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NATURAL RESOURCE CONSERVATION PERFORMANCE:
A CROSS-SECTIONAL COMPARISON OF MADAGASCAR'S PROTECTED AREAS

by

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Background

I recently wrote a paper on a puzzle that developed from the results of some research I conducted for the United States Agency for International Development (USAID) in Madagascar from May 1993 to September 1994. The research was about local (i.e., community-based) initiatives for the management of natural resources. Its aim was to inform the process of decentralization which began in the early 1990s in Madagascar and its context was the country's severe environmental degradation. The research hypothesized that "there exists a significant local capacity for natural resources management," but that this capacity appeared "to be weakened by existing legislation and by the actions of the Malagasy government, while being undermined by uncertainty arising from limited means to implement the regulations."¹ One of the findings of the research showed that, clearly, "[t]here exists a local management capability" in the areas of community decision-making; mobilization of resources for collective action; conflict resolution; and management of natural resources and of public services.²

Drawing from this particular finding and assuming that there is a relationship between the mere existence of local management capabilities and the sustainability of natural resources management, I proceeded to write a paper to try to understand what accounted for variations in how communities managed their resources. Indeed, the research done for USAID also revealed that while some communities were successful in managing their resources sustainably, others were not doing so well.³ I looked at six possible explanatory variables: markets, culture (of which production systems are a prominent aspect), attributes of the physical world, institutions (especially those embedded in property regimes), economic attributes of the physical world, and collective action capacities. My reasoning was that those variables that varied the most should explain why communities living in the periphery of Madagascar's protected areas did not perform the same in the conservation of the resources on which their livelihoods depended.

This led me to the conclusion that property regimes, especially common-property regimes (CPR) explanations had more to offer than collective action (CA) explanations given that little variation in collective action was observed (overall, all communities demonstrated their ability to overcome CA problems in order to achieve commonly identified goals). This is not to say that there was no analytical value to CA explanations. In fact, a secondary conclusion that I drew was that, in order to analyze a puzzle such as this one, within the context of Madagascar, one's analysis has to rest on holistic rather than purely individualistic premises.

In this paper I further analyze the puzzle in terms of what Elinor Ostrom refers to as "the conventional theory of common-pool resources."⁴ I use case studies to see if the theory Ostrom offers is sound in the context of Madagascar's protected areas and try to assess the strengths and shortcomings of the theory in explaining variation in conservation performance.

¹ Rabesahala et al. 1994, p. 2.

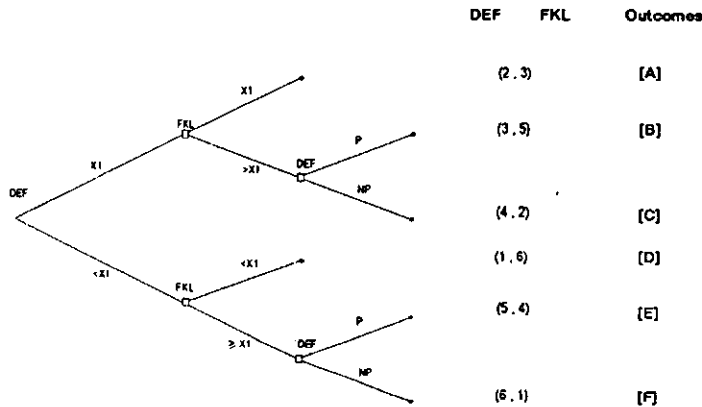
² Ibid., p. 16.

³ Both natural resources and public services such as irrigation systems, roads and paths leading to markets and health care facilities, schools, dispensaries, churches, etc. were considered.

⁴ Ostrom, Elinor. 1997, p. 2.

move simultaneously and, therefore, do not know about each other's decision upon making their moves. FKL's preference ranking is $F > C > A > E > B > D$ and DEF's preference ranking is $D > A > E > F > B > C$ ("is preferred to" is symbolized by ">").⁵ The ranking numbers reflect players' preferences, with "1" representing the best outcome and "6" the least preferred outcome.

Figure A. Game with complete and perfect information



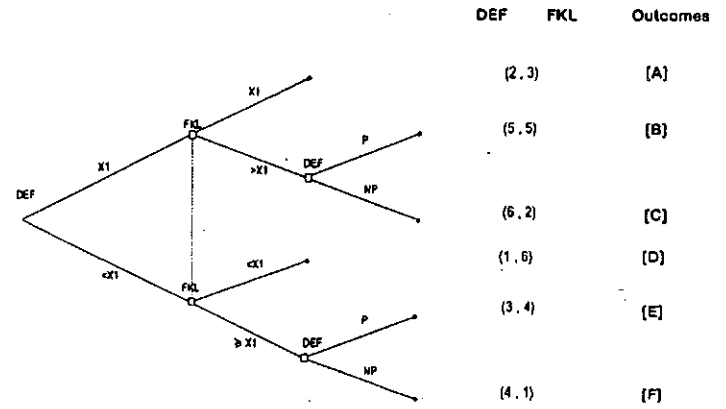
The outcome for this game of complete and perfect information is [A], i.e., (cooperate, cooperate). This model predicts that an equilibrium exists where DEF grants FKL the amount of forest the latter requested and FKL clears no more than DEF's allowance. This outcome is optimal for neither player, but in this situation there is, presumably, no prediction for over-consumption. This type of prediction flies in the face of empirical observations, based on the use of satellite imagery and confirmed by communities' testimonies, which consistently point to the fact that the eastern rain forest of Madagascar is undergoing the fastest rates of destruction.⁶ To get a more realistic (less oversimplified) model, the case of when players initially move without knowledge of each other's decision

⁵ This draws on another paper I wrote in January 1997.

⁶ Green and Sussman. 1990.

is therefore modeled. Empirically, this is the case when DEF and FKL have difficulty accommodating each other's deadlines (administrative and agricultural, respectively) and coordinating each other's decisions.

Figure B. Game with complete and imperfect information



Game B can also be shown in strategic form:

		FKL	
		Comply	Not Comply
DEF	S ₁ (grant X ₁)	(2, 3)	(5, 5)
	S ₂ (grant <X ₁)	(1, 6)	(3, 4)

With complete and imperfect information the outcome of this dominance solvable game is [E], i.e., (not cooperate, not cooperate). Judging from the empirical observations mentioned above, this model has more predictive power than the first model. However, just as in the first model, it operates under strict assumptions, as pointed out by Elinor Ostrom who writes: "These [game

theoretic) models formalize the problem differently, but do not change the basic theoretical assumptions about the finite and predictable supply of resource units, complete information, homogeneity of users, their maximization of profits, and their lack of interaction with one another or capacity to change their institutions.⁷ Nor does this particular game escape from the strict assumption of rationality.

Would the Communities Perform Differently without the External Authority?

These assumptions are admittedly questionable, but they are nonetheless defensible. The most problematic of all, however, is that of "lack of capacity to change institutions." One way to work around the weakness of the above games would be to model with repeated plays with discount rates included in the payoffs. This of course, would not help with the other theoretical assumptions mentioned by Ostrom. The question then becomes: How else would one envision a situation where natural resource users can change their institutions? I propose to answer this question by assessing the possibility of self-governance of common-pool resource using the eight communities for which governance data were gathered in 1993 and 1994. In *Self-Governance of Common-Pool Resources* Ostrom looks at two sets of attributes to assess the possibility of self-governance: the attributes of the resources and those of appropriators. For this analysis I shall hypothesize that *those communities who fulfill most of the conditions are likely to be successful in managing their commons in a sustainable manner*. Conversely, the communities who do not meet most conditions are likely to fail to organize to counter incentives leading to "the tragedy of the commons."

Looking at the attributes of resources (considering agricultural land, forest products, and water for irrigation), a simple table, using Ostrom's four attributes and a simple coding system (if conditions are met, it is coded as "1" and if they are not met it is coded as "0"), the following table results.

Table 1. Attributes of the Resources

	R1 ^a	R2	R3	R4	Yes = 1; No = 0 Total (/4)
<i>Communities of Amber Mountain National Park (North)</i>					
Antsatrana	0	1	1	1	3
Anjavimuhavana	1	1	1	1	4
<i>Communities of Zahamena Nature Reserve (East)</i>					
Ambodivoahangy	0	1	1	1	3
Mahasoa	0	1	1	1	3
Ambatoharanana	1	1	1	1	4
<i>Communities of Andohahela Nature Reserve (South)</i>					
Talakifeno	1	1	1	1	4
Marotoko	1	1	1	1	4
Betanimena	1	1	1	1	4

R1. Feasible improvement: Resource conditions are not at a point of deterioration such that it is useless to organize or so underutilized that little advantage results from organizing. The research indicates that three out of the eight communities are in a situation where key resources (such as fuel wood, water for irrigation, and land for rice culture) are scarce (hence the "0" score). Ambatoharanana, whose population comes from the village of Mahasoa, is not in this situation only because it has started clearing parts of the Zahamena forest recently. It is reasonable to expect that, in time, the forest resources around this community will be depleted as well. Overall, then, the communities of the South score best on this condition.

R2. Indicators: Reliable and valid indicators of the condition of the resource system are frequently available at a relatively low cost. Resource users can easily observe changes in their resource supplies from one period to the next (be it one growing season, one year, five years or more).

R3. Predictability: The flow of resource units is relatively predictable. The resources under study are not mobile and, thus, relatively easy to manage (this would not be the case if, for instance, fisheries were considered).

R4. Spatial extent: The resource system is sufficiently small, given the transportation and communication technology in use, that appropriators can develop accurate knowledge of

⁷ Ostrom, Elinor. 1997, p. 3.

^a Rabesahala et al. 1994, p. 20

external boundaries and internal microenvironments. An important finding that the USAID research brought to light is communities' acute knowledge of where their geographic boundaries lay and what resources are found within the boundaries. While the size of village territory varies, nowhere is it the case that these boundaries include resources that lay beyond communities' monitoring abilities.⁹

Turning now to the attributes of the appropriators, the same resources are considered and the same coding system used.

Table 2. Attributes of the Appropriators

	Yes = 1; No = 0							
	A1	A2	A3	A4	A5	A6	A7	Total (/7)
<i>Communities of Amber Mountain National Park (North)</i>								
Antsatrana	1	1	1	0	0	0	1	4
Anjavimihavana	1	1	1	1	0	0	1	5
<i>Communities of Zahamena Nature Reserve (East)</i>								
Ambodivoahangy	1	1	1	1	1	1	1	7
Mahasoa	1	1	1	1	1	1	1	7
Ambatoharanana	1	1	1	1	1	1	1	7
<i>Communities of Andohahela Nature Reserve (South)</i>								
Talakifeno	1	1	1	1	1	1	1	7
Marotoko	1	1	1	1	1	1	1	7
Betanimena	1	1	1	1	1	1	1	7

A1. Salience: Appropriators are dependant on the resource system for a major portion of their livelihood. All communities are dependent on natural resources for their subsistence. The people of Zahamena derive their subsistence from the forest exclusively. The people of Amber Mountain and Andohahela depend on the forest for fuel wood, construction wood, and for cattle grazing; they depend on water and land for rice production (the people from the North grow other crops as well).

A2. Common understanding: Appropriators have a shared image of how the resource system operates (R1, R2, R3, R4) and how their actions affect each other and the

⁹ This is the closest approximation of the French term *terroir*, which conveniently captures both physical and institutional boundaries. For more on this see Rabesahala and Gauthier. 1995.

resource system. Two communities (East) have, for instance, established community forests (*alam-pokonolona*) so as to ensure the continuing supply of wood products such as construction wood and fuel wood, for future generations. These community forests were initiated by the communities themselves. They are managed and controlled by the *fokonolona* exclusively.

A3. Discount rate: Appropriators use a sufficiently low discount rate in relation to future benefits to be achieved from the resource.

A4. Distribution of interests: Appropriators with higher economic and political assets are similarly affected by a lack of coordinated patterns of appropriation and use. The village leaders, who are often economically better off and politically influential, have a stake equal to any other community member's in preserving the resources. They are, therefore, keen on investing in community self-organization (an example was mentioned in A2). In Antsatrana, however, social cohesiveness is challenged by young individuals whose pursuit of economic interest compels them to assert their independence from the rest of the community (one individual, whose land is particularly fertile for vegetables, relies on income derived from selling the vegetables to purchase rice, a much more difficult crop to grow. This individual considers himself to be in a strong position to challenge the authority of the village elders).

A5. Trust: Appropriators trust one another to keep promises and relate to one another with reciprocity. One of the biggest assets that these communities have, albeit in different degrees, is social capital, i.e., "features of social life—networks, norms, and trust—that enable participants to act together more effectively to pursue shared objectives."¹⁰ Razafintsalama defines the *fokonolona* as a group of individuals related by kinship and living on the same territory.¹¹ For governance purposes, the *fokonolona* (i.e., the collective entity) is headed by the *Ray aman-dReny* (local leaders) and composed of the

¹⁰ Putnam. 1995, pp. 664-665.

¹¹ Razafintsalama. 1981, p. 52.

general assembly. As far as communities living in the periphery of protected areas, there is little, if any, variation in popular understanding of what the "collective" unit is. All community decisions are either "filtered through" or simply made by the *Ray aman-dReny*. This is not to say that the *fokonolona* is a cohesive, always well-functioning, unit. In fact the authority of some community leaders has been, and continues to be, challenged by individuals whose personal and economic interests take precedence over the corporate interest, a phenomenon which has translated into conflicts over access to natural resources in certain areas.¹² The point that needs emphasis here is that the *fokonolona* is predominantly the basis for collective action in the areas studied and that the most severe sanction imposed on those who break social rules is permanent expulsion from the community.

A6. Autonomy: Appropriators are able to determine access and harvesting rules without external authorities countermanding them. In contrast to the two communities of the North, the communities of the East and South are severely isolated from markets and administrative centers. The case of Zahamena is complex, since the communities' access to agricultural land is controlled by DEF. In order to access land, by clearing forests, *Betsimisaraka* farmers have to request a cutting permit from DEF every year. Failure to obtain DEF's permission may result in incarceration. Yet Zahamena communities are difficult to access given the infrastructure in place. DEF's authority is therefore mitigated by the difficulty of enforcing rules.

A7. Prior organizational experience: Appropriators have learned at least minimal skills of organization through participation in other local associations or learning about ways that neighboring groups have organized. Without exception, all communities have demonstrated their ability to organize and mobilize human and material resources for the pursuit of collective goals. As I have mentioned elsewhere, communities have proven capable of achieving their goal of educating their youth by building schools and of getting access to markets and health care facilities by building and maintaining roads and paths that lead to such facilities. The maintenance of schools (building upkeep and control) of quality of

¹² The communities studied around Amber Mountain National Park are a case in point.

education), however, is variable. While some communities have gone as far as hiring private instructors, others have left their children's education in the hands of government-employed instructors whose performance is notoriously mediocre. The contrast between communities' ability to provide the infrastructure and the variability of their capacities to maintain services can be indicative of the fact that the motivations for agreeing on a public good vary. Indeed, it is plausible that, while some communities are motivated by a genuine desire to see their youth educated, it appears that the majority of communities built schools merely as a means to maintain their autonomy from the government when new administrative divisions were imposed on them in 1975. Whatever the case may be, the phenomenon of communal strategies to maintain local autonomy alone demonstrates that communities can agree and act upon achieving a "public good."¹³

Interpreting the results

A quick assessment of the situation indicates that, overall, the communities would be able to manage the commons by themselves. In other words, in the absence of an external authority, all communities present the potential for self-governance. Some communities, however, appear to be weaker than others (*Antsatrana* and *Ambodivoahangy*) for reasons that differ: the communities of the North are weaker than most communities in terms of attributes of both resources and appropriators. The communities of the East score low on attributes of the resources but do well in terms of attributes of appropriators. A first observation that one can make, therefore, is that there appears to be no clear relationship between meeting the conditions of one set of attributes and meeting those of the other. This brings up a first research question: If there is a relationship between attributes of the resources and attributes of appropriators, is there causality? That is, Does good performance in resource conservation explain coming together successfully as a group of appropriators? Or is it self-organization of appropriators that explains good conservation performance?

¹³ Taken from Rabesahala Horning, 1997b.

Comparatively, the communities of Andohahela are the most promising ones for self-governance of common-pool resources. From what assets which these communities have can one derive explanatory variables to explain conservation performance? According to the USAID research, the factors that best explain the conservation outcome (i.e., sustainable use of resources) for the southern communities are: (1) a stable, rather than shifting, production system (paddy rice culture); (2) isolation from markets and administrative centers coupled with sporadic government intervention; and (3) a strong sense of community (social capital) in which *Ray aman-dReny* authority is respected and accepted. Do the communities of the North and East share any of these assets? It appears that the communities of Zahamena (East) have the most in common with the communities of Andohahela: they, too, are physically isolated (in fact they are more so than the Andohahela communities) and possess a strong sense of community. However, their production system is quite distinct. As for the communities of the North, they share production systems with the communities of the South but, unlike all the other communities, they have relatively easy access to markets and external institutions. More importantly they do not share a strong sense of community. It seems fair, therefore, to conclude that the communities of Zahamena stand a better chance than the communities of Amber Mountain for self-governance of common-pool resources.

What assets, then, do Zahamena communities need to acquire to match the potential self-governance performance of Andohahela communities? The primary candidate for change appears to be production systems. Is this a possibility? I have argued elsewhere, about the same communities, that "the most intricately linked factors [influencing resource users' behavior *vis à vis* their environment] are attributes of the physical world, production systems, and property regimes. Together they constitute the most powerful explanation of why, in spite of similar NR [natural resource] management institutions, some communities perform better than others in resource conservation."¹⁴ That is to say, production systems evolve around the attributes of the physical world (topography, ecology, etc.) and of the communities that develop them (culture as reflected by the resource tenure regimes—a bundle of rights regarding

¹⁴ Rabesahala Horning, 1997a, p. 10, emphasis added.

access to, control and use of resources¹⁵). Suggesting that the Zahamena communities change their production systems thus amounts to suggesting that the *Betsimisaraka* (and other ethnic groups practicing *tany* such as the *Tanala*) change their culture and move to areas better physically better suited for paddy rice culture. Clearly, this is not a realistic proposition.

To think of the possibility of self-governance for the *Betsimisaraka* of Zahamena, one then has to think about changing the structure of the game according to "the configuration of rules", of which there are seven types, as specified by Ostrom in "Institutional Arrangements and the Commons Dilemma."¹⁶ The purpose of this would not be limited to giving game theory more predictive power but, more fundamentally, to increase the chances that these communities successfully manage their commons, using institutions that are manipulable by the communities themselves across the levels of analysis (operational, collective choice, and constitutional) specified by the Institutional Analysis and Development (IAD) framework.¹⁷ It would be important to determine which rules are already well specified and which ones would need to be devised.

Conclusion

To what extent does Elinor Ostrom's theory of self-governance help understand variations in conservation performance across the eight communities under study? The distinction made between the two sets of attributes—resources and appropriators—offers a useful way to systematically and consistently compare the potential for self-governance across governance units. As mentioned earlier, however, it has yet to be determined whether and how the two sets of attributes relate to each other to "produce" self-governance. Overall, it is reasonable to say that the communities of the South may be doing best conservation-wise because those communities have developed and maintained the conditions necessary for resource appropriators to organize and counter the perverse effects of opportunistic behavior resulting from existing institutional arrangements concerning Madagascar's protected areas.

¹⁵ For a more complete definition of resource tenure as it applies to Madagascar see Leisz et al.

¹⁶ Ostrom, Elinor. 1993. "Institutional Arrangements and the Commons Dilemma."

¹⁷ Ostrom, Elinor. 1996, p. 21.

A few theoretical puzzles remain, however. Firstly, the theory used for this analysis does not tell us which of the conditions bear more weight relative to each other. More research is needed to determine whether the conditions relating to the resources' attributes are, for instance, more important to meet than the conditions relating to appropriators (or vice versa). It is also necessary to determine which, among the conditions of each set of attributes, are most conducive to successful self-governance. Secondly, the analysis conducted in this paper posits that there is a relationship, a positive relationship to be sure, between self-governance and sustainable natural resource management (or resource conservation). While the theory has helped operationalize the concept of self-governance, it has not addressed the question of whether self-governance is a necessary *and* sufficient condition for resource conservation.

A final point that deserves emphasis is that the indicators used to determine the possibility for self-governance successfully integrate aspects of resource conservation that are too often treated separately. In this conceptualization of the problem of resource degradation and depletion, the physical world, the people living in it, and the institutions the people devise to continue living in it are all part of an ensemble. One would be hard pressed to show that the communities under study understand the world differently.

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