

Strategies for Managing Common Pool Natural Resources in Sub-Saharan Africa: A Review of Past Experience and Future challenges

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Abstract: This article reviews the literature on the conservation and livelihood impacts of recent policy and institutional reforms concerning the management of common pool natural resources in sub-Saharan Africa. The evidence suggests that the specific institutional and natural resource context is critical to the success or failure of reforms. We also identify several methodological and data deficiencies in the literature, which pose significant challenges for the design of effective and sustainable policies in the future. We propose several priorities for future research, including: (i) improving the characterization of the nature, extent, and purpose of policies, (ii) controlling for confounding effects and selection bias in research design, (iii) developing standardized and conceptually sound impact measures that are aligned with the goals of policy reforms, (iv) adopting ecosystems approaches that model complex coupled socio-ecological systems, (v) broadening cost and benefit measures to include the regulation of ecosystem services of significant local, regional, and global value, and (vi) identifying long-term economic incentives and benefit-sharing arrangements among stakeholders, particularly given the increasing competition from alternative land use options. Finally, we find that the literature is dominated by contributions from the natural sciences, suggesting an opportunity to increase the role of environmental economics and policy research.

INTRODUCTION

The economies and livelihoods of people in sub-Saharan Africa (SSA) continue to be highly dependent on the primary production activities associated with natural resource extraction (UNU-UNEP 2012). It is important to distinguish between two categories of natural resources: exhaustible non-living resources (e.g., minerals) and renewable terrestrial and aquatic resources (e.g., forests, woodlands, fisheries, wildlife, rangelands, freshwater and marine ecosystems). Property rights' regimes are generally relatively straightforward to define and manage for non-living resources (Collier et al. 2010). However, in the case of renewable terrestrial and aquatic resources -- the vast living resources and natural ecosystems that support the livelihoods of billions of people, particularly in poorer communities and informal sectors -- it is extremely difficult to clearly define and enforce property rights, including rights of access and use, which are typically used to characterize and manage common pool resources (Ostrom 1990, Ostrom et al. 2002, Agrawal 2001).

Prior to colonial rule, the natural commons¹ in SSA were generally exploited under open access (i.e., freely available for use) or traditional communal tenure (property ownership) systems. Given the relative abundance of most of these resources, there was little concern about degradation and depletion. Such concerns emerged during the colonial and post-colonial eras due to increasing population densities and increased commercial exploitation of common pool resources, along with the associated development infrastructure (e.g., railways, roads) (Adams and Hutton 2007, Carmody 2011).

¹ Throughout the article, we use the terms *natural commons* and *common pool natural resources* interchangeably to refer to natural resources owned and managed collectively by a community or society rather than by individuals.

Various management approaches and policy reforms have been attempted in SSA to address the problems of degradation and depletion of the natural commons. During the colonial and post-colonial eras, regimes aimed at nature conservation placed common pool resources under exclusive control of the state, severely restricting access and use rights of neighboring communities. These centralized regimes replaced unregulated open access or communal management tenure systems (Adams and Hutton 2007).

Since the early 1970s, less restrictive commons' governance systems have emerged because of claims that policies of exclusive control by the state did not sufficiently achieve conservation objectives and, in many cases, worsened the conflict between the livelihoods of communities dependent on the resources and conservation objectives (Adams and Hutton 2007, Carmody 2011, Pearce 2005, Brockington et al. 2008). These less restrictive governance systems combined a mix of measures for partial restrictions on resource use through the creation of buffer zones, the granting of rights (licenses) to resource users that include specific restrictions on harvesting methods and season, as well as the incorporation of economic incentives and institutional changes to promote greater cooperation from affected communities (Pearce 2005, Adams and Hutton 2007, Brockington et al. 2008).

More recently, as in other parts of the world, management of the natural commons in SSA has shifted toward decentralized decision making and the devolution of authority to local communities (Murphree and Hulme 2001, Sunderlin et al. 2008, FAO 2015a). Today, the natural commons in SSA is managed under a number of governance and tenure systems, ranging from unregulated and regulated open access to exclusive state control to private property to community-based, co-management, and

other mixed regimes (Sunderlin et al. 2008, Suich et al. 2009, FAO 2015, Blaikie 2006, Hara et al. 2009).

This article reviews the literature that evaluates the performance of these alternative governance and tenure systems. More specifically, we examine the findings concerning the effectiveness of these policies in achieving the goals of nature conservation and improvement of people's livelihoods in SSA, with the aim of distilling lessons and identifying gaps in the literature to help guide future policy and research on the effective management of the natural commons in the region.

Our discussion is organized as follows. In the next two sections, we present a synthesis of the findings of the literature² concerning the impacts of alternative management regimes and policy reforms in the forest and woodlands, wildlife, and fisheries sectors in SSA on nature conservation and livelihoods, respectively. Then, in the final section, we summarize the key findings and lessons learned, discuss methodological deficiencies in the literature, and propose several priorities for future research.

ASSESSMENT OF CONSERVATION IMPACTS

This section discusses the findings of the literature concerning the conservation impacts of alternative management regimes and policy reforms in the forest and woodlands, wildlife, and fisheries sectors, respectively.³ In particular, we compare the findings concerning restrictive governance regimes, such as reserved areas under exclusive state control, with less restrictive systems that involve participation of affected communities.

² See the Appendix for a brief discussion of our methodology for conducting the literature review. Further details are presented in the on-line supplementary materials.

³ The literature is dominated by these types of studies, with more than half of the empirical evaluation studies we reviewed devoted to evaluating only conservation impacts. See Table 1 in the on-line supplementary materials for details.

Forests and Woodlands

Most studies (87.3%) evaluating forest habitat conservation impacts are in the natural sciences literature,⁴ and use objective assessment methods that are based on biophysical criteria and indicators, such as vegetation cover and species population surveys (Lund et al. 2009, Porter-Bolland et al. 2012).

Impact of reserved (protected) areas

McNally et al. (2011) found that reserved areas were successful in preserving the mangrove forests of Tanzania. In a global review of habitat change studies that primarily used land use/land cover change data, Geldman et al. (2013) found that reserved areas had mostly positive habitat conservation impacts in the 18 African countries examined. The study also found that the effectiveness of reserved areas in retaining tropical forest cover was much lower (61%) in SSA than in other regions (>85%). Based on a survey of experts (scientists, managers), Struhsaker et al. (2005) found that reserved areas were successful in protecting 16 rain forest areas in 11 African countries. They also found that when the perceptions of experts concerning habitat conservation were combined with survey data on other key attributes (e.g., size and ecological characteristics of the reserved area, density of the neighboring human population, donor support), there were important contextual factors underlying the observed variations in the effectiveness of reserved areas. In particular, they found that when there was sufficient public and external donor support, better habitat conservation outcomes were more likely for larger forests that are more ecologically connected (i.e., surrounded by identical or similar habitat), and that are in relatively less accessible and low population density areas.

⁴ See Table 1 in the on-line supplementary materials.

Impact of other management regimes

Studies that supplemented the land use/land cover change data with other forest conservation metrics (e.g., species diversity, volume of trees) found that participatory forest management regimes (e.g., involving local communities in managing the forest either alone or jointly with government agencies, joint and co-management systems) were more successful than open access and exclusive state control in Malawi (Abbot and Homewood 1999), Zimbabwe (Cambell et al. 2001, Mapur and Cambell 2002), and Tanzania (Sauer and Abdalla 2007, Blomely et al. 2008). Other meta-analyses that used multiple forest conservation indicators (e.g., vegetation density, number of valuable species) found either no statistically significant differences between open access and participatory management regimes (Hayes 2006) or concluded that the impacts are context dependent (Ribot et al. 2010, Bowler et al. 2012, Padgee et al. 2006).

Another category of studies (based on socio-economic survey data on perceptions of affected community members)⁵ used indicators of compliance with -- and effective enforcement of -- regulations to assess conservation impacts of exclusive state control of reserved areas. These studies include meta-analyses by Gibson et al. (2005) and Chhatre and Agrawal (2008), which indicate better conservation outcomes when there is strong enforcement of informal communal rules. Robinson et al. (2014) and Benjamin (2008) found similar positive conservation impacts in cases where villagers were able to exclude outsiders in Tanzania and enforce informal communal rules in Mali, respectively. In a comprehensive survey of the state of forest tenure systems in SSA, Sunderlin et al. (2008) found that the share of public forests designated for local community use or ownership had significantly increased in recent years, but at a much slower rate than in other parts of the world. The most recent survey of forest

⁵ See Table 1 in the on-line supplementary materials.

status (FAO 2015a) suggests that in recent years in many parts of SSA, forest and woodland management and governance reforms have achieved some success in reducing forest loss and degradation.

Wildlife

Most studies evaluating wildlife conservation impacts are also in the natural sciences literature and use biophysical data and indicators such as species population surveys (visual sightings, aerial surveys).⁶

Impact of reserved (protected) areas

A meta-analysis by Geldman et al. (2013) found that protected areas were effective in maintaining wildlife species populations in African countries in 16 out of the 17 studies considered. However, studies have found that the practice of total exclusion of people through demarcation of reserved areas has resulted in intense conflict between protected area agencies and local communities across SSA (Weladji and Tchamba 2003, Bauer 2003, Thirgood et al. 2004, Kideghesho et al. 2007, Western et al. 2009). In fact, it was under such exclusionary regimes that wildlife populations inside many protected areas in SSA declined rapidly because of unprecedented poaching of rhino, elephants, and other mammals (Brashares et al. 2004, Craigie et al. 2010, Rademeyer 2012, Bennett 2014). Such poaching may have occurred because the State had the property rights to wildlife resources, and thus local communities had little incentive to deter poaching of wildlife inside protected areas. Moreover, there was no economic incentive for local communities to protect wildlife that strayed outside the protected areas because they were not compensated for land and crop damages caused by such wildlife (Weladji and Tchamba 2003). A few studies (Owen-Smith et al. 2005,

⁶ See Table 1 in the on-line supplementary materials.

Struhsaker et al. 2005, Sinclair et al. 2007, Jachmann 2008, Metzger et al. 2010, Naughton-Treves et al. 2011) have found that aggressive anti-poaching activities have positive conservation impacts relative to other conservation intervention measures such as reserved areas, suggesting that the establishment of protected areas needs to be combined with stricter and well-funded anti-poaching measures.

Impact of community outreach and local participation

The literature consistently finds that community outreach programs that provide benefits to communities participating in conservation efforts⁷ improved the relationship between communities and protected areas and to some extent increased landholders' positive perceptions of wildlife (Ashenafi and Leader-Williams 2005, Adams and Hutton 2007, Mukanjari et al. 2013). Nevertheless, conserving wildlife on communal lands continues to face major challenges. One key challenge is generating conservation benefits that are large enough to outweigh the cost of damages that wildlife inflicts on community's livelihoods (Kinyua et al. 2000, Bulte and Rondeau 2007).

Devolving responsibility for wildlife management to key stakeholders (local communities, protected area agencies, the private sector) has been found to be effective, particularly in southern Africa, where there were substantial increases in wildlife populations (Fabricius et al. 2004, Cousins et al. 2008, Suich et al. 2009). For example, Zimbabwe's Communal Areas Management Program for Indigenous Resources (CAMPFIRE) appears to have both achieved some gains in conserving wildlife resources and benefitted local communities (Muchapondwa 2003, Taylor 2009). Similar positive impacts have been reported in Tanzania with the establishment of community-run Wildlife Management Areas (Goldman 2003). In Namibia, institutions

⁷ Such benefits include technical assistance for farming and forestry activities, improved access to health and education services, revenue sharing, and community participation in park management (Shackelton et al. 2010).

called “conservancies,” through which communities are granted conditional ownership of certain game species and the right to buy and sell game, have also had positive conservation impacts (Barnes 2009). Zambia’s Community Markets for Conservation program, which provides technical and financial assistance and market information along the entire market chain to community members participating in selling game and their products, is another example of a successful participatory approach to conservation (Lewis et al 2011).

Fisheries

Unlike the terrestrial natural commons, the protection of inland and marine fisheries faces special challenges due to the biophysical characteristics of the environment in which marine species live. Although marine protected areas⁸ are a popular fishery protection strategy, due to fish mobility, it is not possible to establish boundaries and restrict access to aquatic resources by fencing off users (i.e., fishers). This complicates the monitoring and enforcement of fishery conservation regulations, and thus there are currently very few cases of *total* exclusion of users in SSA (Weigel et al. 2011). Moreover, in contrast to terrestrial resources, fishery stocks (due to their biophysical nature) are difficult to estimate and assess using spatial assessment tools such as remote sensing. Thus, other methods and metrics are used to assess changes in fishery stocks, with the most common being yield modelling, which is based on catch and fishing effort statistics and sample surveys (De Graaf et al. 2015). This is why the share of studies in the fisheries literature that use data and indicators from socioeconomic surveys is much higher than in the forest and woodland and wildlife literatures.⁹

⁸ Marine protected areas are areas of seas, oceans, estuaries or large lakes where human activity is restricted in order to conserve aquatic life, provide reserved sanctuaries, or create cultural or research facilities (Fox et al. 2012).

⁹ See Table 1 in the on-line supplementary materials.

Impact of marine protected areas

Global assessments suggest that marine protected areas have positive conservation impacts in general, and are particularly effective in remote, sparsely populated areas (Lester et al. 2009, Masica et al. 2010, Fox et al. 2012). These conclusions are consistent with the findings concerning impacts of reserved (protected) areas for terrestrial resources (forest and wildlife). Studies that used biological surveys (of species abundance and richness) and yield data (on catch-per-unit-effort) to evaluate marine protected areas found positive impacts on fisheries in SSA, which is consistent with the findings of global studies (see e.g., McClanahan and Arthur 2001, Francis et al. 2002, Kaunda-Arara and Rose 2004, Cinner et al. 2009, Edwards et al. 2008, Evans et al. 2011, De Launay 2012, Kerwath et al. 2013, Machumu and Yakupitiyage 2013, Nel et al. 2013).

Impact of rights-based management approaches

A rights-based fisheries management approach, which provides conditional fishing rights, has emerged relatively recently as an alternative governance regime that is more flexible than marine protected areas (Cancino et al. 2007, Wilen et al. 2012). The three most common forms of rights-based fisheries management are: 1. individual transferable quotas (ITQs); 2. fishing cooperatives; and 3. territorial use rights in fisheries (TURFs).¹⁰ These tools have been applied separately or in combination. Costello et al. (2010) estimated that in 2007, there were 148 large-scale ITQs-managed fisheries worldwide, but South Africa is the only SSA country with an ITQ-managed fishery. Although there are no assessments of fisheries cooperatives in SSA, there are few examples of cooperation in fisheries management (Kanyange et al. 2014). A global

¹⁰Fishers are granted rights to harvest specific species under the ITQs system according to a biologically determined maximum allowable catch. Under the fishing cooperatives' system, fishing rights are granted to well-defined groups of fishers, instead of individuals. TURFs, on the other hand, grant rights to all species found in a clearly defined geographical boundary (Cancino et al 2007).

survey of cooperatively-managed fisheries suggests that fisher cooperatives have helped fishers to better cope with catch shortfalls and natural disasters and enhance their livelihoods (Ovando et al. 2013). In a comprehensive global assessment of TURFs, BS (2014) found that co-management, longer tenure, clearer boundaries, low species mobility, and smaller size have a significant impact on the ability of TURFs to achieve their overall ecological and social objectives. The BS (2014) survey identified four SSA countries (Benin, Cameroon, Ghana, and Nigeria) with detailed site-specific TURF data (and these countries were included in the empirical analysis) and seven other countries that do not currently have operational TURFs, but are in the process of developing TURF systems.

Many coastal countries in Africa provide licenses to vessels from distant nations to fish within their Exclusive Economic Zones,¹¹ without any restrictions on catch quantities. Such arrangements have been associated with illegal, unreported, and unregulated fishing, leading to overexploitation and serious negative impacts on fish stock recovery and marine ecosystems along most coasts in the region (Agnew et al. 2009). It is estimated, for example, that along the West African coast, actual catches are more than 40 percent higher than reported catches (Falaye 2008).

Impact of co-management regimes

Among small scale fisheries in SSA, there has been a general move away from open access and toward co-management regimes, with varying degrees of state regulation or communal rules (Haller and Chabwela 2009). In the absence of an outright prohibition on fishing in protected areas, measures to empower local communities and institutions through co-management arrangements, combined with restrictions on gear, species,

¹¹ These are areas extending 200 nautical miles from the shore for which a coastal state has jurisdiction over the exploitation of marine resources (UN 1997)),

season, and catch size, have shown some effectiveness in achieving conservation goals (Kasulo and Perrings 2006, Mascia et al. 2010).

After more than twenty years of experience with fishery co-management arrangements in SSA, overall there is evidence that they have not been effective in mobilizing resource users to cooperate to enforce regulations to reduce the pressure on fish stocks (Béné et al. 2009, Cinner 2009).¹² In fact, several studies have shown that illegal fishing practices in SSA continued and, in many cases, even increased in major inland and marine systems (Wilson et al. 2006, Akpalu, 2008, Nunan et al. 2015, Stoop et al. 2016).

The fisheries studies we reviewed highlighted the importance of aligning fishery co-management programs with existing institutional arrangements, including values, beliefs, and norms (Wells et al. 2010, Stoop et al. 2016). The failure in the 1990s of a co-management strategy in Ghana, known as the Community Based Fisheries Management Committees, was reportedly due to its failure to align with local community norms (Akpalu 2008). In Malawi and in countries bordering Lake Victoria, compliance with fishing regulations was found to be significantly higher in villages where the formation of co-management committees was self-facilitated (Njaya 2007, Nunan 2006, Russell and Dobson 2011, Nunan et al. 2015).

¹² As noted earlier, many studies of SSA fisheries have used survey data based on self-assessment and stakeholders' perceptions to evaluate the conservation impacts in SSA of regulating access to fisheries or imposing gear or season restrictions. These studies have found that if regulations are perceived as unfair or inequitable by resource users, then fishers are likely to violate them (Branch and Barry 2006, Akpalu 2008 and 2011, Eggert and Lokina 2010, Abusin and Hassan 2014, Mkumbo & Marshall 2014).

ASSESSMENT OF LIVELIHOOD IMPACTS

In this section, we discuss the findings of the literature concerning the livelihood impacts of alternative management regimes and policy reforms aimed at the forest and woodlands, wildlife, and fisheries sectors. All of the studies we identified that evaluate livelihood impacts were based on socioeconomic survey data and indicators, primarily income or consumption expenditure measures.¹³

Forests and Woodlands

Forest and woodland livelihood assessment studies (those focusing solely on livelihoods as well as those examining both livelihood and conservation impacts) account for 60.7% of the empirical evaluation studies we reviewed.¹⁴

Impact of participatory forest management regimes

The findings of the literature are mixed regarding the impact of participatory forest management programs on livelihoods in SSA. There is evidence that participatory forest management regimes have had a positive impact on the livelihoods of people living within and around forests in Ethiopia (Gobeze et al. 2009, and Gelo and Koch 2014), Tanzania (Meshack et al. 2006, Vyamana 2009, McNally et al. 2011), and Kenya, Tanzania and Uganda (Persha et al. 2011). In addition, Fisher (2004) found that community-based forest management systems had positive impacts on livelihoods (income levels and distribution/equity) in Malawi. However, Jumbe and Angelsen (2006) found that participatory forest management was almost “poverty neutral” in

¹³ See Table 1 in the on-line supplementary materials.

¹⁴ See Table 1 in the on-line supplementary materials.

Malawi. Due to high variability in the quality of data, study design, indicators, and reporting of impacts, Bowler et al. (2012) and Padgee et al. (2006) could not draw clear conclusions in their meta-analyses of livelihood impacts of participatory forest management regimes in SSA.

Decentralization of governance and decision-making

The literature generally appears to suggest that decentralization of power and responsibilities to local users has had very limited success, because local government agencies and political elites retained control of key decision-making processes (Oyono 2004, Benjamin 2008). In particular, almost all studies raised concern about the high probability of decentralization leading to increased inequity, with elites appearing to capture most of the benefits from forest management (Meshack et al. 2006, Lund and Treue 2008, Vyamana 2009).

The literature also indicates that in general, decentralization results in higher forest revenues, mainly because of the comparative advantage of collective action at the village level, given the weak ability of government agencies to monitor and enforce resource restrictions and regulations (Lund 2007, Lund and Treue 2008). In fact, the evidence suggests that when local communities are given rights to all or a portion of the proceeds of forest sales, they have an incentive to enforce regulations, at least on outsiders, either by excluding them or ensuring collection of taxes on actual harvests (Lund 2007, Lund and Treue 2008). Nevertheless, the literature shows that enforcement is challenging when funding is not available for the monitoring and enforcement of forest regulations, which is generally the case in SSA.¹⁵

¹⁵ See Robinson and Lokina (2012) for examples and a discussion of these challenges in Tanzania.

The literature indicates that the main factors responsible for the slow transition toward decentralization in SSA are the focus on providing use rather than ownership rights, the inability of governments to adequately implement decentralization policies and provide the necessary complementary support to enable local institutions to govern and manage their forests, and the continued emphasis on large industrial concessions (Ribot et al., 2010; Sunderlin et al., 2008). In a large meta-analysis that compared 129 case studies across SSA, Yami et al. (2009) found that with decentralization, informal institutions (e.g., local leaders, religious groups, community organizations) play a critical role in achieving sustainable forest management, while the role of formal institutions (e.g., forest departments) appears to diminish.

Livelihood projects

One common approach to forest reforms has been the introduction of “livelihood projects,” which provide locals with other income-generating opportunities and products as an alternative to logging for firewood and charcoal. There is evidence that such projects have been successful in many countries in SSA, particularly when they focus on products such as gums, marula fruits, shea butter, mushroom farming, and bee keeping for honey (Shackleton and Shackleton 2004, Albers and Robinson 2011).

Wildlife

Overall, we find that the literature on the impacts of wildlife governance and management regimes on livelihoods is limited. A recent study of Zambia finds that its network of protected areas is under-performing in terms of achieving conservation and livelihood improvement goals (Lindset et al 2014). Cousins et al. (2008) and Suich et al. (2009) find that in addition to its positive conservation impacts, the decentralization of responsibility for wildlife management to key stakeholders, coupled with policies

encouraging commercial use of wildlife and its products through legal trade, had large positive impacts on the employment and incomes of private ranchers in southern Africa. In fact, in these countries, wildlife ranching is becoming more competitive with more conventional land use options such as livestock ranching, generating much higher economic returns and thus attracting significant shares of rural lands (Carruthers 2008, Barnes 2009). However, the long-term sustainability and economic viability of game ranching on private and public lands (i.e., parks) is uncertain given the changing market conditions and relative prices of alternative land uses in SSA.

Cooperative wildlife management on communal lands also faces several challenges. These include the lack of effective decentralization, whereby local communities are not recognized as legal entities and authority is instead given to regional or local government agencies, and the fact that revenues from wildlife management projects do not go directly to local producer communities, but rather are first transferred to higher-level administrative entities (Cousins et al. 2008, Suich et al. 2009).

Fisheries

The impacts of fishery protections (e.g., marine protected areas) on livelihoods appear to be mixed, with some negative outcomes, which are due in particular to weak governance and enforcement of regulation (Mascia et al. 2010, Fox et al. 2012).

Impact of alternative income-generating activities

We identified a number of SSA studies that echo global assessments concerning the importance of both empowering local resource users and addressing poverty through complementary alternative income-generating activities (livelihood projects) (Francis et al. 2002, Mascia and Claus 2009, Cinner et al. 2009). However, the evidence suggests

that such complementary measures must provide sufficient income to offset the costs of the restrictions on those who are highly dependent on fishing and those who live nearby, particularly during the early years of a marine protected area (i.e., before the fishery has recovered) (McClanahan 2010, Robinson et al. 2012). The literature also emphasizes the importance of identifying the negative distributional effects of some measures and regulations (e.g., reserves, TURFs and ITQs) (McClanahan 2010, Worm et al. 2009).

Rights-based co-management programs

There is some evidence of co-management of the fishery through cooperatives reducing poverty in SSA. The Beach Management Units introduced in Kenya and Tanzania, which provide credit to members and assistance to improve their fish processing and marketing, are one example (Kanyange et al. 2014). However, as with livelihood projects, some researchers have expressed concern about the likely undesirable equity and fairness consequences of rights-based fisheries co-management, such as cooperatives (Bromley 2009). For example, in a multi-country study, Béné et al. (2009) found that although co-management programs appeared to have little conservation impact, they had a strong positive impact on livelihoods, but generally in favor of wealthier users.

As the overwhelming majority of those involved in small-scale fisheries in SSA are poor and fish primarily for subsistence, policies aimed at effective management of such fisheries are bound to have major poverty and food security implications for these groups (Neiland and Béné 2004, Allison 2004, Andrew et al. 2007, Sowman 2006). Studies suggest that the relationship between poverty and sustainable management of the fishery reflects dynamics that are much more complex than the assumptions of ease of entry; immobility and inability to exit; and deep poverty and desperate dependence

on fishing (Onyango and Jentoft 2010). Barret et al. (2011) provide a useful analytical framework for understanding the complex and dynamic interlinkages between nature conservation and poverty, identifying policy and institutional (e.g., market, social) failures as one key mechanism behind both the vulnerability of poor people and the decline and/or collapse of common pool resources.

CONCLUSIONS AND FUTURE RESEARCH NEEDS

This article has reviewed the literature that evaluates the effectiveness of alternative policy and institutional reforms in managing common pool natural resources in SSA, with a focus on the impacts of these policies on the conservation of natural resources and the improvement of people's livelihoods. There appears to be a broad consensus in the literature that policies that restrict access to -- and the use of -- the natural commons, such as forest reserves and marine protected areas, have a positive conservation impact, particularly when resources (terrestrial and marine) are located in relatively remote areas and/or buffer zones have been demarcated between human settlements and protected areas (Robinson et al 2013, De Graaf et al 2015). The literature also tends to find that decentralization of decision making authority to local stakeholders has led to better conservation outcomes than centralized state control and open access policies. The lack of a genuine shift of authority to -- and empowerment of -- local communities has been identified as a major obstacle to decentralization reforms. This suggests a need for innovative bottom-up governance approaches and policy reforms that foster local institutions and knowledge and improve the ability of local communities to manage the natural commons and prevent illicit harvesting and trade of timber, wildlife, and fisheries. The literature also emphasizes the critical role of political stability in ensuring the effective management of common pool resources (White et al. 2012, Dell'Angelo

et al. 2017). In fact, political unrest has been found to encourage illicit trade in natural resources, including illegal harvesting (Gagnier 2013, Bennett 2014). The provision of adequate alternative sources of income (livelihood projects) appears to play an important role in encouraging local stakeholders to participate in the enforcement of regulations and in enhancing the efficacy and positive welfare impacts of conservation efforts. The literature also emphasizes that when evaluating the tradeoff between sustainable conservation and livelihood outcomes, it is important to account for variations in specific contextual factors, such as local institutional settings and management practices (e.g., tenure regimes, rights and incentive systems), and resources' attributes (e.g., size and location, species dominance and densities, whether used for subsistence or commercial purposes). Finally, the literature emphasizes that the specific context – and how it is factored in -- is a major determinant of the success or failure of reforms.

Methodological Deficiencies and Challenges

The studies in our review relied on various types of empirical methods and data. However, in reviewing the literature, we identified a number of methodological deficiencies and challenges.

Lack of appropriate data

One methodological problem that characterizes most empirical performance evaluation studies of SSA is the lack of baseline information on the status of the resource and people's livelihoods *prior* to implementation of policy reforms. This means that the majority of these studies had to use *cross-sectional* data for sites with and without the intervention, rather than data before and after the intervention. One potential bias of this approach is the fact that the sites chosen for intervention are usually already in a biophysical state that requires protection. Moreover, such a narrow research design reduces complex reform policies to a simple dichotomous measure -- i.e., present or not

– and thus does not account for important variations in institutional processes and structures, governance reforms, and benefits across stakeholders.

The impacts of changes in the biophysical dynamics of natural resources are also complex and poorly understood (Barret et al. 2011), due in part to a lack of appropriate data. This is particularly a problem for the fisheries sector, where adequate and reliable data on migration patterns, stocks, and the impacts of climate factors are vital for effective fisheries management, but are completely absent for SSA (Marquette et al. 2002, Worm et al. 2009). For example, such a lack of data, and hence an incomplete understanding of the complexities of marine ecosystems, could cause fisheries ecosystem modeling to over-estimate sustainable yield levels (Andrew et al. 2007, Berkes 2001, Sterner 2007, Marquette et al. 2002, Akpalu 2009).

Another important gap in the literature is the poor understanding of the dynamic interactions between the natural commons and changes in external biophysical processes. For example, although climate change may not have adverse impacts on fish production and catch in SSA due to the expected increase in seasonal upwelling, it heightens the uncertainty about the size and composition of fish populations, nature of habitats, migratory patterns, and the overall ecosystem (McGregor et al. 2007, Zeeberg et al. 2008). However, climate adaptation policies in SSA have not addressed the issue of fisheries management, and the link between the performance of small-scale fisheries and external processes such as climate change, pollution, and market risks have generally not been considered in the design of fisheries policies in SSA (Badjeck et al. 2010).

Inconsistencies in impact measures and lack of cooperation across disciplines

Another deficiency in the current literature is the variation in measures of livelihood (e.g., income, revenue, net benefits, consumption expenditure, livelihood dependence, equity) and conservation impacts (e.g., extent and density of vegetation cover, species

counts and diversity, volume of trees) and the lack of standardized and contextually sound indicators (both biophysical and socioeconomic) to allow for more meaningful comparative assessments and to derive generalizable results. For instance, there is a lack of information about the differentiated impacts on various social groups, particularly the poor and vulnerable. Moreover, the existing literature does not account for the effects of confounding factors (other than policies and tenure systems governing the management of the natural commons), does not cross-validate survey methods (e.g., remote sensing and vegetation surveys), and tends to rely on subjective self-assessments of survey respondents (Ostrom and Nagendra, 2006, Ferraro et al. 2012). Clearly, addressing these issues will require increased collaboration between natural scientists and economists. In fact, only 29.1% of the studies we reviewed were joint assessments of conservation and livelihood (i.e., socio-economic) outcomes, suggesting that the current level of cooperation is low.

Lack of emphasis on non-tangible ecosystems services

Another problem with the existing literature is the poor (or lack of) accounting for the impacts of alternative management regimes on the many non-tangible ecosystems services of natural resources. Although tangible services such as timber and non-timber products have direct local value and are generally included in impact assessments, many of the non-tangible services such as biodiversity and carbon sequestration have significant local, regional and global public good value, but are not assessed (Ferraro 2002, Lund and Treue 2008, Gobeze et al. 2009, Pfaff et al. 2013, Angelsen and Rudel 2013, Masika et al. 2010, Barret et al. 2011).

Future Research Priorities

The methodological and data deficiencies of the current literature pose major challenges for the design of effective and sustainable policies in the future. We

conclude by proposing several priorities for future research aimed at addressing these deficiencies and supporting the design and implementation of more informed and effective policies for managing common pool natural resources in SSA:

1. Improve the characterization of the nature, extent, and purpose of resource management policy reforms to account for variations in specific contextual factors (e.g., institutional processes, tenure systems, interests of and incentives for stakeholders, attributes (size, location, biology) of the specific resource to be managed);
2. Control for the effects of confounding factors (i.e., external to the governance and tenure regimes to be reformed) and selection bias in research design, and cross-validate alternative data collection and survey methods (e.g., remote sensing, ground sighting and counts, socioeconomic surveys of households and experts) to enable researchers to draw rigorous causal inferences. Recent impact evaluation studies (Ferraro and Hanauer, 2014; Ferraro and Pressey, 2015) offer some guidance concerning study designs that are likely to generate scientific evidence that can be used to conduct more rigorous comparative impact assessments;
3. Develop standardized and conceptually sound impact measures that are aligned with the goals of policy reforms and that account for the differentiated impacts on specific social groups;
4. Further investigate the livelihood and poverty impacts of decentralizing the governance and management of the natural commons in SSA;
5. Increase understanding of the dynamic interactions between the natural commons and changes in external biophysical processes (e.g., climate change) through the adoption of ecosystems approaches that model complex coupled

socio-ecological systems (Cinner et al. 2009, Western et al. 2009, Barret et al. 2011);

6. Broaden cost and benefit measures to include the regulation of non-tangible ecosystem services of significant local, regional, and global value;
7. Identify long-term economic incentives and benefit sharing arrangements among stakeholders, particularly given the increasing competition from alternative land use options; and
8. Broaden research beyond examination of sector-specific policy measures and consider integration of reforms aimed at reducing poverty into broader national (macro) development and poverty eradication strategies (Béné et al. 2009, Béné and Friend 2009, Allison et al. 2012, Heck et al. 2007).

Finally, as discussed earlier, the literature has been dominated by contributions from the natural sciences. In fact, economics studies (i.e., those published in economic and development studies journals) accounted for about one-third of the empirical evaluation literature we reviewed, with the smallest contribution of economics studies being in the wildlife category.¹⁶ In contrast, natural sciences studies accounted for more than 85% of the conservation impact studies and significant shares -- 37.5% and 65.2%, respectively -- of the livelihood impact and joint conservation and livelihood impact studies. This suggests that there is a great untapped potential to increase the role of environmental economics and policy research in future assessments of alternative strategies for effectively and sustainably managing the natural commons in SSA.

¹⁶ See Table 1 in the on-line supplementary materials.

APPENDIX: METHODOLOGY OF THE LITERATURE REVIEW

The main source of information for this study was a web-based literature search. We selected studies based on the following criteria. First, we primarily identified studies specifically on the common pool natural resources of SSA. We included meta-analyses that compared the natural commons' situations in SSA and non-SSA countries. Second, we identified SSA studies that focus on three specific types of ecosystems: forests and woodlands, wildlife, and marine and freshwater fisheries. These sectors were chosen because of their relative importance for the livelihoods of the poor in SSA (see online supplementary material for more details).

Our third search criterion concerns the key objectives of the management approaches and policy measures implemented. Conserving natural resources while simultaneously improving livelihoods, particularly of the rural poor, have been the two major goals of almost all management and policy reforms for sustainable development in SSA (Adams and Hutton 2007, Sunderlin et al. 2008, Camody 2011). Thus, we included studies that used a wide range of methods to evaluate the conservation and/or livelihoods impacts of policy reforms and interventions aimed at managing common pool resources in SSA. Based on these three criteria, we identified -- and included in our literature review -- 105 impact evaluation studies (see Table 1 in the on-line supplementary material).

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