



Contents lists available at ScienceDirect

## Biological Conservation

journal homepage: [www.elsevier.com/locate/biocon](http://www.elsevier.com/locate/biocon)

## Review

## The sacred commons: Conflicts and solutions of resource management in sacred natural sites

Claudia Rutte

Department of Behavioural Ecology, Institute for Ecology and Evolution, University of Bern, Baltzerstrasse 6, 3012 Bern, Switzerland

## ARTICLE INFO

## Article history:

Received 7 February 2011  
 Received in revised form 8 June 2011  
 Accepted 19 June 2011  
 Available online xxx

## Keywords:

Conservation management  
 Sacred natural sites  
 Biodiversity  
 Institutional economics

## ABSTRACT

Sacred natural sites are considered an additional pillar for biodiversity conservation, next to the protected areas network. However, sacred landscapes are not primarily conservation areas, but exist for cultural and social reasons. To evaluate their strengths and weaknesses as community-based conservation areas, a thorough understanding of the underlying values, institutional arrangements, and outcomes is required. Here, I use institutional economics for a meta-analysis of publications on sacred natural sites to identify potential conflicts in their maintenance, and to analyze institutional arrangements to solve these conflicts. I show that most sacred natural sites resemble common-pool resources and that many design principles that are linked to common-pool resources are also found in traditional institutions managing sacred places. Design principles are no blue-print solution but they may guide future research to identify locally robust institutional arrangements that are linked to the ecological integrity of sacred natural sites.

© 2011 Elsevier Ltd. All rights reserved.

## Contents

1. Introduction .....	00
2. Literature .....	00
3. Classifying sacred natural sites .....	00
4. Testing design principles in sacred natural site institutions .....	00
4.1. Successful management of common-pool resources (CPRs) .....	00
4.2. Data collection .....	00
4.3. Results .....	00
5. Discussion .....	00
5.1. Competition over natural resources .....	00
5.2. Modernization versus tradition .....	00
5.2.1. Spiritual versus economic values .....	00
5.2.2. Spiritual versus ecological values .....	00
5.3. Changing spiritual values .....	00
6. Future research .....	00
7. Conclusions .....	00
Acknowledgements .....	00
Appendix A. Supplementary material .....	00
References .....	00

## 1. Introduction

In a wide variety of societies, landscapes are deemed sacred and are partly or fully protected through social norms that are based on

spiritual values. Sacred natural sites are defined as areas of land or water having special spiritual significance to peoples and communities (Wild and McLeod, 2008). Sacred landscapes exist in countries all over the world, and are found in mainstream faiths and numerous local belief systems. They may honor a deity, provide sanctuary for spirits, be a living expression of ancestors, or protect

E-mail address: [claudia.rutte@iee.unibe.ch](mailto:claudia.rutte@iee.unibe.ch)

0006-3207/\$ - see front matter © 2011 Elsevier Ltd. All rights reserved.  
 doi:10.1016/j.biocon.2011.06.017

Please cite this article in press as: Rutte, C. The sacred commons: Conflicts and solutions of resource management in sacred natural sites. *Biol. Conserv.* (2011), doi:10.1016/j.biocon.2011.06.017

a sanctified historic place (Dudley et al., 2009). Sacred natural sites occur at a variety of scales and can be as small as a rock formation or forest patch, or can extend to an entire mountain range (reviewed in Bhagwat and Rutte, 2006). The total number of sacred natural sites is unknown – a global estimate in excess of a quarter of a million is realistic (e.g. 50,000 sacred groves have been reported from India so far (Malhotra et al., 2007), estimates for Ghana (Ntiama-Baidu, 1995) account to at least 2000 sacred groves). By protecting sacred natural sites, local people derive benefits in addition to the spiritual rewards of serving their faith. Sacred natural sites provide a range of ecosystem-services (MEA, 2005); they may serve important health needs of people by providing medicinal plants, protect soil and water and serve as sites for important socio-cultural events such as religious festivals, lifecycle rituals, and secret society meetings (Chandrakanth and Romm, 1991; Dorm-Adzobu et al., 1991; Dudley et al., 2010; Fomin, 2008).

In recent years, conservation specialists have become increasingly aware of the existence of these sites and the capacity of traditional societies to conserve biodiversity (Ormsby and Bhagwat, 2010; Verschuuren et al., 2010; Wild and McLeod, 2008). Since Gadgil and Vartak (1976) published the first study on the ecology of sacred groves in the Western Ghats of India, a substantial body of literature has accumulated that reports on biodiversity in sacred natural sites. Sacred natural sites may play an important role for the conservation of biodiversity because they cover a wide variety of habitats and landscapes, and are often located in biodiversity rich regions (reviewed in Bhagwat and Rutte, 2006; Dudley et al., 2010; Ormsby and Bhagwat, 2010). Furthermore, sacred natural sites are maintained through traditional methods by communities and are deeply rooted in local culture. The exclusion of local people is believed to be one of the reasons why governmental protected areas are often ineffective, despite the large sums of money and manpower invested in them (Brown, 2003). Sacred natural sites are thus considered an additional pillar of biodiversity conservation (Bhagwat and Rutte, 2006; Dudley et al., 2010; Lebbie and Guries, 2008) besides the protected areas network, due to their ecological values and the assumed stability of the institutions managing them.

However, sacred natural sites are neither traditional conservation areas nor are the traditional institutions managing these sites unchanging. Sacred natural sites are areas that humans are using and shaping and are not necessarily representing pristine nature in a fixed state (Juhé-Beaulaton and Roussel, 2003; Sheridan and Nyamweru, 2008). Sacred natural sites are primarily protected by communities for their spiritual or cultural value, and may be additionally valued for social, economic, and ecological reasons, resulting in different forms and intensity of social conflict and human impact on natural resources. Biodiversity conservation is thus one of several concomitant values of sacred natural site protection and cannot be understood in isolation from the full set of values and the set of governing and managing tools that shape human conduct towards these sites. The traditional institutional arrangements of communities that manage these areas are not fixed entities, but change due to socioeconomic and cultural influences (Sheridan and Nyamweru, 2008). Many sacred natural sites have existed for a long period of time (several hundreds or even thousands of years), while others are facing serious threats and many have disappeared (Bhagwat and Rutte, 2006; Chandrakanth et al., 2004).

To evaluate the strengths and weaknesses of sacred natural sites as community-based conservation sites, a thorough understanding of the underlying values, institutional arrangements, and outcomes is required. Such insight will enable us to answer questions like: What are the main functions of sacred natural sites and how can these functions co-exist (or when do conflicts arise)? What are the conditions that lead to successful management of

sacred natural sites? The answers will help to develop policies and initiatives aimed at conserving biodiversity while respecting cultural and spiritual values of sacred natural sites.

In this study I use institutional economic theory and insights derived from new institutionalism (North, 1990; Ostrom, 1990) to identify potential conflicts related to sacred natural sites and to analyze institutional arrangements of communities managing sacred natural sites. First, I classify sacred natural sites based on the entities for which they are valued. In a literature review, I show that many (if not most) existent sacred natural sites resemble common-pool resources. Second, I test whether design principles (DP) that are linked to long-enduring common-pool resources are also found in the governing and management regimes of sacred natural sites. I conclude the paper with a description of conflicts related to sacred natural sites that may lead to their ecological degradation, and discuss possible management solutions to address these conflicts. I also make recommendations for future research on sacred natural sites. The paper seeks to foster interdisciplinary research that is required to fully understand a component of traditional natural resource management that is common, widespread, and that serves both people and nature.

## 2. Literature

In August 2010, I searched for peer-reviewed papers and conference proceedings on the interdisciplinary ISI Web of Knowledge database (<http://www.wok/mimac.ac.uk>, search keywords and combinations: sacred and natural and site, spiritual and value and conservation, sacred and site and management, sacred and conservation). From 119 captured articles I excluded those from the review that report only ecological data or on historic sites. I screened case studies published by the International Union for the Conservation of Nature (IUCN) and the United Nations Educational, Scientific and Cultural Organization (UNHCR) that are available on the internet. Additionally, I used the snowball approach by screening citations in these publications which captured one publication. I found 67 publications from which I extracted information on the underlying values in order to classify sacred natural sites using institutional economics, and on different institutional arrangements in order to test design principles that have been linked to robust common-pool resource management.

## 3. Classifying sacred natural sites

In economics, goods are categorized based on two properties: the difficulty of excluding potential users from their consumption and on whether or not their consumption is rivalrous (i.e., whether one individual's consumption of the good leads to subtractions from any other individual's consumption of that good) (Samuelson, 1954). Four types of goods are distinguished based on these two properties. (1) Private goods for which one person's consumption subtracts from the availability of consumable benefits to others, but exclusion is relatively easy; (2) common-pool resources for which rivalry also occurs, but exclusion is difficult; (3) club goods which are non-rivalrous and exclusion is easy; and (4) public goods for which consumption is non-rivalrous, but exclusion is not possible. This distinction is helpful for identifying the structure of possible conflicts that require different regulatory solutions. Private goods and club goods are relatively easy to manage because the resource is non-rivalrous (club goods) and/or potential resource users can be easily excluded (club goods and private goods). Common-pool resources face problems of overuse, because they are both difficult to exclude and characterized by high rivalry. Thus, a common-pool resource may be subject to the tragedy of the commons (Hardin, 1968) and requires more complex

**Table 1**

Classifying sacred natural sites based on economic theory. Sacred natural sites where the underlying beliefs encompass the natural environment can be either private goods or common-pool resources. Sacred natural sites where the spiritual beliefs refer to only a spiritual being are club goods or public goods.

	Exclusion easy	Exclusion difficult
Rivalrous resources	Private good Very small SNS where spiritual value refers to a spiritual entity that is connected to its natural surroundings (e.g. sacred tree or small rock formation)	Common-pool resource SNS where spiritual value refers to a spiritual entity that is connected to its natural surroundings (e.g. sacred grove, sacred lake)
Non-rivalrous resources	Club good SNS where spiritual value refers to a spiritual entity that is not connected to its natural surroundings (e.g. sacred grove that has been replaced by a temple building)	Public good Large SNS where spiritual value refers to a spiritual entity that tends to be less connected to its natural surroundings (e.g. sacred mountain that is visited by numerous pilgrims)

regulatory solutions to avoid overuse. Here the term 'common pool resource' does not necessarily mean governed by a 'common property regime'. A common property regime is a particular institutional arrangement regulating the preservation, maintenance, and consumption of a resource; common-property is defined as private property of a group of people (Bromley, 1991).

According to this classification, sacred natural sites may resemble club goods, private goods, public goods, and common-pool resources, depending on which type of resource is involved (Table 1). Sacred natural sites exist because people consider nature itself, a god, or a spirit as an integral part of the community, and this spiritual entity is connected to the site. As a spiritual being is always believed to be there no matter how many people seek its blessing, this spiritual entity is non-rivalrous. Depending on what kind of disturbances people consider detrimental to the integrity of the spiritual entity, certain human activities in the site and the use of certain natural resources need to be regulated. Thus, a sacred natural site resembles a club good if people believe that the deity or spirit requires no natural surrounding at all (i.e., no conflict arises through use of rivalrous resources) and access to the site is relatively easy to regulate. If it is believed that the deity or spirit requires no natural surrounding and the exclusion of potential users of the spiritual resource is difficult or impossible, e.g. because the sacred natural site is too large, it resembles a public good. If however, the spiritual being is represented by a natural entity (as it is the case in some animistic beliefs) or is believed to require a certain natural surrounding (e.g. grove is the abode of a deity), such a sacred natural site resembles a common-pool resource. It requires the regulation of access of potential users to the site as well as regulation of the use of natural resources in order to avoid overuse. Sacred natural sites that are valued for their spiritual and natural resources, and are small enough so that it is relatively easy to exclude potential users, resemble private goods. Each type of good poses a distinct conflict potential and requires different management tools in order to maintain it.

The analysis of 67 publications on sacred natural sites revealed that more than half (37) of the publications referred to sacred natural sites that resemble common-pool resources. These are sites of considerable size (exclusion difficult) where natural (rivalrous) resources are closely connected to the site's sacredness. Thirty publications contained no information that allowed classification. Thus, it can be assumed that many if not most, existent sacred natural sites resemble common-pool resources. How do communities manage these sites and avoid overuse of natural resources while providing spiritual, social, and economic services?

#### 4. Testing design principles in sacred natural site institutions

##### 4.1. Successful management of common-pool resources (CPRs)

New institutionalism emphasizes that institutions play a significant role in creating incentives which, in turn, influence cost and benefit calculations, and hence human behavior (North, 1990). Here

I use the language of institutional analysis to refer to institutions as 'the shared concepts used by humans in repetitive situations organized by rules, norms, and strategies' (Ostrom, 1986). Rules, in turn, are 'shared prescriptions (must, must not, may) that are mutually understood and enforced in particular situations in a predictable way by agents responsible for monitoring conduct and for imposing sanctions'. Since Hardin's (1968) influential paper on the tragedy of the commons only two institutional solutions have been recognized to avoid overuse of resources by rational people: private ownership, which might yield sound management in self-interest, or government ownership and centralized regulation of resources. Many sacred natural sites are privately owned and managed by religious organizations, or have been taken over by governmental agencies.

Yet, numerous field studies show that some resource users succeed in preventing over-harvesting of resources upon which they depend without privatization or governmental intervention (National Research Council, 2002; Ostrom, 1990, 2000). Examples of such community-managed common pool resources include irrigation systems (Blomquist, 1992; Trawick, 2001), fishing grounds (Acheson, 2003; Berkes, 1992), pastures (Campbell et al., 2006; Gilles et al., 1992; Netting, 1981), forests (McKean, 1986; Schoonmaker Freudenberger, 1993), and wild plants and animals (Dyson-Hudson and Smith, 1978; Eerkens, 1999). To understand the institutional solutions resource users employ to maintain common-pool resources, scholars in diverse disciplines came together and adopted the Institutional Analysis and Development (IAD) framework (Kiser and Ostrom, 1982) that facilitates a comparison across cases and enables a synthesis (Oakerson, 1986). The IAD framework was developed in order to understand how institutions are formed, how they work and change (Ostrom, 2005). It stresses the importance of institutional arrangements and other contextual factors that influence human behavior. Based on the IAD analyses, eight design principles were identified that are related to long-term robustness of institutions used to govern common pool resources (Table 2) (Ostrom, 1990, 2005). The term robustness is used here as 'the maintenance of desired system performance when subjected to external or internal unpredictable perturbations' (Carlson and Doyle, 2002). These design principles may synthesize core factors affecting the long-term survival of institutions that manage common-pool resources, but they should not be seen and adopted as blue-print policy solutions (Ostrom, 2005). In a meta-analysis of 112 published articles that evaluated the validity of the design principles for explaining success or failures in diverse common-pool resources, two-thirds confirm the relevance of the design principles (Cox et al., 2010). It is likely that the design principles (Table 2) are also represented in institutions that manage sacred natural sites, although spiritual beliefs and practices may play a special role in maintaining sacred natural sites.

##### 4.2. Data collection

I was unable to use most of the 67 publications from the literature review for analysis of these design principles due to a lack

**Table 2**  
Design principles that are linked to robust common-pool resources (based on Poteete et al. (2010) and Cox et al. (2010)). Please note: DP8 was not tested in the current study.

DP1a	Clearly defined boundaries: The set of individuals or households with right to the resource must be clearly defined
DP1b	Clearly defined boundaries: The boundaries of the CPR must be well defined
DP2	Proportional equivalence between benefits and costs: Rules-in-use should allocate benefits associated with a common-pool resource in proportion to contributions of required inputs
DP3	Collective-choice arrangements: Most individuals affected by a natural resource regime should be authorized to participate in making and modifying its rules
DP4	Monitoring: The individuals charged with monitoring rule adherence and resource conditions should be accountable to users
DP5	Graduated sanctions: Sanctions for violated rules should be graduated
DP6	Conflict-resolution mechanism: There should be rapid, low-cost, local arenas to resolve conflicts among users or between users and officials
DP7	Minimal recognition of rights: The rights of local users to make their own rules should be recognized by the national or local government
DP8	Nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises

of required data. I chose only those publications that allowed a conclusion on whether the site is community-managed and on at least one design principle, leaving 18 publications (and 21 sites) for analysis. The absence of information does not mean the absence of design principles, as none of the studies intended to test the principles. The sample unit for my analysis was not unified but comprised single site, community, district, or region scale on which I collected information on the management of sacred natural sites. The following data were extracted: demarcation or fencing of site(s), rules that define access to site(s), membership in governing body, monitoring, sanctioning for rule breakers, conflict resolution, and national or sub-national legislation of sacred natural sites. Further, data to evaluate the performance of sacred natural site institutions using ecological (disturbance of site), social (effectiveness of rules), and spiritual (ceremonies held in site) criteria were collected. As an overall-criterion for the robustness of a sacred natural site institution I recorded the age of each site.

#### 4.3. Results

The meta-analysis of studies that dealt with social or cultural aspects of sacred natural sites revealed that most design principles (DP) that are found in institutions governing common-pool resources are also common in institutions that govern sacred natural sites (Fig. 1; detailed results are available as [Supplementary online-material](#)). Social and physical boundaries are often clearly defined (DP1a present in 73%, and DP1b present in 38% of studies), and monitoring is often vested with community members that are accountable within their community (DP4 present in 55% of studies). Graduated sanctions are frequently used by communities to punish a rule-breaker (DP5 present in 41% of studies). Information on proportional equivalence of costs and benefits (DP2 present in

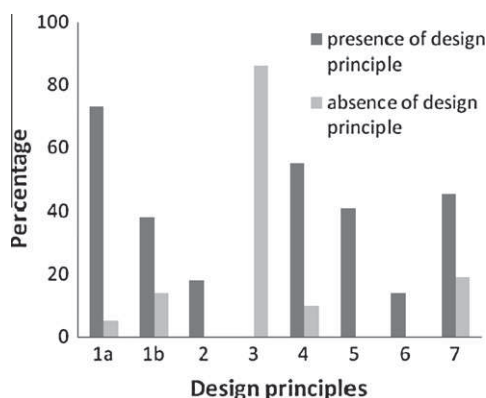
18% of studies) and on the presence of a local conflict resolution arena (DP6 in 14% of studies) is scarce. Most traditional communities do have a local conflict-resolution arena and it can thus be assumed that in most cases where information is lacking design principle six is met. For example, the Panchayats in India and the Kabary in Madagascar are village arenas in which disputes are discussed and settlement is attempted before regional or national courts are approached. Notably, collective-choice arrangements (DP3 absent in 86% of studies) are not involved in sacred natural site institutions. Except from two studies that do not allow a classification, it can clearly be concluded that the responsibility of setting the rules and performing the ritual ceremonies and practices related to a sacred natural site are vested with only a few individuals of a community, such as elders, chiefs, and priests. Minimal recognition of the rights of the community to manage their sacred natural sites (DP7 present in 45% of studies) is most often linked with a sufficiently managed sacred natural site (undisturbed or low disturbance, effective rules). Linkages among DPs1–6 and a well maintained sacred natural site are less clear.

#### 5. Discussion

Sacred natural sites play an important role as biodiversity-rich sites of high cultural significance to local people. Yet, sacred natural sites are today facing a variety of threats, including exploitation of natural resources and destruction (Bhagwat and Rutte, 2006; Higgins-Zogib et al., in press). Commonly, these threats are attributed to a change or weakening of values. To develop strategies that strengthen sacred natural site institutions it will be important to further specify the underlying conflicts of prevailing threats. Based on the literature review, I identify four conflicts and processes that potentially lead to unfavorable outcomes in terms of ecological integrity of sacred natural sites and thus decreasing their value for biodiversity conservation. I highlight potential solutions and policies to deal with these conflicts in order to avoid the degradation of natural resources in sacred natural sites and maintain their value for biodiversity conservation. Additional processes affecting biodiversity of sacred natural sites might exist, as well as processes affecting their sacredness (e.g. unmindful visitation; Higgins-Zogib et al., in press) that I do not address here.

##### 5.1. Competition over natural resources

Common-pool resources are subject to the tragedy of the commons. Institutional arrangements that have been linked with robust common-pool resources (Ostrom, 1990) provide ways of organizing governance that avoids their overuse. From a behavioral perspective, the design principles are making use of evolved mechanisms that facilitate human cooperative behavior. Laboratory and field experiments using games designed to create social dilemma situations in which a tension between private and common interest exists, have shown that reciprocity, reputation (Wedekind and



**Fig. 1.** Presence and absence of design principles in the governing and management of sacred natural sites. The data are based on 21 sites. Please note: numbers for presence and absence of each design principle do not add to 100% as for many sites values were often missing (see also [Supplementary online-material](#)).

Milinski, 2000; Wedekind and Braithwaite, 2002), and punishment (Fehr and Gächter, 2002; Henrich, 2006) are mechanisms that can increase cooperation among unrelated individuals. Given the choice, people prefer institutional arrangements in which those who over-consume common-property resources are punished compared to those in which they go free (Güerker et al., 2006). An experiment designed to study social–ecological systems showed that punishment is used but lacks a gross positive effect on resource harvesting unless combined with communication (Janssen et al., 2010). A recent study on common-property users in Ethiopia (Rustagi et al., 2010) found that groups with relatively more group members who cooperated if others cooperated were more successful in maintaining their forest resources because these conditional cooperators were more likely to invest in forest patrols aimed at enforcing firewood collection rules.

Institutional arrangements designed to incorporate behavioral mechanisms that facilitate cooperation might increase rule compliance. Clear social boundaries, monitoring and sanctioning increase trust that others will cooperate as well. Local conflict-resolution arenas might be important for cooperation mechanisms to be effective by making rule-breaking and sanctioning visible within a larger group. Fairness as created by institutional arrangements producing an equivalence of benefits and costs also plays an important role for people to accept rules (Fehr and Schmidt, 1999; Tabibnia and Liebermann, 2007). Minimal recognition of the rights of communities to manage their resources, and thus legal security, seems to be a precondition for many commons institutions to work sufficiently. Therefore, it is not surprising that common-pool resources and sacred natural sites that resemble common-pool resources are governed by similar means.

However, two exceptions are interesting to be investigated in future studies. A proportional equivalence of costs (e.g. contributing to cultural and social events and ceremonies, clearing fire corridors around a site) and benefits (e.g. opportunity for spiritual worship) might be less relevant for the persistence of sacred natural sites. Sacred natural sites are not primarily protected for livelihood contributions as compared to common-pool resources that are managed for the sole reason for maintaining a resource on which the resource users depend for their livelihood (such as fish, irrigation water, and grazing ground). However, in such cases where sacred natural sites do provide economic benefits (e.g. tourism, sale of timber) the equivalence principle seems to be of importance (Nyamweru et al., 2008). Another prominent exception is that collective-choice arrangements do not play a role in governing of sacred natural sites. Governing committees consist of members that do not represent all social and ethnic classes of a community and are mostly dominated by males. This might be due to the high respect elders, priests, shamans, and healers enjoy within their traditional communities. However, in light of modernization and weakening of traditional values, councils of elected members representing more or all social and ethnic classes as well as having women on their board might be required to maintain sacred natural sites. In Kenya, some Kaya forests are being managed by Kaya Conservation Development Groups where the priest is still vested with the ritual performance in these sacred forests, but youth, women and other community members take a role in decision making (Tengeza, 2003). It remains to be studied how the performance of such modern councils affects the institution sacred natural site.

Spiritual beliefs might enhance (or even replace) some of the effects of social arrangements in sacred natural site institutions. For example, in most cases local people believe in supernatural monitoring and punishment which might have reduced the need for community monitoring and sanctioning. Yet, the existence of common-pool resources that are well maintained without spiritual beliefs suggests that a change or decline of spiritual beliefs among community members does not necessarily lead to the degradation

of a sacred natural site (as long as some value for its protection is still maintained). For example, sacred palace forests in Cameroon have significant public support as places of social and cultural significance, and ritual usage of old and newly created sacred forests is increasing although indigenous belief systems are weakening. Yet, rule compliance is decreased and the forests are increasingly used for exploitation and cash crop cultivation (Fomin, 2008). Clear definitions using rules and a strict local sanctioning mechanism might improve the situation for these forests.

Design principles are thus no blueprints but they can help to identify relevant research questions to understand the existence of sacred natural sites and how they may contribute to biodiversity conservation.

## 5.2. Modernization versus tradition

### 5.2.1. Spiritual versus economic values

A second conflict arises from the competition of spiritual values (e.g. site is the abode of a deity that protects the village and must not be disturbed) with economic values (e.g. use of land for agriculture, timber). Sacred natural sites may become open-access resources and are being damaged, because the spiritual value becomes irrelevant with the advent of 'modernization', or because the economic value dominates the spiritual value due to new market situations. Numerous sacred natural sites are being degraded or have disappeared during recent decades due to such processes (Chandrakanth et al., 2004; Chouin, 2002; Juhé-Beaulaton and Roussel, 2003; Kalam, 1996).

### 5.2.2. Spiritual versus ecological values

Sacred natural sites like some sacred mountains that are huge, but remote and difficult to access, and thus require little or no regulation of access may become insufficiently managed common-pool resources or public goods due to the advent of modern transportation that increases the number of pilgrims while debasing religious beliefs and practices. The shrine of Badrinath in the Indian Himalaya is the major Hindu pilgrimage place. Formerly, pilgrims had to manage an arduous trek to Badrinath; today 400,000 pilgrims come by bus and truck during a short period of time, resulting in the destruction of a sacred forest (Bernbaum, 2010).

These developments might be seen as unfavorable by the respective local community and counter-measures might be taken. Yet, these measures may fail to address the conflict potential if not recognized as such or if the community lacks the support from external forces. For example, the Chief priest of Badrinath joined forces with Indian scientists to re-establish the sacred forest in a series of ceremonial plantings, and gaining enthusiasm of pilgrims and local villagers for the trees (Bernbaum, 2010). Such action will help to re-strengthen the link between spiritual values and the natural surroundings, but the problem of regulating access to a common-pool resource or public good that was not as prevalent before, remains. To prevent sacred natural sites from becoming open-access resources, legal national or sub-national recognition of community property rights for sacred natural sites might be required. However, it is worthwhile noting here that no single broad type of ownership – government, private, community – uniformly succeeds or fails to halt major resource deterioration (Dietz et al., 2003; Poteete et al., 2010). Yet, when legal ownership and operational control are held by different entities – as it is often the case for sacred natural sites – problems may arise. For example, state and community entities may vary in their policy norms and in their underlying motives for using the sites which might lead to destruction of sacred natural sites (Chandrakanth et al., 2004). Also, in light of changing socioeconomic and cultural conditions in many parts of the world, it might be important for the traditional managers to hold some or the whole 'bundle' of property rights to meet

external threats (e.g., immigration, external resource users). A review (Wily, 2008) of recent legal changes in property rights and in legalizing customary management in African countries suggests that legal support for sacred groves is still limited. Social-cultural factors in general are given a low profile with more emphasis upon the economic values of forests to communities. Even where legal arrangements exist for communities to hold common-property rights their practical implementation is slow or absent (Wily, 2008). Sacred natural sites are today internationally recognized by political bodies (e.g. Convention on Biological Diversity, UN Permanent Forum on Indigenous Issues) and several declarations on developing appropriate policies for their protection have been signed. Yet, sacred natural sites are least recognized in national policies and action towards an improvement of their legal status will thus be most efficient on the national and sub-national level.

### 5.3. Changing spiritual values

Sacred natural sites like sacred groves may become club goods, protected for their spiritual values only, because a change in spiritual beliefs disconnects the spiritual being from nature. A shift from nature worship towards icon worship can be observed in some sacred groves in South India; that shift has resulted in felling the trees and constructing temple buildings instead ('Sanskritisation', Kalam, 1996). The destruction of a grove can actually mean an upgrading of the sacred site rather than its loss. In sacred groves, most trees are not sacred but merely form an enclosure to protect the spiritual focal point. The protective function of the trees may well be transferred to a wall whenever it is thought appropriate (Chouin, 2002).

The cultural assimilation of animistic peoples into mainstream religions (e.g. Sanskritization, Christianization) is a process of change in spiritual values throughout the world. This has led to instances of degradation of sacred natural sites, but that pattern is not uniform. Often, local people continue to adhere to their traditional beliefs while being assimilated in more formal religions. It remains with the local communities to define the use of sacred natural sites based on their values; those values might change. Communicating the ecological value of sacred natural sites, however, might give it appropriate consideration. Conservation scientists can play an important role as communicators in the process of change.

## 6. Future research

Conservation initiatives will highly benefit from understanding the outcomes of traditional institutional arrangements affecting the sacredness, biodiversity, and livelihood contributions of sacred natural sites. Future research could be framed around theoretical concepts that have been developed to understand common-pool resources (e.g. Ostrom, 1990; Poteete et al., 2010), social and ecological

systems (e.g. Berkes et al., 2003; Ostrom, 2009), and human cooperation (e.g. Milinski et al., 2002; Rustagi et al., 2010). SANASI (<http://www.sanasi.org>), a database on sacred natural sites of the earth has recently been established by the author and aims to serve as a platform for exchange among scholars from different fields and practitioners to exchange ideas and develop collaborations.

Comparisons of sacred natural site institutions within similar cultural and socio-economic environments, but resulting in different outcomes, will be a promising approach to identify important institutional parameters in resource maintenance. For example, sacred natural sites may be government or community owned (Chandrakanth et al., 2004; Malhotra et al., 2007), but no study yet analyzed whether and how property rights, i.e. the right to exclude users from the site, to manage the site, to use the site, and to transfer the site (Hanna and Munasinghe, 1995), influence the maintenance of sacred natural sites.

Evaluation of sacred natural sites is mostly missing in research so far which makes it impossible to assess the impact of institutional arrangements (or any other measures). To fill this gap in future research, I identified some criteria for success and failure of sacred natural sites to maintain ecological, social, cultural and spiritual functions (Table 3). A methodological notice here is that traditional arrangements to manage sacred natural sites need to be clearly distinguished from such arrangements that have replaced them in many countries, e.g. by a joint management of government and local communities.

## 7. Conclusions

Sacred natural sites are resulting from a complex interplay of human values and behavior, institutional arrangements, and ecology. Three conflict potentials, i.e., among resource users, between spiritual and economic values, and between spiritual and ecological values, and the process of detaching spiritual values from nature might be especially relevant for the future integrity of sacred natural sites. Identifying underlying conflicts and processes of ongoing threats is an important first step for finding potential solutions. A change in values cannot be prevented, but it might be possible to add an ecological value by communicating ecosystem services of sacred natural sites to local communities. For preventing the overuse of resources from sacred natural sites no single blue-print exists and will ever exist. Yet, some general guidelines might be valuable to consider. The insights of field researchers acquainted with local situations and the presented meta-analysis suggest that strategies to strengthen the rights of local communities will be important to sufficiently manage sacred natural sites. Educational programs that help to revive traditional knowledge and practices can support these strategies. Social processes that enable institutional change as adaptation to changing socioeconomic conditions (i.e. change of values, change of rules, power relations within community) have so far not gained enough

**Table 3**  
Criteria to assess institutions that manage sacred natural sites. The list is not comprehensive and aims to serve as an initial step to develop valid and practically feasible evaluation criteria.

	Ecological criteria	Social criteria	Spiritual/cultural criteria
Success	Low rate of human disturbance High percentage of vegetation cover High biodiversity compared to sample sites in same habitat Viable populations of selected species (e.g. threatened, endangered species) Maintaining livelihood resources for local people (e.g. medicinal plants, firewood)	Effective rules Equitable rules Old age (long-term survival) Adaptive capacity to changes Few conflicts	Powerful deity/spirit Regular ceremonies
Failure	High rate of human disturbance Low percentage of vegetation cover Low biodiversity compared to sample sites in same habitat Overexploitation of livelihood resources	Ineffective rules Inequitable rules Many conflicts	Neglect of site (e.g. stopped ceremonies)

attention. Policy makers will highly benefit from understanding the potential, and the limits, of local communities to contribute to biodiversity conservation. Future research should thus take a close look into the institutional arrangements that are used by communities to govern and manage sacred natural sites and how ecological, cultural and social processes are interwoven.

### Acknowledgements

I am thankful to Katrin Daedlow, Antonio Valsangiacomo, Shonil Bhagwat, Fabrizio Frascaroli, Martin Beckenkamp and two anonymous referees for comments on earlier versions of the manuscript. My research is funded by the Cogito Foundation and the Berne University Research Foundation.

### Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.biocon.2011.06.017.

### References

- Acheson, J.M., 2003. Capturing the Commons: Devising Institutions to Manage the Maine Lobster Industry. University Press of New England, Hanover, NH.
- Berkes, F., 1992. Success and failure in marine coastal fisheries of Turkey. In: Bromley, D.W. et al. (Eds.), *Making the Commons Work: Theory, Practice, and Policy*. ICS Press, San Francisco, CA.
- Berkes, F., Colding, J., Folke, C., 2003. *Navigating Social–Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press, Cambridge, UK.
- Bernbaum, E., 2010. Sacred mountains and global changes: impacts and responses. In: Verschuuren, B., Wild, R., McNeeley, J., Oviedo, G. (Eds.), *Sacred Natural Sites: Conserving Nature and Culture*. Earthscan, London.
- Bhagwat, S.A., Rutte, C., 2006. Sacred groves: potential for biodiversity management. *Frontiers in Ecology and the Environment* 4 (10), 519–524.
- Blomquist, W., 1992. *Dividing the Waters: Governing Groundwater in Southern California*. ICS Press, San Francisco, CA.
- Bromley, D.J., 1991. *Environment and Economy: Property Rights and Public Policy*. Basil Blackwell, New York.
- Brown, K., 2003. Integrating conservation and development: a case of institutional misfit. *Frontiers in Ecology and the Environment* 1 (9), 479–487.
- Campbell, B., Gordon, I., Luckert, M., Petheram, L., Vetter, S., 2006. In search of optimal stocking regimes in semi-arid grazing lands: one size does not fit all. *Ecological Economics* 60 (1), 75–85.
- Carlson, L.M., Doyle, J., 2002. Complexity and robustness. *PNAS* 99, 2538–2545.
- Chandrakanth, M.G., Romm, J., 1991. Sacred forests, secular forest policies and people's actions. *Natural Resources Journal* 31, 741–756.
- Chandrakanth, M.G., Bhat, M.G., Accavva, M.S., 2004. Socio-economic changes and sacred groves in South India: protecting a community-based resource management institution. *Natural Resources Forum* 28, 102–111.
- Chouin, G., 2002. Sacred groves in history: pathways to the social shaping of forest landscapes in coastal Ghana. *IDS Bulletin* 33 (1), 39–46.
- Cox, M., Arnold, G., Villamayor-Tomás, S., 2010. A review of design principles for community-based natural resource management. *Ecology and Society* 15 (4), 38.
- Dietz, T., Ostrom, E., Stern, P.C., 2003. The struggle to govern the commons. *Science* 302, 1907–1912.
- Dorm-Adzobu, C., Ampadu-Agyei, O., Veit, P.G., 1991. *Religious Belief and Environmental Protection: The Malshegu Sacred Grove in Northern Ghana*. World Resources Institute, Acts Press, Washington, DC, Nairobi, Kenya.
- Dudley, N., Higgins-Zogib, L., Mansourian, S., 2009. The links between protected areas, faiths, and sacred natural sites. *Conservation Biology* 23 (3), 568–577.
- Dudley, N., Bhagwat, S.A., Higgins-Zogib, L., Lassen, B., Verschuuren, B., Wild, R., 2010. Conservation of biodiversity in sacred natural sites in Asia and Africa: a review of the scientific literature. In: Verschuuren, B., Wild, R., McNeeley, J., Oviedo, G. (Eds.), *Sacred Natural Sites: Conserving Nature and Culture*. Earthscan, London.
- Dyson-Hudson, R., Smith, E.A., 1978. Human territoriality: an ecological reassessment. *American Anthropologist* 80, 21–41.
- Eerkens, J.W., 1999. Common pool resources, buffer zones, and jointly owned territories: hunter-gatherer land and resource tenure in Fort Irwin, Southeastern California. *Human Ecology* 27 (2), 297–318.
- Fehr, E., Schmidt, K.M., 1999. A theory of fairness, competition, and cooperation. *Quarterly Journal of Economics* (August), 817–868.
- Fehr, E., Gächter, S., 2002. Altruistic punishment in humans. *Nature* 415, 137–140.
- Fomin, D.E.S., 2008. Royal residences and sacred forests in western Cameroon: the intersection of secular and spiritual authority. *Journal of the Study of Religion, Nature, and Culture* 2 (3), 391–407.
- Gadgil, M., Vartak, V.D., 1976. Sacred groves of Western Ghats in India. *Economic Botany* 30, 152–160.
- Gilles, J.L., Hammoudi, Abdellah, Mahdi, Mohamed, 1992. Oukaïmedene, Morocco: a high mountain Agdal. In: Bromley, D. et al. (Eds.), *Making the Commons Work: Theory, Practice, and Policy*. ICS Press, San Francisco, CA.
- Gürerk, Ö., Irlenbusch, B., Rockenbach, B., 2006. The competitive advantage of sanctioning institutions. *Science* 312, 108–111.
- Hanna, S., Munasinghe, M., 1995. *Property Rights and the Environment: Social and Ecological Issues*. Beijer International Institute of Ecological Economics and The World Bank, Washington, DC.
- Hardin, G., 1968. Tragedy of the commons. *Science* 162, 1243–1248.
- Henrich, J., 2006. Cooperation, punishment, and the evolution of human institutions. *Science* 312, 60–61.
- Higgins-Zogib, L., Dudley, N., Aziz, T., Malla, S., in press. The High Ground: Sacred Natural Sites, Bio-Cultural Diversity and Climate Change in the Eastern Himalayas, WWF International, Gland, Switzerland.
- Janssen, M.A., Holahan, R., Lee, A., Ostrom, E., 2010. Lab experiments for the study of social–ecological systems. *Science* 358, 613–617.
- Juhé-Beaulaton, D., Roussel, B., 2003. May Vodun sacred spaces be considered as a natural patrimony? In: Gardner, T., Moritz, D. (Eds.), *Göttinger Beiträge zur Asienforschung Nr. 2–3: Creating and Representing Sacred Spaces*. Peust and Gutschmidt Verlag, Göttingen.
- Kalam, M.A., 1996. *Sacred Groves in Kodagu District of Karnataka (South India): A Sociohistorical Study*. Institut Français de Pondicherry, Pondicherry, India.
- Kiser, L.L., Ostrom, E., 1982. The tree worlds of action: a metatheoretical synthesis of institutional approaches. In: Ostrom, E. (Ed.), *Strategies of Political Enquiry*. Sage, Beverly Hills, CA.
- Lebbie, A., Guries, R.P., 2008. The role of sacred groves in biodiversity conservation in Sierra Leone. In: Sheridan, M.J., Nyamweru, C. (Eds.), *African Sacred Groves. Ecological Dynamics and Social Change*. James Currey Ltd., Oxford.
- Malhotra, K.C., Gokhale, Y., Chatterjee, S., 2007. *Sacred Groves in India, Indira Gandhi Rashtriya Manav Sangrahalaya*. Bhopal and Aryan Books International, New Delhi.
- McKean, M., 1986. Management of traditional common lands (Iriaichi) in Japan. In: National Research Council (Ed.), *Proceedings of the Conference on Common Property Resource Management*. National Academies Press, Washington, DC.
- Millennium Ecosystem Assessment (MEA), 2005. *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington.
- Milinski, M., Semmann, D., Krambeck, H.-J., 2002. Reputation helps solve the 'tragedy of the commons'. *Nature* 415, 424–426.
- National Research Council, 2002. *The Drama of the Commons*. National Academies Press, Washington, DC.
- Netting, R.M.C., 1981. *Balancing on an Alp: Ecological Change and Continuity in a Swiss Mountain Community*. Cambridge University Press, New York.
- North, D.C., 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press, Cambridge, UK.
- Ntiamao-Baidu, Y., 1995. *Indigenous vs. Introduced Biodiversity Conservation Strategies: The Case of Protected Area Systems in Ghana*. African Biodiversity Series 1.
- Nyamweru, C., Kibet, S., Pakia, M., Cooke, J.A., 2008. The Kaya forests of coastal Kenya. 'Remnant patches' or dynamic entities? In: Sheridan, M.J., Nyamweru, C. (Eds.), *African Sacred Groves. Ecological Dynamics and Social Change*. James Currey Ltd., Oxford.
- Oakerson, R., 1986. A model for the analysis of common property problems. In: National Research Council (Ed.), *Proceedings of the Conference on Common Property Resource Management*. National Academies Press, Washington, DC.
- Ormsby, A.A., Bhagwat, S.A., 2010. Sacred forests of India: a strong tradition of community-based natural resource management. *Environmental Conservation* 37, 320–326.
- Ostrom, E., 1986. An agenda for the study of institutions. *Public Choice* 48, 3–25.
- Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Actions*. Cambridge University Press, Cambridge, UK.
- Ostrom, E., 2000. Collective action and the evolution of social norms. *Journal of Economic Perspectives* 14 (3), 137–158.
- Ostrom, E., 2005. *Understanding Institutional Diversity*. Princeton University Press, Princeton, NJ.
- Ostrom, E., 2009. A general framework for analyzing sustainability of social–ecological systems. *Science* 325, 419–422.
- Poteete, A.R., Janssen, M.A., Ostrom, E., 2010. *Working Together. Collective Action, the Commons, and Multiple Methods in Practice*. Princeton University Press, Princeton.
- Rustagi, D., Engel, S., Kosfeld, M., 2010. Conditional cooperation and costly monitoring explain success in forest commons management. *Science* 330, 961–965.
- Samuelson, P.A., 1954. The pure theory of public expenditure. *Review of Economics and Statistics* 36 (4), 387–389.
- Schoonmaker Freudenberger, M., 1993. Regenerating the Gum Arabic Economy: local-level resource management in Northern Senegal. In: Friedmann, J., Rangan, H. (Eds.), *In Defense of Livelihood: Comparative Studies on Environmental Action*. Kumarian Press, West Hartford, CT.
- Sheridan, M.J., Nyamweru, C., 2008. *African Sacred Groves. Ecological Dynamics and Social Change*. James Currey Ltd., Oxford.
- Tabibnia, G., Liebermann, M.D., 2007. Fairness and cooperation are rewarding. Evidence from social cognitive neuroscience. *Annals of the New York Academy of Sciences* 1118, 90–101.

- Tengeza, A.H., 2003. Traditional leadership and gender: handling controversies in sacred forests. *COMPAS Magazine* 9, 29–30.
- Trawick, P., 2001. Successfully governing the commons: principles of social organization in an Andean irrigation system. *Human Ecology* 29 (1), 1–25.
- Verschuuren, B., Wild, R., McNealey, J., Oviedo, G., 2010. *Sacred Natural Sites: Conserving Nature and Culture*. Earthscan, London.
- Wedekind, C., Milinski, M., 2000. Cooperation through image scoring in humans. *Science* 288, 850–852.
- Wedekind, C., Braithwaite, V.A., 2002. The long-term benefits of human generosity in indirect reciprocity. *Current Biology* 12, 1012–1015.
- Wild, R., McLeod, C., 2008. *Sacred Natural Sites. Guidelines for Protected Area Managers*. IUCN, Gland, Switzerland.
- Wily, L.A., 2008. Are sacred groves in Sub-Saharan Africa safe? The legal status of forests. In: Sheridan, M.J., Nyamweru, C. (Eds.), *African Sacred Groves. Ecological Dynamics and Social Change*. James Currey Ltd., Oxford.



**Web-only material** (to supplement Rutte: The sacred commons: conflicts and solutions of resource management in sacred natural sites)

**Presence or absence of design principles (DP1-7) in institutions that manage sacred natural sites.** Results are based on single sites, communities, districts, or regions. Blank fields indicate that no adequate information was available. Evaluation measures for the performance of sacred natural site institutions include disturbance of sites, effectiveness of rules, whether spiritual ceremonies are held in sites, and age of sites. Whenever available, information on the potential of sites for biodiversity conservation and on current threats they are facing, is given.

Sacred natural site(s)	Physical boundary (DP 1a)	Social boundary (DP 1b)	Equal benefits /costs (DP 2)	Collective choice (DP 3)	Monitoring (DP 4)	Graduated sanctions (DP 5)	Local conflict-resolution (DP 6)	Minimal recognition of rights (DP 7)	Performance evaluation	Source	Potential for biodiversity conservation	Current threats mentioned by author(s)
Sacred forests, Benin		YES		NO	YES			YES	low disturbance	Juhé-Beaulaton & Roussel 2003		reduced transmission of traditional knowledge
Sacred palace forests, Grassfields, Cameroon	YES	YES		NO				NO (but responsibility still vested with local communities)	low disturbance, decreased rule compliance, regular ceremonies and rituals	Fomin 2008	indigenous trees within open grassland	population pressure, encroachment for cultivation, Christianity
Illubabor sacred grove, Ethiopia	YES (mobile grove)			NO					ritual ceremonies stopped	Berhane-Selassie 2008		ritual experts and custodians were displaced by newcomers
Malshegu sacred grove, Ghana	YES	YES	YES	NO	YES			YES	undisturbed, effective rules, biannual rituals, 300 years old	Dorn-Adzobu et al. 1991	isolated forest in the semi-arid surrounding	
Nkoduroom sacred grove, Ghana	NO	YES		NO	YES	YES		YES	undisturbed, 300 years old	Ntiemoa-Baidu 1995		
Sacred groves, Bortianor village, Ghana	YES			NO	YES		YES	YES	undisturbed, effective rules	Campbell 2005	higher biodiversity than surrounding areas (intensive farmland)	
Sacred groves, Tallensi-Nabdram district, Ghana		YES	YES	NO		YES		YES	effective rules	Barre et al. 2009		western education, different faiths, migration
Three sisters cave Kaya forest, Kenya	YES	YES		NO	YES				low to high disturbance	Metcalfe 2009	high biodiversity (rare and endemic plants), IUCN red listed - vulnerable bat species ( <i>Taphozous hildegardae</i> )	

Kaya Mtwakara, Kwale district; Kenya	NO	YES	YES	high disturbance; decreased rule compliance	Nyamweru 2008	complaints about unfair sharing of monetary revenues from site; local trade of building poles
Kaya Fungo, Kilifi district, Kenya	NO	YES	YES	high disturbance; decreased rule compliance	Nyamweru 2008	conflict between clans over spiritual leadership; trade of building poles in urban market
Kaya Mudzimuvya, Kilifi district, Kenya	YES	NO	YES	low to high disturbance, decreased rule compliance	Nyamweru 2008	commercial timber production, encroachment for cultivation
Kaya forests, Mijkenda, Kenya	YES	YES	YES	low to high disturbance, decreased rule compliance	Githitho 2003	encroachment for cultivation, commercial timber production, tourism
Anavelona sacred forest, Madagascar	YES	NO	YES	low disturbance, effective rules	Rabesahala Horning 2008	high biodiversity, tropical forest in semi-arid region
Androy taboo forests, Madagascar	YES	NO	YES	low disturbance, effective rules	Tengö & von Heland 2010	marginal change in forest cover in Androy between 1984-2000
Chinda and Mungwa sacred forests, Mozambique	NO	YES	NO	decreased rule compliance, rain and post-war ceremonies	Virtanen 2002	higher biodiversity than nearby unprotected forest sites
Sacred groves, Moyamba district, Sierra Leone	YES	NO	YES	low-high disturbance, decreased rule compliance	Lebbie & Guries 1995	in 14 surveyed sacred groves 31 % of tree species known in the country were identified
Sacred groves, North Pare Mountains, Tanzania	YES	NO	YES	initiation ceremonies, rain making ceremonies	Sheridan 2009	920 sacred groves in Mwanga district make up 8 % of the land area and 68 % of its forested area

Sacred groves, Ugundu chieftaincy, Tanzania	YES	YES		age of sites between 6 and 300 years	Mgumia 2003	Sacred groves (cultural vegetation) have more woody species than state managed Forest reserve (natural vegetation)	weakening of traditional institutions; neglect by Department of Forestry
Magezigoomu sacred grove, Uganda	YES	YES	NO	YES	YES	high disturbance, decreased rule compliance, 600 years old	Christianity and Islam, increased ethnic diversity
Musaka sacred grove, Uganda	YES	YES	NO	YES	YES	low disturbance, effective rules	Christianity and Islam, increased ethnic diversity (fear of snakes may be the reason why this grove is better protected than Magezigooma grove)
Sacred forests, Muzarabani, Zimbabwe	NO	YES	NO	NO	NO	loss of 40 % sacred forest area between 1960-1993; decreased rule compliance	African elephant ( <i>Loxodonta africana</i> ) in sacred forests; more loss of forest area between 1960-1993 that had not been considered sacred

## References

- Banana AY, Bahati J, Gombya-Ssembajjwe W and Vogt N. 2008. Legal recognition of customary forests in Uganda. In: Sheridan MJ and Nyamweru C (Eds). African Sacred groves. Ecological Dynamics and social change. Oxford: James Currey Ltd.
- Barre RY, Grant M and Draper D. 2009. The role of taboos in conservation of sacred groves in Ghana's Tallensi-Nabdam district. Social & Cultural Geography 10(1): 25–39.
- Berhane-Selassie T. 2008. The socio-politics of Ethiopian sacred groves. In: Sheridan MJ and Nyamweru C (Eds). African Sacred groves. Ecological Dynamics and social change. Oxford: James Currey Ltd.
- Byers BA, Cunliffe RN and Hudak AT. 2001. Linking the conservation of culture and nature: a case study of sacred forests in Zimbabwe. Human Ecology 29(2): 187–218.

- Campbell MO'N. 2005. Sacred groves for forest conservation in Ghana's coastal savannas: Assessing ecological and social dimensions. Singapore J. Trop. Geogr. 26(2): 151-169.
- Dorm-Adzobu C, Ampadu-Agyei O and Veit PG. 1991. Religious belief and environmental protection: The Malshegu Sacred Grove in Northern Ghana. Washington, DC: World Resources Institute, and Nairobi, Kenya: Acts Press.
- Fomin DES. 2008. Royal Residences and Sacred Forests in Western Cameroon: The Intersection of Secular and Spiritual Authority. Journal of the Study of Religion, Nature, and Culture 2(3): 391-407.
- Githitho AN. 2003. The sacred Mijikenda Kaya Forests of coastal Kenya and biodiversity conservation. In: Lee C and Schaaf T (Eds). Proceedings of the international workshop on the importance of sacred natural sites for biodiversity conservation held in Kuming and Xishuangbanna Biosphere Reserve, China. Paris: United Nations Educational, Scientific and Cultural Organization (UNESCO).
- Juhe-Beaulaton D and Roussel B. 2003. May Vodun sacred spaces be considered as a natural patrimony? In: Gardner T and Moritz D (Eds). Göttinger Beiträge zur Asienforschung: Creating and representing sacred spaces. Nr. 2-3. Göttingen: Peust & Gutschmidt Verlag.
- Lebbie AR and Guries RP. 1995. Ethnobotanical value and conservation of sacred groves of the Kpaa Mende in Sierra Leone. Economic Botany 49(3): 297-308.
- Metcalfe K, Ffrench-Constant R and Gordon I. 2009. Sacred sites as hotspots for biodiversity: the Three Sisters Cave complex in coastal Kenya. Oryx 44(1): 118-123.
- Mgumia FH and Oba G. 2003. Potential role of sacred groves in biodiversity conservation in Tanzania. Environmental Conservation 30(3): 259-265.
- Ntiamao-Baidu Y. 1995. Indigenous vs. Introduced Biodiversity Conservation Strategies: The Case of Protected Area Systems in Ghana. African Biodiversity Series 1.
- Nyamweru C, Kibet S, Pakia M and Cooke JA. 2008. The Kaya forests of coastal Kenya. 'Remnant patches' or dynamic entities? In: Sheridan MJ and Nyamweru C (Eds). African Sacred groves. Ecological Dynamics and social change. Oxford: James Currey Ltd.
- Rabesahala Horning N. 2008. Behind sacredness in Madagascar. In: Sheridan MJ and Nyamweru C (Eds). African Sacred groves. Ecological Dynamics and social change. Oxford: James Currey Ltd.
- Sheridan MJ. 2009. The environmental and social history of African sacred groves: a Tanzanian case study. African Studies Review 52(1): 73-98.
- Tengö M and von Heland J. 2010. Adaptive capacity of local indigenous institutions – the case of the taboo forests of southern Madagascar. In: Boyd E and Folke C (Eds). Governing social-ecological transformation: Adapting to the challenge of global environmental change. Cambridge, UK: Cambridge University Press.
- Virtanen P. 2002. The role of customary institutions in the conservation of biodiversity: Sacred forests in Mozambique. Environmental Values 11: 227-241.