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Multi-level governance and power in climate change policy networks

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ABSTRACT

This article proposes an innovative theoretical framework that combines institutional and policy network approaches to study multi-level governance. The framework is used to derive a number of propositions on how cross-level power imbalances shape communication and collaboration across multiple levels of governance. The framework is then applied to examine the nature of cross-level interactions in climate change mitigation and adaptation policy processes in the land use sectors of Brazil and Indonesia. The paper identifies major barriers to cross-level communication and collaboration between national and sub-national levels. These are due to power imbalances across governance levels that reflect broader institutional differences between federal and decentralized systems of government. In addition, powerful communities operating predominantly at the national level hamper cross-level interactions. The analysis also reveals that engagement of national level actors is more extensive in the mitigation and that of local actors in the adaptation policy domain, and specialisation in one of the climate change responses at the national level hampers effective climate policy integration in the land use sector.

1. Introduction

Climate change governance has evolved into a complex polycentric structure that spans from the global to national and sub-national levels, relying on both formal and informal networks and policy channels (Bulkeley et al., 2014; Jordan et al., 2015). Across as well as within countries, national, sub-national, and international state and non-state actors are involved in formulating and implementing climate policies and actions (Newell, 2000). Such a complex governance structure reflects the 'glocal' nature of climate change: its distinct impacts are felt at and its solutions involve multiple levels of governance (Gupta et al., 2007).

Although research on multi-level governance (MLG) of climate change has increased in recent years, we do not understand well how power impacts the integration of policy decision-making processes across levels of governance (Doherty and Schroeder, 2011; Gupta, 2014; Marquardt, 2017). In particular, the MLG literature has focused on national-supranational relations, while national-subnational networking remains less explored (but see Jänicke and Quitzow, 2017; Velazquez Gomar et al., 2014). The predominantly global nature of climate change mitigation and local nature of climate change impacts and adaptation also pose specific MLG challenges for climate policy integration. How cross-level interaction differs between the mitigation and adaptation sub-domains remains largely unexplored (Di Gregorio et al., 2017a; Jordan et al., 2012; Locatelli et al., 2015). Finally, many studies have looked at supranational MLG processes, such as environmental governance in the EU and at global-national linkages in climate change governance (Bache, 1998; Betsill and Rabe, 2009; Hooghe, 1996; Jordan et al., 2012; Piattoni, 2009). However, MLG of climate change faces distinct challenges in the Global South and remains an underexplored area (but see Bisaro et al., 2010; Fahey and Pralle, 2016; Gallemore et al., 2015; Gruby and Basurto, 2013; Gupta, 2007; Jörgensen et al., 2015; Korhonen-Kurki et al., 2016; Locatelli et al., 2017; Rantala et al., 2014; Ravikumar et al., 2015; Rosenau, 2007; Sanders et al., 2017).

This article addresses all of the aforementioned three gaps. First, it

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develops an innovative theoretical framework that draws from institutional and policy network approaches to theorise how power relations facilitate and hamper cross-level interactions between national and subnational governance levels. The policy network lens allows for a detailed analysis of meso-level interactions between all policy domain actors (Rhodes, 1997), providing a more in-depth analysis of MLG processes. Second, it investigates how MLG differs across the policy subdomains of mitigation and adaptation and what this implies for policy integration. Third, it contributes new knowledge on MLG challenges in the Global South from evidence on land use and climate change policy networks in the federal and decentralized nations of Brazil and Indonesia.

We first outline how our theoretical framework combines institutional and policy network approaches and draw a number of propositions about MLG systems. We then introduce the two cases and the social network analysis measures used to investigate power imbalances and cross-level interactions. Next we report and compare the country level evidence focusing on the assessment of barriers to cross-level interactions and on the role of dominant and minority network communities in overcoming such barriers. We conclude by drawing implications from the evidence for the future of climate change policy processes.

2. Multi-level governance and policy networks

2.1. Multi-level governance in environmental domains

In order to address the complexity of long-term environmental challenges, such as loss of biodiversity and climate change, and to overcome the limits of both central leadership and locally fragmented decentralization, Underdal (2010) suggests a multi-level system of governance combining sufficiently decentralized adaptive governance for local initiatives to grow, but also fostering networks for the diffusion of best practice and enhance collective action across scales. MLG involves shifts in power and authority relations along three dimensions: 1) devolution of power from central to local governments; 2) increased sharing of power between the state and civil society, and; 3) reduction of state sovereignty through joining of international coordination mechanisms (Piattoni, 2009). According to Hooghe and Marks (2003) this 'unraveling of the central state' could lead into one of two main types of MLG systems: Type I resembling a federal system and Type II resembling a polycentric system with several semi-autonomous centers of authority (Skelcher, 2005).

While MLG facilitates learning and achieving benefits at multiple scales there is no guarantee that it can successfully deal with complex human-ecological systems (Biermann et al., 2016; Ostrom and Janssen, 2005). A study comparing 47 cases found that a higher number of actors and levels in decision making improves environment outputs, but otherwise MLG outcomes are context specific and environmental preferences of the actors involved remain the main determinant of environmental outcomes (Newig and Fritsch, 2009). This explains some of the critiques of MLG, which include its limited ability to assess the importance of different levels of governance, its conceptual vagueness, and its lack of clarity about how to reconcile governmental hierarchies with horizontal autonomy. In responses to critiques about the disregard of the politics underpinning MLG processes (Peters and Pierre, 2004; Rosenau, 2004; Stubbs, 2005) a key development led to the analysis of the politics of scale highlighting the contested nature of cross-scale interactions (Bulkeley, 2005; Lebel et al., 2005; Paavola, 2007).

The politics of scale suggests that environmental decisions are 'created, constructed, regulated and contested, between, across and among scales' through networking (Bulkeley, 2005, p.876). The emergence of environmental regime complexes and proliferation of transnational climate governance networks (Abbott, 2012; Betsill and Bulkeley, 2006) illustrate how governance increasingly occurs through interactions between formal and informal 'spheres of authority' (Rosenau, 2003). Our paper follows this line of enquiry investigating the political and networked nature of multi-actor MLG processes. Unlike other MLG studies, however, our empirical analysis focuses primarily on interactions across national and sub-national policy domains (Velazquez Gomar et al., 2014), yet includes international actors operating at these levels and therefore the effects of transnational networks. Like Young (2002), we chose to focus on the jurisdictional scale, not because it is the most relevant one, but because we are particularly interested to assess whether jurisdictions themselves and mismatches between jurisdictional and climate change related scales pose particular challenges to cross-level interactions.

2.2. Conceptual framework and propositions

The conceptual framework draws on institutional and policy network theories. In his work on fit, interplay and scale Orang Young (2002) identifies five drivers that shape interactions across governance levels: the levels and type of decentralisation; authority and power differentials across jurisdictions; blocking policy coalitions; the constellation of discourses; and cognitive transitions. Policy network approaches emphasise the relational features of policy processes (Bulkeley, 2000; Ingold and Fischer, 2014; Weible, 2005). Multi-level policy networks approaches focus on interactions within as well as across levels of governance. Both the national and sub-national climate and land use policy domain include government, non-government and international actors that operate at the respective jurisdictional level (Fig.1). Multi-level network approaches suggest that closed network structures - such as dense network communities - facilitate cooperation, sparser interactions linking network communities within and across level facilitate information and resource sharing (Girvan and Newman, 2002; Lubell et al., 2014; McAllister et al., 2015), and suggest that networking patterns differ by policy domain (Laumann and Knoke, 1987). By combining the two approaches, we add the multi-level and polycentric dimension to the study of policy networks (Ernstson et al., 2010; Galaz et al., 2012) and highlight the interactionist features of multi-level governance (Ansell et al., 1997; Guerrero et al., 2015; Mathias et al., 2017). Our innovative framework focuses on three of these drivers to theorise how power relations facilitate or hamper interactions in MLG systems. The three drivers are the institutional dimension of 1) the levels and limits of decentralization; the political dimension of 2) cross-level differentials in authority and power and the relational dimension of 3) close-knit network communities. Next we develop a series of propositions related to the framework, which we then investigate in the empirical analysis.

2.3. MLG and climate change mitigation and adaptation in land use

While coordination across levels of governance is crucial for both

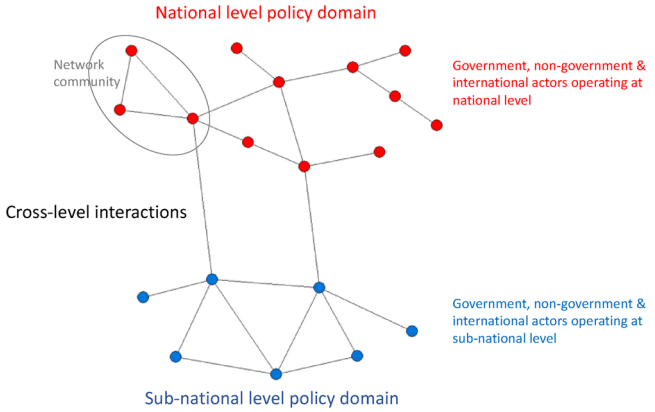

Fig. 1. Conceptual diagram of a multi-level governance network.

climate change mitigation and adaptation, MLG challenges differ for the two policy sub-domains. Research on MLG and mitigation in forests indicates how information flows across governance levels and cross-scale institutions that increase trust and empower local actors need to be enhanced to deliver effective and equitable carbon emission reduction (Forsyth, 2009; Korhonen-Kurki et al., 2013a; Ravikumar et al., 2015). The MLG adaptation literature underlines the need to overcome legal inconsistencies and tensions regarding distribution of competences across levels to facilitate integration of policies and to overcome local barriers to implementation (Juhola, 2016). It also highlights how often the most limiting elements to coordination originate from higher governance levels, while devolution of authority can enhance proactive adaptation (Amundsen et al., 2010; Vedeld et al., 2016). Differences in spatial, time and sectoral scales between mitigation and adaptation mean that interaction patterns differ across the two sub-domains (Klein et al., 2005; Locatelli et al., 2015). Thus, the global and long-term nature of mitigation and the local short-term nature of adaptation suggest that:

Proposition 1. Local actors are likely more engaged in sharing information and collaborating on adaptation issues while international and national actors discuss and collaborate more on mitigation.

2.4. Political institutions and MLG policy networks

While political institutions organised around jurisdictions help to govern policy problems, they can also create mismatches that hamper effective decision making around cross-level environmental problems such as climate change (Berkes, 2006; Brondizio et al., 2009; Cash et al., 2006; Folke et al., 2007; Young, 2002). Such mismatches have been observed in socio-ecological systems where institutional, social and ecological connectivity differ (Bodin et al., 2014; Bodin and Tengo, 2012; Gruby and Basurto, 2013). It follows that:

Proposition 2. Jurisdictional boundaries create barriers to cross-level interactions reinforcing mismatches between institutional responses and climate change realities.

Because jurisdictions are part of the institutional structure of the polity, such mismatches are likely to endure over time. Yet, the emergence of deterritorialised spheres of authority such as the creation of domain specific cross-level institutions and facilitation of multi-sector and multi-level policy processes and policy learning can help reduce such barriers (Amundsen et al., 2010; Armitage et al., 2007; Ingold, 2014; Pahl-Wostl, 2009; Rosenau, 2007; Tompkins and Adger, 2004).

At the same time, MLG systems feature devolution of power from central to supra-national and to sub-national state and non-state actors (Bache et al., 2015; Piattoni, 2009). One distinction between Type I and Type II MLG is the level of polycentricity, which is higher in the latter. Because Type I are more hierarchical and nested systems, levels of decentralization are more likely to determine power differentials across governance levels (Atkinson and Coleman, 1992; Fischer, 2014; Kriesi et al., 2006; Young, 2006). We therefore suggest that:

Proposition 3. In Type I MLG systems power differentials between levels of governance in the climate change domain mirror broader institutions of decentralisation.

The current form of federalism in Brazil introduced in the 1988 Constitution gives high level of political, legislative, administrative and financial autonomy to states and to a lesser extent to municipalities (Rosenn, 2005). In Indonesia, after the fall of the New Order, the 1999 Act on regional autonomy gave the highest level of autonomy to districts (third tier of government), as opposed to the provinces (second tier of government). This unusual form of decentralization sought to prevent secessionist movements (Turner and Podger, 2003). In a re-centralization attempt, recent legal changes sub-ordinate districts to provinces, but these changes are not fully implemented (Ostwald et al., 2016). While Type I and II are ideal types, in many contexts both features are present. If our case studies are akin to Type I MLG systems, Brazil should display a clear decrease in power from national to state to municipal level policy networks, while in Indonesia we would expect district level networks to play a relatively more important role compared to provincial level networks.

2.5. Network communities facilitating cross-level interactions

MLG theory suggests that no level of policymaking can simply make and enforce decisions on other levels. Instead compliance is a matter of negotiation and cooperation between a diversity of actors at different levels (Daniell and Kay, 2017). Dense areas of interactions in policy networks – or network 'communities' (Botta and del Genio, 2016; Dickison et al., 2018) – facilitate both information sharing and co-operation (Di Gregorio, 2012; Girvan and Newman, 2002). In terms of power, it does not just matter whether an actor is or not a member of such a tight-knit community, but whether the community includes powerful policy actors. Powerful tight-knit communities able to steer decision-making are called policy communities (Marsh and Rhodes, 1992). In a multi-level governance context, cross-level interactions are facilitated if network communities contain actors operating at different levels of governance. Improved cross-level interactions can result from bottom-up policy processes with more active local level participation (Ingold, 2011) or through dominant network communities operating across governance levels. Thus:

Proposition 4. Policy domains where powerful network communities operate primarily at one governance level will experience major barriers to cross-level interactions.

Despite MLG leading to some degree of 'unravelling of the state', state actors retain decision making authority and often orchestrate multi-level and transnational environmental governance networks (Ansell et al., 1997; Brockhaus and Di Gregorio, 2014; Brockhaus et al., 2014; Hale and Roger, 2014; Hooghe and Marks, 2003; Leifeld and Schneider, 2012). In his work on British government, Rhodes (1981) shows how central government departments used policy networks in their own interest and how central-local government power relations were asymmetrical. Further evidence confirms how central government actors are able to steer climate governance networks in their own favour (Gillard et al., 2017). In Trinidad and Tobago there were similar asymmetries as central government actors exercised power by withholding access to information from other policy actors (Tompkins et al., 2002). However, in the Global South the influence of international actors on climate policy is likely to be more relevant than in the North, because international aid finances much climate change action (Yamin and Depledge, 2004). Consequently, in the Global South dominance of government actors, as opposed to international and intergovernmental actors in the climate change domain also indicates a high level of national ownership of policy processes (Di Gregorio et al., 2012; Korhonen-Kurki et al., 2013b).

Proposition 5. In the absence of national ownership of climate change policy processes, international policy actors dominate MLG networks in the Global South.

The next section presents the methods starting with a short description of the case studies and then providing details about data collection and analysis.

3. Methods

3.1. The case studies

Brazil and Indonesia are good cases for investigating power in the MLG of climate change in the land use sector. While the two countries

have adopted different forms of political decentralization, in both agribusiness interests dominate the land use sector, which to date remains the major driver of carbon emissions. In both countries land-use development and change has been key to economic development over the past decades, with Brazil becoming the second largest producer of beef and soy globally and Indonesia the largest producer of palm oil (Euler et al., 2017; Oliveira, 2016). Agricultural development and associated deforestation have led to increases in carbon emissions. Unlike Indonesia, Brazil has substantially reduced deforestation rates from 2005, before experiencing a resurge after 2012 (Nepstad et al., 2014). Land-use is a key target for emission reductions in the Intended Nationally Determined Contributions of both countries (Forsell et al., 2016). Climate change and land use policy agendas, include efforts to reduce deforestation and forest degradation and climate smart-agriculture approaches and a mix of national and international initiatives, many operating under the global climate change regime of the UNFCCC. Most international finance focuses on mitigation action, with adaptation funding and action lagging somewhat behind in both countries (Di Gregorio et al., 2017a).

3.2. Research design

Given the intensity of data collection required for cross-level policy network analysis, we chose to limit the data collection on policy networks to one or two jurisdictions at each level of governance. In Indonesia, the selected policy domain involves policy actors active in land use and climate change policy at the national level, in the province of West Kalimantan, and in the Kapuas Hulu district of the West Kalimantan province. In Brazil, the policy domain includes policy actors active at the federal level, in the Amazonian state of Mato Grosso, and in the Alta Floresta and Sinop municipalities in Mato Grosso. We purposefully selected sub-national jurisdictions that have experienced large-scale land-use change and conversion of forests into commercial agriculture in the last decades, and that had formally expressed commitment to conservation and climate change action. Our analysis focuses on the interactions among a broad variety of policy actors across the three levels of governance. We do not suggest that results are representative for Brazil and Indonesia as a whole, but they are likely to reflect wider interaction flows between national level and remote, forest rich sub-national level jurisdictions in the two countries.

3.3. Network boundaries and data collection

The network boundary specification aimed at identifying organizations that were involved in climate change and land use policies and actions. It followed the criteria of 'relevance', including any government and non-governmental organizations that were perceived by others and defined themselves as part of the climate and land use policy domain operating at national and selected sub-national jurisdictions. This followed a dual approach: documentary evidence, researchers' expertise, preliminary visits to all investigated jurisdictional levels in both countries and interviews with key informants produced an initial list of policy actors active at each jurisdictional level (nominalist approach). This was then validated by perceptions of actors themselves, who indicated whether they were involved in the climate and land use policy domain (realist approach) (Laumann and Knoke, 1987). This resulted in a full roaster of 168 organizations in Brazil and 160 in Indonesia. In the second phase of the fieldwork we undertook face to face surveys of around 30 minutes with 226 representatives of organizations across the three levels of governance (105 in Brazil, 63% response rate, and 121 responses in Indonesia, 75% responses rate)[1]. In Brazil 15% and in Indonesia 33% of actors were international or transnational organisations. Respondents were asked the following network related questions in reference to full roaster lists:

1) Indicate those organizations [from the list] that stand out as especially *influential*
   a) on domestic *mitigation* policies
   b) on domestic *adaptation* policies
2) Indicate those organizations with which your organization *regularly exchanges information*
   a) about *mitigation* policies and actions
   b) about *adaptation* policies and actions
3) Indicate those organizations with which your organization regularly *collaborates*
   a) concerning climate change *mitigation* related issues
   b) concerning climate change *adaptation* related issues

Responses provide the policy network data, where the nodes are the organizations interviewed and the ties refer to six network relations: 1a) *reputational power* in *mitigation* and 2b) in *adaptation*; 2a) *communication* on *mitigation* and on 2b) *adaptation* policies and actions; 3a) *collaboration* on *mitigation* and on 4a) *adaptation* related issues.

3.4. Data analysis

We first assessed the extent to which the level of governance represented an obstacle for cross-level communication and collaboration in the policy networks. It entailed comparing the extent to which interactions occur within as opposed to across levels of governance. This assessment was done using a homophily index (Scott, 2000). ***Homophily*** refers to the tendency of actors that share a specific similarity to interact more closely, compared to actors that do not (McPherson et al., 2001). The E–I Index (Krackhardt and Stern, 1988) is an overall measure of homophily that compares internal and external group ties. The index ranges from -1 (high homophily) to +1 (high heterophily).

We measured and compared homophily along three different attributes: governance level (federal/national, state/provincial, municipality/district); organization type (state actor; domestic and international NGO; business; research institute; intergovernmental organization; donor); and main activity (mainly mitigation; mainly adaptation; both mitigation and adaptation; limited activities for both mitigation and adaptation). To investigate homophily by governance level in more detail, we undertook an analysis of variance based on the density in interactions within each level as a test for homophily by level (variable homophily model) and compared the results across the four communication and collaboration relations.

To assess ***authority and power differentials across levels,*** we used two actor-level centrality measures for two forms of power: indegree centrality (a measure of prominence in a network) and betweenness centrality (a brokerage measure of control over network connections across other actors). Indegree centrality refers to the sum of incoming ties of a policy actor (Knoke and Burt, 1983). The higher the indegree, the more sought after a policy actor is in a network. Betweenness centrality measures the number of times an actor lies on the shortest path between two other actors and is a measure of intermediation across the whole network and an indicator of brokerage (Ingold, 2011). The more actors depend on a specific actor to make connections with other actors, the more power that actor has. We used the measure of normalized betweenness, which compares actual betweenness to the maximum possible betweenness (Freeman, 1976; Scott, 2000).

Since we are interested in assessing power differentials of governance levels as opposed to individual actors, we then calculated average indices for each level of governance. The indices are the average indegree centrality for each of the six relations (reputational power, information exchange and collaboration on mitigation and on adaptation) and the average betweenness centrality for the four network relations that refer to actual interactions (communication and collaboration on

[1] We also undertook semi-structured interviews with policy actors, but this paper focuses on the network survey data results.

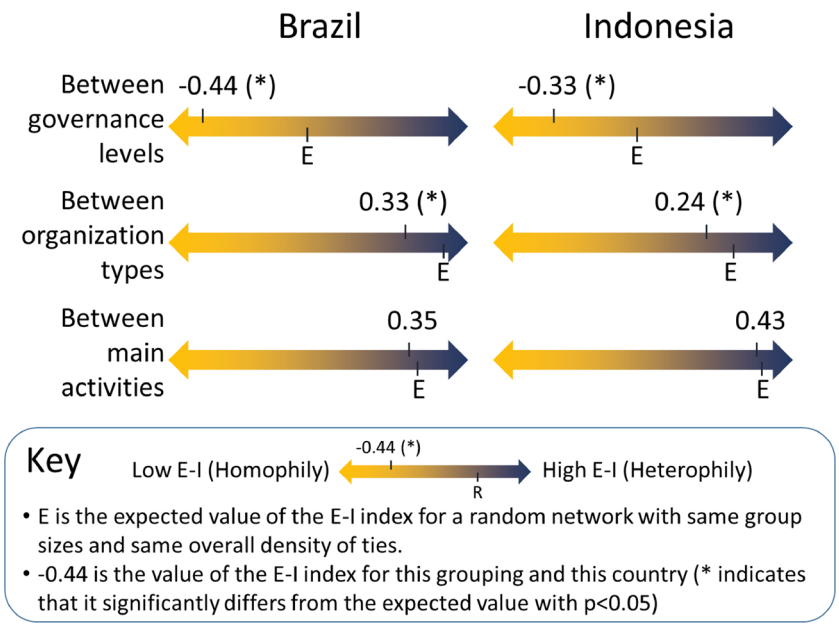

Fig. 2. E–I Index for governance level, organizational type and main activity for the multi-relational network (communication and collaboration ties on both mitigation and adaptation).

mitigation and on adaptation) of the actors operating at each level of governance. We then compared the distribution of the indices across levels. We also wanted to understand the role that international actors, who might be operating at both national and sub-national levels, play in cross level power differential, and we therefore calculated than same power indices by level from which actors originate from, creates a separate category for international actors. As robustness check, because the indegree often follows a power law distribution, we also calculated the log-transformation of the indices and indegree eigenvector measures, which is a more global measure of influence, and they confirm the same results (see Appendix A Figs. A.1 and A.2).

Next we investigated the presence of ***network communities*** in the multi-level governance networks. We identified dense groups using the Louvain community detection methods in Pajek, which partitions the network into separate groups based on density of interaction using a modularity optimisation methods (Vincent et al., 2008). We investigated coarser and finer partitions and selected four main network communities in each country's climate change policy network, which highlighted cross-level divides. We present the results for the collaboration network. In the supplementary material we also present the results for the communication network as well as for a finer partition for six network communities (Supplementary material Figs. S.1–S.4). We characterized and labelled each network community according to the main feature of the actors that compose it, and identified the dominant network communities as those containing more powerful actors based on indegree centrality. We then investigated the extent to which dominant network communities facilitate or hamper cross-level interaction.

4. Results

4.1. Barriers to cross-level interaction

While there are many communication and collaboration ties related to mitigation and adaptation across levels of governance, policy actors mostly interact within levels. We find strong evidence of homophily with respect to governance level. We also find some evidence of homophily in relation to the type of organization, but no evidence of homophily in relation to main activity (Fig.2). Thus, organizations at the same level of governance have a strong tendency to interact primarily among themselves, and more so than organizations of the same type. These findings provide initial evidence on proposition two that jurisdictional boundaries create barriers to cross-level interaction and reinforce mismatches between governance systems and climate change impacts and responses.

4.2. Cross-level differences between mitigation and adaptation

Governance level homophily differs in the four interaction networks (Fig. 3). ***Collaboration networks*** behave similarly in Brazil and Indonesia: actors operating at mid level dominate mitigation collaboration networks and local actors are more active in collaboration on adaptation. The ***communication networks*** reflect different forms of decentralization: the density of communication interaction is the highest at mid level (state) in Brazil and at local level (district) in Indonesia. Countervailing tendencies can lead to an increase or a decrease in density moving from national to local levels. We would expect higher densities at national than local level if the former dominates interactions. This is expected in polities where autonomy decreases from national to local level. Yet, as the group size decreases, we expect an increase in density from national to local levels because smaller networks tend to have higher densities. Thus care should be taken when comparing density between networks of different sizes (Prell, 2012).

Comparing ***mitigation and adaptation*** relations, all mitigation relations have higher density of interactions than their adaptation counterparts - over the whole multi-level networks, as well as within and across each levels, with only one exception: in Indonesia at the district level communication on adaptation is denser than communication on mitigation. Three out of four adaptation relations show an increase in within-level density as we move from central to mid to local level, while three out of four mitigation relations show a decrease. Homophily in collaboration on adaptation is higher in both countries at the local level (municipality and district levels) than at mid level (state and provincial levels) (Fig. 3.). Overall, networking among local level actors is denser in relations on adaptation than on mitigation. This evidence corroborates proposition one that overall patterns of interactions across governance levels differ for climate change mitigation and adaptation, with local actors relatively more engaged in adaptation and national level actors in mitigation.

Homophily prevails across all governance levels in all network

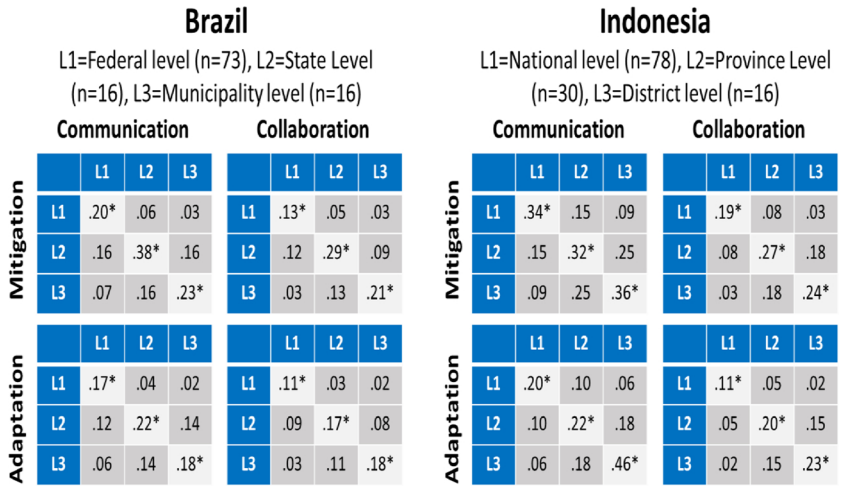

Fig. 3. Density tables of cross-level interactions (* denotes presence of homophily at a statistically significant level with $p < 0.05$).

Table 1
Survey responses on main challenges to linking climate change adaptation and mitigation.

Linking adaptation and mitigation is difficult because…	% agree		Scored as No 1 challenge	
	IN*	BR**	IN	BR
…coordinatingthe multiple actors across sectors and scales is very complex	**88%**	77%	**40**	24
…of different priorities with regards to adaptation and mitigation	86%	84%	26	20
…of insufficient technical knowledge and guidance about addressing them together	86%	77%	14	20
…there is little dialogue between adaptation and mitigation actors	79%	65%	13	10
…current climate change policy frameworks treat them as separate action arenas	74%	**85%**	15	**26**
…it makes implementation more complex	39%	53%	1	5

* IN = Indonesia.
** BR = Brazil.

relations: but is it primarily due to actors' preferences for and institutional advantages of working within governance levels? Or is it an indicator of institutional barriers that policy actors face? Two factors suggest that actors are experiencing barriers to cross-level interactions. First, homophily with respect to levels of governance is much higher than homophily based on type of organization or type of activity. Second, among a series of six challenges policy actors themselves scored the difficulty to engage in cross-level and cross-sectoral coordination as the most important in Indonesia and the third most important in Brazil (Table 1). Such severity of multi-level governance barriers is evident in other countries in the climate and land use domain (Korhonen-Kurki et al., 2016).

4.3. Authority and power differentials by level of governance

When comparing power differentials across governance levels - the jurisdictional levels at which actors operate - in both countries we find that the type of decentralization of the polity is mirrored in cross-level power differentials in the climate and land policy domain, suggesting that both are more akin to Type I MLG systems (proposition three). In Brazil, influence of climate and land use policy networks, measured by indegree centrality indices, decreases from federal, to state, to municipality level. In Indonesia the district level has higher indices compared to the provincial level, again mirroring the specific type of decentralization of the Indonesian polity (Fig. 4 and see Appendix Fig. A.1 for robustness checks).

Our second centrality measure that reflects a brokerage or mediator function, betweenness centrality, highlights the role of second level of governance (state level in Brazil and provincial level policy networks in Indonesia) in linking across higher and lower level policy networks. The relative importance of this level of governance in facilitating communication and collaboration between different levels is higher in Brazil than Indonesia (Fig. 4 and see Appendix Fig. A.1. for robustness checks). This suggests that actors operating at state level in Brazil, and to a lesser extent at provincial level in Indonesia, perform important liaison functions across governance levels. This mediator role at the second level of governance may also reflect that geographic proximity facilitates interactions. The relative difference between the two countries highlights the importance of state level policy networks in federal polities like Brazil, and the slightly weaker role of provincial level networks in Indonesia.

These results also show that policy networks at different levels of governance serve different functions: actors operating at national level include the most influential actors in cross-level networks and as such are sought after by other policy actors, while policy actors operating at the second level of governance are important facilitators of communication and collaboration between central and third level of governance.

4.4. Authority and power of international actors

The above analysis focuses on the level of governance at which actors operate, illustrating power differentials across these levels. International actors operate at all three governance levels and are more numerous at national than lower levels. In order to assess the specific role of international actors, below are the results for the level at which actors originate from, which creates a separate category for *international* actors (Fig. 5). International actors play an important role in the domain, but have lower average indegrees indices than national level actors in both Brazil and Indonesia, suggesting a good level of national ownership in both countries (see Appendix Fig. A.2 for robustness check). However, they play opposite roles in terms of brokerage: in

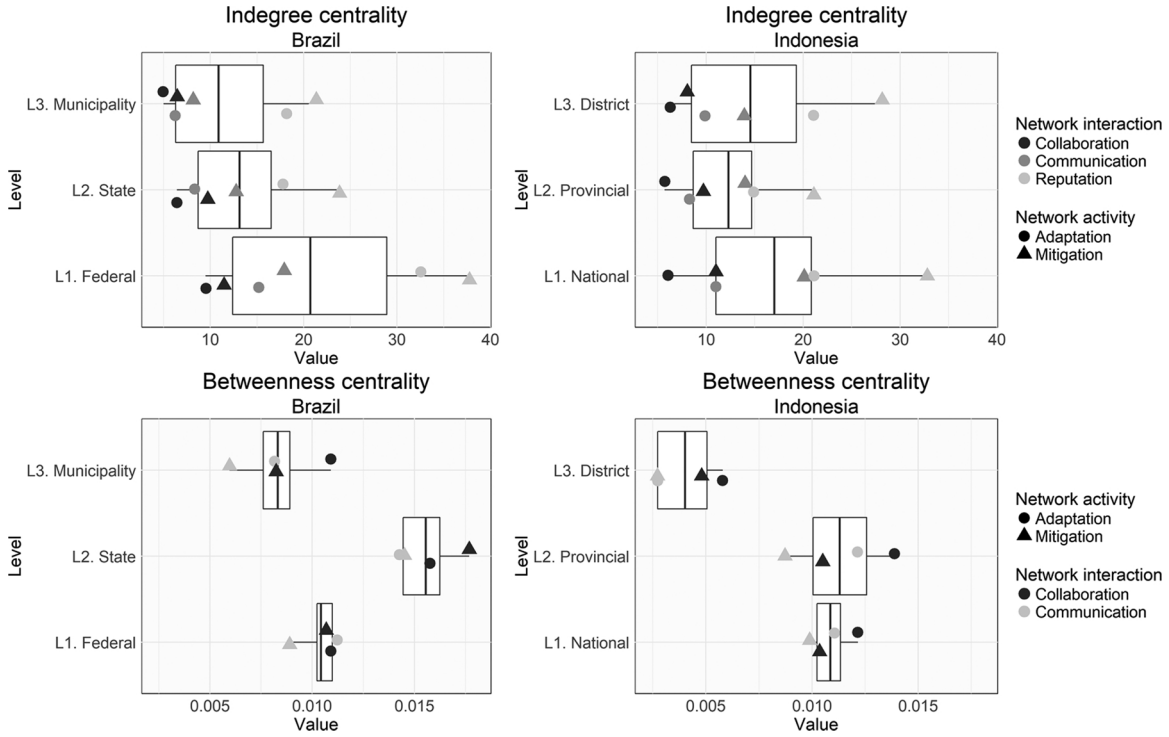

Fig. 4. Centrality indices (indegree and betweenness) in Brazil and Indonesia by Level of Governance (level at which actors operate): The boxplots show mean (bold line), interquartile range (box), minimum and maximum (whisker), and individual values (dots with shapes and colors as functions of main activity and network interaction).

Brazil international actors have the lowest betweenness indices, while they have the highest in Indonesia, suggesting that they play a key mediator role in Indonesia. In fact, the cross-level brokerage role of provincial level is due to international NGOs with offices at all three governance levels operating a number of forest conservation and climate mitigation related projects in the Kapuas Hulu district. Their presence facilitates communication and collaboration links between national and district level.

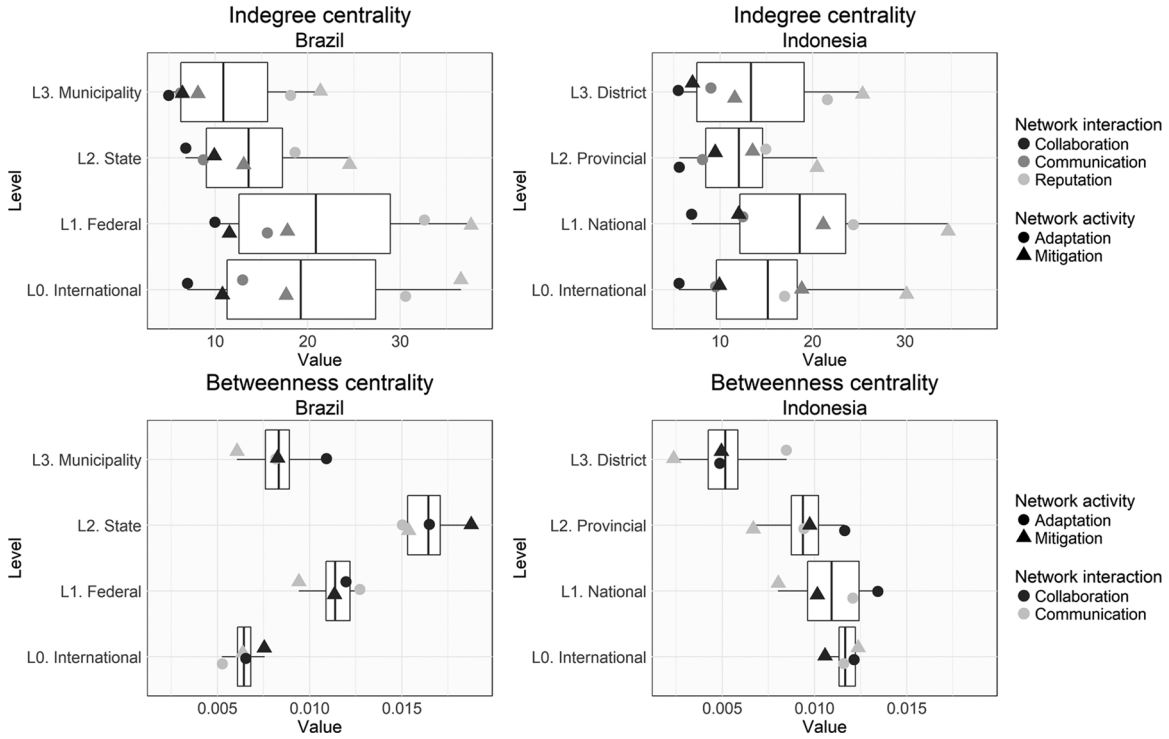

Fig. 5. Centrality indices (indegree and betweenness) in Brazil and Indonesia by Actor Level (level from which actors originate): The boxplots show mean (bold line), interquartile range (box), minimum and maximum (whisker), and individual values (dots with shapes and colors as functions of main activity and network interaction).

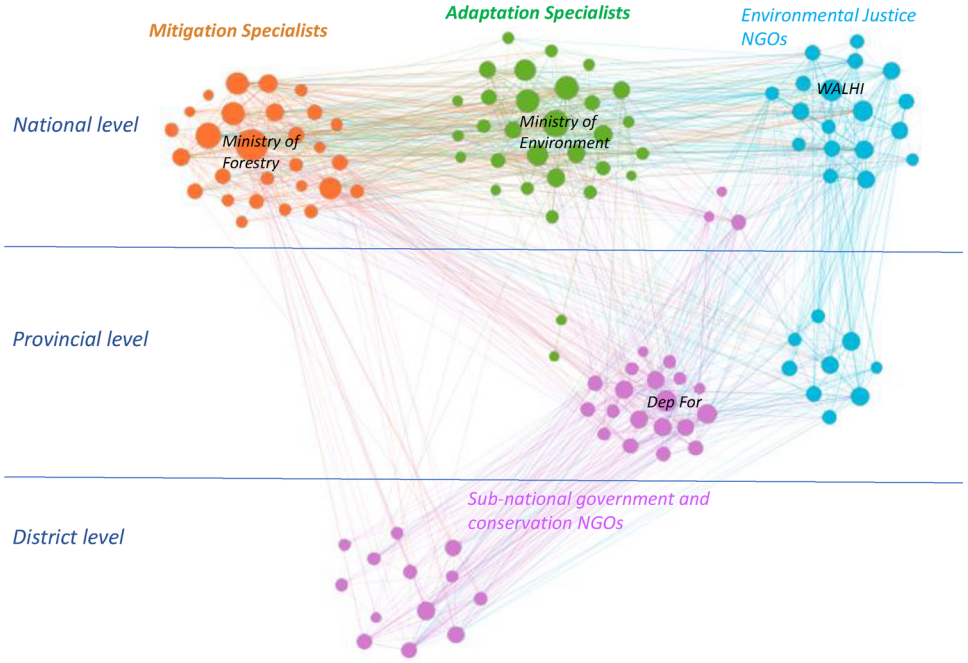

Fig. 6. Indonesia main four network communities across governance levels.
Size of nodes = indegree centrality; Colour of nodes = network community; Colour of tie = source of the tie. The most influential actor in each network community is named: Ministry of Forestry; Ministry of Environment; Friends of the Earth Indonesia (WALHI); Provincial Department of Forestry (Dep For).

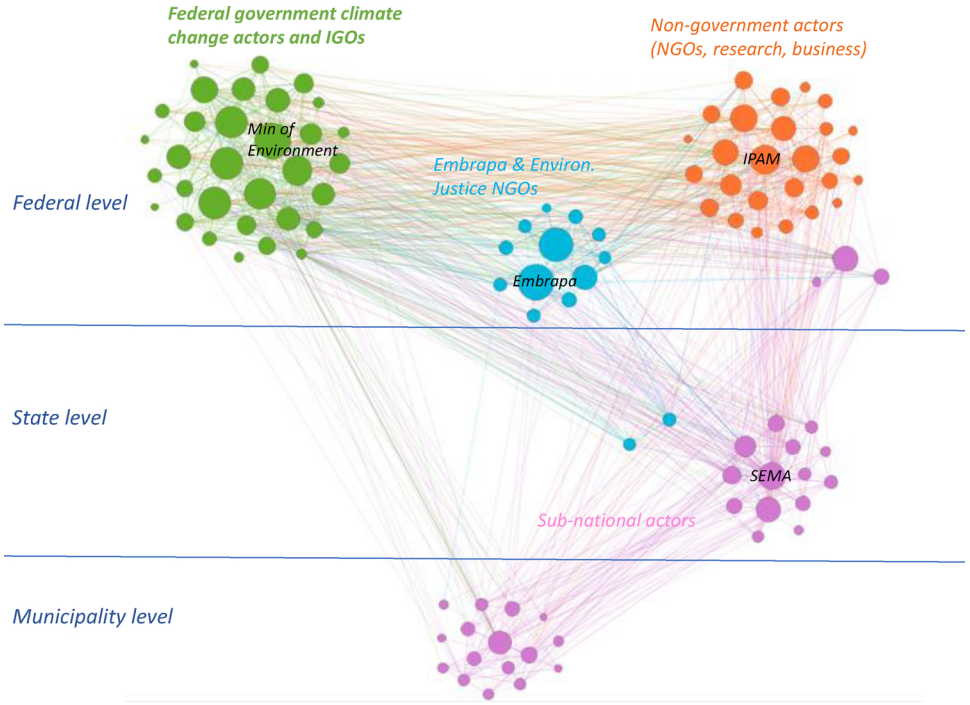

Fig. 7. Brazil network communities across governance levels.
Size of nodes = indegree centrality; Colour of nodes = network community; Colour of tie = source of the tie. The most influential actor in each network community is named: Ministry of Environment; Brazilian Agricultural Research Corporation (Embrapa); Amazon Environmental Research Institute (IPAM); State Environmental Agency of Mato Grosso state (SEMA).

In the following sections, we take a deeper look at how network communities hinder or facilitate cross-level collaboration and which types of actors perform key functions in connecting governance levels.

4.5. Network communities, power and cross-level collaboration on climate change

In both countries the most influential network community in the climate and land use domain contains exclusively actors operating at the national level and has limited collaboration ties with actors at lower levels of governance (Figs. 6 and 7). In Indonesia, the dominant network community primarily includes mitigation specialists, both state and non-state actors as well as intergovernmental organizations. The second most prominent network community contains mainly national level adaptation specialists and is formed by a mix of state and non-state actors. It has only two members from the provincial level, which are marginal actors in the climate domain. In Brazil, the two most influential network communities include only actors from the national level domain. The dominant community includes the majority of federal government actors and key intergovernmental organizations working on both mitigation and adaptation issues. The second community is composed primarily of non-state actors such as conservation NGOs, research institutes and business representatives working predominantly on climate change mitigation. A third smaller national domain level

community, with strong ties to the dominant climate change community is formed by the government supported Brazilian Agricultural Research Corporation and a number of less influential environmental justice NGOs. This network community has two state level members: a government agency and an NGO that work on indigenous rights issues. Thus, overall dominant climate change network communities operate almost exclusively at national level, limiting cross-level collaboration. The configuration of network communities in the communication networks is almost identical (See supplementary material Figs S.1 and S.2).

In both countries, it is the remaining and less prominent communities that perform important cross-level liaison functions bringing together actors based and operating at different levels of governance. In Indonesia, a community of environmental justice NGOs liaises national and provincial levels. Another community brings together most sub-national policy actors, but has weaker links to the national level through two international NGOs and a mining business association. This is the only community that crosses all three levels of governance, but it does not include any national level government actor. Similarly, in Brazil the least influential community includes most sub-national actors and spans all governance level. Yet, one key difference is that in Brazil the link to national level is through federal government agencies, while in Indonesia it is through international actors.

5. Discussion

The complex and multi-scale nature of climate change has attracted increasing attention to governance approaches able to span across levels of governance (Gupta, 2007). In addition, since the failure of Copenhagen, the mobilisation of alternative spheres of authority to nation states, such as emerging transnational networks as well as local initiatives has been welcomed as an opportunity to strengthen climate action (Jordan and Huitema, 2014). Yet, the challenges of mismatches between governance and physical scale of the environmental problem continue to threaten effective action. Adaptive management, improved coordination and the use of boundary organizations have all been indicated as useful approaches to address some of the challenges (Cash and Moser, 2000). Still, how distribution of power facilitates or hampers integration of policy decision-making processes across levels of governance needs to be better understood (Doherty and Schroeder, 2011; Gupta, 2014; Marquardt, 2017).

In the Global South the role of power in multi-level governance around climate change is likely to differ from the North in a number of ways. First, given that most finance for climate change derives from international actors, such external actors are likely to play a more important role in steering MLG in the Global South. Second, while international actors are important, climate and land use studies in the Global South highlight limited evidence of the hollowing out of the power of central government actors vis-à-vis sub-national actors (Compagnon, 2014; Di Gregorio et al., 2017b; Mwangi and Wardell, 2012; Phelps et al., 2010; Rantala and Di Gregorio, 2014; Tompkins and Adger, 2004). This indicates that national governments retains key steering power in cross-level interactions (Jessop, 2004). Third, priorities between mitigation and adaptation have shown to be valued differently. The Global South, less able to address climate change impacts, is likely to value more adaptation over mitigation action (Haddad, 2005). The same is true for local actors, who are in the front lines experiencing and having to address such impacts (Adger et al., 2005a).

To understand further how distribution of power plays out across level of governance we used a joint institutional and policy network approach to multi-level governance. The framework provides a powerful tool to analyse the interplay of political institutions and cross-level interactions. We presented evidence that while complex transboundary environmental problems like climate change require multi-level governance structures, the very act of governing across scales involves major barriers (Bulkeley and Betsill, 2005; Gupta, 2007). In particular, we found that three major drivers hamper cross-level interaction: 1. the distinct nature and interests of the two sub-domains of climate change mitigation and adaptation (Locatelli et al., 2015); 2. cross-level power differentials reinforcing scale mismatches between institutions and environmental problems (Folke et al., 2007; Young, 2006); 3. the lack of cross-level reach of dominant communities in MLG systems (Ştefuriuc, 2009). We discuss each one in turn.

5.1. Distinct priorities across governance levels in the two climate change sub-domains

Policy network analysis helps investigate and compare policy domains in detail (Broadbent, 2010; Knoke et al., 1996; Marsh, 1998) allowing to identify differences in interactions between the policy sub-domains of climate change mitigation and adaptation (Di Gregorio et al., 2017a). Investigating these interactions is particularly important in the land use sector in the Global South because of the need to reduce trade-offs and exploit synergies between mitigation and adaptation (Duguma et al., 2014b; Locatelli et al., 2015; Smith et al., 2014; Swart and Raes, 2007).

The evidence from Brazil and Indonesia suggest that patterns of cross-level interaction differ for climate change mitigation and adaptation. While mitigation is the dominant policy domain in both countries, local level actors are more engaged in adaptation than mitigation compared to national level actors. That is, adaptation might be a higher priority for these local actors, which supports arguments that mitigation is predominantly a global and adaptation a mainly local concern (Klein et al., 2005; Locatelli et al., 2011). Yet, at the same time, effective mitigation and adaptation require collaboration among all levels of governance (Adger, 2001; Adger et al., 2005b). With local actors being less influential than national actors, local climate change concerns and adaptation agendas are getting limited attention in Brazil's and Indonesia's land use sector. These kinds of impacts of differential power have important equity consequences as the costs and benefits of adaptation are highly skewed at the local level (Adger, 2001, 2006; Paavola and Adger, 2006).

We also found higher specialisation in climate change at the national compared to local level, in particular in Indonesia. This can be due to higher level of expertise in climate change at the national compared to local levels, but it can also mean that local level actors are more aware of cross-sectoral linkages and of the need to address climate and development objectives together (Denton et al., 2014; Kok and de Coninck, 2007; Swart and Raes, 2007). Given that national level actors dominate policy decisions, this lack of attention to the integration of mitigation, adaptation and development policy agendas in the land use sector could lead to trade-offs as well as potential benefits from integration being ignored (Di Gregorio et al., 2017a; Duguma et al., 2014a; Locatelli et al., 2015).

5.2. Political institutions and cross-level power differentials

Institutional approaches to MLG argue that we need to look at both formal and informal institutions to explain whether jurisdictions connect through forms of hierarchy, interdependence, or independence (Bache and Flinders, 2004b). At the same time, as a way to resolve conflicts among different interests over environmental resources, MLG is explicitly political in nature (Lebel et al., 2005; Paavola, 2007; Peters and Pierre, 2004; Stubbs, 2005). While decision-making power is shared across governance levels, scholars differ in terms of which level is the most influential (Bache and Flinders, 2004a; Fairbrass and Jordan, 2004). Some argue that MLG strengthens the power of nation

states vis-à-vis supranational entities (Moravcsik, 1998), others that it weakens it (Rhodes, 1994). In addition, as we argued above power differentials across levels differ between developed and developing countries. Whether domestic actors lead or are pushed by global interests in climate change decision making is an empirical question, and may differ by country. In addition, the uncertainty of the climate change domain increases the complexity of decision making processes further, making it difficult to predict which level of governance is able to exert most influence on policy decisions (Fairbrass and Jordan, 2004).

Accordingly, in our case studies we show that the major barriers to cross level interactions are institutional and political in nature. In both our case studies we find that formal administrative institutions of the state hamper MLG, corroborating that jurisdictional boundaries create barriers to cross-level interaction and reinforce mismatches between governance systems and cross-level climate change policy problems. While mitigation specialists talk extensively with adaptation specialists in Brazil, and central government actors interact substantially with major NGOs in Indonesia, in both countries the major barrier to interactions lies between national and sub-national governance levels, as evidenced in other cases from the Global South (Korhonen-Kurki et al., 2016; Ravikumar et al., 2015).

We also find clear evidence that cross-level power differentials in the climate change and land use domain mirror broader institutions of decentralization in Indonesia and federalism in Brazil. This suggests that both countries depict features that are akin to Type I MLG systems. Following Hooghe and Marks (2003) Brazil, as a federal state, is expected to conforms to this type. Indonesia's MLG structure, however, in not as nested. Yet, power differentials in the climate and land use domain in Indonesia reflect its own somewhat peculiar form of decentralization – with district level having historically more autonomy than provinces (Sanders et al., 2017). With both case studies featuring Type I MLG systems, we have not been able to see whether in more polycentric governance structures in the Global South power differentials across governance levels in the climate change policy domain might be impacted differently (Galaz et al., 2012; Gallemore and Munroe, 2013). In fact, moving away from the dichotomy between Type I and Type II MLG systems towards the exploration of the degree of dispersion of authority - both horizontally and vertically - in terms of degree of polycentricity could be useful to explore more nuances between different multi-level governance systems (Paavola, 2012).

5.3. *Powerful network communities and cross-level interactions*

One critique of the MLG literature is that the details about cross-level interactions "remain murky" (Ansell et al., 1997; Marks et al., 1996, p.167). Combining MLG with policy network approaches brings into focus the meso-level, situated between institutional and individual behaviour levels (Knoke et al., 1996; Marsh and Rhodes, 1992). This allows to identify how policy actors come together across levels, and to investigate in detail the role that different network communities play in MLG. We find that in both Indonesia and Brazil cross-level barriers are reinforced by the most powerful network communities interacting mainly at the national level. Sub-national governance levels are much more closely connected among themselves and make more efforts to reach out to the national level, but as in other countries have less power and remain marginal in national climate change policy decisions (Adger et al., 2005b; Tompkins et al., 2002).

Finally, the role of international actors differs in the climate and land use policy domain in the two countries. While both countries have strong national ownership of climate and land use processes, international actors play a marginal role in policy processes in Brazil. We therefore cannot test whether proposition five holds. In Indonesia, however, international actors have a much stronger presence in national and well as sub-national policy processes. They play an important facilitating role in mediating cross-level communication and collaboration between national and district levels, through international NGOs leading sub-national climate and land use initiatives. Still across the Global South, including in middle income countries like Indonesia and Brazil, climate change action relies largely on multi-lateral and bi-lateral funding and in the case of Indonesia on transnational advocacy networks of conservation and climate change NGOs, with international actors exerting both direct and indirect influence.

6. Conclusions

The complexity and multi-level nature of climate change requires governance systems able to manage and resolve conflicts of interests across multiple scales and among diverse policy actors. Within the Global South this is the more important, as priorities are likely to be influenced by powerful international interests. In this comparative analysis on MLG in the land use sector we find evidence of major barriers to cross-level interaction due to institutional and political constraints. An innovative framework that combines institutional and policy network approaches allowed us to investigate in detail the nature and drivers of these barriers. Improved integration of mitigation, adaptation and development objectives can help to reduce the divergence of interests of actors positioned at different levels of governance with respect to climate change responses. Efforts to overcome mismatches between governance structures organised around jurisdictions with the broader scale of climate change as an environmental problem requires tailored solutions exploiting existing and developing new institutions with explicit cross-level functions. A move towards polycentricity and more adaptive governance systems as advocated in the some of the literature might help overcome existing barriers to cross-level interactions. The evidence also suggests that such innovative institutions need to be specifically designed and dedicated to integrate weaker local level interests in centrally dominated policy processes. International and national level climate change actors retain an important responsibility in this regard.

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Appendix A

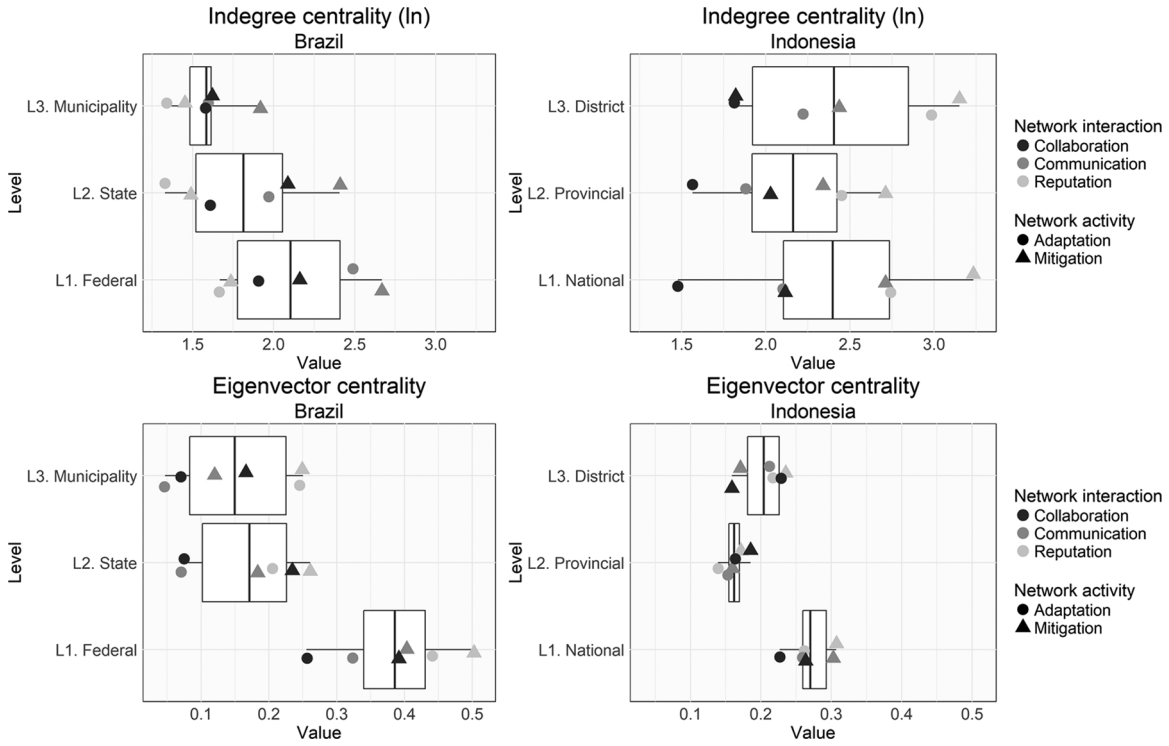

Fig. A1. Centrality indices (natural log of indegrees and eigenvector centrality) in Brazil and Indonesia by Level of Governance (level at which actors operate). The boxplots show mean (bold line), interquartile range (box), minimum and maximum (whisker), and individual values (dots with shapes and colors as functions of main activity and network interaction).

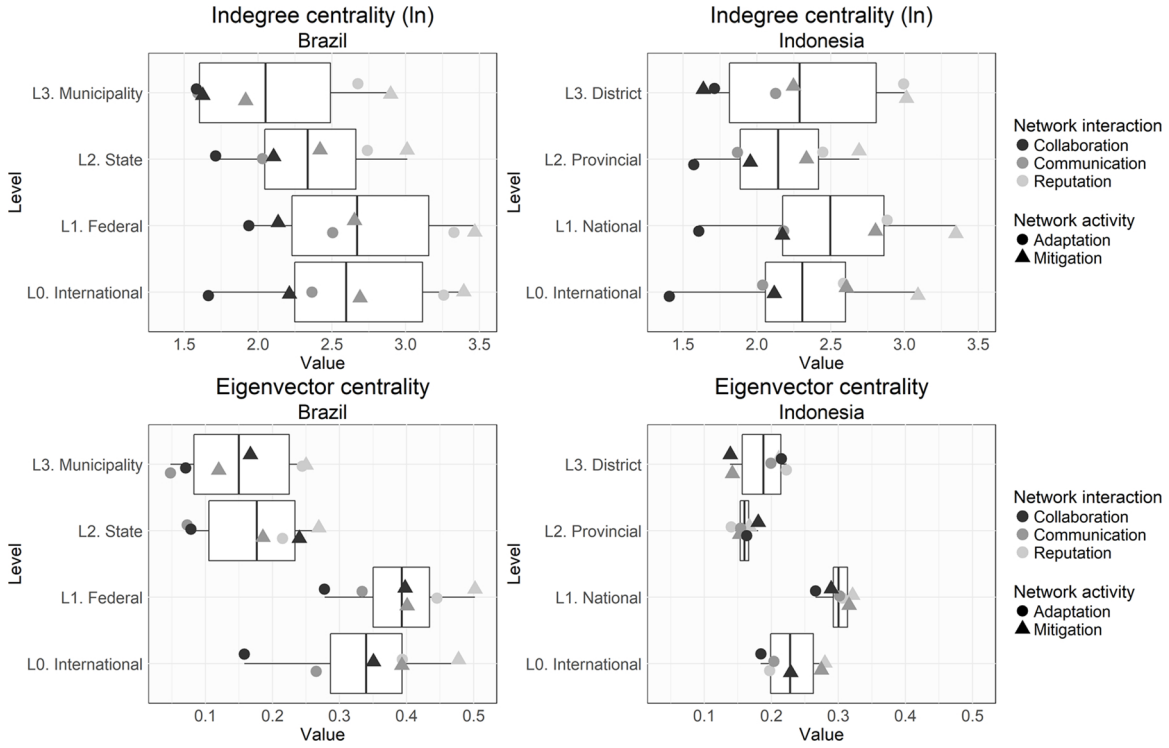

Fig. A2. Centrality indices (natural log of indegrees and eigenvector centrality) in Brazil and Indonesia by Actor Level (level from which actors originate). The boxplots show mean (bold line), interquartile range (box), minimum and maximum (whisker), and individual values (dots with shapes and colors as functions of main activity and network interaction).
Size of nodes = indegree centrality; Colour of nodes = network community; Colour of tie = source of the tie. The most influential actor in each network community is named: Ministry of Environment; Brazilian Agricultural Research Corporation (Embrapa); Amazon Environmental Research Institute (IPAM); Chico Mendes Institute for Biodiversity Conservation (ICMBio).

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.gloenvcha.2018.10.003.

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