The adaptive governance of the commons

Understanding shifts in modes of governance in community forestry systems

(A research proposal-in-progress)

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Abstract - Under what conditions can social-ecological systems be expected to develop sustainably? Social-ecological systems (SESs) – such as for example community forests and their users – have been compared to "moving targets:" Due to the interactions and interdependence between the systems' components, SESs are characterized by change, change that can often not be anticipated in terms of intensity and direction. Sustainability is therefore not a steady-state equilibrium that can be developed towards to. I argue that the long-enduring success of community forest systems – success defined in terms of forests not degrading and its users staying happy – is intimately related to a user group's ability to adapt its mode of governance, when confronting change. I hold that forest users that engage in experimentation, learn from experience and are able to adapt to change are more likely to avoid forest degradation or social disintegration. In this research, I focus on the conditions that are expected to make this happen. The particular social-ecological systems that I propose to look at, involve a total of fifty community forestry systems in Guatemala, Honduras, Bolivia, and Mexico, respectively. I line up the following variables to explain variation in community forestry systems' ability to develop sustainably: Diversity in types of actors, social memory, functional redundancy, and trust among actors. These explanatory variables are operationalized through social network analysis metrics – i.e. quantifiable algorithms regarding relevant social network characteristics. I propose to derive the indicators related to the dependent variable (the sustainable development of community-forestry systems – the social as well as the ecological side of the picture) from an existing database, compiled by the *International Forestry Resources and Institutions* (IFRI) research program.

Background: This proposal-in-progress is to develop into a pre-proposal to be submitted to the integrated programs grant facility of WOTRO. WOTRO-grants are aimed at supporting research to the benefit of development and societal issues of local and global concern. An integrated program has to be a collaborative initiative of researchers from the Netherlands and from one or more developing countries. Developing country researchers and relevant stakeholders from outside the scientific community are expected to be engaged in all phases of the program. The cap of WOTRO grants is set at 700,000 Euros, mostly to be spent on PhD research.
(See: http://www.nwo.nl/subsidiewijzer.nsf/pages/NWOP_5VEKKV). Considering other funding opportunities is still up for discussion in this phase.

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1. Introduction & research question

Social systems' adaptive capacity remains an insufficiently studied part of the subject of climate change (Berkes and Jolly 2001). Climate change affects natural and human systems. Among other things, it is likely to render both ecological- and social-system processes and outcomes more variable and less predictable. Hence, it is expected that the likelihood of *success* – a term that I will define and operationalize, later on in this essay – of environmental governance will increasingly be linked with a social system's ability to adapt to and deal with – often unanticipated – change and disturbances. Timely and appropriate *shifts in modes of governance* will more and more determine the sustainability of social-ecological systems (Parry et al. 2007). Is it possible to measure a social-system's capacity to make the necessary and timely *shifts in modes of governance* in response to critical changes? Is it possible to predict a social-ecological system's chances of sustaining itself – by means of adapting its mode of governance – when facing severe alterations in either the natural or the social system? These questions will be addressed in this essay by looking at the particular sub-set of social-ecological systems that consists of forests and forest users that govern and exploit their natural resources as common property. A conceptual, explanatory model is proposed is inspired by theories that deal with communication, learning and governance in a networked environment, and by scholars that have theorized about resilience, robustness and vulnerability. A methodological proposal is developed that leans on network analysis.

Why particularly look at forests, when investigating social-ecological systems' capacity to deal with change and disturbance? Forests are important and deforestation is a major problem, both at a local and a global scale. Firstly, it is estimated that globally deforestation leads to the yearly release of about 2 billion tons of CO_2, accounting for 25% of all man-made emissions of this greenhouse gas (FAO 2005). Also, FAO (2005) holds that forests harbor more biodiversity than any other terrestrial ecosystem (see also Aguilar-Støen and Dhillion 2003; Fearnside 1999; Gorenflo and Brandon 2005; Myers 1988; Wilson 1988). Hence, deforestation is recognized as one of the major causes of biodiversity loss (Ehrlich 1988; Perrings et al. 1995; Wood, Stedman-Edwards, and Mang 2000). Furthermore, forests play an important role in the livelihoods of millions of rural poor world wide (Lynch and Talbott 1995; White and Martin 2002; World Resources Institute (WRI) 2002; World Wide Fund for Nature (WWF) 2002), meaning that forest degradation negatively affects many people's ability to make a decent living (Sunderlin et al. 2005).

Why particularly look at *community* forests[1], then? First, worldwide, the area of forest land that *de jure* or *de facto* is governed as common property is significant. Combining the estimates of White and Martin (2002) and FAO (2005), Agrawal (2007) compiles a list of 36 countries, accounting for over 80% of the world's forests, and estimates that in these countries, 326 million hectares (8.3% of the total area) are governed as common property. So, understanding the complexities that go into the collective governance of forest resources is by no means a trivial issue. Second, besides being important in and by itself, the study of community forestry issues has been shown to add to our general understanding of *common pool resource* (CPR)[2] governance. Hence, the questions addressed in this essay have direct consequences for our understanding of sustainability issues related to many other social-ecological systems that are or will eventually be affected by climate change or other sources of – often erratic and unpredicted – change.

Hardin's claim (1968) that communities would *never* be able to set-up a sustainable common property governance system has been importantly challenged by at least 20 years worth of empirical and theoretical research (Kennedy 2007). It is however still widely acknowledged that governing the commons is by no means an easy thing to do. Firstly, we are increasingly

[1] Community forests are defined here as forests that *de facto* are not managed under a private ownership regime: A group of people – that can but does not need to be a distinguishable community – uses the forest and its resources as a commons.
[2] Common pool resources are characterized by the difficulty of excluding actors from using them and the fact that the use by one individual or group means that less is available for use by others. (The latter point distinguishes CPR from pure public goods which exhibit both non excludability and non rivalry in consumption). Source: "Livelihoods Connect" website (glossary) <http://www.eldis.org/go/livelihoods/>

confident about a significant (causal?) correlation between the sustainability of CPR governance systems on the one hand, and a set of explanatory – mostly institutional – criteria (i.e. *design principles*), on the other: If a social-ecological system meets these criteria – the argument goes – it is more likely to maintain its natural resource base intact, and its people happy. Secondly, we are also gradually furthering our understanding of the conditions under which it is more likely that these criteria will be met – i.e. (mostly modest) answers are beginning to take shape to the question of when it is more likely that social systems will craft and enforce the institutional arrangements that are considered to be critical to CPR success.

A so-far understudied area of inquiry however, relates to the *adaptive capacity* of social systems: Are community-forest users able to make the necessary and timely shift in their modes of governing their natural-resource base when confronting critical alterations of the social-ecological system, for example due to climate change? The research question that drives this project can be formulated as follows: *Under what conditions can it be expected that community-forest governance systems will respond to change and disturbance in such a way that both critical ecological- and social functions of the system remain intact – i.e. forest do not degrade and forest users can continue to meet their needs?* In what follows, I will go through the relevant literature (section 2) with the purpose to build a model that integrates the conditions that are thought to add to the likelihood of social systems reacting timely and adequately to changes and disturbance (section 3). This model will then serve as the foundation for a set of working hypotheses. I will subsequently operationalize the variables: I propose to measure the independent variables using social network analysis metrics. The dependent variables will be measured using data from gathered by the *International Forestry Resources and Institution* (IFRI) research network (section 4). Then, a research design is proposed to test the hypotheses, and the logic behind the sample selection is explained (section 5).

2. Literature review

A vast literature – both theoretical and empirical – has emerged (and continues to expand) on *the commons* (for an overview see Laerhoven and Ostrom 2007), due to which we are beginning to gain some understanding of what in general – but also under particular circumstances – can be expected to go into the sustainable – i.e. long-enduring – governance of natural resources that are treated by its users as common property. Examples of such commons include irrigation systems (e.g. Ostrom and Gardner 1993), water resources (e.g. Blomquist, Schlager, and Heikkila), the oceans (e.g. Wilson 2007), fisheries (e.g. Berkes 1992), wildlife (e.g. Gibson and Marks 1995), protected areas and biodiversity (e.g. Hayes 2006), watersheds (e.g. Kerr 2007), cattle and rangelands (McGrath, Almeida, and Merry 2007) and indeed also community forests (e.g. Gibson, McKean, and Ostrom 2000).

In broad strokes – that admittedly do no justice to the details – the study of the commons has so far mainly focused on either *performance* (i.e. putting to the theoretical and empirical test the claims that certain (sets of) institutions and other conditions add to the likelihood of CPR governance success) or *emergence* (i.e. testing hypotheses about what makes it more likely that certain institutional arrangements – supposedly critical for the success of CPR governance – emerge). For example, one can test if and to what extent institutions that effectively organize monitoring, result in more sustainable CPR governance (e.g. Gibson, Williams, and Ostrom 2005), and, one can study under what circumstances it is more likely that effective monitoring institutions will be more likely to be crafted and implemented (e.g. Agrawal and Goyal 2001). A topic that seems much less advanced – but that given (among other things) the urgency posed by the effects of climate change is not less important or relevant – is that of *shifts in modes of governance*.

a. Studying the performance of different modes of CPR governance

When can it be expected that CPR governance systems perform well? From the literature, a notion is beginning to develop about a set of *design principles* – a term coined by Elinor Ostrom (1990)[3] but also (maybe more implicitly) studied by Wade (1988), Baland & Platteau (1996), and Kerr (2007) – i.e. criteria that are thought to add to the likelihood of common pool resource governance performing well for a longer period of time. This notion initially was posited as a number of hypotheses derived from extensive fieldwork (e.g. McCay and Acheson 1987), the review of existing case-study material (e.g. Ostrom 1990), and theoretical and empirical literature on institutional development (e.g. North 1990). After formulating them, the *design principles* have been – and continue to be – empirically tested in various contexts (Sarker and Itoh 2001; Sekher 2001; Yandle 2003; Quinna et al. 2007). Agrawal (2001) argues that compiling generic lists of the conditions under which groups of users will self-organize and sustainable govern the resources upon which they depend is flawed and too costly. He holds that it makes more sense – for the purpose of developing a "coherent, empirically relevant theory of the commons" – to invest in statistical, comparative case studies (rather than single case analyses), that are carefully selected with the unveiling of causal mechanisms in mind.

b. Studying the emergence of successful modes of CPR governance

The above mentioned body of literature suggests that well-functioning community-forest governance systems have to have *rules* regarding the harvesting and use of certain forest products, in an attempt to keep total extractions within limits (e.g. Agrawal 2000, 1994; Banana and Gombya-Ssembajjwe 2000; Behera and Engel 2006; Mehta and Kellert 1998). Rules serve no purpose, without effective monitoring: Having an effective monitoring and sanctioning system has time and again been proven to be among the most powerful predictors of CPR success (Agrawal 1994; Agrawal and Goyal 2001; Gibson and Lehoucq 2003; Klooster 2000; Gibson, Williams, and Ostrom 2005). The making and enforcing of rules, in essence requires *collective*

[3] Ostrom's original *design principles* are reproduced in appendix 1

action, in one form or another. Hence, much of the efforts aimed at gaining understanding regarding the emergence of successful modes of CPR governance are zooming in on variables that are thought to affect the likelihood of social dilemmas getting solved, such as *group size* (Agrawal and Goyal 2001; Esteban and Debraj 2001), *heterogeneity* (Baland and Platteau 1999; Vedeld 2000; Hackett 1992; Ostrom and Gardner 1993; Bardhan and Dayton-Johnson 2002), and *leadership* (Bianco and Bates 1990; Vedeld 2000)[4].

c. Studying shifts in modes of CPR governance

Both the *performance* and the *emergence* literature are inherently inclined to be rather static. Can their findings be extrapolated and applied to situations where system equilibriums swing from one extreme to the other? Anderies et al. (2004) state that in order "*to enhance the robustness of social-ecological systems, it might be desirable to have institutions that are not persistent but may change as social and ecological variables change*" (no page number). Can this ability of social systems to change its institutions be measured and predicted?

In this essay, I perceive a community forest and its users as a social-ecological system. Ecological systems are complex (e.g. Holling 1973). Climate change is likely to increase the complexity of these system, rendering system-functioning and outcomes more erratic (Berkes and Jolly 2001). Social systems attempting to sustain these complex ecological systems are complex, too, due to, among other things, social dilemmas (Olson 1965), because of the apparent difficulty to craft the institutions that would be appropriate to solve these (North 1990; Ostrom 2005), and as a consequence of the bounded rationality of actors attempting to construct inferential models regarding the environment – both social and natural – in which they operate (March 1978; Simon 1957, 1955). A growing number of scholars interested in sustainability is taking into account simultaneously and in an integrated manner both the complexity of ecological systems and the complexity of social systems (Berkes, Colding, and Folke 2003; Berkes and Folke 1998; Gunderson, Holling, and Light 1995). Social and ecological systems respond to one another, or,

[4] For an overview of this literature, see Van Laerhoven (2008)

as Gunderson (2003) puts it, "*systems of people and nature co-evolve in an adaptive dance*". Such integrated social-ecological systems (SESs) cannot be studied with some hypothetically ideal – supposedly sustainable – steady-state equilibrium in mind. To the contrary, SESs are like "moving targets" (Walters and Holling 1990), continuously changing, because of the internal dynamics of the components themselves and due to the interaction between these dynamic elements. Direction and intensity of this change is often unanticipated – an inherent trait of SESs that seems to be aggravated by climate change.

With "change" being the middle name of social-ecological systems, Holling (2001) holds that communities that want to succeed at maintaining their SES intact for a prolonged period of time need the "*capacity to create, test, and maintain adaptive capability*." Social systems governing a natural resource base need to foster its adaptive capabilities and create opportunities. Folke et al. (2003), following the same line of reasoning, state that in order to be successful, social systems need to be *resilient*. The resilience of an integrated system of people and the natural environment is determined by its ability to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks. For social systems, resilience boils down to the ability to build and increase the capacity for learning and adaptation. It requires that the social part of the SES *engages in experimentation, learns from experience and is able to adapt to change*. In this research, I focus on the conditions that are expected to make this happen.

d. What makes a social system resilient?

From the literature, I derive four variables that have been associated with an increased likelihood of groups engaging in experimentation, with their ability to learn from experience, and with their capacity to adapt to change.

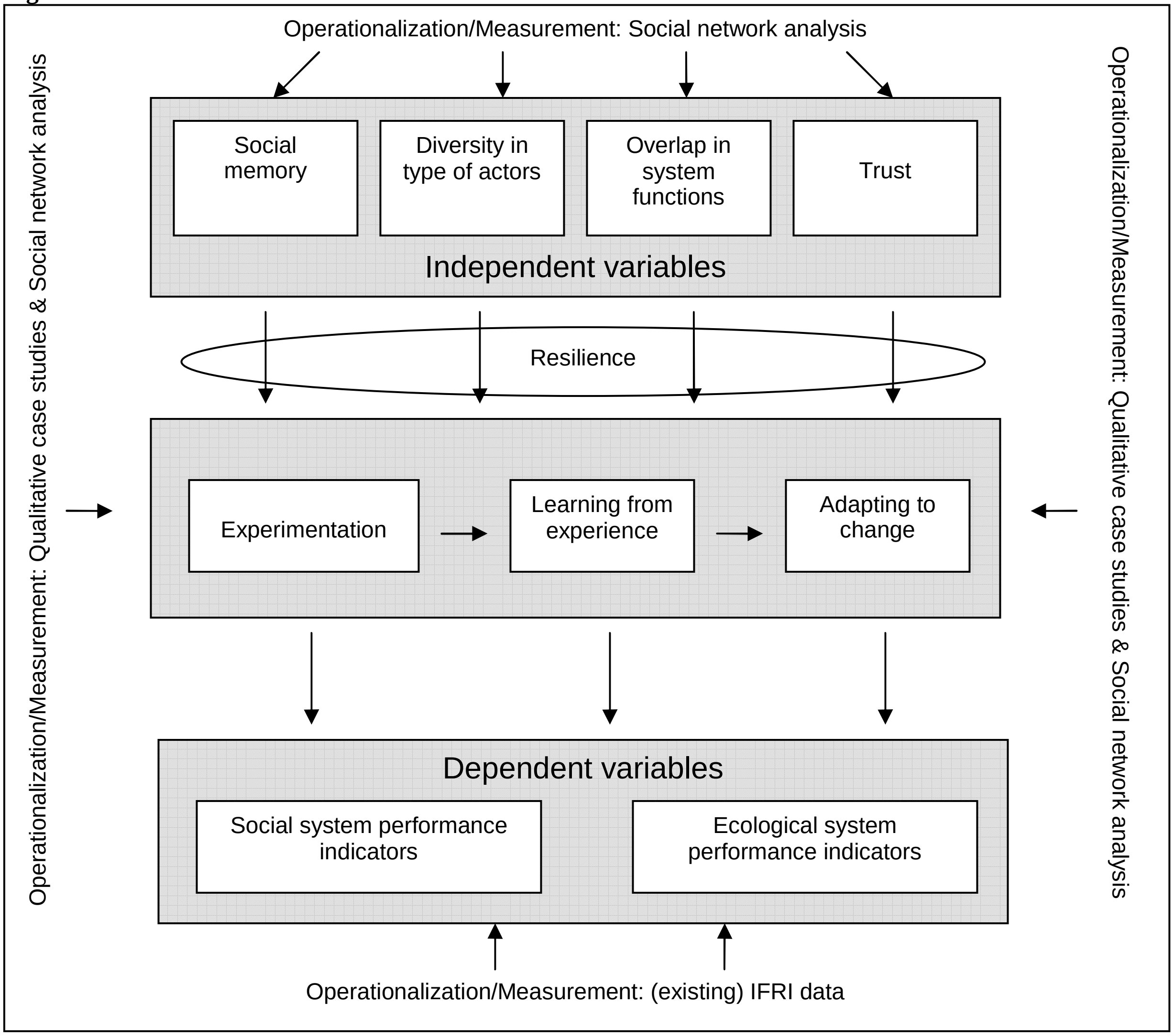
- *Diversity in types of actors*: The governance of CPRs requires *creativity*. Related to SES change and disturbance, problems will occur, the framing and solving of which has never before been an issue. Different types of actors within the social system will increase the innovative capacity of that system. It will provide different frameworks for interpretation, which will lead to a variety of scenarios with regard to the inferential logic underlying the problem. It will also diversify the portfolio of problem-solving strategies, and hence increase the likelihood of success (e.g. Folke et al. 2005; Ostrom 2005)

- *Social memory*: The governance of CPRs requires engaging in constant *social learning*. Lessons-learned from experimentation and past cases of problem-solving should somehow be "stored" within the social system in such a way that in future occasions they can be (widely) drawn and build upon in the face of recurring change and disturbance (e.g. McIntosh, Tainter, and McIntosh 2000)
- *Overlap in functions*: The governance of CPRs requires *robustness*: The removal of components (i.e. actors or functions) should not lead to overall system disintegration. Change and disturbance – for example, change in social or ecological systems due to climate change – can lead to the elimination of crucial system components, thus rendering the SES as a whole more vulnerable to collapse. Redundancy will provide a buffer in case of loss of actors or function (e.g. Janssen et al. 2006; Low et al. 2003);
- *Trust among actors*: The governance of CPRs requires many forms of *collective action.* The ability to overcome social dilemmas – the number one barrier to engagement in the kind of collective action that is necessary to sustain SESs – is intimately linked with trust (e.g. Ostrom and Walker 2003; Rothstein 2000, 2005)

3. Model & working hypotheses

Based on the insights and lessons provided by the literature described above, I propose testing the following causal model to study the ability of community-forest users to adapt their mode of governance to change and disturbance in a timely and adequate manner (figure 1):

Figure 1: Causal model



The working hypotheses that I seek to test in this research are the following:

- *Diversity in types of actors*: The more diverse the types of actors involved in the governance of a community forest, the more diverse the attempts at framing and understanding problems related to SES change and disturbance. Also, the more diverse the trial-an-error efforts at problem solving will be, thus the more likely it is that a social system will be able to respond to change and disturbance in a timely and adequate manner. Consequently, the more likely it is that a SES will endure;

- *Social memory*: The more effectively lessons-learned from past experiences "get stored" (i.e. are recalled by crucial actors and can be retrieved for future reference, and recycled or build upon when facing new but similar problems), the more likely it is that community-forest users will be able to make the changes in their governance system that are necessary to solve problems caused by changes in either the social or the ecological component of the integrated SES. Consequently, the more likely it is that a SES will endure;
- *Overlap in functions*: The more redundant social system functions with regard to the governance of the community forest, the more likely it is that change in either the social or the ecological system will not lead to SES collapse – i.e. the necessary adjustments can be made in response to for example climate change. Consequently, the more likely it is that a SES will endure;
- *Trust among actors*: The more trust exist between actors engaging in the governance of a community forest, the more likely it is that they will solve social dilemmas, and engage in the collective action it takes to re-craft a SES governance system, when it is confronted with disturbance. Consequently, the more likely it is that a SES will endure.

4. Operationalization: rendering the variables measurable

From the model (figure 1) it can be derived that my ultimate dependent variables are *social system performance* and *ecological system performance*. My intermediate variables are the identified as *engagement in experimentation*, *learning from experience*, and *adaption to change*. The latter variable, lays at the core of the argument developed in this essay - i.e. experimentation and learning from experience enhance the capacity of a social system to adapt its mode of governance, which in turn increases the likelihood of finding social and ecological systems with good or improving performance. The explanatory variables include *social memory, diversity in types of actors*, *overlap in system function*, and *trust*.

What indicators will be used to operationalize these variables? Variation in the dependent variables will be measured by using an existing data base containing biophysical and institutional data on community forestry systems all around the world (IFRI). Variation in the intermediate and explanatory variables will be measured using network analysis metrics that measure actors' roles (at the level of network vertices), relations and flows between actors (at the level of network ties), and characteristics of the network itself (at the network level).

a. Operationalizing the ultimate dependent variables

The dependent variables (related to SES performance indicators) will be operationalized by establishing an add-on to another ongoing data-collection effort– the *International Forestry Resources and Institutions* (IFRI) research program, initiated by Elinor Ostrom at Indiana University – now operating from the University of Michigan. IFRI started in 1993 as a global research network, with the purpose of producing long-term comparative research on forests and forest governance (CIPEC 2002). The IFRI database integrates biophysical with social-institutional data regarding variables that are assumed to affect the social-ecological dynamics of forests and communities in 15 countries in Africa, Asia, and America. Data is gathered by inter-disciplinary research teams that on average spent two to four weeks on each site, using a combination of qualitative research methods and forest inventories. Since data collection efforts are standardized, results can be compared (for analyses based on IFRI data, see for example Hayes 2004; Gibson, Williams, and Ostrom 2005; Laerhoven 2008). Existing IFRI data will serve as the foundation of the measurement of variation in the dependent variables of my conceptual model, notably variation on social and ecological system performance indicators. Social-system information recorded by IFRI include detailed (often longitudinal) data regarding socio-economic, cultural, institutional and organizational characteristics of all the different groups that in one way or another are involved with the forest in question. Ecological-system data from IFRI include quantitative foresters' assessments of a wide array of indicators related to forest conditions, plus a forest-user appreciation of the development of the forest (again, on a number of relevant criteria) during the five years leading up to the IFRI survey.

b. Operationalizing the intermediate and explanatory variables

I propose to measure both the intermediate variables – i.e. *engagement in experimentation, learning from experience,* and *adaption to change* – and the explanatory variables – i.e. *diversity in type of actors, social memory, overlap in system functions, and trust* – by means of social network analysis metrics, also. This approach is novel, but deemed promising by some pioneering scholars in the field of the study of the study of SESs (e.g. Bodin, Crona, and Ernstson 2006) and CPRs (Lubell et al. 2002; Schneider et al. 2003).

The social component of SESs can be perceived as one social network with distinct characteristics – for example related to size, configuration, and modularity (*network level*). The actors within such networks hold different roles and positions (*vertex level*). Information can flow between network nodes (and between networks) in varying ways (*tie level*). These traits can be measured and quantified. A variety of algorithms developed for social network analysis will be recorded and linked to the indicators related to the independent variables of my model, for example in the following way:

Examples of social network metrics to measure the intermediate variables

- *Engagement in experimentation*: The existence of many *cliques* in a network can be argued to lead to the emergence of various interpretation frameworks and platforms for experimentation and alternative forms of problem solving;
- *Learning from experience*: Strong ties between actors are argued to be needed to transfer tacit knowledge; Access to actors with relevant knowledge (*reachability*) may facilitate the dissemination of information; dense networks may lead to high levels of peer pressure and thus prohibit innovation.

- *Adapting to change*: Networks with high centrality may facilitate the emergence of leadership and centralized management, and facilitate rapid responses when needed.

Examples of social network metrics to measure the explanatory variables

- *Diversity in types of actors:* A number of measures related to the degree of separation between network actors, exist. For example, it can be argued that the number of "cliques" and in a network is an expression of network diversity.
- *Social memory*: The density of a network is argued to be an indicator for the likelihood that information (from experimentation or from past occasions of problem-solving) gets stored with many network actors. In networks with a high density information ("lessons-learned") can later – e.g. in times of change, disturbances or uncertainty – easily be drawn upon.
- *Overlap in functions:* Many links between network actors renders the loss of single actors less disruptive. Network fragmentation on the other hand, renders a network vulnerable should certain fragments disappear.
- *Trust among actors*: Dense networks can be argued to foster feelings of belonging, whereas separation between network actors can undermine trust.

Tables 1-3 provide an exhaustive list of network metrics, and an indication of how they are linked with the respective variables in this research.

Table 1: Measures to describe networks[5]

Measure	Definition	Link with variables						
		experiments	**learning**	**adapting**	**Social memory**	**diversity**	**overlap**	**trust**
Size	Number of actors in the network	+			+/-	+	+	-
Inclusiveness	Ration of connected actors to the total number of actors				+	-		+
Connectivity/ Reachability	Maximum or average path distance between any two actors in the network	-	+		+	-		+
Connectedness	Ratio of pairs of vertices that are mutually reachable to total number of pairs of vertices	-	+		+	-		+
Density	Ratio of the number of actual links to the number of possible links in a network		+		+	-	+	+
Centralization	Difference between the centrality scores of the most central actor and those of all other actors in a network			+	-	-		
Symmetry	Ratio of number of symmetric to asymmetric links in a network							+
Clique	Maximal complete sub-network containing three vertices or more	+				+		
Strongly connected network	A network is strongly connected if each pair of vertices is connected by a path		+	+	+			+
Weakly connected network	A network is weakly connected if each pair of vertices is connected by a semi-path		-	-	-			-

(Wasserman and Faust 1994; de Nooy, Mrvar, and Batagelj 2005; Measures & definitions based on Brass 1995; Monge and Contractor 2003)

[5] In tables 1, 2, and 3, pluses and minuses indicate what a high value on each one of the measures is expected to mean for the value of the variables.

Table 2: Measures to describe actor roles

Measure	Definition	Link with variables						
		experiments	**learning**	**adapting**	**Social memory**	**diversity**	**overlap**	**trust**
Degree	Number of direct links with other actors			+				
In-degree	Number of directional links to the actor from other actors			+				
Out-degree	Number of directional links from the actor to other actors			+				
Range/diversity	Number of links to different actors	+				+		
Closeness	Extent to which the actor is close to, or can easily reach all the others in the network							+
Betweenness	Extent to which an actor mediates, or falls between any two other actors on the shortest path between these actors						-	
Centrality	Extent to which the actor is central in the network			+				
Prestige	Based on asymmetric relationships, prestigious actors are the object rather than the source of relations			+				
Star	An actor who is highly central			+				
Liaison	An actor who has links to two or more groups that would otherwise not be linked, but is not a member of either groups						-	
Bridge	An actor who is a member of two or more groups						-	
Gatekeeper	An actor who mediates or controls the flow (i.e. is the single link) between one part of the network and another						-	
Isolate	An actor who has no, or relatively few links to other	+			-			-

Table 3: Measure to describe relations and flows

Measure	Definition	Link with variables						
		experiments	**learning**	**adapting**	**Social memory**	**diversity**	**overlap**	**trust**
Frequency	How many times, or how often the link occurs		+					+
Stability	Existence of the link over time		+		+			
Multiplexity	Extent to which two actors are linked by more than one relation						+	+
Symmetry (reciprocity)	Extent to which relationship (link) is bidirectional							+

In addition, a pinpointed (brief) case study will be conducted – using qualitative research methods, like focus group and key-respondent interviews – with the specific purpose to get a sense of variation in the extent of experimentation that forest users have engaged in (historically and currently), and the extent to which forest users have proven capable of learning from experience, and to adapt to change.

5. Research Design & sample selection

a Research design

Of course, as with any form of (social) science research it is my aim to cheat the laws of physics – particularly those related to "time" – and establish a counterfactual that would allow me to put a firm causal claim on the table. What would have happened, had the independent variables identified in the model, not interfered? A common way of circumventing the problem of not being able to go back in time and manipulate the extent to which explanatory variables interfere during the second time around, is through the comparison between control and treatment groups. In this research, comparisons will be made between community forestry systems that are largely similar (1) with regard to conditions that are identified as important for SES governance success (see sections 2a and 2b), and (2) with regard to the intensity, direction, and general characteristic of the change or disturbance that the systems are experiencing or have experienced in the (recent) past, but that differ significantly on the independent variables. Gerring (2001) holds that in order to deal the dilemmatic trade-off between *internal validity* (obtained via in-depth case studies) and *external validity* (obtained through large-N studies), research must evaluate qualitative data across a large number of observations. This research follows up on that advice.

b Sample selection

Since *random assignment* (i.e. designing true experiments) is impossible in this case, I will resort to *random selection* (i.e. designing a quasi-experiment): This research will focus on a sample selection of 50 forests (plus the various groups that use them in one way or another) in Mexico

(7), Guatemala (9), Honduras (7), and Bolivia (27), respectively. In these countries, biophysical and climatic circumstances do not vary too widely; forest policies leave a reasonable margin for local governance initiatives, and; the importance of community forestry is significant (see for example Andersson, Gibson, and Lehoucq 2006; Bray, Antinori, and Torres-Rojo 2006; Tucker 2004, 2004). Furthermore, it is expected that in these countries the characteristics of changes and disturbances – for example as related to climate change – will be more or less similar. Important also in selecting these particular cases, is the availability of high-quality data on social and ecological system performance indicators.

c Data collection

The IFRI data collection effort is strongly structured in terms of social networks. Individual forest users are assigned to sites, settlements, forest user groups, forest associations, and non-harvesting associations. Data collection necessary for the measurement of the identified social network metrics will follow the IFRI structure. Network data will be collected using standardized surveys that include questions referring to forest governance actors and their relations. This form of data collection will be complemented by qualitative data collection efforts needed to get a sense of (1) certain aspects regarding the intermediate variables, and (2) the characteristics of change and/or disturbances that have occurred.

d Data analysis

For methods to process the data, I refer to an emerging literature that uses network metrics for statistical analysis in a context of the governance of natural resources (Nyblom et al. 2003; Berardo and Scholtz 2006; Lubell 2004; Lubell et al. 2002; Schneider et al. 2003).

6. Literature

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Appendix 1 - Ostrom's design principles (1990), copied from Anderies et al. (2004):

1. *Clearly defined boundaries* - The boundaries of the resource system (e.g., irrigation system or fishery) and the individuals or households with rights to harvest resource units are clearly defined.

2. *Proportional equivalence between benefits and costs* - Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.

3. *Collective-choice arrangements* - Most individuals affected by harvesting and protection rules are included in the group who can modify these rules.

4. *Monitoring* - Monitors, who actively audit biophysical conditions and user behavior, are at least partially accountable to the users or are the users themselves.

5. *Graduated sanctions* - Users who violate rules-in-use are likely to receive graduated sanctions (depending on the seriousness and context of the offense) from other users, from officials accountable to these users, or from both.

6. *Conflict-resolution mechanisms* - Users and their officials have rapid access to low-cost, local arenas to resolve conflict among users or between users and officials.

7. *Minimal recognition of rights to organize* - The rights of users to devise their own institutions are not challenged by external governmental authorities, and users have long-term tenure rights to the resource.

8. *Nested enterprises* - Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.