



Research article

Influence of forest management systems on natural resource use and provision of ecosystem services in Tanzania

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ABSTRACT

Social, religious and economic facets of rural livelihoods in Sub-Saharan Africa are heavily dependent on natural resources, but improper resource management, drought, and social instability frequently lead to their unsustainable exploitation. In rural Tanzania, natural resources are often governed locally by informal systems of traditional resource management (TRM), defined as cultural practices developed within the context of social and religious institutions over hundreds of years. However, following independence from colonial rule, centralized governments began to exercise jurisdictional control over natural resources. Following decades of mismanagement that resulted in lost ecosystem services, communities demanded change. To improve resource protection and participation in management among stakeholders, the Tanzanian government began to decentralize management programs in the early 2000s. We investigated these two differing management approaches (traditional and decentralized government) in Sonjo communities, to examine local perceptions of resource governance, management influences on forest use, and their consequences for forest and water resources. While 97% of households understood the regulations governing traditionally-managed forests, this was true for only 39% of households for government-managed forests, leading to differences in forest use. Traditional management practices resulted in improved forest condition and surface water quality. This research provides an essential case study demonstrating the importance of TRM in shaping decision frameworks for natural resource planning and management.

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1. Introduction

Global forest cover is declining at alarming rates (Hansen et al., 2010) primarily driven by agricultural expansion (FAO, 2006) and increasing demand for forest resources by populations whose livelihoods are strongly linked to natural resources (Jha and Bawa, 2006; Ezebilo, 2012) resulting in substantial losses of biodiversity and ecosystem function (Bawa and Seidler, 1998). Environmental degradation is increasingly linked to food shortages and community vulnerability (Franke and Chasin, 1980; Hjort af Ornäs and Salih, 1989), especially in dryland systems where recurrent famine, drought, disease, and conflicts leave populations struggling

to meet basic needs (McCann, 1997). Following the release from colonial governance, development in sub-Saharan Africa largely focused on improving infrastructure, education, and the economy. Management of natural resources was commonly moved to centralized governments where national policies of resource use were established, frequently resulting in unsustainable exploitation, leading scholars to question the long-term sustainability of such policies (Brundtland Report, 1987; Redclift, 1984).

In Tanzania, post-independence land management strategies dismantled indigenous systems with policies of forced village settlements giving control of natural resources to centralized government institutions, which gave top-down policy directions to be carried out by village councils (Shivji, 2002). Such institutions governed large tracks of land through sweeping policies of agricultural development and forestry, but were based on management principles devised for temperate regions (Pretty, 2011; Yeager, 1982). The largest blocks of intact forest were placed in Forest Reserves, designated as Catchment Forest Reserves or Nature

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Reserves (managed by the Forestry and Beeking Division of the Ministry of Natural Resources and Tourism), Game Reserves or Game Controlled Areas (managed by the Wildlife Division), or National Parks (managed by the National Parks Authority), and largely became inaccessible to local communities. While these practices succeeded in securing ecological capital that would become the basis of the tourism-driven economy, they did little to ensure the sustainable use of resources by rural communities. Top-down policies governing non-timber forest products and water withdrawals were ineffective, as they did not reflect the natural fluctuations in resource availability (Hall and Bawa, 1993; van Koppen et al., 2004). Nationalized forest management programs failed to adapt to local conditions and conflicted with traditional religious systems (German et al., 2010; Kamara et al., 2004), forcing communities to rely on shrinking areas of natural resources often leading to decades of destructive exploitation.

More recently, governmental and developmental agencies have realized that key improvements in the decision-making process needed to incorporate local participants in a more decentralized manner (Müller and Guimbo, 2011; Wily, 2000). Land tenure policies developed in the 1990's strengthened village level rights, supporting regional governance of forests and legitimized traditional practices and institutions. The 2001 National Forest Program and the Forest Act of 2002 (URT, 2002) officially instituted reform policies that designated the co-management and joint ownership of forests between local communities and regional governments. The goals of this approach were to improve forest health with sustainable use practices, improve livelihoods through appropriate forest uses, and increase the accountability of management institutions (Wily and Dewees, 2001; Tacconi, 2007) while building social capital. A management program built on social capital can have positive ecological as well as economic benefits (Krishna, 2002). When people have confidence that other community members will likewise engage in cooperative resource use behavior, they are less likely to exploit resources unsustainably (Agrawal, 2002). Community-based Forest Management, specifically Village Forest Reserves became a new designation that limited forest threats and protected forest species while addressing livelihood needs (Blomley et al., 2008) and recent research has demonstrated that participating in local forest governance is strongly associated with improved forest outcomes (Persha et al., 2011). These stakeholders also bring local ecological knowledge (LEK) and social capital to the social-ecological system that may improve participation among villagers and achieve larger conservation goals (Berkes et al., 2000).

Decentralizing resource management has become an increasingly important part of development (Mmari, 2005) and is promoted to alleviate rural poverty while conserving biodiversity (Agrawal et al., 2008; Lund and Treue, 2008). In a decentralized system, decision-making power is shifted to lower levels of government—closer to the people who are directly affected by management and more capable of adapting to changing local conditions and needs. This transfer of power is expected to improve the responsibility of managers with the physical proximity to resources, LEK, and improved information all contributing to better and more efficient management (Agrawal and Yadama, 1997; Ostrom et al., 1999). While roughly two-thirds of developing countries utilize some form of decentralization (Agrawal and Ostrom, 2001), the co-management of forests often results in a failure of the regional government to provide adequate protection standards and rarely are management strategies, power, and participation integrated (Wily, 2001). Government institutions frequently resist transferring the appropriate and sufficient power necessary to regional or local governing bodies that would enable them to effectively carry out management goals (USAID, 2000). Further, many policies have

provided access to, but not custodial responsibility for forests, offering no incentive to sustain the resources long-term (Wily, 2001). Thus, despite the participation of many communities in these management systems, Tanzania's forest cover has continued to decline—from over 41 million hectares in 1990 to 37 million hectares in 2000, and to approximately 33 million hectares in 2010—an annual decline of over 1% with subsequent lost biodiversity and forest products (FAO, 2011; URT, 2001).

Rural Tanzania provides an excellent example of how differing forest management institutions can influence food and water security (White and Martin, 2002). Most households are directly dependent on natural resources such as hunting, medicinal plants, timber, bee-keeping, charcoal production, surface water for irrigation and consumption, and soil fertility (Shvidenko et al., 2005). Despite the importance of forest management to large portions of the population, the effect of different forest management strategies has not been well quantified (Lund and Treue, 2008; Persha and Bloomley, 2009). This study uses an interdisciplinary approach to examine the influence of two differing management strategies on social and ecological systems among Sonjo villages of Northern Tanzania. The Sonjo are an agriculturally-based society living on the border of some of Africa's greatest biodiversity resources: the Serengeti National Park, Ngorongoro Conservation Area and Lake Natron. The Sonjo are subsistence farmers dependent on surface irrigation and seasonal rainfall, having occupied permanent villages in this mountainous region for hundreds of years (Gray, 1963). Pre-colonization, the Sonjo were dependent on forests governed by informal practices with oversight by traditional leaders (*mwanamijie*) with social and religious norms influencing resource use behaviors (Adams et al., 1994). As reported in Strauch and Almedom (2011) and Gray (1963), the *mwanamijie* draw from an extensive knowledge base to govern traditional forests and their resources. Presently, forests in the Loliondo Forest Reserve are managed by either traditional practices or decentralized government strategies. Our objectives were to (1) examine local perceptions of each management system; (2) determine if differences in forest use exist; and (3) identify how natural resources such as forest structure, plant use, and water quality differed between forests. We hypothesized that differences in perceptions of forest management strategies result in differences in management compliance; and that this influences resource quality.

2. Methods

2.1. Study site

Data were gathered in the Sale Division of the Ngorongoro District, in northern Tanzania (2° 10' S, 35° 45' E). This district is located between the Rift Valley escarpment and the Serengeti Plains, divided by the Loliondo Game Controlled Area boundary (Fig. 1). The region is characterized by steep, forested mountains with sloping valleys and permanent springs feeding streams. The primary crops are maize, various beans, and cassava, with sorghum, millet, bananas, sugar cane, papaya, mango, oranges, onions and tomatoes making up smaller contributions. Of the Sonjo villages in the area, we focused on Samunge, the largest village, Kisangiro, Yasimdito, and Sale. Sale is not exclusively a Sonjo village, but a majority of its inhabitants are Sonjo. These villages were chosen as representative of the nine distinct Sonjo villages. Most villages have access to the Loliondo Forest Reserve (LFR), but many other areas have historically been protected as traditional forests. Villagers use the term "forest" to describe the hillside and riparian regions covered in trees, although woodland is a more appropriate term. In Samunge, the decentralized government-managed forest (GF) is the southern portion of the LFR termed Catchment Forest Reserve,

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