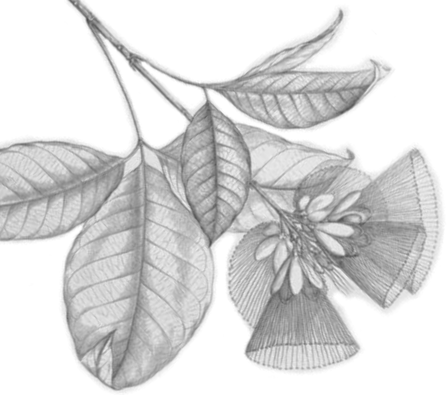

Social-Ecological System constraints of Protected Areas. A case study of Mexican protected forests

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ABSTRACT

Protected Areas are worldwide accepted as conservation policy instrument. However, effectiveness of this instrument for sustainability management of protected resources is still problematic. It is in this context this paper investigates Social-Ecological System constraints which lead to unsuccessful situations in protected forests in Mexico. To achieve this objective, a methodology of E. Ostrom SES framework to carry out meta-analysis of case studies of Mexican forests is used. The results show that constraints are imbedded into attributes of governance of these resources by local communities through a set of variables whose patterns of interactions lead to successful or unsuccessful situations. These variables are variables characterizing governance system and variables characterizing actors' system. The interactions of these variables lead to successful situations in case studies in which local community members highly participate in governance system.

Keywords: Conservation Policy; Sustainable Management; Protected Areas; Resource Systems.

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Protected Areas (PAs) are worldwide accepted as main instrument for conservation policy (Brooks et al. 2004; Jepson et al. 2017; Adamsen 2000). However, besides of this considerable importance of this instrument, PAs as Social-Ecological Systems present constraints to achieve sustainable[4] management of protected resources (Laurance et al. 2012). Thus, this paper presents Social-Ecological constraints of PAs as conservation policy instrument that must be considered for sustainable management achievement. This helps to determine importance of PAs to Social-Ecological benefits which is still lacking in literature (Coetzee 2017).

The view of PAs in terms of Social-Ecological Systems implies community members participation in governance of protected resources. This calls attention to E. Ostrom theory of governance of Social-Ecological Systems which is considered as the best theory ever developed in this context (Cumming 2014). According to E. Ostrom, negative effect of these factors to successful management of Social-Ecological Systems is caused by lack of understanding of functionality of their interactive processes (Ostrom 2009). Misunderstanding of functionality of Social-Ecological Systems is due to their complex system. To understand their complexity, the use of a framework is required (Van den Bergh et al. 1997; Adamsen 2000). The use of a framework provides an empirical method to understand social-ecological systems for achieving the conservation objectives (Andam et al. 2008; Anderies et al. 2004). Thus, to achieve the objective of identifying the constraints that lead to unsuccessful situations across PAs E. Ostrom SES framework method is used. It helps to carry out a meta-analysis of 32 case studies of Mexican protected forests by which an analytical comparison of two successful cases studies and two unsuccessful cases studies is done. This paper responds the research question of; what variables whose poor performance presents Social-Ecological System constraints for successful situations in protected forests. The protected forests of Mexico are considered as the best example to study impact of conservation policy, because of high support of the federal government policy (Gallina 2012) which shows a shift from a nonimpact of paper parks of 1990s to the recent positive impact (Pfaff et al. 2017).

CONSERVATION BARRIERS TO SUSTAINABLE MANAGEMENT OF PROTECTED AREAS (PAS)

Protected Areas are oldest instrument of conservation policy (Moldovan 2014), and nowadays their importance for biodiversity conservation is widely recognized (Watson et al. 2016; Brooks et al. 2004). This recognition is not only due to its oldest character as conservation instrument but also its

[4] The conservation of natural resources does not necessarily mean sustainable development (Hoag & Skold 1996). Sustainable programs are cost-effective and make use of local materials and skills whereas conservation programs are not economically restricted. Thus, sustainable management is designed to meet Social-Ecological needs at the same time ensuring conservation.

capability for; conservation of biodiversity and ecosystem services (Rodrıguez-Jorquera et al. 2017), conservation of natural values and reduce biodiversity loss (Jepson et al. 2017), reduction of deforestation (Andam et al. 2008), enhancing tourism (Reinius & Fredman 2007), and very often enhancing cultural values (Gallina 2012). In Mexico, the importance of PAs for deforestation reduction is also observed. The non-mixed-use PAs are more performer in reducing the deforestation than mixed-use PAs (Pfaff et al. 2017), this depends on the control and enforcement measures that have been increasingly implemented and marked a renew in recent conservation policy in Mexico. A typical example is Sierra la Laguna Biosphere Reserve, Baja California Sur by which conservation helped to increase scientific knowledge, intensify taxonomic and ecological work, promotion of conservation of species and ecosystems, restoration of soil, reforestation and invasive species control (Cámara et al. 2014).

However, even if importance of PAs for conservation is globally acknowledged, the means in which this instrument contributes to Social-Ecological benefits are still unclear[5] (Coetzee 2017). Normally, PAs conservation policy consists of a protection de facto by being inaccessible which is sometimes lawfully difficult (Joppa et al. 2008). This generates constraints in governance system and system of participants which impedes to meet Social-Ecological benefits. The PAs are expected to work as conservation policy instrument but also to meet social and economic objectives (Watson et al. 2014). This raises a very crucial important topic of cost-effectiveness that was missed in global contextual oriented (Weaver & Lawton 2017). Thus, to have effective protected areas, the establishment of this instrument must be directed by local ecological benefits (Joppa et al. 2008), and the local communities have to benefit from protected areas in order to willingly contribute to the successful of the conservation policy. According to Porter-Bolland et al. (2012), community managed forests are less deforested than protected areas. This means that in some cases, adoption of community management approach of PAs can provide more effectiveness and success. However, when the local communities or individuals do not understand the conservation processes, they tend to deforest the protected areas (Curran et al. 2004). Thus, community management participation in PAs governance is necessary, and the processes in which effective outcomes from the conservation policy must be easily understandable.

To better understand the reason why the instrument of protected areas succeeds in some cases and not in others, it is necessary to understand the implications of the conservation policy to achieve sustainability of protected resources, in face of the heterogeneity of the communities, local government and federal government objectives. For example, the touristic incentives are very common but when it

[5] Goals enhanced by PAs have been global oriented goals than local ones

does not benefit the local communities, the latter tend to not support the conservation policy (Reinius & Fredman 2007). It is further mentioned that protected areas do not favor or benefits local needs like ecological systems (Coetzee 2017), hence like community managed areas, the conservation poly by protected areas have to take into account the social and economic incentives of local inhabitants, as well as their property rights and local capacities (Porter-Bolland et al. 2012).

Forest conservation in Mexico

In Mexico, as in most countries in the world, several approaches focusing on the conservation and economic benefits of the forests have been implemented. According to Mendez-Lopez et al. (2014), these approaches are; a) the establishment of Protected Areas (PA), a scheme that has been strongly promoted by international conservation groups and enthusiastically adopted by the government b) the promotion of payment-based conservation, represented mainly by the federal program of Payment for Environmental Services (PES); and c) the development of community-based conservation initiatives, mainly implemented by indigenous or peasant communities and which are in some case officially recognized as the so-called Indigenous and Community Conserved Areas (ICCA) (Mendez-Lopez et al. 2014). These approaches are not different from what are proposed by E. Ostrom by which, the forests can be interchangeable governed either by the state, the market or the communities (Ostrom 1990). This work is concerned with the third approach which deals with the conservation by the community-based model in the concept of E. Ostrom.

Methodology

The methodology of this research consists of: (i) utilization of Social-Ecological System Meta-Analysis Database method[6] (SESMAD 2014), as analytical model of diagnosis across the case studies of protected community forests of Mexico, to be able to carry out the identification, codification and analysis of variable results and interpretation of the results. The use of the SESMAD method is in line with the scientific progress of the SES framework, (ii) use of data got from the meta-analysis of case studies of Mexican protected forests to analytically compare two successful cases studies and two unsuccessful cases studies.

The meta-analysis of the case studies was done by using the meta-analysis techniques (statistical analysis, Analytic Hierarchy Process, and Comprehensive Meta-Analysis software) for data analysis, identification of patterns of interactions and their effect on the outcomes across the Mexican

[6] Social-Ecological System Meta-Analysis Database is a database of the variables characterizing the functionality of the common resources which affect and are affected by large social-ecological factors. It has been developed by the young researchers of the Indiana University (Cox 2014).

protected community forests. The analysis and interpretation of data were done through the relational database and the use of statistical parameters within the context of the conservation based on protected areas.

SESMAD method was used as to select the variables to be used in case-based meta-analysis. This was done by using an Analytic Hierarchy Process (AHP) method. The only criterion for this technique is that based on theoretical importance of the variable on how far each variable impact the achievement of the eight principles of the successful governance of the commons. The basis on the 8 principles for the selection of more important variables to be used in the meta-analysis results to detail reflections of the design principles of the 172 SES variables. To base on eight design principles provides a synthetic loop of the performance of each of 172 variables to successful governance of the community forests. The objective of this selection is to choose the variables whose presumed performance is highly ranked. Because not all 172 variables have impact on the successful or unsuccessful conditions of the community forests (SESMAD 2014). The variables selected for this research are 60 variables out of 172 variables included in the SESMAD, and they are classified as: variable type, variable component type, variable kind, and theme concerned by each variable. This classification detailed given in Table 1. In summary, the variable description shows how a set of the variables used in this research are distributed into four components of the SES framework. The variables are distributed in their respective component i.e. Actors, Governance System or Natural Resource System, and more some of them make part of interactions and outcomes. This can be seen in the Table 2. This permitted to collect, codify, and present the data.

Table 1. Variable classification.

Variable data type		Variable component		Variable attachment		Theme	
Binary	8	Environmental Common, Natural Resource System, and Natural Resource Units	10	Case Component	18	Outcomes	10
Categorical	14	Governance System	12	Component Interaction	42	Institutions	16
Interval	2	Actors	38			Incentives	9
Ordinal	34					Social Capital	5
Text	2					Basic	3
						Biophysical	1
						Context	2
						Spatial	2
						Enforcement	7
						External	1
						Heterogeneity	1
						Leadership	3

Source: Proper design according to SESMAD (2014).

Table 2. Variable components in the form of E. Ostrom SES framework.

SOCIAL, ECONOMIC, AND POLITICAL SETTINGS (S)		
Natural Resource System (RS)		
Variables	**Attachment**	**Theme**
Biodiversity trend	Interaction	Outcomes
Commons condition trend	Interaction	Outcomes
Provision services condition	Interaction	Outcomes
Regulating services condition	Interaction	Outcomes
Interactions (I)		
Variables	**Attachment**	**Theme**
Actor adaptive capacity	Actor	Outcomes
Actor group boundary clarity	Actor	Institutions
Actor group boundary fuzziness	Actor	Institutions
Biodiversity trend	Natural Resource System	Outcomes
Collective action	Actor	Outcomes
Commons boundary negotiability	Actor	Institutions
Commons condition trend	Environmental Common	Outcomes
Commons feedback visibility fix	Actor	Incentives
Commons feedback visibility use	Actor	Incentives
Commons political power	Actor	Context
Governance strictness trend	Governance System	Institutions
Governance system effect	Governance System	Outcomes
Inter-group trust	Governance System	Social Capital
Provision services condition	Natural Resource Unit, Natural Resource System	Outcomes
Regulating services condition	Natural Resource Unit, Natural Resource System	Outcomes
User group well-being change	Actor	Outcomes
Governance System (GS)		
Variables	**Attachment**	**Theme**
Governance strictness trend	Interaction	Institutions
Governance system effect	Interaction	Outcomes
Inter-group trust	Interaction	Social Capital
Users (U)		
Variables	**Attachment**	**Theme**
Actor adaptive capacity	Interaction	Outcomes
Actor group boundary clarity	Interaction	Institutions
Actor group boundary fuzziness	Interaction	Institutions
Actor group trust	Case Component	Social Capital
Collective action	Interaction	Outcomes
Commons boundary negotiability	Interaction	Institutions
Commons feedback visibility fix	Interaction	Incentives
Commons feedback visibility use	Interaction	Incentives
Commons political power	Interaction	Context
Community Participation	Case Component	Social Capital
User group well-being change	Interaction	Outcomes
Outcomes (O)		
Variables	**Attachment**	**Theme**
Actor adaptive capacity	Actor	Component Interaction
Biodiversity trend	Natural Resource System	Component Interaction
Collective action	Actor	Component Interaction
Commons condition trend	Environmental Common	Component Interaction
Governance system effect	Governance System	Component Interaction
Provision services condition	Natural Resource Unit, Natural Resource System	Component Interaction
Regulating services condition	Natural Resource Unit, Natural Resource System	Component Interaction
User group well-being change	Actor	Component Interaction
RELATED ECOSYSTEMS (ECO)		

Source: Proper design based on E. Ostrom (2007; 2009)

The collection of the data for empirical analysis was done from published papers in national and international journals on 32 case studies of the community forests in Mexico. The 32 case studies were got according to how far each case study appeared in literature of protected community forests. The data got from published papers were codified into a set of 60 variables. The data codification helps to identify two classes of variables across the case studies and this includes the identified variables which are further subject to analysis, and unidentified variables which do not allow any further analysis. The presentation of the variables and their corresponding coded performance is done by using tables and the most used table is a table in a format of E. Ostrom by which the interactions of a set of the second variables to affect the outcomes (Ostrom 2007), and it is given in Table 2. To analyze the data, the statistical methods were used. These include variables frequencies, descriptive statistics such as mean descriptions, standard deviation, standardized mean difference, were used: i) to determine each variable performance in the case studies, ii) to apprehend common elements in different studies, and iii) to identify the variables whose interactions are responsible for differing results across similar studies. From these variables, we can determine the successful and unsuccessful case studies. In this paper, we use data got from a sample of 32 case studies where overall average of 2.18 points of the variable outcomes is based on to determine the successful or unsuccessful cases. The successful cases are the ones whose performance outcomes are greater than the overall average and the unsuccessful cases are the ones whose performance outcomes are less than the overall average. From this criterion two successful case studies and two unsuccessful case studies were randomly chosen to determine the variables which explain the successful and unsuccessful conditions.

By using the Comprehensive Meta-Analysis software, the variables which explain more the successful or unsuccessful situations across the case studies were determined. According to the Figure 1. these are the variables which have Z-values greater than 3.00 points and significant P-values of lower than 0.000 with lower limit of 0.963 and upper limit of 1.589, therefore, 26 variables are considered as more significantly explicative of the successful and failure situations within the case studies, and they applied to the chosen case studies to show how in some cases, they constitute constraints to successful conditions.

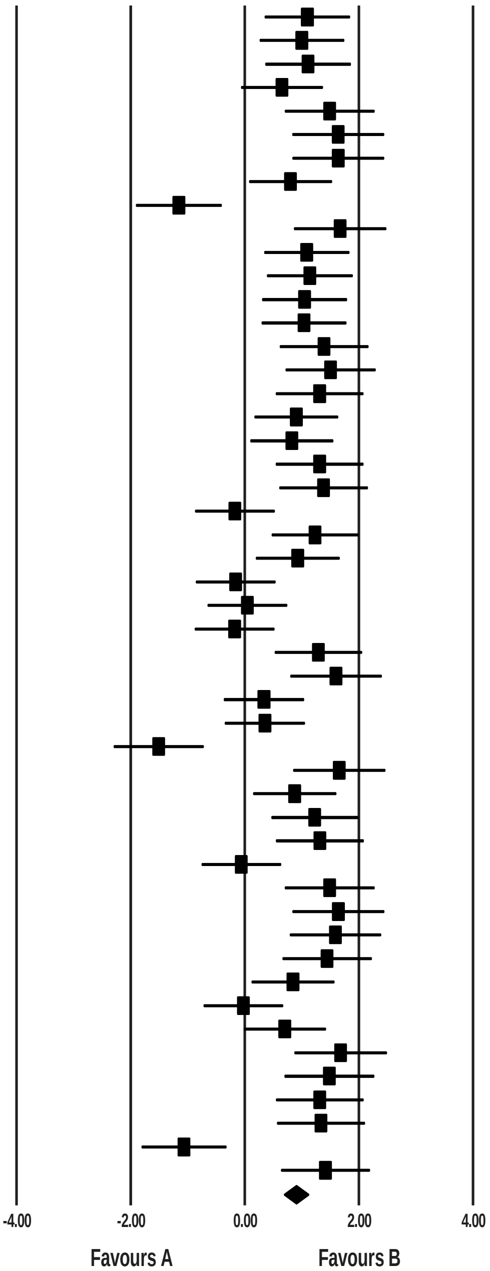
The Case Studies

The case studies used to carry out a comparative analysis are cases which use protection policy and they are the following:

Figure 1. Meta-Analysis of Case Studies of Mexican Community Forests.

Study name	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Actor adaptive capacity	1.097	0.380	0.144	0.353	1.842	2.888	0.004
Actor group boundary clarity	1.001	0.376	0.141	0.265	1.738	2.665	0.008
Actor group boundary fuzziness	1.110	0.380	0.145	0.364	1.856	2.917	0.004
Actor group coordination	0.652	0.364	0.132	-0.060	1.365	1.794	0.073
Actor group trust	1.488	0.400	0.160	0.704	2.272	3.719	0.000
Biodiversity trend	1.639	0.409	0.167	0.837	2.441	4.004	0.000
Collective action	1.640	0.409	0.167	0.838	2.442	4.006	0.000
Commons boundaries	0.803	0.368	0.136	0.081	1.524	2.181	0.029
Commons boundary negotiability	-1.155	0.383	0.146	-1.905	-0.405	-3.019	0.003
Commons condition trend	1.672	0.411	0.169	0.866	2.478	4.065	0.000
Commons feedback speed fix	1.087	0.379	0.144	0.343	1.831	2.865	0.004
Commons feedback speed use	1.142	0.382	0.146	0.393	1.890	2.989	0.003
Commons feedback visibility fix	1.048	0.378	0.143	0.308	1.788	2.775	0.006
Commons feedback visibility use	1.040	0.377	0.142	0.300	1.779	2.755	0.006
Commons political power	1.390	0.395	0.156	0.616	2.163	3.522	0.000
Community Participation	1.505	0.401	0.161	0.719	2.291	3.752	0.000
Conflict resolution	1.313	0.390	0.152	0.548	2.079	3.364	0.001
Costs of exit	0.904	0.372	0.138	0.175	1.632	2.430	0.015
Cultural dependence	0.825	0.369	0.136	0.102	1.549	2.237	0.025
Cultural services condition	1.313	0.390	0.152	0.548	2.079	3.364	0.001
Ecosystem service management	1.381	0.394	0.155	0.609	2.154	3.505	0.000
Ecosystem services markets	-0.172	0.355	0.126	-0.868	0.523	-0.485	0.628
Effect confidence	1.232	0.386	0.149	0.474	1.989	3.188	0.001
Environmental monitoring	0.929	0.373	0.139	0.199	1.660	2.493	0.013
External monitoring	-0.159	0.355	0.126	-0.855	0.536	-0.449	0.653
External recognition	0.047	0.354	0.126	-0.648	0.741	0.132	0.895
External support	-0.178	0.355	0.126	-0.874	0.517	-0.502	0.615
Governance strictness trend	1.290	0.389	0.152	0.527	2.053	3.315	0.001
Governance system effect	1.597	0.407	0.165	0.800	2.394	3.928	0.000
Incentive type	0.336	0.357	0.127	-0.363	1.036	0.943	0.346
Institutional diversity	0.354	0.357	0.127	-0.346	1.053	0.991	0.322
Interest heterogeneity	-1.507	0.401	0.161	-2.294	-0.721	-3.757	0.000
Inter-group trust	1.657	0.410	0.168	0.853	2.461	4.038	0.000
Leadership	0.876	0.371	0.137	0.149	1.602	2.362	0.018
Leadership accountability	1.227	0.386	0.149	0.470	1.983	3.178	0.001
Leadership authority	1.317	0.391	0.153	0.551	2.082	3.371	0.001
Multiple levels	-0.060	0.354	0.126	-0.754	0.635	-0.168	0.866
Participation in environmental monitoring	1.488	0.400	0.160	0.704	2.272	3.720	0.000
Participation in rule making	1.642	0.409	0.168	0.840	2.444	4.011	0.000
Participation in social monitoring (enforcement)	1.591	0.406	0.165	0.794	2.387	3.915	0.000
Past collaboration	1.444	0.398	0.158	0.665	2.223	3.632	0.000
Personal communication	0.847	0.370	0.137	0.122	1.571	2.290	0.022
Perverse incentives	-0.024	0.354	0.125	-0.718	0.671	-0.067	0.947
Proportionality (of costs and benefits)	0.702	0.365	0.133	-0.013	1.418	1.924	0.054
Provision services condition	1.681	0.412	0.170	0.874	2.488	4.082	0.000
Regulating services condition	1.482	0.400	0.160	0.699	2.266	3.708	0.000
Self monitoring	1.315	0.391	0.153	0.550	2.081	3.368	0.001
Self Sanctions	1.337	0.392	0.153	0.569	2.105	3.413	0.001
Transaction costs	-1.064	0.378	0.143	-1.805	-0.322	-2.811	0.005
User group well-being change	1.415	0.396	0.157	0.639	2.191	3.574	0.000
	0.900	0.108	0.012	0.688	1.112	8.323	0.000

Std diff in means and 95% CI



Source: The Author

CASE 01: THE CORENCHI (COMITE DE RECURSOS NATURALES DE LA CHINANTLA) COMMUNITIES

The CORENCHI is a regional committee formed in 2004 by six Chinantec communities to improve control of their natural resources, strengthen conservation efforts and obtain more socioeconomic benefits from landscape management. To date the communities, have multiple areas for conservation of 27,564 ha, some of which have been certified as a Community Conserved Areas (CCA) by the Mexican National Natural Protected Areas Commission (CONANP). Some achievement of CORENCHI communities are: i) conservation of more than 27,500 ha of diverse tropical forests, ii) agreement on a common strategy for managing the payments for environmental services iii) definition of a joint strategy among six communities to preserve common property within their borders, iv) development of strategic productive projects, aiming to strengthen community economy through sustainable resource management; and v) creation of communal statutes to normalize and regulate the use of and access to common resources. Following on the success of these measures, the communities are exploring further economic diversification through scientific tourism, added-value marketing of coffee and commercialization of selected non-timber forest products (Bray et al. 2012; Bray et al. 2008; Nieratka et al. 2015; Bost 2014; Berget et al. 2015; Ibarra et al. 2011).

CASE 02: SIERRA DE SANTA MARTA

It is in EAST of the state of Veracruz, in the region of Tuxtlas. It covers an area of 150,000 ha. It was formally declared by presidential decree as Zone of Forest Protection and Wildlife Refuge on 28 April 1980. In 1988 was reclassified by SEDESOL (Secretaría de Desarrollo Social), as special biosphere reserve. But there are no taken measures to prevent the continued destruction of forest areas of the reserve, land degradation and unsustainable use of natural resources in the 82,300 ha. In contrast, these measures passed in charge of the regional economic policies through the support programs to livestock development and assistance programs as external inputs. Thus, few became richer, the poorest and most resource degradation continued. This region is composed of 92 communities out of which, 86 are ejidos and agrarian communities and five colonies of private properties (Durand & Lazos 2008; Paré & García 2015; Arroyo-Rodriguez & Mandujano 2006; Durand & Lazos 2004; Negrete-Yankelevich et al. 2013; Arroyo-Rodríguez et al. 2007).

CASE 03: SERRANIA DE JUAN GRANDE GOLDEN EAGLE PROTECTION AREA

It is in the northern state of Aguascalientes, in the municipality of El Llano, the site comprises of 2589.45 ha, principally designated for the conservation of the golden eagle (*Aquila chrysaetos*). The protected area is common land that forms part of the Ejido Palo Alto and has been voluntarily and specifically put aside by the community for conservation purposes. It is also formally recognized as a protected area by the CONANP.

The local communities have rights to the land, both common land and private, but they cannot sell this land. There are no permanent settlements within the protection area itself, with the nearest settlement being Palo Alto that has a population of 4,215 people. However, the management of the area remains the responsibility of the Ejido community, with assistance from the State Government of Aguascalientes and CONANP, and decisions on its management are reached through community meetings, such as the Palo Alto Ejido Assembly. The ejido Board is responsible for operations and monitoring within the area, and coordination with government departments, academic institutions and Non-Governmental Organizations (CONANP 2006; SEMARNAT 2002; Aguascalientes-IMAE 2010a; Aguascalientes-IMAE 2010b; CONANP 2008; CONANP 2009; Aguascalientes-IMAE 2006).

Case 04: Huitzilac Community

Huitzilac is one of seven communities located within the CBCH in the State of Morelos, Mexico, located between and in proximity to Mexico City and the City of Cuernavaca. Organized through common goods, the local mechanism for collective decision-making, 920 commoners collectively hold and manage Huitzilac's land and natural resources, today, facing significant loss of its forest cover, Huitzilac is still the most forested community within the CBCH and considered Mexico City's green lung (Frias & Meredith 2004).

Results

Even though the four case studies are protected areas, their governance systems lead to different situations. From empirical analysis of variable performance of case studies, it was identified that the variables behave into two categories: the category of variables whose performances are homogeneous across the cases studies and the category of variables whose performances vary across the case studies. The former variables are: commons actions, commons aggregation, governance knowledge use, governance scale, governance system description, governance system spatial extent, markets, rights type, the actor group size, commons spatial extent. The latter are the remaining 50 variables which are applied to further analysis to identify those variables whose interactions and patterns of interactions explain the successful or unsuccessful conditions of the case studies. This is done by calculating the effect sizes of the variable performance among the case studies (Borenstein et al. 2009), and the Comprehensive Meta-Analysis program were applied (Pigott 2012). After identifying the variables whose effect sizes are highly significates to explain the success of the case studies, a comparative study of two successful case studies with two unsuccessful ones was done to determine how the interactions of these variables lead to successful or unsuccessful situations. The comparative analysis by meta-analysis is done because, not all successful case studies specifically have same characteristics, neither are the failed case studies. Each case has its unique configuration of variable interactions and formed patterns of interactions.

The first example is a case study number one (01) which is successful case study with total outcomes of 31 points. It has a resource system characterized by improved biodiversity trend, improved commons condition trend, improved cultural services condition, improved provision services condition, and improved regulating services condition. The improvement in the status of this resource system is in relation with the interactions on one hand with the governance system characterized by: more strict governance, a governance system which meets goals, and high inter-group trust, and on the other hand with a system of actors characterized by: a high trust in actor group, high collective actions, a moderate commons boundary negotiability, a high common political power, a high community participation, existence of the conflict resolution, a high effect confidence, a high environmental monitoring and participation in environmental monitoring, a high participation in rule making, a high participation in social monitoring, low self-monitoring, an existence of self-sanctions, and an improved user group well-being change. The interactions of the resource system, and governance system with action arena of actors results in high adaptive capacity of actors, improved biodiversity trend, high collective action, improved commons condition trend, improved cultural services condition, high effect confidence, high governance system effect, improved provision services condition, improved regulating service condition, and improved user group well-being.

The second example here is a case study number three (03). It is also among successful case studies with total outcomes of 31 points. The resource system is characterized by improvement in biodiversity trend, commons condition trend, cultural services condition, provision services condition, and regulating services condition. This improvement status of the resource system is due to the interactions in one hand with the governance system characterized by; more strict governance, a governance system which meets goals, and high inter-group trust, on the other hand with a system of actors characterized by: a high actor group trust, high collective actions, a low commons boundary negotiability, a high common political power, a high community participation, existence of the conflict resolution, a high ecosystem services management, a high effect confidence, a high environmental monitoring and participation in environmental monitoring, a low interest heterogeneity, a medium in leadership accountability and high leadership authority, a high participation in rule making, a high participation in social monitoring, a high past collaboration, moderate self-monitoring, an existence of self-sanctions, and an improved user group well-being change.

The interactions of the resource system, and governance system with action arena of actors results in high adaptive capacity of actors, improved biodiversity trend, high collective action, improved commons condition trend, improved cultural services condition, high effect confidence, high governance system effect, improved provision services condition, improved regulating service condition, and improved user group well-being.

Whereas the successful case studies present better performance of variables interactions and ending results, the failed case studies present poor variable performances as well as poor performance in outcomes. This situation is explained in the following two examples of unsuccessful case studies:

The first example among failed case studies is a case study number seven (07) has total outcomes of 15 points. It is a constituent of a resource system is characterized by: worsen biodiversity trend, worsen commons condition trend, mixed effect of cultural services condition, worsen provision services condition, and mixed effect of regulating services condition. The resource system condition is related to the interactions with the governance system and system of actors characterized by: (i) a governance system which is less strict, which fails to meet goals, and a low inter-group trust, and (ii) a system of actors characterized by: a medium actor group trust, low collective actions, a medium commons boundary negotiability, a medium common political power, a low community participation, lack of conflict resolution, lack of ecosystem service management, a low effect confidence, a medium interest heterogeneity, a low leadership authority, a low environmental monitoring and participation in environmental monitoring, a low participation in rule making, a low participation in social monitoring, a medium past collaboration, a medium self-monitoring, existence of self-sanctions, and a worsen user group well-being change. The interactions and combination of the above characteristics reads to the results such as: low adaptive capacity of actors, worsen biodiversity trend, low collective action, worsen commons condition trend, low effect confidence, low governance system effect, worsen provision services condition, mixed effect of regulating service condition, and worsen user group well-being.

The second case as an example of failed case studies is case number four (04) with total outcomes of 13 points. It is a constituent of the resource system characterized by: worsen biodiversity trend, worsen commons condition trend, worsen cultural services condition, worsen provision services condition, and worsen regulating services condition. The status of these resources is in relationship with the interactions with the governance system and system of actors. A governance system characterized by: less strict governance, a governance system which fails to meet goals, low inter-group trust, and high transaction costs. A system of actors characterized by: a medium actor group trust, low collective actions, a high commons boundary negotiability, a low common political power, a low community participation, lack of conflict resolution, lack of ecosystem service management, a low effect confidence, a high interest heterogeneity, a low leadership accountability and authority, a low participation in rule making, a low participation in social monitoring, a low past collaboration, a low self-monitoring, a lack of self-sanctions, and a worsen user group well-being change. The interactions and combination of the above characteristics reads to the results such as: medium adaptive capacity of actors, worsen biodiversity trend, low collective action, worsen commons condition trend, worsen cultural services condition, very confident effect, low governance system effect, worsen provision services condition, worsen regulating service condition, and worsen user group well-being.

Based on the above configurations of the case studies, it is identified that each case study has got its own configuration which results in success or failure of the resource governance system. This depends on how variable performance changes i.e. change in a variable may cause change in whole system outcomes, and more not all variables' changes have the same impact on the system outcomes. Thus, each case generates its own complexity and consequently, the use of blueprint policies cannot guarantee the successful management.

In summary, the successful situations of the case studies are due to the resource system characterized by: improved biodiversity trend, commons condition trend, cultural services condition, provision services condition, and regulating services condition. The status of these resources is due to the interactions with the governance system and system of actors. The governance system is characterized by: more strict governance, a governance system which meets goals, and high inter-group trust, whereas a system of actors is characterized by: a high actor group trust, high collective actions, a low commons boundary negotiability, a high common political power, a high community participation, a high degree of existence of the conflict resolution, a medium regulation ecosystem service management, a high effect confidence, a high environmental monitoring and participation in environmental monitoring, a high participation in rule making, a high participation in social monitoring, a moderate self-monitoring, an existence of self-sanctions, and an improved user group well-being change.

The interactions and combination of the above characteristics lead to the results such as: high adaptive capacity of actors, improved biodiversity trend, high collective action, improved commons condition trend, improved cultural services condition, high effect confidence, high governance system effect, improved provision services condition, improved regulating service condition, and improved user group well-being.

Whereas, the unsuccessful situations depend on the poor performance of set of variables within the case studies which are characterized as follows:

The resource system is characterized by worsen biodiversity trend, worsen commons condition trend, worsen cultural services condition, worsen provision services condition, and worsen regulating services condition. The states of these resources are affected and affect the interactions with the governance system and system of actors. The governance system is characterized by: a less strict governance, a governance system which fails to meet goals, and low inter-group trust. The system of actors is characterized by: a low actor group trust, a low collective actions, a high commons boundary negotiability, a low common political power, a low regulation ecosystem service management, a low effect confidence, a low environmental monitoring and participation in environmental monitoring, a low participation in rule making, a low participation in social monitoring, a low self-monitoring, a lack of self-sanctions, and a worsen user group well-being change. The degrees of performance of these variables constitute constraints to the successful situations of within these cases. Thus, there must be institutional change to positive foster these variables to contribute to the success of this case studies. Instead of having the interactions and combinations which lead to low adaptive capacity of actors, worsen biodiversity trend, low collective action, worsen commons condition trend, worsen cultural services condition, low effect confidence, low governance system effect, worsen provision services condition, worsen regulating service condition, and worsen user group well-being.

CONCLUSION

To conclude, it is necessary that PAs must be designed in the way that they address local incentives to raise willingness of sustaining PAs resources for a long time. This is because, the PAs constitute SESs whose sustainability depends on actions of community members and governance systems in place. These systems do not equally perform across the case studies. Depend on the variable interactions within these systems, some cases are successful and others not. From analyzed case studies, these variables are: i) the variables characterizing the governance system which are: strictness of governance system, degree to which governance system meets goals, and high inter-group trust, and ii) the variables characterizing system of actors which are: high actor group trust, high collective actions, low commons boundary negotiability, high common political power, high community participation, high degree of existence of the conflict resolution, medium regulation ecosystem service management, high effect confidence, high environmental monitoring and participation in environmental monitoring, high participation in rule making, high participation in social monitoring, moderate self-monitoring, existence of self-sanctions, and improved user group well-being change. The interactions of these variables lead to successful situations in case studies in which local community members participate in governance system, whereas, in case studies whose local community participation in governance system is not the priority, they lead to unsuccessful situations. Thus, institutional design and change must be based on placing each variable in adequate state for not being a constraint instead of being catalyzer for achieving the successful situation.

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Restrições do Sistema Sócio-Ecológico de Áreas Protegidas. Um estudo de caso de florestas protegidas mexicanas

RESUMO

Áreas Protegidas são mundialmente aceitas como instrumento de política de conservação. No entanto, a eficácia desse instrumento para o gerenciamento da sustentabilidade de recursos protegidos ainda é problemática. É neste contexto que este trabalho investiga as restrições do Sistema Sócio-Ecológico que levam a situações sem sucesso em florestas protegidas no México. Para atingir este objetivo, é utilizada uma metodologia de estrutura do Sistema Sócio-Ecológico de E. Ostrom para realizar a meta-análise de estudos de casos de florestas mexicanas. Os resultados mostram que as restrições estão embutidas nos atributos de governança desses recursos pelas comunidades locais por meio de um conjunto de variáveis cujos padrões de interação levam a situações bem-sucedidas ou malsucedidas. Essas variáveis são variáveis que caracterizam o sistema de governança e variáveis que caracterizam os atores. As interações dessas variáveis levam a situações bem-sucedidas em estudos de caso nos quais os membros da comunidade local participam intensamente do sistema de governança.

Palavras-chave: Política de Conservação; Manejo Sustentável; Áreas Protegidas; Sistemas de Recursos.

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