

# Society & Natural Resources

## An International Journal

ISSN: 0894-1920 (Print) 1521-0723 (Online) Journal homepage: <http://www.tandfonline.com/loi/usnr20>


# Leadership and Trade-Offs Between Social-Ecological Outcomes in Community-Governed Forests

Sanchayan Nath

To cite this article: Sanchayan Nath (2018) Leadership and Trade-Offs Between Social-Ecological Outcomes in Community-Governed Forests, *Society & Natural Resources*, 31:7, 790-806, DOI: 10.1080/08941920.2018.1448131

To link to this article: <https://doi.org/10.1080/08941920.2018.1448131>



View supplementary material 



Published online: 26 Mar 2018.



Submit your article to this journal 



Article views: 63



View related articles 



View Crossmark data 



# Leadership and Trade-Offs Between Social–Ecological Outcomes in Community-Governed Forests

Sanchayan Nath<sup>a,b</sup> 

<sup>a</sup>School of Public and Environmental Affairs, Indiana University, Bloomington, IN, USA; <sup>b</sup>Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands

## ABSTRACT

I explore the effect of leadership on the trade-off between social and ecological outcomes of community driven efforts in governing forests globally. I do so by using logistic regression and QCA (qualitative comparative analysis) for the analysis of cross-sectional data from the International Forestry Resources and Institutions (IFRI) research program. While the net effect of leadership on the trade-off in forestry outcomes is significant, there are multiple causal paths via which various factors influence the trade-off in forestry outcomes. Some of these paths take place in the presence of leadership, while the presence or the absence of leadership is irrelevant for the rest of the paths. This finding indicates that leaders often play an important role in the decisionmaking process during the governance of forests, especially when hard decisions need to be taken.

## ARTICLE HISTORY

Received 4 June 2017

Accepted 27 February 2018



## KEYWORDS


Community governance; forest commons; IFRI; leadership; logistic regression; QCA; trade-off in social-ecological outcomes

## Introduction

Among the large number of factors (Leach and Pelkey 2001; Agrawal 2007; Pagdee, Kim, and Daugherty 2007; Ostrom 2009) which influence the condition of the earth's natural resource systems, leadership is often considered critical for the sustainable governance of such systems (Black, Groombridge, and Jones 2011; Gutierrez, Hilborn, and Defeo 2011; Sutton and Rudd 2014). However, the evidence on how leadership influences outcomes is often contradictory (Webler and Tuler 2006). While some scholars (Cheng and Sturtevant 2012; Gilmour, Dwyer, and Robert 2013) argue that leaders influence outcomes positively, others (Crona and Bodin 2010; Steenbergen 2016) argue that leaders often undermine well-functioning systems. A few scholars have argued that leadership affects different phases, of the governance process, in different ways—for instance, Bianco and Bates (1990) have demonstrated that “leadership is more significant for initiating cooperation than for sustaining it.” The effect of leadership on outcomes is also contingent on the state of other variables—for instance, Vedeld (2000) has argued that “the impact of leadership on collective action diminishes ... when extensive recourse to state authorities undermines a community's autonomy” (van Laerhoven 2010).

This article seeks to further elucidate the leadership–outcome conundrum in natural resource governance. Natural resource governance decisions are characterized by synergies (win–win/lose–lose) as well as trade-offs (win–lose/lose–win) among various outcomes. In

**CONTACT** Sanchayan Nath  [s.nath@uu.nl](mailto:s.nath@uu.nl)  School of Public and Environmental Affairs, Indiana University, 1315 E. Tenth Street, Bloomington, IN-47405, USA.

 Supplemental data for this article can be accessed on the [publisher's website](#).

© 2018 Taylor & Francis

contrast to synergies, which are often “untenable” in most natural resource governance situations, trade-offs in outcomes are generally the “norm” (Dahlberg and Burlando 2009). In addition, trade-offs in governance outcomes also affect “long-term sustainability of human well-being” (Rodríguez et al. 2006).

However, systematic analysis, of how leadership affects trade-offs in outcomes, is limited.

This article contributes to the debate outlined above, by exploring the effect of leadership on the trade-off between social and ecological outcomes of community-driven efforts in governing forests globally.

The research presented in this article assumes significance in view of the unabated destruction of forests globally. For instance, consider statistics from the United Nations Environment Program which reveal that approximately 13 million hectares of forests are lost due to deforestation every year (Achard 2009). This inability to conserve the world’s forests has far-reaching consequences for several planetary boundaries for which humanity has already overstepped the thresholds of their safe operating space (Steffen et al. 2015).

This article uses cross-sectional data from the International Forestry Resources and Institutions (IFRI) research program. The methodological tools used for the analysis of this data are logistic regression and qualitative comparative analysis (QCA).

This article is one among only a limited number of research efforts, which have applied statistical tools, to empirically test relationships considered theoretically important, in the natural resource governance literature. This article is also the first effort in using a mixed method design of logistic regression and QCA, to explore relationships in the case of forests studied under the aegis of the IFRI research program.

The next section reviews the literature on governance of natural resource systems, to identify a list of factors which influence governance outcomes. It also discusses the rationale behind the use of multiple methods, in this study. It then outlines the research question of this study and presents the hypothesis to be tested. Subsequent sections describe the empirical components of this study: the process used to conceptualize the dependent and independent variables; the methods used; and finally, the findings. The article concludes with a note on some of the limitations of this study and also outlines the scope for further research in this area.

## Literature Review

Agrawal (2007) has conducted a detailed review of the literature on community-governed resource systems. He identifies four groups of factors that affect outcomes in such systems—“the characteristics of the resource system, the user group, the institutional arrangements, and the external environment.” Resource characteristics which influence governance 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.” User characteristics which influence governance 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.”

Institutional arrangements which influence governance outcomes include “rules 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.”

While the list of factors, which affect outcomes, appears to be quite large, findings from some empirical studies suggest that leadership variables are strongly associated with outcomes in complex social–ecological situations. For instance, “effective leadership and management” is one of the most “frequently recurring themes” associated with successful outcomes in watershed partnerships (Leach and Pelkey 2001). Similarly, Gutierrez, Hilborn, and Defeo (2011) identify “strong leadership” as contributing significantly to successful outcomes in co-managed fisheries. The social-ecological system framework too identifies leadership/entrepreneurship variables as being associated with successful collective action outcomes (Ostrom 2009). Among studies on forestry governance, Pagdee et al. (2007) too conclude that leadership is influential for the success of community forestry. van Laerhoven (2010) also demonstrates that leadership does contribute to effective forest governance.

Many scholars have attempted to use statistical tools to empirically explore the factors (listed earlier) that influence forestry outcomes. Gibson, Williams, and Ostrom (2005) examine 178 forest user groups accessing 220 forests from across the world to conclude that forestry outcomes are associated with frequent monitoring and sanctioning activities, irrespective of the level of social capital, formal organization, or user group dependence in the concerned forests. Chhatre and Agrawal (2008) analyze data from 152 forests in nine countries, to show that the probability of forest regeneration increases in the presence of local enforcement, irrespective of the state of other factors, such as the size of the user group associated with the forest, the size of the forest, the importance (subsistence and/or commercial) of the forest for the concerned user group, or the nature of collective action directed at improving forestry conditions. van Laerhoven (2010) examines data from 240 forests in 15 countries to demonstrate that effective forest governance is associated with variables such as leadership, autonomy, and social capital. Thus, the literature appears to suggest that the variables causally linked to forest outcomes are leadership, monitoring and sanctioning mechanisms, social capital, organization, and autonomy. Other variables used in such studies include user group dependence on the forest, user group heterogeneity, size of forests, user group size, etc.

Statistical tools used by scholars, in such studies, vary. Gibson, Williams, and Ostrom (2005) use chi-square tests of significance between the dependent and the independent variables. Ostrom and Nagendra (2006) use results from a one-way ANOVA to study the relationship between forest conditions and forest ownership type. In recent years, several scholars have used logistic regression techniques to study forestry conditions (Chhatre and Agrawal 2008; van Laerhoven 2010; Coleman 2011). This is because outcome variables in IFRI studies are often dichotomous in nature (good/bad; high/low).

There has been considerable debate among scholars on the applicability of statistical tools for the analysis of data from the IFRI research program. Gibson, Williams, and Ostrom (2005) contend that regression-based models may suffer from specification error or selection bias. Similarly, Hayes (2006) observes that she did not use regression-based models in her article to avoid statistical challenges arising out of selection bias, omitted variable bias, and endogeneity. van Laerhoven (2010) however disagrees with both. He

points out that while Gibson, Williams, and Ostrom (2005) and Hayes (2006) may have avoided various errors, biases, and endogeneity in their studies, by refusing to use regression models, their studies actually suffer from the disadvantage of not considering the effects of control variables on their dependent variables. He also argues that in the social sciences, most studies are characterized by the absence of random samples. Therefore, “methodologically, this is not commonly seen as a reason to abstain from more advanced forms of developing inferential claims.” Arguing along similar lines, Persha, Agrawal, and Chhatre (2011) call for more “explicit quantitative analysis” of causal relationships in studies of forestry governance. They observe that “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.

Persha, Agrawal, and Chhatre (2011) also argue that more studies need to be conducted to develop an increased understanding of the trade-off between social and ecological outcomes. This is because earlier studies have generally studied outcomes in isolation—focusing either on social outcomes or on ecological outcomes, instead of trying to develop more complex multidimensional social–ecological outcome variables.

Ecological outcomes in forests have been measured in three different ways by scholars: user group ranking of forest conditions (Gibson, Williams, and Ostrom 2005; Chhatre and Agrawal 2008; van Laerhoven 2010), forester ranking of forest conditions (Gibson, Williams, and Ostrom 2005; Hayes, 2006; Chhatre and Agrawal 2008), or forest mensuration data (Ostrom and Nagendra 2006).

Scholars are however divided on which of these three methods provide the most accurate measure of ecological outcomes. Gibson, Williams, and Ostrom (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 expert opinion may be biased toward median values marked by a tendency to classify a majority of forests as “about normal.” On the other hand, Ostrom and Nagendra (2006) argue that foresters may find it difficult to successfully evaluate changes in forest density. According to them, “assessments” of forest conditions by forest users “are largely congruent” with actual forest conditions. In line with this argument, van Laerhoven (2010) uses an aggregate measure, based on user group ranking of forest conditions, to measure ecological outcomes in forests.

As explained earlier, while statistical techniques have often been used to study forestry data, the application of QCA to study the same data has been minimal. Keep in mind though, that the QCA technique has sometimes been used to study collective action scenarios (for instance, see Lam and Ostrom 2010). The QCA research approach was developed by Ragin (1987). It uses set theory and Boolean algebra to study multiple conjunctural causation. In other words, the QCA research approach is based on the idea that different combinations of the same set of conditions (independent variables) may result in the same outcome (dependent variable), depending on the context (Marx, Rihoux, and Ragin 2014). In recent years, the use of QCA research approach, to study social science phenomena, has found widespread acceptability. Marx, Rihoux, and Ragin (2014) document more than 300 applications of this approach between 1987 and 2011.

## Research Question and Hypothesis

This study is guided by the following overarching research question—consider community forestry (as characterized by the IFRI research program): what is the relationship between *leadership* and the *trade-off* in *outcomes*?

While *outcomes* can be of varied types, this study considers only two types: social and ecological. The *ecological* outcome of a forest depicts the change in forestry conditions over time, as characterized by the change in average basal area of a forest, over time. The *social* outcome of a forest is characterized by the change in subsistence livelihood generated by the forest, over time.

In some forests, the ecological condition of the forests may improve over time, whereas the use of the forest for livelihood generation may witness a reduction. A different situation can arise, if livelihood generation increases, but the ecological condition deteriorates. Some forests may be characterized by *positive ecological outcome* (increase in average basal area of forest over time) and *negative social outcome* (reduced livelihood generation). Some forests may be characterized by a *negative ecological* outcome (decrease in average basal area of forest over time) and a *positive social* outcome (increased livelihood generation). Such forests are said to be characterized by *trade-off* in outcomes.

Other forests may be characterized by *positive* ecological as well as *positive* social outcomes. The remaining forests may be characterized by *negative* ecological as well as *negative* social outcomes. Such forests *do not* demonstrate *trade-off* in outcomes.

In other words, some forests may be characterized by trade-offs in outcomes, while other forests may not demonstrate any such trade-off.

Community forestry is characterized by the presence of groups of people who use, abuse, and/or govern forests for their needs and/or for greater good. Such groups of people are called user groups. User groups can differ from each other in terms whether a user group has a *leader* or not.

The goal of this article is to understand whether forests characterized by trade-offs in outcomes are associated with the leadership of user groups using such forests (or vice-versa). Forests with trade-offs are compared to forests without trade-offs.

The following two hypotheses are tested:

Hypothesis 1:

The *presence* of user group *leadership* *increases* the probability of observing community-governed forests characterized by *trade-offs* in social–ecological outcomes. The *absence* of user group leadership increases the probability of observing community-governed forests which are *not* characterized by trade-offs in social–ecological outcomes. This relationship holds *even* in the presence of other variables like social capital, group heterogeneity, user group size, forest dependency, rules, and multilevel governance. (All these variables are conceptualized in a later section).

Hypothesis 2:

There are multiple causal paths through which various factors influence the trade-off in forestry outcomes. Some of these paths take place in the presence of leadership, while the rest of the paths occur in the absence of leadership.

Logistic regression is used to test the first hypothesis. QCA is used to test the second hypothesis.

Mixed method studies, combining the QCA approach with statistical techniques, are also becoming increasingly common<sup>1</sup>. Greckhamer, Misangyi, and Fiss (2013) observe that QCA “provides an alternative understanding of causality ... by making the leap from net-effects thinking to configurational thinking.” This is because the QCA approach with its emphasis on identifying multiple conjunctural causation is particularly useful for studying social science phenomena which are often characterized by “nonlinear relationships and equifinality.” In contrast, statistical regression techniques often “imply singular causation and linear relationships.” Thus, a mixed method study, which combines statistical techniques with the QCA approach, can be used to study the same data set “from different perspectives” by testing different kinds of hypotheses—for instance, to identify the independent net effects of causally relevant variables as well as to identify multiple, causally relevant paths to the same outcome (Vis 2012; Greckhamer, Misangyi, and Fiss 2013). Some have argued that regression analysis techniques can also be used to study multiple conjunctural causation by creating interaction terms of multiple variables. However, as Vis (2012) points out, the interpretation of interaction terms composed of more than two variables can be a challenging task. In other words, as Vis (2012) argues “*adding a configurational approach to a regression analysis helps to uncover patterns in the empirical data that otherwise would have remained hidden.*”

## Data, Measurement, and Methods

### Data

This is a cross-sectional study of forests monitored by the IFRI program. The IFRI research program originated in March 1992 (Wertime et al. 2007). Today, IFRI is a global research program based out of University of Michigan at Ann Arbor. The program aims to explain why certain communities have used forest resources in a sustainable manner, while others have not. The study of people–forest interactions in the program requires the collection of historical, socioeconomic, and demographic information about forestry communities. It also collects biophysical information about the associated forests. This information is stored in a database for analysis over a period of time. Studies by Gibson, Williams, and Ostrom (2005), Hayes (2006), Ostrom and Nagendra (2006), Chhatre and Agrawal (2008), van Laerhoven (2010), Coleman (2011), and Persha, Agrawal, and Chhatre (2011) have all been based on the data collected through the IFRI program.

The data set used for this study contains data collected between 1993 and 2013. This data set contains information on 240 forests from 15 countries: Bhutan, Bolivia, Brazil, Ethiopia, Guatemala, Honduras, India, Kenya, Madagascar, Mexico, Nepal, Tanzania, Thailand, Uganda, and the United States. Later versions of this data set (to which the author does not have access) may contain data on a larger number of forests.

### Common Terms

This section defines several terms that readers shall encounter repeatedly in the rest of the article:

- 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. 2007).
- 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. 2007).
  - 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).

**Conceptualization of Dependent Variable (Outcome)**

The dependent variable (outcome) is named as “TradeOff.” This variable is used to compare forests with trade-offs to forests without trade-offs. It characterizes trade-offs between the average basal area for each forest and the subsistence livelihoods generated from the forest. It is an aggregate measure composed of two other variables: an ecological outcome variable and a social outcome variable.

The ecological outcome of a forest characterizes the change in forestry conditions over time. The ecological outcome variable is named as “Ecological Outcome.” It describes whether the average basal area of each forest has changed over time.

The social outcome of a forest is the use of the forest for the generation of livelihoods. The social outcome variable is named as “Social Outcome.” It is adapted from the study of Persha, Agrawal, and Chhatre (2011). This variable measures the change in subsistence livelihood generated by the forest over time.

Forests are often characterized by trade-offs between these two kinds of outcomes—sometimes the ecological outcome of forests may improve over time, whereas livelihood generation from the forest (social outcome) may witness a reduction. A different situation may arise, if livelihood generation (social outcome) increases, but the ecological condition witnesses a fall.

Four combinations of “Ecological Outcome” and “Social Outcome” are possible, as illustrated in Table 1.

- A trade-off occurs in only two of these four possible combinations:
- a. when “Ecological Outcome” is 1 and “Social Outcome” is 0. This represents a positive ecological condition and a negative social condition.
  - b. when “Ecological Outcome” is 0 and “Social Outcome” is 1. This represents a negative ecological condition and a positive social condition.

**Table 1.** Combinations of ecological and social outcomes.

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



The remaining two combinations indicate the absence of a trade-off between outcomes. “TradeOff” compares forests with trade-offs to forests without trade-offs. It is dichotomous in nature, taking two values:

- a. a value of 1 which represents forests characterized by the *presence of trade-offs* between social and ecological outcomes
- b. a value of 0 which represents forests characterized by the *absence of trade-offs* between social and ecological outcomes

### Sample Size

While the data set contains information on 240 forests, only a limited number of forests have been visited more than once. This study analyses only those forests which contain data for atleast two time-points. This is because the outcome variable analyses changes in forestry conditions over time—which requires the analysis of data over two different time-points. In addition, only those forests are studied, which have user groups associated with them. Therefore, the sample size of this study is smaller: 79 forests across seven countries: Guatemala (4), India (7), Kenya (8), Nepal (24), Thailand (2), Uganda (27), and the United States (7). For 38 forests, the value of the dependent variable (outcome) is 1 (Table 2). There are 41 forests for which the value of the dependent variable (outcome) is 0.

### Conceptualization of Independent Variables (Conditions)

The various independent variables used in this study are as follows:

- a. Leader: This variable measures leadership of user groups. It tries to answer the question —“Is this forest associated with a user group which has a leader?” This is a dichotomous variable. It takes two values: a value of 1, if the forest is associated with a user group which has a leader; and, a value of 0, if the forest is associated with a user group which does not have a leader. The conceptualization of this variable is adapted from van Laerhoven (2010).
- b. Hetero: This variable measures user group heterogeneity. It tries to answer the question —“Is this forest associated with at least one user group, in which, given the local definition of wealth, there is great difference in wealth amongst households in the user group?” This is a dichotomous variable. It takes two values: a value of 1, if there is great difference in wealth; and, a value of 0, otherwise. The conceptualization of this variable is adapted from the study of van Laerhoven (2010).
- c. SocCap: This variable measures the social capital of user groups. The conceptualization of this variable has been adapted from the study of Gibson, Williams, and Ostrom (2005). This variable measures the “frequency of cooperative activities that user groups undertake in a forest.” Forest user groups typically undertake four different kinds of cooperative activities: harvesting, processing, marketing or sales, and contracting.

**Table 2.** Sample size and distribution of the dependent variable.

	Number of forests
When TradeOff = 1	38
When TradeOff = 0	41
Total no. of forests	79

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. It takes two values: a value of 1, if social capital of the user group is high; and, a value of 0, otherwise.

- d. **Dependency:** This variable measures the dependency of the user groups on the forests. The conceptualization of this variable has been adapted from the study of Gibson, Williams, and Ostrom (2005). The IFRI research program requires respondents to answer the question: “what percentage of the user group’s needs does this forest supply?” (Wertime et al. 2008). Respondents provide percentages of their needs in terms of firewood, biomass, timber, and food. The “summed percentages of user group needs ... for food, biomass, timber, and firewood” are then “dichotomized at mean” to obtain the values of this variable. The variable is thus dichotomous in nature. It takes two values: a value of 1, if dependency of the user group on the forest is high; and, a value of 0, otherwise.
- e. **Rules:** This variable tries to answer the question—“What is the level of enforcement of rules used to govern the forest?” It is a categorical variable which can take five different values ranging from 0 (low) to 4 (high), depending on the level of enforcement. The conceptualization for this variable has been adapted from the study of Chhatre and Agrawal (2008).
- f. **UserGrpSize:** This variable tries to answer the question—“What is the total number of households from different user groups associated with this forest?” This variable contains the natural log of actual user group size. This is a continuous variable. It takes values ranging from 0 to 7.47.
- g. **MultiGov:** This variable measures multilevel governance of the forest. It tries to answer the question—“Is any external organization involved in the governance of this forest?” (Wertime et al. 2008). This variable can take two values: a value of 0, if no external organization is associated with the forest; a value of 1, if more than one external organization is associated with the forest.
- h. **CountryId:** This variable is used to control for variation in the institutional characteristics of countries where forests are located. It can take seven different values representing different countries in which the forests are located.

Table 3 summarizes the distribution of the independent variables.

## Methods

The dependent variable “TradeOff” is binary and has been conceptualized as a dichotomous variable. Logistic regression is therefore used to test hypothesis 1. All the

**Table 3.** Distribution of independent variables.

Variable	No. of observations	Mean	Std. dev.	Min	Max
Leader	79	0.42	0.5	0	1
Hetero	79	0.46	0.5	0	1
SocCap	79	0.37	0.49	0	1
Dependency	79	0.34	0.48	0	1
Rules	67	2.70	1.70	0	4
UserGrpSize	79	4.29	2.00	0	7.47
MultiGov	79	0.72	0.45	0	1
CountryId	79	6	2.14	2	9

eight independent variables are used for the statistical study. The statistical software used is STATA.

Not only the dependent variable (outcome) is dichotomous in nature, but five out of the eight independent variables (conditions) are also binary and dichotomous in nature. Crisp-set QCA (vis-à-vis using fuzzy-set QCA) is therefore used to test hypothesis 2. The fsQCA software is used for conducting the QCA analysis.

## Results and Discussion

### Statistical Analysis

The dependent variable is not skewed in any particular direction (Table 2). Among the independent variables, Leader and Hetero are not skewed in any particular direction (Table 3). SocCap and Dependency are skewed slightly to the left, whereas Rules, UserGrp-Size, and MultiGov are skewed slightly to the right. Table 4 represents the relationship between the dependent variable (TradeOff) and the primary independent variable (Leader). Forests are fairly well distributed across all the four quadrants.

Hetero and SocCap are correlated with each other (Table 5). Similarly, Rules, UserGrpSize, and MultiGov are correlated with each other (Table 5). Therefore, different combinations of these variables are used in different models to test the association between Leader and TradeOff.

Logistic regression analysis has been conducted for six different groups of models, as outlined in Table 6.

Tables 1a, 1b, 2a, 2b, 3a, and 3b in the supplementary file outline the results of the logistic regression analysis for these six groups of models. Chi-square values are high for all the six groups of models. The linktest function in Stata was used to test for specification errors in these models. The results were robust and indicated the absence of specification errors. However, omitted variable bias cannot be ruled out. The value of variance inflation factor (VIF) is approximately equal to 1 for all independent variables in all the models thus indicating that the effect of multicollinearity in the models is minimal. Table 7 lists the odds ratios for these six groups of models.

*Leader* demonstrates high statistical significance across all models, irrespective of the variables being controlled. Leader is positively associated with TradeOff. The odds ratio for Leader varies between 3.61 and 4.79, depending on the variables being controlled. The rest of the independent variables are not statistically significant in any of the models. This is in line with hypothesis 1. The *presence* of user group *leadership increases* the probability of observing community-governed forests characterized by *trade-offs* in social-ecological outcomes. The *absence* of user group leadership increases the probability of observing community-governed forests which are *not* characterized by trade-offs in social-ecological outcomes. This relationship holds *even* in the presence of other variables like social capital, group heterogeneity, user group size, forest dependency, rules, and multilevel governance.

**Table 4.** Relationship between TradeOff and leader.

Number of forests TradeOff	Leader	
	0	1
0	29	12
1	17	21

**Table 5.** Correlation matrices.

	SocCap	Hetero	UserGrpSize	UserGrpSize	Rules	MultiGov
SocCap			Rules	0.6133		
Hetero	0.516		MultiGov	0.6204	0.478	

**Qualitative Comparative Analysis**

TradeOff is again taken as the outcome variable, for the QCA phase of the research. QCA is conducted for all the six models outlined earlier. Not only the dependent variable (outcome) is dichotomous in nature, but five out of the eight independent variables (conditions) are also binary and dichotomous in nature. Therefore, crisp-set QCA (vis-à-vis using fuzzy-set QCA) is used to test hypothesis 2. However, CountryId is not used for QCA because its role was primarily to control for institutional variation across countries during statistical analysis. Its inclusion in QCA is unnecessary, since the idea of control variables in QCA has not been theoretically explored yet. It is also difficult to dichotomize CountryId. The dichotomized version of UserGrpSize takes two values: 1 (if user group size for the forest is greater than the average user group size across forests and 0 (otherwise). The dichotomized version of Rules takes two values: 1 (if rule enforcement is high) and 0 (otherwise).

For the sake of simplicity, this section discusses the results of QCA only for model 1 (Table 8). The results of QCA analysis for all the other models are along similar lines.

First, this section tests for the presence of any necessary conditions. Based on a benchmark of 0.90 consistency level, none of the four conditions are found to be necessary for the outcome. Then, a truth table is created, to test for the presence of sufficiency conditions using the fsQCA software. A cutoff frequency of 2, and a raw consistency cutoff of 0.50 are used for generating the truth table. fsQCA generates three kinds of solutions: a complex solution, an intermediate solution, and a parsimonious solution. A conservative approach is taken and only the complex solution is reported in Table 9. The solution coverage of 0.76 indicates that about 76% of set membership in the outcome is explained by the final solution. The solution-consistency value as well as the consistency value for each of the five solution paths is greater than or equal to 0.50. This indicates good model specification. It also indicates that there is minimal deviation in subset relations, as compared to the empirical information.

There are five causal paths through which the conditions of Leader, SocCap, Dependency, and Rules are associated with the TradeOff in forestry outcomes. These five paths can be combined with a single solution term in the following manner:

**Table 6.** Models for logistic regression analysis.

	Dependent variable	Independent variables							
	TradeOff	Leader	SocCap	Hetero	Dependency	UserGrpSize	Rules	MultiGov	CountryId
Model 1a	Yes	Yes	Yes		Yes		Yes		Yes
Model 1b	Yes	Yes		Yes	Yes		Yes		Yes
Model 2a	Yes	Yes	Yes		Yes			Yes	Yes
Model 2b	Yes	Yes		Yes	Yes			Yes	Yes
Model 3a	Yes	Yes	Yes		Yes	Yes			Yes
Model 3b	Yes	Yes		Yes	Yes	Yes			Yes

**Table 7.** Odds ratios for the six models.

Model 1a			Model 1b		
	Odds ratio	$P > z$		Odds ratio	$P > z$
Leader	3.78	0.03	Leader	3.61	0.03
SocCap	0.61	0.42	Hetero	0.85	0.77
Dependency	0.79	0.69	Dependency	0.75	0.62
Rules	0.98	0.90	Rules	0.95	0.76
Countryld	1.12	0.46	Countryld	1.15	0.34
_cons	0.44	0.47	_cons	0.37	0.38

Model 2a			Model 2b		
	Odds ratio	$P > z$		Odds ratio	$P > z$
Leader	4.79	0.01	Leader	4.75	0.01
SocCap	0.91	0.88	Hetero	1.34	0.57
Dependency	1.13	0.83	Dependency	1.08	0.90
MultiGov	0.45	0.20	MultiGov	0.40	0.14
Countryld	1.18	0.21	Countryld	1.18	0.19
_cons	0.31	0.26	_cons	0.30	0.22

Model 3a			Model 3b		
	Odds ratio	$P > z$		Odds ratio	$P > z$
Leader	3.88	0.01	Leader	3.76	0.01
SocCap	0.77	0.65	Hetero	1.10	0.86
Dependency	0.93	0.89	Dependency	0.88	0.81
UserGrpSize	1.01	0.97	UserGrpSize	0.99	0.91
Countryld	1.17	0.24	Countryld	1.18	0.19
_cons	0.23	0.18	_cons	0.21	0.15

$$\text{Leader}^*(\sim \text{SocCap}^* \sim \text{Dependency} + \text{SocCap}^* \text{Dependency}) + \text{Leader}^* \text{Rules} \\ + \text{Rules}^*(\sim \text{SocCap}^* \sim \text{Dependency} + \text{SocCap}^* \text{Dependency}) \rightarrow \text{TradeOff}$$

This solution term consists of two different components:

Component a :  $\text{Leader}^*(\sim \text{SocCap}^* \sim \text{Dependency} + \text{SocCap}^* \text{Dependency} + \text{Rules})$

This component consists of Paths 1, 2, and 3. It represents all those forests for which *leadership* is associated with a trade-off in outcomes.

Component b :  $\text{Rules}^*(\sim \text{SocCap}^* \sim \text{Dependency} + \text{SocCap}^* \text{Dependency})$

This component consists of Paths 4 and 5. It represents all those forests for which the presence or the absence of *leadership* does not make any difference to forestry outcomes.

In other words, there are multiple causal paths through which various factors influence the trade-off in forestry outcomes. Some of these paths take place in the presence of leadership, while the presence or absence of leadership is irrelevant for the rest of the paths. This is in line with hypothesis 2.

**Table 8.** Models for QCA.

	Dependent variable	Independent variables							
	TradeOff	Leader	SocCap	Hetero	Dependency	UserGrpSize	Rules	MultiGov	Countryld
Model 1a	Yes	Yes	Yes		Yes		Yes		

**Table 9.** Results of the qualitative comparative analysis.

		Raw coverage	Unique coverage	Consistency
Path 1	Leader * Rules	0.39	0.15	0.62
Path 2	Leader * $\neg$ SocCap * $\neg$ Dependency	0.18	0.03	0.75
Path 3	Leader * SocCap * Dependency	0.15	0.06	0.63
Path 4	Rules * $\neg$ SocCap * $\neg$ Dependency	0.33	0.18	0.73
Path 5	Rules * SocCap * Dependency	0.18	0.09	0.50
Solution coverage: 0.76				
Solution consistency: 0.63				

**Discussion**

Statistical analysis of forestry data when combined with QCA generates some interesting cumulative findings. The net effect of leadership on the trade-off in forestry outcomes is significant and, is visible, irrespective of the kind of variables used as controls. This finding is in line with the findings of van Laerhoven (2010) who demonstrates that leadership influences governance outcomes, in community-governed forests. However, as revealed by the QCA, there are five different causal paths through which the association between leadership and the trade-off in forestry outcomes is significant. Each of these five paths represents five different groups of forests. For some of the forests, leadership is associated with a trade-off in forestry outcomes. However, for the rest of the forests, leadership does not affect forestry outcomes. This finding substantiates findings by Webler and Tuler (2006) who argue that the role of leadership varies with context.

Different scholars have come to different conclusions about how leadership influences outcomes. Andersson and Agrawal (2011) have argued that leadership is ineffective, unless it is incentivized by local institutional arrangements. Similarly, Vedeld (2000) has argued that interference by external authorities undermines the effect of leadership. However, as this article demonstrates, the presence or absence of community-defined rules or external decision-making authorities does not affect the statistical significance of the relationship between leadership and the trade-off in governance outcomes.

Leaders play different roles in natural resource governance. Leaders monitor and sanction their followers to ensure that the desired governance outcomes are achieved (Bianco and Bates 1990). They are also involved in dispute resolution within their communities (Vedeld 2000). Not only leaders are engaged in long-term, goal-setting exercises but they also get involved in day-to-day decision-making (Black, Groombridge, and Jones 2011; Stoll 2017). They encourage their community members to “pursue collective goals” but sometimes they have to take hard decisions about whether to prioritize socioeconomic outcomes over environmental outcomes (Pero and Smith 2008). In such cases, leaders often act as “energy centers” absorbing the costs of taking such decisions, adapting “social norms” which take forward such decisions, and then “applying constant pressure” on their communities to ensure that such decisions are implemented (Gilmour, Dwyer, and Robert 2013).

As this study demonstrates, while the net effect of leadership on the trade-off in forestry outcomes is significant, only in some of the causal paths leadership does influence the trade-off in governance outcomes. It is in such cases, that leaders, as discussed above, play the role of what Gilmour, Dwyer, and Robert (2013) refer to as energy centers.

Forests characterized by trade-offs represent the gray, messy areas of governance. Hard decisions need to be taken—should trees be felled to increase livelihood generation for the community? Or, consider a situation where forestry conditions have been declining and communities feel that any further short-term deterioration of the forest may influence the sustainability of the forest, on the long run. What should the community do in such cases, if their dependency on the forest (for livelihood generation) is very high?

It is during such times, that communities probably feel the need to delegate decision-making to their leaders. In other words, leaders are called into action, when hard decisions need to be taken—and, resolving trade-offs is probably among the most difficult decisions that communities need to make. In contrast, forests characterized by synergies in outcomes, i.e., forests characterized by good ecological and social outcomes are probably governed well by the associated communities, and therefore, leaders probably do not make much difference to the decision-making process in such community-governed forests. Similarly, leaders are probably unable to influence the governance of forests which are in bad condition (characterized by poor social, as well as, ecological outcomes)—they are probably not in a position to undo the damage that has been done before they arrived in the scene.

## Conclusion

As argued by Leach and Pelkey (2001), Pagdee et al. (2007), Ostrom (2009), van Laerhoven (2010), and Gutierrez, Hilborn, and Defeo (2011), this study too demonstrates that leadership plays an important role in natural resource governance. Drawing on ideas proposed by Persha, Agrawal, and Chhatre (2011), this article argues that leadership influences trade-offs in social–ecological outcomes and as argued by Sutton and Rudd (2014), this research too shows that contextual differences often influence the role played by leadership. While the net effect of leadership on the trade-off in forestry outcomes is significant, there are multiple causal paths through which the association between leadership and the trade-off in forestry outcomes is demonstrated. Forests characterized by trade-offs represent the gray, messy areas of governance. It is during such times, that communities probably feel the need to delegate decision-making to their leaders.

However, this study is limited to understanding leadership in forestry *user groups*, as conceptualized by the IFRI research program. The program also conceptualizes leadership in other forms—for instance, an interesting area for further research is the analysis of how leadership in forestry *associations* or leadership in forestry *governance organizations* (vis-a-vis *user groups*) is associated with outcomes. This study may also suffer from an omitted variable bias. Therefore, the identification of omitted variables which influence trade-offs in governance outcomes is an additional area for future research. Also note that the validity of this study is somewhat restricted by the limited number of data points currently available for analysis. Most of the forests (in the sample) are concentrated in two countries. While it may be difficult, due to global geopolitics, to create through fieldwork a more balanced data set (with an equal number of forests selected from each country), replication of this study, once a larger data set becomes available in a few years, will demonstrate whether the findings are more universally valid.



## Note

1. For a more detailed understanding of the debate between the relevance and applicability of statistical techniques vis-à-vis QCA refer the studies of Ragin (1987), Grofman and Schneider (2009), and Fiss et al. (2013).

## Acknowledgments

This article was conceptualized in the last few courses (Y673 and E622) co-taught by (the late) Dr. Elinor Ostrom, before she left us in 2012. This article is dedicated to her. I would also like to thank Dr. Ashwini Chhatre, Dr. Catherine Tucker, Dr. Forrest Fleischman, Dr. Harini Nagendra, Dr. Veena Sreenivasan, Venkat Nadella, and various anonymous reviewers for their comments on different versions of this paper.

## Funding

This work was supported by stipends from the Ostrom Workshop and SPEA, Indiana University, Bloomington, USA.

## ORCID

Sanchayan Nath  <http://orcid.org/0000-0002-9944-1249>

## References

- Achard, F. 2009. *Vital forest graphics: Stopping the downswing?* Arendal, Norway: UNEP/Earthprint.
- Agrawal, A. 2007. Forests, governance, and sustainability: Common property theory and its contributions. *International Journal of the Commons* 1 (1):111–136. doi:10.18352/ijc.10.
- Andersson, K., and A. Agrawal. 2011. Inequalities, institutions, and forest commons. *Global Environmental Change* 21 (3):866–75. doi:10.1016/j.gloenvcha.2011.03.004.
- Bianco, W. T., and R. H. Bates. 1990. Cooperation by design: Leadership, structure, and collective dilemmas. *American Political Science Review* 84 (1):133–47. doi:10.2307/1963633.
- Black, S. A., J. J. Groombridge, and C. G. Jones. 2011. Leadership and conservation effectiveness: Finding a better way to lead. *Conservation Letters* 4 (5):329–39. doi:10.1111/j.1755-263X.2011.00184.x.
- Cheng, A. S., and V. E. Sturtevant. 2012. A framework for assessing collaborative capacity in community-based public forest management. *Environmental Management* 49 (3):675–89. doi:10.1007/s00267-011-9801-6.
- Chhatre, A., and A. Agrawal. 2008. Forest commons and local enforcement. *Proceedings of the National Academy of Sciences of the United States of America* 105 (36):13286–91. doi:10.1073/pnas.0803399105.
- Coleman, E. A. 2011. Common property rights, adaptive capacity, and response to forest disturbance. *Global Environmental Change* 21 (3):855–65. doi:10.1016/j.gloenvcha.2011.03.012.
- Crona, B., and Ö. Bodin. 2010. Power asymmetries in small-scale fisheries: A barrier to governance transformability? *Ecology and Society* 15 (4):32. <http://www.ecologyandsociety.org/vol15/iss4/art32/>.
- Dahlberg, A., and C. Burlando. 2009. Addressing trade-offs: Experiences from conservation and development initiatives in the Mkuze Wetlands, South Africa. *Ecology and Society* 14 (2):37. <http://www.ecologyandsociety.org/vol14/iss2/art37/>.
- Fiss, P. C., D. Sharapov, and L. Cronqvist. 2013. Opposites attract? Opportunities and challenges for integrating large-N QCA and econometric analysis. *Political Research Quarterly* 66 (1):191–98.
- Gibson, C. C., J. T. Williams, and E. Ostrom. 2005. Local enforcement and better forests. *World Development* 33 (2):273–84. doi:10.1016/j.worlddev.2004.07.013.

- Gilmour, P. W., P. D. Dwyer, and D. W. Robert. 2013. Enhancing the agency of fishers: A conceptual model of self-management in Australian abalone fisheries. *Marine Policy* 37:165–75. doi:[10.1016/j.marpol.2012.04.015](https://doi.org/10.1016/j.marpol.2012.04.015).
- Greckhamer, T., V. F. Misangyi, and P. C. Fiss. 2013. The two QCAs: From a small-N to a large-N set theoretic approach. In *Configurational theory and methods in organizational research*, ed. P. C. Fiss, B. Cambré, and A. Marx, vol. 38, 49–75. Bingley, United Kingdom: Emerald Group Publishing Limited.
- Grofman, B., and C. Q. Schneider. 2009. An introduction to crisp set QCA, with a comparison to binary logistic regression. *Political Research Quarterly* 62 (4):662–72. doi:[10.1177/1065912909338464](https://doi.org/10.1177/1065912909338464).
- Gutierrez, N. L., R. Hilborn, and O. Defeo. 2011. Leadership, social capital and incentives promote successful fisheries. *Nature* 470 (7334):386–89. doi:[10.1038/nature09689](https://doi.org/10.1038/nature09689).
- Hayes, T. M. 2006. Parks, people, and forest protection: An institutional assessment of the effectiveness of protected areas. *World Development* 34 (12):2064–75. doi:[10.1016/j.worlddev.2006.03.002](https://doi.org/10.1016/j.worlddev.2006.03.002).
- Lam, W. F., and E. Ostrom. 2010. Analyzing the dynamic complexity of development interventions: Lessons from an irrigation experiment in Nepal. *Policy Sciences* 43 (1):1–25. doi:[10.1007/s11077-009-9082-6](https://doi.org/10.1007/s11077-009-9082-6).
- Leach, W. D., and N. W. Pelkey. 2001. Making watershed partnerships work: A review of the empirical literature. *Journal of Water Resources Planning and Management*. 127 (6):378–85. doi:[10.1061/\(ASCE\)0733-9496\(2001\)127:6\(378\)](https://doi.org/10.1061/(ASCE)0733-9496(2001)127:6(378)).
- Marx, A., B. Rihoux, and C. Ragin. 2014. The origins, development, and application of qualitative comparative analysis: The first 25 years. *European Political Science Review*. 6 (1):115–42. doi:[10.1017/S1755773912000318](https://doi.org/10.1017/S1755773912000318).
- Ostrom, E. 2009. A general framework for analyzing sustainability of social-ecological systems. *Science (New York, N. Y.)* 325 (5939):419–22. doi:[10.1126/science.1172133](https://doi.org/10.1126/science.1172133).
- Ostrom, E., and H. Nagendra. 2006. Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory. *Proceedings of the National Academy of Sciences of the United States of America* 103 (51):19224–31. doi:[10.1073/pnas.0607962103](https://doi.org/10.1073/pnas.0607962103).
- Pagdee, A., Y.-S. Kim, and P. J. Daugherty. 2007. What makes community forest management successful: A meta-study from community forests throughout the world. *Society & Natural Resources* 19 (1):33–52. doi:[10.1080/08941920500323260](https://doi.org/10.1080/08941920500323260).
- Pero, L. V., and T. F. Smith. 2008. Institutional credibility and leadership: Critical challenges for community-based natural resource governance in rural and remote Australia. *Regional Environmental Change* 8 (1):15–29. doi:[10.1007/s10113-007-0042-4](https://doi.org/10.1007/s10113-007-0042-4).
- Persha, L., A. Agrawal, and A. Chhatre. 2011. Social and ecological synergy: Local rulemaking, forest livelihoods, and biodiversity conservation. *Science (New York, N. Y.)* 331 (6024):1606–8. doi:[10.1126/science.1199343](https://doi.org/10.1126/science.1199343).
- Ragin, C. C. 2014. *The comparative method: Moving beyond qualitative and quantitative strategies*. 1st ed. Oakland, CA, USA: University of California Press.
- Ragin, Charles C. *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*. University of California Press, Oakland, CA, USA. 1987. <http://www.jstor.org/stable/10.1525/j.ctt1pnx57>
- Rodríguez, J., T. D. Beard Jr, E. Bennett, G. Cumming, S. Cork, J. Agard, A. Dobson, and G. Peterson. 2006. Trade-offs across space, time, and ecosystem services. *Ecology and Society* 11 (1): 28. <http://www.ecologyandsociety.org/vol11/iss1/art28/>.
- Steenbergen, D. J. 2016. Strategic customary village leadership in the context of marine conservation and development in Southeast Maluku, Indonesia. *Human Ecology* 44 (3):311–27. doi:[10.1007/s10745-016-9829-6](https://doi.org/10.1007/s10745-016-9829-6).
- Steffen, W., K. Richardson, J. Rockström, S. E. Cornell, I. Fetzer, E. M. Bennett, R. Biggs, S. R. Carpenter, W. De Vries, C. A. de Wit, and C. Folke. 2015. Sustainability. Planetary boundaries: Guiding human development on a changing planet. *Science (New York, N. Y.)* 347 (6223):1259855. doi:[10.1126/science.1259855](https://doi.org/10.1126/science.1259855).
- Stoll, J. S. 2017. Fishing for leadership: The role diversification plays in facilitating change agents. *Journal of Environmental Management* 199:74–82. doi:[10.1016/j.jenvman.2017.05.011](https://doi.org/10.1016/j.jenvman.2017.05.011).

- Sutton, A. M., and M. A. Rudd. 2014. Deciphering contextual influences on local leadership in community-based fisheries management. *Marine Policy* 50:261–69. doi:[10.1016/j.marpol.2014.07.014](https://doi.org/10.1016/j.marpol.2014.07.014).
- van Laerhoven, F. 2010. Governing community forests and the challenge of solving two-level collective action dilemmas—A large-N perspective. *Global Environmental Change* 20 (3):539–46. doi:[10.1016/j.gloenvcha.2010.04.005](https://doi.org/10.1016/j.gloenvcha.2010.04.005).
- Vedeld, T. 2000. Village politics: Heterogeneity, leadership and collective action. *Journal of Development Studies* 36 (5):105–34. doi:[10.1080/00220380008422648](https://doi.org/10.1080/00220380008422648).
- Vis, B. 2012. The comparative advantages of fsQCA and regression analysis for moderately large-N analyses. *Sociological Methods & Research* 41 (1):168–98. doi:[10.1177/0049124112442142](https://doi.org/10.1177/0049124112442142).
- Webler, T., and S. Tuler. 2006. Four perspectives on public participation process in environmental assessment and decision making: Combined results from 10 case studies. *Policy Studies Journal* 34 (4):699–722. doi:[10.1111/j.1541-0072.2006.00198.x](https://doi.org/10.1111/j.1541-0072.2006.00198.x).
- Wertime, M., E. Ostrom, C. Gibson, and F. Lehoucq. 2007. *International forestry resources and institutions (IFRI) research program: Field manual. Version 13*. Bloomington: Indiana University, Center for the Study of Institutions, Population, and Environmental Change (CIPEC).