Leadership and Social-ecological Outcomes in IFRI forests

Sanchayan Nath

Doctoral Scholar, Joint PhD in Public Policy,
The Vincent and Elinor Ostrom Workshop in Political Theory and Policy Analysis,
School of Public and Environmental Affairs (SPEA),
Department of Political Science,
Indiana University, Bloomington, USA.

Email: sancnath@indiana.edu

Abstract

Studies on the role of leadership in collective-action situations, social dilemma situations or in commons related scenarios have been limited. Ostrom's SES (social-ecological) framework however identifies leadership/entrepreneurship variables as being strongly associated with successful collective action outcomes (Ostrom 2009). Persha et al. (2011) observe that the "causal pathways" and the "complex relationship" between factors (that affect forest conditions) and the resulting social and ecological outcomes have not been systematically studied in empirical scholarly research. The research question that I seek to answer in this paper is – What is the effect of leadership on the trade-off between social and ecological outcomes in community managed forests? My study uses data collected by the IFRI (International Forestry Resources & Institutions) program between 1993 and 2008 from 108 forests across 13 countries.I find that "User-group leadership" is strongly associated causally with "Trade-off in Outcomes" irrespective of the contextual variables used.

Keywords: Forest, leadership, social ecological outcome, trade-off, IFRI

Introduction

The United Nations Environment Program (Achard 2009) estimates that approximately 30% of the total terrestrial surface on earth is covered by forests but that 13 million hectares of these forests are lost due to deforestation every year with far reaching consequences for two (rate of bio-diversity loss and climate change) of the nine interlinked planetary boundaries for which humanity has already overstepped the thresholds of their safe operating space (Rockstrom et al, 2009). The International Forestry Resources and Institutions (IFRI) research program has studied more than 240 forests across more than 15 countries, in the last two decades. This program views forests through the lens of a social-ecological system (SES)[1] with the aim of explaining why certain communities are able to use forest resources in a sustainable manner while some are not able to do so (Wertime et al. 2008). Ostrom (2009) presents a comprehensive framework to study outcomes in social-ecological systems. She identifies a list of variables which are associated with collective action outcomes - size of resource system, productivity of system, predictability of system dynamics, resource unit mobility, number of users, leadership, norms/social capital, knowledge of the SES, importance of resource to users and collective-choice rules. Outcomes can be measured using social performance measures, using ecological performance measures or by measuring externalities to other SESs. Persha et al. (2011) observe that the "causal pathways" and the "complex relationship" between factors (that affect forest conditions) and the resulting social and ecological outcomes have not been systematically studied in empirical scholarly research.

In this paper, I seek to explore the effect of leadership on the trade-off between social and ecological outcomes by using forestry data available from IFRI studies. I begin this paper by reviewing the existing literature based on forestry studies, in order to identify various factors associated with social-ecological outcomes. I review different techniques used by scholars to study these factors and also review the various methods used for conceptualizing these factors. I then elaborate on the hypotheses of my study, and define the various variables considered in the context of this paper. I outline the methods applied in this study, and then discuss the findings. I conclude this paper with a note on the weaknesses of this paper and the scope for further research.

Literature Review

Agrawal (2007) performs a detailed study of the writings of commons scholars on forest governance and identifies four groups of factors that affect forest conditions – "the

[1] While scholars are yet to agree on a common definition for social-ecological systems (SES), for the purposes of this paper, I use the definition proposed by Anderies et al. 2004 ~ "A SES is an ecological system intricately linked with and affected by one or more social systems. An ecological system can loosely be defined as an interdependent system of organisms or biological units. "Social" simply means "tending to form cooperative and interdependent relationships with others of ones kind" (Merriam- Webster Online Dictionary 2004). Broadly speaking, social systems can be thought of as interdependent systems of organisms. Thus, both social and ecological systems contain units that interact interdependently and each may contain interactive subsystems as well. We use the term "SES" to refer to the subset of social systems in which some of the interdependent relationships among humans are mediated through interactions with biophysical and non-human biological units."

characteristics of the resource system, the user group, the institutional arrangements, and the external environment." Various resource characteristics which influence forest outcomes include "size of the resource system, its boundaries, whether the resource is mobile, the extent to which resource units can be stored, rate and predictability of flow of benefits from the resource system, and ease of monitoring resource conditions." Various user characteristics which influence forest outcomes include "the size of the group, whether the boundaries of the group are clearly defined, the nature of heterogeneity among group members, extent of interdependence among them and their dependence on the resource, and whether the group possesses sufficient resources to meet the costs of initiating and maintaining collective action." Various institutional arrangements which influence forest outcomes include "(r)ules that are easy to understand and enforce, locally devised, take into account differences in types of violations, help deal with conflicts, and help hold users and officials accountable".

Various scholars have used statistical techniques to identify factors associated with forest outcomes. Gibson, et al. (2005) examine 178 forest user groups accessing 220 forests from across the world to conclude that "regardless of levels of social capital, formal organization, or forest dependence, regular monitoring and sanctioning are strongly associated with better forest conditions." Hayes (2006) draws upon data from 163 forests in 13 countries to demonstrate that there are "no statistically significant differences in forest conditions between legally protected forests and forests governed by users who establish and recognize forest rules." Ostrom and Nagendra (2006) study 42 forests across 5 countries, to conclude that "a higher percentage of community forests than government forests were characterized by" forest conditions that had improved or remained constant over time. Chhatre and Agarwal (2008) analyze data from 152 forests in 9 countries, to show that "higher levels of local enforcement have a strong and positive but complex relationship to the probability of forest regeneration…. even when the influence of a number of other factors such as user group size, subsistence, and commercial importance of forests, size of forest, and collective action for forest improvement activities is taken into account." Van Laerhoven (2010) examines data from 240 forests in 15 countries to demonstrate that "social capital, organization, leadership and autonomy contribute to" effective forest governance. Thus, the literature on empirical studies appears to suggest that the variables causally linked to successful forest outcomes are monitoring and sanctioning mechanisms, social capital, organization, leadership and autonomy. The other variables used in such studies include size of forests, commercial value of forests and user group size. The statistical tools used by scholars vary. Gibson et al. (2005) use chi-square tests of significance between the dependent (forest conditions) and the independent variables (levels of social capital, formal organization, forest dependence and regular monitoring and sanctioning). Hayes (2006) uses the Kolmogorov–Smirnov test to analyze her data. Ostrom and Nagendra (2006) use results from a one-way ANOVA to study the relationship between forest conditions and forest ownership type. Due to the dichotomous nature of the outcome variables (good/bad; high/low), scholars have been using logistic regression techniques to study forestry conditions in recent years (Chhatre and Agarwal 2008; Van Laerhoven 2010; Coleman 2011). There has also been considerable debate among scholars on the statistical tools to be used for such exercises. Gibson et al. (2005) contend that in these exercises, regression based models may suffer from specification error or selection bias. Similarly, Hayes (2006) observes that she did not use regression based models to avoid statistical challenges arising out of selection bias, omitted variable bias and endogeneity. However, Van Laerhoven (2010) argues that since in the social sciences, most studies are characterized by an absence of random samples, “methodologically, this is not commonly seen as a reason to abstain from more advanced forms of developing inferential claims”. Additionally he observes that the results of Gibson et al. (2005) and Hayes (2006) suffer from the disadvantage of not considering the effect of control variables on their dependent variables.

Persha et al. (2011) observe that the “causal pathways” and the “complex relationship” between factors (that affect forest conditions) and the resulting social and ecological outcomes have not been systematically studied in empirical scholarly research. They call for more “explicit quantitative analysis of this relationship” – especially with regard to the trade-off between social and ecological outcomes as previous work tends to focus analysis on these social and ecological outcomes in isolation from each other, rather than in tandem as a single outcome constructed across both social and ecological dimensions.” Based on a study of 84 IFRI cases from 6 countries, they study the effect of forest rule-making behaviour on the trade-offs between social and ecological forestry outcomes. Persha et al. (2011) use the measure “dependence on the forest for subsistence livelihoods” to conceptualize the “social benefits” derived from forests. They use “the percent of households that depend substantially on the forest for subsistence livelihoods as an indicator of livelihood contributions of the same forest”. Ecological outcomes in forests have been measured in three different ways by scholars - user group ranking of forest conditions (Gibson et al., 2005; Chhatre and Agarwal 2008; Van Laerhoven 2010), forester ranking of forest conditions (Gibson et al., 2005; Hayes, 2006; Chhatre and Agarwal 2008) or forest mensuration data (Ostrom and Nagendra 2006). Scholars are divided on whether ecological outcomes should be measures based on user rankings, forester rankings or forest mensuration data. Gibson et al. (2005) contend that because parameters for measuring outcomes may differ across ecological zones, therefore, cross sectional studies should not be based on forest mensuration data. Rather, the qualitative assessment of an expert, or the opinion of users in close regular contact with the forest, enables more accurate comparison across ecological zones. However, they also note that since the expert “may not have specific criteria from which to gauge differences between forests”, their opinion may be biased towards median values marked by a tendency to classifying a majority of forests as ‘‘about normal.’’ According to Nagendra and Ostrom (2011), foresters may find it difficult to successfully evaluate changes in forest density. They however observe that “evaluations of changes in tree density derived from forest plots are largely congruent with assessments made by forest users … and their evaluations can be used to provide reliable assessments of changes in tree density in the areas they access.” Van Laerhoven (2010) uses an aggregate measure, based on user group ranking of forest conditions, to measure ecological outcomes in forests. He observes that in IFRI studies, “groups of respondents living at the site and using the forests were asked whether (1) tree density, (2) the density of shrubs and bushes on the forest land, (3) the density of the ground cover on the forest land, and (4) the area over which vegetation exists, had changed during the 5 years prior to the site visit. The answer categories ranged from decreased (coded -1), remained the same (coded 0), to increased (coded 1). If the sum of the answer to these four questions was positive”, Van Laerhoven (2010) codes the variable as ‘‘1’’ symbolizing a “net improvement” in forest conditions. If the sum of the answers is negative, he codes the variable as “0”. In case, the sum of the answers is zero, he uses forester ranking of the corresponding forests to decide whether this variable should be coded as “0” or “1”. Van Laerhoven (2010) assigns a “1” to the variable, if the forester opinion is that the forest is in good condition; he assigns a zero, otherwise. Gibson et al. (2005) measure the social capital among members of an IFRI forest user-group "by combining a number of variables regarding the frequency of cooperative activities that user groups undertake in a forest. These activities are cooperative harvesting, cooperative processing, cooperative marketing or sales, and financial contracts. The frequency measures … in the protocol have the categories never, occasionally, seasonally, and year-round". The "occurrence of each of the cooperative activities for each user group" is added and then "dichotomized at the mean" to obtain "a measure of social capital". Hayes (2006) uses an independent variable called forest rules which is based on whether the IFRI forest user groups have defined rules for the usage of forest products.

Studies on the role of leadership in collective-action situations, social dilemma situations or in commons related scenarios have been limited to lab-based experimental scenarios (Rutte and Wilke 1984, De Cremer and Vugt 2002, Hogg and Knippenberg 2003, Dijk et al 2003, De Cremer 2006, Cox et al 2011). Non-experimental empirical studies may have been more limited. However, the findings from some of these empirical studies seem to suggest that leadership variables are strongly associated with outcomes in complex social-ecological situations. For instance, "Effective leadership and management" appears to be one of the most "frequently recurring themes" associated with successful outcomes in watershed partnerships (Leach & Pelkey 2001). Similarly, Gutierrez et al (2011) identifies "strong leadership" as contributing significantly to successful outcomes in co-managed fisheries. Ostrom's SES (social-ecological) framework too identifies leadership/entrepreneurship variables as being strongly associated with successful collective action outcomes (Ostrom 2009). Based on a synthesis of 69 case-studies from around the world, Pagdee et al (2006) identify the following variables as being influential to the success of community forestry - and effective local organizations with available financial and human resources, effective enforcement, well-defined property rights, effective institutional arrangements, and community interests and incentives. Laerhoven (2010) too appears to suggest that leadership does contribute to effective forest governance. Field work however does not necessarily validate these findings (Poteete, Janssen & Ostrom 2010).

Research Questions and Hypothesis

The research question that I seek to answer in this paper is – What is the effect of leadership on the trade-off between social and ecological outcomes in community managed forests? The condition of a well-managed forest should either remain the same or improve over time (ecological outcome). Similarly, users of a forest are dependent on the forest for the generation of livelihoods (social outcome). There is often a trade-off involved in maximizing these two outcomes – sometimes the ecological conditions of forests may improve over time, where-as the dependency of users on the forest for livelihood generation could witness a reduction. A different situation could arise, if livelihood dependency increases but the ecological condition witnesses a fall. I conceptualize these situations as trade-offs. Similarly, user-groups could differ from each other in terms whether a user-group has a leader or not. This paper seeks to explore whether the presence or the absence of a leader of user-groups is causally associated with the trade-offs between social and ecological outcomes. My hypothesis is that leadership is causally associated with the trade-offs between social and ecological outcomes *even* in the presence of other variables like social capital of the group, the group heterogeneity, the size of the resource system and the presence of rules for forest usage.

Methods and Measurement

The International Forestry Resources and Institutions (IFRI) research and training

program owes its origins to a seminar (funded by the Forests, Trees and People Program at the Food and Agriculture Organization) held at IUB in March 1992 (Wertime et al. 2008). In the last two decades, the program has studied more than 240 forests across more than 15 countries. Today, IFRI is a global research program based out of the University of Michigan at Ann Arbor and is supported by the Workshop in Political Theory and Policy Analysis (Workshop) and the Center for the Study of Institutions, Population, and Environmental Change (CIPEC) at IUB. The IFRI research program aims to explain why certain communities are able to use forest resources in a sustainable manner while some are not able to do so. The study of people-forest interactions in the program requires the collection of historical, socio-economic and demographic information about the communities and their settlements and bio-physical information about the forests. Teams of inter-disciplinary researchers spend two to four weeks at each site collecting data. Extensive interviews are carried out with all people who either interact with the forest or who are able to influence the usage of the forests. Sophisticated forestry techniques are used to collect the bio-physical data. The social and bio-physical information thus collected is stored in a database for analysis over a period of time. Studies by Gibson et al. (2005), Hayes (2006), Ostrom and Nagendra (2006), Chhatre and Agarwal (2008), Laerhoven (2010), Coleman (2011) and Persha et al. (2011) have all been based on the data collected through the IFRI program.

Before I proceed further, I would like to define several terms that we will come across repeatedly in this paper –

a) Forest - The IFRI program defines a forest as "an area of at least 0.5 hectares, containing woody vegetation (trees, bushes, shrubs, etc.) exploited by at least three separate households and governed overall by the same legal structure" (Wertime et al. 2008).

b) User group - The IFRI program defines a user group as "a group of people who harvest from, use, and/or maintain one or more forests and who share the same rights and duties to products from the forest(s), even though they may or may not be formally organized. What makes this definition distinct from one that includes a few random individuals collecting miscellaneous items from the forest is that the users know the shared duties and rights that they hold in common for harvesting from the forest" (Wertime et al. 2008).

c) Leader – The IFRI program defines the leader of a user group as an "individual in this group who investing time, energy, and perhaps money-in trying to work out coordinated strategies within the group concerning maintenance, investment in upgrading the forest(s), or harvesting forest products" (Wertime et al. 2008).

My dependent variable is named as "Trade-off in outcomes". It measures the trade-off involved in maximizing two outcomes – a social outcome and an ecological outcome. The condition of a well-managed forest should either remain the same or improve over time (ecological outcome). Similarly, users of a forest are dependent on the forest for the generation of livelihoods (social outcome). Sometimes the ecological conditions of forests may improve over time, where-as the dependency of users on the forest for livelihood generation could witness a reduction. A different situation could arise, if livelihood dependency increases but the ecological condition witnesses a fall. I conceptualize these situations as trade-offs.

My conceptualization of the ecological outcome variable, named as “Ecological Outcome” is adapted from Van Laerhoven (2010) who uses an aggregate measure, based on user group ranking of forest conditions, to measure ecological outcomes in forests. He observes that in IFRI studies, “groups of respondents living at the site and using the forests were asked whether (1) tree density, (2) the density of shrubs and bushes on the forest land, (3) the density of the ground cover on the forest land, and (4) the area over which vegetation exists, had changed during the 5 years prior to the site visit. The answer categories ranged from decreased (coded -1), remained the same (coded 0), to increased (coded 1). If the sum of the answer to these four questions was positive”, Van Laerhoven (2010) codes the variable as ‘‘1’’ symbolizing a “net improvement” in forest conditions. If the sum of the answers is negative, he codes the variable as “0”. In case, the sum of the answers is zero, he uses forester ranking of the corresponding forests to decide whether this variable should be coded as “0” or “1”. Van Laerhoven (2010) assigns a “1” to the variable, if the forester opinion is that the forest is in good condition; he assigns a zero, otherwise. Thus, “Ecological Outcome” can take two values 1 (if the forest condition is has improved or remained the same since the last IFRI visit) and 0 (otherwise).

My conceptualization of the social outcome variable, named as “Social Outcome” is adapted from Persha et al. (2011) who use the measure “dependence on the forest for subsistence livelihoods” to conceptualize the “social benefits” derived from forests. They use “the percent of households that depend substantially on the forest for subsistence livelihoods as an indicator of livelihood contributions of the same forest”. Thus the variable “Social Outcome” seeks to answer the question - is the percentage of households from user-groups (using this forest for subsistence) greater than the percentage of households from user-groups (using forests for subsistence) of all forests in this country. It takes a value of 1, if the corresponding percentage value for the forest is greater than the country-average, and 0 otherwise.

Thus the variable “Trade-off in outcomes”, can take four possible values depending on the values of the variables “Social Outcome” and “Ecological Outcome”.

Table 1 – Trade-off in outcomes

		Social Outcome	
		0	1
Ecological Outcome	0	00	01
	1	10	11

For the purpose, of this study, I consider only two particular cases out of the four possible values that the variable “Trade-off in outcomes” can take –

a) Case 1 – when “Ecological Outcome” is 1 and “Social Outcome” is 0 – representing an positive ecological conditions and negative social conditions

b) Case 0 – when “Ecological Outcome” is 0 and “Social Outcome” is 1– representing an negative ecological conditions and social social conditions

Thus, the variable “Trade-off in outcomes” for this study is dichotomous in nature.

This is the reason why the sample size of this study is 108 while the IFRI dataset contains data on more than 240 forests. I consider only those forests for which - a) Case 1 – the “Ecological Outcome” is 1 and the “Social Outcome” is 0 – representing an positive ecological conditions and negative social conditions; b) Case 0 – the “Ecological Outcome” is 0 and the “Social Outcome” is 1– representing an negative ecological conditions and social social conditions

I ignore those forests for which the “Ecological Outcome” is 1 and the “Social Outcome” is 1 or the “Ecological Outcome” is 0 and the “Social Outcome” is 0.

Table 2 – Sample Size

No. of Cases		Social Outcome	
		0	1
Ecological Outcome	0	45	57
	1	51	94

The various independent variables used in this study are –

a) UG_Leader - This variable tries to answer the question – “Is this forest associated with user groups which has an leader?” - This is a dichotomous variable – Value of 1 – if the user group has a formal leader; Value of 0 – otherwise

b) UG_Heterogeneity - This variable tries to answer the question – “Is this forest associated with atleast one user group, in which, given the local definition of wealth, there is a great difference in wealth amongst households in the user group?” This is a dichotomous variable – Value of 1 – if there is great difference in wealth; Value of 0 – otherwise

c) UG_Social Capital – This variable measures the social capital of the groups associated with the forest. The conceptualization for this variable has been adapted from Gibson et al. (2005) who measure the social capital among members of an IFRI forest user-group “by combining a number of variables regarding the frequency of cooperative activities that user groups undertake in a forest. These activities are cooperative harvesting, cooperative processing, cooperative marketing or sales, and financial contracts. The frequency measures … in the protocol have the categories never, occasionally, seasonally, and year-round”. The “occurrence of each of the cooperative activities for each user group” is added and then “dichotomized at the mean” to obtain “a measure of social capital”. This is a dichotomous variable – Value of 1 – if there is great difference in wealth; Value of 0 – otherwise

d) Forest_Product Rule – This variables seeks to answer the question – “Do accessing, harvesting, processing or selling rules exist for this forest, that affect the harvesting level or use of this product?” The conceptualization for this variable has been adapted from Hayes (2006) who uses an independent variable called forest rules which is based on whether the IFRI forest user groups have defined rules for the usage of forest products. This is a dichotomous variable – Value of 1 – if rules exist; Value of 0 – otherwise

e) Forest_Size - This variable tries to answer the question – “What is the size of the forest?” - as measured in hectares.

f) UG_Size – This variable tries to answer the question – “What is the total number of households from different user-groups associated with this forest?”

This is a cross sectional study which studies different forests at a single point in time. My study uses IFRI data collected between 1993 and 2008. The sample size is 108 forests across 13 countries. I use logistic regression to model the relationship between outcomes and the independent variables. The reason why I use this particular method is because my dependent variables are dichotomous in nature.

Results and Discussion

The dependent variable is not skewed in any particular direction (Table 3). Similarly, the independent variables too are not skewed in any particular direction (Table 4). There appears to be no significant correlation is observed between the independent variables.

Table 3 - Distribution of the dependent variable

Trade-off in outcomes	
0	57
1	51
Total	108

Table 4 - Distribution of the independent variables

	No. of Obs	Mean	Std. Dev.	Min	Max
UG_Leader	108	0.48	0.5	0	1
UG_Heterogeneity	108	0.65	0.47	0	1
UG_Social Capital	108	0.36	0.48	0	1
Forest_Product Rule	92	0.77	0.42	0	1
Forest_Size	108	10558.24	33633	2.7	224500
UG_Size	108	304.03	619.43	6	5116

The 2-by-2 figure (Table 5) represents the relationship between the dependent and primary independent variable. Since the important dependent variables and independent variables are dichotomous in nature, 2-by-2 figures provide the most illustrative explanations. The y-axes represent the dependent variables, and the x-axes represent the independent variables. This figure indicates that there is no skew in the distribution of values.

Table 5 - Relationship between Dependent and Independent Variables

No. of Forests		UG_Leader	
		0	1
Trade-off in outcomes	0	37	20
	1	19	32

Table 6 – Results after application of logistic regression techniques

	m1 b/se	m2 b/se	m3 b/se	m4 b/se	m5 b/se	m6 b/se
UG_Leader	1.304*	1.240*	0.962*	1.232*	1.348*	1.231*
	(0.54)	(0.53)	(0.47)	(0.52)	(0.51)	(0.50)
UG_Heterogeneity	-1.758**	-1.575**	-1.618**	-1.936***	-1.877***	
	(0.59)	(0.57)	(0.50)	(0.58)	(0.56)	
UG_Social Capital	1.707**	1.876**	1.375**	1.406**		1.856**
	(0.59)	(0.58)	(0.51)	(0.54)		(0.57)
Forest_Size	-0.000	-0.000	-0.000		-0.000	-0.000*
	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)
Forest_Product Rule	1.072	1.040		0.985	0.931	0.616
	(0.67)	(0.66)		(0.64)	(0.62)	(0.59)
UG_Size	0.001		0.001	0.001	0.001	0.000
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Constant	-1.030	-0.906	0.003	-1.040	-0.441	-1.623*
	(0.73)	(0.71)	(0.48)	(0.71)	(0.67)	(0.64)
chi2	38.611	37.278	38.188	31.629	29.256	28.873
AIC	102.232	101.565	123.198	107.214	109.587	109.970
BIC	119.884	116.695	139.291	122.345	124.718	125.100
N	92	92	92	92	92	92

I find that "UG_Leader" is strongly associated causally with "Trade-off in Outcomes" at $p < 0.05$ level of significance irrespective of the variables being controlled for. As predicted by theory, UG_Heterogeneity and UG_Social Capital too are statistically significant across models. I checked for specification errors in model m1 using the linktest function in Stata. The variable _hat was statistically significant (z=4.02) at $p > 0.001$. The variable _hatsq was not statistically significant at $p > 0.1$. The values of VIF and tolerance level is near 1 for all variables thus indicating that the effect of multicolinearity in the model is minimal.

Conclusion

This paper takes a step forward in developing an understanding of the relationship between leadership and outcomes in social-ecological systems. Specifically, it builds on the work of Persha et al. (2011) in studying the relationship between leadership and trade-offs in social-ecological outcomes.

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