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A framework for analyzing institutional gaps in natural resource governance

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Abstract: In this paper, we present the Inter-Institutional Gap (IIG) framework as a novel approach to conceptualizing the often-overlooked interconnectivity of different rule-levels between formal and informal institutions in a natural resource system. This framework goes beyond the existing concepts of legal pluralism, institutional void, structural hole, and cultural mismatch, each of which offer valuable insights to particular gaps between formal and informal institutions, but do not sufficiently address the interaction at every rule level (i.e. constitutional choice, collective choice and operational choice rules). In order to demonstrate the potential of our framework for better understanding the underlying causes of inter-institutional gaps, we apply it to four case studies that encompass diverse geographical locations, governance levels, and social-ecological systems. Results reveal that institutional gaps tend to exist when there are unintended, unforeseen or hidden gaps between the different rule levels operating among the different institutions involved in governing a single resource system. More specifically we observe that: (i) inter-institutional gaps are co-existing, therefore if a certain gap is identified, other gaps may be expected; (ii) certain gaps may reveal latent gaps; and (iii) intermediaries may be key to addressing inter-institutional gaps. In many cases, sustainable natural resource management and regulation cannot be achieved without directly addressing the inter-institutional gaps that exist between formal and informal institutions operating in the same resource system. The framework facilitates analysis and understanding of multi-level governance structures in pursuit of addressing complex natural resource management issues.

Keywords: Collaboration, governance systems, public policy, rules-in-use, sustainable development, top-down approaches.

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1. Introduction

Natural resource governance in coupled social and ecological systems often involves multi-level interactions between formal and informal institutions based on agreed-upon rules (Cash et al. 2006; Poteete 2012). When such interactions are absent or there are insufficient rules, disparity and incoherence can arise between institutions managing the same resource, potentially posing a challenge to sustainable natural resource governance (Acheson 2006; Rahman et al. 2012). Such challenges, if unnoticed or not adequately addressed, can lead to conflict and degradation of natural resources as well as undesired outcomes for the stakeholders involved (Berkes 2002; Rastogi 2014). In this paper, we refer to the absence of rule-based interactions as ‘inter-institutional gaps’. These inter-institutional gaps can reveal a lack of productive collaboration between stakeholders, undermining the potential for collaboration, and ultimately, sustainable resource management (Sokile et al. 2003). While we know these inter-institutional gaps are widely encountered in the literature (Drèze and Sen 2002; Poteete 2012), to our knowledge, a systematic framework to analyze, understand and identify such gaps is lacking.

Institutions involved in natural resource management are typically divided into two categories: ‘formal’ and ‘informal’ (North 1991; Grigsby 2002). North (1991) defined ‘formal’ as a *de jure* body of rulemaking and enforcement in a hierarchical organizational structure, accompanied by codified norms of behavior and bureaucratic polity. In contrast, ‘informal’ refers to a rule system that largely lacks such official codification, and thus typically comprises habitual, verbalized, or customary rules, and conducts, which function as the *de facto* rulemaking and enforcement body. Conflict has been commonly observed both in the form of the informal practices of local communities being negatively and substantially impacted by centralized (often post-colonial) formal regimes (North 1991; Grigsby 2002), as well as resistance by communities and their associated informal institutions to government policy (Young 2006). Despite the intrinsic differences that often challenge collaborative interactions between these institutions, existing natural resource management research shows that such interactions are crucial to promoting the long-term sustainable use of natural resources and the adaptive capacity of resource users across scales and levels (Dietz et al. 2003; Cash et al. 2006). Gibson et al. (2000) and Cash et al. (2006, 2) define scale as ‘the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon, and levels as the unit of analysis that are located at different posi-

tions on a scale'. This paper presents an analytical framework designed to better understand the rule-level interactions between formal and informal institutions in natural resource management.

2. Background

North's (1991) widely-used definition of formal and informal institutions recognizes their foundational differences in the areas of rule-making and enforcement (Grigsby 2002); however, efforts to diagnose inter-institutional gaps have not adequately addressed the missing or insufficient interactions between the institutions. Since rules are the prerequisites for enforcement, it is for this reason we use rule-making as a novel entry point into better understanding inter-institutional gaps. Our approach draws on Ostrom et al. (1994)'s multi-level rule hierarchy described in the Institutional Analysis and Development (IAD) framework and subsequently the Social Ecological Systems (SES) framework (Ostrom 2007, 2009). Both these frameworks suggest that institutions are arranged into three layers of 'rules-in-use' (hereafter called rule levels): operational choice, collective choice, and constitutional choice rules (McGinnis and Ostrom 2014). This hierarchy of rules-in-use has been applied to analyzing common-pool resource issues across numerous case studies and has consistently demonstrated linkages between insufficient inter-institutional interactions and resource management failures (Imperial 1999; Agrawal 2001; Agrawal and Ostrom 2001; Carlsson and Berkes 2005; Gibson 2005).

By integrating formal and informal institutions and their corresponding rule levels that govern actions into a matrix, we present an analytical framework embedded within the broader SES framework to better capture the interplay between formal and informal institutions (Pahl-Wostl 2009; Garmestani and Benson 2013; Epstein et al. 2015). Notably, some recent initiatives have been undertaken to make the SES framework more compatible with other natural resource based approaches, such as the ecosystem service framework and tele-coupled environmental governance (Challies et al. 2014; Partelow and Winkler 2016). While the purpose of these initiatives is to situate governance mechanisms in resource management frameworks within the broader social-ecological systems concept (Ban et al. 2015), the objective of the IIG framework is to facilitate the analysis of multi-level governance mechanisms, a missing component in the previous initiatives. More specifically, we aim to contribute to an enhanced understanding of the 'action situation' of institutional analysis, widely considered the 'black box' of natural resource management policy decisions (Ostrom 2011). According to the SES framework, an action situation is the domain in which resource users and governing actors come to interact (Ostrom 2011). Here, we recognize that the analysis of any action situation requires that it be grounded in a consideration of historic and place-specific cultural and political contingences (Cote and Nightingale 2012). We subsequently employ Ostrom's rule hierarchy in the IIG framework in an effort to provide a lens for

inter-institutional analysis that is applicable to action situations cross-culturally (Anderies et al. 2004; Ostrom 2010). However, in analyzing action situations, Ostrom's SES framework has been critiqued for not sufficiently considering processes of social and political change (Cote and Nightingale 2012). As we situate the IIG framework within Ostrom's SES framework, we realize that it inherits this limitation.

In what follows, we conceptualize the often overlooked interconnectivity of rule-level changes between social actors and groups and across their multiple sets of rules. To achieve this we identify the 'inter-institutional gap' (IIG) that occurs when there is *an absence of agreed upon 'rules of the game' between autonomous institutional regimes in a social-ecological system*. The IIG framework analytically combines the existing concepts of legal pluralism, institutional void, structural hole, and cultural mismatch, and in so doing addresses the limitations of these concepts, each of which offers only partial, albeit valuable, insights to particular gaps between formal and informal institutions. IIG addresses these shortcomings by accounting for the interactions between formal and informal at every rule level. We then demonstrate the potential of our framework by applying it to four case studies of common property resources that span diverse geographical locations, governance levels, and social-ecological systems: (1) coastal fishery management in South Korea; (2) forest resource management in Bangladesh; (3) tiger conservation in India; and (4) wildlife management with Indigenous communities in Canada. We conclude by discussing within- and cross-case insights to critically reflect on the overall strengths and limitations of the IIG framework, suggesting theoretical directions for future research.

3. Challenges raised by institutional diversity for natural resource management

3.1. Three levels of rules-in-use within institutions

Ostrom et al. (1994) proposed that all institutions are arranged in three levels of rules including operational choice, collective choice, and constitutional choice. Operational choice rules are the day-to-day decision making rules, which determine the actions of different institutional actors in a system. They are devised under the guidance of collective choice rules (Ostrom 2011; Mincey et al. 2013). Collective choice rules structure institutional arrangements for rule enforcement. Thus, a difference between operational choice and collective choice rules involves practicing a right and determining the right to be practiced (Ostrom and Schlager 1996). These rules are, in turn, formulated under the conditions that constitutional choice rules set (Ostrom 2011; Carlsson and Berkes 2005). Constitutional choice rules are the highest level of the rule hierarchy, determining who will take part in collective choice decision-making processes (Ostrom et al. 1994). While rule making at the operational and collective choice levels is an ongoing, and more fluid process, at the constitutional choice level there is "less fluid decision making

arrangements” (Ostrom 2011, 18). This means operational and collective choice rules are subordinate to constitutional choice rules. The three levels of rules-in-use are nested, reflecting the dynamic nature of rule-making and its influences on resource sharing, as well as the need for communication and interaction between the multiple actors involved, such as resource-users, managers and stakeholders (Ostrom 2010).

Ostrom et al. (1994) define action as the moves or decisions taken by a ‘player in the game’. As Kiser and Ostrom (2000) illustrate, an action in a tennis game would include either defending the baseline or charging the net. Actions are guided by rules, and actions without any legal guidance is considered a violation of rules (Kiser and Ostrom 2000). Importantly, actions at each level are guided by the corresponding rule levels (e.g. operational actions are guided by operational choice rules) (Schlager and Ostrom 1992). In this paper we characterize non-constitutional actions as those guided by both operational and collective choice rules. Operational actions involve decisions where ‘individuals are authorized to take a wide variety of actions at this level without prior arrangements with other individuals’ (76) and collective choice actions involve decisions that are taken ‘to determine, enforce, continue or alter action authorized within institutional arrangements’ (76). Further, constitutional actions are guided by “rules governing future collective decisions to authorize action” (Kiser and Ostrom 2000) (see also Annex 1).

To characterize common-pool resource rule systems, Ostrom et al. (1961) and Ostrom (1990) suggested the idea of nested enterprises, arguing that every level of institution should possess some degree of rule-devising autonomy in order to integrate temporally and spatially generated knowledge. Heltberg (2002) further noted that without such rule-making autonomy, there is often a lack of coherence between different rule levels leading to potential governance failures. However, such autonomy requires mutual recognition, reciprocity, and linkages between formal and informal institutions, which have generally not surfaced in most existing top-down natural resource management systems (Sandberg 2007).

3.2. Relevant perspectives on institutional mismatches

Various attempts have been made to conceptualize and address the governance challenges raised by inter-institutional gaps and mismatches, most notably the concepts of legal pluralism, institutional void, structural hole, and cultural mismatch. Table 1 summarizes the main characteristics of these concepts. Potential causes of conflicts related to institutional diversity are further discussed below.

3.2.1. Legal pluralism

Legal pluralism problematizes the co-existence of multiple sets of legal systems, or constitutional choice rules, as they apply to the same jurisdiction or resource system (von Benda-Beckmann 2002; Bavinck and Gupta 2014). This concept

Table 1: Summary of four existing concepts used to explain natural resource management conflicts and their limitations in applying three levels of rules.

Concepts	Issues addressed by the concepts	Potential causes of conflicts	Limitations of the concepts	References
Legal pluralism	Recognizes the interplay at the constitutional-choice rule level by addressing the co-existence of multiple sets of legal systems, or constitutional choice rules (between formal, codified, and informal, historically and culturally evolved institutions)	Conflict arises between actors operating under formal and informal constitutional-choice rules due to differences in codification, formality, legality, and legitimacy	Addresses multiple constitutional level rules and their divergent cultural and knowledge sources, but not the spinoff into divergent rule making at subsequent rule levels	Meinzen-Diek and Pradhan 2001; Bavinck and Gupta 2014
Institutional void	Explains the absence or lack of recognition of collective action initiated by informal actors (e.g. community members) by constitutional choice rules of formal institutions	Conflict develops where there exists insufficient organization, institution, or entity to bridge the gap between formal constitutional choice rules and modern institutional spaces (e.g. new actors, movements)	Explains how collective action is initiated by informal actors in a dynamic and changing environment in the absence of agreed upon rules but does not address gaps at other rule levels associated with these diverse rulemaking interests	Hajer 2003, 2009
Structural hole	Identifies the role of networks or structural social capital (i.e. connectedness of actors) in shaping ideas, and influencing information, communication and material resource flows at the operational level	Conflict develops in situations where subgroups or communities have no connection between them. These situations create a competitive advantage for and often abused by a third party that brokers the flow of information and control the interactions between the disconnected parties	Deals with missing network connections that limit knowledge flow and coordination but fails to demonstrate how this disconnect may result from the absence of common understanding and rule making between operational actors	Burt 2000, 2004
Cultural mismatch	Explains the lack of recognition by formal institutions of informal constitutional rules associated with ethnically diverse groups in post-colonial societies (e.g. with distinct cultural practices- resource ownership, cultivation pattern, and sharing of resources and outputs)	Conflict arises when there is insufficient understanding or appreciation of locally embedded constitutional choice rules by formal rule practitioners, resulting in formal practitioners' exclusion from broader informal constitutional rules and practices	Explains the failure to recognize informal constitutional rules in ethnic diverse societies but does not address how cultural differences can interfere with common understanding and rule making at other rule levels	Acheson 2006; Mills et al. 2010

emphasizes that there are ‘multiple sources and characteristics of law, varying according to degrees of codification, formality, legality, legitimacy, scope, content and process’, and that law not only emanates from government, but also from custom and culture (Bavinck and Gupta 2014, 80). Studies of legal pluralism have mainly focused on the imposition of centralized and codified laws of colonial and/or post-colonial governments on the prevailing customary laws of indigenous resource users (which are typically unwritten and lacking formal structures like institutional hierarchy, bureaucracy and legislation) (Merry 1988; Bavinck and Jyotishi 2014). Despite its fairly wide adoption within socio-legal scholarship (Merry 1988), the analytical scope of legal pluralism tends to be limited to the interplay of constitutional choice rules between formal and informal institutions.

3.2.2. Institutional void

Institutional void describes institutional conflict that arises when there are no accepted rules and norms to guide how the political process between formal and informal institutions operates and when policy measures are yet to be agreed upon (Hajer 2003). These conflicts typically operate in the void between the classic modernist institutions (i.e. well-crafted hierarchical institutions with codified rules of actions for decision making) and modern institutional spaces (characterized by the involvement of new actors in decision-making processes who initiate collective action based on informal institutions). An example of such a void can be seen when the public acts external to formal institutions to effect change (Hajer 2009). Also, Everingham (2009) suggest that such a void may result from the absence of an intermediary agency or the presence of a weak agency between policy actors and the ground level informal institutional actors. In such cases, formal constitutional choice rules (e.g. governmental resource regulatory bodies) are unable to appropriately respond to or deal with the collective choice rules of the informal institution. More generally, institutional void describes one particular type of situation where there is insufficient bridging between formal constitutional rules and informal collective choice rules. While there is usefulness in the concept, institutional void describes collective choice actions but it does not address rules.

3.2.3. Structural hole

Structural holes exist in a network when two groups of actors (operating across formal and informal institutions) are not connected, but there is a third party with ties to both parties (Burt 2000, 2004). This disconnect creates a situation in which the third party can appropriate or manipulate outcomes by brokering the flow of information between these groups. Building on the work of Granovetter (1973), Burt (2002) recognized that these holes arise because of network closure within well-connected groups. Closure increases homogeneity of belief, behavior, and knowledge; and enhances information flow among group members. In natural resource management, structural holes may be at work where pathways

used by formal institutional actors (resource managers, scientists) show limited effectiveness in disseminating information, effecting change of opinions, beliefs and outcomes of informal/customary institutional actors (resource users, community members). As a result, studies have highlighted the need for high level brokering organizations to leverage social capital, and bridge these holes (Barnes-Mauthe et al. 2015). While the concept of a structural hole is useful for explaining an inter-institutional gap that exists between actors operating across formal and informal institutions, it does not directly address underlying issues of rule-levels and rule-making.

3.2.4. Cultural mismatch

Acheson (2006) and Hodge (2011) indicate a type of rule-level mismatch between institutions, termed ‘cultural mismatch’, which focuses on the gap between the informal constitutional choice rules and the formal operational or collective choice rules. Often, ethnically diverse and post-colonial societies have distinctive cultural practices concerning resource ownership, cultivation patterns and the sharing of resources and outputs that can significantly influence their resource use decision-making. Due to their local origin and embeddedness, these rules remain outside the broader formal institutions and governance adopted at a national scale. This often leads to alienation of informal institutions from formal rule making processes and a lack of understanding by formal rule practitioners who operates under formal operational or collective choice rules. On the other hand, government officials can see themselves as the legally-empowered regulative authority on behalf of the state and consider resource user communities as subjects of the state (Ostrom 1996), thus failing to understand the informal constitutional choice rules of local minority communities. This situation can result in a lack of recognition and consideration of informal constitutional rules by actors operating under formal institutions, and conversely the lack of recognition and consideration of formal collective choice rules by actors operating under informal institutions. However, the concept of cultural mismatch does not fully acknowledge the gaps between the rule hierarchies, depending instead on behavioral approaches to understanding formal and informal actors.

4. Conceptual framework: inter-institutional gap

While each of these concepts assists in identifying gaps between formal and informal institutions, as shown in Table 1, none takes into consideration the interactions at every rule level (i.e. constitutional choice, collective choice and operational choice rules) between institutional regimes, likely limiting their ability to effectively characterize inter-institutional gaps. Therefore, in order to go beyond the existing concepts and provide a more integrated understanding of the different pathways that generate inter-institutional disconnectedness in natural resource management, we present the concept of ‘inter-institutional gap’ (see Figure 1).

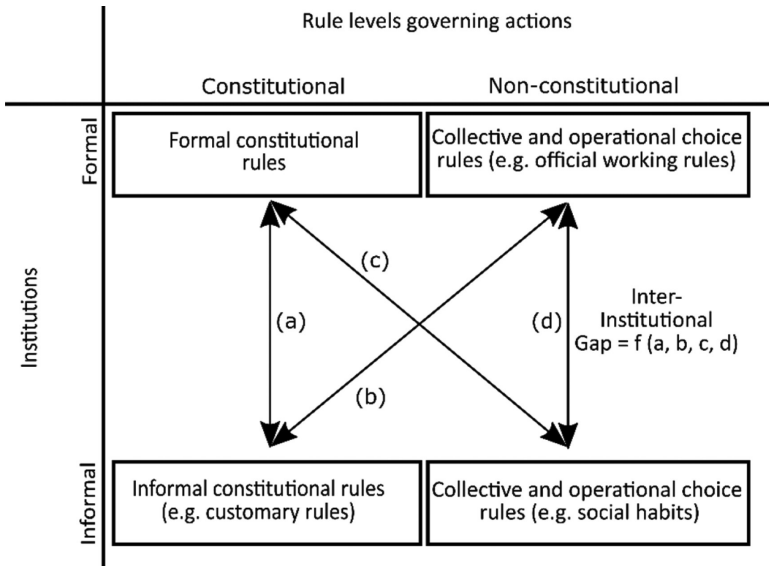


Figure 1: Conceptual diagram depicting inter-institutional gap framework, highlighting the gap as the function (f) of four possible interactional gaps that could occur between formal and informal institutional regimes. These are: (a) gap between formal and informal constitutional choice rules (i.e. between ‘constitutional laws’ and ‘customary laws’); (b) between informal constitutional choice rules and formal collective and operational choice rules (i.e. ‘customary laws’ and ‘binding working rules’); (c) between formal constitutional and informal collective and operational choice rules (i.e. “constitutional laws’ and ‘social rules/habits’); and (d) between formal and informal collective and operational choice rules (i.e. ‘binding working rules’ and ‘social rules/habits’). Actions axis involves constitutional (guided by constitutional choice rules) and non-constitutional (guided by collective choice and operational choice rules) actions.

4.1. Institutions and rule levels

Our IIG framework uses two dimensions of ‘Institution’ previously introduced: (1) the ‘formal’ and ‘informal’ categories of institutions (North 1991), and (2) the ‘constitutional choice’, ‘collective choice’, and ‘operational choice’ rule levels identified by Ostrom et al. (1994) (see Section 2.1). First, the framework applies the ‘formal’/‘informal’ distinction to categorize institutions, as represented in rows. Second, the framework distinguishes constitutional and non-constitutional rule levels governing actions according to the three levels of rules-in-use. Across the three levels of rule-in-use, the framework combines collective choice-guided rules and operational choice-guided rules as non-constitutional rule levels (Kiser and Ostrom 2000). We combine these two rule levels for two reasons: first, for analytical clarity – as collective and operational choice rules are similar in terms of level of rigidity and enforcement. Second, we have not found any relevant

theoretical concepts that can precisely identify the gaps between these two types of rules. In short, the columns are categorized into constitutional and non-constitutional rule levels as a way of capturing the key differences in codification, collective decision-making, operation, enforcement and fluidity between these types of rules. For example, passing a new codified law in the government is an action based on constitutional choice rules that is incorporated into the formal institutions (action corresponding to Constitutional-Formal quadrant in Figure 1). Elected elders enforcing customary laws is an action based on constitutional choice rules within the informal institutions (Constitutional-Informal). Regional agricultural extension officers operating under the formal institution's jurisdiction implement, report and enforce the extension office's operational policies based on operational choice decisions that are experience, context- and temporal-specific (Non-constitutional-Formal). Fourth, social habits is an example of actions based on non-constitutional rules by individuals or communities that are adhering to informal institutions that are also experiential, contextual, and temporal-specific (Ostrom et al. 1994) (Non-constitutional-Informal).

4.2. Legal pluralism: gap between constitutional rules of both formal and informal institutions

In many developing and post-colonial societies, the formal and authoritative constitutional choice rules or laws often do not recognize existing informal (e.g. customary and collective action based self-governance) rules, although they are the constitutional choice rules in the body of informal institutions. Therefore, these two different constitutional choice rules can be identified as the interactive components of both formal and informal institutions between which the absence of congruence can be aptly explained by the concept of legal pluralism (Figure 1a).

4.3. Institutional void: gap between constitutional rules of formal institutions and non-constitutional rules of informal institutions

In a self-governed system, an informal institution has collective choice rules for implementing constitutional objectives (e.g. social rules that regulate withdrawing and conserving of resources for collective benefit). These objectives are site-specific and implicated with local resource-use politics. Often, actors operating under formal institutions judge these self-governed actions as being illegitimate because formal constitutional laws may have completely different resource management objectives based on higher-level political generalization (e.g. national-level). The absence of synchronization and coordination between formal constitutional choice rules and the informal collective choice rules may result in one form of inter-institutional gap, aligning with what the literature has described as an institutional void. Ostrom et al. (1961) have figuratively characterized this situation as: "there are too many governments and not enough government" (Figure 1b).

4.4. Structural hole: gap between non-constitutional rules of both formal and informal institutions

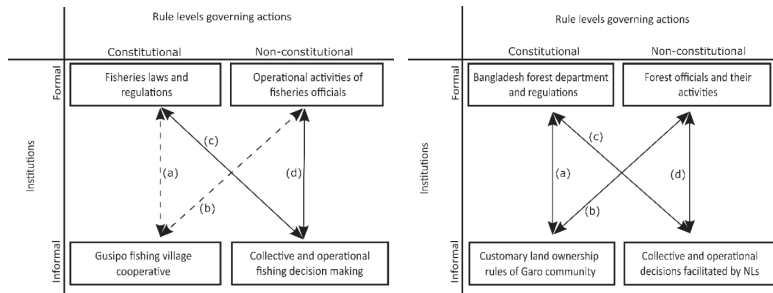
The flow of resources (e.g. information, knowledge, material resources) between actors operating under formal and informal institutions plays a pivotal role in mending inter-institutional gaps. However, mediating agencies or brokering actors are generally required for ensuring such flow (Cash et al. 2006). For example, bureaucrats, on behalf of formal institutions such as governments, often play this role, while local leaders do the same for resource-dependent communities. Subsequently, government officials and local leaders usually perform the mediating role, which can be observed as the mix of collective choice and operational choice rules. However, the gap can become evident because of the lack of legal provision for mediation with the community by ground-level formal institutional actors. This can lead to the lack of government officials' capacity or their reluctance to communicate with local community members, limiting their ability to bridge the gap between community members and the government since the rules do not equip them for required action (Ostrom 1996). In addition, this inter-institutional gap may be exacerbated when local leaders, also as community members and potential users of resources, capitalize on the resource flow and hijack the mediation process for their own benefit (Krishna 2002; Rahman et al. 2015). Community members with relatively low social and human capital are generally worse off under such a situation, because they can arbitrate neither with the government officials nor with the local leaders (Rahman et al. 2015). Therefore, the network closure within these two groups, and lack of information flow across them, can be seen as a form of inter-institutional gap, recognized in the concept of structural hole (Figure 1c).

4.5. Cultural mismatch: gap between constitutional rules of informal institutions and non-constitutional rules of formal institutions

Many communities and rural societies have their own ingrained customs and norms, which they apply to resource governance. As stated earlier, these rules may not be recognized by the formal governance system. Conversely, the resource users may view the officials as intruders in their land who disrupt their customary resource-use practices. This situation is particularly evident in common-pool resource management where rights of use and exclusion are not clear. Here the concept of cultural mismatch can be used to describe the gap associated with a lack of common understanding between constitutional choice rules of informal institutions and collective and operational choice rules of formal institutions (Figure 1d).

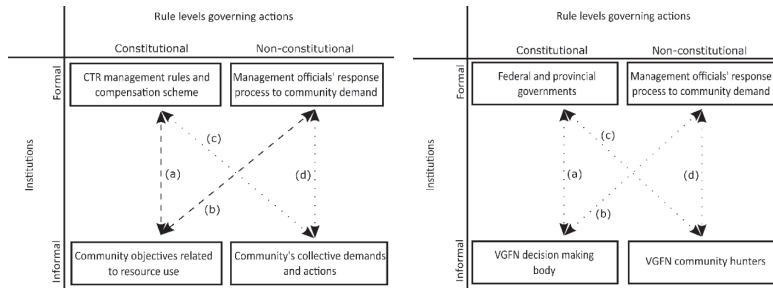
5. Case study application of the IIG framework

To better address the underlying causes of inter-institutional gaps, we apply the framework to four diverse case studies of common property resource governance:



Case study 1: Fisheries management, South Korea
 a) Gusipo fishing community adopt informal constitutional rules guided by fisheries authority: legal pluralism latent; b) Formal institution has operational guidelines for connecting with Gusipo fishing village cooperative: cultural mismatch latent; c) Fisheries authority does not have legal mechanism for responding to collective rules of Gusipo cooperative: institutional void not co-exist; d) No operational mechanism for interacting with community members' collective rules: structural hole co-exist

Case study 2: Protected area management in MNP, Bangladesh
 a) Customary Garo institution and formal forest conservation rules separate and distinct: legal pluralism co-exist; b) Forest officials are not familiar with Garo cultural and social laws: cultural mismatch co-exist; c) Formal institution does not have legal? mechanism for responding to communities' collective rules: institutional void not resolved; d) No operational mechanism for interacting with Garo community members: structural hole co-exist



Case study 3: Wildlife conservation in CTR, India
 a) Sole authority of wildlife management belongs to CTR: legal pluralism latent; b) Resident communities' resource use objectives align with CTR: cultural mismatch latent; c) TCF establish mechanism for responding to collective choice rules of communities: institutional void mediated; d) TCF establish mechanism for interacting with community members and CTR: structural hole mediated

Case study 4: Wildlife co-management in Old Crow, Canada
 a) VGFN and federal and provincial government made agreement for joint management: legal pluralism mediated; b) PCMB has operational guidelines for connecting with VGFN and formal institutions: cultural mismatch mediated; c) PCMB mediates the collective rules of VGFN and formal institutions: institutional void mediated; d) PCMB bridges interactions between VGFN community members and government officials: structural hole mediated

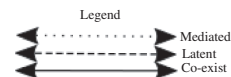


Figure 2: Case study analysis. Mediated: indicates the presence of rules that establishes coordination between formal and informal institutions; Latent: indicates the presence of mediating actors with non-permanent mediation rules; Co-exist: indicates the complete absence of coordination rule.

(1) coastal fishery management in South Korea; (2) forest resource management in Bangladesh; (3) tiger conservation in India; and (4) wildlife management with indigenous communities in Canada. For each case we seek to unveil the various inter-institutional gaps encountered and underline how the actors addressed them (successfully or not). Figure 2 summarizes our interpretation of the inter-institutional gaps for each case, further described below. Where gaps were identified, they were then categorized as being: (1) co-existing: a situation where no legal or negotiated settlement has been made for coordination among formal

and informal institutional actors based on their active involvement. This situation has the potential for conflicting interactions between formal and informal actors; (2) latent: temporary mechanisms or rules (not incorporated into formal legal frameworks) exist for coordinating formal and informal actors, particularly as a result of the actions of boundary organizations. This situation assumes that the disappearance of boundary organizations may bring back the potential for conflicting interactions; or (3) mediated: formal rules exist for facilitating coordination between formal and informal actors. These rules may not completely solve conflicting interactions between the actors, but provide legal directives for mediation. Then, following the guidance of Eisenhardt (1989), we conduct a cross-case analysis to further test and refine our framework.

5.1. Individual case description and interpretation with the IIG framework

5.1.1. Case study #1: coastal fisheries in South Korea

This case study takes place in the fishing village of Gusipo, located in the Gochang County of South Korea (Song 2014). In South Korea, the central government controls the creation and enforcement of fisheries law and regulations, including the temporal closed season regulations for swimming crab (*Portunus trituberculatus*). In the village of Gusipo, the government closure spanned June 16 to August 15 in 2012. However, this rule was increasingly recognized as inconsistent with the local fish harvesters' observations that the crabs were still molting at the end of August. As a result, a voluntary agreement between fishers in Gusipo to abstain from fishing until the end of August was reached. Fishers who legally travelled from other areas under the government-set permit system dismissed the local agreement and started harvesting crab once the official government closure ended, claiming they were following national regulations. As a result, Gusipo fishers were forced to enter the crab fishing early, driven by a fear of resource scarcity. Local fishers approached the central government about amending the national regulations; however, the revision process required an enactment of ministerial ordinances or a tabling of an amendment at the National Assembly – a process too long and cumbersome for local fishers to engage in. The inability of the government regulatory bodies to respond to the collective decisions of the Gusipo fishers shows a disjuncture between formal constitutional choice rules and informal customary rules (also can be recognized as informal constitutional choice rules). Further, different operational choice rules between these actors, in terms of the formal non-constitutional choice rules adhered to by the government and the informal social customs upheld by the community, led to a lack of knowledge transfer. Actors that could have potentially bridged this knowledge gap, such as local fishery officers, were unable to intervene because they were restricted by their particular operational context. This is an example of an institutional gap between the formal constitutional rules determined by the national fisheries laws and regulations and the informal Gusipo fishing village voluntary agreement. The fisheries authority did not have mechanisms for responding to the collective choice rules of the Gusipo cooperative

and there appeared to be a lack of structural mechanisms for sufficient interaction between community members and fisheries officials responsible for informal and formal operational-choice rules, respectively.

5.1.2. Case study #2: protected forest in Bangladesh

Madhupur National Park (MNP) is the second largest national park in Bangladesh and a category V Protected Area under the International Union for Conservation of Nature (IUCN) classification. In MNP, there are tensions in land resource ownership between the Bangladesh Forest Department (BFD) and the local communities, and in particular the ethnic Garo community. Historically, the Garo community inhabited the park and they still claim themselves as the rightful owners of the land, although this is not acknowledged by the government (Rahman et al. 2014). As a result, the community uses their long-standing informal social customs and constitutional choice rules to govern access to land resources (e.g. matriarchal land inheritance system), which are at odds with the formal patrilineal processes for land sharing (Stavenhagen 2007). Inter-institutional conflict results because the formal constitutional choice rules of the BFD and the customary rules of the Garo community do not adequately recognize each another. There is also a cultural mismatch between the community's customary rules for land resource management and the day-to-day operational choice rules used by the forest officials to make decisions (Rahman et al. 2014). This situation is made more complex by the recent emergence of new leaders in Garo society (Krishna 2011). These new leaders have more modern education and political understanding, taking over from the older village leaders. However, these new leaders often try to control community collective decisions in ways that personally benefit them. Increasingly, they are involved in informal land transactions that results in them being compensated for giving land to non-Garo buyers. As such, these new leaders do not faithfully represent the community, leading to a lack of leadership in representing the community's customary rules in negotiations with government officials. This case illustrates the difficulty faced when informal constitutional choice rules set by customary Garo governing bodies and formal forest conservation rules are separate and distinct. Moreover, formal national forest policies and regulations do not have sufficient mechanisms to respond to communities' collective choice rules, leading to an inter-institutional gap between formal constitutional choice rules and informal non-constitutional choice rules. Similar to case study 1, there appears to be no structural and legal mechanism for interaction between Garo community members and forest officials who follow informal and formal non-constitutional choice rules, respectively.

5.1.3. Case study #3: wildlife conservation in northern India

The Corbett Tiger Reserve (CTR) is one of the oldest protected areas (PA) in India. The CTR landscape serves, among other things, as a major tourist destination, a global site for tiger conservation and a vital area for local livelihoods (Jhala et al. 2011; Rastogi et al. 2014). CTR management has sole authority of wildlife

management within the national reserve. A number of local communities historically reside along the perimeter of CTR, and maintain complex relationships with the park ecosystem. The complex interactions involve the formal CTR management and the community's collective demands and actions, as well as the engagement of an NGO. In the past, tensions arose when wild animals, such as elephants, wild boars, tigers, and leopards from CTR, attacked the crops or cattle of villagers residing along the periphery. The formal process for compensation set by the 'constitutional laws' of the Corbett Tiger Reserve was deemed far too long, cumbersome, and inaccessible for remote village communities, making it difficult for many community members to receive any compensation. These issues gave rise to social mobilization by community members against animal conservation, leading to retaliatory killings of animals (Rastogi et al. 2014). In this circumstance, the ineffectiveness of formal constitutional choice rules provoked animal hunting, as practiced in the past, guided by informal collective choice rules developed by the community members. This incongruence of rules even led to the killing of tigers, which undermined formal wildlife conservation efforts.

The Tiger Corbett Foundation (TCF), as a mediating organization, started to fulfill some of these inter-institutional gaps. It saw the necessity of providing interim relief to community-members following a tiger attack. In 1997, TCF started an Interim Relief Scheme. Under this scheme, following an attack, the aggrieved person would contact TCF, who subsequently dispatched a team to the site of attack to document the attack and provide interim relief. With time, this process has proved successful and no retaliatory kills of tigers have been reported while the scheme has been in operation. This provides an example of an inter-institutional gap being filled by an external agency. Meanwhile, there exists a mismatch between the formal operational-choice rules of the management official's response process and informal operational rules from the community's collective demands and actions (an institutional void). TCF bridges this structural gap again by engaging on the ground, establishing relationships with both parties (conservation officials and the community) and maintaining communication and knowledge flow – its 'attack report' is regarded as formal proof of cattle-kill by CTR management. Importantly, however, TCF (as an external agency) is not accountable to either CTR or the resident communities since TCF operates on a voluntary basis, and is neither part of the formal nor informal institutional hierarchy. The IIG Framework illustrates a latent inter-institutional gap between the formal and informal operational-choice rules, which may be intensified if TCF, as an external agency, is discontinued or changed. For example, if the compensation scheme were to be discontinued, retaliatory killings of wildlife would likely also return, risking increased severity of the inter-institutional gap.

5.1.4. Case study #4: indigenous communities in Canada

The Vuntut Gwitchin First Nation (VGFN) is self-governing under the Vuntut Gwitchin Government (VGG) in the Yukon Territory of northern Canada. Self-governing First Nations are defined as 'governments designed, established and

administered by Aboriginal peoples under the Canadian Constitution through a process of negotiation with Canada and, where applicable, the provincial government' (Government of Canada 2013). According to this definition, the informal customary institutions of this Indigenous group have gone through a process of formalization. For example, the VGFN has traditional decision-making structures integrated within contemporary forms of government (Government of the Vuntut Gwitchin First Nation 2006). For the members of the VGFN, the Porcupine Caribou (*Rangifer tarandus*) holds particular social, cultural and economic significance. Over the last thirty years, the management of the Porcupine Caribou herd has offered an instructive example of transboundary inter-institutional cooperation to manage a shared resource, as it includes two countries, two territories, one state, and seventeen aboriginal communities, including the VGFN (Padilla and Kofinas 2014). Key formal institutional actors range from the local to the international levels: local (the VGG Natural Resource department), territorial (Yukon Fish and Wildlife Management Board), national (Environment Canada), and international (International Porcupine Caribou Board) entities. Within the self-governing process, informal institutional actors within Indigenous communities, such as the elections of Chief and Council, and the annual General Assembly, govern based on informal constitutional choice rules, and hunters base social interactions on informal non-constitutional choice rules. Differences in government structures, geographies, cultures, and knowledge systems, all can serve as gaps that hinder the sustainable management of this resource. In particular, the formal collective choice rules for caribou management by federal or territorial agencies do not necessarily align with the informal constitutional rules in the VGFN (i.e. local rules, often traditional ecological knowledge-based, for caribou harvest and management) (Brunet et al. 2014). One strategy to address these gaps has been the establishment of the Porcupine Caribou Management Board (PCMB) in 1986 to facilitate the co-management of the shared resource with representatives from Canadian stakeholders. Often, government ministers have deferred authority for decision-making to the PCMB, creating room for legal pluralism and joint management. Ad-hoc decisions (collective choice rules) made by the PCMB to address stakeholder concerns may not necessarily align with the formal constitutional rules from the federal government. For instance, PCMB has the responsibility to negotiate shared management actions, such as a harvest management plan that specifies what operational actions will be taken (e.g. hunting closures, sex limitations) if the abundance estimates of the herd reach particular levels. In this case, the IIG framework helps illustrate how a mediating agency, by developing common understandings and shared rules (like the PCMB), can broker the gaps between formal and informal institutions across rule levels.

5.2. Cross-case analysis

In each of our four case studies, two or more institutional gaps were identified indicating the need for a framework to help understand and categorize the various

pathways through which gaps can occur and result in an IIG. The following cross-case analysis identifies three key lessons: (i) gaps are co-existing; (ii) some gaps may reveal hidden ones; and (iii) intermediaries may be key to both addressing and creating inter-institutional gaps.

5.2.1. Inter-institutional gaps are co-existing

Our case study analysis using the IIG Framework highlights the co-existence of two or more gaps or potential interactions across formal and informal institutions, something that existing concepts do not sufficiently take into account. Across all four cases we found patterns of these associations.

For instance, in the case of MNP, complex tensions in land resource ownership between the government (the Bangladesh Forest Management) and the local communities (notably the ethnic Garo community) can be seen. Actors operating under formal and informal institutions are established with aims that are partly distinct: the forest management's formal constitutional choice rules aim mainly to preserve the forest and its resources, while the community's informal constitutional and non-constitutional choice rules protect the community's livelihoods. Customary and formal forest conservation rules co-exist but are distinct; therefore, legal pluralism is found. The legal pluralism observed at the constitutional choice rule level reveals a second inter-institutional gap between informal constitutional and formal operational choice rules. Indeed, forest officials do not recognize Garo customary rules for land resource management; subsequently they are not familiar with their cultural and social practices (e.g. matriarchal land hereditary rules; land conversion and cultivation techniques) (Rahman et al. 2014). The concept of legal pluralism addresses the tension between the formal government and the ethnic Garo institutions by identifying inter-institutional gaps between the formal and informal constitutional choice rules. However, the interplay between informal constitutional and formal operational choice-level rules remains obscured, illustrating one type of co-existing inter-institutional gap. This case also has a third inter-institutional gap, as the government does not recognize Garo's operational and collective choice rules. Decision-makers in formal institutions do not acknowledge their responsibility to know the collective demands of the community. As a result, operational-level officials (local-level forest officers) are not mandated by existing rules to establish or bridge this missing connection with the Garo community, resulting in a fourth inter-institutional gap. Together, one gap exacerbates another gap, resulting in another type of co-existing inter-institutional gap, and the entire institutional interactions end up with hierarchical gaps. Without agreed-upon mechanisms to address these gaps, the community has pursued self-organized paths of communication to voice their disagreement (e.g. demonstration and rallies in MNP).

Through the institutional void concept, Hajer (2003) recognized the participative nature of the new order of politics that challenges governments and policy-makers to adapt to the changing nature of decision-making. Our study has built

on Hajer's concept of institutional void by incorporating diverse rule levels into decision-making. In doing so, our case studies identified the co-existing nature of rules underlying resource governance systems. Furthermore, our cases build on the concept of structural holes (Burt 2000, 2004) to illustrate that they can arise in the absence of mutually-agreed upon rules between formal and informal non-constitutional choice rules. In short, when constitutional-choice rules insufficiently acknowledge community-level context and demands, it generally leads to co-existing gaps. These gaps can be observed between formal operational choice rules and informal collective choice rules, where operational-level officials are not mandated, nor do they have the necessary agency, to establish missing connections with local communities. The cases serve to demonstrate that inter-institutional gaps are closely associated with one another and reveal that where there is legal pluralism, cultural mismatch is likely; and when there is an institutional void, structural holes are likely.

5.2.2. Some inter-institutional gaps may reveal hidden ones

Applying the IIG framework to our case studies also reveals that some inter-institutional gaps may be hidden or latent. In the case of Corbett Tiger Reserve in India, we found latent inter-institutional gaps that present as legal pluralism, cultural mismatch, and structural hole. Different stakeholders wanted to optimize different aspects of the Reserve. Since the government is the sole management authority, and its objectives complement those of the community, the mediating rules between the constitutional levels potentially become unnecessary. The benefits derived from the community as a result of the positive externality of conservation can help explain this arrangement (Agrawal 2001). Subsequently, issues of legal pluralism and cultural mismatch in this context are latent. While the objectives of formal and informal actors are parallel and distinct at the constitutional choice level, the absence of agreed-upon rules appeared at the collective choice-level of informal institutions and constitutional choice-level of formal institutions because of their divergent objectives. For example, CTR management is concerned with preserving the tiger while the community is concerned with the safety of livestock, life and property. These distinct objectives are, again, latent or not considered a problem as long as there is no interaction between wildlife and communities' goods. However, during wildlife attacks, a tiger may destroy property of community members, who respond with killing it (or another tiger). This disrupts CTR's objective of conservation and tensions arise. Such crises reveal a lack of agreed-upon rules between the two institutions, more precisely the inflexible formal institutional process for compensation and local community's collective choice actions of killing the tiger in response to wildlife attacks.

In the case of South Korea, a different process occurred but with similar outcomes: legal pluralism is latent, and institutional void and structural hole emerged during crises. Here, the central government has constitutional authority and rule making power over the creation and enforcement of fisheries law and regulations. But the community and government came to an agreement, which resulted

in the community being allowed to design its' own rules as long as they complied with the official regulations. This aligns well with the increasing call for decentralization in natural resource management (Sekhar 1998; Ribot 2003), which attempts to satisfy the institutional void between formal and informal institutions by: (i) including increasing efficiency and equity in natural resource management (Huther and Shah 1998), (ii) improving service delivery (Smoke and Lewis 1996), and (iii) growing participation and contributing to democracy (Ribot 2002). However, the decentralization process cannot be completely effective when there is an absence of coordination between the formal constitutional choice rules (fishery regulations) and the informal collective choice rules. In this case, the community adopted the informal collective choice rule recognized by the government. However, they had no means to enforce their voluntary agreement aiming to postpone fishing, prolonging the period of crab molting. They had no power to impede external fishers to exploit the resource. This resulted in an outcome much like the Indian case (#3): the government operated as the sole authority managing this resource, and considers mediating rules at constitutional levels as unnecessary. But with exogenous variables on the system (Hagedorn 2013) such as crises and uncertainty, this can trigger serious conflicts or damages on the resource systems.

5.2.3. Intermediaries play key roles in addressing and creating inter-institutional gaps

In two of our cases, intermediaries played important roles in decreasing the potential for inter-institutional gaps in the form of structural holes and institutional voids.

In the case of the VGFN, the Porcupine Caribou Management Board plays the role of intermediary, under a co-management scheme. Through this mediating agency, common understandings and shared rules have been developed that may serve to broker the gaps between formal and informal institutions across rule levels. In so doing it is possible to develop common understanding that is necessary for negotiating resource management by different users within an interdependent action situation. Common understandings may grow from a history of shared experiences, enhanced by common terms that result from common expectations. This is necessary because of the difficulties associated with playing 'a game without coming to a common understanding of the rules' (Kiser and Ostrom 2000).

The PCMB was developed specifically to address the gaps between different levels of institutions effectively linking higher-level processes of decision making with local-level decision-making to achieve regional consensus on herd management decisions (Kofinas 2005). The Board's broad representation and role as a communication and coordination body enabled elected officials and government ministries to build a level of inter-institutional trust and defer authority for decision-making (Kofinas 1998). This speaks to the importance of having an intermediary body that can make ad-hoc decisions (collective

choice rules) that respond to stakeholder concerns, demonstrating some flexibility within the formal (and often rigid) constitutional rules. The Board is then able to create agreed-upon management plans before a crisis occurs, as well as prioritize informal harvest management (e.g. through education campaigns, discouraging particular harvest practices) over more formal regulation and enforcement. While this may create some legal pluralism in the management of the wildlife resource, we do not observe this as necessarily negative as it responds to the system complexity. Although conflicts still occur, the PCMB demonstrates a case where engaging all stakeholders (including resource-users) in co-management can be effective. This situation contrasts with the case from South Korea in which there was no mediation between the formal constitutional choice rules of the government and the collective choice rules of the fishers with regards to postponing the crab harvest.

In the case of Corbett Tiger Reserve, India, the Corbett Foundation provides interim relief to community members following an attack by wildlife, alleviating the effects of the formal institution's inability to respond to the collective choice rules of the community. This intermediary reduced the gaps created by institutional voids and structural holes. However, it is also not accountable to either the formal or informal institutions. As donor and grant-based operations such as the Corbett Foundation can be discontinued on relatively short notice when their funding ends, insufficient preparation by local communities and government for an intermediary's exit may manifest latent inter-institutional gaps or exacerbate existing management challenges. In Bangladesh, new leaders were found to have replaced village leaders to play important bridging roles between community members and government officials. However, they also tended to take advantage of their position to enrich themselves at the expense of other villagers. In this case, they tended to create inter-institutional gaps rather than resolve them.

6. Discussion

6.1. Contribution of the IIG framework to understanding inter-institutional interactions

Addressing inter-institutional gaps is far from simple. The problem with authoritative, centralized and hierarchical governance is that it tries to establish homogenous and uniform rule systems across diverse resource systems, although each might already have locally-based, heterogeneous, and contextualized informal management institutions in place (Agrawal 2001). Huitema et al. (2009) considered these 'classic modernist' approaches to institutional design (e.g. the structure of formal institutions in many post-colonial countries) as unfeasible, ineffective, and inefficient. IIG provides a more in-depth analytical lens through which to view the rule-based behaviours of multi-dimensional institutions. Even when there is a desire among formal institutions to achieve coherence of rules by incorporating actors

operating within informal institutions in formal decision-making processes, an inter-institutional gap may persist if there is an absence of common understanding and shared experiences between the community and government. In the absence of common understandings and experiences, actions by formal governments that involve smaller groups may serve to reinforce power differences and engrained power hierarchies in colonial contexts (Helmke and Levitsky 2004). Traditional knowledge scholarship emphasizes this situation (Nadasdy 1999).

Our case studies show that the IIG framework is able to account for the various interactions occurring between inter-institutional gaps. Some of these interactions are closely associated: where there is a gap between the constitutional choice rules of formal and informal institutions, a gap between informal constitutional choice and formal non-constitutional choice rules is likely; and when there is a gap between formal constitutional choice and informal non-constitutional choice rules, a gap between formal and informal non-constitutional choice rules is likely. The IIG framework thus supports the insight of Ostrom et al. (1961) that the degree to which polycentric institutions:

...function independently, or instead constitute an interdependent system of relations...[depends on] the extent that they take each other into account in competitive relationships, enter into various contractual and cooperative undertakings or have recourse to central mechanisms to resolve conflicts...(p. 831)

In light of this integrated understanding of the interdependence of institutions, we argue that if a structural hole is resolved, the problem of institutional void might be mediated. This is because the decision-makers in formal institutions may use local-level officials as mediating agents for the transfer or exchange of information with communities. This intervention ultimately will serve as an indirect communication network between informal institutions and the formal government. Similarly, when formal government recognizes legal pluralism, it actually acknowledges the existence of cultural diversity, or the locally-embedded cultural system. In so doing, it enhances incorporation of customary or informal constitutional rules into the operational and collective activities of local-level government officials, and opens up opportunities to negotiate a cultural mismatch.

6.2. Mediation to address inter-institutional gaps

Our study of inter-institutional gaps highlights the importance of mediation between formal and informal institutions to establish rules at all levels needed to regulate the management of natural resources. When these are absent, bureaucrats and local leaders may attempt to develop informal socially-binding rules to perform a mediating role between formal and informal institutions (Krishna 2011; Rahman et al. 2015). However, due to the lack of constitutional choice rules mandating their communication, government officials may also become reluctant to bridge the gap with local community members (Ostrom 1996).

As a result, attempts to mediate by interested actors may face problems of legitimacy and representativeness, as noted by Ribot (2002): *'[if] self-interested, no representative, or autocratic institutions such as interest groups, nongovernmental organizations (NGOs), or customary authorities, are chosen in the absence of overseeing representative bodies, there is a risk of strengthening their autocracy and weakening democracy. Pluralism without representation favors the most organized and powerful groups. It favors elite capture'*. A lack of accountability tends to render the social actors and groups (and thus the management of the resource) vulnerable to a re-emergence of the institutional gaps if mediators decide to relocate or disappear. Further, even when mediators remain, the lack of meaningful involvement of local users reduces the legitimacy of decisions made.

While previous studies have identified the importance of establishing 'boundary' or 'bridging' organizations at different levels and scales to enhance accountability, legitimacy and facilitate the co-production of knowledge (Cash 2001; Folke et al. 2005), the application of our framework highlights the need for overarching congruence between and among the different rule levels of multiple institutions to better guide the complexity of natural resource governance. Ultimately there is a need for more collaborative institutional arrangements that are capable of enabling flexibility and innovation in the face of environmental change (Adger et al. 2005), while also ensuring accountability and transparency.

7. Conclusion

Understanding the complex interactions between formal and informal institutions is one of the persisting challenges facing sustainable natural resource management, policy and governance. In many regions around the world, conflict between actors operating under formal and informal institutions continues to be observed, despite the many calls for fostering meaningful interactions between these groups to enhance the long-term sustainable use of natural resources and the adaptive capacity of resource users (Dietz et al. 2003; Cash et al. 2006). In this paper we presented the Inter-Institutional Gap (IIG) framework as an integrated approach to conceptualizing the often overlooked interconnectivity of rule-level changes between formal and informal institutions and across their multiple sets of rules used in a social-ecological system. The IIG enhances the analytical capacity of existing SES framework by highlighting how (the absence of) rules inform different inter-institutional gaps (and their interactions). Our application of the IIG framework to diverse natural resource governance case studies reveals that an IIG can be created when there are unintended, unforeseen or hidden gaps between different rule hierarchies in two or more simultaneously operating institutions. Individual case study analyses highlight multi-scalar interactions between rules and the resulting inter-institutional gaps. Additionally, from our cross-case analysis we observed that: (i) inter-institutional gaps are nested and may be hierarchal,

therefore if a certain gap is identified, other gaps may be expected; (ii) certain gaps may reveal latent gaps; and (iii) intermediaries may be key to addressing inter-institutional gaps (or creating them).

This paper presents the initial foundation of the IIG framework, and, therefore, calls for further refinement and validation through field experimentation and observation to improve our understanding of the different sets of conditions that may give rise to an IIG, how local ecological knowledge may intersect with patterns of rule-making to shape natural resource outcomes, as well as identifying potentially innovative local responses to an IIG which may be relevant to other natural resource contexts. It is also important to further characterize the hierarchical nature of IIG in order to identify potential areas for policy action necessary to overcoming gaps between rule levels. For future application of this framework in a specific case we suggest identifying the scales at which institutions are operating and the different levels of rules they are using in order to generate descriptions of rules, actors and actions across scales and levels. These descriptions can be used to identify potential rule-based discrepancies in managing negotiations between formal and informal actors.

In summary, we believe the IIG framework can facilitate more comprehensive understandings of multi-level and multi-scale and collaborative governance structures in addressing complex natural resource management issues. In doing so, it has the potential to help policy-makers, practitioners, and researchers assess the various ways that gaps across institutions emerge and also contribute to the identification of potential areas where the coordination of formal and informal institutions could be improved.

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Annex I: Glossary

Action: moves or decisions taken by a player in the game. For example, an action in tennis would include either defending the baseline or charging the net. Action taken without any rule guidance is a violation at all rule levels (Kiser and Ostrom 2000).

Non-constitutional action: comprises operational choice actions (first level) and collective choice actions (second level).

Operational choice actions: “individuals are authorized to take a wide variety of actions at this level without prior arrangements with other individuals” (Kiser and Ostrom 2000, 76). Seeking compensation from TCF following a tiger attack on cattle is an example of an operational choice action of an aggrieved community member (see Case study #3).

Collective choice actions: individuals are authorized “to determine, enforce, continue or alter action” as directed by existing rules (Kiser and Ostrom 2000, 76). In the case of MNP, the new roles and actions of new leaders in land right transactions on behalf of the community is an example of collective choice action under an informal institution (see Case study #2).

Constitutional action (third level action): individuals are authorized to make rules governing collective actions and future decision making (Kiser and Ostrom 2000). For example, the authority to institute an annual “closed season” through

temporal closure of crab fishing activities even by licensed harvesters under the formal constitutional rules of the South Korean government is a constitutional action (see Case study #1).

Institutions: rules of the game which is used by individuals to guide their actions and decisions (North 1991).

Formal institutions: as a *de jure* body of rulemaking and enforcement in a hierarchical organizational structure, usually accompanied by codified norms of behavior and bureaucratic polity (North 1991).

Informal institutions: a rule system that largely lacks official codification, and thus typically comprises habitual, verbalized, or customary rules, codes, and conducts, which function as the *de facto* rulemaking and enforcement body (North 1991).

Polycentric: different centers of decision-making which are formally independent of each other (Ostrom et al. 1961).

Rule: a coercion mechanism that prompts a decision by directing whether an action is allowed or not allowed.

Rule levels: based on Ostrom et al. (1994)'s multi-level rule hierarchy, where institutions are arranged into three layers of 'rules-in-use': operational choice, collective choice, and constitutional choice rules.