13

Environmental Protection via Land Administration

Libia Y. Romero Lara, Jaap Zevenbergen, and Kees Bronsveld

CONTENTS

Introduction

Protection of the environment on private lands, and lands where people hold private interests, embodies both a challenge and an opportunity for any government (Shogren et al. 2003). The challenge is the complex task of understanding and integrating the arrangement of diverse rights including "property rights, access rights, harvesting rights, management rights, exclusion rights and alienation rights" (Sandberg 2007), among others. The opportunity is the improved level of care afforded to the environment that private rights to land and resources can provide (United Republic of Tanzania 1997).

Achieving desired results in the implementation of environmental policies is considered to require collaboration between private right holders and other actors with vested interests in the land. Whenever the points of agreement and disagreement between these actors have not been considered and identified, there is a high chance that accomplishment of the policies will be frustrated (Cocklin et al. 2007). For this reason, it is considered important to improve knowledge bases about the diverse range of rights held in the areas of interest, while also promoting inclusion of the right holders in participatory decision-making processes. In this respect, Williamson (2001) identifies the crucial role that cadastres can play in understanding and administering the relationships between people and land.

However, while such collaborative approaches are promoted, it is still generally not clear to what extent existing rights, interests, and uses over land determine the performance of environmental policy implementations (Wanitzek and Sippel 1998). Prescribed environmental measures, and the stakeholders involved, often focus merely on environmental implications and underestimate the importance of other critical variables: the underlying role of land rights, establishment of quantifiable indicators regarding community and individual rights, as well as implementation of instruments designed to deal with those rights (Balint 2006) are often neglected. Therefore, it is necessary to improve understandings of the relationship between land rights, land uses, and environmental measures—potentially using alternative analysis tools relating to land, and not merely the cadastre.

The aforementioned sentiments are especially relevant in a country like Tanzania, where the presence and strength of various types of formal and traditional rights are diverse (Wanitzek and Sippel 1998). Tanzania is vastly dependent on its natural resources, which play an important role in terms of social and economic goods and services in its national economy (United Republic of Tanzania 2009). Disputes regarding land in or around protected areas in Tanzania are well known. This is a consequence of overlapping interests between local communities throughout the Tanzanian countryside and government institutions that manage and administer these protected areas (Wanitzek and Sippel 1998). The need to deal with possible conflicts becomes evident when one considers the enormous space covered by protected areas in Tanzania: 39.6% of the total land area is protected (World Resource Institute 2009).

This chapter aims to challenge conventional understandings of the conflicting relationship between environmental measures and private rights and additionally propose new mechanisms for dealing with it. For this, results from a case study in a protected area in Tanzania, Saadani National Park (SANAPA), are used. The data collected from the study, plus the literature accompanying review, are interpreted using an adaptation of the DPSIR (driving forces–pressures–state–impacts–responses) framework. This method assumes cause–effect relationships between interacting components of social, economic, and environmental systems (UNEP-GRID Arendal 2009). Following the identification of the elements assumed to be influential in the effect relationships between the establishment of SANAPA and the rights of local communities, some indicators are drawn to enable predictions of conflicts. This chapter is also innovative in that it applies the Dynamic Actor Network Analysis (DANA) software, a tool for supporting the analysis of actors involved in a process through the modeling of their perceptions. Using the aforementioned approaches, it was considered possible to identify suitable instruments for addressing conflicts between environmental measures and private land interests.

Overall, the empirical data collected allowed the following: (1) the identification of elements that have more influence in the establishment of an environmental measure in a protected area containing existing rights,

(2) establishment of possible indicators for conflicts between application of environmental measures and existing land rights, (3) formation of understandings of the way in which stakeholders' perceptions influence the implementation of an environmental measure in a protected area, and (4) proposal of possible instruments that could be included in the design of an environmental measure design.

Theoretical Perspective

Although environmental protection is a subject that generates much positive sentiment globally, it involves significant debate due to the restrictions it places on human activities. These involve limiting different types of rights and uses over natural resources. They stimulate resistance when either the economic productivity of land or the established way of life is disturbed (Doremus 2003).

Among the range of available alternatives for environmental protection, the establishment of protected areas—such as national parks (Cernea and Schmidt-Soltau 2006) and wildlife reserves—is a largely accepted approach by national and international organizations (Udaya Sekhar 2003). The institution of national parks has facilitated the task of prevention of loss of biodiversity and wildlife destruction caused by development and land conversion. However, because of the level of enforcement, right holders—particularly in developing countries—are susceptible to the establishment of such areas (Skonhoft 1998). They not only lose their access to natural resources, resulting most of the time in forced livelihood changes, but also are exposed to forced displacement:

> compulsory removal initiated when a project's need for 'right of way' is deemed to override the 'right to stay' of the inhabiting populations (Cernea and Schmidt-Soltau 2006).

Factors like landlessness, joblessness, homelessness, marginalization, food insecurity, loss of access to common property, and social disarticulation are commonly associated with population displacements after the establishment of a protected area (Cernea and Schmidt-Soltau 2006).

Several studies (Langholz and Lassoie 2001; Lindsey et al. 2005; Songorwa 1999) illustrate how the acceptance of protected areas by local people depends on harmonizing their own interest with the goals of the nature reserve.

The acquisition of land rights is a strategy frequently adapted by governments for the establishment of protected areas such as parks. According to the situation in place, the way it is implemented may vary from a voluntary basis, through donation or purchase at a mutually agreed price, to condemnation (Doremus 2003).

There exists no unique formula for selecting suitable approaches to reach the multifunctional goals that environmental protection seeks. The context, including landscape, land tenures, and governance arrangements constitute some of the factors that will lead to the selection of a particular strategy (Cubbage et al. 2007). However, whatever conservation approach is taken rights holders—and in general those who have been disturbed with the establishment of the protected areas—should be informed, educated, and taken into account (Van Gossum et al. 2005). Sensitivity to the specific conservation goals and the local context and continuous monitoring are also key issues (Wells et al. 1992).

In Tanzania, all land is considered as public land with value and kept by the president for the general public. Since 1969, and under the Government Leasehold Act, "Rights of Occupancy" have been issued with development conditions enforced. Customary rights of occupancy are also recognized. Under the National Land Policy (NLP), revocation of rights of occupancy might occur in cases of public interest, and it should include compensation on the bases of cost-opportunity. The second edition of the NLP includes the establishment of means for protection of sensitive areas such as national parks, and it states that such areas are not the subject of allocation to individuals. Unfortunately, the registration of statutory allocation of these areas does not take place, causing, in most of the cases, encroachments and alienations.

As soon as an area is declared a national park, any previous claims on the land and all existing rights are vested in the president (Tanzania National Parks, and Department of Planning and Projects Development 2003). The NLP has recognized weaknesses in provisions on compensation leading to complaints about rates, delays in payment, and the nonemployment of alternative assessment techniques.

Generally speaking, Tanzanians highly approved the establishment of protected areas: they considered them part of the country's national heritage (Wanitzek and Sippel 1998). However, as previously discussed, whether this was also at the exclusion of the preexisting livelihoods in those areas, or neighboring areas, is a more debated matter.

Methodology

A case study was considered the most relevant research strategy to utilize. The fieldwork was conducted in Tanzania, in the city of Dar es Salaam and the small villages of Uvinje and Buyuni, inside the park, and Saadani village, placed on the border zone of the park. The main criteria for selection of the study area were (1) existence of high levels of enforcement of environmental measures in the area of study and (2) presence of conflicts or observable effects on local people and/or their rights.

Data were collected from interviews, observations, and secondary sources. Data were collated and analyzed by first representing the different components of the SANAPA right holders' system and their interactions using a modified DPSIR analysis. DPSIR uses processes to explain the interrelations between human activities and environment (Nilsson et al. 2009). Five base categories, logically bonded, are prescribed: driving forces, pressure, state, impact, and responses (European Environment Agency 1999). The framework in this context needed to be adapted: although DPSIR is an established and frequently employed framework for understanding the roots and scope of environmental problems (Niemeijer and de Groot 2008), it is usually concentrated merely on environmental issues, with little attention given to social and economic issues (Svarstad et al. 2008). Considering that the changes were done only in the subject represented, and that all the aforementioned three issues are relevant for this study, the essence of the framework is preserved; thus, it is assumed to remain reliable. As a matter of fact, since its very beginnings in 1979 the conceptual framework known today as DPSIR has had different adaptations to make it suitable for different contexts, as described by Gabrielsen and Bosch (2003).

Once all the data collected were structured under the different categories that DPSIR prescribes, identification of the variable indicators was undertaken. The development of indicators is based on the modeling of stakeholders' perceptions, based on an actor-oriented approach. The indicators were essentially quantitative, but also qualitative, in the case of those characteristics relevant to the study with nonquantifying qualities. The assumption behind this approach is that once the perceptions and views of different actors or stakeholders involved in a policy issue are exposed (in a model in this case) useful understandings are gained for identifying the core issues that develop into conflicts. Consequently, responses that might reduce the level of conflicts can be identified. However, once the analysis is based on perceptions it is quite hard to talk about "objective reality" (Bots et al. 1999); therefore, the conception of the model presented is fully based on inferences about the data provided by the interviewees.

The selected tool to model stakeholders' perceptions was DANA, software developed at the Delft University of Technology, Netherlands, by Pieter W.G. Bots. In DANA, "causal relations diagrams" are used to model the perceptions of stakeholders; those diagrams are no more than factors and mechanisms relevant to each actor and the causal relations between them (Hermans 2004). In DANA, actors represent different people, organizations, or general groupings that play a role in the issue being analyzed. Two groups of actors can be modeled using this tool: stakeholders and agents. Changes introduced by actors' actions, or external influences, can take place in the issue analyzed. When these changes affect an actor's interest, such an actor is called a stakeholder; otherwise, such an actor is an agent (Bots 2009).

The stakeholders included in the analysis were Tanzania National Parks (TANAPA) and local villagers. They both influenced and are influenced by

the system. Due to the diversity of circumstances and effects caused, local villagers were divided into four categories for a deeper model and analysis: (1) villagers from Saadani, (2) villagers living inside the park, (3) villagers who resettled, and (4) villagers who moved to Saadani village looking for opportunities brought by the park. The perceptions of each stakeholder needed to be considered taking into account the limited data available and the people interviewed. It is assumed that the perceptions taken from the interviews represent the perceptions of a certain actor type in the model.

The final step of the analysis was to propose possible instruments to reduce the level of conflict between stakeholders. The feasibility of application of those instruments was not part of the scope of this research.

Results

Results from the DPSIR conceptual framework analysis are first discussed. As per the framework, the following categories are used: driving forces, pressures, state, impact, and responses.

The first elements that came into place as driving forces were the policies adopted by the government of Tanzania regarding environmental issues, specifically those dealing with national parks and land. These policies were the basis for the current regulating act that subsequently allowed the creation and administration of the network of protected areas, already in place in Tanzania, with emphasis on disapproval of human settlement inside them. Population factors such as increase, irregular distribution and vicinity to protected areas (attracted by the potential benefits in tourism) have also to be considered as Driving Forces. The devotion of rural communities to exploitation of natural resources can also explain their tendency to settle near protected areas.

Meanwhile, there are two pressures that represent the way drivers affect the system: (1) establishment of SANAPA and (2) presence of human settlements. In 1969, and after a demand from the villagers themselves, the Saadani ecosystem was declared as a game reserve in an attempt to protect the wildlife, which was in serious threat due to permanent hunting. People were allowed to keep on using natural resources, without farming or settlement. However, later in 1998 TANAPA revealed its intention of increasing the area and level of protection of the Saadani ecosystem. The Saadani ecosystem is home to approximately 35,000 people mostly distributed in 10 main settlements, spread out around the park (Tanzania National Parks, and Department of Planning and Projects Development 2003). According to the opinions collected from different villagers, local communities entirely rely on the use of natural resources from the region, which introduces a strong pressure on the system, leading to a threat for the protection and conservation of the entire

ecosystem and then to conflicts with the community that used to have free access to those resources. Roettcher (2001) cited by Ally Hassan (2005) already refers to the situation, illustrating the dependence of local communities on the protected area to obtain firewood, water, building materials, and dwarf palm.

The state or current condition found can be summarized in three items: (1) uncertainty about boundaries, (2) resettlements, and (3) increasing conflicts between SANAPA administration and local communities. People in Saadani do not know where they can keep their livestock, where they can grow crops, or where they can go and collect natural resources. None of the villagers interviewed have ever been told about the boundary of the park, nor have they even seen a map of it. They simply do not know where the boundary of their village is. As already discussed, eviction of all those living inside a national park is the next step once an area is declared. In the case of SANAPA, that was not different. Some conflicts also arise due to crop damage by wild animals; illegal use of natural resources; and people seeking water, firewood, and other resources to build their houses and for other general purposes.

The impact of this situation is reflected in the increased limitation of livelihoods and a negative perception about the park. The economy of the area around the Saadani ecosystem is quite limited: fishing, limited cropping, and small livestock keeping are the available options. After gradual limitations in uses in the park (from open access to game reserve, and then national park) in terms of access to natural resources, their main "supplier" has been restricted. Therefore, their livelihoods have been limited. People who settled around Saadani claim that they have been living with natural resources from the Saadani ecosystem for a very long time; therefore, they already have "rights" over them. Another issue to consider is the low generation of income through the development of tourism in the park. Compared to other national parks in Tanzania, like Serengeti or Kilimanjaro, the tourism rate in SANAPA is quite low, mainly because of poor and unreliable access to the area and the limited quality of the beach. Moreover, according to the available information for this study SANAPA administration has provided no mechanisms to guarantee that some of the revenue generated is directed to community development projects. In general, SANAPA administration is not highly rated among most of the villagers, both outside and inside the park. The lack of consultation and community involvement in decision-making processes has caused people to distrust the administration.

Finally, given the state and its impact on the system, some actions were taken or are planned to be taken. Responses like the implementation of community-based conservation address many of the categories in the DPSIR chain.

The identification of elements in each category of the DPSIR conceptual framework allowed the selection and definition of indicators (Ojeda-Martínez et al. 2009); Table 13.1 contains the list of indicators that correspond to the elements analyzed.

Regarding the results from the modeling and analysis of perceptions, as discussed, this can be seen as a good way of identifying divergences in the

TABLE 13.1

Indicators according to DPSIR Framework of SANAPA and Land Rights Holders

Indicator	Description
Driving Forces	
Population growth	Estimated percentage of the rate of population growth per year
Population density	Number of people settled around the protected area per square kilometer
Economic activities	Economic activities taking place around the protected area and that involve the use of natural resources
Economic instruments	Type of economic instruments provided in the environmental policy
Type of rights	Type of rights (customary/statutory) and its characteristics
Pressure	
Category of conservation	Type of category of the protected area
Size of protected area	Area in square kilometers of the protected area
External population	Number of people neighboring to the protected area
Internal population	Number of people living inside the protected area
Minimum distance of settlements	Distance in kilometers from the protected area to the closest settlement
State	
Clarity about boundaries	Percentage of the population that recognizes the boundaries of the protected area
	Existence of conflicting maps or boundary descriptions
Participatory decision-making process	Percentage of the population consulted about the decisions to make
Representativeness	Percentage of each sector or group of the community that took part in the decision process
Socialization	Means used to inform the community about the decision and projects to carry out
Compensation fairness	Rate of the compensation paid against the commercial value of each possession
Compensation satisfaction	Percentage of the population that considers the compensation paid was fair.
Buffer zones	Area in square kilometers of the buffer zones around the protected area
Crop damage	Number of incidents reported regarding crop damaged by animals.
Land availability	Extension of land in kilometers available for normal community development.
Impact	
Restriction of resources	Type of restriction imposed on local communities regarding the use of natural resources
Training in alternative economic activities	Number of projects developed
	Percentage of local people involved
	Budget invested

(*Continued*)

TABLE 13.1 (*Continued*)

Indicators according to DPSIR Framework of SANAPA and Land Rights Holders

Indicator	Description
Capacitating about wildlife–human coexistence	Number of projects developed
	Percentage of local community involved
	Budget invested
Responses	
Tourism benefits	Percentage of the revenues obtained from tourism allocated to projects in benefit of the community
Job generation	Number of local people hired for administration of the protected area
Community development	Status of the main social facilities of the community (school, hospital, etc.)
	Budget in project to improve the status of the social facilities of the community
Infrastructure development	Status of the infrastructure
	Budget in project to improve the status of the infrastructure

views of different stakeholders related to an issue, allowing in turn the recognition of conflict between them. Five stakeholders were identified in the "system SANAPA-local people."

The first stakeholder identified was TANAPA. It is the organization that manages and regulates the national parks in Tanzania. The perception graph was derived from the literature. Four goals were identified: (1) maintenance of flora and fauna of SANAPA safe from conflicting interests of a growing population, (2) community development, (3) preservation of natural heritage, and (4) reduction of conflicts. All these goals are deeply influenced by the management of SANAPA and by interaction with local communities.

The second stakeholder group identified was the group of people who were living in Saadani, even prior to the establishment of the previous game reserve. They report having faced a gradual limitation in their rights and the area of their village. They recognize their illegal access to the park as the only way to access land and the resources needed for life, once their traditional rights were reduced. They support the preservation of the natural heritage and want their incomes and community development programs to be increased. Land tenure insecurity should be reduced, and their traditional rights and livelihoods should not be lost.

The third stakeholder group comprises those people who are living, and continue living, inside the park after its establishment, despite what is envisaged in the legislation. In general, their goals coincided with those of the previous actor; however, they also do not want to see more changes in rights to land and resources.

The fourth stakeholder group is the group of villagers who, contrary to the second category, were told to move out of SANAPA after receiving

compensation. They appear to be the most affected villagers neighboring SANAPA. They were living in an area declared as protected, but unlike the previous actor they were not allowed to stay inside the park and were forced to settle somewhere else. Some of them, trying to be as close as possible to their original place of residence, settled in Saadani village. As expected, they do not want their livelihoods and access to land and land resources to be reduced, but also they seek to do away with resettlements and impoverishment.

The fifth stakeholder group, the last stakeholder analyzed in this study, is the group of villagers who spontaneously migrated from elsewhere and went to Saadani after they learned about the establishment of the park, searching for opportunities that tourism would bring. The establishment of the park is believed to increase the investment in community projects. Thus, villagers expect an improvement in their quality of life. They are mostly interested in the opportunities from the park itself to improve their economic condition and increase their incomes.

Meanwhile, in addition to the five stakeholder groups some other agents were identified, but they were not included in the analysis. In summary, these included (1) the president of Tanzania, who is responsible for the declaration of any protected area, and he or she can also modify the boundaries of a national park; (2) Ministry of Tourism and Natural Resources (MTNR), which heads TANAPA; (3) Tanzanian Wildlife Division; and (4) district local government. All nine actors are linked together, creating a network as seen in Figure 13.1.

After modeling five of the nine actors' perceptions, two analysis cases were conducted: (1) TANAPA and integrated local villagers' perceptions, meaning that all the four categories of local people were grouped in the same perception view; and (2) TANAPA and different villagers' perceptions, in which a simplified view of each different villager's category was considered. The first

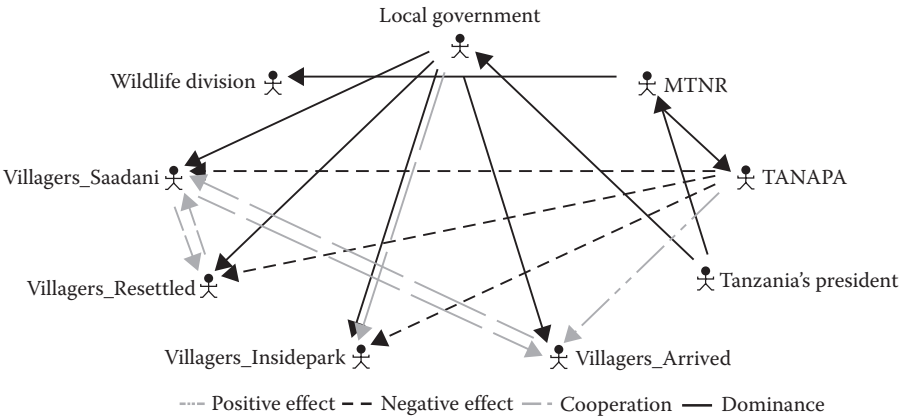

FIGURE 13.1
Actor relations in the establishment of Saadani National Park.

analysis case revealed that the stakeholders diverge only in the actions that should be taken, not in their goals.

In summary, local people experienced dissatisfaction with the extinction of their traditional rights with the establishment of SANAPA, whereas TANAPA experiences dissatisfaction with the illegal access of local people to the park. According to the analysis in DANA, the inferred best strategy from the point of view of local people is to increase access to the park and have more investment in community projects by TANAPA. Their worst strategy would be to keep things as they are. On the contrary, from the point of view of TANAPA the best strategy would be to reduce the illegal access to the park of local people, while preserving their investment in community projects. This clearly shows the divergence in relation to access to the park according to each stakeholder: local people want more of it, whereas TANAPA wants to reduce it. The differences in experience of one stakeholder when the best strategy of the other has taken place allowed identifying that apparently TANAPA is more tolerant to the illegal access to the park by local people than the latter to the extinction of their traditional rights.

The second analysis case (Figure 13.2) reiterated the findings of the first, with identified conflicts in the actions to be taken.

An interesting result of this analysis was that there is not only conflict between TANAPA and the different villagers but also conflict between villages. This means that different categories of villagers also diverge in the

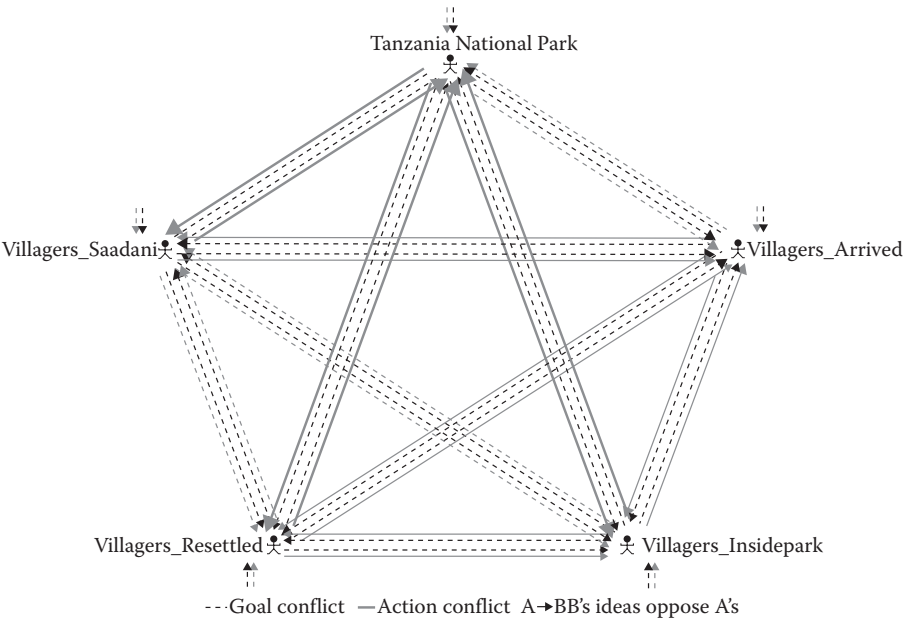

FIGURE 13.2
Goal and action conflict relation between actors—analysis 2.

actions that should be taken, and in what they experience from these actions. The category of villagers that mostly rejects the actions to be taken for TANAPA comprises those who stayed inside the park, which can be explained by the "feeling" they have that they might experience an eviction at any time.

Comparing the results of both analyses, it was noticed that the first case showed an expected level of conflict between TANAPA and local communities and the analysis of the second case allowed identification that actually the different categories of local communities differ in the way they perceive the issue of the establishment of the park. Thus, the level of disagreement between them and the administration of the park, regarding the way things should be done, also differs. This is an expected result, taking into account that each group of villagers was not affected in the same way.

Finally, regarding the results from the process of selecting policy instruments, it is apparent that a variety of instruments could be adopted according to the type of policy and measures implemented. The selection of the optimum instrument for each case is an important task. It should be the most efficient, effective, equitable, and acceptable instrument for both communities and authorities (Australian Public Service Commission 2009). A list of possible instruments to be applied is proposed (Table 13.2). These are

TABLE 13.2

Proposed Instruments to Be Included in the Implementation of SANAPA

Instrument	Description	Conflict Addressed
Using Markets		
Targeted subsidies	Subsidies for the development of alternative economic activities that do not depend on natural resources inside the park.	Illegal access to SANAPA. Reduction of livelihoods.
Creating Markets		
Water easement	This is a relevant instrument considering that rivers running inside the park are the only access that the local communities have to freshwater.	Illegal access to SANAPA. Extinction of traditional rights of local communities. Reduction of livelihoods.
Environmental Regulation		
Zoning	Establishment of a transition zone around the villages surrounding the park where access to certain natural resources is allowed with certain restrictions.	Illegal access to SANAPA. The extinction of traditional rights of local communities.
Engaging the Public		
Information provision	Continuous diffusion of printed materials about the relevance of SANAPA and its management.	The lack of proper communication between the parties involved.
Community participation	Periodic multi-way dialogues between TANAPA staff and local communities.	

compiled from a synthesis of the results from the DPSIR framework analysis, DANA modeling process, and the four categories of instruments proposed by the World Bank (1997) and cited by Sterner (2003) and SIDA (2003).

Discussion

Before the establishment of SANAPA in 2005, there were already various communities settled in the area with a long tradition of use and access to land and natural resources. These land uses and access regimes are now illegal. Moreover, villagers have little or no clarity about the boundaries of the park and they do not have any security with respect to the rights they actually hold. Although the Wildlife Policy calls for survey and acquisition of land title deeds after the establishment of protected areas, no registration was found in the case of SANAPA. This fact might be explained by two issues. One is that most of the rights that people had were customary, and not registered: when the park was established, having no preceding registration, there was no registration to update. Another issue might be the lack of communication between environmental and land agencies.

The results of the analysis performed with the DPSIR framework and DANA software coincide with the discussion about possible conflicts emerging in the event of the establishment of protected areas, as raised by Vatn (2005) and Bergseng and Vatn (2009). Contrasting with the classification of conflicts that these authors proposed with the results obtained in this research, it can be suggested that TANAPA and local communities experience four different disagreements: (1) conflicts of interests regarding the compensation paid, (2) conflicts of interests regarding the extinguishment of rights, (3) conflicts of facts regarding the decrease of livelihoods, and (4) conflicts of value regarding their perceptions.

The conceptual framework implemented in this research proved to be a very useful tool to capture the main issues associated with the subject of study. All the elements were presented in a very simple but highly illustrative manner. This is the major advantage of DPSIR, together with its flexibility. Nonetheless, as discussed by Svarstad et al. (2008), the major disadvantage of DPSIR can also be its weakness: it may lead to simplistic representations of complex issues as the one dealt with in this research.

The integration of the DPSIR framework with the modeling of perceptions is conceived as a complementary approach to increase the analysis and understanding of this complex tenure problem. While DPSIR provides a generalized vision, the modeling of perception graphs provides deep perspectives on the actors involved. Both approaches, either individually or combined, can be applied in the field of land administration. Among the advantages, one could better represent complex land tenure situations (or the existing continuum of land rights), seek to value security of tenure, better

understand the context in which a cadastre and a land register operate, and in general analyze the effects of any land reform (Deininger 2003).

The formulation of indicators from the framework coincides with the approach supported by Balint (2006). He highlighted the importance of identifying relevant factors to improve community-conservation approaches close to protected areas and used them in the form of indicators to foresee the success or failure of initiatives taken for environmental conservation or in the context of land administration: land management initiatives. The indicators in this research observe some characteristics that were discussed by Veleva et al. (2001) related to quality: they were abstracted based on the data collected in the field, which despite the encountered limitations are assumed to be accurate. They were kept simple, and easy to implement and evaluate.

Meanwhile, including the perceptions of the most relevant actors involved in the system provided insights on the cause–effect relations between actions and the conflicts between them, with respect to SANAPA. This was the main reason for the use of this approach: such valuable output would have stayed hidden with a different approach.

Given the type of the research carried out, the analysis and interpretation given to the data collected included a number of assumptions. The perception graphs do not reflect the whole view and opinions of the actors analyzed. This is due to limitations in data collection and the inability of the method to extract the complexity embedded in the issue being studied and to adequately model how people perceive it. For example, the perception graphs in DANA were simplified to enable calculations to be performed. Although this may have resulted in a reduction of the reliability of the results, the complexity of interpreting the results was also reduced, which resulted in a more comprehensible understanding.

In general, the results of the analysis performed by DANA cannot be taken as complete, although they provide a good basis for understanding the issue through discussions of the outputs. Furthermore, the validation of the model should ideally be performed by the actors themselves, which would give relevant inputs to improve an initial approach; also, the analysis should include the perspectives of different analysts. Discussions with the actors represented are the best way to ensure the quality of the results. The analysis of two simplified models, one assuming all villagers as one actor and the other assuming an independent view of the identified different types of villagers, is considered as a way of validating the models constructed.

Policy instruments as tools that assist the achievement of policy objectives are also worthy of discussion, particularly their relevance and impact on the field of land administration. Due to the complexity of the issue analyzed, the proposed instruments supposed a combination of different policy responses, each addressing detected conflicts concerning the establishment of SANAPA. This approach is assumed to work better than trying to tackle each problem individually. However, the identification of the best instruments demands a judicious study not only about the impact the instruments will have but

also about the feasibility in cost, administration, and time, among other factors. Due to time constraints, such a study was not carried out before proposing the instruments and neither was there a joint discussion with the actors potentially involved in the implementation. This, of course, undermines their validity and approval. Nevertheless, they are considered a good starting point for debate of the parties involved. Using the output of the DPSIR framework as a background, and the output of DANA analysis as the guider, it was possible to provide a more reliable, although not complete, group of instruments.

The topic of this research is a complex issue that can be addressed in several ways and with different degrees of extension and depth. The approach adopted was extensive enough to go from explanation of constitutive elements and identification of conflicts through to proposal of instruments to reduce those conflicts. It was considered deep enough to allow the use of a conceptual framework to explain the relationship of such elements, and to represent the views and perceptions of the actors involved. However, the methodology adopted and results produced could be improved in precision, with a wider and more detailed information capture exercise, especially in relation to the modeling of actors' perceptions—a technique that imposes a somewhat higher degree of subjectivity than a conceptual framework. An influential element for the reliability of these methods, apart from the data collected, is the follow-up discussions with the informants in the case of DPSIR and with the actors in the case of DANA. The same applies to the policy instruments.

In general, the two main methodologies applied after fieldwork suited the intention of responding to the research questions and seemed to complement each other. They also gave a basis to research more about them and expand their potential application in the land administration domain. Inclusion of spatial analysis could also add more valuable and interesting outputs.

Conclusion

Using an adaptation of the DPSIR conceptual framework allowed identification and explanation of the elements that, according to the data gathered, appear influential in defining the effects of a specific environmental measure on the existing rights to land of a local community. The elements were listed, on a causal basis, under five different categories: driving forces, pressures, state, impact, and responses. Even though data limitations and assumptions made during the construction of the framework may decrease the reliability of the output, the framework seems to capture the relevant elements associated with the subject of study.

Depictions and analyses of perception graphs of the most relevant stakeholders were carried out using the DANA software. The graphs were developed using the data collected, the analyst's view, and several assumptions

regarding how much one factor influenced the situation. Though validation of the models by the included stakeholders was not feasible, the outputs of the analysis appear to be consistent in reporting a conflict of actions in the two models constructed. The use of DANA imposed limitations on the complexity of the models and of the actor's perception graphs. They should be kept simple to not affect software performance, and also because the results of the analysis are more difficult to interpret.

After the analysis of perception graphs and the identification of elements creating tension between stakeholders, several policy instruments—ones considered to most likely address the identified conflicts—were proposed as responses to reduce the conflicts.

In general, the DPISR framework and DANA modeling methodologies seem to be complementary. The first allows analysis of the general elements relevant to a policy subject, whereas the second helps to place those elements in the way each actor perceives them. Due to their being based on causal relations, both DPSIR framework and DANA software need more data to give more reliable outputs. The simultaneous use of different methodologies allows cross-checking and hence improves validity and reliability of results.

Overall, several recommendations are derived from the research. First, to improve the quality of outputs for similar future research the fieldwork should ideally be carried out in two steps. An initial step should aim to collect and identify the main elements and their relations in the system being studied. Interviews should be flexible and incorporate brainstorming. An initial DPSIR framework and actor's perception model should be drawn. These drafts should be the basis for a second round of data collection. Second, although DPSIR has proved to be a flexible and adaptable framework, the adaptation of concepts should be judiciously analyzed to determine the degree of distorted results it might have, and thus the implications for quality outputs. Third, after the identification of indicators to understand the effect of an environmental measure on the rights of local communities, it is recommended to identify the desired or ideal state for each of the elements that are included in the analysis. Thus, comparative studies can be performed between the ideal and the current condition of the elements and goals. Weighting of each indicator could also be undertaken. Fourth, due to the fact that actors behave according to their interests and values, the modeling of actor perceptions should first identify the different types of interests. Those who share values and interests can be jointly modeled and represented. Fifth, further analysis of the acceptability and efficacy of the proposed instruments might be included in the models of perceptions. Sixth, additional study is needed on the reliability of the results of the analysis of actors' perception graphs that DANA generates. Finally, the applicability of DANA software, and in general of the concept of perception modeling, to study the aptitudes and viewpoints of stakeholders regarding land administration issues (e.g., registration, land titling, and land consolidation projects) could be further trialed.

References

Ally Hassan, N. 2005. Experiences of land use conflict management strategies in rural Tanzania: The case of protection and utilization of Saadani ecosystem. University of Dar es Salaam–University of Dortmund.

Australian Public Service Commission. 2009. *Smarter Policy: Choosing Policy Instruments and Working with Others to Influence Behaviour*. Canberra, Australia: Australian Public Service Commission.

Balint, P. 2006. "Improving community-based conservation near protected areas: The importance of development variables." *Environmental Management* 38 (1):137–148.

Bergseng, E., and A. Vatn. 2009. "Why protection of biodiversity creates conflict—some evidence from the Nordic countries." *Journal of Forest Economics* 15 (3):147–165.

Bots, P., M. van Twist, and J.H. Ron van Duin. 1999. Designing a Power Tool for Policy Analysts: Dynamic Actor Network Analysis. Paper read at Proceedings of the 32nd Hawaii International Conference on System Sciences, Maui, HI.

Bots, P.W.G. 2009. DANA: Dynamic Actor Network Analysis, 2009 2004, accessed September, 2009, http://dana.actoranalysis.com/.

Cernea, M.M., and K. Schmidt-Soltau. 2006. "Poverty risks and national parks: Policy issues in conservation and resettlement." *World Development* 34 (10):1808–1830.

Cocklin, C., N. Mautner, and J. Dibden. 2007. "Public policy, private landholders: Perspectives on policy mechanisms for sustainable land management." *Journal of Environmental Management* 85 (4):986–998.

Cubbage, F., P. Harou, and E. Sills. 2007. "Policy instruments to enhance multi-functional forest management." *Forest Policy and Economics* 9 (7):833–851.

Deininger, Klaus. 2003. Land policies for growth and poverty reduction. A World Bank policy research report. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/2003/06/2457830/land-policies-growth-poverty-reduction.

Doremus, H. 2003. "A policy portfolio approach to biodiversity protection on private lands." *Environmental Science and Policy* 6 (3):217–232.

European Environment Agency. 1999. *Environmental Indicators: Typology and Overview*. Copenhagen, Denmark.

Gabrielsen, P., and P. Bosch. 2003. Environmental Indicators: Typology and Use in Reporting. EEA internal working paper. Copenhagen, Denmark: European Environment Agency.

Hermans, L.M. 2004. "Dynamic actor network analysis for diffuse pollution in the province of North-Holland." *Water Science and Technology* 49 (3):205–212.

Langholz, J., and J. Lassoie. 2001. "Combining conservation and development on private lands: Lessons from Costa Rica." *Environment, Development and Sustainability* 3 (4):309–322.

Lindsey, P.A., J.T. du Toit, and M.G.L. Mills. 2005. "Attitudes of ranchers towards African wild dogs *Lycaon pictus*: Conservation implications on private land." *Biological Conservation* 125 (1):113–121.

Niemeijer, D., and R. de Groot. 2008. "Framing environmental indicators: Moving from causal chains to causal networks." *Environment, Development and Sustainability* 10 (1):89–106.

Nilsson, M., H. Wiklund, G. Finnveden, D.K. Jonsson, K. Lundberg, S. Tyskeng et al. 2009. "Analytical framework and tool kit for SEA follow-up." *Environmental Impact Assessment Review* 29 (3):186–199.
Ojeda-Martínez, C., F.G. Casalduero, J.T. Bayle-Sempere, C.B. Cebrián, C. Valle, J.L. Sanchez-Lizaso et al. 2009. "A conceptual framework for the integral management of marine protected areas." *Ocean and Coastal Management* 52 (2):89–101.
Sandberg, A. 2007. "Property rights and ecosystem properties." *Land Use Policy* 24 (4):613–623.
Shogren, J.F., G.M. Parkhurst, and C. Settle. 2003. "Integrating economics and ecology to protect nature on private lands: models, methods, and mindsets." *Environmental Science and Policy* 6 (3):233–242.
SIDA. 2003. Instruments for Environmental Policy. Environment Policy Division—Swedish International Development Cooperation Agency.
Skonhoft, A. 1998. "Resource utilization, property rights and welfare—wildlife and the local people." *Ecological Economics* 26 (1):67–80.
Songorwa, A.N. 1999. "Community-based wildlife management (CWM) in Tanzania: Are the communities interested?" *World Development* 27 (12):2061–2079.
Sterner, T. 2003. *Policy Instruments for Environmental and Natural Resource Management*. Gothenburg, Sweden: RFF Press.
Svarstad, H., L.K. Petersen, D. Rothman, H. Siepel, and F. Wätzold. 2008. "Discursive biases of the environmental research framework DPSIR." *Land Use Policy* 25 (1):116–125.
Tanzania National Parks, and Department of Planning and Projects Development. 2003. Saadani National Park Management Zone Plan Environmental Impact Assessment. Arusha, Tanzania.
UNEP-GRID Arendal. 2009. Cities environment report on the Internet, November 25, 2003, accessed August 17, 2009, http://www.ceroi.net/.
Udaya Sekhar, N. 2003. "Local people's attitudes towards conservation and wildlife tourism around Sariska Tiger Reserve, India." *Journal of Environmental Management* 69 (4):339–347.
United Republic of Tanzania. 1997. National Environmental Policy. Dar es Salaam, Tanzania.: Vice President's Office.
United Republic of Tanzania. 2009. National Website of the United Republic of Tanzania 2007, accessed June 21, 2009, www.tanzania.go.tz.
Van Gossum, P., S. Luyssaert, I. Serbruyns, and F. Mortier. 2005. "Forest groups as support to private forest owners in developing close-to-nature management." *Forest Policy and Economics* 7 (4):589–601.
Vatn, A. 2005. *Institutions and the Environment*. Cheltenham, United Kingdom: Edward Elgar.
Veleva, V., and M. Ellenbecker. 2001. "Indicators of sustainable production: Framework and methodology." *Journal of Cleaner Production* 9 (6):519–549.
Wanitzek, U., and H. Sippel. 1998. "Land rights in conservation areas in Tanzania." *GeoJournal* 46 (2):113–128.
Wells, M., K. Brandon, and L. Hannah. 1992. *People and Parks: Linking Protected Area Management with Local Communities*. Washington, DC: World Bank.
Williamson, I. 2001. "The Evolution of Modern Cadastres," accessed November 28, 2014, http://www.fig.net/pub/proceedings/korea/full-papers/session6/williamson.htm.
World Resource Institute. 2009. EarthTrends Environmental Information 2007, accessed August 17, 2009, www.earthtrends.wri.org/.