Moeliono, M., C. Gallemore, L. Santoso, M. Brockhaus, and M. Di Gregorio. 2014. Information networks and power: confronting the "wicked problem" of REDD+ in Indonesia. *Ecology and Society* 19(2): 9. http://dx.doi.org/10.5751/ES-06300-190209

Research, part of a Special Feature on REDD+ national policy networks: information flows, influence and coalitions for change

Information networks and power: confronting the "wicked problem" of REDD+ in Indonesia

Moira Moeliono [1], *Caleb Gallemore* [2], *Levania Santoso* [1], *Maria Brockhaus* [1] *and Monica Di Gregorio* [3]

ABSTRACT. Reducing Emissions from Deforestation and Forest Degradation (REDD+) is a priority issue for forest and climate policy in Indonesia, and REDD+ policy-making activity has been characterized by considerable public consultation. Despite this engagement, discussions on REDD+ in Indonesia are reported to have remained top-down, a disconcerting pattern when adaptive governance and transformational change require cross-scale and cross-sectoral communication. Explicitly modeling the patterns of information exchange related to REDD+ can clarify these claims and help identify potential barriers to the transformational change needed to implement REDD+. We used data obtained through semistructured and structured interviews held in 2011 with representatives from a broad range of organizations (N = 64), formally or informally involved in the national REDD+ policy processes in Indonesia, to study REDD-related information exchange. Adopting a social network analysis approach, we found that (1) organizations perceived as most influential in REDD+ policy formulation, often, but not exclusively, those with institutional authority over particular aspects of REDD+, tend not to seek information from other actors and (2) organizations exchange information primarily within three clusters of similar organizations, with weak connections between clusters. This evidence suggests weak information exchange between the national government, national civil society, and transnational actors. We contend that the emergence of brokers able to connect these different clusters will be crucial for effective and inclusive REDD+ governance in Indonesia.

Key Words: *Indonesia; information exchange; natural resource governance; power; REDD+; social network analysis*

INTRODUCTION

"Wicked" problems,for which there is no clear path to an optimal solution, no consensus on what an optimal solution would look like, and not even a clear definition of the boundary of the problems to be confronted (Rittel and Webber 1973), are unfortunately widespread in the management of social-ecological systems (Chapin et al. 2008, Jentoft and Chuenpagdee 2009, Peterson 2009). Prins and Rayner (2007) see climate change as a wicked problem because it is open, complex, and imperfectly understood.

In the face of wicked problems, when framing the problem itself is a political process, discourse structured by coalitions, ideology, and social practices can take on a central role in defining policy choices (Arnold et al 2012, Brockhaus and Angelsen 2012, Di Gregorio et al. 2013). The discourses that help frame and respond to wicked problems coevolve with the patterns of relationships among engaged parties (Hajer and Versteeg 2005). As a result, power relations, emerging from formal institutional arrangements and informal network structures, can have an important influence on the way wicked problems of sustainability are framed and responses are defined (Chatterton and Style 2001).

Indonesia has become a leader in international efforts to reduce emissions from deforestation and forest degradation in developing countries, and to enhance forest carbon stocks; it embraces Reducing Emissions from Deforestation and Forest Degradation (REDD+) as an opportunity to improve forest governance (Scheyvens and Setyarso 2010, Government of Indonesia 2012). Improving governance, however, would require transformational change, i.e., changing existing policies and practices, particularly to incorporate more inclusiveness, transparency, and accountability, (Di Gregorio et al. 2012).

As shown by other cases discussed in this Special Feature of *Ecology and Society*, REDD+ brings together complex networks of actors engaged in multilevel governance (Forsyth 2009, Brockhaus and Angelsen 2012), which includes exchanges of information. The relevance of information, as well as how it is interpreted, used, and abused, shapes the discourse on REDD+ and influences how REDD+ unfolds (Brockhaus and Angelsen 2012).

Considerable theoretical and empirical research suggests that adaptive management of social-ecological systems requires networks that combine dense local informational flows with effective connections across groups and scales to foster the combination of local knowledge, cross-scale coordination, and social learning (Ostrom 1998, Tompkins and Adger 2004, Folke et al. 2005, Newman and Dale 2005, Newig et al. 2010). Emerging qualitative results indicate the networks of organizations engaged in REDD+ policy making may depart considerably from this ideal. Mayers et al. (2010), for example, report that knowledge of REDD+ in Ghana is restricted primarily to a small group of governmental actors. This is also the case in Indonesia, where Indrarto et al. (2012) note that numerous public consultations on REDD+ have tended toward one-way communication, rather than establishing strong dialogue between discourse coalitions through meaningful information exchange. These observations, however, are qualitative, and do not result from explicit studies of the meso-level patterns of information exchange in the respective countries. Modeling information exchange between organizations can allow us to identify specific factors that can define wicked problems for specific groups. This leads to our guiding question: can current patterns of information sharing in REDD+ policy making in Indonesia underpin the transformational change (Di Gregorio et al. 2012) required for

[1]Center for International Forestry Research, [2]University of Ohio, Center for International Forestry Research, [3]Sustainability Research Institute, University of Leeds

REDD+ to address the wicked problems of diverse forest economies and ecologies across a vast archipelago?

We begin with some brief background on the development of REDD+ in Indonesia before outlining our conceptual framework, in which we argue that a combination of institutional inertia and differing perceptions of the value of different information sources limits information exchange between government, transnational organizations, and national civil society groups. We tested these claims by analyzing survey data using social network analysis methods and concluded that patterns of interorganizational information exchange may limit the adaptive potential of REDD+ governance in Indonesia. Although our focus here is on REDD+, our findings reveal patterns similar to those in other sectors such as water management (Wieriks 2011), climate policy (Bulkeley 2000), and transportation infrastructure (Hudalah et al. 2010). We conclude with some observations of the implications of these findings for REDD+ policy in Indonesia.

BACKGROUND: REDD+ POLICY MAKING IN INDONESIA

In 2007, President Yudhoyono declared that Indonesia would reduce its greenhouse gas emissions through a strategy relying heavily on avoidance of deforestation and reduction of emissions from peatlands. The commitment was formalized in 2009 with a promise to reduce Indonesian greenhouse gas emissions by at least 26% against business-as-usual levels by 2020, and up to 41% with external help (Yudhoyono 2009, Government of Indonesia 2012). Although reduction of Indonesia's high deforestation rate could substantially reduce emissions (Ministry of Forestry of the Republic of Indonesia 2008), there are significant institutional and economic barriers to doing so (Government of Indonesia 2012).

One of the first steps in the REDD+ development process in Indonesia was the establishment of the Indonesian Forest Climate Alliance (IFCA). IFCA was mandated to conduct a study to assess the preparation needed to synergize all efforts and initiatives that targeted, or that would contribute toward, reducing emissions from deforestation and forest degradation in Indonesia (Indrarto et al. 2012) In effect, IFCA was a forum for communication, coordination, and consultation among stakeholders working on forest climate change in Indonesia (Ministry of Forestry of the Republic of Indonesia 2008). At the same time, the Indonesian government concentrated on plans to implement REDD+ schemes in Indonesia and released a policy setting out the implementation stages and a related time line: a preparedness phase (2007), transition/pilot activities (2008–2012), and full implementation; this policy was integrated into the national strategy in 2010 (Ministry of Forestry of the Republic of Indonesia 2008, Indrarto et al. 2012)

Political and bureaucratic reforms and decentralization processes have been ongoing in multiple sectors since 1998. Political struggles between district, provincial, and national governments have emerged during the decentralization process (Barr et al. 2006), resulting in overlapping and unclear rights and duties, which could potentially be made more complex with the addition of rights to revenue streams from carbon (Galudra et al. 2011). Combined with corruption and institutional weakness, these factors have produced a system with poor enforcement of environmental and social protection, and weak community participation in which deforestation and forest degradation remain high (Indrarto et al. 2012).

Despite the complexities of decentralization and the contested legality of government control, the Ministry of Forestry claims more than 70% of Indonesia's landmass as being under its legal mandate (Galudra et al. 2011), and the national government is a significant driver in REDD+ policy formulation. In addition to the Ministry of Forestry, which was making plans for REDD+ projects as early as 2007 (Indrarto et al. 2012), several other national government agencies, especially the Indonesian National Council on Climate Change, the REDD+ Task Force, and the National Planning Agency, emerged as key institutional leaders (Scheyvens and Setyarso 2010). Because government tasks are assigned on the basis of formal institutional mandates (Prasetyo 2011), complex concerns such as those involved in the management of complex social-ecological systems may slip between organizational purviews. In addition to the challenge of cross-cutting issues, Indonesian bureaucracy, as well as the parliament, is increasingly fragmented along political lines, and growing business–government relationships challenge government autonomy (Di Gregorio et al. 2012, Luttrell et al. 2014).

REDD+ policy making remains largely state led (Di Gregorio et al. 2012), although a series of nongovernment and international actors have been prominent in REDD+ policy debates. For example, transnational conservation organizations such as the World Wide Fund for Nature and The Nature Conservancy, as well as carbon-trading businesses such as PT Rimba Raya Utama and Infinite Earth, are engaged in both pilot projects and policy discussions. National organizations, particularly members of the Civil Society Forum for Climate Justice, an umbrella group of environmental and social nongovernmental organizations (NGOs), have adopted vocal positions on REDD+ in national and international media. The United Nations, through the UN-REDD Programme, and the World Bank, through the Forest Carbon Partnership Facility, have both provided funding and advice for REDD+ Readiness activities, although the extent to which they have had substantive influence on proceedings is unclear (Indrarto et al. 2012). Additionally, UN-REDD positions itself as a broker for REDD+ and has acted to engage both government and civil society organizations (UN-REDD Programme Indonesia 2011). Financially more significant is the agreement between Indonesia and Norway, concluded in May 2010, which will provide US$1 billion in funding to support REDD+ policy development in the country, most importantly including a 2-year moratorium on primary forest extraction permits, intended to provide time to reform forest governance and permitting processes (Murdiyarso et al. 2011). In May 2013, the moratorium was extended for another two years (Fajar 2013).

THEORETICAL FRAMEWORK: WICKED PROBLEMS, POWER, AND POLICY NETWORKS

Because climate change is a wicked problem (Prins and Rayner 2007) so is REDD+. Lacking clear definitions or solutions (Rittel and Webber 1973), wicked problems require creative framing and innovative adaptive responses. As Gunderson et al. (2002) note, however, human systems can be adaptive or resistant to change depending on the context. On one hand, humans are able to generate novel institutions in response to policy failures. On the

other, uncertainties about the consequences of current policy/management approaches can lead to a resistance to change, particularly when there are vested interests in maintaining status quo policies. The policy-making process for REDD+, for example, has involved an unusual number of consultations compared with previous forest policy processes; however, Indrarto et al. (2012) note that two-way communication remains limited. As in other cases, information flows might be purposively controlled to further parochial interests but can be inhibited at a more discrete level, for example, by prevailing institutional ideologies (Brockhaus and Angelsen 2012) and cognitive biases, indicating that power and marginality are important considerations in assessing learning and adaptive governance (Ostrom 1998, 2010, 2012, Berkes and Folke 2002, Armitage et al. 2008).

Several researchers have noted the growing importance of policy networks as conduits of information and agents in governance (Kennis and Schneider 1991, Börzel 1997, Peterson 2003, Castells 2011, Newig et al. 2010). These writers suggest the creation of policy has become an iterative process in which a diversity of actors exchange, compete, and negotiate in both formal and informal arenas (Peterson 2003, Weible and Sabatier 2005, Leifeld and Schneider 2010, Fischer 2011). By producing and disseminating information, state and nonstate actors can affect the viability of policy creation and implementation (Börzel 1997, Peterson 2003).

Social and policy networks can be especially important for the adaptive management of natural resources and environmental policy making (Tompkins and Adger 2004, Bodin et al. 2006, Janssen et al. 2006). A network perspective provides a lens for studying the governance of social-ecological systems and highlights the need to optimize the trade-offs between different network structures. For example, densely connected clusters with multiple connections amongst members promote information exchange, but they must be complemented by connections between clusters to ensure different perspectives are acknowledged (Newman and Dale 2005, Bodin et al. 2006, Ernstson, et al. 2010, Newig et al. 2010, Sandström and Rova 2010).

Cash et al. (2003), however, argue that for information to effectively cross boundaries between research, governmental, and civil society sectors, the information must pass a threefold test of credibility, salience, and legitimacy (CSL). On their terms, credible information is technically adequate and reliable, salient information is directly relevant to decision-making needs, and legitimate information is perceived as respectful of the perspectives of diverse stakeholders. Of course, the perception of whether or not any given informational object has these characteristics will differ from person to person (White et al. 2010) or, in our case, from organization to organization. As Clark et al. (2011) note, different communities can have different perceptions of what counts as credible, salient, or relevant knowledge, producing barriers to information flows.

Given the barriers to information exchange across community boundaries highlighted by research under the CSL framework, we expected information sharing on REDD+ in Indonesia to be focused within a small number of different communities. In network analysis terms, we hypothesized that information exchange networks would exhibit homophily, the tendency for people to interact with people similar to themselves (McPherson et al. 2001). Documented extensively in interpersonal social networks, there is evidence that homophily also can be found amongst organizations (Atouba and Shumate 2010). We add to the CSL framework by considering the role of three forms of power. North (1990, 2005) distinguishes between institutions, or the rules of the game under which people operate, and organizations, the groups people form to perform collective action. On this basis, we distinguished two forms of power. Institutional power arises from an organization's position within a set of laws, in our case, the Indonesian system of government. Organizational power, however, arises from the resources and expertise an organization can bring to bear on given issues. Inspired by work highlighting the importance of power relations in natural resource management networks (Crona and Bodin 2010), we considered an additional form of power, endogenous to the patterns of information flows themselves, which emerges when organizations are positioned to broker (Burt 2005) information exchange between otherwise disconnected groups. We hypothesized that both organizational and institutional power would be negatively related to information sharing, as organizations with these forms of power are unlikely to require information search. Network power, on the other hand, would by definition be positively related to an organization's level of information sharing.

We therefore anticipated that the REDD+ policy arena would be characterized by multiple clusters of densely connected organizations, with limited connections between clusters. On the basis of our qualitative interviews, we expected interaction to take place primarily within three broad clusters: government agencies; transnational actors, including donors, international organizations, and transnational NGOs; and domestic NGO members of the Civil Society Forum for Climate Justice. These three groups have differing views on what kinds of information are credible, salient, and, especially, legitimate. We further expected that organizations possessing institutional and organizational power would be more likely to be sought out as partners but less likely to acknowledge others as partners in information exchange.

METHODS

Data on information exchange were collected from 2011 to early 2012, through a survey and semistructured interviews with policy actors engaged in national REDD+ policy in Indonesia. Following a policy network approach, we focused our analysis at the level of organizations (meso level; Laumann and Knoke 1987, Marsh and Smith 2000). Therefore, we specifically investigated interorganizational linkages. It is important to remember, however, that interpersonal relationships and staff transfer are certainly also important vectors for information exchange, but they were beyond the scope of the current research.

At each organization we interviewed high-level representatives speaking for the organization. Based on previous studies, particularly a political economy analysis of REDD+ policy processes in the country and a media discourse analysis (Cronin and Santoso 2010, Brockhaus and Di Gregorio 2012, Indrarto et al. 2012), and in consultation with a panel of actors from different stakeholder groups involved in national REDD+ policy, we identified 115 organizations (see Table 1), as particularly active

Table 1. REDD+ policy actors in Indonesia.

Type of organization	Organizations identified	Organizations interviewed	Organizations included in analysis
Central government agencies	29	17	16
Regional government agencies	14	3	3
Universities and national research centers	8	2	2
Private-sector organizations	16	11	9
National NGOs	19	13	13
International NGOs	11	10	10
International organizations	6	4	3
Donors	12	8	8
Total	115	68	64

on REDD+ policy at the national scale. Note, however, that several of these organizations are actually subunits of the same organization. Because of confidentiality issues and scheduling conflicts, we were only able to conduct 68 interviews. Four of those interviews were incomplete; thus, 64 were included in our network analysis. However, an assessment of influence of those not interviewed indicated that they had on average only one-third of the influence of interviewed actors and that the most influential actors were interviewed, limiting the possible bias because of missing data.

Respondents were asked to identify organizations from the list of 115 with whom they "regularly and routinely exchange information," as well as those they regarded as particularly influential on REDD+ policy in Indonesia. Information was also collected on attributes of the organizations, including the number of employees, headquarter locations, and membership in the Civil Society Forum for Climate Justice.

We adopted a social network analysis approach (Wasserman and Faust 1994) in analyzing these data. Social network analysis encompasses a very large and growing number of formal methods for assessing patterns of social relationships. We modeled the social world as composed of nodes, representing our respondent organizations, which are connected by ties, representing information exchange. The ties could be directed or undirected. A directed network would include a tie between organizations A and B if organization A reported information exchange with organization B, whether or not organization B reported the same relationship with organization A. To adequately represent the concept of exchange, we converted our raw data into an undirected network. Our survey item characterized information exchange to be sought as "regular and routine." In principle, we would expect regular and routine partners to acknowledge one another. For this reason, information exchange between two nodes was considered reciprocal only if the organizations reported one another as partners.

We used four methods in our analysis. The first two provide descriptive measures of network structure. Degree is the number of ties that touch each organization, a measure of the prominence of an organization that is robust to omitted data (Borgatti et al. 2006, Wang et al. 2012). In directed networks, two measures are used to preserve information about the direction of the ties. Indegree is the number of ties directed toward a node (in our network, for example, the number of organizations that reported sharing information with the organization in question), and outdegree is the number directed away from a node (the number of organizations that a given organization reports as information partners). Girvan-Newman clustering is based on a measure called "betweenness," i.e., the number of shortest paths between all pairs of organizations in a network that pass through a given node (Freeman 1978-1979); clusters based on this measure identify groups of nodes that share information with one another more frequently than they share information with members of other groups (Freeman 1978-1979, Newman and Girvan 2004).

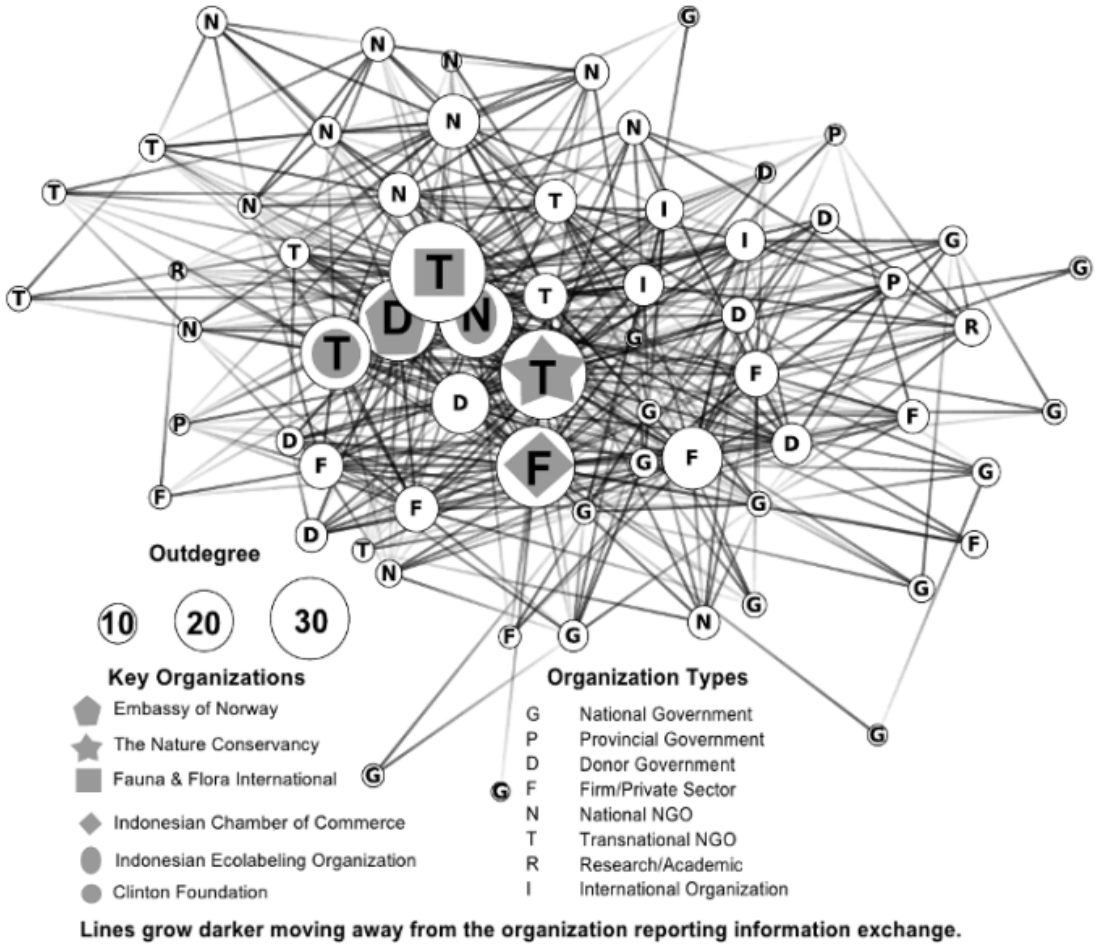
We used our final two statistical procedures to test possible explanations for the observed network patterns. Krackhardt and Stern (1988) developed the E-I Index to measure homophily. The measure is calculated as:

$$\frac{e-i}{e+i} \quad (1)$$

where E is the number of edges between groups (external) and I is number of edges within groups (internal). The result is a value scaled between -1 and 1, where -1 indicates inward looking and 1 indicates outward looking. As the distribution of this value is heavily dependent on the number of exchange relations, we tested the statistical significance of the resulting clusters by comparing the observed values to 10,000 random permutations of the observed network and report the α values for finding a more extreme measure in the randomly permuted networks than that found in the observed network.

The E-I Index, unfortunately, did not allow us to test for the effects of organizational and institutional power. Ball and Newman (2013) utilize unreciprocated edges as an indicator of social status, suggesting that people often named as partners by many others that they themselves do not recognize as partners enjoy a high social status. On the basis of this idea, we estimated a statistical model with an organization's unreciprocated indegree as the dependent variable. In other words, the dependent variable is the number of times that organization was named as an information partner minus those times the organization reciprocated this relationship. Because network data are not independent, we utilized quadratic assignment procedure (QAP) regression, a form of regression that uses permutation to correct for non-normality

Fig. 1. Directed network of information exchange between actors in the REDD+ policy arena in Indonesia (indegree).



(Krackhardt 1988, Dekker et al. 2007). Because QAP can produce overly conservative estimates of statistical significance (Dekker et al. 2007), we report the α value for each coefficient based on 10,000 permutations of the dependent variable.

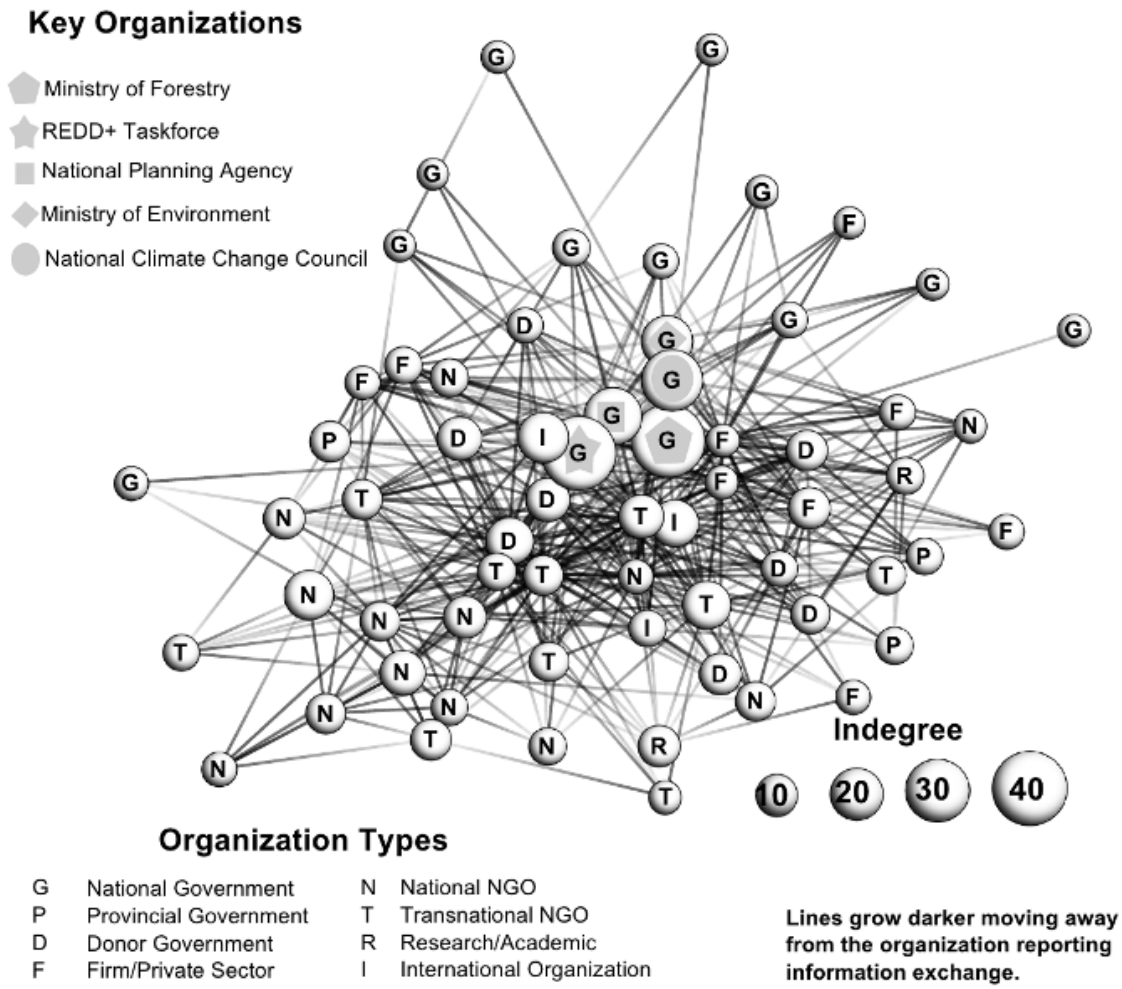
Relying on self-reports of information sharing raises a potential source of error. Recalling that all social connections relevant to a particular issue, in this case REDD+, can be challenging (Marsden 2005), particularly in the case of large organizations, we controlled for the size of an organization as measured by the natural logarithm of paid organizational employees, ln (employees), and the number of organizational partners as measured by the organization's total degree in the directed networks (degree) to address this potential problem. Network analysis calculations, E-I Index tests, and QAP regression were undertaken with UCINET 6.391 (Borgatti et al. 2002), and networks were visualized with NetDraw 2.119 (Borgatti 2002).

RESULTS

All 64 actors reported exchanging information with others. Figures 1 and 2 map how these exchanges are structured. Figure 1 shows government agencies having high indegrees, meaning that many other organizations reported sharing information with them. Figure 2 shows that the same government organizations have relatively low outdegrees, indicating they did not report sharing information with many other organizations. Transnational NGOs and private sector organizations have high outdegrees but only moderate or low indegrees.

There was thus an obvious asymmetry between being nominated as an information exchange partner and nominating others. Figure 3 shows a network of only reciprocated exchanges, in which both actors in a pair report exchanging information. The four clusters highlighted were identified using the Girvan-Newman algorithm, although they were also visible to inspection. In this visualization, we see reciprocal information exchange confined within four distinct clusters, consisting of national government agencies, two private sector organizations, Indonesian NGOs, and a more mixed large cluster consisting of donors, large international conservation agencies, and a few national actors. All members of the Indonesian NGO cluster belong to the Civil

Fig. 2. Directed network of information exchange between actors in the REDD+ policy arena (outdegree).



Society Forum and are linked to international donors, international organizations and transnational NGOs through a "bridge," with only one organization from each cluster exchanging information directly.

A test of the three hypothesized clusters confirmed the tendency of organizations to share information with similar organizations: Table 2 reports the E-I Index value for the three anticipated clusters in the undirected network, along with the probability that an index calculated on 1 of 10,000 permuted datasets was lower than the observed value.

All E-I Index values are negative and statistically significant, indicating homophily in all three groups. Government agencies have the highest degree of homophily and are thus most likely to exchange information with each other only, though the value for the Civil Society Forum is almost as extreme.

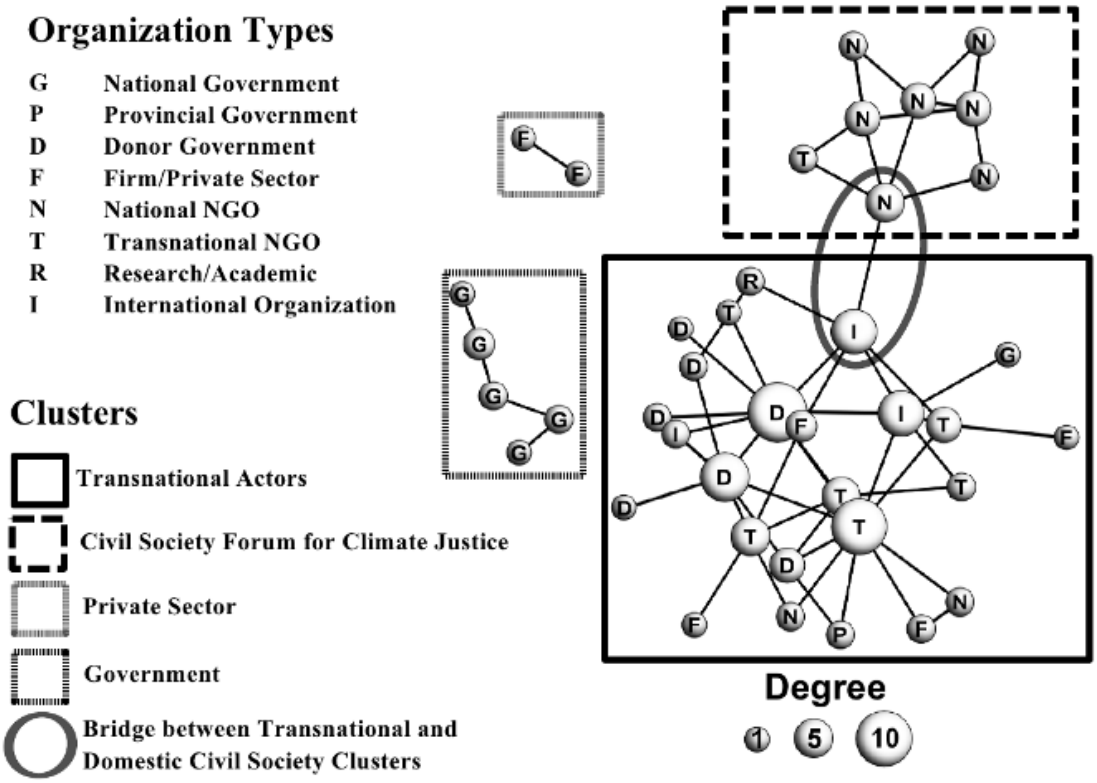
The QAP regression was used to assess the extent to which unreciprocated indegrees (being identified as an information partner by others without reciprocating) were determined by

Table 2. E-I index showing homophily for the three main organizational types (national organizations, transnational organizations) and the NGOs of the Civil Society Forum; * = significant at the 0.05 level.

Group	E-I Index (α-Value)
Government Agencies	-0.900 (0.000)*
Transnational Organizations	-0.367 (0.039)*
Civil Society Forum	-0.833 (0.022)*

power relations. At the 0.1 level, we found statistically significant positive estimates for both Influence and the interaction between Government and Influence in the model, but only the interaction terms had statistical significance at the standard 0.05 level (Table 3). In other words, the combination of formal institutional power with specific organizational influence in the REDD+ policy domain was associated with an organization being identified as

Fig. 3. Reciprocal information exchange.



an information partner by many organizations that it did not itself identify as partners. No other relationships could be distinguished from what would be expected by random chance, given the distribution of the data.

Table 3. Quadratic assignment procedure (QAP) regression estimates (n = 60). α-value estimates in parenthesis (based on coefficient estimates for 10,000 permutations); * = sig. at 0.05 level.

Independent variable	Dependent Variable: Unreciprocated Indegree
Intercept	2.63 (1.00)
Influence	0.313 (0.051)
Degree	-0.0835 (0.507)
LN(Employees)	0.120 (0.819)
Government	-4.27 (0.239)
Government*Influence	0.410 (0.030)*
R^2	0.844 (0.008)

DISCUSSION

Despite the many workshops and meetings to discuss the REDD+ processes, which should have provided information exchange with low transaction costs (Leifeld and Schneider 2010) and facilitated trust-building (Henry and Dietz 2011), organizations tended to exchange information with similar organizations, which could indicate differing perceptions of the CSL of information and information sources, as well, perhaps, as a lack of trust between groups (Henry and Dietz 2011). Interestingly, government agencies were completely isolated in the reciprocated network: regular reciprocated information exchange occurred only with other government agencies, a phenomenon identified by the high negative E-I Index for governmental organizations.

Outside of the government, there was considerable information sharing, at least within the cluster consisting primarily of transnational organizations, reflecting a common alliance of international organizations, donors, and conservation groups (Eccleston 1996, Levine 2002, Corson 2010). This cluster was connected by a single tie to the NGOs of the Civil Society Forum for Climate Justice, established to provide a coherent message to the Conference of Parties of the UNFCCC and reflecting a historical alliance between the environmental justice and agrarian movements (Peluso et al. 2008, Forum masyarakat sipil Indonesia untuk keadilan iklim 2009, Pye 2010). The cluster of private sector organizations, although only represented by two actors, also showed inward-looking trends. Interestingly, these two organizations are business associations that serve to support businesses through acting as liaison to the government and providing businesses with information on policies and opportunities.

With these results in mind we now address our initial question: can current patterns of information sharing in REDD+ policy making in Indonesia underpin the transformational change (Di

Gregorio et al. 2012) required for REDD+ to be effective in managing diverse forest economies and ecologies across a vast archipelago?

REDD+ is a wicked problem within a social-ecological system and requires adaptive management driven by social learning (Ostrom 1998, Newman and Dale 2005, Newig et al. 2010), which in turn requires effective exchange of information perceived as credible, salient, and legitimate by stakeholders. Transformational change leading to adaptive management necessitates changing business-as-usual policy approaches that support deforestation and forest degradation (Brockhaus and Angelsen 2012). Our results, however, suggest the patterns of information exchange that could underpin such a significant change were not present at the time of the study, even though the policy process shaping REDD+ promised to be more inclusive, transparent, and accountable.

It has been argued that communication networks connecting multiple groups with differing perspectives are a central component of effective governance and learning in complex social-ecological systems. Although these networks can evolve naturally, our results indicate the information-seeking strategies of individual organizations are not necessarily sufficient to ensure that effective patterns of information exchange emerge.

Given institutional and cognitive inertia and the consequent difficulty of promoting ongoing social learning and adaptive management, building effective information exchange networks must be a conscious part of the process of institution building for REDD+. This is especially true given that different interests of actors lead to competition and distrust (Cronin and Santoso 2010, Brockhaus and Angelsen 2012) and actors may be more likely to view information produced by those with similar interests as more credible and legitimate (Henry and Dietz 2011).

In addition to the problems posed by lack of reciprocated communication among organizational clusters, this study suggests growing concerns with the role of power in the management of sociological systems (Armitage et al. 2008, Crona and Bodin 2010) are justified. As has been argued in other work (Di Gregorio et al. 2012), REDD+ is a state-led process; and other organizations involved in the REDD+ policy arena in Indonesia clearly recognize the importance of government agencies, especially those specifically mandated to administer REDD+, for providing information about policy and the state of the forests in the country. The challenge for REDD+ in Indonesia, perhaps, is that to address the wicked problems posed by REDD+ in an adaptive way, REDD+ can be government led but not government dominated. Despite efforts to build inclusiveness and transparency, institutional norms developed over a long time are proving hard to overcome. Although the newly established National Council for Climate Change and the REDD+ Task Force have considerable influence on REDD+ in the country and are not clearly business-as-usual organizations, they remain outside the formal bureaucracy and rely on operational support from established agencies.

Power has a significant effect on patterns of information exchange between organizations. We found clear evidence of an interactive effect between institutional power, for which being a government agency is a proxy, and organizational power, measured by the number of organizations recognizing an organization as influential, which together make an organization likely to be claimed often as an information partner without acknowledging information exchange. There are two possible ways to interpret this outcome. It could be that organizations with high amounts of both forms of power have too many activities; therefore, our respondents simply did not remember all information-exchange relationships. Because we added in controls for degree and organizational size, however, the more likely interpretation is that the information exchange relationships reported by other organizations are simply not seen as important by organizations high in institutional and organizational power. This interpretation is consistent with the characterization of the REDD+ discussion as one-way.

Together, the effects of homophily and power generate a network that lacks the integration between diverse groups understood to be a central component of effective adaptive management of social-ecological systems. The relative disconnect between governmental, transnational, and domestic civil society organizations suggests not only that multiple perspectives are unlikely to be fully integrated, but also that groups may regard one another as information sources lacking in CSL. As a result, civil society and other actors interested in transformational change may lack the connections to the most important government agencies needed to bring about fully transformational change.

It is important, however, to remember that this analysis is only a snapshot in time, in the relatively early stages of REDD+ policy development in Indonesia. The institutional arrangement for REDD+ in the country was largely ad hoc at the time of the fieldwork and remains so, meaning there are opportunities for change. Some of these changes could come about at relatively low cost simply by working to build trust and more regularized connections between the clusters of organizations identified in this study. Newly established governmental organizations such as the REDD+ Agency (Jakarta Post 2013), for example, are quite well placed to act as brokers (Burt 2005) between these different groups. For this to happen, the REDD+ Agency would need to act to facilitate translation of credible technical knowledge into terms that are salient to policy makers. In addition, it will be necessary to mediate between academic and policy-making elites and stakeholders that have not had a dominant voice in the policy process to improve the legitimacy of information (Clark et al. 2011). Because information exchange within the clusters identified appears to be robust, it might only be necessary to broker a few cross-cutting connections to create a much more integrated and effective network of information exchange.

CONCLUSION

REDD+ in Indonesia was adopted as a tool for solving the wicked problem of forest governance. The policy process shaping REDD+ promised to be more inclusive, transparent, and accountable. While it did include more consultations and information exchange, these were reportedly mostly one-way and top-down. This characterization is supported by our finding that information exchange is still more concentrated within relatively isolated clusters of similar organizations, with governmental organizations exchanging information regularly only with one another.

As proponents of the CSL framework point out, information sharing does not come naturally. In the case of REDD+ policy in Indonesia we have an example of how those barriers to exchange play out in the formation of coalitions of actors with different interests and perceptions of information value. Considering the role of power in determining who can safely ignore information builds on the CSL framework. This can be used to identify barriers to and opportunities for information exchange, promoting transformational change in addressing wicked problems. Because power relations are ubiquitous (Foucault 1980), students of social-ecological systems can benefit by adopting novel analytic tools to support not the eradication of power but rather an understanding of the opportunities for transforming power relations in support of more sustainable futures.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/6300

Acknowledgments:

This research is part of the policy component of the Center for International Forestry Research (CIFOR) Global Comparative Study on REDD (http://www.forestsclimatechange.org/global-comparative-study-on-redd.html), led by Maria Brockhaus. The methods applied in this study build on work undertaken in Comparing Climate Change Policy Networks (COMPON, http://compon.org/), led by Jeffrey Broadbent and financially supported by the National Science Foundation. Monica Di Gregorio and Maria Brockhaus adapted the COMPON research "Protocol for Policy Network Analysis." Funding for CIFOR's research was provided the Norwegian Agency for Development Cooperation, the Australian Agency for International Development, the UK Department for International Development, the European Commission, the Ministry for Foreign Affairs of Finland, the David and Lucile Packard Foundation, the Program on Forests, and the U.S. Agency for International Development.

LITERATURE CITED

Armitage, D., M. Marschke, and R. Plummer. 2008. Adaptive co-management and the paradox of learning. *Global Environmental Change* 18(1):86-98. http://dx.doi.org/10.1016/j.gloenvcha.2007.07.002

Arnold, J. S., M. Koro-Ljungberg, and W.-L. Bartels. 2012. Power and conflict in adaptive management: analyzing the discourse of riparian management on public lands. *Ecology and Society* 17(1): 19. http://dx.doi.org/10.5751/ES-04636-170119

Atouba, Y., and M. Shumate. 2010. Interorganizational networking patterns among development organizations. *Journal of Communication* 60(2):293-317. http://dx.doi.org/10.1111/j.1460-2466.2010.01483.x

Ball, B., and M. E. J. Newman. 2013. Friendship networks and social status. *Network Science* 1(1):16-30. http://dx.doi.org/10.1017/nws.2012.4

Barr, C., I. A. P. Resosudarmo, A. Dermawan, J. McCarthy, M. Moeliono, and B. Setiono, editors. 2006. *Decentralization of forest administration in Indonesia: implications for forest sustainability, economic development and community livelihoods.* Center for International Forestry Research, Bogor, Indonesia.

Berkes, F., and C. Folke. 2002. Back to the future: ecosystem dynamics and local knowledge. Pages 121-146 *in* L. H. Gunderson and C. Holling, editors. *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington, D.C., USA.

Bodin, Ö., B. Crona, and H. Ernstson. 2006. Social networks in natural resource management: what is there to learn from a structural perspective? *Ecology and Society* 11(2): r2. [online] URL: http://www.ecologyandsociety.org/vol11/iss2/resp2/

Borgatti, S. P. 2002. *NetDraw: graph visualization software*. Analytic Technologies, Harvard University, Cambridge, Massachusetts, USA.

Borgatti, S. P., K. M. Carley, and D. Krackhardt. 2006. On the robustness of centrality measures under conditions of imperfect data. *Social Networks* 28(2):124-136. http://dx.doi.org/10.1016/j.socnet.2005.05.001

Borgatti, S. P., M. G. Everett, and L. C. Freeman. 2002. *UCINET 6 for Windows: software for social network analysis*. Analytic Technologies, Harvard University, Cambridge, Massachusetts, USA.

Börzel, T. 1997. What's so special about policy networks? An exploration of the concept and its usefulness in studying European governance. *European Integration Online Papers* 1(16). [online] URL: http://eiop.or.at/eiop/pdf/1997-016.pdf

Brockhaus, M., and A. Angelsen. 2012. Seeing REDD+ through 4Is: a political economy framework. Pages 15-30 *in* A. Angelsen, M. Brockhaus, W. D. Sunderlin, and L. V. Verchot, editors. *Analysing REDD+: challenges and choices*. Center for International Forestry Research, Bogor, Indonesia.

Brockhaus, M., and M. Di Gregorio. 2012. A brief overview. Component 1 on national REDD+ policies and processes. *CIFOR Infobrief 13.* Center for International Forestry Research, Bogor, Indonesia.

Bulkeley, H. 2000. Discourse coalitions and the Australian climate change policy network. *Environment and Planning C: Government and Policy* 18(6):727-748. http://dx.doi.org/10.1068/c9905j

Burt, R. S. 2005. *Brokerage and closure: an introduction to social capital*. Oxford University Press, New York, New York, USA.

Cash, D. W., W. C. Clark, F. Alcock, N. M. Dickson, N. Eckley, D. H. Guston, J. Jäger, and R. B. Mitchell. 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences USA* 100(14):8086-8091. http://dx.doi.org/10.1073/pnas.1231332100

Castells, M. 2011. A network theory of power. *International Journal of Communication* 5:773-787. [online] URL: http://ijoc.org./index.php/ijoc/article/view/1136/553

Chapin, F. S., III, S. F. Trainor, O. Huntington, A. L. Lovecraft, E. Zavaleta, D. C. Natcher, A. D. McGuire, J. L. Nelson, L. Ray, M. Calef, N. Fresco, H. Huntington, T. S. Rupp, L. DeWilde, and

R. L. Naylor. 2008. Increasing wildfire in Alaska's boreal forest: pathways to potential solutions of a wicked problem. *BioScience* 58(6):531-540. http://dx.doi.org/10.1641/B580609

Chatterton, P., and S. Style. 2001. Putting sustainable development into practice? The role of local policy partnership networks. *Local Environment: The International Journal of Justice and Sustainability* 6(4):439-452. http://dx.doi.org/10.1080/13549830120091725

Clark, W. C., T. P. Tomich, M. van Noordwijk, D. Guston, D. Catacutan, N. M. Dickson, and E. McNie. 2011. Boundary work for sustainable development: natural resource management at the Consultative Group on International Agricultural Research (CGIAR). *Proceedings of the National Academy of Sciences USA*. Early edition. http://dx.doi.org/10.1073/pnas.0900231108

Corson, C. 2010. Shifting environmental governance in a neoliberal world: US AID for conservation. *Antipode* 42 (3):576-602. http://dx.doi.org/10.1111/j.1467-8330.2010.00764.x

Crona, B., and Ö. Bodin. 2010. Power asymmetries in small-scale fisheries: a barrier to governance transformability? *Ecology and Society* 15(4): 32. [online]. URL: http://www.ecologyandsociety.org/vol15/iss4/art32

Cronin, T., and L. Santoso. 2010. *REDD+ politics in the media. A case study from Indonesia.* CIFOR Working Paper 49. Center for International Forestry Research, Bogor, Indonesia. [online] URL: http://www.cifor.org/publications/pdf_files/WPapers/WP-49Santoso.pdf

Dekker D., D. Krackhardt, and T. A. B. Snijders. 2007. Sensitivity of MRQAP tests to collinearity and autocorrelation conditions. *Psychometrika* 72(4):563-581. http://dx.doi.org/10.1007/s11336-007-9016-1

Di Gregorio, M., M. Brockhaus, T. Cronin, and E. Muharrom. 2012. Politics and power in national REDD+ policy processes. Pages 69-90 *in* A. Angelsen, M. Brockhaus, W. D. Sunderlin, and L. V. Verchot, editors. *Analysing REDD+: challenges and choices*. Center for International Forestry Research, Bogor, Indonesia.

Di Gregorio, M., M. Brockhaus, T. Cronin, E. Muharrom, L. Santoso, S. Mardiah, and M. Büdenbender. 2013. Equity and REDD+ in the media: a comparative analysis of policy discourses. *Ecology and Society* 18(2): 39. http://dx.doi.org/10.5751/ES-05694-180239

Eccleston, B. 1996. Does North-South collaboration enhance NGO influence on deforestation policies in Malaysia and Indonesia? *Journal of Commonwealth and Comparative Politics* 34(1):66-89. http://dx.doi.org/10.1080/14662049608447717

Ernstson, H., S. Barthel, E. Andersson, and S. T. Borgström. 2010. Scale-crossing brokers and network governance of urban ecosystem services: the case of Stockholm. *Ecology and Society* 15(4): 28. http://www.ecologyandsociety.org/vol15/iss4/art28/

Fajar, N. R. 2013. Memperpanjang moratorium kehutanan, memperpanjang kehidupan. *Antara News,* 15 May. [online] URL: http://www.antaranews.com/berita/374828/memperpanjang-moratorium-hutan-memperpanjang-kehidupan

Fischer, M. 2011. Social network analysis and qualitative comparative analysis: their mutual benefit for the explanation of policy network structures. *Methodological Innovations Online* 6 (2):27-51. [online] URL: http://unige.ch/ses/spo/Membres/Enseignants/Fischer/Publications/7FEEDd01-1.pdf

Folke, C., T. Han, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441-473. http://dx.doi.org/10.1146/annurev.energy.30.050504.144511

Forsyth, T. 2009. Multilevel, multifactor governance in REDD+: participation, integration, and coordination. Pages 113-122 *in* A. Angelsen, editor. *Realising REDD+: national strategy and policy options*. Center for International Forestry Research, Bogor, Indonesia.

Forum masyarakat sipil Indonesia untuk keadilan iklim. 2009. Indonesian Civil Society Forum for Climate Justice, Brussels, Belgium. [online] URL: http://www.csoforum.net/profil.html

Foucault, M. 1980. Two lectures. Pages 78-108 *in* C. Gordon, editor. *Power/knowledge: selected interviews and other writings: 1972-1977*. Random House, New York, New York, USA.

Freeman, L. C. 1978-1979. Centrality in social networks conceptual clarification. *Social Networks* 1(3):215-239. http://dx.doi.org/10.1016/0378-8733(78)90021-7

Galudra, G., M. Van Noordwijk, S. Suyanto, I. Sardi, U. Pradhan, and D. Catacutan. 2011. Hot spots of confusion: contested policies and competing carbon claims in the peatlands of Central Kalimantan, Indonesia. *International Forestry Review* 13 (4):431-441. http://dx.doi.org/10.1505/146554811798811380

Government of Indonesia. 2012. *Final draft of Indonesia's National Strategy on REDD+*. Government of Indonesia, Jakarta, Indonesia. [online] URL: http://www.ukp.go.id/informasi-publik/doc_download/12-draft-final-strateginasional-redd

Gunderson, L. H., C. S. Holling, and G. D. Peterson. 2002. Surprises and sustainability: cycles of renewal in the Everglades. Pages 315-332 *in* L. H. Gunderson and C. S. Holling, editors. *Panarchy: understanding transformations in human and natural systems*. Island Press, Washington, D.C., USA.

Hajer, M., and W. Versteeg. 2005. Symposium: governance networks. Performing governance through networks. *European Political Science* 4:340-347. http://dx.doi.org/10.1057/palgrave.eps.2210034

Henry, A. D., and T. Dietz. 2011. Information, networks, and the complexity of trust in common governance. *International Journal of the Commons* 5(2):188-212. [online] URL: http://www.thecommonsjournal.org/index.php/ijc/article/view/312/231

Hudalah, D., Winarso, H. & Woltjer, J. 2010. Policy networking as capacity building: an analysis of regional road development conflict in Indonesia. *Planning Theory* 9:315-332.

Indrarto, G. B., P. Murharjanti, J. Khatarina, I. Pulungan, F. Ivalerina, J. Rahman, M. N. Prana, I. A. P. Resosudarmo, and E. Muharrom. 2012. *The context of REDD+ in Indonesia: drivers, agents, and institutions*. Center for International Forestry Research, Bogor, Indonesia. [online] URL: http://www.cifor.org/online-library/browse/view-publication/publication/3876.html

Jakarta Post. 2013. Govt forms REDD+ agency. 7 September. [online] URL: http://www.thejakartapost.com/news/2013/09/07/govt-forms-redd-agency.html

Janssen, M. A., Ö. Bodin, J. M. Anderies, T. Elmqvist, H. Ernstson, R. R. J. McAllister, P. Olsson, and P. Ryan. 2006. Toward a network perspective of the study of resilience in social-ecological systems. *Ecology and Society* 11(1): 15. [online] URL: http://www.ecologyandsociety.org/vol11/iss1/art15/

Jentoft, S., and R. Chuenpagdee. 2009. Fisheries and coastal governance as a wicked problem. *Marine Policy* 33(4):553-560. http://dx.doi.org/10.1016/j.marpol.2008.12.002

Kennis, P., and V. Schneider. 1991. Policy networks and policy analysis: scrutinizing a new analytical tool box. Pages 25-59 *in* B. Marin and R. Mayntz, editors. *Policy networks: empirical evidence and theoretical considerations*. Westview, Boulder, Colorado, USA.

Krackhardt, D. 1988. Predicting with networks: nonparametric multiple regression analysis of dyadic data. *Social Networks* 10 (4):359-381. http://dx.doi.org/10.1016/0378-8733(88)90004-4

Krackhardt, D., and R. N. Stern. 1988. Informal networks and organizational crises: an experimental simulation. *Social Psychology Quarterly* 51(2):123-140. http://dx.doi.org/10.2307/2786835

Laumann, E. O., and D. Knoke. 1987. *The organizational state: social choice in national policy domains.* University of Wisconsin Press, Madison, Wisconsin, USA.

Leifeld, P., and V. Schneider. 2010. *Institutional communication revisited: preferences, opportunity structures and scientific expertise in policy networks*. MPI Collective Goods Preprint No. 2010/12. http://dx.doi.org/10.2139/ssrn.1598196

Levine, A. 2002. Convergence or convenience? International conservation NGOs and development assistance in Tanzania. *World Development* 30(6):1043-1055. http://dx.doi.org/10.1016/S0305-750X(02)00022-0

Luttrell, C., I. A. P. Resosudarmo, E. Muharrom, M. Brockhaus, and F. Seymour. 2014. The political context of REDD+ in Indonesia: constituencies for change. *Environmental Science & Policy* 35:67-75. http://dx.doi.org/10.1016/j.envsci.2012.10.001

Marsden, P. V. 2005. Recent developments in network measurement. Pages 8-30 *in* P. J. Carrington, J. Scott, and S. Wasserman, editors. *Models and methods in social network analysis*. Cambridge University Press, New York, New York, USA. http://dx.doi.org/10.1017/CBO9780511811395.002

Marsh, D., and M. J. Smith. 2000. Understanding policy networks: towards a dialectical approach. *Political Studies* 48 (1):4-21. http://dx.doi.org/10.1111/1467-9248.00247

Mayers, J., S. Maginnis, and E. Arthur. 2010. *REDD readiness requires radical reform: prospects for making the big changes needed to prepare for REDD-plus in Ghana.* The Forests Dialogue, Yale University, New Haven, Connecticut, USA. [online] URL: http://www.growingforestpartnerships.org/sites/growingforestpartnerships.org/files/gfp_REDDReadinessRequiresRadicalReform.pdf

McPherson, M., L. Smith-Lovin, and J. M. Cook. 2001. Birds of a feather: homophily in social networks. *Annual Review of Sociology* 27:415-444. http://dx.doi.org/10.1146/annurev.soc.27.1.415

Ministry of Forestry of the Republic of Indonesia. 2008. *IFCA 2007 Consolidation report: reducing emissions from deforestation and forest degradation in Indonesia.* Forestry and Research Development Agency, Jakarta, Indonesia.

Murdiyarso, D., S. Dewi, D. Lawrence, and F. Seymour. 2011. *Indonesia's forest moratorium: a stepping stone to better forest governance?* Working Paper 76. Center for International Forestry Research, Bogor, Indonesia.

Newig, J., D. Günther, and C. Pahl-Wostl. 2010. Synapses in the network: learning in governance networks in the context of environmental management. *Ecology and Society* 15(4): 24. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art24

Newman, L., and A. Dale. 2005. Network structure, diversity, and proactive resilience building: a response to Tompkins and Adger. *Ecology and Society* 10(1): r2. [online] URL: http://www.ecologyandsociety.org/vol10/iss1/resp2/

Newman, M. E. J., and M. Girvan. 2004. Finding and evaluating community structure in networks. *Physical Review* E 69:026113. http://dx.doi.org/10.1103/PhysRevE.69.026113

North, D. C. 1990. *Institutions, institutional change and economic performance*. Cambridge University Press, Cambridge, UK. http://dx.doi.org/10.1017/CBO9780511808678

North, D. C. 2005. *Understanding the process of economic change*. Princeton University Press, Princeton, New Jersey, USA.

Ostrom, E. 1998. Scales, polycentricity, and incentives: designing complexity to govern complexity. Pages 149-167 *in* L. D. Guruswamy and J. A. McNeely, editors. *Protection of global biodiversity: converging strategies*. Duke University Press, Durham, North Carolina, USA.

Ostrom, E. 2010. Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change* 20(4):550-557. http://dx.doi.org/10.1016/j.gloenvcha.2010.07.004

Ostrom, E. 2012. Nested exernalities and polycentric institutions: must we wait for global solutions to climate change before taking actions at other scales? *Economic Theory* 49(2):353-369. ttp://dx.doi.org/10.1007/s00199-010-0558-6

Peluso, N. L., S. Afiff, and N. F. Rachman. 2008. Claiming the grounds for reform: agrarian and environmental movements in Indonesia. *Journal of Agrarian Change* 8(2-3):377-407. http://dx.doi.org/10.1002/9781444307191.ch8

Peterson, H. C. 2009. Transformational supply chains and the 'wicked problem' of sustainability: aligning knowledge, innovation, entrepreneurship, and leadership. *Journal on Chain and Network Science* 9(2):71-82. http://dx.doi.org/10.1111/j.1471-0366.2008.00174.x

Peterson, J. 2003. *Policy networks*. Political Science Series 90. Institute for Advanced Studies, Vienna, Austria. [online] URL: http://www.ihs.ac.at/publications/pol/pw_90.pdf

Prasetyo, H. 2011. *Suspension of new licenses, REDD+ strategy and other policy matters.* REDD+ Exchange, Oslo, Norway. [online] URL: http://gyroconference.event123.no/oslo/reddexchange/pop.cfm?FuseAction=Doc&pAction=View&pDocumentId=31038

Prins, G., and S. Rayner. 2007. *The wrong trousers: radically rethinking climate change policy*. A Joint Discussion Paper of the James Martin Institute for Science and Civilization, University of Oxford and the MacKinder Centre for the Study of Long-Wave Events. London School of Economics, London, UK.

Pye, O. 2010. The biofuel connection – transnational activism and the palm oil boom. *Journal of Peasant Studies* 37(4):851-874. http://dx.doi.org/10.1080/03066150.2010.512461

Rittel, H. W. J., and M. M. Webber. 1973. Dilemmas in a general theory of planning. *Policy Sciences* 4:155-169. http://dx.doi.org/10.1007/BF01405730

Sandström, A., and C. Rova. 2010. Adaptive co-management networks: a comparative analysis of two fishery conservation areas in Sweden. *Ecology and Society* 15(3): 14. [online] URL: http://www.ecologyandsociety.org/vol15/iss3/art14/

Scheyvens, H., and A. Setyarso. 2010. Development of a National REDD-plus System in Indonesia. Pages 15-52 *in* H. Scheyvens, editor. *Developing national REDD-plus systems: progress, challenges, and ways forward: Indonesia and Viet Nam country studies*. Institute for Global Environmental Strategies, Kanagawa, Japan. [online] URL: http://enviroscope.iges.or.jp/modules/envirolib/upload/3051/attach/redd_final.pdf

Tompkins, E. L., and W. N. Adger. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society* 9(2): 10. [online] URL: http://www.ecologyandsociety.org/vol9/iss2/art10

UN-REDD Programme Indonesia. 2011. *Semi-annual report 2011: UN-REDD Programme Indonesia*. UN-REDD Programme Indonesia, Jakarta. http://www.un-redd.org/UNREDDProgramme/CountryActions/Indonesia/tabid/987/language/en-US/Default.aspx

Wang, D. J., X. Shi, D. A. McFarland, and J. Leskovec. 2012. Measurement error in network data: a reclassification. *Social Networks* 34(4):396-409. http://dx.doi.org/10.1016/j.socnet.2012.01.003

Wasserman, S., and K. Faust. 1994. *Social network analysis: methods and applications*. Cambridge University Press, Cambridge, UK.

Weible, C. M., and P. A. Sabatier. 2005. Comparing policy networks: marine protected areas in California. *Policy Studies Journal* 33(2):181-201. http://dx.doi.org/10.1111/j.1541-0072.2005.00101.x

White, D. D., A. Wutich, K. L. Larson, P. Gober, T. Lant, and C. Senneville. 2010. Credibility, salience, and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater. *Science and Public Policy* 37 (3):219-232.

Wieriks, M. 2011. *Water governance and policy networks in Indonesia: the challenges of a decade of water sector reformation*. Thesis. Delft University of Technology, Delft, Netherlands.

Yudhoyono, S. B. 2009. Intervention By H. E. Dr. Susilo Bambang Yudhoyono, President of the Republic of Indonesia, on climate change at the G-20 Leaders Summit 25 September 2009, Pittsburgh, Pennsylvania, USA. Forest Climate Center, Indonesia. [online] URL: 25%20Intervention%20by%20President%20SBY%20on%20Climate%20Change%20at%20the%20G-20%20Leaders%20Summit.pdf