[†]	Governance institutions neglect social-ecological problems that transcend established administrative or jurisdictional boundaries		Governance institutions have too coarse a spatial resolution than is suitable to address the social-ecological problems at hand
Underlying problem	Lack of governance extent		Lack of governance precision
Mechanism	Spillover	Leakage	Panacea trap
Description	Governance institutions do not govern a social-ecological problem that expands beyond their administrative or jurisdictional boundaries	Governance institutions address a social-ecological problem but create leakage(s), i.e., counterproductive effects outside the targeted area or domain of the intervention	Governance institutions are not specific enough to be effectively implemented and enforced
Example from a public policy perspective[‡]	European countries have not (yet) implemented specific public policies to mitigate the deforestation effects of their demand for soy in remote jurisdictions[§]	A forest moratorium shifts deforestation to neighboring areas or other countries, producing negative externalities in distant jurisdictions	A Multilateral Environmental Agreement that is too broad in scope to govern particular telecoupled flows
Example from a private governance perspective	A Voluntary Sustainability Standard focuses on reducing harmful on-farm impacts at sites of production but neglects sustainability issues outside the farm such as air pollution from pesticide use	Supply chain actors implement zero-deforestation policies that target only one region, allowing actors in other regions or neighboring countries to deforest	Supply chain actors set broad sustainability goals that are insufficiently operationalized and lack specific and measurable targets, unambiguous definitions, and exact coverage

[†]Adapted from Bergsten et al. (2014).
[‡]We present the different types of mismatches from both public policy and private governance perspectives because their analytical focus differs. From a public policy perspective, the focus is on the jurisdictional scale, defined as clearly bounded political units (e.g., towns, provinces, states, or countries; Cash et al. 2006). In contrast, the private governance perspective puts more emphasis on the scale of the supply chain or associated flows.
[§]The newly adopted EU Regulation on deforestation-free supply chains addresses this mismatch (European Commission 2022). It is expected to enter into force in summer 2023. Once it is in force, operators and traders will have 18 months to implement the new rules.

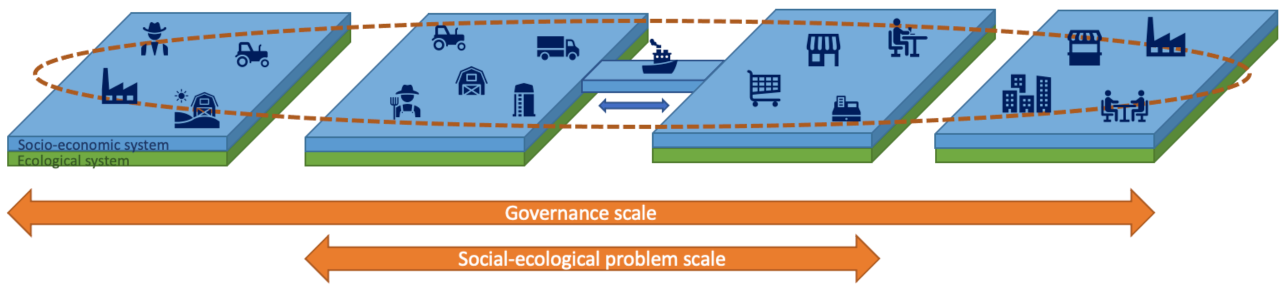
As a result of resolution mismatches, new kinds of mismatches may emerge when governing institutions do not reflect the values, interests, and beliefs of different social groups. What Epstein et al. (2015) have termed "social mismatches" points to the spatial scalar challenge of matching governance objectives and rules with social customs and patterns of resource use, stakeholder expectations and needs, and social organization scales (Epstein et al. 2015). In telecoupled systems, international governance based on global goals carries a clear risk of diverging from issues that are seen as most important by local stakeholders. Global initiatives such as the Kimberley Process, for example, promote transparency in supply chains, but in so doing, they risk favoring global ideals (e.g., of traceability and accountability) over the day-to-day needs and concerns of local communities (Pedersen et al. 2021*a*). Research on gold mining in Tanzania, for instance, found that a centrally imposed transparency initiative had not addressed inequalities, informal structures, and power asymmetries in the mining sector (Pedersen et al. 2021*b*). Likewise, conservation projects that are governed by external actors (such as states, international nongovernmental organizations, or private firms) tend to subordinate local institutions, customary practices, and traditional ecological knowledge, resulting in relatively ineffective conservation management (Dawson et al. 2021). International conservation initiatives may overlook social and political complexities in local systems and create unintended and undesirable effects, including restricted access to land and natural resources and the erosion of customary natural resource governance institutions (Persson and Mertz 2019, Persson et al. 2021). If local people are merely seen as recipients of services and are not involved in the design of sustainability interventions, a mismatch between local goals and strategies and those of the wider project can emerge. In the case of a World Bank conservation project in Argentina, project concepts and ideas were decided by external actors, rather than in partnership with local beneficiaries (Busck-Lumholt et al. 2022*b*). Sustainability issues prioritized at the global scale may not match with local people's understanding of and aspirations for sustainability.

Self-governance and local rule development have been found to be highly important for effective natural resource management (Ostrom 1990). Otherwise, there is a high risk that international or transnational governance schemes are insufficiently adapted to local contexts. If governance actors perceive that transnational institutions do not fit the local contexts (i.e., social mismatch as result of a resolution mismatch), they may create their own institutions. This situation occurred with the establishment of the Icelandic Responsible Fisheries certification program as an alternative to the transnational Marine Stewardship Council certification scheme (Foley 2017), and with the introduction of Indonesian and Malaysian Sustainable Palm Oil schemes as alternatives to the Roundtable on Sustainable Palm Oil (Higgins and Richards 2019).

ADDRESSING MISMATCHES IN TELECOUPLED SYSTEMS

These examples suggest that global commodity flows, through boundary and resolution mismatches, pose multiple environmental governance challenges that are difficult to address through territorial or global governance approaches. Against this background, both public and private actors have attempted to rescale governance to account for social-ecological interactions

Fig. 4. Resolution mismatches. Governance institutions have a coarser scale than is suitable to address the social-ecological problems they target.



across long distances and between jurisdictions. With respect to global governance, governance rescaling has been defined as "a shift in the locus, agency, and scope of global [...] politics and governance across scales" (Andonova and Mitchell 2010:257). Scaling up governance to make it more comprehensive in terms of target area, actors, or supply chain segments can limit the risk of boundary mismatches. In contrast, scaling down governance might enhance the context sensitivity of interventions and the participation of local stakeholders, thus correcting resolution mismatches. Additionally, creating new governance scales can be another strategy to avoid mismatches. In telecoupled systems, such governance institutions comprise due diligence laws, as elucidated below. We next present three illustrative examples of public, private, and hybrid governance forms to illustrate the opportunities and challenges involved in addressing both boundary and resolution mismatches.

Social and environmental provisions in trade agreements

The inclusion of binding, measurable, carefully monitored, and sanctionable social and environmental provisions in preferential or regional trade agreements presents a potential instrument to govern trade-related environmental impacts between specific countries or regions (Kehoe et al. 2020). Recently, researchers have advocated shifting focus on the relation between trade and the environment away from merely mitigating the negative impacts of trade, and toward focusing on how to harness the positive environmental effects of trade through, for example, the use of so-called "trade-and-environment agreements" (Roux et al. 2021; https://ieep.eu/news/a-cup-of-trade-and-environment-agreement-tea/). In theory, environmental provisions in trade agreements can oblige parties to uphold environmental law and implement "Multilateral Environmental Agreements"; increase cooperation, transparency, and participation in environmental matters; and trigger the uptake of voluntary sustainability standards and public regulations targeted at sustainability issues of a specific sector or product. However, empirical evidence of the actual environmental effects of environmental provisions in trade agreements is scarce and inconclusive (Berger et al. 2020).

Although trade agreements do address specific flows at the scale of telecoupled relations, they pose a risk of leakage because trade flows may shift geographically (i.e., trade diversion), and regulated commodities may be replaced by less regulated or unregulated commodities within supply chains (i.e., substitution effect). For example, the U.S.-Peru trade agreement includes a binding Forest Annex, which details measures to strengthen forest governance in Peru, including the establishment of chain-of-custody systems to verify the legality of timber exports. However, because the Forest Annex is strongly focused on protecting CITES-listed timber species, one risk is that it increases exports of species not listed in CITES. It could also prompt U.S. importers to switch to other, less regulated markets (Del Gatto et al. 2009). Governance institutions that target specific geographic areas or commodities risk creating boundary mismatches. This situation suggests that trade agreements may be more effective at reducing leakage effects at regional scales when they contain binding, measurable, and enforceable sustainability chapters, and they involve regional blocs rather than individual countries, and commodity groups rather than single commodities. However, the risk of resolution mismatches increases when the spatial scale of trade agreements increases.

Trade agreements can suffer from resolution mismatches. For example, Berger et al. (2020) reviewed 48 preferential trade agreements of five emerging economies and found that three-quarters of the agreements make reference to general environmental goals in their preamble or other chapters. However, these provisions are not of substantive nature, meaning that they do not imply any substantive rights or obligations in environmental matters to the parties. Additionally, some countries restate their commitment to ratify or implement Multilateral Environmental Agreements in their trade agreements, thus, only restating the pledges already made elsewhere. If countries only make commitments to general environmental goals and international conventions without defining concrete actions in their trade agreements, they are unlikely to address the specific social and ecological problems of telecoupling in particular social-ecological systems.

Moreover, if the needs and priorities of local communities are overlooked or deprioritized, social mismatches may arise. Failure to recognize the economic, social, and environmental concerns of affected communities can also induce a boundary mismatch. For example, a trade ban may prove ineffective if it does not recognize the economic concerns of local communities, who may derive little economic benefit from the ban, and hence have little incentive for conservation or sustainable resource use (Abensperg-Traun 2009). Consequently, the resource may be sold illegally or into alternative markets, creating leakage effects that limit the effectiveness of the trade ban. For instance, Busch et al. (2022) estimated that a European ban on importing high-deforestation palm oil from Indonesia would have only minor effects on deforestation because, among other reasons, non-participating countries would absorb the high-deforestation palm oil. More research is needed on how to avoid mismatches when designing trade agreements and trade bans.

Due diligence obligations and laws

The proliferation of due diligence policies shows that public sector actors increasingly govern social and environmental conduct beyond their own borders. Due diligence policies are a clear example of "rescaling" or "territorial extension", whereby states or groups of states extend their regulatory influence to actions abroad (Scott 2020). Although due diligence laws are implemented within formal administrative boundaries on a jurisdictional scale, they govern extra-jurisdictional processes by obliging transnational companies to monitor their supply chains and to rectify unsustainable impacts. Due diligence policies tend to be applied at scales applicable to telecoupled systems because they address flows that extend beyond jurisdictional boundaries.

Due diligence requirements often apply to specific commodities, as in the case of the EU Timber Regulation, which prohibits the sale of illegally harvested wood on the EU market, and the EU Renewable Energy Directive, under which member states can count biofuels toward the attainment of their renewable energy targets only if the biofuel production complies with certain sustainability criteria (European Union 2018), irrespective of whether the biofuel crops are produced inside or outside the EU (Scott 2020). Additionally, the EU adopted a Regulation on deforestation-free supply chains in December 2022, which prohibits the placing of palm oil, soy, wood, cattle, cocoa, coffee, rubber, and some derived products on the EU market if these commodities are linked to deforestation and forest degradation or if they are non-compliant with all relevant applicable laws in force in the country of production (European Commission 2022). These sector-specific due diligence policies use conditional market access as a mechanism to secure foreign producers' compliance with EU rules. More recently developed, economy-wide, mandatory due diligence laws, at the national and European levels, rely on another governance mechanism, namely self-reporting and public scrutiny. The French Duty of Vigilance Law, for example, requires companies to assess and report the risks of infringing environmental and human rights in their supply chains, as well as measures to mitigate such risks. If preventable human rights violations or environmental damages occur, the company can be held liable and can be required to remedy the harm (Schilling-Vacaflor 2021). Additionally, the European Commission proposed a Directive on sustainable corporate governance that covers human rights and environmental due diligence (Schilling-Vacaflor and Lenschow 2023). In sum, due diligence laws attempt to alleviate the boundary mismatch that occurs because importing countries, in principle, have no jurisdiction over producing countries, where sustainability problems appear.

However, due diligence policies may suffer from resolution mismatches because they do not target any particular locality, but rather general social-environmental problems, irrespective of their local manifestation. This situation can lead to social mismatches. The EU Timber Regulation, for example, demands that timber is sourced legally according to the laws of the producer country. However, such policies that are reliant on local laws risk endorsing certification systems that neglect the rights of certain local communities (Bartley 2014) and work against sustainability by incentivizing a regulatory "race to the bottom" among exporting countries (dos Reis et al. 2021). Furthermore, if mandatory due diligence laws require companies to report on risk mitigation in their supply chains, companies may focus their reporting on issues that are not key priorities for local stakeholders. For example, under the French Duty of Vigilance Law, companies have focused on environmental issues such as deforestation in the soy and beef supply chains while neglecting other issues such as biodiversity loss, pesticide use, water scarcity, and water pollution. The companies prioritize labor rights, whereas the rights to health, land, water, and food may be more important for local stakeholders (Schilling-Vacaflor 2021).

Landscape or jurisdictional approaches to supply chain governance

Landscape approaches aim to reconcile competing social, economic, and environmental interests and objectives at the landscape scale. Landscape approaches have been widely employed in international conservation projects and are now also increasingly taken up in sustainable supply chain management (Sayer et al. 2013, Boshoven et al. 2021). They are based on multistakeholder collaboration (e.g., public authorities, producers, companies, civil society organizations), which sets them apart from purely public jurisdictional governance approaches that do not seek to involve all affected stakeholders. These relatively recent governance approaches rest on the premise that the involvement of public actors allows for the implementation and enforcement of mandatory requirements for production practices, provided that enforcement capacities exist (Bager 2021). Public actors have regulatory authority over the area covered, "allowing for better monitoring and enforcement as well as addressing the problem of institutional mismatch" (von Essen and Lambin 2021:6–7). A jurisdictional approach is a type of landscape approach that uses formal administrative boundaries to define the scope of action and involvement of stakeholders (Denier et al. 2015).

Landscape and jurisdictional approaches aim to avoid the boundary mismatches that commonly affect public and private governance initiatives that focus exclusively at farm or supply-chain scales. This narrow focus can create "islands of good practice" while surrounding areas continue with business as usual (UNDP 2019:12). Many of the social-ecological problems that sustainability initiatives such as voluntary sustainability standards target manifest in the wider landscape, leading to mismatches between the scale of the intervention and the scale of the sustainability challenges being addressed (Sonderegger et al. 2022). For example, where companies seek to reduce commodity-driven deforestation by certifying some of their own or their suppliers' farms or plantations, deforestation may shift to non-certified areas (Heilmayr et al. 2020). Jurisdictional and landscape approaches are assumed to reduce the risk of leakages (and thus boundary mismatches) because they target entire jurisdictions or landscapes rather than a selected smaller area. In terms of certification and standard-setting, landscape and jurisdictional approaches have been introduced to upscale governance to reduce the risk that commodity sourcing produces ungoverned impacts beyond the production area or unit (e.g., farms). Sustainable cocoa initiatives, for example, are evolving in their focus from the farm level to sector, landscape, and jurisdictional levels (Carodenuto 2019, Parra-Paitan et al. 2022, 2023). Empirical evidence on the effectiveness of landscape and jurisdictional approaches is scant, however, given their recent emergence (Bager 2021, von Essen and Lambin 2021).

Jurisdictional and landscape-based certification and sourcing also have limitations. Governance at the landscape level remains limited to a certain regionally confined scale and may not address all potentially relevant telecoupled dynamics such as migrant worker flows or illicit financial flows (Sonderegger et al. 2022). Additionally, the risk of leakage persists because neighboring jurisdictions may have weaker environmental protections (von Essen and Lambin 2021). Non-compliant production may shift to neighboring places with fewer restrictions (Meyfroidt et al. 2018), and commodities from non-compliant neighbors might be laundered into the more tightly regulated jurisdiction (Gibbs et al. 2016, Boshoven et al. 2021).

Institutional interplay

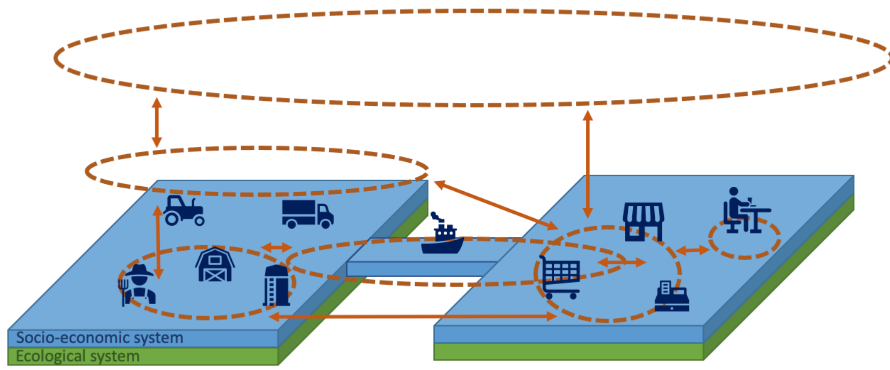
Although we focus on how specific institutions can define and address what they conceive as mismatches, in practice, telecoupled systems are typically governed by several institutions, which interact horizontally at the same level of social organization or vertically across levels (Fig. 5). Institutions influence the decision-making, commitments, behavior, and effects of one another (Oberthür and Gehring 2006). Institutional interplay is based either on functional linkages that occur when developments in one issue area unavoidably affect another issue area, such as between institutions on agricultural production and land use, or it is based on political linkages that arise when actors recognize interdependencies and deliberately forge institutional interactions (Young 2005). For example, the EU's Forest Law Enforcement Governance and Trade (FLEGT) initiative interacts with private certification schemes and public legal timber regulations in partner countries (Overdevest and Zeitlin 2014). FLEGT promotes better enforcement of forest law and the establishment of export licencing systems in partner countries to identify, monitor, and export legally harvested timber products destined for EU markets. Additionally, the FLEGT initiative, adopted in 2003, encouraged U.S. environmental activists to advocate for an extension of the U.S. *Lacey Act* from fish and wildlife to plants, leading to amendment of the *Lacey Act* in 2008. This example highlights how institutional interactions can lead to the convergence of separate national or regional governance regimes. The convergence between FLEGT and the U.S. *Lacey Act* ensured that illegally harvested timber is not simply diverted from one market to another (Overdevest and Zeitlin 2014).

Creating effective collaborative ties between institutions has been repeatedly proposed as a solution to rectify mismatches (Galaz et al. 2008, Bodin et al. 2017, Enqvist et al 2020). Bergsten et al. (2014:1) argue that "boundary mismatches are impossible to resolve if the focal ecological processes are not contained within the spatial jurisdiction of either a single high-level actor responsible for the whole area or by several lower level actors who collaborate" and thus jointly build a comprehensive governance system at a larger scale. This idea suggests that studying telecoupled systems from the perspective of polycentric governance, defined as systems of overlapping jurisdictions with formally independent but interlinked centers of decision-making, could yield valuable insights into how to resolve mismatches in global land and agricultural commodity governance. Beyond examining the effectiveness of single governance institutions in isolation, a more systematic evaluation of the interplay and potential synergies between different governance interventions can advance the understanding of how to design governance solutions that match the scale of the problem at hand.

A social-ecological network approach can be used to study collaborative natural resource governance across jurisdictional boundaries (Janssen et al. 2006, Bodin and Tengö 2012, Barnes et al. 2019). Studies could adopt such an approach to represent telecoupled systems as networks of social actors and ecological resources connected through commodity flows and institutional or social linkages. Although it is difficult to account for different kinds of social actors and the processing of commodities (e.g., from cocoa bean to chocolate bar) with this approach, it can help to capture how material, information, and communication flows connect different ecosystems, actors, and institutions (Janssen et al. 2006, Bodin and Tengö 2012). This approach is particularly suited to the analysis of landscape-scale responses to boundary mismatches because it highlights horizontal institutional interplay, as demonstrated, for example, in research on an agricultural landscape in Madagascar (Bodin and Tengö 2012) and wetlands in Sweden (Bergsten et al. 2014).

Research on telecoupling highlights the need to combine traditional place-based governance approaches with flow-based governance, which "considers a place in light of its relationships with other places, by tracking and managing where key flows start, progress, and end" (Liu et al. 2018:65). Flows are dynamic, and their origin and destination may change over time as a result of, for example, changing infrastructure, market demand, or biophysical conditions (dos Reis et al. 2023). Flow-based governance arrangements such as certification schemes, zero-deforestation commitments, and due diligence laws are designed to govern commodity flows, irrespective of changing trading relationships between supply chain actors. However, flow-based governance may generate new forms of social exclusion, inequality, and ecological simplification in places of production if transnational notions of sustainability do not match with local needs and realities (Newig et al. 2020). This idea highlights that flow-based governance can cover the full spatial scale of telecoupled systems, but their flow specificity comes at the cost of place specificity. Evidence suggests that the effectiveness of flow-based governance benefits from synergistic place-based governance (zu Ermgassen et al. 2022). For example, governments can support the implementation of zero-deforestation commitments by providing additional disincentives for deforestation through, for example, credit restrictions for non-compliant individuals and companies, and through anti-

Fig. 5. Schematic illustration of institutional interactions in a telecoupled system. The circles denote the governance scales of different institutions.



corruption measures that improve the reliability of geospatial forest information on which private governance schemes depend (Garrett et al. 2019). More research is needed to investigate the interplay between institutions that focus on the full spatial extent of the problem and institutions that are adapted to the local context.

CONCLUSION

The governance of telecoupled systems is beset with problems of fit. Because most social and environmental problems in a globalizing world are neither purely local nor global in scale, addressing these problems requires governance responses that transcend political borders to match the spatial scale of the problem while also being sensitive to local context. Here, we applied the established concepts of institutional fit and governance mismatches to complex sustainability issues arising due to telecoupling. We identified two types of mismatches that are pertinent in the governance of telecoupled systems. First, boundary mismatches occur when governance institutions neglect social-ecological problems that transcend established jurisdictional boundaries, either because the institutional design fails to cover the full scale of the problem or because the intervention induces leakages. Second, resolution mismatches arise when governance institutions have a coarser resolution than is suitable to address the social-ecological problem they aim to address. Because of a lack of governance precision, governance instruments are too general to be effectively implemented and enforced. In the context of land and global agricultural commodity governance, approaches such as due diligence laws and policies, landscape and jurisdictional approaches to supply chain governance, and environmental provisions in trade agreements present important steps toward creating institutional fit in the governance of telecoupled systems.

Scaling or rescaling governance to match the scale of telecoupled systems is an inherently political process. The scale at which a given problem is perceived and framed influences the scale at which it is addressed (Newig and Moss 2017). Rescaling governance can entrench, rather than restructure, existing power relations and global inequalities. For instance, companies may stop sourcing from places with weak public governance, where the risk of infringing environmental or human rights is high, and shift to places with stricter governance to meet consumer demands for more transparency and due diligence (Gardner et al. 2019). This effect increases the risk of unintentionally marginalizing small-scale producers in these regions by excluding them from international value chains and the economic benefits of the global economy (Zhunusova et al. 2022). The most vulnerable people and countries may become subject to extraterritorial control and externally imposed notions of sustainability if actors of the Global North seek to govern environmental and social issues beyond their own borders.

We do not claim that rescaling governance institutions to perfectly match telecoupled social-ecological systems will necessarily solve telecoupled sustainability issues, or even that it is attainable in all circumstances. Rather, we acknowledge that the risk of mismatches persists and identifying an “optimal spatial scale” may not be possible. Any attempt to resolve boundary or resolution mismatches comes with the risk of creating new mismatches, and because material flows, immaterial connections, and spillover relations are dynamic (dos Reis et al. 2020), governing telecoupled systems requires recognizing constantly evolving problem structures and continuously evaluating and adapting governance initiatives. However, even if it were possible to create institutional fit, there would be no guarantee of effective governance, due to implementation or enforcement problems. Nonetheless, we see substantial value in distinguishing different types of mismatches in telecoupled settings to be more productive in devising multiple, well-aligned, and adaptive governance arrangements that are better equipped to bring about the required change toward social and environmental sustainability. Looking at land-based commodity flows through the lens of boundary and resolution mismatches helps us to better anticipate potential governance weaknesses arising from a lack of governance precision or extent, and hence, enables better policy debates. Our analysis indicates that complementary interventions at various spatial scales, rather than single interventions, are needed to govern telecoupled systems effectively.

The most pressing and challenging future research question is how to align multiple governance institutions to govern telecoupled systems. Advancing understanding of institutional mismatches in telecoupled systems requires interdisciplinary research, which itself needs to grapple with the challenge of bridging scales embedded in different research approaches, problem definitions, and perspectives (Friis et al. 2023). While we have focused on spatial mismatches in the governance of telecoupled systems, future investigations could analyze the occurrence and implications of temporal mismatches. Telecoupled systems are dynamic, and the spatiotemporal connections between regions and actors can change over time (dos Reis et al. 2020, 2023, Leijten et al. 2022), requiring adaptive governance responses. Additionally, investigating to what extent governance institutions fit with the complete life cycle of products merits further research because the spatial scale of governance expands when the temporal scale of governance is upscaled to the product life cycle. The task, albeit formidable, is to design governance systems in which effective institutional interplay offsets institutional mismatches of single institutions.

[1] Bergsten et al. (2014) note that the two types of mismatches may overlap, for example, when jurisdictional boundaries compel actors to govern ecological processes at too fine a scale.

[2] However, we acknowledge that the different types may overlap or be nested in reality, depending on which governance institution is taken as the analytical vantage point. For example, what appears as a spillover of one governance institution may be an induced leakage of another governance intervention.

[3] For example, the Convention on Biological Diversity, United Nations Convention to Combat Desertification, United Nations Framework Convention on Climate Change, and New York Declaration on Forests are not flow specific.

Author Contributions:

J. C. coordinated the development and conceptualization of the study and wrote the original draft of the manuscript, as well as the revisions. G. S., J. N., P. M., and E. Challies contributed to conceptualizing the study and drafting, revising, and editing, the manuscript; authors' names are listed according to the degree of contribution. S. B., L. B. L., E. Corbara, C. F., A. F. P., P. L., C. P. P., S. Q., N. R., and J. Z. contributed to discussing the concepts at two workshops and revising and editing the manuscript; authors' names are listed alphabetically to indicate equal contributions. All authors approved the final manuscript.

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Data Availability:

Data/code sharing is not applicable to this article because no new data/code were created or analyzed in this study.

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