Evaluating Failures In Tropical Forest Management: Incorporating Local Perspectives Into Global Conservation Strategies

Julia Evelyn Latham

Ph.D.

The University of York

Environment Department

September 2013

Thesis Abstract

Despite decades of varied conservation and management interventions, tropical forests remain one of the world's most threatened biomes. Tropical forests directly support the livelihoods of millions of people in poverty through the provision of food and fuel, while also delivering vital ecosystem services such as carbon sequestration and watershed protection. Approaches to conserve and manage tropical forests have evolved in recent decades, reflecting an increasing appreciation for the multiple ecological, social and economic services they provide. However, growing appreciation for the multiple benefits of forests has arguably not been met with their growing realisation in practice. Indeed, it is becoming apparent that trade-offs in forest conservation and management are common, whereas 'win-win' outcomes for both development and conservation are rare. Despite this, emerging policies aimed at reducing emissions from deforestation and degradation (REDD+) have harnessed international attention, given theoretical benefits not just for climate change mitigation, but biodiversity conservation and poverty alleviation. For REDD+ to succeed where other policies arguably have failed, critical examination of existing tropical forest conservation and management policies is necessary to provide implementation recommendations.

In this thesis I critically review the history of interventions to conserve and manage tropical forests (Chapter 2), and highlight three repeated failures in implementation that are common to all examined policies: low appreciation by management for the heterogeneity of target communities and dependence on forest resources; low levels of community inclusion and participation in management; and a continued deficit in clearly defined social and economic indicators of intervention success. To address these concerns I suggest examination of policy implementation at the local level is needed, with focus on what works where, for whom, and why, rather than what the 'silver bullet' for tropical forest conservation and management might be. Using a case-study approach in Tanzania, I examine the implementation of different management regimes, including strict protection and Participatory Forest Management (PFM), from the local socio-economic perspective.

In the first empirical chapter (Chapter 3), I measure household awareness of the different forest management regimes in the study area using household questionnaire surveys. Results show that awareness of forest management and rules and regulations was clear, however confusion in the type of regime in place was apparent. Overall, awareness for top-down management structures was high, yet few households were engaged in rule formation of the PFM forests and none were aware of joint-management status. Findings indicate that forest management implementation

must consider heterogeneity in villager awareness for management regimes, yet logistic regression models show this heterogeneity cannot necessarily be defined in a predictable way based on household socio-economic characteristics. Management implementation that focuses on transparent, uniform and consistent communication of information across whole forest-adjacent communities is therefore more likely to succeed.

In the second empirical chapter (Chapter 4), I quantify household forest product use in the study area to examine the impact of forest access restrictions on household ability to meet firewood needs. Household perceived need for firewood was compared with quantity consumed to provide an indication of household firewood sufficiency. Results indicate management effectiveness is reflected by this measure of firewood sufficiency. Harvest from non-forest areas was found to significantly reduce firewood sufficiency, presenting concerns for household welfare and/or leakage of harvesting activities to other less-well protected forests in the area given a recent ban on firewood collection in a nearby National Park. Results of this chapter support suggestions that forest management adopt a landscape approach in planning, to account for local resource needs and avoid the negative impacts of leakage and detriment to local welfare.

Finally, in Chapter 5 I use a qualitative approach to examine local perceptions of the challenges for forest protection, and compare these across stakeholder groups from the villager to management level. Issues that permeate the discourses are categorised into three themes: education, governance and forest dependency. The importance of each issue was found to vary by stakeholder group, identifying a disconnect and division in accountability for forest protection between villagers and management officials. Results suggest more novel approaches for social engagement and community inclusion in forest management are necessary. I suggest that facilitation of villager empowerment is needed for village institutions to be effectively accountable for forest protection, thereby aiding long term management success.

Overall, the thesis shows that forest conservation and management interventions need to account for the perspectives and needs of local forest-adjacent communities. In Chapter 6, results are discussed in light of the three repeated failings of tropical forest conservation and management interventions, as outlined in Chapter 2. Results confirm these failings in implementation exist in the study area. As such, I suggest that the local socio-economic measures used in this thesis can be used in future evaluations of global tropical forest policy. Results also present important implications for emerging REDD+ policies, as limits to achieving the multiple benefits of climate change mitigation, biodiversity conservation, and poverty alleviation are identified.

Contents

Chapter 3

Measuring Household Awareness of Tropical Forest Management Regimes in Rural Tanzania.

Chapter 4

The Impact of Access Restrictions on Household Forest Product Use and Firewood Sufficiency in Rural Tanzania.

Chapter 6

Appendices

List of Tables

Chapter 1

No Tables.

Chapter 2

No Tables.

Chapter 3

Chapter 4

Chapter 5

Chapter 6

No Tables.

Appendix

List of Figures

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

No Figures.

Appendix V

Acknowledgements

This research was funded by the Economic and Social Research Council (ESRC), studentship 105028383. I am grateful to the Tanzanian Commission for Science and Technology (COSTECH) for permission to conduct fieldwork in Tanzania. Many thanks also to Udzungwa Forest Project (UFP) and the Udzungwa Ecological Monitoring Centre (UEMC) for logistical support throughout the field period. I would like to thank Dr. Andrew Marshall for his unflappable supervision, support and advice throughout the last four years. I'd also like to thank Dr. Marshall for the loan of his trusty vehicle in Tanzania, despite getting stuck in mud frequently it never let me down. I am very grateful to Dr. Susannah Sallu at the University of Leeds, for her constant support and constructive advice, and for providing invaluable additional supervision even when not obliged to do so. For additional supervison I would like to thank Steve Cinderby at the Stockholm Envrionment Insitute (SEI) in York, and also Dr. Samarthia Thankappan and Dr. Murray Rudd on my Thesis Advisory Committee.

For thoughtful discussion at different stages of the research I would like to thank Tom Blomley, Marije Schaasfma, Julie Simons, Katherine Homewood, Brian Orland and Larry Gorenflo, Salla Rantala and Nike Doggart. For assistance with data handling I am extremely grateful to Johan Nygren. Thanks also to Phil Platts for support and assistance with cartography, and to Mike Kramer for assistance with graphic design. I am grateful to Professor Neil Burgess and Professor David Raffaeli for examining the thesis.

Throughout the ten month field period I was assisted by Mohamed A. Kambi in translation and logistics. In addition, I was assisted by five enumerators Ladislaus Mkatihela, Shafii Rashidi, Katenga Henry, Joseph Damiani Nyambi and Hassan Pamuhi, and Nizar Kilale assisted with additional transcribing. Fieldwork would not have been possible without this assistance, for which I am extremely grateful. I would like to thank the Tanzania National Park Authority staff at the Udzungwa Mountains National Park for making me feel welcome during fieldwork. I am extremely grateful to all villagers who let me conduct research within their homes, and all other respondents within this research, including Government Officials, TANAPA staff at Udzungwa Mountains National Park and World Wide Fund for Nature staff. Thank you to the staff at UEMC for making my stay comfortable and enjoyable, to Stacey Noel at SEI in Dar es Salaam for opening up her home to me, and to Anne-Marie Soulsby for being a constant source of support and help. Thanks also to Dr. Kate Nowak, Trevor Jones, Dr. Francesco Rovero and Baraka De Graaf for friendship in the field. My fieldwork period was also made enjoyable by all the Tanzanian people I encountered, for their welcoming smiles I am grateful.

I'd like to thank friends and colleagues in the Environment Department for all the support, fun and friendship over the past four years. I am very grateful to Tom Holmes for assistance with proofing, especially for spotting the unsavoury characters and all that entailed! Thank you to my York family, Daisy and Mike Chapman, for their generosity and always providing such a welcome home for me and making sure I am well-fed. Thanks also to the Bandeira family for making me feel at home in their home. To anyone I have inadvertently forgotten and to everyone who has helped me along the way, I thank you.

A special thank you to my friends and family for their continued support, love and friendship. Thanks especially to Johanna, Nat, Liz, Sal and Cara for always listening to me chatter on about my thesis. An extra thanks to my Dad, for believing in me, for reading drafts, and for always being willing to engage in long discussions with me over my work. Most of all, I thank Ed, for living through this with me whether near or far, for being patient and encouraging, and for always being able to make me laugh. This thesis is dedicated to you.

Author's Declaration

I declare that the work contained in this thesis is my own and has not been submitted for any other degree or award. Colleagues who contributed in a supervisory role are included as co-authors on the respective chapters, wherein the nature of their contributions are detailed. However, I played the dominant role in all study design, data collection, data analysis, interpretation and writing.

Signed

Julia Evelyn Latham

Women collecting firewood from Udzungwa Mountains National Park on Thursday, harvest day.

“Msitu ni uhai” / “Forest is life”

1 General Introduction

Overview

The conservation of biodiversity has conventionally been the central aim of tropical forest management, by setting aside areas for protection and restricting human encroachment. However, approaches to conserve and manage tropical forests have evolved in recent decades, reflecting growing appreciation for the multiple ecological, social and economic services that tropical forests supply. Since the 1980s, global forest conservation and management interventions have increasingly sought to incorporate the rights and needs of local communities in their design (e.g. Wells and Brandon 1992; Adams 2004). For example, such incorporation is manifest in widely practiced forms of participatory forest management (PFM), whereby the rights and responsibility of management are devolved to the local community level (Schreckenberg et al. 2006). Yet, despite decades of such varied interventions, deforestation and degradation rates in tropical countries remain high (FAO 2010). Experience now indicates that 'win-win' interventions, that both conserve biodiversity and promote human well-being, are the exception rather than the norm (McShane et al. 2011). Arguably, increasing recognition for the multiple values of tropical forests has not been met with increasing realisation in practice.

New hope for the conservation and management of tropical forests is offered by emerging international policy aimed at reducing emissions from deforestation and degradation (REDD+). REDD+ is a financial incentive aimed at changing current land use practices in developing countries, by ensuring forests are worth more standing by way of carbon storage than harvested for resources or cleared for alternative land use. Primarily, REDD+ remains a climate mitigation strategy, yet REDD+ activities have the potential to provide additional poverty alleviation and biodiversity conservation co-benefits (UNFCCC 2007). Given this, REDD+ has harnessed international attention, not just within political forums but also the scientific literature and media. In 2009, the Copenhagen Accord recognised the importance of REDD+, and funds were mobilised and pilot projects initiates in the tropics (UNFCCC 2009). The complexities of REDD+ policies are reflected in the volume of literature now available regarding the technicalities of such an international initiative (e.g. Bottcher et al. 2009; Romijn et al. 2012; Streck 2012). However, comparatively less attention has been afforded to examination of REDD+ potential to account for the failures of existing policies at the sub-national level, to significantly improve upon its chances of success (e.g. Corbera et al. 2010). This issue is the central motivation for this thesis.

The important role of communities in conservation planning has been emphasised. Implementation needs to consider the heterogeneous nature of communities for adaptive management, given the involvement of multiple actors with multiple interests and influence (Agrawal and Gibson 1999; Berkes 2004; Berkes 2007). As such, for tropical forest conservation and management interventions to achieve both social and ecological successes, recognition and support for local social dynamics must be granted rather than focussing on the conservation agenda alone. In this thesis, I adopt this community-centred approach to make recommendations for the conservation and management of tropical forests and REDD+, by evaluating interventions to conserve and manage tropical forests from the local socio-economic perspective.

Case-study Approach

This thesis adopts a case-study approach to examine local socio-economic perspectives of tropical forest conservation and management regimes. Research was carried out in Tanzania, where methods for REDD+ policy are currently being tested through the existing PFM programme in the country (Burgess et al. 2010). A study area was selected based on proximate forest patches that were subject to varied management regimes, while also being of high conservation value and facing increasing population pressure. The Eastern Arc Mountains, which extend from south-east Kenya to southern Tanzania, are one of the world's most important areas for the conservation of biodiversity (Burgess et al. 2007). The majority of the forests within the Eastern Arc in Tanzania are managed by either the Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism, the Tanzanian National Park Authority (TANAPA) or District Natural Resource Departments, as Protected Areas, gazetted or proposed Forest Reserves or Village Forest Reserves (Burgess et al. 2007). High pressures are exerted on these forests, given hundreds of rural communities living adjacent to forest boundaries and the limited management and financial capacity of the FBD (Burgess et al. 2007). Indeed, an estimated 63% of the Udzungwa mountains in the Eastern Arc have been heavily degraded by human activities (Marshall 2007). Tanzania's human population is rapidly expanding, with the latest national census revealing the national population has more than tripled in the last 45 years, from 12.3 million people in 1967 to 44.9 million in 2012 (NBS 2013). Continued population growth means increasing pressure on Tanzania's forest network, as forest biomass such as

firewood and charcoal provides the main source of cooking fuel in Tanzania, accounting for over 90% of total energy consumption (Felix and Gheewala 2011; Schaafsma et al. 2012).

Forest Management in Tanzania

In total, Tanzania has over 34 million hectares of forested land, over half of which is within gazetted or proposed Forest Reserves, Game Reserves or National Parks (*c.* 18.8 ha), with the remainder outside the reserve network on village or general land (Blomley et al. 2008). Tanzania has a long history of state-driven forest management, established during the German colonial administration. However, continued deforestation and government budgetary constraints led to the promotion of PFM by the Tanzanian government since the mid-1990s (MNRT 1998, 2002). PFM now governs over 10% of Tanzania's forested land (Blomley et al. 2008), in the form of Community Based Forest Management (CBFM) in Village Forest Reserves or Joint Forest Management (JFM) in Government-owned forests. Evidence for improved forest condition with community inclusion in management has been found (Blomley and Ramadhani 2006; Blomley et al. 2008; Blomley and Iddi 2009), yet outcomes for local livelihoods are mixed but poorly understood (e.g. Vyamana 2009; Pfliegner 2010). Tanzania is one of the nine initial countries under the UN REDD programme, a collaborative initiative designed to assist countries with 'REDD readiness', and donor funding now supports a national strategy, investment in research and capacity and the establishment and continuation of sub-national pilot projects (Milledge 2009). Some of these pilot projects are currently testing REDD+ implementation linked to the existing PFM programme in the country (Burgess et al. 2010), and thus the ability of sub-national regimes such as PFM to shape local forest-user actions remains significant.

In Tanzania between 130,000 and 500,000ha of land continues to be deforested annually due to agriculture, overgrazing, charcoal burning, fuelwood harvesting, wildfires and commercial logging (FAO 2010). In the Eastern Arc, conservation strategies appear to have reduced the rate of habitat loss, with most forest loss happening outside the protected network within deciduous woodlands (Green et al. 2013). However, these woodlands are an important source of ecosystem services, and forest protection in the country still faces a number of significant challenges. In coastal forests, limited capacity within government administrations has contributed to poor management of Forest Reserves, whereas National Parks and Village Forest Reserves have been more effectively managed (Burgess et al. 2013). In 2011, a new semi-autonomous Government Executive Agency, the Tanzania

Forest Service (TFS), was established with the mission of "Sustainably managing the National forest and bee resources in order to contribute to the social, economic, ecological and cultural needs of present and future generations" (www.tfs.go.tz). The TFS is now responsible for the operations of the FBD and for the management of national Forest Reserves, bee reserves and forest and bee resources on general land. However, the FBD remain responsible for developing relevant policies, laws and regulations and overseeing implementation in the sector.

Study Area

To meet the aims and objectives of this thesis, primary data were collected in five forest-adjacent villages within the Eastern Arc Mountains region of Tanzania (Figure 1). Data were collected using a mixed methods approach, using participatory mapping techniques, structured household questionnaires and semi-structured interviews, during a seven month field period between March and December 2011. Villages were selected to maximise variation in forest management regime whilst minimising geographic spread, to avoid high variation in ecological and social factors. Three different management regimes are represented within this study sample: National Park (Sonjo village), CBFM (Kiberege and Tundu villages), and JFM (Signali village). The final village, Magombera, is adjacent to Magombera Forest which currently has no formal management or protection. This forest has a complex history, having been degazetted as a Forest Reserve in 1981 with the intention of annexation into the Selous Game Reserve. This annexation was not completed, and at the time of data collection half of the forest was owned by the Kilombero Sugar Company and proposals for the remainder to be gazetted as a Nature Reserve were being discussed (Marshall, pers. comm., and see Marshall 2008 for summary).

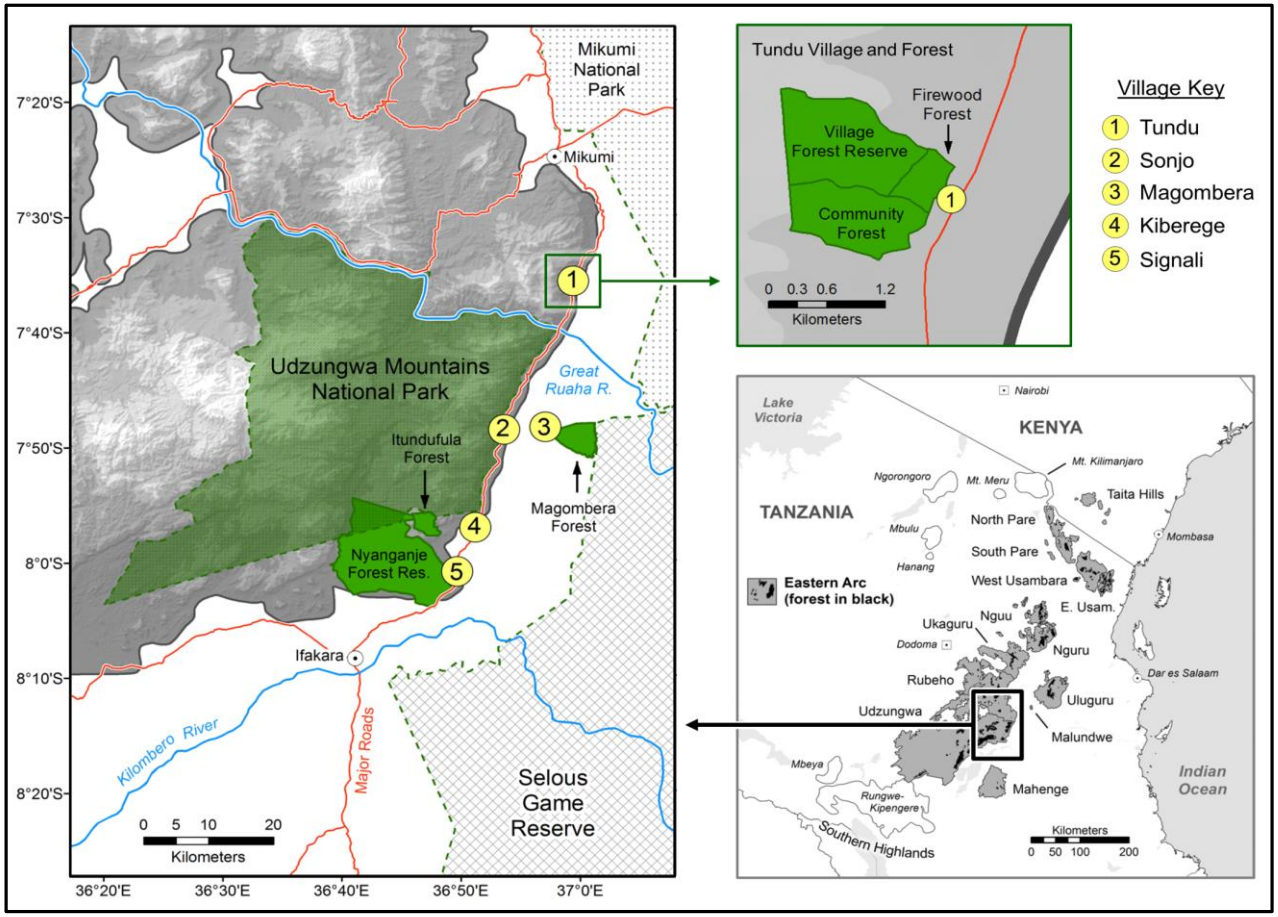


Figure 1. Location of the five study villages in Tanzania and adjacent forests. Adapted using data on Eastern Arc Mountain boundaries and forests from Platts et al. (2011), Protected Area boundaries from UNEP-WCMC (2010), Magombera forest and Selous Game Reserve boundary with the assistance of the Udzungwa Forest Project (UFP) and Tundu Village Forest boundaries from WWF (2006). Data on spatial infrastructure with the assistance of the Valuing the Arc project (http://www.valuingthearc.org).

The Udzungwa Mountains National Park (UMNP) is part of the ecologically significant Eastern Arc Mountain block. The park provides extensive ecosystem services benefitting local agriculture and national power through hydro-electric generation, and attracts international tourism. Immigration to the area is high due to the agricultural value of the land, illustrated by the presence of a large sugar plantation and processing factory owned by the Kilombero Sugar Company. UMNP was gazetted in 1992, with the intention of safeguarding the mountain water catchments and biological value (Nyundo et al. 2006). Prior to gazettement, several tree nurseries and fuel-efficient stove projects were established and continued in villages located along the Eastern border of the park, with the support of the World Wide Fund for Nature (WWF). The intention was that tree planting would eventually substitute villagers firewood needs, that at the time were being met by the forest. For the first ten years after gazettement, the Tanzania National Park Authority (TANAPA) allowed adjacent villagers to collect dead firewood from within the park two days per week while tree planting activities became established. However, tree planting projects were poorly adopted, and it proved difficult to stop firewood harvest activities (Bancet 2007). Thus, this concession continued, albeit scaled down to access for women only on one day per week, until June 2011 when it was banned completely due to concerns for its impact on biodiversity (Nyundo et al. 2006; Rovero et al. 2008).

Participatory Forest Management (CBFM and JFM) was initiated in three of the study villages through donor-led support, with Kiberege and Tundu villages assisted with a CBFM planning and implementation process by World Wide Fund for Nature (WWF), and joint management of Nyanganje forest between Signali village and the Government through Kilombero District Council initiated by the Norwegian Agency for Development Cooperation (NORAD). Uniquely in Tundu village, the village council, with the assistance of WWF, chose to implement CBFM by dividing the Village Forest Reserve into three separate forest areas: Village Forest Reserve (VFR), Community Forest (CF) and Firewood Forest (FWF). Village by-laws govern the use of these forests, with collection of dead firewood by villagers allowed in the FWF two designated days a week. No resource harvest is allowed within the VFR, this area is set aside for conservation. Within the CF plots are assigned to households within the village on a voluntary basis, no resource harvest is allowed and these households are required to tend their plots on the proviso of allowed resource harvest in the future once the forest condition has improved. In Kiberege village only dead firewood harvest is allowed within the Village Forest on one

designated day a week. The same was also true in Nynganje forest until the firewood ban in UMNP in June 2011, when the Signali Village Environment Committee extended this ban to include the JFM forest and so no more resource collection was allowed.

Several villages, including all five study villages, occur on the Eastern edge of UMNP. These villages lie sandwiched between UMNP to the West and the Selous Game Reserve to the East, with intensive sugar cane cultivation to the North. All study villages except for Magombera are situated on the main road connecting Mikumi town to Ifakara. This busy road artery is paved until shortly after Tundu village, with the remainder of the study villages situated close to the unpaved road. Magombera village is situated *c.*6km from this main road, accessed via a further unpaved road. Given its situation, Tundu has better access to markets for goods and services than the other villages, with Magombera village the most remote of the five. However, despite this difference in location and access, socio-economic characteristics are similar across the study sample; the most recently available national census indicates similar population growth rates in all villages, with agriculture the predominant livelihood activity and households dependent on forest products for energy (NBS 2002). Increasing population growth means pressure on resources is high in the area, with the 2011 firewood ban potentially amplifying this pressure (Gorenflo and Orland 2013). Therefore, analysis of local community perspectives of forest conservation and management interventions is of vital and timely importance in the area.

Thesis Aim and Objectives

In this thesis I aim to evaluate tropical forest conservation policies using local socio-economic perspectives, for the identification of priorities for future forest conservation and management implementation. In meeting this aim, this thesis has the following objectives:

1. To critically review tropical forest conservation and management interventions in light of emerging REDD+ policies, and highlight common obstacles to intervention success.

2. Based on these identified obstacles, to suggest metrics that are then used to evaluate implementation of tropical forest conservation and management interventions from the local community perspective.

3. To measure household awareness of forest management regimes in rural Tanzania and identify key predictors of awareness.

4. To measure the impact of forest access restrictions and awareness on household ability to meet fuelwood needs in rural Tanzania.

5. To identify the challenges in achieving local forest protection in rural Tanzania through comparison of multi-level stakeholder perceptions.

Chapter Outlines

Research is presented as a series of chapters (2 to 5), in the style of scientific papers. Each chapter can be understood individually from the whole, while still contributing to the thesis aims and objectives, as outlined below. While this means there is some repetition between chapters, this format was selected over the traditional thesis format to ease subsequent publication. Together, Chapters 2 to 5 address the thesis aims and objectives as described here. Chapter 2 is based on critical analysis of tropical forest management literature to date, and identifies the need for the collection and analysis of primary data that is conducted in Chapters 3-5. Chapter 6 provides a summary discussion to synthesise key findings and their significance, and provide possible directions for future research. To maintain the paper-style format, references cited within each chapter are listed at the end of each chapter.

Chapter 2 – Tropical Forest Conservation and Management: Critical Analysis of Approaches and Lessons for the Future

This thesis commences at the broad spatial scale by detailing and describing the evolution of policies to conserve and manage tropical forests. Through critical analysis of the literature, barriers to success that are common to all interventions are identified. By identifying such common obstacles, this chapter aims to suggest metrics that can be used to evaluate implementation of tropical forest conservation and management interventions from the local community perspective. As such, the need for the empirical

research conducted in Chapters 3-5 is identified. This chapter was motivated by the heightened expectation regarding theorised REDD+ co-benefits, in scientific and political forums, being unmatched by suggestions of how such benefits can be realistically achieved in practice. With decades of experience with interventions to conserve and protect tropical forests to draw upon, this chapter asks what lessons can be learned for REDD+ policies to achieve success, where arguably other policies have struggled. This chapter also serves as a useful review of tropical forest conservation and management literature, and presents suggestions to guide improvement of future management for both policy makers and practitioners.

Chapter 3 – Local-Level Awareness of Tropical Forest Management Regimes

Following the broad scale approach of Chapter 2, this chapter presents the first empirical analysis of tropical forest management implementation from the community perspective. This is done by measuring local-scale awareness of the different forest management regimes, and associated rules and regulations, using household questionnaire data collected in all study villages. Specifically, household awareness of the management authority and rules and regulations is quantified, and participation in the formation of rules and regulations for PFM forests assessed. Logistic regression models are then used to determine whether household socio-economic characteristics predict measured awareness for the management authority. These data are then used to examine and compare local awareness of different forest management regimes, and to establish whether variation can be attributed to heterogeneity in the community based on household socio-economic characteristics. By doing so this chapter aims to inform tropical forest management practice at the sub-national level, through identification of important household characteristics that can benefit local level implementation through the targeted communication of management.

Chapter 4 – Local-Level Forest Utilisation and Firewood Sufficiency: The Impact of Management Restrictions

The fourth chapter continues examination of tropical forest management implementation from the community perspective, by assessing household ability to meet vital resource needs given restrictions imposed by forest management. Household questionnaire data is used to assess local utilisation of each forest in the study area, by quantifying monthly consumption of forest products harvested. Level of harvesting from each forest is then

used as an indication of compliance with each management regime. However, this chapter focusses on household ability to meet firewood needs in light of management restrictions on forest access, given local dependence on firewood for energy. Household monthly need for firewood is compared with quantity consumed to give a measure of household sufficiency. Firewood sufficiency is then compared by harvest location, defined either by the relevant forest management regime, market purchase, or harvested from cultivated areas. Generalised linear models are used to test the influence of harvest location and household socio-economic characteristics, including awareness of management regimes from Chapter 3, on household need, consumption and sufficiency of firewood separately. These data are used to indicate the impact of management restrictions on household ability to meet firewood needs, and assess the implications of forest access restrictions for leakage of harvesting activities and/or detriment to local welfare.

Chapter 5 – Stakeholder Perceptions of the Challenges for Forest Protection

In this chapter a qualitative approach is adopted in the analysis of local community perspectives of forest management implementation. Semi-structured interviews with forest stakeholders from the local to national level, incorporating villagers and management officials, are carried out to discuss attitudes and opinions towards forest conservation in the area and the country. Perceived challenges for achieving forest protection are categorised by theme and issue, and compared by stakeholder group. Comparison in perceptions allowed for identification of similarity and discord between stakeholders, and division in accountability for forest management. These data are then used to make suggestions for improved implementation of forest conservation and management interventions in the country. The qualitative analysis in this Chapter also provide insight to the quantitative findings of Chapters 3 and 4.

References

Adams, W.M., 2004. Against Extinction. The Story of Conservation. Earthscan, London, UK.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: the role of community in natural resource conservation. World Development 27, 629-649.

Bancet, A., 2007. Questioning livelihoods, ideologies & practices of environmentalism in Africa through an ethnographical comparative survey. Study case of the adjacent populations of the Udzungwa Mountains National Park in Tanzania, In Paper for presentation at the Workshop on: How Does Environmental Governance Affect the Poor? Global and Local Forces Shaping Poverty Alleviation in Africa. Oxford University Centre for the Environment, 25th January.

Berkes, F., 2004. Rethinking community-based conservation. Conservation Biology 18, 621-630.

Berkes, F., 2007. Community-based conservation in a globalized world. Proceedings of the National Academy of Sciences 104, 15188-15193.

Blomley, T., Iddi, S., 2009. Participatory Forest Management in Tanzania: 1993 - 2009. Lessons Learned and Experiences To Date., Ministry of Natural Resources and Tourism, Forestry and Beekeeping. Dar es Salaam.

Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N., 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. Oryx 42, 380-391.

Blomley, T., Ramadhani, H., 2006. Going to scale with participatory forest management: early lessons from Tanzania. International Forestry Review 8, 93-100.

Bottcher, H., Eisbrenner, K., Fritz, S., Kindermann, G., Kraxner, F., McCallum, I., Obersteiner, M., 2009. An assessment of monitoring requirements and costs of 'Reduced Emissions from Deforestation and Degradation'. Carbon Balance and Management 4, 7.

Burgess, N.D., Bahane, B., Clairs, T., Danielsen, F., Dalsgaard, S., Funder, M., Hagelberg, N., Harrison, P., Haule, C., Kabalimu, K., Kilahama, F., Kilawe, E., Lewis, S.L., Lovett, J.C., Lyatuu, G., Marshall, A.R., Meshack, C., Miles, L., Milledge, S.A.H., Munishi, P.K.T., Nashanda, E., Shirima, D., Swetnam, R.D., Willcock, S., Williams, A., Zahabu, E., 2010. Getting ready for REDD+ in Tanzania: a case study of progress and challenges. Oryx 44, 339-351.

Burgess, N.D., Butynski, T.M., Cordeiro, N.J., Doggart, N.H., Fjeldså, J., Howell, K.M., Kilahama, F.B., Loader, S.P., Lovett, J.C., Mbilinyi, B., Menegon, M., Moyer, D.C., Nashanda, E., Perkin, A., Rovero, F., Stanley, W.T., Stuart, S.N., 2007. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. Biological Conservation 134, 209-231.

Burgess, N.D., Malugu, I., Kinyau, N., Sumbi, P., Kijazi, A., Komba, R., Harrison, P., Lazier, J., Williams, A., Mbwambo, Z., 2013. How are coastal forests being protected? The

coastal forest reserve network and its management., In The Arc Journal. Issue No. 28. Tanzania Forest Conservation Group (www.tfcg.org).

Corbera, E., Estrada, M., Brown, K., 2010. Reducing greenhouse gas emissions from deforestation and forest degradation in developing countries: revisiting the assumptions. Climatic Change 100, 355-388.

FAO, 2010. Global Forests Resources Assessment 2010, In Food and Agricultural Organisation of the United Nations. Rome, Italy.

Felix, M., Gheewala, S.H., 2011. A Review of Biomass Energy Dependency in Tanzania. Energy Procedia 9, 338-343.

Gorenflo, L.J., Orland, B., 2013. Human Resource Demand and Biodiversity Conservation at Udzungwa Mountains National Park, Tanzania: Challenges and Opportunities through Community Design, In Proceedings of the Ninth TAWIRI Scientific Conference, 4th-6th December 2013, Tanzania.

Green, J.M.H., Larrosa, C., Burgess, N.D., Balmford, A., Johnston, A., Mbilinyi, B.P., Platts, P.J., Coad, L., 2013. Deforestation in an African biodiversity hotspot: Extent, variation and the effectiveness of protected areas. Biological Conservation 164, 62-72.

Marshall, A.R., 2007. Disturbance in the Udzungwas: Responses of Monkeys and Trees to Forest Degradation. Ph.D. Thesis, University of York, UK.

Marshall, A.R., 2008. Ecological Report on Magombera Forest. WWF Tanzania.

McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H.V., Dammert, J.L., Pulgar-Vidal, M., 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. Biological Conservation 144, 966-972.

Milledge, S.A.H., 2009. Getting REDDy in Tanzania: Principles, Preparations and Perspectives. The Arc Journal 24, 3-6.

MNRT, 1998. National Forest Policy. The United Republic of Tanzania. Tanzania Ministry of Natural Resources and Tourism, Dar es Salaam.

MNRT, 2002. The New Forest Act. No. 14 of 7th June 2002. Tanzania Ministry of Natural Resources and Tourism. Dar es Salaam.

NBS, 2002. Population and Housing Census. Volume IV. National Bureau of Statistics, Ministry of Planning, Economy and Empowerment. Dar es Salaam. Tanzania.

NBS, 2013. 2012 Population and Housing Census. National Bureau of Stastistics, Ministry of Finance, Dar es Salaam and Office of Chief Government Statistician, Zanzibar. Dar es Salaam. Tanzania.

Nyundo, B.A., Mtui, A., Kissaka, H., 2006. An assessment of ecological and social-economic impacts caused by collection of deadwood, medicinal plants cutting of grass for

thatching in Udzungwa Mountains National Park. Unpublished report for the World Wildlife Fund - Tanzania Programme, Dar es Salaam. 104 pp.

Pfliegner, K., 2010. The Impacts of Joint Forest Management on Forest Condition, Livelihoods and Governance: Case Studies from Morogoro Region in Tanzania. Ph.D. Thesis, University of East Anglia, UK.

Platts, P.J., Burgess, N.D., Gereau, R.E., Lovett, J.C., Marshall, A.R., McClean, C.J., Pellikka, P.K.E., Swetnam, R.D., Marchant, R.O.B., 2011. Delimiting tropical mountain ecoregions for conservation. Environmental Conservation 38, 312-324.

Romijn, E., Herold, M., Kooistra, L., Murdiyarso, D., Verchot, L., 2012. Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+. Environmental Science & Policy 19-20, 33-48.

Rovero, F., Nyundo, B.A., Kitegile, A.S., 2008. The impact of human disturbance (especially deadwood collection) on the biodiversity of Mwanihana forest, Udzungwa Mountains National Park: a re-assessment following the 2005 study. Report by World Wide Fund for Nature, Tanzania Programme Office, Tanzania.

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R.D., Balmford, A., Bateman, I.J., Burgess, N.D., Chamshama, S.A.O., Fisher, B., Green, R.E., Hepelwa, A.S., HernÃ¡ndez-Sirvent, A., Kajembe, G.C., Kulindwa, K., Lund, J.F., Mbwambo, L., Meilby, H., Ngaga, Y.M., Theilade, I., Treue, T., Vyamana, V.G., Turner, R.K., 2012. Towards transferable functions for extraction of Non-timber Forest Products: A case study on charcoal production in Tanzania. Ecological Economics 80, 48-62.

Schreckenberg, K., Luttrell, C., Moss, C., 2006. Participatory forest management: An overview. Overseas Development Institute.

Streck, C., 2012. Financing REDD+: matching needs and ends. Current Opinion in Environmental Sustainability 4, 628-637.

UNEP-WCMC, 2010. The World Database on Protected Areas (WDPA). Cambridge, UK: UNEP-WCMC. URL http:/www.wdpa.org.

UNFCCC, 2007. Reducing Emissions from Deforestation in Developing countries: Approaches to Stimulate Action. Decision 2/CP.13. Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007.

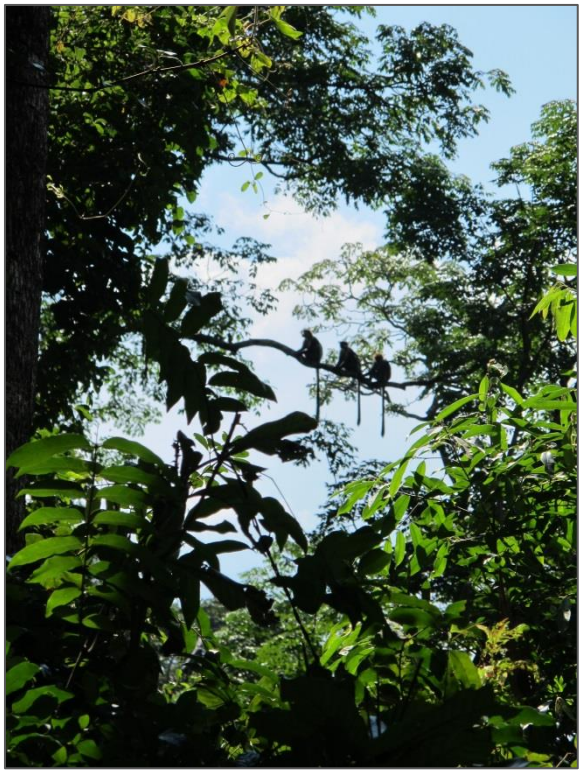
UNFCCC, 2009. Copenhagen Accord, In Decision 2/CP.15.

Vyamana, V.G., 2009. Participatory forest management in the Eastern Arc Mountains of Tanzania: who benefits? International Forestry Review 11, 239-253.

Wells, M., Brandon, K., 1992. People and parks: linking protected area management with local communities. The World Bank, Washington DC.

WWF, 2006. Mpango wa matumizi bora ya ardhi ya kijiji: Kijiji cha Tundu, wilaya ya Kilosa. Halmashauri ya kijiji cha Tundu.

2 Tropical Forest Conservation and Management: Critical Analysis of Approaches and Lessons for the Future



View from inside Udzungwa Mountains National Park

Repeated Failings in Tropical Forest Conservation and Management: What Lessons for REDD+?

Latham, J. E[1], Sallu, S. M.[2], Cinderby, S.[3], Marshall, A. R.[1, 4.]

1. CIRCLE, Environment Department, University of York, York, UK.
2. Sustainability Research Institute, School of Earth & Environment, University of Leeds, Leeds UK.
3. Stockholm Environment Institute, Environment Department, University of York, York, UK.
4. Flamingo Land Ltd., Kirby Misperton, North Yorkshire, UK.

Abstract

Deforestation rates in tropical countries remain high despite decades of conservation and management interventions. Policies to manage tropical forests have evolved throughout this time, with each step, in turn, hailed as the silver bullet for conservation policy. This evolution continues, with Reducing Emissions from Deforestation and Degradation (REDD+) the most recent initiative to enter the conservation forum. Critical assessments of existing tropical forest management strategies are providing important implementation recommendations for emerging REDD+ policy, with principles of good governance such as transparency, inclusion and accountability highlighted as crucial for intervention success. However, detailed recommendations to improve such governance features, especially at the local level, remain lacking. This paper critically examines the evolution of key interventions for tropical forest conservation and management to isolate common barriers to success, to inform REDD+ implementation. The evolution of tropical forest conservation and management interventions reflects increasing appreciation for the multiple ecological, social and economic values of tropical forests. Yet, it is argued here that this increasing appreciation has not been met with increasing realisation in practice. Three repeated failures of interventions are identified: low appreciation by management for the heterogeneity of target communities and dependence on forest resources; low levels of community inclusion and participation in management; and a continued deficit in clearly defined social and economic indicators of intervention success. To address these concerns, it is suggested focus be placed on evaluating what works where, for whom, and why from multiple perspectives, rather than what the new silver bullet for tropical forest management might be. Empiric analysis of current modes of implementation can inform such evaluation, and this paper suggests metrics to achieve this based on analysis of local resource-user perspectives.

Keywords: Participatory Forest Management, Protected Areas, Integrated Conservation and Development Projects, Payments for Ecosystem Services, Sustainability, Governance.

Introduction

Despite decades of conservation and management interventions, deforestation rates in tropical countries remain alarmingly high (FAO 2010). Measuring the degree of global forest loss is challenging, but estimates vary between 25% and 50% lost since the adoption of agricultural practices (Lewis 2006; Asner et al. 2009). Tropical forests are highly species rich (Wilson 1992) and contain most of the world's biodiversity hotspots (Myers et al. 2000), and the numerous goods and services that tropical forests provide extend from the local to the global scale. Tropical forests supply direct livelihood benefits to millions of people dependent on forest resources while also delivering vital ecosystem services including watershed protection, nutrient recycling and carbon sequestration (World Bank 2004; Chomitz et al. 2007). The ecological, economic and social benefits provided by tropical forests are highly interdependent and variable on both spatial and temporal scales. It naturally follows that the factors that drive tropical deforestation and degradation are similarly complex and operate across such multiple levels, ranging from global and national politics and economics to local power dynamics and poverty (Poffenberger 2009).

Given the complexity of this social-ecological landscape, policies to manage tropical forests sustainably must effectively address the multiple ecological, social and economic drivers in their design to achieve success (Kanninen et al. 2007; Karsenty 2008). However, history demonstrates that this has not always been the case. Traditionally forest conservation and management interventions have been designed with a particular focus in mind, with little motivation for the possibility of multiple outcomes. For example, forests have been conserved for economic production (e.g. timber plantations), to conserve biodiversity (e.g. National Parks), for catchment protection (e.g. water catchment forests) or to enhance social principles (e.g. community-managed reserves). The success of such projects has often been measured against their original intended outcome, with unintended costs of the intervention receiving little attention at the implementation stage. More recently, popularity for a transdisciplinary approach to addressing environmental degradation has increased in the pursuit of 'win-win' solutions for both conservation and development. This is illustrated by growing efforts to measure the multiple impacts of conservation and management interventions (e.g. Brooks et al.

2006; Bowler et al. 2010; Waylen et al. 2010). Yet, it is argued here that the complexities of social and economic arrangements at the local level continue to be overlooked or misunderstood in practice, impeding efforts for conservation and management of tropical forests interventions to achieve multiple benefits.

In this paper the importance of the implementation of policy, rather than the concept alone, is emphasised through critical examination of the rise of transdisciplinary approaches in tropical forest conservation and management interventions. First, the transition in appeal of strictly protectionist policies to more encompassing community-based interventions is discussed, alongside the associated conservation-poverty debate. The advance of payments for ecosystem services, and the ensuing prominence of policies aimed at reducing emissions from deforestation and degradation (REDD) as the ultimate 'win-win' for tropical forest conservation and management, is then outlined. The aim is to characterise the barriers to success that are common to these tropical forest conservation and management interventions, and identify key metrics that can be used in evaluations of management implementation to inform the design of future tropical forest policy.

The Evolution of Interventions to Conserve and Manage Tropical Forests

The conservation of biodiversity has conventionally been a central aim of tropical forest management, through the setting aside and protection of areas from human encroachment. Yet, mounting criticism of strictly protectionist approaches saw the advent of development as a conservation mechanism in the 1980s, with the importance of incorporating the support of people living in and around forested areas recognised (Wells and Brandon 1992; Adams 2004; Adams and Hutton 2007). This shift in focus is manifest in the promotion of Integrated Conservation and Development Projects (ICDPs), and Participatory Forest Management (PFM) around this time. This convergence of conservation and development principles is not restricted to tropical forest ecosystems and has more broadly been observed within the global conservation policy agenda (Roe 2008). Recognition of this growing movement is evident in binding international agreements such as the Millennium Development Goals, and likewise in the adaptation of public policy statements by leading international conservation organisations; Conservation International for example recently adapted their logo and mission

statement to signify the more inclusive aim of “sustainable care for nature and human well-being”.

With the launch of the Millennium Ecosystem Assessment in 2005 the term ‘ecosystem services’ grew in popularity, and the indispensable role of biodiversity and the nature of its services for sustained human well-being was emphasised (MEA 2005). By economically valuing these services Payments for Ecosystem Services (PES) has become a prominent policy tool, promoting the conservation of natural resources in the market place through direct financial incentives. In 2006 attention shifted once again when the Stern Review underlined the financial impact of global climate change (Stern 2006), striking a chord with the political and financial elite and firmly placing climate change at the top of the environmental agenda. Significantly for tropical forests, Reducing Emissions from Deforestation and Degradation (REDD) was identified as a cost-effective climate change mitigation strategy (Eliasch 2008), and has since been the focus of intense global discussion in the scientific literature and the media. As such, interventions to conserve and manage tropical forests have evolved over time, reflecting increasing appreciation for, and focus on, the ecological, social and economic services they provide. Such ‘waves’ of change in focus of key policies over time can be illustrated using forest conservation and management policy in Africa as a model (Figure 1). However, as this paper will determine, increasing appreciation for and focus on the multiple values of tropical forests in policy does not necessarily equate to their realisation in practice.

Figure 1. Schematic representation of the evolution of interventions to conserve and manage tropical forests, illustrating the waves of changing focus of key policies over time using tropical forest policy in Africa as a model.

Expectation over REDD is mounting given theory that such policies could provide co-benefits that extend from climate change mitigation to biodiversity conservation and poverty alleviation (UNFCCC 2007). Indeed, REDD+ has evolved from the initial REDD concept to incentivise five core activities that reflect principles of sustainable forest management: reducing emissions from deforestation, reducing emissions from degradation, conservation of carbon stocks, enhancement of carbon stocks and sustainable management of forests. Sustainable Forest Management (SFM), however, is not new and is no easy feat. SFM is a dynamic concept with the aim of "maintaining and enhancing the economic, social and environmental value of all types of forests, for the benefit of present and future generations" (UNFF 2007), the definitive 'win-win' for tropical forest management. While REDD+ offers new hope for the protection of tropical forests, its significance depends on its ability to account for the failures of the past. Given

the potential for multiple benefits it is vital that REDD+ implementation draws upon experiences of existing conservation and management interventions; tackling identified inefficiencies to improve its chances of success. This paper begins by critically examining the shifting focus of such interventions, and their ability to address the multiple drivers of tropical forest deforestation and degradation.

Strict Protection to Conserve Tropical Forests

Protected areas (PAs) are estimated to contain 19.6% of the world's humid tropical forests (Scharlemann et al. 2010). The available literature on the ecological and socio-economic impact of PAs is extensive but not exhaustive, the issues are multiple and complex and highly dependent on spatial and temporal scales. Importantly for the management of tropical forests, several studies have shown that legal protection is an effective strategy for reducing deforestation (Pelkey et al. 2000; Bruner et al. 2001; DeFries et al. 2005; Naughton-Treves et al. 2005; Nepstad et al. 2006; Oliveira et al. 2007; Joppa et al. 2008; Nagendra 2008; Gaveau et al. 2009). However it is not always a simple case of protection equals protected, as there are numerous caveats to such a conclusion. The locality and habitat type of a PA might alone lend itself to reduced deforestation given increased difficulty of resource extraction (Joppa and Pfaff 2009). Legally protecting one area and not the immediate vicinity might increase the likelihood of deforestation activities being displaced into unprotected areas ('Leakage'; Oliveira et al. 2007; Ewers and Rodrigues 2008; Laurance et al. 2012). In addition, protection alone might be insufficient without measures of enforcement (Pelkey et al. 2000), and the measured impact of protection is dependent on land use regulations governing comparison sites (Gaveau et al. 2012; Pfeifer et al. 2012). In an attempt to control for such observable variables both Andam et al. (2008) and Pffaf et al. (2009) matched study areas with and without legal protection, and found that while previous attempts to assess the deforestation impacts of PAs might have overestimated their success, legal protection still reduced deforestation. However, the evidence base for analysing PA outcomes remains limited as does understanding of the conditions under which PAs succeed or fail to deliver conservation outcomes (Geldmann et al. 2013). Many authors caution that tropical deforestation within PAs is continuing albeit at a slower rate than outside (Curran et al. 2004; Mas 2005; Gaveau et al. 2009), with an estimated 1.75 million ha of humid tropical forest lost from protected areas between 2000 and 2005 (Scharlemann et al. 2010).

Setting aside areas for state-driven protection can be considered the cornerstone of biodiversity conservation, yet PAs could arguably be perceived as the catalyst for the combination of conservation and development principles that are prevalent in modern conservation approaches. A key criticism of strict protection is that it leads to displacement and the removal of people's property and rights; not just the physical removal of people and communities from areas, but also the loss of access to often vital resources and cultural heritage (World Bank 2002; Brockington and Igoe 2006). It is argued that any economic benefits accrued locally by a PA are little compensation for loss of access and do little for local development (Wilkie et al. 2006). In this way it becomes clear that strict protection alone does not address poverty alleviation, which is arguably the root cause of environmental exploitation and degradation (Sanderson and Redford 2003; Adams et al. 2004; but see Andam et al. 2010).

The rhetoric regarding the negative social and economic impacts of strict protection is clear; it cannot be disputed that the creation of some PAs resulted in the eviction and displacement of local people, with long-term material and psychological implications (Brockington and Igoe 2006; Cernea and Schmidt-Soltau 2006; West et al. 2006; Adams and Hutton 2007). However, limited empirical evidence exists and uncertainty regarding the direct socio-economic impacts of PAs continues, primarily because supporting evidence is extremely difficult to gather. Eliciting the value of natural resources to households is extremely complicated and leaves a large margin for error (Sheil and Wunder 2002), and efforts to place an economic value on these resources are highly variable (Vedeld et al. 2004; Vedeld et al. 2007). It can also be very hard to control for exogenous factors other than the presence of a PA that may be acting upon a household's welfare (Wilkie et al. 2006). In addition, and most pertinent, the lack of ex ante data precludes proving the current welfare of people surrounding PAs is owing to the establishment of protection itself. This is a consistent failing observed here throughout the history of tropical forest conservation and management interventions; the preservation of biodiversity being the focus of policy at the outset, with an apparent lack of foresight for the extending impacts of management regimes and resulting implications. Standardised methods to elicit the socio-economic impacts of conservation interventions are only recently catching up on the well-established use of ecological indicators, for example in Gabon where longitudinal studies have been established with the creation of new PAs to track changes in local welfare over time (Wilkie et al. 2006).

A developing concern in the logic of strict protection is that PAs are becoming islands in a sea of human population growth and development, and that ecological links with the surrounding habitat means continuing habitat loss and degradation outside these reserves could significantly impact biodiversity within (DeFries et al. 2005; Laurance et al. 2012). In this way, it becomes increasingly clear that PAs cannot act in isolation; their effectiveness will depend on the surrounding landscapes and integration with local socio-economic activities (Schwartzman et al. 2000). However, despite such recognition for their flaws, PAs continue to be a prominent policy for conservation and management. Indeed, the Convention on Biological Diversity's Aichi biodiversity targets, adopted in 2010, call for terrestrial and inland water coverage of PA and other area-based conservation measures to be increased from the current coverage of 12.7% to 17% (CBD Aichi Targets, COP 10 Decision X/2, 1). Although, efforts to learn from past experience are acknowledged given this target calls for such areas to be conserved through 'effective and equitable management', to be 'ecologically representative', 'well-connected', and 'integrated into the wider landscape'. Exactly how such equity in management and integration into the landscape will be interpreted and achieved remains to be seen. Indeed, some have argued that enhancing the management effectiveness of existing areas would be more beneficial for biodiversity than concentrating on PA expansion alone (Costelloe 2010; Nicholson et al. 2012).

The Advent of People-Centred Conservation

Growing disenchantment with the strict protection approach to conservation contributed to advance in new policies that incorporate rural development needs with conservation goals. The World Wide Fund for Nature (WWF) first introduced the term ICDPs in the mid-1980s. ICDPs work under the premise that understanding the social and economic requirements of rural communities, which might otherwise hinder biodiversity conservation, will help meet both environmental and development goals (Hughes and Flintan 2001). The term ICDP now encompasses a wide range of initiatives whose central aim remains biodiversity conservation; projects enhance state-managed PAs by working with the communities surrounding them, through alternative income generating activities such as agroforestry, ecotourism or sustainable resource use. The underlying assumption of ICDPs is that local dependence on natural resources poses the most important threat to the biodiversity of an area, and so by providing rural communities with alternative livelihoods, the resulting reduction in poverty would lead to effective conservation by

alleviating this dependence (Wells and Brandon 1992). In this way, local socio-economic benefits are indirectly linked to the conservation of biodiversity.

ICDPs harnessed a great deal of attention at their outset given the appeal of providing 'win-win' solutions to the problems of biodiversity conservation and poverty alleviation (Naughton-Treves et al. 2005). The approach did not appeal to all however, for example it was argued by Oates (1999) that the growing emphasis on development might eventually erode conservation goals to the extent that they are no longer adequately addressed. Nonetheless, the intuitively appealing approach of ICDPs attracted a major proportion of international conservation funding, and projects quickly became a popular tool for conservation in the tropics. However after over twenty years of ICDP experience, scholars and practitioners agree that practice has not met with expectation (Wells et al. 1998; Hughes and Flintan 2001), and integration of conservation and development aims remains the exception (Barrett et al. 2005; Garnett et al. 2007).

ICDPs have been reproached for their insufficient monitoring and evaluation, with funding pouring into projects despite ambiguity regarding their success (McShane and Wells 2004). The failure of interventions to be accountable for their multiple impacts once again becoming apparent. ICDPs have been particularly criticised for neglecting the complex and heterogeneous nature of communities in their implementation, serving to expedite inequitable benefit-sharing within target communities and thus the possibility of continuing degrading practices by non-elite resource-users that might not feel project benefits (Blom et al. 2010). For example, the Eco-Development Project around Periyar Tiger Reserve in India received US$6 million in funding, nearly half of which was spent on community based conservation activities, and was internally evaluated a success (Gubbi et al. 2008). However, an independent external analysis conducted two years post-project found most community benefits provided were no longer in use, and there was little lasting legacy for improved attitudes to conservation (Gubbi et al. 2008). Gubbi et al. (2008) point out that, while this particular ICDP had addressed several institutional concerns previously raised by critics of the approach, there remained little capacity building for target communities to maintain benefits received, and poor monitoring and evaluation resulted in impaired ability for adaptive management.

Wells et al. (2004) suggest success of ICDPs is dependent on full understanding of the root causes of environmental degradation, such as local resource dependence, and relevant

national and regional policies. In addition, flexibility and adaptability is needed in design, to establish cooperative partnerships between stakeholders that advance both conservation and development aims (Barrett et al. 2005). Suggestions to improve ICDPs are based on the need for implementation that allows for such adaptive management, including effective stakeholder engagement, the use of appropriate incentives, a multiscalar approach and explicit identification of targets and trade-offs (Wells et al. 2004). Indeed, Garnett et al. (2007) identify the need for ICDP monitoring and evaluation to learn from the social sciences if robustness and resilience is to be achieved, rather than relying on "hunches and suppositions". With the lack of clearly defined project goals an identified barrier to ICDP success, achieving biodiversity conservation again remains the main focus based on expected developmental project benefits (Brandon and Wells 1992).

Whilst it is acknowledged that conservation and development aims are closely linked, their joint realisation remains elusive (Adams et al. 2004; Salafsky 2010). Increasingly it has been argued that the developmental incentives felt by local communities from a project must be directly linked to its environmental objective to achieve success (Brandon and Wells 1992; Murombedzi 1999; Ferraro 2001). Alongside the advance of ICDPs, literature on common property arrangements and common pool resources flourished, and challenges to Garret Hardin's (1968) Tragedy of the Commons thesis led to theory that locally-situated resource user groups can self-organise and create institutional arrangements and management regimes that help allocate benefits equitably over long time periods (Ostrom et al. 1999; Ostrom 2003). Community-based Natural Resource Management (CBNRM) has since become a popular concept, describing the devolution of resource management authority to local users. In forestry this led to the development of PFM, where the rights and responsibilities of forest management are devolved to local communities.

Whilst theory behind PFM can be attributed to that of ICDPs, its implementation is not centred on protected area management but rather group or private forest reserves. Styles of PFM can take many different names varying on the co-management theme but two main forms exist, describing the degree to which power is decentralised. Firstly, Joint Forest Management (JFM) in which communities enter into agreements with government or other forest owners to jointly share management responsibilities; and secondly Community Based Forest Management (CBFM), whereby power is completely devolved to local communities and they manage their own forest reserve (Schreckenberg et al. 2006).

The central idea behind the decentralisation of natural resource management is not only to avoid the tragedy of the commons but also to enhance local social and economic conditions, thereby a promising path to sustainable forest management by definition alone. PFM has been adopted widely across the tropics since the 1980s with many countries incorporating participatory approaches into national policy (Schreckenberg et al. 2006).

Overall, benefits of PFM for forest condition have been demonstrated, yet there is little evidence for how this equates to improvements in biodiversity and for the livelihoods of the communities in question (Bowler et al. 2010; Porter-Bolland et al. 2012). Outcomes for the social and economic impacts of PFM on local communities remain poorly monitored and understood, highlighting once more the need for standardised indicators to measure the multiple outcomes of conservation and management interventions (Bowler et al. 2010). Concerns have been raised for inequitable capture of PFM benefits by local community elites (Shackleton et al. 2002; Roe et al. 2009), and consensus is growing that CBFM is performing better than JFM primarily due to the level of participation and hence benefit felt by communities (Kumar 2002; Vyamana 2009; Blomley et al. 2011). It is clear that communities participating in devolved management of natural resources need to feel the benefits gained outweigh the opportunity and transaction costs involved, and that these benefits are felt equitably across the community (Meshack et al. 2006; Blomley et al. 2008; Anderson and Mehta 2013). As such, incentives for villagers to engage and participate with PFM needs to be adequately addressed, as otherwise not only are villagers expected to no longer utilise the forest for vital resource but also to incur the cost of protecting it (Robinson and Lokina 2011).

Participatory regimes have faced criticism for being poorly implemented in practice (Berkes 2004; Larson and Ribot 2007; Ribot et al. 2010), with participation only instrumental and communities excluded from design and decision-making (Kellert et al. 2000; Rasul and Karki 2007; Vermeulen and Sheil 2007; Larson and Soto 2008). Given this, there has been much debate on the role of communities in conservation planning, emphasising the need to consider the heterogeneous nature of communities for adaptive management given they are composed of multiple actors, with multiple interests and influence on decision-making (Agrawal and Gibson 1999; Berkes 2004; Berkes 2007). As such, for interventions to achieve both social and ecological successes that are meaningful and effective, recognition and support for local social dynamics must be granted rather

than focussing on the conservation agenda alone. This is a theme that permeates this evaluation of tropical forest management regimes; the deficiency in the conservation agenda's understanding and monitoring of social dynamics, in turn affecting local resource-dependent livelihoods and hence intervention success.

Evidence suggests variation in institutional setups on the ground exists, with discrepancy between official management statistics and actual practice observed (Ribot 2004; Agrawal et al. 2008; Cotula and Mayers 2009; Hajjar et al. 2009). Indeed, participation in forest management is often described in dichotomous terms, being either participatory or not, however the degree of participation is rarely assessed empirically (Lund et al. 2009). Further research is thus required to empirically qualify the degree to which a management regime is being enacted at the grassroots level. As such, failures of community conservation may not be a fault of the concept, but rather of its implementation, especially with regard to improper devolution of authority and rights and responsibilities (Berkes 2004). For example, addressing the problem of local elite capture in PFM is difficult, but depends on ensuring transparency and downwardly accountable community institutions in its implementation (Anderson and Mehta 2013). Recent research has focussed on identifying the characteristics of well-governed institutions, with the importance of local-level rule-making autonomy in natural resource governance highlighted (Chhatre and Agrawal 2009). Positive management of the commons has also been found to be associated with strong local leadership, social cohesion and participation in governance institutions (Gutierrez et al. 2011; Persha et al. 2011). Such principles of good governance, characterised by "accessibility, accountability, predictability and transparency", are essential to sustainable development (Morita and Zaelke 2005 p.16), and associated with improved forest condition (Hayes and Persha 2010; Umemiya et al. 2010). Local governance and institutions will have a significant impact upon the costs and benefits of conservation felt by local resource users, and thus their behaviour (Berkes 2004; Vyamana 2009). This is an enduring paradigm in conservation, a discipline that is dependent on restricting human use of natural resources, yet requires the support of said users to succeed. The turn of the millennium saw the emergence of new approaches to incentivise such support, marking a significant shift in direction for the global conservation agenda.

Market-Based Instruments for Biodiversity Conservation

In 2002 Ferraro and Kiss persuasively called for 'direct' payments for biodiversity conservation to become policy tools, arguing they were more effective than previous indirect-benefit methods such as ICDPs (Ferraro and Kiss 2002). In this way the conservation of natural resources is incentivised by pricing positive environmental externalities, as methods for tropical forest protection had thus far failed to account for the external market forces that drive environmental degradation. National policy does not always support local activities, and without a market value for standing forests alternative land uses often remain more economically viable.

Although placing a price on ecosystem services comes with huge uncertainty, Costanza et al. (1997) calculated the global value of ecological services at between US$16-54 trillion per year, with most of this outside the current market. Placing a value on the world's natural capital sparked wide debate and controversy, with disagreements regarding the technicalities of such a calculation and the ethics of emphasising the monetary value of what many hold as invaluable (Masood and Garwin 1998). Nonetheless it is clear that tropical forest management continues to face a huge challenge in the attempt to significantly alter land use practices, and so it is argued that their provision of vital ecosystem services should not be ignored. With heightened awareness surrounding the threat of global climate change, carbon markets became a popular mitigation tool by incentivising reductions in greenhouse gas emissions. Tropical forests may cover only ca. 10% of the Earth's land surface but they are essential for climate regulation, processing approximately six times more carbon than humans release into the atmosphere through the use of fossil fuels (Lewis 2006).

In 1997 the Kyoto Protocol established the Clean Development Mechanism (CDM), which came into force in 2005 as an enabling mechanism whereby developing countries can invest in sustainable projects which reduce carbon dioxide from the atmosphere (UNFCCC 1997). In theory the developing world benefits from these projects through the sale of carbon credits, or 'Certified Emissions Reductions' (CERs), and developed countries use the CERs to meet quantified emission limitation and reduction commitments agreed by the Kyoto protocol. Afforestation and reforestation projects are the only forestry-related projects allowed under the CDM, but they are poorly represented within overall CDM activity (Thomas et al. 2010). The CDM is viewed as "imperfect but useful", although the unequal distribution of projects across the developing world has raised criticism (Boyd et

al. 2009 p821). Issues regarding the contribution of CDM projects to local sustainable development have also risen, with concern once again for their impact on local livelihoods (Sutter and Parreno 2007; Boyd et al. 2009). One reason for this is the varying degree to which local stakeholders are engaged in projects, with criticism regarding community participation and problems with vertical and horizontal communication identified (Boyd 2009). Once more, the failure of a project is attributed to problems of poor governance and improperly considered local socio-economic implications.

Beyond the carbon focus, PES is another incentive-based mechanism for conservation whereby ecosystems are protected through payments for the services they provide. Unlike the CDM, PES is not linked to trade regulations and so is based on voluntary payments that are direct between the beneficiaries of the service to the provider. Wunder (2006) defines PES as a voluntary transaction, by which a well-defined environmental service is being bought by at least one buyer from at least one provider on the condition that the service is actually preserved. The theory being that internalising environmental services will attract additional funding and make conservation profitable and financially sustainable (Pirard et al. 2010). PES has been hailed as another approach that can provide 'win-win' outcomes not just for conservation but for poverty alleviation. By directly valuing biodiversity, it is anticipated PES can benefit the poor by increasing incomes and diversifying livelihoods (Grieg-Gran et al. 2005). However this is still a relatively new approach to conservation and little has been documented by way of its impacts on these multiple outcomes. Pro-poor PES projects have been realised in some small-scale projects, and although challenges remain they have the potential to contribute to poverty alleviation and conservation goals at the global level (Milder et al. 2010; Wunder 2013). However, issues of justice and equity have once more arisen especially regarding land tenure and rights, and PES will only work if the value of the environmental service exceeds the opportunity and transaction costs of the project (To et al. 2012; Wunder 2012). Similar to interventions described thus far, PES outcomes depend on complex local institutional and socio-cultural contexts, necessitating an enhanced understanding of the conditions under which their benefits might be realised rather than solely relying on them as another 'win-win' policy panacea (Muradian et al. 2013).

REDD+ is a scaled-up version of PES and the newest initiative in the drive toward sustainable forest management. Deforestation and forest degradation contribute an estimated 17% of anthropogenic greenhouse gas emissions (IPCC 2007; van der Werf et

al. 2009; Muradian et al. 2013) and, unlike the CDM, REDD+ is an international initiative that intends to financially compensate developing countries for reduced rates of deforestation and forest degradation. The initiative has commanded a lot of attention at the global level, with the Copenhagen Accord recognising the importance of REDD+ in 2009, and funds mobilised and pilot projects initiated in the tropics (UNFCCC 2009). Nevertheless, caution is advised. As Redford and Adams (2009) emphasise, conservation history is littered with the next big idea, with great faith placed in new approaches that appear to promise dramatic solutions to our continuing degradation of nature, only for disillusionment to set in a few years later. Discussion now centres on whether the theoretical 'win-win' promises of REDD+ policies can be delivered in practice.

REDD+: The Silver Bullet?

The financial incentive that REDD+ provides is intended to change current land use practices by ensuring that forests are worth more standing, than harvested for resources or cleared for alternative land use. The plethora of literature surrounding REDD+ has so far centred on the difficulty of measuring, reporting and verifying reductions of deforestation and degradation and ensuring permanence (Gibbs et al. 2007; Fry 2008; Bottcher et al. 2009; Romijn et al. 2012), methods of financing (Streck 2012), whether benefits will sufficiently exceed the opportunity costs of the foregone alternatives (Lu and Liu 2012; but see Fisher et al. 2011), and the potential biodiversity outcomes of a carbon-based tropical forest management policy (Gardner et al. 2012). As a market-based instrument the technical and methodological concerns surrounding REDD+ are extremely important, but the questionable ability of this tool to address the socio-political and behavioural issues that underlie tropical deforestation, and have thus far impeded conservation and management success, is fundamental (Karsenty 2008).

Concerns have been raised regarding the social implications of such an initiative, with histories of corruption, poor land tenure and indigenous peoples rights in many target countries, the potential for inequitable benefit transfer is high (Skutsch and McCall 2010; Larson 2011). It is postulated that community inclusion in REDD+ monitoring will overcome some of these foreseen concerns, with many countries intending to implement REDD+ policies through participatory forest management plans (Danielsen et al. 2010; Larrazabal et al. 2012). However, It has also been argued that more than twenty years'

experience with devolution and community-centred forest management might be compromised, with REDD+ threatening to recentralise forest management and rearrange value systems, resulting in similar socio-economic impacts observed with PAs (Phelps et al. 2010; Sandbrook et al. 2010). The fundamental question remains whether REDD+ will consider previously documented failings in policy design. While REDD+ does account for market failures, it is still a top-down and western dominated policy initiative that is susceptible to poor implementation, given the nature of where it is coming from and its underlying goals. The challenge being how best to translate high-level policy into local reality.

The question that remains unanswered, but is alluded to, is whether even the great increase in financial resources that REDD+ is projected to provide will be able to fix the aforementioned gaps in governance that have historically dogged tropical forest management (Corbera et al. 2010). Indeed, improved governance, such as through enhanced accountability, inclusion and transparency, has been emphasised as central to effective REDD+ policies (Skutsch and McCall 2010; Corbera and Schroeder 2011; Kanowski et al. 2011; Barr and Sayer 2012; McDermott et al. 2012), yet few recommendations for how to improve forest governance at the national or sub-national level have been proposed in detail (Gregersen et al. 2010; Corbera and Schroeder 2011). REDD+ is a global initiative, yet even if reductions in the rate of deforestation and degradation are accounted for at the national level, it will require sub-national projects to succeed. REDD+ policies must create alternatives to land conversion that are socially viable and change the behaviour of economic actors (Kanninen et al. 2007; Grainger et al. 2009). Thus, ability of sub-national regimes such as PFM to shape local forest-user actions remains significant for REDD+ (Irawan and Tacconi 2009; Hayes and Persha 2010; Phelps et al. 2010; Larrazabal et al. 2012). In this way we return to the same issues of governance, local implementation and institutions in place that are persistent concerns for successful forest conservation and management.

It is fast becoming apparent that trade-offs between conservation goals and human well-being are inherent in tropical forest management (McShane et al. 2011). Interventions to conserve and manage tropical forests necessitate some level of restriction be placed on resource extraction, with resulting implications for the well-being of communities whose livelihoods depend on these resources (Sunderlin et al. 2005; Schelhas and Pfeffer 2009; Sigalla 2013). Thus, economic valuation of the total value of forests are necessary at

multiple scales to calculate the cost-benefit ratio of protection not just at the global but local level (Naidoo and Ricketts 2006). Vital in is this assessment is an understanding of the ability of resource-users to meet resource needs elsewhere given increased forest protection. Compensation-based mechanisms, such as REDD+, assume that resource users have access to functioning markets or land for cultivation to meet their resource needs. Where this is not the case, restriction may lead to increased poverty if food and fuel demands are not met, or increase the probability of leakage if such demands are displaced to less-well protected areas (Fisher et al. 2011; Robinson et al. 2011; Albers and Robinson 2013). Both outcomes limit the ability of REDD+ policies to meet stated climate change mitigation, biodiversity conservation and poverty alleviation goals. For REDD+ projects to provide permanence and avoid leakage, drivers need to be assessed and accounted for, and alternatives provided.

Repeated Failings in Tropical Forest Conservation and Management

Critical assessments of existing tropical forest management regimes and their lessons for REDD+ are mounting (Bond et al. 2009; Blom et al. 2010; Hayes and Persha 2010; Pirard et al. 2010; Lederer 2011; Corbera 2012), providing an important basis for future REDD+ policy implementation. Yet, despite this burgeoning debate there remains a fundamental gap in our empirical testing. While recommendations emerge based on experiences of existing management regimes, rarely is the manifestation of that regime verified at the ground level (e.g. Lund et al. 2009), arguably the most crucial step in the qualification of efficacy. Variation between policy discourse and actual practice on the ground can be explained by actors that exercise *de facto* control in the absence of, or despite, formal *de jure* rights (Poteete and Ostrom 2004). While principles of good governance have been identified as key to this variation here, the precise causes and remedies remain elusive. The absence of this type of analysis at the local level presents important implications for a developing global REDD+ strategy.

Three repeated failings of tropical forest conservation and management interventions have been identified in this review. Firstly, projects fail to account for the heterogeneity of communities, with poor understanding of local resource use dependence and the availability of alternatives; secondly, poor implementation at the local level and lack of true participation leads to little opportunity for lasting intervention legacy; and lastly,

analysis of project success is hampered by continued oversight for the importance of clearly defined social and economic indicators. Obstacles to successful interventions, such as those raised here, cannot be fixed by one global initiative that will ultimately depend on sub-national projects for success. Indeed it seems clear given the complexity of social-ecological systems and local cultural contexts, that a panacea for SFM cannot exist and a combination of strategies will be needed. The overriding priority therefore becomes not in determining which intervention is best, but what works where, for whom and why, and ensuring the adopted approach is fully evaluated from multiple perspectives.

Improving the governance of social-ecological systems is inherently complex, but can be informed by empirical analysis of current modes of implementation across different management regimes at the local level. As principles of good governance, the transparency and accountability of local institutions can be empirically verified from a local community perspective, through strategic questioning. For example, measuring local awareness for management regimes can give an indication of transparency and inclusion in regime implementation (Latham et al. Chapter 3). Analysis of variation in community awareness can help identify key socio-economic characteristics at the local level at which communication of management information can be targeted to improve such transparency. Local-level resource dependence and ability to meet needs given forest access restrictions can be quantitatively assessed, to provide an indication of compliance with regimes and verify the influence of transparency and inclusion on resource user behaviour (Latham et al. Chapter 4). Cross-stakeholder analysis of conservation and management knowledge and goals can help identify conflicting views and interests held by multiple actors, and any divisions in perceived accountability for the conservation and management of forest resources (Latham et al. Chapter 5).

Such examination requires in-depth investigation of management practice at the sub-national level, however it is only through such investigation that better understanding of the causes for variation between policy discourse and local-level practice can be achieved. As highlighted here, the complexities of social-ecological systems are such that all too easily they can be ignored, misunderstood or inadequately measured. This paper argues that only by distilling such complexities into measurable components at the local level, can identification of the key features associated with principles of good governance be achieved at the global level. For this to be realised, the perspective of local forest users

ought to be included in evaluations of tropical forest conservation and management interventions, to improve future success.

Conclusion

By reviewing experience with key tropical forest conservation and management interventions, three repeated failures of forest conservation and management interventions have been outlined in this paper: low appreciation for the heterogeneity of local resource dependent communities in design, poorly implemented community inclusion and participation in management, and continued oversight for the importance of clearly defined social and economic indicators of success. To address these concerns, focus ought to be placed not on determining which intervention is best, but evaluating what works where, for whom, and why, and from multiple perspectives. Empirical analysis of current modes of implementation can aid this evaluation, and it is suggested this can be achieved through analysis of local resource user perspectives.

Acknowledgements

This manuscript was researched and prepared by J.E.L., with the supervision of S.M.S, S.C, and A.R.M. Research was carried out with funding from the Economic and Social Research Council (ESRC). Many thanks to Mike Kramer at Brane (www.brane.co.uk) for assistance with figure graphic design.

References

Adams, W.M., 2004. Against Extinction. The Story of Conservation. Earthscan, London, UK.

Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., Roe, D., Vira, B., Wolmer, W., 2004. Biodiversity Conservation and the Eradication of Poverty. Science 306, 1146-1149.

Adams, W.M., Hutton, J., 2007. People, parks and poverty: Political ecology and biodiversity conservation. Conservation and Society 5, 147.

Agrawal, A., Chhatre, A., Hardin, R., 2008. Changing governance of the world's forests. Science 320, 1460.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: the role of community in natural resource conservation. World Development 27, 629-649.

Albers, H.J., Robinson, E.J.Z., 2013. A review of the spatial economics of non-timber forest product extraction: Implications for policy. Ecological Economics 92, 87-95.

Andam, K.S., Ferraro, P.J., Pfaff, A., Sanchez-Azofeifa, G.A., Robalino, J.A., 2008. Measuring the effectiveness of protected area networks in reducing deforestation. Proceedings of the National Academy of Sciences 105, 16089.

Andam, K.S., Ferraro, P.J., Sims, K.R.E., Healy, A., Holland, M.B., 2010. Protected areas reduced poverty in Costa Rica and Thailand. Proceedings of the National Academy of Sciences 107, 9996.

Anderson, J., Mehta, S., 2013. A Global Assessment of Community Based Natural Resource Management: Addressing the Critical Challenges of the Rural Sector, In Report prepared by the International Resources Group (IRG) for the United States Agency for International Development (USAID). Washington, DC.

Asner, G.P., Rudel, T.K., Aide, T.M., DeFries, R., Emerson, R., 2009. A Contemporary Assessment of Global Humid Tropical Forest Change. Conservation Biology 23, 1386-1395.

Barr, C.M., Sayer, J.A., 2012. The political economy of reforestation and forest restoration in Asia-Pacific: Critical issues for REDD+. Biological Conservation 154, 9-19.

Barrett, C.B., Lee, D.R., McPeak, J.G., 2005. Institutional arrangements for rural poverty reduction and resource conservation. World Development 33, 193-197.

Berkes, F., 2004. Rethinking community-based conservation. Conservation Biology 18, 621-630.

Berkes, F., 2007. Community-based conservation in a globalized world. Proceedings of the National Academy of Sciences 104, 15188-15193.

Blom, B., Sunderland, T., Murdiyarso, D., 2010. Getting REDD to work locally: lessons learned from integrated conservation and development projects. Environmental Science & Policy 13, 164-172.

Blomley, T., Lukumbuzya, K., Brodning, G., 2011. Participatory Forest Management and REDD+ in Tanzania. World Bank. Washington DC.

Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N., 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. Oryx 42, 380-391.

Bond, I., Grieg-gran, M., Wertz-Kanounnikoff, S., 2009. Incentives to sustain forest ecosystem services: a review and lessons for REDD. Natural Resource Issues No. 16. International Institute for Environment and Development, London UK, with CIFOR, Bogor, Indonesia and World Resources Institute, Washington D.C., USA.

Bottcher, H., Eisbrenner, K., Fritz, S., Kindermann, G., Kraxner, F., McCallum, I., Obersteiner, M., 2009. An assessment of monitoring requirements and costs of 'Reduced Emissions from Deforestation and Degradation'. Carbon Balance and Management 4, 7.

Bowler, D., Buyung-Ali, L., Healey, J.R., Jones, J.P.G., Knight, T., Pullin, A.S., 2010. The evidence base for community forest management as a mechanism for supplying global environmental benefits and improving local welfare., In Systematic Review No. 48. Collaboration for Environmental Evidence.

Boyd, E., 2009. Governing the Clean Development Mechanism: global rhetoric versus local realities in carbon sequestration projects. Environment and planning. A 41, 2380.

Boyd, E., Hultman, N., Timmons Roberts, J., Corbera, E., Cole, J., Bozmoski, A., Ebeling, J., Tippman, R., Mann, P., Brown, K., Liverman, D.M., 2009. Reforming the CDM for sustainable development: lessons learned and policy futures. Environmental Science & Policy 12, 820-831.

Brandon, K.E., Wells, M., 1992. Planning for people and parks: design dilemmas. World Development 20, 557-570.

Brockington, D., Igoe, J., 2006. Eviction for conservation: A global overview. Conservation and Society 4, 424.

Brooks, J.S., Franzen, M.A., Holmes, C.M., Grote, M.N., Borgerhoff Mulder, M., 2006. Development as a conservation tool: Evaluating ecological, economic, attitudinal, and behavioural outcomes., In Systematic Review No. 20. Collaboration for Enviornmental Evidence.

Bruner, A.G., Gullison, R.E., Rice, R.E., Da Fonseca, G.A.B., 2001. Effectiveness of parks in protecting tropical biodiversity. Science 291, 125.

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

Chhatre, A., Agrawal, A., 2009. Trade-offs and synergies between carbon storage and livelihood benefits from forest commons. Proceedings of the National Academy of Sciences 106, 17667.

Chomitz, K.M., Buys, P., De Luca, G., Thomas, T.S., Wertz-kanounnikoff, S., 2007. At loggerheads? Agricultural expansion, poverty reduction, and environment in the tropical forests. World Bank, Wahington, D.C.

Corbera, E., 2012. Problematizing REDD+ as an experiment in payments for ecosystem services. Current Opinion in Environmental Sustainability 4, 612-619.

Corbera, E., Estrada, M., Brown, K., 2010. Reducing greenhouse gas emissions from deforestation and forest degradation in developing countries: revisiting the assumptions. Climatic Change 100, 355-388.

Corbera, E., Schroeder, H., 2011. Governing and implementing REDD+. Environmental Science & Policy.

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253-260.

Costelloe, B.T., 2010. The power of global indicators to predict future policy outcomes. MSc Thesis. Imperial College London, UK.

Cotula, L., Mayers, J., 2009. Tenure in REDD: Start-point or afterthought? Natural Resource Issues No. 15. International Institute for Environment and Development, London, UK.

Curran, L.M., Trigg, S.N., McDonald, A.K., Astiani, D., Hardiono, Y.M., Siregar, P., Caniago, I., Kasischke, E., 2004. Lowland forest loss in protected areas of Indonesian Borneo. Science 303, 1000.

Danielsen, F., Skutsch, M., Burgess, N.D., Jensen, P.M., Andrianandrasana, H., Karky, B., Lewis, R., Lovett, J.C., Massao, J., Ngaga, Y., Phartiyal, P., Poulsen, M.K., Singh, S.P., Solis, S., Sørensen, M., Tewari, A., Young, R., Zahabu, E., 2010. At the heart of REDD+: a role for local people in monitoring forests? Conservation Letters 4, 158-167.

DeFries, R., Hansen, A., Newton, A.C., Hansen, M.C., 2005. Increasing isolation of protected areas in tropical forests over the past twenty years. Ecological Applications 15, 19-26.

Eliasch, J., 2008. The Eliasch Review - Climate Change: Financing Global Forests, In Office of Climate Change. Crown Copyright.

Ewers, R.M., Rodrigues, A.S.L., 2008. Estimates of reserve effectiveness are confounded by leakage. Trends in Ecology & Evolution 23, 113-116.

FAO, 2010. Global Forests Resources Assessment 2010, In Food and Agricultural Organisation of the United Nations. Rome, Italy.

Ferraro, P.J., 2001. Global Habitat Protection: Limitations of Development Interventions and a Role for Conservation Performance Payments. Conservation Biology 15, 990-1000.

Ferraro, P.J., Kiss, A., 2002. Direct payments to conserve biodiversity. Science 298, 1718-1719.

Fisher, B., Lewis, S.L., Burgess, N.D., Malimbwi, R.E., Munishi, P.K., Swetnam, R.D., Turner, R.K., Willcock, S., Balmford, A., 2011. Implementation and opportunity costs of reducing deforestation and forest degradation in Tanzania. Nature Climate Change 1, 161-164.

Fry, I., 2008. Reducing emissions from deforestation and forest degradation: opportunities and pitfalls in developing a new legal regime. Review of European Community & International Environmental Law 17, 166-182.

Gardner, T.A., Burgess, N.D., Aguilar-Amuchastegui, N., Barlow, J., Berenguer, E., Clements, T., Danielsen, F., Ferreira, J., Foden, W., Kapos, V., Khan, S.M., Lees, A.C., Parry, L., Roman-Cuesta, R.M., Schmitt, C.B., Strange, N., Theilade, I., Vieira, I.C.G., 2012. A framework for integrating biodiversity concerns into national REDD+ programmes. Biological Conservation 154, 61-71.

Garnett, S.T., Sayer, J., Du Toit, J., 2007. Improving the effectiveness of interventions to balance conservation and development: a conceptual framework. Ecology and Society 12, 2.

Gaveau, D.L.A., Curran, L.M., Paoli, G.D., Carlson, K.M., Wells, P., Besse-Rimba, A., Ratnasari, D., Leader-Williams, N., 2012. Examining protected area effectiveness in Sumatra: importance of regulations governing unprotected lands. Conservation Letters 5, 142-148.

Gaveau, D.L.A., Epting, J., Lyne, O., Linkie, M., Kumara, I., Kanninen, M., Leader Williams, N., 2009. Evaluating whether protected areas reduce tropical deforestation in Sumatra. Journal of biogeography 36, 2165-2175.

Geldmann, J., Barnes, M., Coad, L., Craigie, I.D., Hockings, M., Burgess, N.D., 2013. Effectiveness of terrestrial protected areas in reducing habitat loss and population declines. Biological Conservation 161, 230-238.

Gibbs, H.K., Brown, S., Niles, J.O., Foley, J.A., 2007. Monitoring and estimating tropical forest carbon stocks: making REDD a reality. Environmental Research Letters 2, 045023.

Grainger, A., Boucher, D.H., Frumhoff, P.C., Laurance, W.F., Lovejoy, T., McNeely, J., Niekisch, M., Raven, P., Sodhi, N.S., Venter, O., Pimm, S.L., 2009. Biodiversity and REDD at Copenhagen. Current Biology 19, R974-R976.

Gregersen, H., El Lakany, H., Karsenty, A., White, A., 2010. Does the Opportunity Cost Aproach Indicate the Real Cost of REDD+? Rights and Realities of Paying for REDD+. Rights and Resources Institute, Washington, DC.

Grieg-Gran, M., Porras, I., Wunder, S., 2005. How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. World Development 33, 1511-1527.

Gubbi, S., Linkie, M., Leader-Williams, N., 2008. Evaluating the legacy of an integrated conservation and development project around a tiger reserve in India. Environmental Conservation 35, 331-339.

Gutierrez, N.L., Hilborn, R., Defeo, O., 2011. Leadership, social capital and incentives promote successful fisheries. Nature 470, 386-389.

Hajjar, R., Gough, A., Mathey, A.H., Nitschke, C., Paudel, S.K., Skrivanos, P., Waeber, P.O., Innes, J., 2009. Criteria and indicators for sustainable forest management in the face of decentralization: are they still relevant in their current form, In XIII World Forestry Congress. Buenos Aires, Argentina, 18 – 23 October.

Hardin, G., 1968. The Tragedy of the Commons. Science 162, 1243-1248.

Hayes, T., Persha, L., 2010. Nesting local forestry initiatives: Revisiting community forest management in a REDD plus world. Forest Policy and Economics 12, 545-553.

Hughes, R., Flintan, F., 2001. Integrating conservation and development experience: a review and bibliography of the ICDP literature.

IPCC, 2007. Climate Change 2007: The Physical Science Basis. , In Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. ed. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B.M.Tignor and H.L. Miller, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

Irawan, S., Tacconi, L., 2009. Reducing Emissions from Deforestation and Forest Degradation (REDD) and decentralized forest management. International Forestry Review 11, 427-438.

Joppa, L.N., Loarie, S.R., Pimm, S.L., 2008. On the protection of “protected areas”. Proceedings of the National Academy of Sciences 105, 6673.

Joppa, L.N., Pfaff, A., 2009. High and Far: Biases in the Location of Protected Areas. PLoS ONE 4, e8273.

Kanninen, M., Murdiyarso, D., Seymour, F., Angelsen, A., Wunder, S., German, L., 2007. Do trees grow on money? The implications of deforestation research for policies to promote REDD. Center for International Forestry Research (CIFOR, Bogor, Indonesia).

Kanowski, P.J., McDermott, C.L., Cashore, B.W., 2011. Implementing REDD+: lessons from analysis of forest governance. Environmental Science & Policy 14, 111-117.

Karsenty, A., 2008. The architecture of proposed REDD schemes after Bali: facing critical choices. International Forestry Review 10, 443-457.

Kellert, S.R., Mehta, J.N., Ebbin, S.A., Lichtenfeld, L.L., 2000. Community Natural Resource Management: Promise, Rhetoric, and Reality. Society & Natural Resources 13, 705-715.

Kumar, S., 2002. Does "Participation" in Common Pool Resource Management Help the Poor? A Social Cost-Benefit Analysis of Joint Forest Management in Jharkhand, India. World Development 30, 763-782.

Larrazabal, A., McCall, M.K., Mwampamba, T.H., Skutsch, M., 2012. The role of community carbon monitoring for REDD+: a review of experiences. Current Opinion in Environmental Sustainability 4, 707-716.

Larson, A.M., 2011. Forest tenure reform in the age of climate change: Lessons for REDD+. Global Environmental Change 21, 540-549.

Larson, A.M., Ribot, J.C., 2007. The poverty of forestry policy: double standards on an uneven playing field. Sustainability Science 2, 189-204.

Larson, A.M., Soto, F., 2008. Decentralization of natural resource governance regimes. Annual Review of Environment and Resources 33, 213-239.

Laurance, W.F., Useche, D.C., Rendeiro, J., Kalka, M., Bradshaw, C.J.A., Sloan, S.P., Laurance, S.G., Campbell, M., Abernethy, K., Alvarez, P., 2012. Averting biodiversity collapse in tropical forest protected areas. Nature 489, 290-294.

Lederer, M., 2011. From CDM to REDD+ -- What do we know for setting up effective and legitimate carbon governance? Ecological Economics 70, 1900-1907.

Lewis, S.L., 2006. Tropical forests and the changing earth system. Philosophical Transactions of the Royal Society B: Biological Sciences 361, 195.

Lu, H., Liu, G., 2012. A case study of REDD+ challenges in the post-2012 climate regime: The scenarios approach, In Natural Resources Forum. pp. 192-201. Wiley Online Library.

Lund, J.F., Balooni, K., Casse, T., 2009. Change we can believe in? Reviewing studies on the conservation impact of popular participation in forest management. Conservation and Society 7, 71.

Mas, J.F., 2005. Assessing protected area effectiveness using surrounding (buffer) areas environmentally similar to the target area. Environmental Monitoring and Assessment 105, 69-80.

Masood, E., Garwin, L., 1998. Audacious bid to value the planet whips up a storm. Nature 395, 430.

McDermott, C.L., Coad, L., Helfgott, A., Schroeder, H., 2012. Operationalizing social safeguards in REDD+: actors, interests and ideas. Environmental Science & Policy 21, 63-72.

McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H.V., Dammert, J.L., Pulgar-Vidal, M., 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. Biological Conservation 144, 966-972.

McShane, T.O., Wells, M.P., 2004. Integrated Conservation and Development?, In Getting biodiversity projects to work. eds T.O. McShane, M.P. Wells, pp. 3-9. Columbia University Press, New York.

MEA, 2005. Ecosystems and Human Well-being: Biodiversity Synthesis., In Millennium Ecosystem Assessment. World Resources Institute, Washington, DC, USA.

Meshack, C.K., Ahdikari, B., Doggart, N., Lovett, J.C., 2006. Transaction costs of community-based forest management: empirical evidence from Tanzania. African Journal of Ecology 44, 468-477.

Milder, J.C., Scherr, S.J., Bracer, C., 2010. Trends and Future Potential of Payment for Ecosystem Services to Alleviate Rural Poverty in Developing Countries. Ecology and Society 15, 4.

Morita, S., Zaelke, D., 2005. Rule of Law, Good Governance and Sustainable Development, In Seventh International Conference on Environmental Compliance and Enforcement. pp. 9-15.

Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., de Blas, D.E., Farley, J., Froger, G., Garcia-Frapolli, E., Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J.F., Leroy, P., May, P., Méral, P., Mibielli, P., Norgaard, R., Ozkaynak, B., Pascual, U., Pengue, W., Perez, M., Pesche, D., Pirard, R., Ramos-Martin, J., Rival, L., Saenz, F., Van Hecken, G., Vatn, A., Vira, B., Urama, K., 2013. Payments for ecosystem services and the fatal attraction of win-win solutions. Conservation Letters 6, 274-279.

Murombedzi, J.C., 1999. Devolution and stewardship in Zimbabwe's CAMPFIRE programme. Journal of International Development 11, 287-293.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853-858.

Nagendra, H., 2008. Do parks work? Impact of protected areas on land cover clearing. AMBIO: A Journal of the Human Environment 37, 330-337.

Naidoo, R., Ricketts, T.H., 2006. Mapping the Economic Costs and Benefits of Conservation. PLoS Biol 4, 2153–2164.

Naughton-Treves, L., Holland, M.B., Brandon, K., 2005. The role of protected areas in conserving biodiversity and sustaining local livelihoods. Annu. Rev. Environ. Resour. 30, 219-252.

Nepstad, D., Schwartzman, S., Bamberger, B., Santilli, M., Ray, D., Schlesinger, P., Lefebvre, P., Alencar, A., Prinz, E., Fiske, G., 2006. Inhibition of Amazon deforestation and fire by parks and indigenous lands. Conservation Biology 20, 65-73.

Nicholson, E., Collen, B., Barausse, A., Blanchard, J.L., Costelloe, B.T., Sullivan, K.M.E., Underwood, F.M., Burn, R.W., Fritz, S., Jones, J.P.G., McRae, L., Possingham, H.P., Milner-Gulland, E.J., 2012. Making Robust Policy Decisions Using Global Biodiversity Indicators. PLoS ONE 7, e41128.

Oates, J.F., 1999. Myth and reality in the rain forest: How conservation strategies are failing in West Africa. University of California Press.

Oliveira, P.J.C., Asner, G.P., Knapp, D.E., Almeyda, A., Galvan-Gildemeister, R., Keene, S., Raybin, R.F., Smith, R.C., 2007. Land-use allocation protects the Peruvian Amazon. Science 317, 1233.

Ostrom, E., 2003. How types of goods and property rights jointly affect collective action. Journal of Theoretical Politics 15, 239-270.

Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D., 1999. Revisiting the commons: local lessons, global challenges. Science 284, 278.

Pelkey, N.W., Stoner, C.J., Caro, T.M., 2000. Vegetation in Tanzania: assessing long term trends and effects of protection using satellite imagery. Biological Conservation 94, 297-309.

Persha, L., Agrawal, A., Chhatre, A., 2011. Social and Ecological Synergy: Local Rulemaking, Forest Livelihoods, and Biodiversity Conservation. Science 331, 1606-1608.

Pfaff, A., Robalino, J., Sanchez-Azofeifa, G.A., Andam, K.S., Ferraro, P.J., 2009. Park Location Affects Forest Protection: Land Characteristics Cause Differences in Park Impacts across Costa Rica. ECONOMIC GEOGRAPHY 9, 5.

Pfeifer, M., Burgess, N.D., Swetnam, R.D., Platts, P.J., Willcock, S., Marchant, R., 2012. Protected Areas: Mixed Success in Conserving East Africa's Evergreen Forests. PLoS ONE 7, e39337.

Phelps, J., Webb, E.L., Agrawal, A., 2010. Does REDD+ Threaten to Recentralize Forest Governance? Science 328, 312.

Pirard, R., Bille, R., Sembres, T., 2010. Upscaling Payments for Environmental Services (PES): Critical issues. Tropical Conservation Science 3, 249-261.

Poffenberger, M., 2009. Cambodia's forests and climate change: Mitigating drivers of deforestation. Natural Resources Forum 33, 285-296.

Porter-Bolland, L., Ellis, E.A., Guariguata, M.R., Ruiz-Mallén, I., Negrete-Yankelevich, S., Reyes-García, V., 2012. Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. Forest Ecology and Management 268, 6-17.

Poteete, A.R., Ostrom, E., 2004. Heterogeneity, group size and collective action: The role of institutions in forest management. Development and change 35, 435-461.

Rasul, G., Karki, M., 2007. Participatory forest management in South Asia: a comparative analysis of policies, institutions and approaches. International Centre for Integrated Mountain Development (ICIMOD). Kathmandu, Nepal.

Redford, K.H., Adams, W.M., 2009. Payment for Ecosystem Services and the Challenge of Saving Nature. Conservation Biology 23, 785-787.

Ribot, J.C., 2004. Waiting for democracy. The politics of choice in natural resource decentralization. World Resources Institute Washington, DC.

Ribot, J.C., Lund, J.F., Treue, T., 2010. Democratic decentralization in sub-Saharan Africa: its contribution to forest management, livelihoods, and enfranchisement. Environmental Conservation 37, 35-44.

Robinson, E.J.Z., Albers, H.J., Williams, J.C., 2011. Sizing reserves within a landscape: The roles of villagers reactions and the ecological-socioeconomic setting. Land economics 87, 233-249.

Robinson, E.J.Z., Lokina, R.B., 2011. Efficiency, enforcement and revenue tradeoffs in participatory forest management: an example from Tanzania. Environment and Development Economics 1, 1-19.

Roe, D., 2008. The origins and evolution of the conservation-poverty debate: a review of key literature, events and policy processes. Oryx 42, 491-503.

Roe, D., Nelson, F., Sandbrook, C., (eds.). 2009. Community management of natural resources in Africa: Impacts, experiences and future directions. Natural Resource Issues No. 18, International Institute for Environment and Development, London UK.

Romijn, E., Herold, M., Kooistra, L., Murdiyarso, D., Verchot, L., 2012. Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+. Environmental Science & Policy 19-20, 33-48.

Salafsky, N., 2010. Integrating development with conservation:: A means to a conservation end, or a mean end to conservation? Biological Conservation 144, 973-978.

Sandbrook, C., Nelson, F., Adams, W.M., Agrawal, A., 2010. Carbon, forests and the REDD paradox. Oryx 44, 330-334.

Sanderson, S.E., Redford, K.H., 2003. Contested relationships between biodiversity conservation and poverty alleviation. Oryx 37, 389-390.

Scharlemann, J.P.W., Kapos, V., Campbell, A., Lysenko, I., Burgess, N.D., Hansen, M.C., Gibbs, H.K., Dickson, B., Miles, L., 2010. Securing tropical forest carbon: the contribution of protected areas to REDD. Oryx 44, 352-357.

Schelhas, J., Pfeffer, M.J., 2009. When global environmentalism meets local livelihoods: policy and management lessons. Conservation Letters 2, 278-285.

Schreckenberg, K., Luttrell, C., Moss, C., 2006. Participatory forest management: An overview. Overseas Development Institute.

Schwartzman, S., Moreira, A., Nepstad, D., 2000. Rethinking tropical forest conservation: perils in parks. Conservation Biology 14, 1351-1357.

Shackleton, S., Campbell, B., Wollenberg, E., Edmunds, D., 2002. Devolution and community-based natural resource management: Creating space for local people

to participate and benefit? Overseas Development Institute. Natural Resource Perspectives, Number 76. Programme for Land and Agrarian Studies.

Sheil, D., Wunder, S., 2002. The value of tropical forest to local communities: complications, caveats, and cautions. Conservation Ecology 6, 9.

Sigalla, H.L., 2013. Trade-Offs between Wildlife Conservation and Local Livelihood: Evidence from Tanzania. African Review 40, 155-178.

Skutsch, M.M., McCall, M.K., 2010. Reassessing REDD: governance, markets and the hype cycle. Climatic Change, 1-8.

Stern, N., 2006. The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge, UK.

Streck, C., 2012. Financing REDD+: matching needs and ends. Current Opinion in Environmental Sustainability 4, 628-637.

Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L., Wunder, S., 2005. Livelihoods, forests, and conservation in developing countries: an overview. World Development 33, 1383-1402.

Sutter, C., Parreno, J.C., 2007. Does the current Clean Development Mechanism (CDM) deliver its sustainable development claim? An analysis of officially registered CDM projects. Climatic Change 84, 75-90.

Thomas, S., Dargusch, P., Harrison, S., Herbohn, J., 2010. Why are there so few afforestation and reforestation Clean Development Mechanism projects? Land Use Policy 27, 880-887.

To, P.X., Dressler, W.H., Mahanty, S., Pham, T.T., Zingerli, C., 2012. The Prospects for Payment for Ecosystem Services (PES) in Vietnam: A Look at Three Payment Schemes. Human Ecology 40, 237-249.

Umemiya, C., Rametsteiner, E., Kraxner, F., 2010. Quantifying the impacts of the quality of governance on deforestation. Environmental Science & Policy.

UNFCCC, 1997. Kyoto protocol to the UN framework convention on climate change, United Nations, New York.

UNFCCC, 2007. Reducing Emissions from Deforestation in Developing countries: Approaches to Stimulate Action. Decision 2/CP.13. Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007.

UNFCCC, 2009. Copenhagen Accord, In Decision 2/CP.15.

UNFF, 2007. Non-legally binding instrument on all types of forests: Note by the Secretariat. A/C.2/62/L.5. United Nations Forum on Forests, Seventh Session, New York.

van der Werf, G.R., Morton, D.C., DeFries, R.S., Olivier, J.G.J., Kasibhatla, P.S., Jackson, R.B., Collatz, G.J., Randerson, J.T., 2009. CO2 emissions from forest loss. Nature Geoscience 2, 737-738.

Vedeld, P., Angelsen, A., Bojö, J., Sjaastad, E., Kobugabe Berg, G., 2007. Forest environmental incomes and the rural poor. Forest Policy and Economics 9, 869-879.

Vedeld, P., Angelsen, A., Sjaastad, E., Kobugabe Berg, G., 2004. Counting on the environment: Forest incomes and the rural poor. Environmental Economics Series 98. World Bank, Washington D. C.

Vermeulen, S., Sheil, D., 2007. Partnerships for tropical conservation. Oryx 41, 434-440.

Vyamana, V.G., 2009. Participatory forest management in the Eastern Arc Mountains of Tanzania: who benefits? International Forestry Review 11, 239-253.

Waylen, K.A., Fischer, A., McGowan, P.J.K., Thirgood, S.J., Milner-Gulland, E.J., 2010. The effect of local cultural context on community-based conservation interventions: evaluating ecological, economic, attitudinal and behavioural outcomes., In Systematic Review No. 80. Collaboration for Environmental Evidence.

Wells, M., Brandon, K., 1992. People and parks: linking protected area management with local communities. The World Bank, Washington DC.

Wells, M., Guggenheim, S., Khan, A., Wardojo, W., Jepson, P., 1998. Investing in Biodiversity: A Review of Indonesia's Integrated Conservation and Development Projects. The World Bank, East Asia Region, Washington DC.

Wells, M.P., McShane, T.O., Dublin, H.T., O'Connor, D., Redford, K.H., 2004. The future of integrated conservation projects: Building on what works, In Getting biodiversity projects to work: Towards better conservation and development. eds T.O. McShane, M.P. Wells, pp. 397-422. Columbia University Press, New York, New York, USA.

West, P., Igoe, J., Brockington, D., 2006. Parks and peoples: the social impact of protected areas. Annu. Rev. Anthropol. 35, 251-277.

Wilkie, D.S., Morelli, G.A., Demmer, J., Starkey, M., Telfer, P., Steil, M., 2006. Parks and people: Assessing the human welfare effects of establishing protected areas for biodiversity conservation. Conservation Biology 20, 247-249.

Wilson, E.O., 1992. The diversity of life. New York, NY: W. W. Norton & Company.

World Bank, 2002. World Bank Operational Manual OP 4.12., World Bank, Washington DC.

World Bank, 2004. Sustaining forests: A development strategy, Washington DC.

Wunder, S., 2006. Are direct payments for environmental services spelling doom for sustainable forest management in the tropics. Ecology and Society 11, 23.

Wunder, S., 2012. Of PES and other animals. Oryx 46, 1-2.

Wunder, S., 2013. When payments for environmental services will work for conservation. Conservation Letters 6, 230-237.

3 Local Awareness of Tropical Forest Management Regimes

Conducting participatory mapping exercises in Tundu village

Measuring Household Awareness of Tropical Forest Management Regimes in Rural Tanzania.

Latham, J. E.[1], Sallu, S. M.[2], Marshall, A. R.[1, 3.]

1. CIRCLE, Environment Department, University of York, York, UK.
2. Sustainability Research Institute, School of Earth & Environment University of Leeds, Leeds UK.
3. Flamingo Land Ltd., Kirby Misperton, North Yorkshire, UK.

Abstract

Greater understanding of local awareness of forest management regimes - the rules in place, the actors shaping and abiding by the rules and the sanctioning authorities - is required to qualify the realities of policy implementation at the local level. Household-level awareness of forest management regimes is a necessary prerequisite if the rules of natural resource management are to be complied with, yet few assessments of the level and drivers of awareness at this scale have been made. In this paper we measure household awareness of forest management regimes in five villages adjacent to forests subject to different protection status in Tanzania, from National Park through Participatory Forest Management (PFM) to no formal management. Logistic regression is used to assess determinants of awareness using household questionnaire data. Analysis showed that household awareness of forest management and rules and regulations were clear, regardless of the regime in place. However confusion in the type of regime in place was evident, with 45% of households showing inaccurate awareness of the authority in charge. Overall awareness of top-down management structures was high, however only 3% of households were engaged in rule formation in participatory-managed forests and all households were unaware of joint management status. The observed disparity in awareness empirically supports evidence for inconsistency between official forest management designation and actual practice on the ground, in particular low levels of participation within supposed PFM regimes. Household location was found to be the only significant predictor of awareness besides management regime, with households further away from the forest less aware of the management authority. Findings indicate forest management implementation must consider heterogeneity in villager awareness of management regimes, but that this heterogeneity cannot necessarily be defined in a predictable way based on socio-economic characteristics. As such, greater focus is needed on transparent, uniform and consistent dissemination of management regime information across forest-adjacent communities.

Keywords: Tropical Forest Management, Participatory Forest Management, Governance, Awareness, Determinants, REDD+.

Introduction

Decades of conservation interventions suggest the most crucial juncture for the success of any tropical forest management regime is at the implementation stage on the ground (Latham et al. Chapter 2). Management regimes are comprised of rules, actors shaping and complying with the rules, and sanctioning authorities (Corbera and Schroeder 2011). Actor compliance in natural resource management regimes is influenced by many factors and is fundamental for achieving success (Keane et al. 2008), but awareness of the governing regime is of foremost importance if such behaviour is to be achieved (Keane et al. 2011). Rule compliance has been shown to increase with awareness of the rules and regulations in place (Nkonya et al. 2008); yet few attempts have been made to measure local awareness of natural resource management regimes or the factors influencing it, and none specifically examining awareness of tropical forest management at the household level. Greater understanding of local level variation in tropical forest management regime awareness is therefore required to qualify the realities of policy implementation at this scale. By determining the factors influencing this awareness, local implementation of conservation interventions can be enhanced through targeted forest management planning and communication (Keane et al. 2011).

Discrepancy between official natural resource management statistics and actual practice on the ground has been documented, though rarely empirically verified (Ribot 2004; Agrawal et al. 2008; Cotula and Mayers 2009; Hajjar et al. 2009). Nonetheless, awareness for the regulations of Community-Based Natural Resource Management (CBNRM) was found to vary at the community level in Uganda, with awareness lower in more remote communities while those with farming or environmental groups present were more aware of and likely to enact regulations (Nkonya et al. 2008). A similar finding was reported in Madagascar, where individual awareness of wildlife laws was generally low, but was improved by involvement in local tourism activities and forest management committees (Keane et al. 2011). Similar analytical approaches have identified household factors such as education levels, wealth, ethnicity, age, gender and occupation are important in predicting attitudes to (Infield 1988; Gillingham and Lee 1999; Mehta and Heinen 2001; Kideghesho et al. 2007; McClanahan et al. 2009; Tomicevic et al. 2010), and participation in (Lise 2000; Zbinden and Lee 2005; Dolisca et al. 2006) conservation management.

Analysis of this sort is important for identifying heterogeneity within communities, enabling more focussed implementation of management based on identified household socio-economic characteristics. However, such approaches have not yet been applied in measuring household-level awareness of management, and the factors influencing this awareness, in a tropical forest context.

Analysis of local awareness is particularly important given the relatively rapid change in favoured tropical forest policy, and associated management, observed in recent decades (Latham et al. Chapter 2). Policy focus has shifted from strict Government protection towards the promotion of participatory regimes, whereby responsibility is either in full or in part devolved to forest-adjacent communities. More recently, interest in the payments for ecosystem services approach has increased, with international effort directed toward the development of policy aimed at mitigating climate change, through the reduction of carbon emissions from deforestation and degradation (REDD+). However, the shifting focus of policy discourse has arguably not been met with equivalent change in management success, suggesting greater emphasis on the features of successful local implementation is needed, rather than examination of the concept alone (Latham et al. Chapter 2). Proposals for national REDD+ implementation are being discussed based upon existing decentralisation reforms, and thus the ability of sub-national regimes such as participatory management to shape local forest-user actions remain significant (Irawan and Tacconi 2009; Hayes and Persha 2010; Phelps et al. 2010; Larrazabal et al. 2012).

Participatory forest management (PFM) is widely practised across the tropics (Schreckenber et al. 2009), in either one of two main forms that denote the degree of decentralisation: Joint-Forest Management (JFM), for which communities enter into an agreement with local or national Government to jointly manage the forest, or Community-Based Forest Management (CBFM) for which the rights and responsibilities of forest management are wholly devolved to local communities. It is generally agreed that participatory forms of forest management have been successful in terms of improving forest condition (Agrawal et al. 2008; Bowler et al. 2010; Porter-Bolland et al. 2012), however outcomes for local livelihoods remain mixed yet poorly understood (Vyamana 2009; Bowler et al. 2010). Participatory regimes have been criticised for being poorly implemented in practice (Ribot et al. 2010; Berkes 2004), with participation only instrumental and communities excluded from design and decision-making (Kellert et al. 2000; Vermeulen and Sheil 2007; Larson and Soto 2008). Indeed, evidence for inequitable

sharing of forest benefits and responsibilities within communities has been found despite the intended participatory nature of PFM regimes (Lund and Treue 2008; Pfliegner 2010). Importantly, while successes or otherwise of PFM are frequently attributed to the presence of participation in forest management, the level of popular participation on the ground is in fact rarely verified or characterised (Lund et al. 2009). For future policy to be framed upon reported successes of existing management, it is vital that the extent to which that management is being enacted at the local level is qualified.

To assess management practice at the local level this study quantifies household-level awareness of forest management regimes in five Tanzanian villages, each adjacent to forests under varying forms of management ranging from strict protection to PFM and no formal management. Household questionnaires are used to gauge awareness of the nearest forest management authority and rules and regulations. Household demographic, wealth and environmental variables are then used to determine factors influencing this awareness through regression analysis. These data are used to examine and compare local level variation in awareness of different forest management regimes, to ascertain whether variation can be attributed to particular household socio-economic characteristics. In this way, this paper aims to inform tropical forest management practice at the sub-national level, through empirical examination of local awareness of forest management and identification of important household characteristics that may benefit local level implementation through targeted communication of management.

Methods

Case Study Area

Research was carried out in the Eastern Arc Mountains region of Tanzania, where improving understanding of local level forest management in this area is becoming increasingly important, not least because of the region's global importance for biodiversity (Myers et al. 2000; Burgess et al. 2007), but because Tanzania is piloting methods for REDD+ policy linked to the existing PFM programme (Burgess et al. 2010). Tanzania is considered to be at the forefront of PFM practice in Africa, with over 10% of forested land now subject to PFM (Blomley et al. 2008). Community inclusion in forest

management has been found to improve forest condition (Blomley and Ramadhani 2006; Blomley et al. 2008; Blomley and Iddi 2009), with evidence suggesting CBFM is more effective than JFM (Blomley et al. 2011). However deforestation remains an issue in Tanzania; between 130,000 and 500,000ha of land are deforested annually due to agriculture, overgrazing, charcoal burning, fuelwood harvesting, wildfires and commercial logging (FAO 2010).

Data collection was conducted in five forest-adjacent villages in the Morogoro region of Tanzania (Figure 1). Villages were selected to maximise variation in forest management regime whilst minimising geographic spread to avoid high variation in ecological and social factors; with one forest under strict protection as a National Park (NP), one under Joint Forest management (JFM), two under Community-Based Forest Management (CBFM) and the remaining in management transition (Table1). This forest was degazetted as a Forest Reserve in 1981 with the intention of annexation into the Selous Game Reserve. This forest has a complex history, and at the time of data collection remained formally unprotected (Marshall, pers. comm., and see Marshall 2008 for summary).

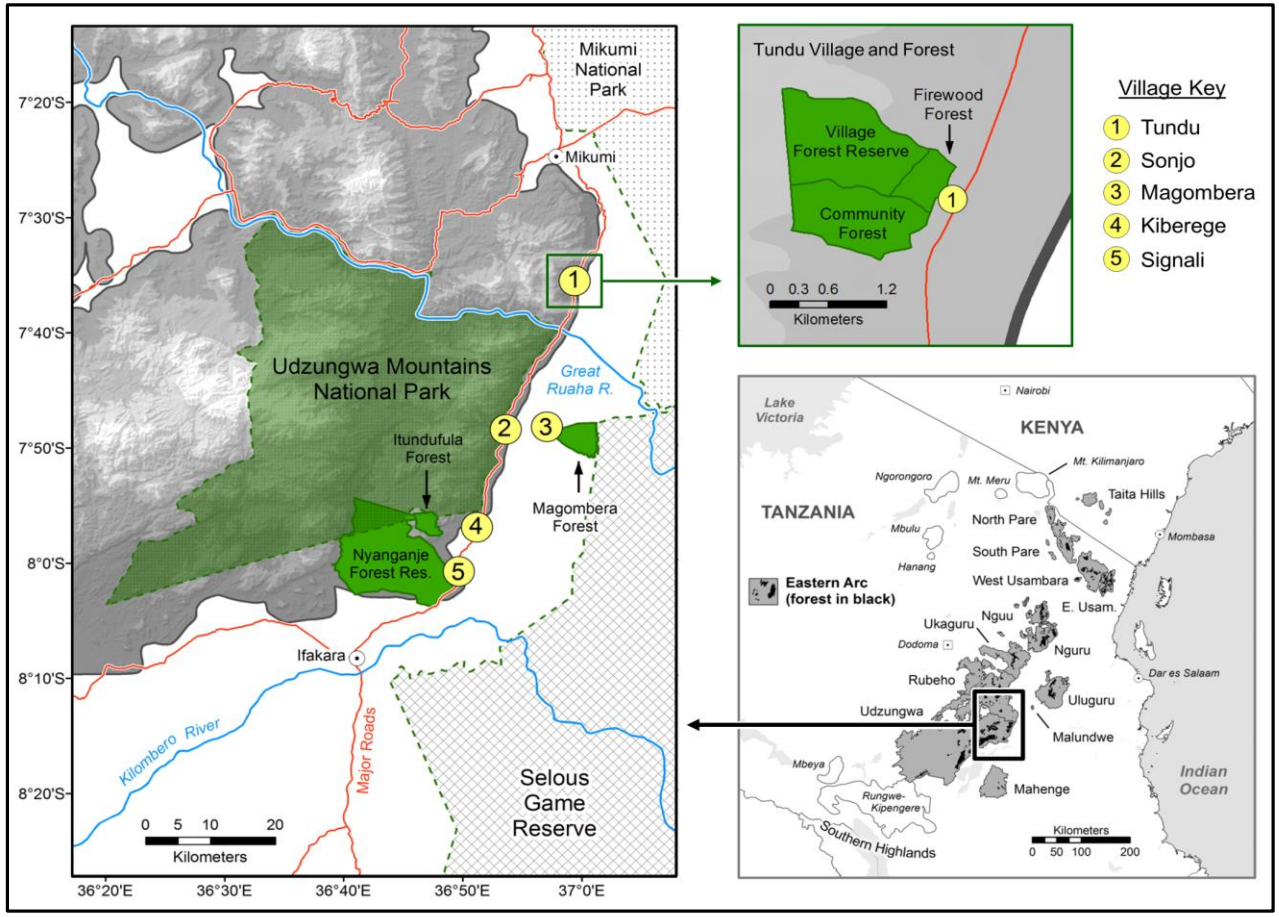


Figure 1. Location of the five study villages in Tanzania and adjacent forests. Adapted using data on Eastern Arc Mountain boundaries and forests from Platts et al. (2011), Protected Area boundaries from UNEP-WCMC (2010), Magombera forest and Selous Game Reserve boundary with the assistance of the Udzungwa Forest Project (UFP) and Tundu Village Forest boundaries from WWF (2006). Data on spatial infrastructure with the assistance of the Valuing the Arc project (http://www.valuingthearc.org).

Table 1. Description of study villages and adjacent forests

Village	Geographic Location	Village Size [a]	Mean House-hold Size	Dominant Tribe(s)	Adjacent Forest [b]	Forest Protection Status	Forest Manage-ment Regime	Regime Established	Sanctioning Authority	Rules and Regulations [c]
Magombera	7°48'24.01"S 36°57'16.03"E	289	3.1	Hehe Pogoro Ngindo	Magombera (0.7km)	In transition (no formal management)	Transition	1981	None	No formal R&R regarding resource use
Kiberege	7°57'5.85"S 36°51'21.90"E	1275	4.1	Pogoro Ngoni Bunga Hehe	Itundufula (5.4km)	Village Forest	CBFM	2003[$]	Kiberege Village	Only dead firewood harvest allowed (i.e. no cutting tools)
Tundu	7°35'44.28"S 36°59'39.90"E	757	4.2	Vidunda	Tundu Community Forest (0.2km)	Village Forest	CBFM	2007[$]	Tundu village	Village forest divided into three areas: VFR – no resource harvest allowed FWF – only dead firewood harvest allowed two days a week CGF - No resource harvest allowed
Signali	8° 0'54.82"S 36°49'48.90"E	576	5.5	Pogoro Ngindo	Nyanganje (1.4km)	Forest Reserve (IUCN category IV)	JFM	1998[$]	Kilombero District Council & Signali Village	Only collection of dead firewood allowed (i.e. no cutting tools). (ban introduced mid-fieldwork in July 2011 after which no resource collection allowed)
Sonjo	7°48'36.14"S 36°53'49.44"E	259	4.8	Ngindo Pogoro Ndamba	Udzungwa Mountains NP (0.3km)	NP (IUCN category II)	NP	1992	TANAPA	Women allowed entry once a week to harvest dead firewood, no cutting tools allowed (ban enforced mid-fieldwork in July 2011 after which no resource harvest allowed)

***NP** = National Park, **CBFM** = Community-Based Forest Management, **JFM** = Joint-Forest Management, **TANAPA** = Tanzania National Park Authority, **R&R** = Rules and Regulations, **VFR** = Village Forest Reserve, **FWF** = Firewood Forest, **CGF** = Community Group Forest.. [a] Number of households, [b] Numbers in parenthesis indicate distance to forest from central village meeting place, [c] Defined through interview with sanctioning authority representatives, [$] Year PFM policy process initiated.*

The Udzungwa Mountains National Park (UMNP) is of significant social, economic and ecological importance at both the local and global scale. The park provides extensive ecosystem services benefitting local agriculture and national power through hydro-electric generation, and attracts international tourism. Immigration to the area is high due to the agricultural value of the land, illustrated by the presence of a large sugar plantation and processing factory owned by the Kilombero Sugar Company. According to the most recently available national census, the population growth rate in Kilombero district increased from 3.4% between 1978 and 1988 to 3.9% between 1988-2002, and in Kilosa district from 2.3% to 2.5% over the same time period (NBS 2002). The predominant livelihood activity in all villages was agriculture (85.1% engaged in the agriculture industry in Kilosa district, 81.3% Kilombero district; NBS 2002), and households were dependent on forest resources for cooking energy (90% firewood and 9% charcoal in rural Kilombero district, 94% firewood and 5% charcoal in rural Kilosa district; NBS 2002).

Data Collection

Data were collected during a seven month field period between March and December 2011 using a mixed method approach in study villages. Data collection began with focus groups of between 6-10 villagers in each village to facilitate spatial awareness of the study area, as names for forest patches varied locally, and to establish criteria for sampling stratification. Focus groups were conducted separately for male and female villagers to allow women more opportunity for expression, given the division of labour in this study society. Focus group discussions were based on a structured questionnaire eliciting village-level demographic information including criteria for wealth-ranking, such as household access to electricity, transport and food availability (Appendix I). A participatory mapping exercise was used to harness spatial representation of village amenities and nearby forest patches. Consensus was reached within each focus group before a group-nominated scribe marked spatial information, such as forest location, on a satellite map of the local area.

To gauge public awareness of management a total of five-hundred household questionnaires were administered (Appendix IIA). This number of questionnaires was chosen to maximise variability in responses whilst maintaining a sample size that was logistically and financially viable within the sampling time-frame. A wealth-ranking exercise was used to assign households to one of two high- or low-income wealth categories based on village-specific wealth criteria identified during focus groups. Households were then stratified by sub-village and wealth, and random number generation was used to select one-hundred household heads as respondents in each

village to maintain equal sample sizes between villages. Questionnaires were translated into Swahili by a Tanzanian research assistant. Enumerators local to each study village were hired to conduct the questionnaires. Questionnaires were first pre-tested within each village to check for applicability of questions within the local context, and improvements made based on resulting suggestions. If household heads were unavailable, questionnaires were administered to spouses where possible, otherwise a new household was randomly selected whilst adhering to the same wealth and sub-village criteria. Household questionnaires were designed to elicit information relating to household socio-economics, livelihood activities and nearby forest management and use. Households were asked to identify their nearest forest, if management was in place, the management rules and regulations and the authority responsible for management. Households were also asked to identify any other nearby forest, with associated management questions then repeated for that forest. In all villages the village centre (defined by central meeting place), and each sampled household location was recorded using GPS.

Official management designation and the rules and regulations in place for each forest were confirmed through interviews with representatives of management for each forest (see Latham et al. Chapter 5 for details). A total of 47 semi-structured interviews were carried out for this purpose (Appendix III). Members of the Village Council in each village were interviewed, including the Village Chairperson and head of the Village Environmental Committee. Also interviewed were Forest and Natural Resource officials at each Ward, Division, District and Regional and National levels, the TANAPA UMNP Chief Park Warden and Community Conservation Warden and representatives of two locally-based Non-Governmental Organisations (NGOs) working on issues of natural resource management in the area.

Data Analysis

Local Awareness of Forest Management and Associated Rules and Regulations

Qualitative data from household surveys were coded to provide binary response data, by scoring responses to forest management questions as true or false. Responses scored were, a) awareness of whether the named nearest forest was managed, b) awareness of who managed the forest (henceforth defined 'sanctioning authority') and c) awareness of whether rules and regulations regarding forest resource use were in place. Scoring criteria were based on official forest management regime designation as outlined in Table 1. In the case of Nyanganje Forest Reserve, only answers stating both the village and district council manage the forest were scored as

correct, answers of either authority alone were scored incorrect owing to the joint-management status of the forest. Scores for each management question were then compared both in total and by management regime using binomial tests to test for a significant deviation from a true probability of success equal to 0.5 (expected for uninformed guesses) occurred. All statistical analyses were carried out using R (version 3.0.0; http://cran.r-project.org), with the False Discovery Rate (FDR; Benjamini and Hochberg 1995) correction of alpha values for repetitive testing employed.

Determinants of Household Awareness

Further analysis was carried out to determine what factors might predict a household's awareness of the named nearest forest sanctioning authority. A broad set of 16 household-level demographic, wealth and environmental predictor variables were hypothesised to influence awareness (Table 2; Appendix IV). Variables were chosen based on previous research aimed at examining predictors of attitudes to and participation in conservation management (e.g. Dolisca et al. 2006; Kideghesho et al. 2007). All variables were coded from household questionnaire data except for distance to the forest. Distance from each household to the nearest boundary edge of the named nearest forest (see Figure 1) was calculated using ArcGIS Desktop 10.0. As an indicator of wealth, the total value of assets owned by each household was calculated. Households were asked in the questionnaire to indicate the number of assets owned from a list, such as mobile phone, bicycle, television and furniture, and indicate the value in Tanzanian shillings of these items. The value of each asset was then multiplied by the number owned, in turn totalled to calculate the 'assets' variable. The management regime of each forest was also included as a predictor of awareness.

Table 2. Description of predictor variables.

Type	Household variable	Description
Demographic	age	Age of household head
	gender	Gender of household head (M or F)
	education	Number of years household head in formal education
	occupation	Occupation of household head
	born	Household head born in village (Y or N)
	hhsize	Number of household residents
	hhwomen	Proportion of female household residents
	group	Number of social group memberships within household
Wealth	land	Area of land attributed to household (hectares)
	hse_material	Main material of household structure (brick or mud)
	assets	Total household asset value (*1000 Tanzanian shilling)
	incomes	Number of household income sources
Environmental	stove	Household owns fuel-efficient stove (Y or N)
	woodlot	Household planted trees/woodlot (Y or N)
	distance	Distance from household to named nearest forest (km)
	offman	Management regime of the named nearest forest (NP, CBFM, JFM, None)

***M** = Male, **F** = Female, **Y**= Yes, **N**= No.*
1 Tanzanian shilling was equal to mean 0.000635 US dollars during the period of data collection (March-December 2011).

Pearson correlation and Variance Inflation Factors were used to assess covariation between all predictor variables (Zuur et al. 2010). No high intercorrelation was present (Pearson P≤ 0.7 and/or VIF ≤ 5) and so all variables were retained. Variables with uneven spread (occupation only; 98% farmer) were excluded from models. Before modelling, variables with a strong skew were transformed as follows: age, village_yrs, hhsize, assets (square root); group, incomes (log10); land, distance (cube root).

Logistic regression was used to investigate the influence of predictor variables on household awareness of the nearest forest sanctioning authority. Spline correlograms (ncf package; Bjornstad 2012) were used to test for spatial-autocorrelation, as within-village observations may not be independent given households from the same village face equivalent socio-economic and environmental factors. Significant spatial auto-correlation was present at short lag-distances of 4km (Appendix V.1A). With only five villages sampled it was not appropriate to include village as a random factor using generalised linear mixed models (e.g. Crawley 2002). However spline correlograms of the Pearson residuals suggested spatial correlation within villages was successfully accommodated by the logistic regression model, with household location accounted for through the inclusion of the OffMan variable (Appendix V.1B).

Minimum adequate models were obtained using backwards-forwards selection based on the Akaike Information Criterion (Murtaugh 2009). Final models were validated through observation

of residual spread. Analyses of deviance (likelihood ratio tests) were used to test the probability that the amount of deviance explained was not significantly reduced from the full (unreduced) model (Zuur et al. 2010). The probability that the slope estimate of each variable was significantly different from zero was determined, based on a *t* distribution (Quinn and Keough 2002). FDR correction of alpha values for repetitive testing was employed on slope estimates, resulting in 95% significance alpha cut-off of 0.024.

Results

Household Sample

84% of household heads were male and 16% female, with a mean age of 46.5 years old (+1.25, -1.24; 95% bootstrapped confidence intervals) and six years (+0.21, -0.22) of formal education (Appendix V). Immigration to the villages was high with more than half of respondents born elsewhere (54%), but permanent settlement was evident with the majority of houses made from brick rather than mud (86%), with "good agricultural land" the most widely cited reason for moving to the area (59% of those born elsewhere). The main occupation of respondents was farming (98.2%) with the remainder either self- (0.8%) or wage- (0.4%) employed or pastoralist (0.6%). All households surveyed were dependent on forest resources (firewood and/or charcoal) as their sole source of cooking energy.

34.2% of respondents named the National Park as their nearest forest (n=171), 24.0% the CBFM forests (n=120), 20.2% the JFM forest (n=101) and 20% the forest under no formal management (n=100). The remaining 1.6% of the household sample (n=8) was excluded from further analysis having identified privately-owned areas or farmland as their nearest forest, or left the question unanswered. These findings indicate a divergence from the 'one village - one forest' study design structure adopted, with households from more than one village identifying the same forest as their nearest. This was particularly apparent for most households in Kiberege village, who identified the National Park as their nearest forest rather than the community-managed Itundufula village forest (n=71).

Management Regime Awareness

Awareness of Forest Management

77% of all households correctly understood whether the forest they named as nearest was managed. When compared by management regime, 98% households nearest to the forests under strict protection or participatory management accurately understood the forest was managed, however all households identifying the forest under transitional management as nearest incorrectly stated the forest was managed. Despite the overall trend for correct awareness of whether management was in place, nearly half of all respondents were incorrectly aware who the sanctioning authority in charge of the nearest forest was (45%).

Correct household identification of the nearest forest sanctioning authority varied according to the management regime in place, with the majority of CBFM- and strict protection-adjacent households aware who the authority was (Figure 3). However, only 1.7% of all CBFM-adjacent households identified themselves as being responsible for management, with most indicating the village Government as the sanctioning authority. All JFM-adjacent households failed to correctly identify the sanctioning authority of the forest; with most stating either the national park authority or Government was solely responsible for management rather than being jointly managed with the community (Table 3).

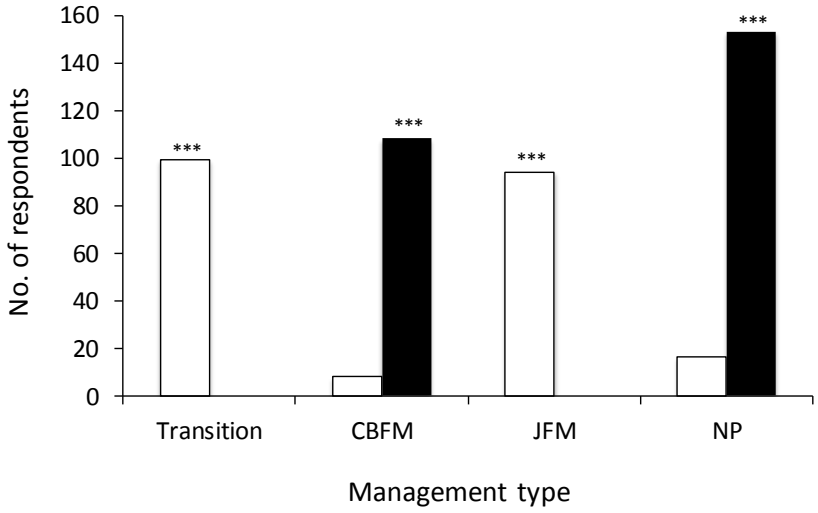


Figure 2. Number of respondents aware of the nearest forest sanctioning authority by management regime (solid bars 'True', empty bars 'False'), ***binomial tests, $p<0.001$, $\alpha_{FDR}=0.05$.

Table 3. Household-identified sanctioning authority of each forest when named as either nearest or another nearby forest. NA indicates that forest was not named as another nearby forest by any household.

Forest name	Management regime	Official sanctioning authority	Household-identified sanctioning authority when forest named as:	
			Nearest	Other
Magombera	Transition	None	57.6% TANAPA 33.3% Selous Game Reserve 7.1% 'White Man' 2% Government	*NA*
Itundufula	CBFM	Kiberege village	73.7% Village Government 10.5% TANAPA 10.5% Government 5.3% Village Environmental Committee	61.1% Village Government 22.2% TANAPA 16.7% Government
Tundu village forest	CBFM	Tundu village	92.8% Village Government 3.1% Government 2.1% Household themselves 1% Village Environmental Committee 1% Other	*NA*
Nyanganje	JFM	Kilombero District Council and Signali village	61.7% TANAPA 33% Government 4.3% Village Government 1% Don't Know	*NA*
UMNP	NP	TANAPA	90.5% TANAPA 7.1% Government 2.4% Don't Know	76.3% TANAPA 8.8% Selous Game Reserve 5% Queen Elizabeth 3.8% Government 2.5% 'White Man' 3.6% Other

All households in Magombera village identified Magombera forest, under transitional management, as their nearest. 92.9% of these households incorrectly believed Government management was already in place, as a national park or a game reserve. It is clear that perceptions of the management status of this forest are confused, potentially influenced by the convoluted history of the forest (see Marshall 2008 for summary) and the proximity of the forest to the centralised-managed Selous Game Reserve and UMNP.

Most households adjacent to Itundufula forest, under community-based management, correctly stated the village Government was the authority in charge. However, these households represent only 20% of the Kiberege village sample, with 71% of household respondents in this village

identifying the National Park as their nearest forest. UMNP is geographically nearer than Itundufula to many households in Kiberege village, however the small number of respondents identifying the village forest has potential implications for the effectiveness of CBFM in this village. In Signali village over 60% of respondents identified TANAPA as the sanctioning authority for Nanganje forest, and less than 5% identified the village Government.

Awareness of Nearest Forest Rules and Regulations

89% of all respondents correctly understood whether the forest nearest to their household was subject to rules and regulations. This includes most households adjacent to the forest under transitional management (82%), who correctly stated there were no rules and regulations in place even though all had answered that the forest was managed. Of the 355 respondents who were correct in stating the forest was subject to rules and regulations (hence excluding transitional management forest-adjacent households), 96% went on to describe the rules in place. The most prominent description being "only women without cutting tools are allowed entry to the forest" (45%).

Most CBFM-adjacent households (97%) were correctly aware that rules and regulations governed the forests, with the most widely cited rule being the "need to seek permission before entering and not to cut trees indiscriminately" (52%). However, it was only for these forests that a small proportion of respondents (3%) stated rules are in place but they are not enforced and "people do what they want to anyway". Given the nature of Participatory Forest Management, both CBFM- and JFM-adjacent households were asked whether they had taken part in the formation of the rules and regulations relating to those forests. 3% of these households answered than they had, with only 1 JFM-adjacent household and 5 CBFM-adjacent households responding positively.

Determinants of Household Awareness

Household awareness of the nearest forest sanctioning authority was best modelled by demographic variables household size, education and social group membership, the wealth variable house material and the environmental variable distance to the forest and by the management regime of the forest (Table 4). However, demographic variables education and social group membership were not retained in the minimum adequate model. Distance to the forest was the only significant predictor of awareness, with a negative relationship between distance and probability of household awareness of the forest sanctioning authority. When modelled alone however, distance was found to explain only 2.5% of the variation in probability of awareness (AIC=534.82, p=0.00045), explaining significantly less than the minimum adequate

model (Model 1; analysis of deviance: p[D]<0.001). The management regime of the forest was the strongest predictor, explaining over 58% of the variation in awareness in all models. Local awareness varied significantly between villages, depending on the type of forest management regime, with limited awareness of forests under joint or transitional management. However this could not be compared within villages, limiting the scope of logistic regression models, due to limited variation in forest management regime at this scale.

Table 4. Logistic regression models, based on backward-forward selection using AIC, of household awareness of the nearest forest sanctioning authority versus alternative minimum adequate models of demographic, wealth and environmental predictor variables. Statistics include the probability of deviation from a slope of zero (p), direction of the trend (positive$^+$, negative$^-$), the percent deviance explained by each variable (%D_V), the difference in AIC between the model in question and the AIC-best model (Model1; ΔAIC), the percent deviance explained by each model (%D), and probability of decreased deviance explained for each model from the next-best model (p[D_M]), and from the full model (p[D_G]), following analysis of deviance. Bold type indicates significant variables following FDR correction (α_{FDR} = 0.024).

Household variable	**Model 1**	**Model 2**	**Model 3**
Distance to forest $^-$	***p* = 0.0018** **(%D_V = 1.74)**	***p* = 0.0011** **(%D_V = 1.94)**	***p* = 0.0031** **(%D_V = 1.6)**
Brick House $^+$	p = 0.033 (%D_V = 0.51)	p = 0.057 (%D_V = 0.42)	p = 0.053 (%D_V = 0.44)
Household Size$^+$	p = 0.073 (%D_V = 0.62)	p = 0.083 (%D_V = 0.58)	p = 0.16 (%D_V = 0.36)
Education level$^+$	*NA*	p = 0.28 (%D_V = 0.22)	p = 0.29 (%D_V = 0.20)
Number of Social Groups$^+$	*NA*	*NA*	p = 0.37 (%D_V = 0.15)
Forest Management Regime$^+$	CBFM: p = 0.99077 JFM: p = 1.00 NP: p = 0.99092 (%D_V = 58.86)	CBFM: p = 0.9907 JFM: p = 0.99996 NP: p = 0.99085 (%D_V = 58.98)	CBFM: p = 0.99074 JFM: p = 0.99994 NP: p = 0.99085 (%D_V = 58.85)
AIC	168.91	169.73	170.88
ΔAIC	0	0.82	1.97
%D	71.53	71.75	71.90
p[D_M]	0.28	0.36	*NA*
p[D_G]	0.991	0.998	0.0.999

Discussion

Awareness that forests were managed was high in the study area, however there was clear confusion regarding the type of management in place for some forests. The observed disparity in local awareness of the sanctioning authority of forests has important implications for tropical forest management policy, indicating inconsistency between official management designation and local level perspectives. Findings empirically support discussions in the literature surrounding discrepancy between official natural resource management statistics and actual practice on the ground (Ribot 2004; Agrawal et al. 2008; Cotula and Mayers 2009; Hajjar et al. 2009).

Local Awareness of Forest Management

Overall, local awareness of top-down forest management structures was high, evidenced by the high response rate of TANAPA, Government or Selous Game Reserve as the sanctioning authority for most forests. TANAPA have a strong presence in the local area, UMNP park headquarters are located very near to Sonjo village and TANAPA have a Community Outreach Programme in place to work with villages bordering the National Park (TANAPA Community Outreach Officer, pers. comm.). The prominence of TANAPA is evident not just in the correct reporting of their being the authority in charge of UMNP but also in the number of respondents also reporting TANAPA as the sanctioning authority for Nyanganje, Magombera and Intundufula forests. The proximity of these forests to UMNP and TANAPA's outreach potentially influencing this perspective and blurring perceived management boundaries.

This top-down perspective may also be true for the forests subject to Community-Based Forest Management in this area, even though it is the most participatory form of forest management. In a case study of CBFM in Tanzania, Rantala et al. (2012) note that village councils imposed strict regulations on forest access and that by doing so they followed the same reserve-centric, exclusionary model of centralised governance. Only a small percentage of CBFM-adjacent households in the case-study identified themselves as responsible for forest management and involved in rule formation, hence CBFM in these villages might also be perceived as another form of centralised management albeit at the lowest administrative level. Nevertheless, awareness of this management structure may be important even if locally perceived as centralised control, as in Uganda Nkonya et al. (2008) found that the probability to comply with regulations enacted by village councils was greater than for those passed by higher legislative bodies. Indeed, further analysis into the effect of household awareness on forest resource use and regime compliance is needed in the study area. However, improving awareness and compliance at the local level may not result in overall management success, as local achievements may be jeopardised by larger scale factors such as non-local resource users and foreign influence (Gutierrez et al. 2011).

Of the three villages adjacent to forests subject to PFM, only Tundu village showed clear awareness of the CBFM structure in place. In Kiberege village the majority of the household sample identified UMNP, not their village forest, as their nearest and in Signali village all households were unaware of JFM status. While associations between awareness of the regime and its outcomes in terms of forest condition or livelihood benefits cannot be made here, findings are in accordance with reports that CBFM is performing better than JFM in Tanzania (Blomley et al. 2011). Evaluations of the impact of PFM on forest management are numerous and provide

important evidence for policy makers, practitioners and scholars; yet rarely when measuring the outcomes of PFM is the level of participation on the ground empirically verified (Lund et al. 2009). Participation in PFM is often described in dichotomous terms, being either participatory or not, but institutional setups on the ground can vary and it is important to verify the degree of this variation if outcomes are to be attributed to the style of management. Three forests in the case study are designated under participatory management, however findings in fact indicate low levels of participation in their management. Attributing any change in forest or household socio-economic condition in these villages to the occurrence of participation in forest management would, as a consequence, likely be erroneous.

Reducing awareness to a binary variable may lend itself to over-simplification given the potential influence of complex socio-political interactions between forest stakeholders that remains unaccounted for. For example, the reporting of Queen Elizabeth as the sanctioning authority of UMNP can seem obscure without further explanation. The national park was officially opened in 1992 by the former president of the World Wild Fund for Nature (WWF), Prince Bernhardt of the Netherlands. Rumour spread locally that this 'white man' had come by helicopter to sign a contract and thereby own the forest (Bancet 2007). The sudden exclusionary management of the forest being perceived as land acquisition by foreign actors, most readily associated with recent British colonial rule as governed by Queen Elizabeth (Bancet 2007). Thus, qualitative inspection of the historical and socio-political forest landscape is needed to fully appreciate any observed variation in the awareness and behaviour of forest-users. Population density in the study area is high, with land availability scarce and land use competitive given the prevalence of cash crops such as sugar adding to the complex socio-political arrangements in the area.

Factors Affecting Local Awareness of the Forest Sanctioning Authority

Household distance to the forest was the most significant predictor of local awareness of the sanctioning authority, in agreement with Nkonya et al. (2008), who found that awareness of CBNRM regulations was lowest among more distant communities in Uganda. This presents a double-jeopardy situation for the welfare of these households, given more-distant forest resources and the least understanding of management regimes. Observed variation in awareness of the sanctioning authority could not be attributed to any other particular socio-economic characteristics within the villages. Yet previous research has established such determinants elsewhere, with awareness of protected species higher in better-educated individuals and those that were involved in tourism and CBNRM in Madagascar (Keane et al. 2011), and the presence of environmental groups improving awareness for regulations in Uganda (Nkonya et al. 2008). While

education levels, household size, house material and social group membership were found to be of importance in analysis, these factors did not explain a significant amount of the variation in awareness in the study area.

Modelling observed awareness was limited here by the lack of variation within forest management regimes sampled. Indeed, the type of forest management regime in place was found to be the strongest predictor of local awareness of the sanctioning authority. To improve this, up-scaling of the approach is recommended to measure awareness in more villages adjacent to forests under the same management regimes, allowing for greater variation in potential demographic, wealth and environmental determinants by management regime. Notwithstanding, even at the scale measured here, findings present important implications for forest management and policy practitioners. Findings suggest that inadequacies in awareness cannot be attributed to particular household socio-economic characteristics, but rather to failings in the implementation of management itself. This is especially true for JFM given no adjacent households were aware of the forest's joint-management status, regardless of any demographic, wealth or environmental variation within the village. Thus the communication of management regimes cannot necessarily be targeted at households with particular socio-economic characteristics within a community but rather needs to be widespread, uniform and consistent across all regimes.

Wider Implications for Forest Management

Variation in awareness presents important implications for the ability of forest management regimes to achieve multiple socio-economic and ecological outcomes. Improved forest condition has been linked to forest management regimes that foster good governance, particularly where local resource users have good awareness of the rules and regulations in place and these are adhered to (Hayes and Persha 2010; Umemiya et al. 2010). Key elements of good natural resource governance include transparent and equitable relationships between stakeholders, public accountability and participatory decision making (Brown et al. 2003). In addition, local level rule-making autonomy is associated with greater carbon storage and livelihood benefits (Chhatre and Agrawal 2009), and proactive engagement by local resource users through strong leadership, social cohesion and participation in governance institutions is positively associated with successful management of the commons (Gutierrez et al. 2011; Persha et al. 2011; Campbell et al. 2012). Such principles are adopted by indicators of good forest governance, used to monitor and inform the integrity of institutions and processes that govern forests and aid reform (Brito et al. 2009). Local awareness of forest management regimes might be used as one such metric to indicate transparency in forest governance and in turn, management success. By doing

so, observed awareness in the study area indicates management of the National Park as the most effective, followed by CBFM regimes with JFM performing poorly.

Findings present important implications for developing REDD+ policy, particularly as current discussions surrounding REDD+ implementation are based on existing decentralisation reforms (Irawan and Tacconi 2009; Hayes and Persha 2010; Phelps et al. 2010; Larrazabal et al. 2012). The low levels of participation in PFM observed in the case study are important when considering the social safeguards of any payment-based policy, given the potential for inequitable benefit sharing with disproportionate awareness of management amongst communities. Issues of local level justice and equity that have historically dogged tropical forest management remain relevant for REDD+ (Corbera et al. 2010), prompting fresh analytical reviews of existing management regimes as a basis for improvement (Bond et al. 2009; Blom et al. 2010; Hayes and Persha 2010; Pirard et al. 2010). Mounting commentary stresses the importance of improving governance and institutional processes for REDD+ (Skutsch and McCall 2010; Kanowski et al. 2011; Barr and Sayer 2012; McDermott et al. 2012; Pettenella and Brotto 2012), but there are few recommendations as to how this can be achieved in practice, especially at the country or sub-national level (Gregersen et al. 2010; Corbera and Schroeder 2011). Improving the governance of social-ecological systems such as tropical forests is inherently complex, but can be informed by empirical analysis of current modes of implementation across different management regimes at the local level. Local level awareness of forest management regimes could be used as one such metric.

Conclusion

Measuring local-awareness of forest management regimes empirically verifies discrepancy between official management statistics and ground-level practice, especially the degree of participation in participatory forest management. However, variation in awareness and associated inadequacies in management implementation cannot necessarily be attributed to particular socio-economic traits within communities. The results therefore suggest that forest management communication to local communities cannot necessarily be targeted based on socio-economic information, but rather all levels of a community must be addressed. This is particularly apparent in the implementation of JFM within a village, given no households were aware of the joint-management status in this study. Awareness of regimes could be used as a metric to indicate forest management effectiveness, especially if in conjunction with other quantitative and qualitative measures. However, measuring awareness of the management regimes is the first step

in understanding the effectiveness of forest management regimes at the local level, with further analysis on its effect on forest resource user behaviour and regime compliance required.

Acknowledgements

This study was conceived by J.E.L., who collected and analysed field data and prepared the manuscript. The work was supervised by S.M.S and A.R.M, with thanks to Steve Cinderby at Stockholm Environment Institute, York, for assistance with preparation of methods and data handling. Research was carried out with funding from the Economic and Social Research Council (ESRC) with the permission of the Tanzania Commission for Science and Technology (COSTECH permit number 2011-60-NA-2010-205), after receiving approval from the University of York Environment Department Ethics Committee. We thank village councils and villagers for allowing research to be conducted within all five villages and thanks also to all relevant forest officials. Many thanks also to Mohamed A. Kambi for research assistance in the field, and enumerators Ladislaus Mkatihela, Shafii Rashidi, Katenga Henry, Joseph Damiani Nyambi and Hassan Pamuhi. We also thank Phil Platts for assistance with cartography and the Udzungwa Forest Project for logistical support in the field.

References

Agrawal, A., Chhatre, A., Hardin, R., 2008. Changing governance of the world's forests. Science 320, 1460.

Bancet, A., 2007. Questioning livelihoods, ideologies & practices of environmentalism in Africa through an ethnographical comparative survey. Study case of the adjacent populations of the Udzungwa Mountains National Park in Tanzania, In Paper for presentation at the Workshop on: How Does Environmental Governance Affect the Poor? Global and Local Forces Shaping Poverty Alleviation in Africa. Oxford University Centre for the Environment, 25th January.

Barr, C.M., Sayer, J.A., 2012. The political economy of reforestation and forest restoration in Asia-Pacific: Critical issues for REDD+. Biological Conservation 154, 9-19.

Benjamini, Y., Hochberg, Y., 1995. Controlling the false discovery rate: a practical and powerful approach to multiple testing. Journal of the Royal Statistical Society. Series B (Methodological), 289-300.

Berkes, F., 2004. Rethinking community-based conservation. Conservation Biology 18, 621-630.

Bjornstad, O.N., 2012. ncf: spatial nonparametric covariance functions, In R package version 1.1-4. http://CRAN.R-project.org/package=ncf.

Blom, B., Sunderland, T., Murdiyarso, D., 2010. Getting REDD to work locally: lessons learned from integrated conservation and development projects. Environmental Science & Policy 13, 164-172.

Blomley, T., Iddi, S., 2009. Participatory Forest Management in Tanzania: 1993 - 2009. Lessons Learned and Experiences To Date., Ministry of Natural Resources and Tourism, Forestry and Beekeeping. Dar es Salaam.

Blomley, T., Lukumbuzya, K., Brodning, G., 2011. Participatory Forest Management and REDD+ in Tanzania. World Bank. Washington DC.

Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N., 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. Oryx 42, 380-391.

Blomley, T., Ramadhani, H., 2006. Going to scale with participatory forest management: early lessons from Tanzania. International Forestry Review 8, 93-100.

Bond, I., Grieg-gran, M., Wertz-Kanounnikoff, S., 2009. Incentives to sustain forest ecosystem services: a review and lessons for REDD. Natural Resource Issues No. 16. International Institute for Environment and Development, London UK, with CIFOR, Bogor, Indonesia and World Resources Institute, Washington D.C., USA.

Bowler, D., Buyung-Ali, L., Healey, J.R., Jones, J.P.G., Knight, T., Pullin, A.S., 2010. The evidence base for community forest management as a mechanism for supplying global environmental benefits and improving local welfare., In Systematic Review No. 48. Collaboration for Environmental Evidence.

Brito, B., Micol, L., Davis, C., Nakhooda, S., Daviet, F., Thuault, A., 2009. The governance of forests toolkit (Version 1): a draft framework for assessing governance in the forest sector, In The Governance of Forests Initiative. WRI, Imazon and Instituto Centro de Vida, Washington, DC 20002 USA.

Brown, D., Schreckenberg, K., Shepherd, G., Wells, A., Luttrell, C., Bird, N., 2003. Good Governance: What can we learn from the Forest Sector? Forest Policy and Environment Group. Overseas Devlopment Institute.

Burgess, N.D., Bahane, B., Clairs, T., Danielsen, F., Dalsgaard, S., Funder, M., Hagelberg, N., Harrison, P., Haule, C., Kabalimu, K., Kilahama, F., Kilawe, E., Lewis, S.L., Lovett, J.C., Lyatuu, G., Marshall, A.R., Meshack, C., Miles, L., Milledge, S.A.H., Munishi, P.K.T., Nashanda, E., Shirima, D., Swetnam, R.D., Willcock, S., Williams, A., Zahabu, E., 2010. Getting ready for REDD+ in Tanzania: a case study of progress and challenges. Oryx 44, 339-351.

Burgess, N.D., Butynski, T.M., Cordeiro, N.J., Doggart, N.H., Fjeldså, J., Howell, K.M., Kilahama, F.B., Loader, S.P., Lovett, J.C., Mbilinyi, B., Menegon, M., Moyer, D.C., Nashanda, E., Perkin, A., Rovero, F., Stanley, W.T., Stuart, S.N., 2007. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. Biological Conservation 134, 209-231.

Campbell, S.J., Cinner, J.E., Ardiwijaya, R.L., Pardede, S., Kartawijaya, T., Mukmunin, A., Herdiana, Y., Hoey, A.S., Pratchett, M.S., Baird, A.H., 2012. Avoiding conflicts and protecting coral reefs: customary management benefits marine habitats and fish biomass. Oryx 46, 486-494.

Chhatre, A., Agrawal, A., 2009. Trade-offs and synergies between carbon storage and livelihood benefits from forest commons. Proceedings of the National Academy of Sciences 106, 17667.

Corbera, E., Estrada, M., Brown, K., 2010. Reducing greenhouse gas emissions from deforestation and forest degradation in developing countries: revisiting the assumptions. Climatic Change 100, 355-388.

Corbera, E., Schroeder, H., 2011. Governing and implementing REDD+. Environmental Science & Policy.

Cotula, L., Mayers, J., 2009. Tenure in REDD: Start-point or afterthought? Natural Resource Issues No. 15. International Institute for Environment and Development, London, UK.

Crawley, M.J., 2002. Statistical computing: an introduction to data analysis using S-Plus. Wiley Chichester, UK.

Dolisca, F., Carter, D.R., McDaniel, J.M., Shannon, D.A., Jolly, C.M., 2006. Factors influencing farmers' participation in forestry management programs: A case study from Haiti. Forest Ecology and Management 236, 324-331.

FAO, 2010. Global Forests Resources Assessment 2010, In Food and Agricultural Organisation of the United Nations. Rome, Italy.

Gillingham, S., Lee, P.C., 1999. The impact of wildlife-related benefits on the conservation attitudes of local people around the Selous Game Reserve, Tanzania. Environmental Conservation 26, 218-228.

Gregersen, H., El Lakany, H., Karsenty, A., White, A., 2010. Does the Opportunity Cost Aproach Indicate the Real Cost of REDD+? Rights and Realities of Paying for REDD+. Rights and Resources Institute, Washington, DC.

Gutierrez, N.L., Hilborn, R., Defeo, O., 2011. Leadership, social capital and incentives promote successful fisheries. Nature 470, 386-389.

Hajjar, R., Gough, A., Mathey, A.H., Nitschke, C., Paudel, S.K., Skrivanos, P., Waeber, P.O., Innes, J., 2009. Criteria and indicators for sustainable forest management in the face of decentralization: are they still relevant in their current form, In XIII World Forestry Congress. Buenos Aires, Argentina, 18 – 23 October.

Hayes, T., Persha, L., 2010. Nesting local forestry initiatives: Revisiting community forest management in a REDD plus world. Forest Policy and Economics 12, 545-553.

Infield, M., 1988. Attitudes of a rural community towards conservation and a local conservation area in Natal, South Africa. Biological Conservation 45, 21-46.

Irawan, S., Tacconi, L., 2009. Reducing Emissions from Deforestation and Forest Degradation (REDD) and decentralized forest management. International Forestry Review 11, 427-438.

Kanowski, P.J., McDermott, C.L., Cashore, B.W., 2011. Implementing REDD+: lessons from analysis of forest governance. Environmental Science & Policy 14, 111-117.

Keane, A., Jones, J.P.G., Edwards-Jones, G., Milner-Gulland, E.J., 2008. The sleeping policeman: understanding issues of enforcement and compliance in conservation. Animal Conservation 11, 75-82.

Keane, A., Ramarolahy, A.A., Jones, J.P.G., Milner-Gulland, E.J., 2011. Evidence for the effects of environmental engagement and education on knowledge of wildlife laws in Madagascar. Conservation Letters 4, 55-63.

Kellert, S.R., Mehta, J.N., Ebbin, S.A., Lichtenfeld, L.L., 2000. Community Natural Resource Management: Promise, Rhetoric, and Reality. Society & Natural Resources 13, 705-715.

Kideghesho, J.R., RÃ¸skaft, E., Kaltenborn, B.P., 2007. Factors influencing conservation attitudes of local people in Western Serengeti, Tanzania. Biodiversity and Conservation 16, 2213-2230.

Larrazabal, A., McCall, M.K., Mwampamba, T.H., Skutsch, M., 2012. The role of community carbon monitoring for REDD+: a review of experiences. Current Opinion in Environmental Sustainability 4, 707-716.

Larson, A.M., Soto, F., 2008. Decentralization of natural resource governance regimes. Annual Review of Environment and Resources 33, 213-239.

Lise, W., 2000. Factors influencing people's participation in forest management in India. Ecological Economics 34, 379-392.

Lund, J.F., Balooni, K., Casse, T., 2009. Change we can believe in? Reviewing studies on the conservation impact of popular participation in forest management. Conservation and Society 7, 71.

Lund, J.F., Treue, T., 2008. Are We Getting There? Evidence of Decentralized Forest Management from the Tanzanian Miombo Woodlands. World Development 36, 2780-2800.

Marshall, A.R., 2008. Ecological Report on Magombera Forest. WWF Tanzania.

McClanahan, T.R., Cinner, J., Kamukuru, A.T., Abunge, C., Ndagala, J., 2009. Management preferences, perceived benefits and conflicts among resource users and managers in the Mafia Island Marine Park, Tanzania. Environmental Conservation 35, 340-350.

McDermott, C.L., Coad, L., Helfgott, A., Schroeder, H., 2012. Operationalizing social safeguards in REDD+: actors, interests and ideas. Environmental Science & Policy 21, 63-72.

Mehta, J.N., Heinen, J.T., 2001. Does Community-Based Conservation Shape Favorable Attitudes Among Locals? An Empirical Study from Nepal. Environmental Management 28, 165-177.

Murtaugh, P.A., 2009. Performance of several variable-selection methods applied to real ecological data. Ecology Letters 12, 1061-1068.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853-858.

NBS, 2002. Population and Housing Census. Volume IV. National Bureau of Statistics, Ministry of Planning, Economy and Empowerment. Dar es Salaam. Tanzania.

Nkonya, E., Pender, J., Kato, E., 2008. Who knows, who cares? The determinants of enactment, awareness, and compliance with community Natural Resource Management regulations in Uganda. Environment and Development Economics 13, 79-101.

Persha, L., Agrawal, A., Chhatre, A., 2011. Social and Ecological Synergy: Local Rulemaking, Forest Livelihoods, and Biodiversity Conservation. Science 331, 1606-1608.

Pettenella, D., Brotto, L., 2012. Governance features for successful REDD+ projects organization. Forest Policy and Economics 18, 46-52.

Pfliegner, K., 2010. The Impacts of Joint Forest Management on Forest Condition, Livelihoods and Governance: Case Studies from Morogoro Region in Tanzania. Ph.D. Thesis, University of East Anglia, UK.

Phelps, J., Webb, E.L., Agrawal, A., 2010. Does REDD+ Threaten to Recentralize Forest Governance? Science 328, 312.

Pirard, R., Bille, R., Sembres, T., 2010. Upscaling Payments for Environmental Services (PES): Critical issues. Tropical Conservation Science 3, 249-261.

Platts, P.J., Burgess, N.D., Gereau, R.E., Lovett, J.C., Marshall, A.R., McClean, C.J., Pellikka, P.K.E., Swetnam, R.D., Marchant, R.O.B., 2011. Delimiting tropical mountain ecoregions for conservation. Environmental Conservation 38, 312-324.

Porter-Bolland, L., Ellis, E.A., Guariguata, M.R., Ruiz-Mallén, I., Negrete-Yankelevich, S., Reyes-García, V., 2012. Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. Forest Ecology and Management 268, 6-17.

Quinn, G.G.P., Keough, M.J., 2002. Experimental design and data analysis for biologists. Cambridge University Press.

Rantala, S., Bullock, R., Mbegu, M.A., German, L.A., 2012. Community-Based Forest Management: What Scope for Conservation and Livelihood Co-Benefits? Experience from the East Usambara Mountains, Tanzania. Journal of Sustainable Forestry 31, 777-797.

Ribot, J.C., 2004. Waiting for democracy. The politics of choice in natural resource decentralization. World Resources Institute Washington, DC.

Ribot, J.C., Lund, J.F., Treue, T., 2010. Democratic decentralization in sub-Saharan Africa: its contribution to forest management, livelihoods, and enfranchisement. Environmental Conservation 37, 35-44.

Schreckenber, K., Moss, C., Luttrell, C., 2009. Participatory forest management: an overview, ed. O.D. Institute.

Skutsch, M.M., McCall, M.K., 2010. Reassessing REDD: governance, markets and the hype cycle. Climatic Change, 1-8.

Tomicevic, J., Shannon, M.A., Milovanovic, M., 2010. Socio-economic impacts on the attitudes towards conservation of natural resources: Case study from Serbia. Forest Policy and Economics 12, 157-162.

Umemiya, C., Rametsteiner, E., Kraxner, F., 2010. Quantifying the impacts of the quality of governance on deforestation. Environmental Science & Policy.

UNEP-WCMC, 2010. The World Database on Protected Areas (WDPA). Cambridge, UK: UNEP-WCMC. URL http:/www.wdpa.org.

Vermeulen, S., Sheil, D., 2007. Partnerships for tropical conservation. Oryx 41, 434-440.

Vyamana, V.G., 2009. Participatory forest management in the Eastern Arc Mountains of Tanzania: who benefits? International Forestry Review 11, 239-253.

WWF, 2006. Mpango wa matumizi bora ya ardhi ya kijiji: Kijiji cha Tundu, wilaya ya Kilosa. Halmashauri ya kijiji cha Tundu.

Zbinden, S., Lee, D.R., 2005. Paying for environmental services: an analysis of participation in Costa Rica's PSA Program. World Development 33, 255-272.

Zuur, A.F., Ieno, E.N., Elphick, C.S., 2010. A protocol for data exploration to avoid common statistical problems. Methods in Ecology and Evolution 1, 3-14.

4 Local Forest Utilisation and Firewood Sufficiency

Conducting household questionnaires in Magombera village

The Impact of Access Restrictions on Household Forest Product Use and Firewood Sufficiency in Rural Tanzania.

Latham, J. E[1], Sallu, S. M.[2], Marshall, A. R.[1, 3.]

1. CIRCLE, Environment Department, University of York, York, UK.
2. Sustainability Research Institute, School of Earth & Environment University of Leeds, Leeds UK.
3. Flamingo Land Ltd., Kirby Misperton, North Yorkshire, UK.

Abstract

Forest products are extremely important to the livelihoods of millions of people living in poverty, with this dependence acting as a local driver of forest degradation. Interventions to conserve tropical forests necessitate restrictions be placed on forest product extraction, resulting in displacement, replacement or reduction of extraction activities with ensuing implications for long-term management success and local welfare. Given this, spatial examination of forest product use at the landscape level is vital to inform forest management decisions and avoid leakage. Here, household questionnaires are used to quantify forest product use in five villages adjacent to forests of different protected status in close proximity in Tanzania, from National Park through Participatory Forest Management (PFM) to no formal management. 95% of households were dependent on firewood as a source of energy. Household perceived need for and consumption of firewood was measured and compared to provide a metric of household firewood sufficiency. Non-compliance with PFM was evidenced by the level of illegal household forest product extraction. Forest access restrictions significantly impact household ability to meet firewood needs, with management effectiveness reflected by household firewood sufficiency. Linear regression showed harvest from a forest under joint management significantly improved firewood sufficiency, suggesting needs-based extraction unrestricted by management rules and regulations. Household awareness of forest sanctioning authorities significantly reduced firewood consumption, indicating a positive relationship between awareness of and compliance with forest management regimes. While firewood sufficiency significantly improved with ownership of a fuel-efficient stove, harvest from cultivated areas significantly lowered firewood sufficiency. This deficit in firewood availability outside forested areas, coupled with a recent ban on firewood extraction within a National Park, presents significant concern for household welfare and/or leakage of harvest activities to other less well protected forests in the area, especially given observed non-compliance with PFM. Findings reinforce the need for a landscape approach to forest management planning, to account for the energy needs of local resource users and avoid the negative impacts of leakage or detriment to human welfare.

Keywords: Tropical Forest Management, Participatory Forest Management, Leakage, Governance, Firewood, Non-Timber Forest Products, Determinants, REDD+.

Introduction

More than 800 million people worldwide depend on forest products as a source of food, fuel and income (Chomitz et al. 2007), with this reliance a local driver of forest degradation. Non-timber forest products (NTFPs) are not only extremely important for the domestic consumption of people living in poverty, but also act as a source of additional income and as a safety net in times of economic hardship or poor food availability (Sunderlin et al. 2001; Adhikari et al. 2004; Babulo et al. 2008). Given this dependence it is unsurprising that policies to conserve tropical forests have evolved over time to incorporate the rights and needs of local communities (Latham et al. Chapter 2). Examination of existing strategies to conserve tropical forests has shown that poor understanding of the heterogeneous nature of local communities and their dependence on natural resources has impeded long-term management success (Latham et al. Chapter 2). Forest management interventions necessitate some level of restriction be placed on forest product extraction, with resulting implications for the welfare of local communities whose livelihoods depend on these resources (Sunderlin et al. 2005; Schelhas and Pfeffer 2009; Sigalla 2013). However while this impact on local livelihoods is easily assumed, its exact nature is hard to measure, especially given local cultural variations and the difficulty in defining and determining 'welfare' (Wilkie et al. 2006; Caplow et al. 2011).

Trade-offs in tropical forest management interventions are inherent (McShane et al. 2011), and economic valuation of the total value of forests are necessary at multiple scales to calculate the cost-benefit ratio of protection not just at the global but local level (Naidoo and Ricketts 2006). One approach to measuring these trade-offs is to quantify the opportunity costs of forgone alternatives, appreciating the economic value of NTFP contributions to livelihoods is essential if compensation or alternatives are to be provided in place of access restrictions. A large body of literature is devoted to estimating this value, improving understanding of the local opportunity costs conveyed by management, with earlier focus on quantifying household extraction of NTFPs and the relationship between dependence and wealth (e.g. Adhikari et al. 2004; de Merode et al. 2004; Delang 2006). However, eliciting the value of NTFPs to households is extremely complicated, and estimates are highly variable leaving a large margin for error (Sheil and Wunder 2002; Vedeld et al. 2004; Vedeld et al. 2007). A vital, though as yet overlooked, measure of management trade-offs is an assessment of forest-users' ability to meet resource needs

elsewhere given increased forest protection. Indeed, wellbeing is defined as "a state of being with others, which arises where human *needs are met*, where one can act meaningfully to pursue one's goals, and where one can enjoy a satisfactory quality of life'' (McGregor 2008). Compensation for access restriction based on cost-benefit analysis assumes that villagers have access to functioning markets or land for cultivation to meet their forest product needs. Where this is not the case, restriction may lead to increased poverty if food and fuel demands are not met (Fisher et al. 2011; Schaafsma et al. In Press).

Examination of forest management trade-offs must also incorporate concerns for leakage, when the benefit of protecting one forest area is negated by the displacement of resource extraction elsewhere (Oliveira et al. 2007; Ewers and Rodrigues 2008; Robinson and Lokina 2011; Laurance et al. 2012). Robinson and Kajembe (2009) identify four possible effects of villager exclusion from a forest area, (1) villagers displace extraction elsewhere (leakage), (2) villagers replace extraction with increased purchase from markets, potentially intensifying pressure on other forest areas supplying those markets, (3) villagers reduce the amount they extract or sell, with potentially negative welfare impacts, and (4) villagers cultivate more resources on their own or village land. In addition to these, two further effects of exclusion are posited here, whereby (5) villagers do not comply with management and continue extraction activities, and (6) in the case of extraction for fuel, villagers switch to alternatives such as gas and electricity where available. To predict these effects and inform management decisions, spatial-temporal models of NTFP use are necessary to define a landscape that does not solely account for ecological characteristics but includes interactions between these and socioeconomic conditions (Robinson et al. 2011).

Recent advances in the NTFP literature have sought to account for spatial aspects of NTFP extraction and resulting patterns of degradation, incorporating the role of the market setting such as resource user behaviour and the costs associated with distance to harvest and market locations (see Albers and Robinson 2013). Models indicate that if labour and resource markets function efficiently then restrictions incurred by forest management will not lead to leakage, however imperfect and costly markets will lead to displacement of forest degrading activities into unprotected areas (Robinson et al. 2011; Albers and Robinson 2013). This is especially important given the varied structure of tropical forest management regimes, the range in top-down to bottom-up governance creating potential for multiple authorities to operate independently within a landscape containing numerous forest patches. Increased protection by an independent authority of one such forest patch, without consideration for the impact on others in such a landscape, can result in leakage of harvesting activities to less-well protected areas and/or local

welfare impacts. Indeed, Robison and Lokina (2011) found villagers displaced NTFP collection to more distant forests after the implementation of PFM, forests that previously were protected based on their distance alone in the absence of local PFM restrictions.

This paper contributes empirically to this growing body of literature through examination of household-level ability to meet forest product needs (henceforth 'sufficiency'), from forests in close proximity and subject to different management regimes in Tanzania. Forest biomass such as firewood and charcoal provides the main source of cooking fuel in Tanzania, accounting for over 90% of total energy consumption (Felix and Gheewala 2011). Fuel-efficient stoves can increase cooking efficiency by 40-75% and, as in other developing countries, projects exist in Tanzania aimed at promoting local stove construction and use (Kammen 1995). However rapid population growth in both urban and rural areas has placed increasing pressure on biomass resources, acting as a major driver of forest and woodland degradation (Felix and Gheewala 2011). Indeed, waves of forest depletion can be observed from the country's largest city Dar es Salaam, indicating increasing pressure on forests at ever greater distances from the city (Ahrends et al. 2010).

The aim of this paper is to inform forest management decisions, at both the local and country level, through examination of the impact of forest access restrictions on household forest product use and firewood sufficiency. Household extraction of forest products is used as an indication of the level of compliance with each management regime. Analysis focusses on household firewood use, given local dependence on firewood as a source of energy. Household monthly consumption of and perceived need for firewood is quantified and compared to provide a metric of household firewood sufficiency. Firewood sufficiency is then compared by household harvest location, defined as forest management regime, market or farmland areas to investigate household ability to meet firewood needs based on harvest location. Linear regression is then used to investigate household correlates of consumption, need and sufficiency using demographic, wealth and environmental variables. Findings are used to assess the impact of access restrictions on household firewood sufficiency, and the potential for leakage and welfare impacts in the area. Spatial understanding of these impacts is especially important in this study area due to recent withdrawal of a long-standing National Park access agreement for local community firewood harvest, and the proximity of other, less-well protected forest patches in the area.

Methods

Study Area

Research was conducted in five forest-adjacent villages in the Kilombero and Kilosa districts of the Morogoro region, Tanzania (Figure 1). Villages were selected to maximise variation in forest management regime whilst minimising geographic spread to avoid high variation in ecological and social factors; with one forest protected as a National Park (NP), one under Joint Forest management (JFM), two under Community-Based Forest Management (CBFM) and the remaining village-adjacent forest in management transition (Table 1). This forest was degazetted as a Forest Reserve in 1981 with intended annexation into the Selous Game Reserve. This forest has a complex history, and at the time of data collection remained formally unprotected (Marshall, pers. comm., and see Marshall 2008 for summary). The most recently available national census reveals continued population growth in these districts, with agriculture the most predominant livelihood activity (NBS 2002).

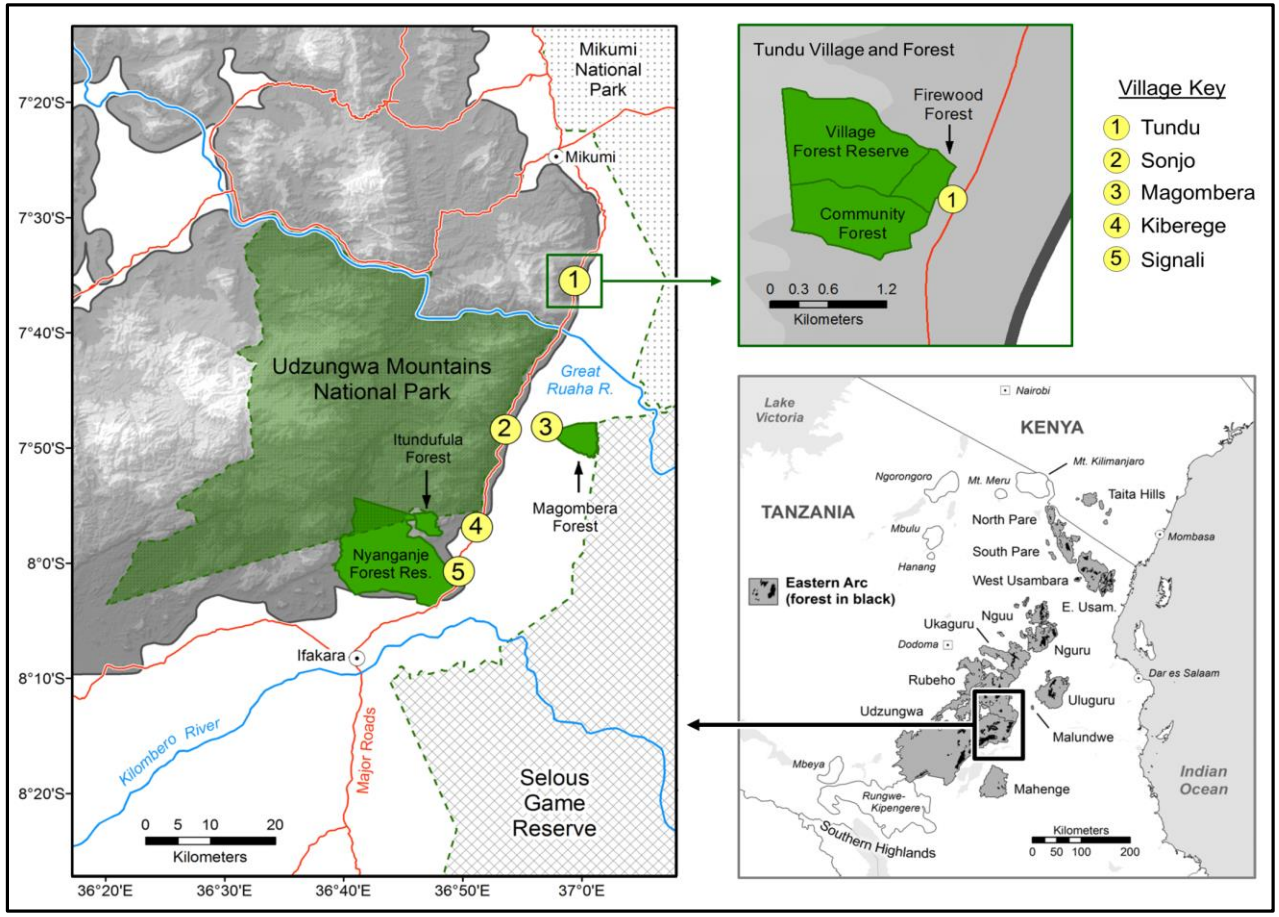


Figure 1. Location of the five study villages in Tanzania and adjacent forests. Adapted using data on Eastern Arc Mountain boundaries and forests from Platts et al. (2011), Protected Area boundaries from UNEP-WCMC (2010), Magombera forest and Selous Game Reserve boundary with the assistance of the Udzungwa Forest Project and Tundu Village Forest boundaries from WWF (2006). Data on spatial infrastructure with the assistance of the Valuing the Arc project (http://www.valuingthearc.org).

Table 1. Description of study villages and adjacent forest.

Village	Geographic Location	Village Size [a]	Mean House-hold Size	Dominant Tribe(s)	Adjacent Forest [b]	Forest Protection Status	Forest Management Regime	Sanctioning Authority	Rules and Regulations [c]
Magombera	7°48'24.01"S 36°57'16.03"E	289	3.1	Hehe Pogoro Ngindo	Magombera (0.7km)	In transition (no formal management)	Transition	None	No formal R&R regarding resource use
Kiberege	7°57'5.85"S 36°51'21.90"E	1275	4.1	Pogoro Ngoni Bunga Hehe	Itundufula (5.4km)	Village Forest	CBFM 1	Kiberege Village	Only dead firewood harvest allowed (i.e. no cutting tools)
Tundu	7°35'44.28"S 36°59'39.90"E	757	4.2	Vidunda	Tundu Community Forest (0.2km)	Village Forest	CBFM 2	Tundu village	Village forest divided into three areas: VFR – no resource harvest allowed FWF – only dead firewood harvest allowed two days a week CGF - No resource harvest allowed
Signali	8° 0'54.82"S 36°49'48.90"E	576	5.5	Pogoro Ngindo	Nyanganje (1.4km)	Forest Reserve (IUCN category IV)	JFM	Kilombero District Council & Signali Village	Only collection of dead firewood allowed (i.e. no cutting tools). (ban introduced mid-fieldwork in July 2011 after which no resource collection allowed)
Sonjo	7°48'36.14"S 36°53'49.44"E	259	4.8	Ngindo Pogoro Ndamba	Udzungwa Mountains NP (0.3km)	NP (IUCN category II)	NP	TANAPA	Women allowed entry once a week to harvest dead firewood, no cutting tools allowed (ban enforced mid-fieldwork in July 2011 after which no resource harvest allowed)

***NP** = National Park, **CBFM** = Community-Based Forest Management, **JFM** = Joint-Forest Management, **TANAPA** = Tanzania National Park Authority, **R&R** = Rules and Regulations, **VFR** = Village Forest Reserve, **FWF** = Firewood Forest, **CGF** = Community Group Forest. .[a] Number of household. s[b] Numbers in parenthesis indicate distance to forest from central village meeting plac. e[c] Defined through interview with sanctioning authority representatives (Latham et al. Chapter 3)*

The Udzungwa Mountains National Park (UMNP) is of significant social, economic and ecological importance both locally and globally. The park provides extensive ecosystem services, benefitting local agriculture and national power through hydro-electric generation and attracting international tourism. Immigration to the area is high due to the agricultural value of the land, illustrated by the presence of a large sugar plantation and processing factory owned by the Kilombero Sugar Company. Prior to and after UMNP gazettement in 1992, several tree nurseries and a fuel-efficient stove project were established in villages located along the Eastern border of the park with the support of the World Wildlife Fund (WWF), with the intention that these would substitute existing villager dependence on the forest's biomass. While these projects were established the Tanzanian National Park Authority (TANAPA) allowed local villagers weekly entry in the park for dead firewood harvest. This concession continued for nearly 20 years until June 2011 when it was banned completely due to concerns for its impact on biodiversity (Nyundo et al. 2006; Rovero et al. 2008). Several villages, including all five study villages, occur on this Eastern edge of UMNP. These villages lie sandwiched between UMNP to the West and the Selous Game Reserve to the right with intensive sugar cane cultivation to the North. With increasing population growth pressure on resources is high in the area (Gorenflo and Orland 2013).

Data Collection

Data were collected during a seven month field period between March and December 2011 using a mixed method approach in study villages. To facilitate spatial awareness of the study area and criteria for sampling stratification, focus groups of between 6-10 villagers were carried out in each village. Focus groups were conducted separately for male and female villagers to allow women more opportunity for expression, given the division of labour in this study society. Focus group discussions were based on a structured questionnaire eliciting village-level demographic information including criteria for wealth-ranking, such as household access to electricity, transport and food availability (Appendix I). A participatory mapping exercise was used to harness spatial representation of village amenities and nearby forest patches, as names for forest patches varied locally. Consensus was reached within each focus group before a group-nominated scribe marked spatial information, such as forest location, on a satellite map of the local area.

A total of 500 household questionnaires were administered across all villages to gauge forest product use in addition to household-level socio-economic and demographic variables. This number of questionnaires was chosen to maximise variability in responses whilst maintaining a sample size that was logistically and financially viable within the sampling time-frame. A wealth-ranking exercise was used to assign households to one of two high- or low-income wealth

categories, based on village-specific wealth indicators identified during focus groups. To ensure a representative sample across the socio-economic spectrum, households were stratified by sub-village and wealth as suggested by Vedeld et al. (2004) and Lund et al. (2008), and random number generation was used to select 100 household heads as respondents in each village. Questionnaires were translated into Swahili by a Tanzanian research assistant, and enumerators were hired and trained to conduct the questionnaires. Enumerators were local to each study village as the associated level of local trust and insight into local conditions was deemed beneficial to the reliability of data collection. Household questionnaires were designed to elicit additional information relating to household socio-economics, livelihood activities and nearby forest management. Questionnaires were pre-tested within each village to allow for local context, and improvements made based on resulting suggestions. Questionnaires were first administered in May and early June, and then repeated across all households in November, to harness information on both wet and dry season forest product use respectively (Appendix II). If household heads were unavailable during data collection, questionnaires were administered to spouses where possible, otherwise a new household was randomly selected whilst adhering to the same wealth and sub-village criteria (n=39). Repeated questioning in the dry season was not possible for some households (n=22), having moved away from the area in the intervening time.

Multiple questions relating to forest product use were asked within questionnaires to triangulate results. Households were first asked to identify their source of energy for cooking, how this was obtained and the monthly quantity used that season. Next households were asked to identify all forests near the household and whether they harvested from that forest, identifying the products harvested. Households were then asked to recall their use per month in that season of 15 pre-determined forest products. Specifically, for each product in that season households were asked to recall the quantity harvested per month, the frequency of harvests and the harvest location. Households were also asked to recall for each product the quantities purchased, sold and consumed per month in that season. Finally, households were asked to identify the quantity of each product they need per month in that season, regardless of availability. All questions relating to specific forest product use and need were repeated in the dry season questionnaire.

It is acknowledged that this recall method of forest product use might lack precision since remembering details of harvest activities might be difficult for households. The most accurate method of quantifying household forest product use is to conduct daily logs of incoming and outgoing product quantities (e.g. Godoy et al. 2000). This was not feasible in this study given financial and temporal constraints, however methods are deemed sufficient given the aim of the

study was to compare like-for-like forest product quantities (i.e. number of firewood bundles/month consumed compared with number of firewood bundles/month needed) and not econometric valuation or explicitly monitoring illegal extraction activities (e.g. Jones et al. 2008). It is noted that questioning of harvest location might be sensitive in some cases where households are concerned to reveal potentially illegal extraction activities, or respondents might be inclined to provide strategic answers designed to please the enumerators and/or the researcher. Enumerators were trained to be aware of these concerns to account for this, and care was taken throughout to communicate the independent nature of this research to respondents. The use of local enumerators was found to alleviate this concern given their local knowledge and trust. In addition triangulation of responses was used to enhance the reliability of data through multiple structured and semi-structured resource-related survey questions (Gavin et al. 2009), including asking respondents to mark their harvest location on a map of the local area.

Data Analysis

Household Forest Product Use

Households were coded into those that either solely harvested products, solely bought products or both harvested and bought forest products. Harvest location for each product was coded as being either a forest area or the household's agricultural fields/private woodlot. Forest areas were further coded by the management regime of that forest (Transition, CBFM 1, CBFM 2, JFM or NP). The percentage of households harvesting each forest product was calculated by harvest location, to provide an indication of resource extraction by management regime. The level of household compliance with each relevant management regime was then determined through reporting of number of forest products extracted, being firewood only or multiple forest products. This measure provides a useful indication of compliance by management regime rules and regulations (defined in Table 1), yet is susceptible to under-reporting as despite best efforts to elicit truthful resource use behaviour some households may have under-reported their degree of forest product use, or indicated harvesting from other areas such as fields or private woodlots, for fear of repercussions.

Household Firewood Sufficiency Score

The majority of households indicated both consuming and needing firewood (n=454), given this and the importance of firewood as a source of energy in this study area, further analysis was

conducted solely on this forest product. The mean quantity of firewood harvested, bought, sold, consumed and needed per household was calculated across both wet and dry seasons to provide an average monthly rate (bundles/month). Mean household firewood consumption was cross-validated via calculation of quantities harvested, bought and sold (consumed = (harvested + bought) - sold). To provide an indicator of household firewood 'sufficiency', household mean quantity of firewood needed/month was deducted from mean quantity consumed/month. Negative sufficiency scores indicated a deficit in household firewood needs, zero values indicated needs were met and positive values indicated a surplus of firewood. One-way Analysis of Variance (ANOVA) and subsequent Tukey's Honest Significant Differences were used to compare mean firewood sufficiency by harvest location.

The period of time between the wet season and dry season questionnaires saw TANAPA introduce a ban on firewood collection (and hence all types of forest product harvesting) in the National Park, which was also extended by the relevant Village Environmental Committee (VEC) for the JFM forest (informed through interview with TANAPA Chief Park Warden and Signali head of VEC). If households indicated a switch in harvest location from either NP or JFM between surveys, differences in mean firewood sufficiency score was tested using Student's t-tests. All statistical analyses were carried out using R (version 3.0.0; http://cran.r-project.org).

Determinants of Household Firewood Sufficiency

Further analysis was carried out to determine what factors might predict household firewood need, consumption and sufficiency score independently. A broad set of 16 household-level demographic, wealth and environmental predictor variables were hypothesised to influence this use of firewood (Table 2; Appendix IV). Variables were chosen based on previous research aimed at examining correlates of NTFP consumption (e.g. Foerster et al. 2012). All variables were coded from household questionnaire data (see Latham et al. Chapter 3 for details). Dependence on firewood as an energy source was represented by whether households solely used firewood for energy or a combination of firewood and charcoal. Previous analysis found household awareness of their nearest forests' sanctioning authority varied in the study sample; there was clear awareness of the National Park status yet only 3% of PFM-adjacent households were engaged in rule formation, and none were aware of the Joint-Management regime (Latham et al. Chapter 3). Thus, awareness was also included as a variable in all models to test its influence on firewood use and sufficiency.

Table 2. Description of household predictor variables.

Type	Variable	Description
Demographic	age	Age of household head
	gender	Gender of household head (M or F)
	education	Number of years household head in formal education
	occupation	Occupation of household head
	born	Household head born in village (Y or N)
	hhsize	Size of household (number of residents)
	hhwomen	Proportion of female residents
Wealth	land	Area of land attributed to household (hectares)
	hse_material	Main material of household (brick or mud)
	assets	Total household material asset value (*1000 Tanzanian shilling)
	incomes	Number of household income sources
Environmental	stove	Presence/absence of fuel-efficient stove (Y or N)
	woodlot	Household planted trees/woodlot (Y or N)
	energy	Household source of energy (Firewood alone or firewood and charcoal)
	aware	Household aware of their nearest forest Sanctioning Authority (Y or N)
	havest_location	Household source of firewood (Buy, Fields/Private, Transition, CBFM1, CBFM2, JFM, NP)

***M** = Male, **F** = Female, **Y**= Yes, **N**= No.*
1 Tanzanian shilling was equal to mean 0.000635 US dollars during the period of data collection (March-December 2011).

Pearson correlation and Variance Inflation Factors were used to assess covariation between all predictor variables (Zuur et al. 2010). No high intercorrelation was present (Pearson P≤ 0.7 and/or VIF ≤ 5) and so all variables were retained. Variables with uneven spread (occupation only, 98% farmer) were excluded from models. Before modelling, variables with a strong skew were transformed as follows: age, hhsize, assets (square root), land (cube root) and response variables firewood need, firewood consumed (log10) and firewood sufficiency (cube root).

Generalised linear models (GLM) with a Gaussian error function were used to investigate the influence of the same predictor variables on (1) household firewood need, (2) household firewood consumed, and (3) household firewood sufficiency. Spline correlograms (ncf package; Bjornstad 2012) were used to test for spatial-autocorrelation as within-village observations may not be independent, given households from the same village face equivalent socio-economic and environmental factors. Significant spatial auto-correlation was present at short lag-distances of 3km, 4km and 4km for need, consume and sufficiency data respectively (Appendix V.2A, V.3A, V.4A). With only five villages sampled it was not appropriate to include village as a random factor using generalised linear mixed models (e.g. Crawley 2002). However spline correlograms of the Pearson residuals suggested spatial correlation within villages was successfully accommodated by each 'Need', 'Consume' and 'Sufficiency' GLM, with household location accounted for through the inclusion of the harvest_location variable (Appendix V.2B, V.3B, V.4B).

Minimum adequate models were obtained using backwards-forwards selection based on the Akaike Information Criterion (Murtaugh 2009). Some levels within the categorical variable harvest_location did not contribute to final models, and so seven independent binary variables were created in its place ('Buy', 'Fields/Private', 'Transition', 'CBFM1', 'CBFM2', 'JFM' 'NP'), each indicating the harvest location as either 'True' or 'False', and backwards-forwards selection repeated. Final models were validated through observation of residual spread. Analyses of deviance were used to test the probability that the amount of deviance explained was not significantly reduced from the full (unreduced) model (p[D]; Zuur et al. 2010). The probability that the slope estimate of each variable was significantly different from zero was determined, based on a *t* distribution (Quinn and Keough 2002). The False Discovery Rate (FDR; Benjamini and Hochberg 1995) correction of alpha values for repetitive testing was employed on these slope estimates for each model in turn, resulting in 95% significance alpha cut-offs of 0.05 for the 'Need' model, 0.039 for the 'Consume' model and 0.025 for the 'Sufficiency' model.

Results

Household Forest Product Utilisation

For a full description of the household sample see Latham et al. (Chapter 3). All households were dependent on forest products as their main source of energy, 48% used both firewood and charcoal for energy, 47% firewood only and 5% charcoal only. 14% of households (n=70) had access to electricity, 46% (n=232) of households had planted trees on their land or owned a woodlot and 42% (n=212) of households owned a fuel-efficient stove. Of the 500 households surveyed, 434 (86.8%) indicated harvesting forest products, 59 (11.8%) households purchased forest products only and 7 (1.4%) left answers incomplete or blank (Figure 2). Of those that harvested products, 166 households (38.2%) supplemented their harvest with additional purchase. Over half of households harvesting products did so using a forest area (n=263; 60.6%), the remainder either harvested from agricultural fields or private woodlots (n=156; 35.9%) or left harvest location unanswered (n=15; 3.5%).

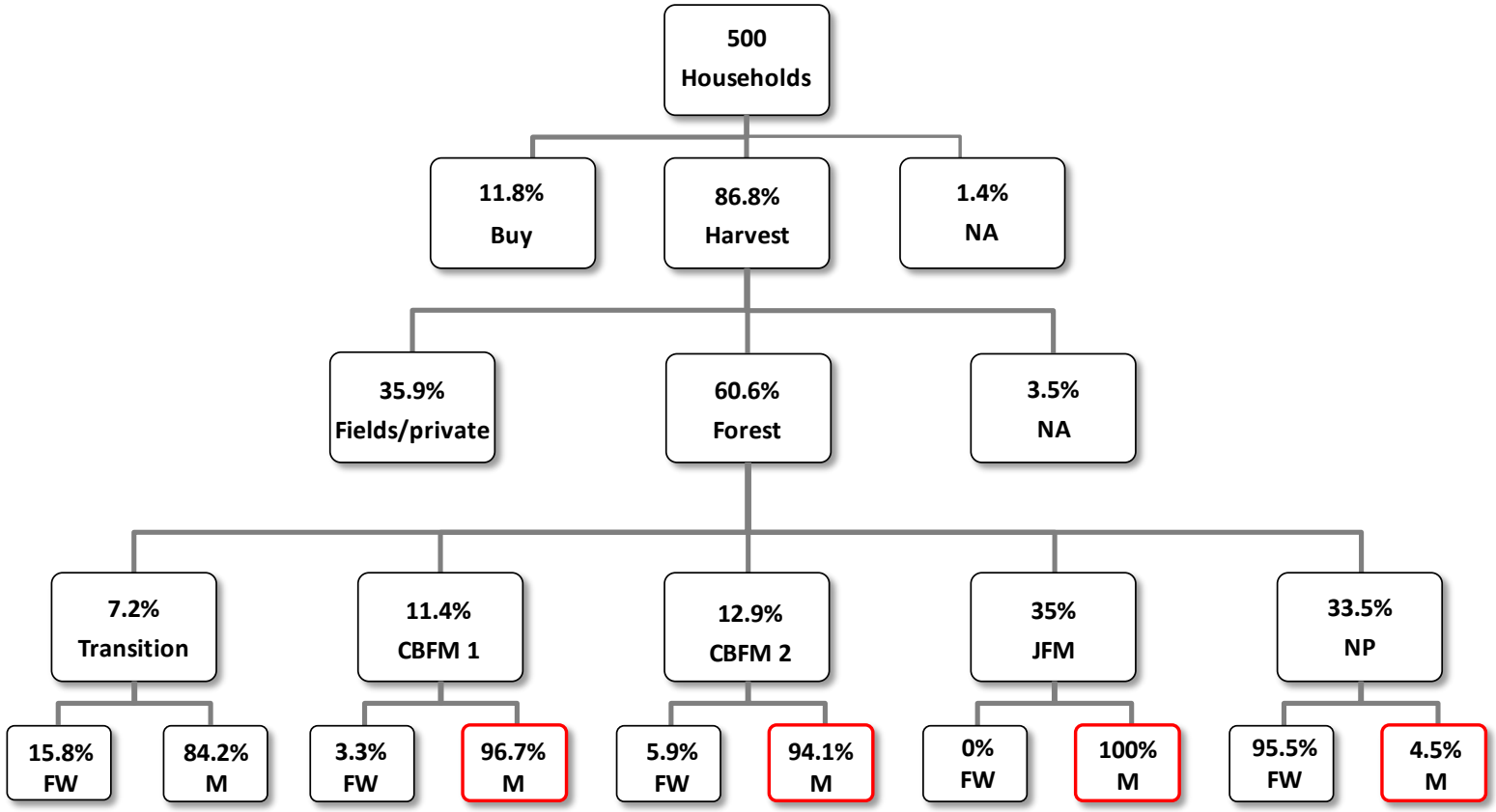


Figure 2. Schematic representation of forest product use by all households, including location of harvest and products harvested (NA = question unanswered by households, FW = Households that harvest firewood only, M = Households that harvest multiple (>1) forest products, Red boxes = households whose level of harvesting is not compliant with the forest management rules and regulations as defined in Table 1 (i.e. harvesting more than firewood alone).

Of the 263 households that reported harvesting from a forest, 60.8% (32% of total sample) did so at a level against the rules and regulations for that forest by indicating harvest of more than just dead firewood. Households indicated harvesting multiple forest products from the PFM forests (JFM, CBFM1 & CBFM2; Figure 3). All households using these forests, except for one using the CBFM1 forest and two using the CBFM2 forest, indicated a level of harvesting that is not compliant with each forests' management rules and regulations. Similar forest products were harvested by households using the 'Transition' forest, although given there was no formal management governing this forest at the time of data collection this type of use cannot be categorised as compliant or not. 95.5% of households harvesting from the National Park indicated harvesting no other product than firewood from this forest, in line with the management rules and regulations in place.

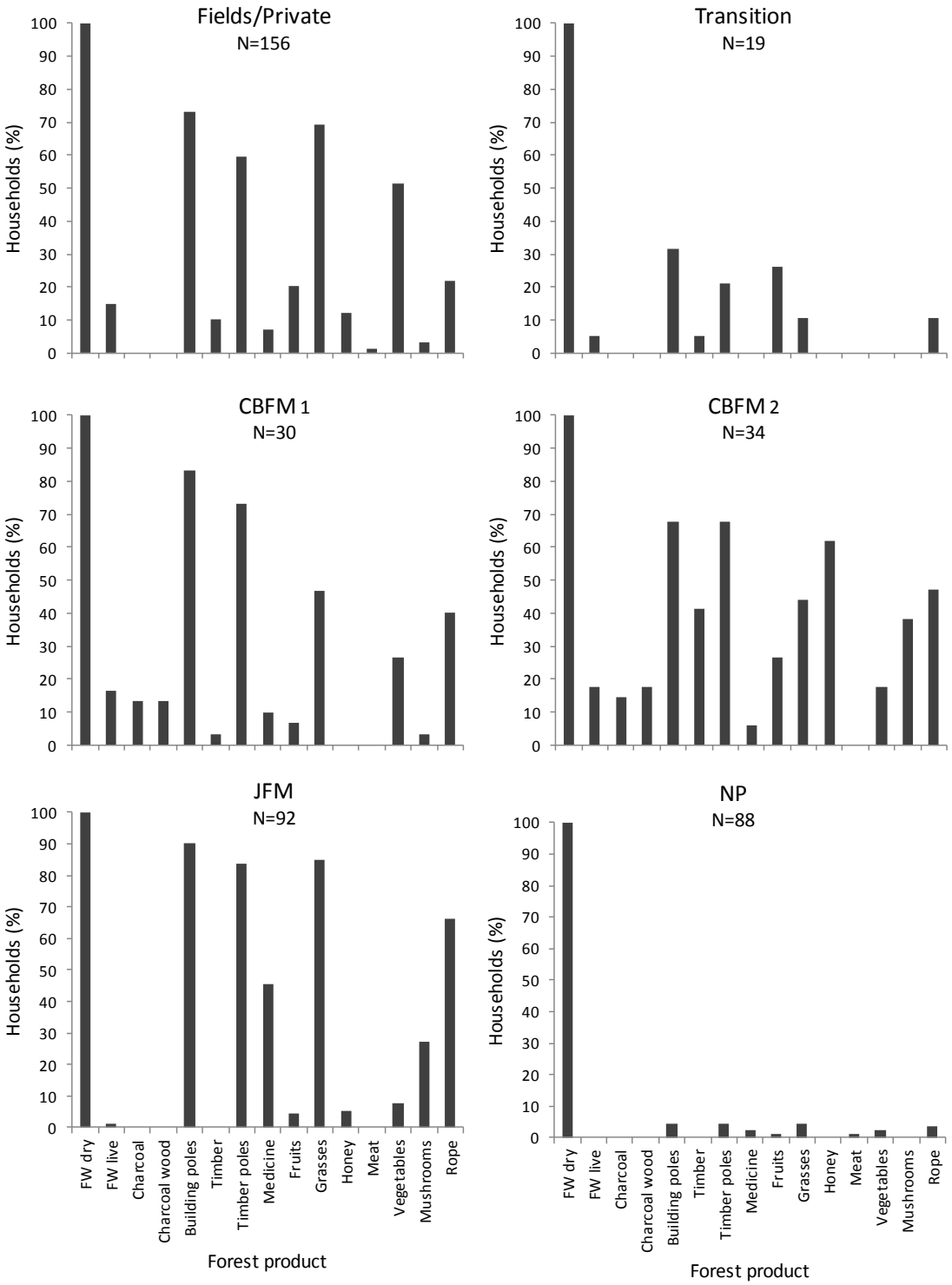


Figure 3. Percentage of households harvesting each type of forest product by harvest location (N=Number of households harvesting from each location).

Household Firewood Sufficiency

Household firewood sufficiency scores varied from -56.0 to 40.0 bundles/month (i.e. a deficit of 56 bundles/month to a surplus of 40 bundles/month), with a mean household score of -4.3 (±9.57) bundles/month across all villages. Scores varied significantly between harvest locations (Figure 4). Households harvesting from the JFM forest had the highest mean score (0.18±0.84 bundles/month), indicating that households were harvesting sufficient firewood from this forest and hence meeting firewood needs.

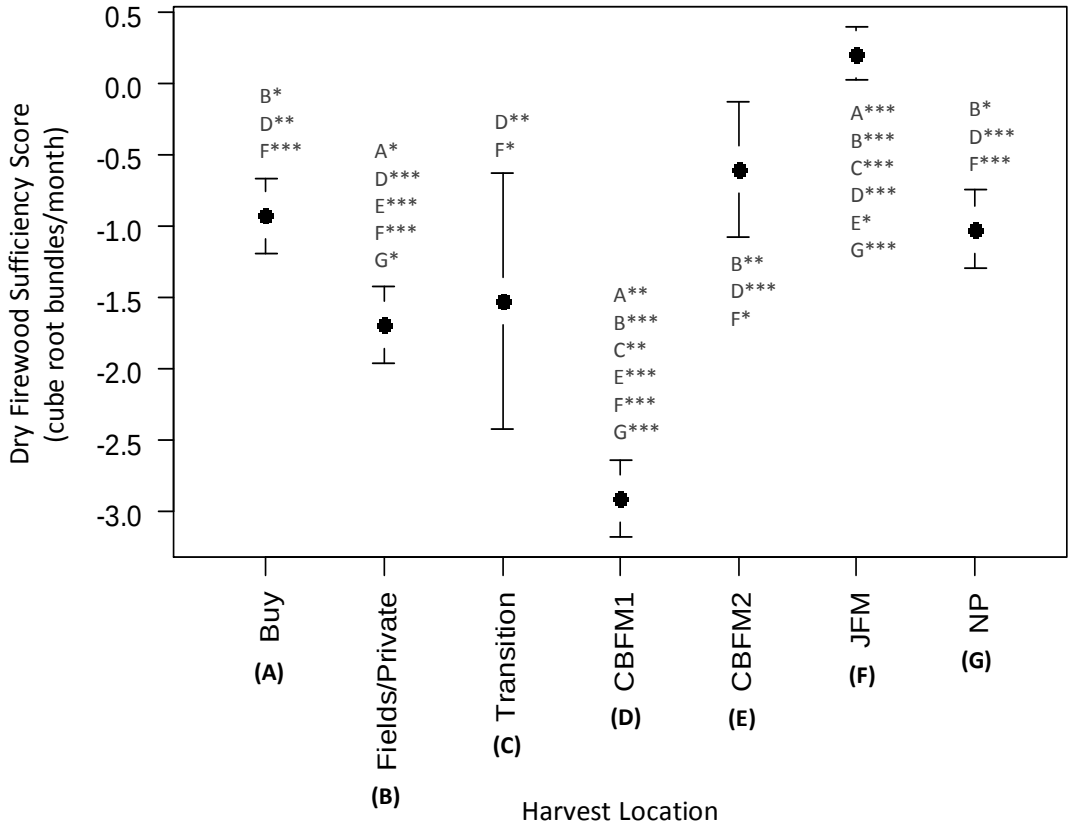


Figure 4. Mean household monthly firewood sufficiency score, and 95% confidence intervals based on the t distribution, by harvest location in order of increasing protection level. Letters indicate significant differences in sufficiency scores between associated levels of harvest location based on one-way analysis of variance and subsequent Tukey's honest significant differences (Tukey's HSD ***p<0.001, **p<0.01, *p<0.05).

Households harvesting from CBFM1 had the lowest mean sufficiency score (-2.06±1.41 bundles/month) signifying a deficit of firewood in households using this forest. Low mean sufficiency score amongst households harvesting from NP indicated a deficit of firewood

harvest from this area, even though weekly firewood collection is allowed and the forest is in good condition. However, while harvest is allowed restrictions are placed on quantity given only women are allowed entry once per week. Households harvesting from fields/private areas had significantly lower sufficiency scores than households harvesting from all forests except for 'Transition' and CBFM1, suggesting the level of firewood harvested from fields and/or private woodlots did not meet needs as sufficiently as forested areas.

All households harvesting firewood from the National Park in the wet season indicated a switch in their harvest location to fields/private areas after the ban on firewood collection was enforced between surveys. Despite this, no significant difference in firewood sufficiency scores was found between seasons for these households (mean wet season=-2.49±4.65 bundles/month, mean dry season=-2.84±6.54bundles/month, p=0.78), although any long-term impacts of the ban might not be reflected within the short time-frame of this study. No such switch was reported by households using the JFM forest with this location still reported in the dry season as the source of harvested products.

Determinants of Firewood Need, Consumption and Sufficiency

Harvest location and household demographic, wealth and environmental variables best predicted household firewood need, consumption and sufficiency (Table 3). Household perceived need for and consumption of firewood was significantly reduced if sourced from markets or harvested from the CBFM2 forest. Households harvesting from fields/private areas and the Transition and CBFM1 forests had significantly higher perceived need for firewood, potentially indicative of these sources being perceived as limited in terms of their provision. Indeed, sufficiency scores of households harvesting from field/private areas and the CBFM1 forest were significantly lower yet not retained in the Consume model, signifying this increased need was not met by quantities consumed from these areas. Households harvesting from the JFM forest consumed significantly more firewood, and were significantly more able to meet firewood needs. Thus, while the needs of households harvesting from this area were not significantly different from those harvesting elsewhere, households were able to harvest and consume firewood as per their requirements and hence were not limited by any forest-related restrictions.

Table 3. Linear regression models, based on backward-forward selection using AIC, of household firewood (1) Need, (2) Consumption (log10 bundles/month) and (3) Sufficiency (cube root bundles/month) versus demographic, wealth and environmental predictor variables. Statistics include the probability of deviation from a slope of zero (*p*), direction of the trend (positive^{+}, negative^{-}), the percent deviance explained by each variable (%D_V), AIC, the percent deviance explained by the model (%*D*) and the probability of decreased deviance explained from the full model (p[*D*]), following analysis of deviance. Bold type indicates significant variables following FDR correction for repetitive testing ('Need' α_{FDR} = 0.05, 'Consume' α_{FDR} = 0.039, 'Sufficiency' α_{FDR} = 0.025).

'Need'	
Harvest Location: CBFM 1^{+}	***p* <0.0001 (%D_V =8.67)**
Harvest Location: Buy^{-}	***p* <0.0001 (%D_V =6.50)**
Harvest Location: CBFM 2^{-}	***p* <0.0001 (%D_V =4.89)**
Harvest Location: Fields/Private^{+}	***p* <0.0001 (%D_V =4.02)**
Harvest Location: Transition^{+}	***p* <0.0001 (%D_V =2.54)**
Fuel-efficient stove ownership^{-}	***p* = 0.0038 (%D_V =1.30)**
Household size^{+}	***p* = 0.0062 (%D_V =1.17)**
Total asset value^{+}	***p* = 0.015 (%D_V =0.92)**
AIC	-24.305
%*D*	48.2
p[*D*]	0.93
'Consume'	
Harvest Location: Buy^{-}	***p* <0.0001 (%D_V =6.25)**
Harvest Location: JFM^{+}	***p* <0.0001 (%D_V =3.23)**
Harvest Location: CBFM 2^{-}	***p* = 0.00022 (%D_V =2.51)**
Household size^{+}	***p* = 0.00043 (%D_V =2.28)**
Total asset value^{-}	***p* = 0.0058 (%D_V =1.39)**
Harvest Location: Transition^{+}	***p* = 0.027 (%D_V =0.88)**
Aware of sanctioning authority^{-}	***p* = 0.039 (%D_V =0.77)**
Area land owned^{+}	*p* = 0.058 (%D_V =0.65)
Household head age^{-}	*p* = 0.059 (%D_V =0.64)
AIC	-159.82
%*D*	39.2
p[*D*]	0.95
'Sufficiency'	
Harvest Location: CBFM 1^{-}	***p* <0.0001 (%D_V =8.35)**
Harvest Location: Fields/Private^{-}	***p* <0.0001 (%D_V =3.08)**
Fuel-efficient stove ownership^{+}	***p* = 0.0021 (%D_V =1.65)**
Harvest Location: JFM^{+}	***p* = 0.0046 (%D_V =1.4)**
Harvest Location: Transition^{-}	*p* = 0.035 (%D_V =0.77)
Household head age^{-}	*p* = 0.051 (%D_V =0.66)
Aware of sanctioning authority^{-}	*p* = 0.055 (%D_V =0.64)
Planted trees/woodlot^{+}	*p* = 0.068 (%D_V =0.58)
AIC	1052.4
%*D*	41.8
p[*D*]	0.93

Larger households were found to have significantly increased perceived need for and consumed more firewood, while those with more valuable assets perceived a greater need for but indicated lower consumption of firewood (Table 4). Households owning a fuel-efficient stove had significantly lower perceived need for firewood, and although stove ownership did not significantly affect quantities of firewood consumed, household ability to meet firewood needs was significantly improved through ownership of a fuel-efficient stove. Households that were aware of the nearest forests' sanctioning authority consumed significantly less firewood and were less able to meet firewood needs, indicating a positive relationship between awareness of the forest management regime and compliance with resource extraction restrictions.

Table 4. Demographic, wealth and Environmental variables that best predict household firewood need, consumption and sufficiency based on linear regression models. Arrows indicate the direction of the relationship between explanatory and response variables, (black arrows indicate significant relationships following FDR correction, grey arrows non-significant relationships ($p > \alpha_{FDR)}$, and *NA* indicates that variable was not retained in that minimum adequate model after backwards-forwards AIC selection. See Table 3 for model details).

Variable	Need	Consume	Satisfaction
Buy	⇩	⇩	*NA*
Fields/Private	⇧	*NA*	⇩
Transition	⇧	⇧	⇩
CBFM 1	⇧	*NA*	⇩
CBFM 2	⇩	⇩	*NA*
JFM	*NA*	⇧	⇧
Stove	⇩	*NA*	⇧
Aware	*NA*	⇩	⇩
Assets	⇧	⇩	*NA*
Household size	⇧	⇧	*NA*
Age	*NA*	⇧	⇩
Land	*NA*	⇧	*NA*
Woodlot	*NA*	*NA*	⇧

Discussion

The level of compliance shown by household forest product extraction activities gives an indication of each forest's management effectiveness. Awareness of the National Park Authority was high (Latham et al. Chapter 3), and this is reflected in the extraction of firewood only by the majority of households utilising the NP, and the observed switch in harvest location to fields or private areas after the firewood ban was introduced. The mean deficit in firewood sufficiency of households harvesting from NP is also indicative of households adhering to its rules and regulations, as the harvest restrictions in place limit the quantity that households can harvest from the forest regardless of their perceived need. The opposite is true for households adjacent to the JFM forest, as no households were aware of this management structure (Latham et al. Chapter 3), and non-compliant resource extraction was reported by many JFM-adjacent households. In addition, no households indicated a switch in harvest location between seasons after a ban on resource collection was introduced by the VEC. Examination of the relationship between awareness and compliance was not the focus of this study, and cannot be directly inferred here, yet findings indicate support for previous research in Uganda that found rule compliance to increase with awareness of the rules and regulations in place (Nkonya et al. 2008). Households harvesting from the JFM forest were significantly more likely to meet their resource needs, indicating few management limits on household harvesting levels and use of this forest was as required.

Households harvesting from the two CBFM forests also indicated a low-level of compliance given the high number of households harvesting more than just firewood. Unlike JFM-adjacent households, the majority of CBFM-adjacent households were aware of the community-based authority of these forests, however very few of these households were engaged in the formation of management rules and regulations (Latham et al. Chapter 3). Interestingly, models show that perceived need for and consumption of firewood was significantly reduced in households harvesting from CBFM2, suggesting that although households harvested multiple forest products, they were perhaps more conscious of consumption quantities when utilising this source. In contrast, households harvesting from CBFM1 were significantly less likely to meet their firewood needs. The distance of this forest from the village may place limits on its ability to meet household needs, given the confines of carrying loads over longer distances (e.g. Robinson et al. 2002). Indeed, most households in the CBFM1-adjacent village indicated using the National Park for firewood, most likely because access is easier due to distance and given the allowance of firewood

harvest before the ban. Thus, findings suggest some constraint on household ability to meet firewood needs from CBFM forests, yet determining whether this constraint is managerial or ecological requires further analysis. The ecological condition, size and age of each forest needs to be measured and included in further analysis, to determine the relationship between forest condition and household firewood sufficiency, as this was not possible within the scope of this study.

Determinants of Household Firewood Utilisation

Ownership of a fuel-efficient stove significantly improved household firewood sufficiency. The use of such stoves have been shown to improve fuel efficiency by 40-70% (Kammen 1995), and households that owned a fuel-efficient stove in this study area perceived significantly lower need for firewood, with potential long-terms benefits in terms of quantities consumed. Gorenflo and Orland (2013) examined possible scenarios to meet fuelwood demand in the same Tundu village and found that only with widespread adoption of fuel-efficient stoves, in conjunction with the use of alternative fuels such as rice husks, can sufficient fuelwood be produced to meet village needs given limited land for wood production. Further investigation into the limits of stove adoption is recommended, given less than half of households in the survey owned fuel-efficient stoves (e.g. Jan 2012). Findings support the recommendation of Fisher et al. (2011) that policies to conserve tropical forests are conducted in parallel with projects aimed at enhancing fuel-efficiency, such as through the use of modified stoves. In addition, given the positive relationship indicated between awareness and compliance, it is recommended that implementation efforts be placed on improving local-awareness of forest management regimes. While households aware of management were less able to meet firewood needs, projects in tandem with the establishment of stoves could might alleviate this trade-off.

Previous research has found household NTFP use to be associated with wealth, with poorer households being more dependent on NTFPs (Adhikari et al. 2004). Interestingly, this study found that increased assets resulted in higher perceived need for firewood while consumption itself decreased, with this possibly due to the availability of firewood remaining limited regardless of increased means to purchase or hire labour for harvest. Thus, concern arises for whether payments to compensate for loss of resource access will address resource needs if availability of resources itself stays the same, or indeed is reduced by management restrictions. McNally et al (2011) examined the effects of a protected area on the trade-offs between two extractive mangrove ecosystem services and

found that many households experienced an immediate loss in the consumption of mangrove firewood, with the loss most prevalent in richer households. As noted by Albers and Robinson (2013), projects that increase rural income may have surprising effects if higher incomes lead to increasing demand for the resources they aim to conserve.

Implications for Leakage and Household Welfare

Households harvesting firewood from agricultural fields and/or private woodlots were significantly less likely to meet their resource needs. This is of particular concern given the recent ban on firewood collection within the national park, with potential implications for leakage to the other forest areas such as the nearby Transition forest with no formal management. Further analysis is required to identify the specific challenges impeding household ability to meet resource needs outside forest areas, such as the availability of energy alternatives and barriers to effective tree planting within the area. Although not a significant predictor of sufficiency score, households solely purchasing firewood also indicated a deficit in firewood needs. In light of the six effects of resource access restriction identified by Robinson and Kajembe (2009) and here, and that households in the study area were constrained by purchasing ability from markets and cultivating alternatives in fields or private areas, the possibility for displacement, reduction, or non-compliance become significant (availability of alternative energy sources such as gas and electricity is low in this study area). This presents serious implications for either long-term management success in the area given leakage or non-compliance, or detriment to local livelihoods through inability to meet demand for fuel and food. The impact on household welfare is significant given restricted NTFP access in Tanzania is likely to hit the poorest hardest (Schaafsma et al. In Press), while in addition potential for leakage presents concern for the area's globally important biodiversity (Myers et al. 2000; Burgess et al. 2007), given the recent firewood ban in the NP and proximity of other less-well protected forests in the area. Long-term monitoring of household forest product needs and sufficiency in the area is recommended, to assess the impact of this ban on household welfare and leakage potential over time. Decentralised power structures allow for independent locally-based forest management decisions that, if not considered at the larger, landscape level, can have important implications for long-term sustainability of forest management at the National level, given continued need for vital forest products. As observed by Robinson and Lokina (2011), considerable leakage of NTFP extraction activities into more distant forests occurred after PFM implementation in Tanzania. Thus, findings lend empirical support to

growing theory behind the need for a landscape planning approach to forest conservation policies (Robinson et al. 2011; Robinson and Lokina 2011).

Wider Implications for Tropical Forest Management

Understanding and addressing the issue of leakage is particularly important for emerging policies aimed at reducing emissions from deforestation and degradation (REDD+), if carbon benefits are to be meaningful and permanent. REDD+ is expected to provide additional benefits to that of mitigating climate change in terms of poverty alleviation and biodiversity conservation, and thus the local welfare costs of restricted forest product access needs to be assessed alongside the global benefit of addressing climate change. Such spatial ecosystem valuation can help evaluate the trade-offs between local and international communities to inform policy (Schaafsma et al. 2012; Schaafsma et al. In Press). However, carbon accounting at the national level will need to include the potentially offsetting emissions of displaced NTFP harvesting activities (Robinson et al. 2013). The consistent failure of forest management regimes to account for the impact of changes in forest protection and resource access on local welfare will likely continue with REDD+ policies, if they do not resolve these issues of incentives and behaviour change. Thus benefits generated through REDD+ must exceed such embedded opportunity, implementation and enforcement costs to achieve success (Robinson et al. 2013). Fisher et al (2011) estimate that the implementation costs of measures to alleviate forest dependency, such as raising agricultural yields and increasing fuel-efficiency through modified stoves, remain feasible within REDD+ policies despite exceeding the opportunity costs of carbon conservation. Findings reinforce the need for a landscape approach to forest conservation planning and the importance of measures to increase fuel efficiency, especially in light of developing REDD+ policies given household forest product needs will still need to be met and potentially increase in the event of increased wealth.

Conclusion

Forest access restrictions significantly impact household ability to meet firewood needs, with management effectiveness reflected by household firewood sufficiency. The importance of awareness of regimes is highlighted, with awareness improving compliance with regime rules and regulations. Findings indicate significant concern for leakage and welfare impacts in the area, with households unable to meet forest product needs outside

forest areas. As such the need to adopt a landscape approach to management planning is highlighted, to reduce potential leakage or detriment to local welfare, as local demands for vital forest products will still need to be met despite forest access restrictions. This is of particular importance for future REDD+ policies, given compensation-based payments for forest protection will be limited if household forest product needs are not met elsewhere. However, further research is required to identify the specific challenges facing households in seeking alternatives to forest product use and alleviating forest-dependency.

Acknowledgements

This study was conceived by J.E.L., who collected and analysed field data and prepared the manuscript. The work was supervised by S.M.S and A.R.M, with thanks to Steve Cinderby at Stockholm Environment Institute, York, for assistance with preparation of methods and data handling. Research was carried out with funding from the Economic and Social Research Council (ESRC) with the permission of the Tanzania Commission for Science and Technology (COSTECH permit number 2011-60-NA-2010-205), with ethical approval from the University of York Environment Department Ethics Committee. Thanks to village councils and villagers for allowing research to be conducted within all five villages, and also all relevant forest management officials. Many thanks also to Mohamed A. Kambi for research assistance in the field, and enumerators Ladislaus Mkatihela, Shafii Rashidi, Katenga Henry, Joseph Damiani Nyambi and Hassan Pamuhi. Thanks also to Phil Platts for assistance with cartography and the Udzungwa Forest Project for logistical support in the field.

References

Adhikari, B., Di Falco, S., Lovett, J.C., 2004. Household characteristics and forest dependency: evidence from common property forest management in Nepal. Ecological Economics 48, 245-257.

Ahrends, A., Burgess, N.D., Milledge, S.A.H., Bulling, M.T., Fisher, B., Smart, J.C.R., Clarke, G.P., Mhoro, B.E., Lewis, S.L., 2010. Predictable waves of sequential forest degradation and biodiversity loss spreading from an African city. Proceedings of the National Academy of Sciences 107, 14556-14561.

Albers, H.J., Robinson, E.J.Z., 2013. A review of the spatial economics of non-timber forest product extraction: Implications for policy. Ecological Economics 92, 87-95.

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J., Mathijs, E., 2008. Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. Agricultural Systems 98, 147-155.

Benjamini, Y., Hochberg, Y., 1995. Controlling the false discovery rate: a practical and powerful approach to multiple testing. Journal of the Royal Statistical Society. Series B (Methodological), 289-300.

Bjornstad, O.N., 2012. ncf: spatial nonparametric covariance functions, In R package version 1.1-4. http://CRAN.R-project.org/package=ncf.

Burgess, N.D., Butynski, T.M., Cordeiro, N.J., Doggart, N.H., Fjeldså, J., Howell, K.M., Kilahama, F.B., Loader, S.P., Lovett, J.C., Mbilinyi, B., Menegon, M., Moyer, D.C., Nashanda, E., Perkin, A., Rovero, F., Stanley, W.T., Stuart, S.N., 2007. The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. Biological Conservation 134, 209-231.

Caplow, S., Jagger, P., Lawlor, K., Sills, E., 2011. Evaluating land use and livelihood impacts of early forest carbon projects: Lessons for learning about REDD+. Environmental Science & Policy.

Chomitz, K.M., Buys, P., De Luca, G., Thomas, T.S., Wertz-kanounnikoff, S., 2007. At loggerheads? Agricultural expansion, poverty reduction, and environment in the tropical forests. World Bank, Wahington, D.C.

Crawley, M.J., 2002. Statistical computing: an introduction to data analysis using S-Plus. Wiley Chichester, UK.

de Merode, E., Homewood, K., Cowlishaw, G., 2004. The value of bushmeat and other wild foods to rural households living in extreme poverty in Democratic Republic of Congo. Biological Conservation 118, 573-581.

Delang, C.O., 2006. Not just minor forest products: The economic rationale for the consumption of wild food plants by subsistence farmers. Ecological Economics 59, 64-73.

Ewers, R.M., Rodrigues, A.S.L., 2008. Estimates of reserve effectiveness are confounded by leakage. Trends in Ecology & Evolution 23, 113-116.

Felix, M., Gheewala, S.H., 2011. A Review of Biomass Energy Dependency in Tanzania. Energy Procedia 9, 338-343.

Fisher, B., Lewis, S.L., Burgess, N.D., Malimbwi, R.E., Munishi, P.K., Swetnam, R.D., Turner, R.K., Willcock, S., Balmford, A., 2011. Implementation and opportunity costs of reducing deforestation and forest degradation in Tanzania. Nature Climate Change 1, 161-164.

Foerster, S., Wilkie, D.S., Morelli, G.A., Demmer, J., Starkey, M., Telfer, P., Steil, M., Lewbel, A., 2012. Correlates of bushmeat hunting among remote rural households in Gabon, Central Africa. Conservation Biology 26, 335-344.

Gavin, M.C., Solomon, J.N., Blank, S.G., 2009. Measuring and Monitoring Illegal Use of Natural Resources. Conservation Biology 9999.

Godoy, R., Wilkie, D., Overman, H., Cubas, A., Cubas, G., Demmer, J., McSweeney, K., Brokaw, N., 2000. Valuation of consumption and sale of forest goods from a Central American rain forest. Nature 406, 62-63.

Gorenflo, L.J., Orland, B., 2013. Human Resource Demand and Biodiversity Conservation at Udzungwa Mountains National Park, Tanzania: Challenges and Opportunities through Community Design, In Proceedings of the Ninth TAWIRI Scientific Conference, 4th-6th December 2013, Tanzania.

Jan, I., 2012. What makes people adopt improved cookstoves? Empirical evidence from rural northwest Pakistan. Renewable and Sustainable Energy Reviews 16, 3200-3205.

Jones, J.P.G., Andriamarovololona, M.M., Hockley, N., Gibbons, J.M., Milner-Gulland, E.J., 2008. Testing the use of interviews as a tool for monitoring trends in the harvesting of wild species. Journal of Applied Ecology 45, 1205-1212.

Kammen, D.M., 1995. Cookstoves for the developing world. Scientific American 273, 72-75.

Laurance, W.F., Useche, D.C., Rendeiro, J., Kalka, M., Bradshaw, C.J.A., Sloan, S.P., Laurance, S.G., Campbell, M., Abernethy, K., Alvarez, P., 2012. Averting biodiversity collapse in tropical forest protected areas. Nature 489, 290-294.

Lund, J.F., Larsen, H.O., Chhetri, B.B.K., Rayamajhi, S., Nielsen, O.J., Olsen, C.S., Uberhuaga, P., Puri, L., Prado, J.P.P., 2008. When theory meets reality - how to do forest income surveys in practice, In Forest & Landscape Working Papers No. 29, 48pp. Forest & Lanscape Denmark, Hørsholm.

Marshall, A.R., 2008. Ecological Report on Magombera Forest. WWF Tanzania.

McGregor, J.A., 2008. Wellbeing, Poverty and Conflict WeD Policy Briefing 01/08, ed. http://www.bath.ac.uk/econ-dev/wellbeing/research/bp/bp1-08.pdf.

McNally, C.G., Uchida, E., Gold, A.J., 2011. The effect of a protected area on the tradeoffs between short-run and long-run benefits from mangrove ecosystems. Proceedings of the National Academy of Sciences 108, 13945-13950.

McShane, T.O., Hirsch, P.D., Trung, T.C., Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H.V., Dammert, J.L., Pulgar-Vidal, M., 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. Biological Conservation 144, 966-972.

Murtaugh, P.A., 2009. Performance of several variable-selection methods applied to real ecological data. Ecology Letters 12, 1061-1068.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853-858.

Naidoo, R., Ricketts, T.H., 2006. Mapping the Economic Costs and Benefits of Conservation. PLoS Biol 4, 2153–2164.

NBS, 2002. Population and Housing Census. Volume IV. National Bureau of Statistics, Ministry of Planning, Economy and Empowerment. Dar es Salaam. Tanzania.

Nkonya, E., Pender, J., Kato, E., 2008. Who knows, who cares? The determinants of enactment, awareness, and compliance with community Natural Resource Management regulations in Uganda. Environment and Development Economics 13, 79-101.

Nyundo, B.A., Mtui, A., Kissaka, H., 2006. An assessment of ecological and social-economic impacts caused by collection of deadwood, medicinal plants cutting of grass for thatching in Udzungwa Mountains National Park. Unpublished report for the World Wildlife Fund - Tanzania Programme, Dar es Salaam. 104 pp.

Oliveira, P.J.C., Asner, G.P., Knapp, D.E., Almeyda, A., Galvan-Gildemeister, R., Keene, S., Raybin, R.F., Smith, R.C., 2007. Land-use allocation protects the Peruvian Amazon. Science 317, 1233.

Platts, P.J., Burgess, N.D., Gereau, R.E., Lovett, J.C., Marshall, A.R., McClean, C.J., Pellikka, P.K.E., Swetnam, R.D., Marchant, R.O.B., 2011. Delimiting tropical mountain ecoregions for conservation. Environmental Conservation 38, 312-324.

Quinn, G.G.P., Keough, M.J., 2002. Experimental design and data analysis for biologists. Cambridge University Press.

Robinson, E.J.Z., Albers, H.J., Meshack, C., Lokina, R.B., 2013. Implementing REDD through Community-Based Forest Management: Lessons from Tanzania. Natural Resources Forum 37 141–152.

Robinson, E.J.Z., Albers, H.J., Williams, J.C., 2011. Sizing reserves within a landscape: The roles of villagers reactions and the ecological-socioeconomic setting. Land economics 87, 233-249.

Robinson, E.J.Z., Kajembe, G.C., 2009. Changing access to forest resources in Tanzania, In EfD Discussion Paper 09-10, joint publication of Environment for Development Initiative and Resources for the Future. Washington DC.

Robinson, E.J.Z., Lokina, R.B., 2011. A spatial-temporal analysis of the impact of access restrictions on forest landscapes and household welfare in Tanzania. Forest Policy and Economics 13, 79-85.

Robinson, E.J.Z., Williams, J.C., Albers, H.J., 2002. The influence of markets and policy on spatial patterns of non-timber forest product extraction. Land economics 78, 260-271.

Rovero, F., Nyundo, B.A., Kitegile, A.S., 2008. The impact of human disturbance (especially deadwood collection) on the biodiversity of Mwanihana forest, Udzungwa Mountains National Park: a re-assessment following the 2005 study. Report by World Wide Fund for Nature, Tanzania Programme Office, Tanzania.

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R.D., Balmford, A., Bateman, I.J., Burgess, N.D., Chamshama, S.A.O., Fisher, B., Freeman, T., Geofrey, V., Green, R.E., Hepelwa, A.S., HernÃ¡ndez-Sirvent, A., Hess, S., Kajembe, G.C., Kayharara, G., Kilonzo, M., Kulindwa, K., Lund, J.F., Madoffe, S.S., Mbwambo, L., Meilby, H., Ngaga, Y.M., Theilade, I., Treue, T., van Beukering, P., Vyamana, V.G., Turner, R.K., In Press. The importance of local forest benefits: Economic valuation of Non-Timber Forest Products in the Eastern Arc Mountains in Tanzania. Global Environmental Change.

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R.D., Balmford, A., Bateman, I.J., Burgess, N.D., Chamshama, S.A.O., Fisher, B., Green, R.E., Hepelwa, A.S., HernÃ¡ndez-Sirvent, A., Kajembe, G.C., Kulindwa, K., Lund, J.F., Mbwambo, L., Meilby, H., Ngaga, Y.M., Theilade, I., Treue, T., Vyamana, V.G., Turner, R.K., 2012. Towards transferable functions for extraction of Non-timber Forest Products: A case study on charcoal production in Tanzania. Ecological Economics 80, 48-62.

Schelhas, J., Pfeffer, M.J., 2009. When global environmentalism meets local livelihoods: policy and management lessons. Conservation Letters 2, 278-285.

Sheil, D., Wunder, S., 2002. The value of tropical forest to local communities: complications, caveats, and cautions. Conservation Ecology 6, 9.

Sigalla, H.L., 2013. Trade-Offs between Wildlife Conservation and Local Livelihood: Evidence from Tanzania. African Review 40, 155-178.

Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L., Wunder, S., 2005. Livelihoods, forests, and conservation in developing countries: an overview. World Development 33, 1383-1402.

Sunderlin, W.D., Angelsen, A., Resosudarmo, D.P., Dermawan, A., Rianto, E., 2001. Economic crisis, small farmer well-being, and forest cover change in Indonesia. World Development 29, 767-782.

UNEP-WCMC, 2010. The World Database on Protected Areas (WDPA). Cambridge, UK: UNEP-WCMC. URL http:/www.wdpa.org.

Vedeld, P., Angelsen, A., Bojö, J., Sjaastad, E., Kobugabe Berg, G., 2007. Forest environmental incomes and the rural poor. Forest Policy and Economics 9, 869-879.

Vedeld, P., Angelsen, A., Sjaastad, E., Kobugabe Berg, G., 2004. Counting on the environment: Forest incomes and the rural poor. Environmental Economics Series 98. World Bank, Washington D. C.

Wilkie, D.S., Morelli, G.A., Demmer, J., Starkey, M., Telfer, P., Steil, M., 2006. Parks and people: Assessing the human welfare effects of establishing protected areas for biodiversity conservation. Conservation Biology 20, 247-249.

WWF, 2006. Mpango wa matumizi bora ya ardhi ya kijiji: Kijiji cha Tundu, wilaya ya Kilosa. Halmashauri ya kijiji cha Tundu.

Zuur, A.F., Ieno, E.N., Elphick, C.S., 2010. A protocol for data exploration to avoid common statistical problems. Methods in Ecology and Evolution 1, 3-14.

5 Stakeholder Perceptions of the Challenges for Forest Protection

Conducting semi-structured interviews in Magombera village

Contrasting Stakeholder Perceptions of Challenges for Tropical Forest Protection in Tanzania.

Latham, J. E[1], Sallu, S. M.[2], Marshall, A. R.[1, 3.]

1. CIRCLE, Environment Department, University of York, York, UK.
2. Sustainability Research Institute, School of Earth & Environment University of Leeds, Leeds UK.
3. Flamingo Land Ltd., Kirby Misperton, North Yorkshire, UK.

Abstract

Achieving both social and ecological success in the management of forest commons is dependent on the perceptions of both resource users and managers, and their ability to achieve effective dialogue regarding management values and goals. Measures of resource user attitudes to conservation interventions can be used as a tool to assess socially contested aspects of management strategies, to aid more effective implementation. However, rarely are local resource user perceptions compared and contrasted with those of management officials. Such analysis is essential given the multi-level, multi-actor governance structures prevalent in tropical forest management, with increasing recognition that inclusion of local community interests will improve management success. In this paper, the attitudes and opinions of different stakeholders towards forest management are investigated using semi-structured interviews, to identify perceived challenges for forest protection in Tanzania. A case study approach is adopted in five villages adjacent to forests subject to differing protected status, from strict protection through participatory management to no formal management. Interviews commenced at the village level and a snowballing method was used to identify and then interview forest management stakeholders up to the national level. Content analysis was used to categorise the social, political and economic issues that permeated the discourses into three emerging themes: (1) education, (2) governance, and (3) forest dependency. The importance of each issue and theme varied by stakeholder group, with discourses highlighting a disconnect between stakeholders and a division in accountability for forest protection. Management officials frequently cited education challenges at the village level, with difficulty in changing local resource user perceptions that resources will always be freely available. Villagers were in agreement that better education was needed within villages to improve forest protection, however this was perceived to be the responsibility of management. Findings suggest villagers were perceived by management officials as an auxiliary of, rather than complimentary to, forest protection. More novel approaches for

social engagement in forest management are necessary, and facilitation of villager empowerment is needed for village institutions to be effectively accountable for forest protection, to aid forest conservation and management success in the long-term.

Keywords: Conservation, Tropical Forest Management, Participatory Forest Management, Content Analysis, Engagement, Accountability.

Introduction

An important challenge for the long-term sustainability of complex social-ecological forest ecosystems is achieving both social and ecological successes that are suitable and effective. This challenge can be intensified when different forest stakeholders bring different assumptions, knowledge and goals for the resource to their decision making (Adams et al. 2002). Sustainable management is dependent on the perceptions of both resource users and managers, and their ability to reach consensus on common values and management goals (Gelcich et al. 2005; McClanahan et al. 2009). However, it has been argued that such focus on the importance of consensus undermines the legitimacy of plurality in discourses regarding conservation, and trade-offs or compromise are the norm (Cairns et al. 2013). Regardless of opinion, it is clear that considered and transparent analysis of the views of different stakeholders towards management problems is essential, if effective dialogue is to be achieved (Adams et al. 2003). In recent decades favoured tropical forest conservation policy, and associated management, has undergone a relatively rapid evolution from traditional government-led protection towards multi-level, multi-actor governance with the inclusion of local community interests (Latham et al. Chapter 2). This recognition for the diversity of actors invested in tropical forest management necessitates equal acknowledgment of the diversity of perceptions held for the resource. It is through identification of the similarities and differences between stakeholder perceptions that socially contested aspects of management can be constructively addressed, and potential solutions implemented (McClanahan et al. 2009). However, rarely are the perceptions of both management officials and resource users contrasted for this purpose.

Preference for participatory styles of forest management, whereby responsibility is either in full or in part devolved to local resource-adjacent communities, has increased since the 1980s and is now widely practiced across the tropics (Schreckenberg et al. 2006). This increase in favour is in part due to increasing awareness for the rights and needs of local

forest-adjacent communities, and growing recognition that local communities can create and sustain institutional arrangements to manage common resources successfully over long time periods (e.g. Wells and Brandon 1992; Ostrom et al. 1999; Ostrom 2003). While examination of experience with these regimes identifies varying levels of success, repeated failures to account for the social dimensions of forest management are evident, with poor understanding of the heterogeneous nature of local communities and their dependence on natural resources impeding long-term management success (Latham et al. Chapter 2). Participatory regimes have been criticised for being poorly implemented in practice (Larson and Ribot 2007; Ribot et al. 2010; Berkes 2004), with projects suffering when participation remains only instrumental and institutions are not sufficiently accountable to the communities in question (Kellert et al. 2000; Xu and Ribot 2004; Vermeulen and Sheil 2007; Larson and Soto 2008). Given this, there has been much debate on the role of communities in conservation planning (Agrawal and Gibson 1999; Redford and Sanderson 2000; Berkes 2004), with a greater need for understanding the knowledge and values of different actors needed to support conservation interventions (Brown 2003). For management of the commons to be truly participatory, either consensus or compromise between all stakeholders will need to be reached and accountability for management clearly defined.

Conservation strategies remain largely externally-driven and donor-led, with top-down implementation based on pre-defined plans that might not take into account local social contexts. Site-specific assessments by funding organisations to create true management partnerships can be time and labour intensive, however limited integration can hinder long-term success once external support is removed (Hoehn and Thapa 2009). Thus, a growing literature is dedicated to evaluating local attitudes, and the factors influencing these attitudes, towards conservation interventions (Cinner and Pollnac 2004; Kideghesho et al. 2007; Tomicevic et al. 2010). Such examination is important for identifying community-level differences in attitudes and its influences, and can be used as a tool to direct more effective management strategies. However, rarely are these local perceptions then compared with those of management officials. Socially contested management of the commons can arise through heterogeneity in perceptions regarding the resource problems that are being addressed (Adams et al. 2003). Such heterogeneity in perceptions exists across multiple scales, especially given the complex interactions involved in multi-level governance of forest commons from the local to international level (Mwangi and Wardell 2012).

Adopting a landscape approach to conservation planning allows consideration for not only the ecological characteristics of an area, but also the interactions between these and the socio-economic conditions (Robinson et al. 2011, Latham et al. Chapter 4). Given prevalent tropical forest policies range between top-down and bottom-up governance structures, there is potential for multiple authorities and actors to operate independently within a landscape containing numerous forest patches. Thus, it is necessary that stakeholder perceptions of one management regime are not considered in isolation of others within such a landscape. Given this, the perceptions of forest stakeholders at multiple scales, encompassing different management regimes, are examined and compared here using a case study approach in Tanzania.

Tanzania has over 34 million hectares of forested land, over half of which is within gazetted or proposed Forest Reserves, Game Reserves or National Parks (*c.* 18.8 Mha), with the remainder outside the reserve network on village or general land (Blomley et al. 2008). Participatory Forest Management (PFM) has been promoted by the Tanzanian Government since the mid-1990s and now governs over 10% of its forested land (Blomley et al. 2008). Community inclusion in forest management has been found to improve forest condition (Blomley and Ramadhani 2006; Blomley et al. 2008; Blomley and Iddi 2009), yet outcomes for local livelihoods are poorly understood (Vyamana 2009), with evidence so far suggesting CBFM is more effective than JFM (Blomley et al. 2011). However, between 130,000 and 500,000ha of land continues to be deforested annually in Tanzania, due to agriculture, overgrazing, charcoal burning, fuelwood harvesting, wildfires and commercial logging (FAO 2010). Thus, a number of significant challenges remain with respect to achieving the objectives of forest protection in the country. In coastal forests, limited capacity within Government administrations has led to poor management of Forest Reserves, whereas National Parks and Village Forest Reserves have been more effectively managed (Burgess et al. 2013). Governance shortfalls in the forestry sector have been exposed, particularly in relation to illegal logging, with communication gaps between rural communities and the Government leading to reduced community support for forest protection (Milledge et al. 2007). Concerns over transparency in forest policy decision-making and implementation, poor enforcement of rules and regulations and distrust between the authorities and the public have been identified in the country (Rantala 2012). In addition, discrepancies in perceptions regarding PFM-associated changes in forest protection have been identified among different stakeholder groups, leading to difficulty in PFM implementation (Robinson and Maganga 2009).

This paper aims to contribute to knowledge of the challenges facing forest protection by examining and comparing the perspectives of forest stakeholders at multiple levels of governance. Such analysis will allow for greater understanding of the similarities and differences in actors' perceptions, and help identification of socially contested aspects of management on which to focus for improvement. Five rural Tanzanian villages, each adjacent to forests subject to different management regimes, are the basis for stakeholder identification. A snowballing approach is used to identify key stakeholders, commencing at the villager level and continuing through village councils, management authorities and Non-Governmental Organisation (NGO) representatives, to the national level. Semi-structured interviews are used to discuss attitudes and opinions towards forest management practices, and content analysis used to identify the main themes in perceptions of challenges for achieving forest protection. These are then compared between stakeholder groups to allow for contrast between perceptions, and hence identify priorities for socially-sensitive management practice.

Methods

Study Area

A case-study approach was adopted in five villages, each adjacent to forests under differing management regimes, in the Morogoro region of Southern Tanzania (Figure 1). Examination of stakeholder perceptions of the challenges for forest protection is of added importance in the area as low levels of household awareness for management authorities was found, with negative implications for regime compliance (Latham et al. Chapter 3). In addition, deficiency in firewood availability and inability of households to meet firewood needs outside forested areas was found in the study villages, highlighting the need to examine both resource user and management perceptions of the challenges for forest protection (Latham et al. Chapter 4).

Villages were selected to maximise variation in forest management regime whilst minimising geographic spread to avoid high variation in ecological and social factors; with one forest under strict protection as a National Park (NP), one under Joint Forest management (JFM), two under Community-Based Forest Management (CBFM) and the remaining in management transition (Table1). All study villages were located within 7km of the Udzungwa Mountains National Park, which was officially gazetted in 1992 by the

Tanzania National Park Authority to safeguard the mountain water catchments and high biodiversity value. PFM was initiated in three study villages through donor-led support, with Kiberege and Tundu villages assisted with a CBFM planning and implementation process by World Wide Fund for Nature (WWF), and joint management of Nyanganje forest between Signali village and the Government through Kilombero District Council initiated by the Norwegian Agency for Development Cooperation (NORAD). At the time of data collection Magombera forest, in management transition, was not subject to any formal management plan, however a number of organisations are cooperating in informal management of the forest given diverse interests and a complex history (Marshall 2008).

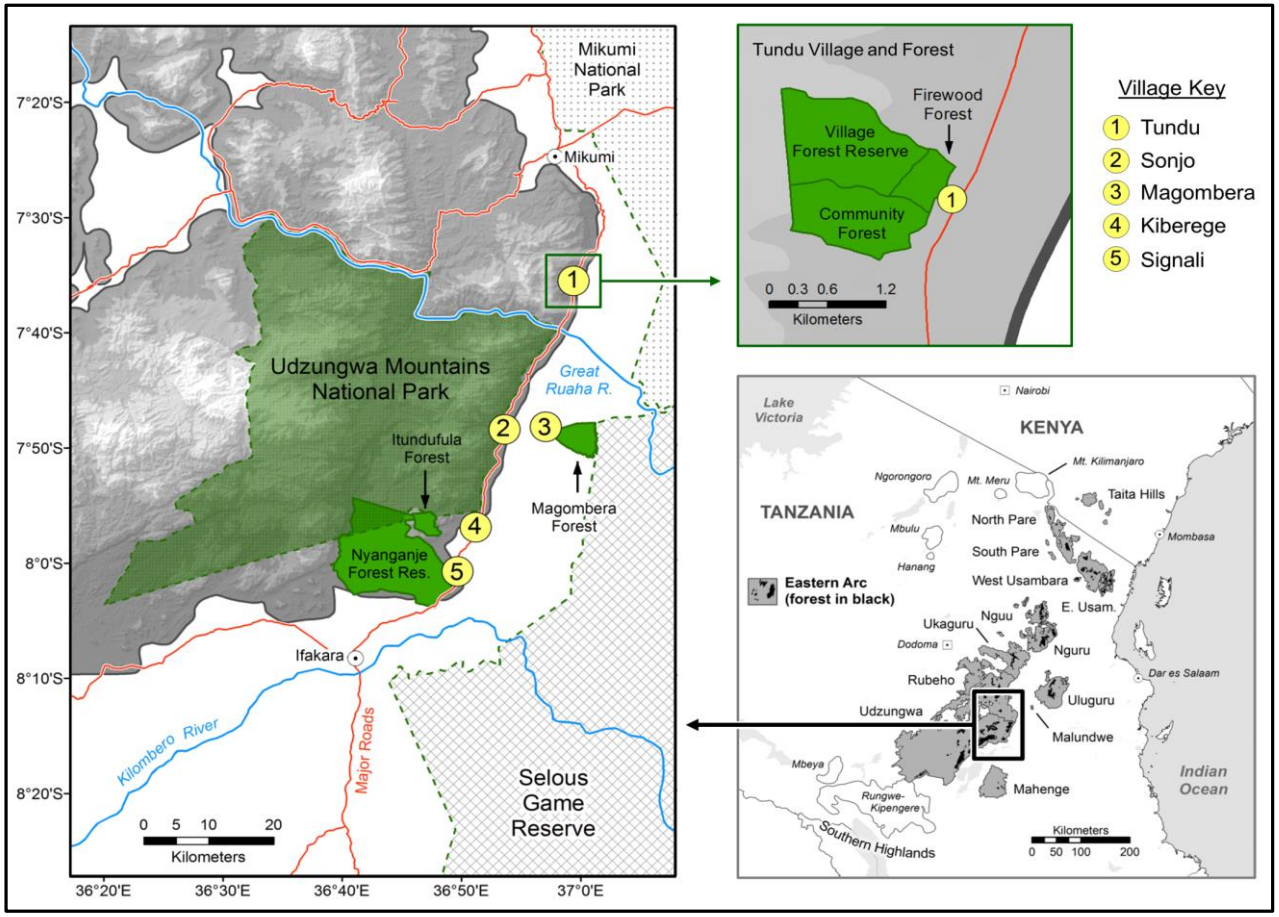


Figure 1. Location of the five study villages in Tanzania and adjacent forests. Adapted using data on Eastern Arc Mountain boundaries and forests from Platts et al. (2011), Protected Area boundaries from UNEP-WCMC (2010), Magombera forest and Selous Game Reserve boundary with the assistance of the Udzungwa Forest Project and Tundu Village Forest boundaries from WWF (2006). Data on spatial infrastructure with the assistance of the Valuing the Arc project (http://www.valuingthearc.org).

Table 1. Description of study villages and adjacent forests.

Village	Geographic Location	Village Size [a]	Adjacent Forest [b]	Forest Protection Status	Current Forest Management Regime	Sanctioning Authority	Year Current Regime Established	Collaborating/ Funding Organisations	Rules and Regulations [c]
Magombera	7°48'24.01"S 36°57'16.03"E	289	Magombera *(0.7km)*	In Transition (no formal management)	Transition	None	1981	UFP, Selous Game Reserve, WWF, Illovo Sugar Company	No formal R&R regarding resource use
Kiberege	7°57'5.85"S 36°51'21.90"E	1275	Itundufula *(5.4km)*	Village Forest Reserve	CBFM1	Kiberege Village	2003[$]	WWF[**]	Only dead firewood harvest allowed (i.e. no cutting tools)
Tundu	7°35'44.28"S 36°59'39.90"E	757	Tundu Community Forest *(0.2km)*	Village Forest Reserve	CBFM 2	Tundu village	2007[$]	WWF[**]	Village forest divided into three areas: VFR – no resource harvest allowed FWF – only dead firewood harvest allowed two days a week CGF - No resource harvest allowed
Signali	8° 0'54.82"S 36°49'48.90"E	576	Nyanganje *(1.4km)*	Forest Reserve (IUCN category IV)	JFM	Kilombero District Council & Signali village	1998[$]	NORAD[**]	Only collection of dead firewood allowed (i.e. no cutting tools). (ban introduced mid-fieldwork in July 2011 after which no resource collection allowed)
Sonjo	7°48'36.14"S 36°53'49.44"E	259	Udzungwa Mountains NP *(0.3km)*	NP (IUCN category II)	NP	TANAPA	1992	WWF[**]	Women allowed entry once a week to harvest dead firewood, no cutting tools allowed (ban enforced mid-fieldwork in July 2011 after which no resource harvest allowed)

***NP** = National Park, **CBFM** = Community Based Forest Management, **JFM** = Joint Forest Management, **TANAPA** = Tanzania National Park Authority, **UFP** = Udzungwa Mountains National Park, **WWF** = World Wide Fund for Nature, **NORAD** = Norwegian Agency for Development Cooperation, **R&R** = Rules and Regulations, **VFR** = Village Forest Reserve, **FWF** = Firewood Forest, **CGF** = Community Group Forest. [a] Number of households, [b] Numbers in parenthesis indicate distance to forest from central village meeting place, [c] Defined through interview with sanctioning authority representatives (Latham et al. Chapter 3), [$] Year PFM policy process initiated, [**] PFM funding agency, specific projects now expired.*

Data Collection

Respondent Sample

Interviews were carried out between March and December 2011, with forest stakeholders ranging from the village up to national level to discuss attitudes and opinions towards forest protection. The aims and independent nature of the research was explained to each respondent prior to commencement, and permission obtained to record interviews. Interviews were carried out in person, either in Kiswahili with the help of a Tanzanian research assistant to aid translation (n=61), or in English where possible (n=61). Interviews were digitally recorded and transcribed into English by two research assistants, with accuracy checked through comparison with notes taken at the time of interview by the lead researcher.

Interviews began at the village level through random selection of household heads that had previously taken part in a household questionnaire survey, conducted as part of the same research agenda (Latham et al. Chapters 3 & 4). Four villagers were interviewed within each study village (n=20 villagers), two from each higher and lower wealth category as pre-defined for the household survey. Snowball sampling (Goodman 1961) was used to identify and map key forest stakeholders by asking interviewees who they consult for forest-related information, with that person next selected for interview, and so on. Respondents were asked whether this stated relationship was reciprocated. To illustrate the observed structure of social network involved forest management from the National to village level in the study area, the network of identified connections was mapped using NodeXL software for Social Network Analysis version 1.0.1.238 (Smith et al. 2010). Stakeholder connections were summarised by organisation and administrative division, to provide clarity in the illustration of this management structure.

The succession of Interviews was halted when the next informant identified was either logistically difficult to reach in the timeframe (e.g. TANAPA headquarters, Arusha, Northern Tanzania), or were unavailable for interview given seniority (e.g. Assistant Director of Forestry Development in the Forest and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism). Two identified stakeholders at the district level, the Kilombero District Natural Resource Officer (DNRO) and the District Executive Director, were unwilling to be interviewed despite best efforts, citing lack of time availability. As such an additional Forest Officer at the district level was interviewed in the place of, and as nominated by, the Kilombero DNRO. One further stakeholder, the Kilombero District Catchment Officer, was travelling throughout the research period and unavailable for interview.

Interview Structure

Semi-structured interviews (SSIs) were carried out using a general topic guide of themes and associated open-ended questions to direct all interviews (Bryman 2012). Three separate sets of similar questions were designed, varying only to account for the background and expertise of potential respondents: Villager, Village Environmental/Natural Resource Committee and Management Officials (Appendix III). All interviews focussed on issues pertaining to each relevant forest and its protection. Questions were framed within a topic guide that was used adaptively, with elaboration on issues of interest and concern to the respondent encouraged. Each interview commenced with discussion regarding the particulars of that stakeholder group, tailored for the respondent type, with discussion of village life (villager and village council) and/or organisation structure and respondent role (village council/management officials) where relevant. Topics covered included perceptions of strategies for forest protection, benefits, conflicts and challenges regarding the relevant forest(s) and its protection, and any current or historical collaborations and partnerships associated with protection. Basic information relating to each respondent was obtained at the start of each interview, including respondent name, age, gender, level of education, occupation, position and number of years in that position (if applicable).

Data Analysis

Content analysis (Bryman 2012) of all interview transcripts was used to identify and classify stakeholder perceptions of challenges for achieving forest protection. Transcribed interviews were coded based on the principles of grounded theory, with quotations assigned to an emerging coding frame of issues and themes (Strauss and Corbin 1990; Bryman 2012). All coding was conducted using QSR NVivo 10 software for qualitative analysis (QSR International Pty Ltd 2012). Initial coding was open and fluid with statements (i.e. a phrase or sentence) coded into perceived issues emerging from the data, such as 'limited resources for forest monitoring' and 'poor leadership'. These were then revised using selective coding into overarching themes of perceived challenges for forest protection, under which issues were re-classified. The number of respondents citing each particular challenge theme and issue was calculated to give an indication of their relative importance. Respondents were classified according to their position as either villager, village council member or management official to allow for comparison in perceptions by stakeholder group. A Chi-square goodness of fit test was then used to test whether the reporting of each challenge theme was independent of the stakeholder group, carried out using R (version 3.0.0; http://cran.r-project.org).

To maintain anonymity in reporting the data, respondents were assigned unique ID codes to indicate the individual and their stakeholder grouping: V1-20 (villagers); VC1-5 (each Village Chairperson); VEO1-5 (each Village Executive Officer); VEC1-7 (leaders and members of each Village Environmental Committee); SVC1-5 (Sub-Village Chairs from 4 of the 5 villages); VCM1 (village council member); W1-4 (Ward Officials including Executive and Forest Officers); DV1-2 (Division Forest Officers); D1-7 (District Officials including Forest Officers, Catchment Officer, Natural Resource Officers, Game Officer and Executive Director); R1-3 (Regional Forest, Natural Resource and Catchment Officers); N1 (National Catchment Forestry & Nature Reserve Manager); T1-2 (TANAPA-UMNP Chief Park Warden and Community Warden); S1 (Selous Game Reserve Sector Manager); NGO 1-3 (WWF local Project Manager, WWF Forestry Programme Officer and UFP Coordinator) and FG1 (local Forest Group). This forest group, 'HIMAVIKULU Network', is a local group under the National MJUMITA Network of community groups involved in PFM in Tanzania. The group works in 13 villages in the area to motivate and assist Village Councils in the conservation Village Forest Reserves.

Results

Stakeholder Sample

A total of 70 stakeholders were identified and 67 interviewed (Table 2). The main occupation of nearly all village-level respondents was farming (n=18), except for one teacher, and an employee of Kilombero Sugar Company. 74% of all village council respondents indicated farming as their main occupation (n=17), with the remainder either a primary school teacher, a rice transporter, a traditional healer or Village Executive Officers.

Table 2. Identified stakeholders by group and code. For continuous variables, numbers indicate mean value with 95% bootstrapped CIs in parenthesis and range in italics.

Stakeholder Group	N (by gender)	Age (years)	Education (number of years)	Length in Current Employment (years)	Respondent Codes
Villager	Male: 10 Female: 10	52.85 (+6.6, -6.75) *24-78*	6.22 (+1.0, -1.06) *0-11*	*NA*	V1-20
Village Council	Male: 21 Female: 2	46.70 (+4.61, -4.22) *29-78*	7.43 (+0.78, -0.70) *4-11*	3.77 (+1.45, -1.35) *0.3-12*	VC1-5; VEO1-5; VEC1-7; SVC1-5; VCM1
Manage-ment Official	Male: 17 Female: 7	47.83 (+2.96, -3.17) *30-59*	17.18 (+2.73, -2.86) *7-27*	5.9 (+2.92, -2.53) *0.1-25*	W1-4; DV1-2; D1-7; R1-3; N1; T1-2; S1; NGO1-3; FG1

Social network mapping of the identified forest management structure showed village councils acted as the main connection between villagers and management officials (Figure 2). Connections mapped individuals identified through the snowballing method, and thus not necessarily the whole network engaged in the management of each forest. All villagers named only village council members as their source of forest-related information, except for one villager who also named a Ward Forest Officer. Mapping illustrated the hierarchy of management from the village council to the national level, with connections identified between councils and individuals from Ward, Division and District administrations, NGOs, a local Forest Group, TANAPA and the Selous Game Reserve. All but one of these connections, between the village council and District, were reported to be reciprocal. Mapping illustrated national level connections were made between District and Regional administrations, and the Selous Game Reserve.

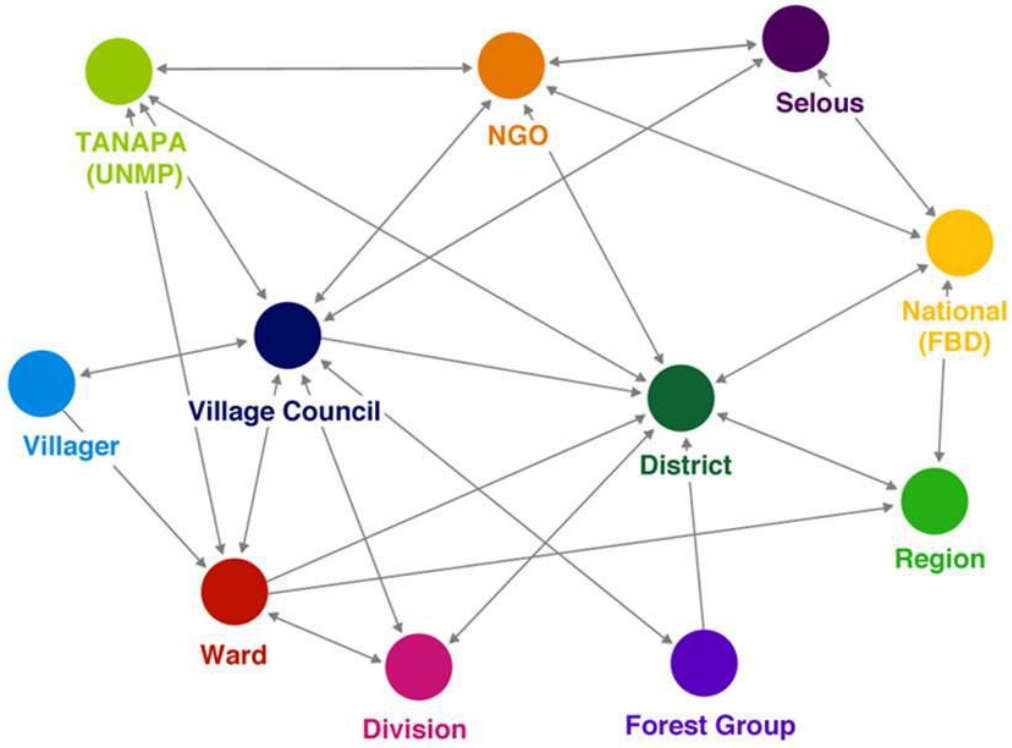


Figure 2. Network map of forest stakeholder connections identified using snowball sampling from the village to national level, grouped by organisation/administrative division. Direction of arrows indicates the stated direction of communications (with double-headed arrows indicating reciprocity). TANAPA = Tanzania National Park Authority, UMNP = Udzungwa Mountains National Park, FBD = Forestry and Beekeeping Division of the Tanzanian Ministry of Natural Resources and Tourism, NGO = Non-Governmental Organisation.

Perceived Challenges for Forest Protection

Challenges for achieving forest protection were identified by 95.5% of interview respondents (n=64). Three overarching themes of challenges emerged during analysis; (1) Education, (2) Governance, and (3) Forest Dependency, that each broadly defined the social, political and economic issues that permeated the discourse. Low levels of education, including awareness for the importance of protection and poor collaboration, were identified as the biggest perceived challenges for achieving forest protection amongst all stakeholders (73.1%). This was followed closely by issues relating to governance, with 67.1% of all respondents identifying issues such as funding shortage and inefficient leadership as limiting protection efficacy. More than half of all respondents also perceived a lack of alternatives available to alleviate local forest dependency as an important challenge facing forest protection (58.2%). Villagers perceived each theme of education, governance and forest dependency to be of equal importance for achieving forest

protection, whereas village councils perceived issues of education to be the biggest challenge, and management officials perceived issues of governance as the biggest challenge for achieving forest protection (Figure 3). However, while differences in reporting of each themed challenge were observed between stakeholder groups, these were not statistically significant ($X^2 = 1.48$, P= 0.83).

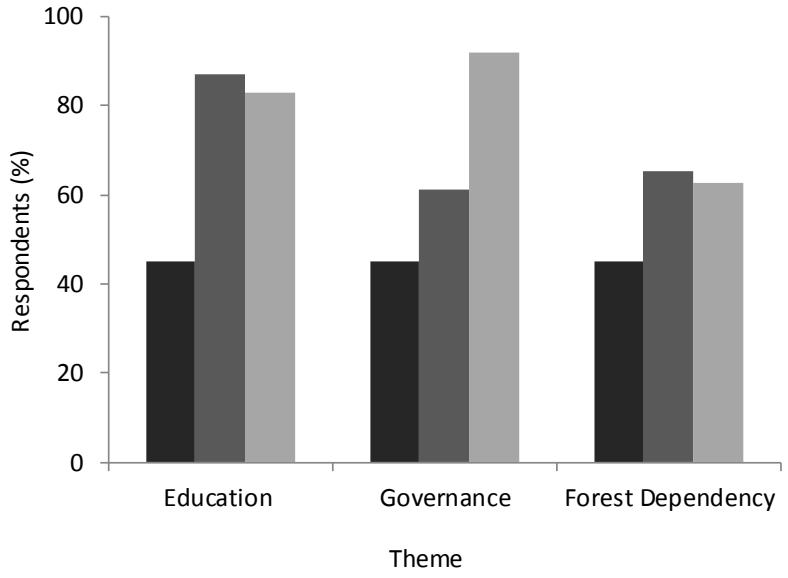


Figure 3. Percentage of respondents citing each theme of challenges for achieving forest protection, by stakeholder group (Black 'Villager'; Grey 'Village Council'; Light grey 'Management Official').

The Challenge of Education for Achieving Forest Protection

Five key issues regarding the challenge of education emerged during analysis, (1) Awareness of forest management structure and benefits, and the need to seek alternatives to forest resources (Awareness); (2) Poor collaboration both within and between forest stakeholders (Collaboration); (3) Low adoption of indicators to monitor management efforts (Indicators); (4) Insufficient training in management and sustainability practices (Training); and (5) High incidences of fires due to poor education (Fire). The perceived importance of these issues varied by stakeholder group (Figure 4).

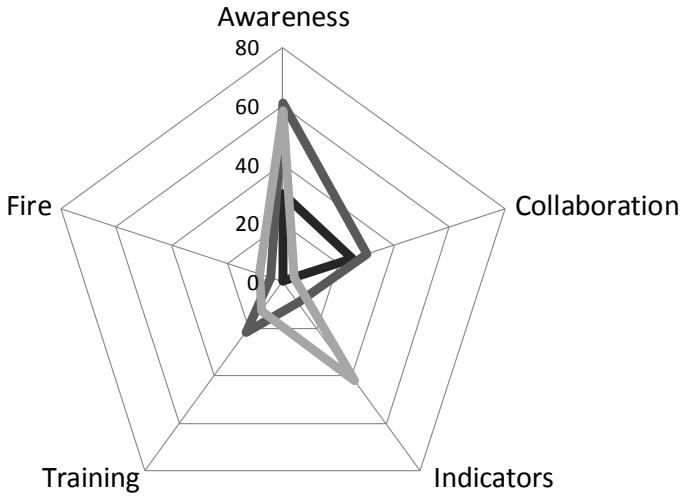


Figure 4. Percentage of respondents citing each issue of education as a challenge for achieving forest protection, by stakeholder group (Black 'Villager'; Grey 'Village Council'; Light grey 'Management Officials'). Note axis scale 0-80%.

Limited Awareness for the Importance of Forest Protection

All stakeholders perceived the need to improve awareness for the importance of forest protection activities as the most important issue of education. However, apportioning accountability for this issue differed by stakeholder group. 58% of management officials stated that the issue was at the local-level, with the need to educate villagers on the long-term tangible benefits and importance of sustainable forest management [D1,3,5,6,7, W4, T1]. Without such education, it was argued, resources would not be managed sustainably at the local level. This was especially relevant for PFM given the perception that, "*Anything that is managed communally is not very good as people will not take safeguarding the resource seriously*" [D5]. The difficulty was reported to lie in changing local perceptions, given a pervading assumption that forest resources were "God-given" and will always be freely available [DV1, R2, T2]. Management officials also placed emphasis on the low adoption rates of fuel-efficient stoves and tree planting within villages, with this attributed to poor local-level awareness for the benefits of these approaches [W4, DV1, D6,7, T2, NGO2]. Only one management official linked this issue of awareness to that of poor collaboration between stakeholders rather than village level issues, stating long-term training and regular follow up from the Government were needed, especially in relation to JFM, but that this was difficult to achieve with too few forest officers [D3].

Villager-level awareness was also cited as the most important issue for education by village council respondents (61%). This poses a challenge for achieving forest protection in that low

villager-awareness was perceived to hinder the adoption of tree planting and stove usage, with the problem attributed to individual awareness for the long-term benefit and relevance of adopting these practices [SVC3,5, VEC4,6, VEO2, VC2,3]. However villagers themselves were in agreement and aware that education was needed in the villages to improve adoption of forest protection methods, such as tree planting activities, however opinion was that this was the responsibility of the relevant management authority to implement [V5,10,11,18]. Thus, while all stakeholders agreed on the need to improve awareness, the solution might not be easily realised given perceived divisions in accountability, as one TANAPA official explained "*Some people established fuel-efficient stoves, but many are still reluctant because they think the park will always provide them with resources.*" [T2].

Two management officials specifically reported issues regarding education on forest fires, stating the high occurrence of damaging fires in the study area and the need to raise awareness for its impact to reduce them [D1, N1]. Only one village council respondent mentioned this issue of fire, perhaps providing insight into the specific challenge of raising awareness and changing perspectives given that, "*Some people here believe that if you start a fire, the further it goes the longer you will live*" [VEC7]. However, the challenge of fire for achieving forest protection was not mentioned by any villager respondent, indeed villagers only perceived issues regarding improved awareness for forest protection methods and collaboration within villages as specific challenges within the education theme.

Poor Collaboration at the Village Level

Village meetings provide the main opportunity for villagers to discuss and raise awareness for village developmental issues with their councils, and act as the platform linking administration between villagers and management officials as illustrated by the management structure network in the study area. Thus, low villager collaboration on forest-related matters was related to poor attendance at these meetings by village council respondents [SVC5, VEC3, VEO1, VC5], and regular attendance by the same people made it difficult to reach those that did not [VC5]. Yet village council respondents also cited a need for improved collaboration between stakeholders, expressing the desire for management officials to attend village meetings and provide education on ways villagers can improve forest protection [VC1,5, VEC6, VEO4]. One Village Executive Officer perceived National Park management to be top-down given that, once rules were in place, villagers had no voice or authority as the forest was a Government resource [VEO4]. At the village level, the issue of collaboration was also highlighted through reporting of low levels of trust and deteriorating social values in villages, with an increasing concern for self rather than community

[V7,8,11,12,20]. Only one management official cited the issue of collaboration, with this being directed towards a lack of cooperation by villagers rather than any issues within their stakeholder group [D3].

Inadequate Training and Use of Indicators

Management officials perceived the provision of adequate training for achieving forest protection as a challenge, linked to a lack of funds available to address this issue [D4, S1, FG1]. Village council respondents reinforced the need for such training specifically for their Environmental Committees, with guidance on land use planning and monitoring and enforcement needed in addition to methods for improving tree planting projects [SVC4, VEO2,3, VEC3, VC4]. Both TANAPA and WWF were reported to have assisted with such guidance in some villages [VC4,5], however it's absence was noted by those that had not received such support [VEO2]. One Village Executive Officer reported difficulties in implementing management plans to adapt to local conditions, for example, in their village the unaddressed problem of water shortage hampered efforts of tree nurseries to maintain long-term planting efforts [VEO3].

The need to collect data to monitor progress in forest protection over time was reported by nearly half of all management officials (42%), with consensus that such indicators could be used to highlight areas of weakness and act as a motivational tool for forest management [W3, DV2, D1,2,3,5, R1,3, S1, N1]. However, all of these respondents reported no such indicators were used to monitor forest management progress, with monitoring taking place through observation alone without the use of standardised measurements. WWF were reported to have provided training in the use of indicators in 2006, but lack of funds and manpower within Government divisions meant they had not yet been implemented [N1]. Only two village council respondents reported the challenge of not having indicators to monitor forest protection progress, both of whom were Environmental Committee leaders from two villages involved in PFM, for which community-monitoring is required [VEC1,3]. This problem of measuring and monitoring by VECs was attributed to there being no form of payment for such.

Governance Challenges for Forest Protection

Seven governance-specific issues of forest protection emerged during analysis, (1) Lack of resources, both material and financial, hindered execution of forest protection (Lack resources); (2) Difficulties arising from conflict within and between stakeholders of forest management (Conflict); (3) Poor leadership influenced forest protection (Inefficient Leadership); (4) Lack of, or

withdrawal, of external support (External Support); (5) Poor communication of management within and between stakeholders (Communication); (6) Political processes of forest protection too long or complicated (Political Process); and (7) Inequitable sharing of forest-related benefits (Benefit sharing). The importance of these perceived issues varied by stakeholder group (Figure 5).

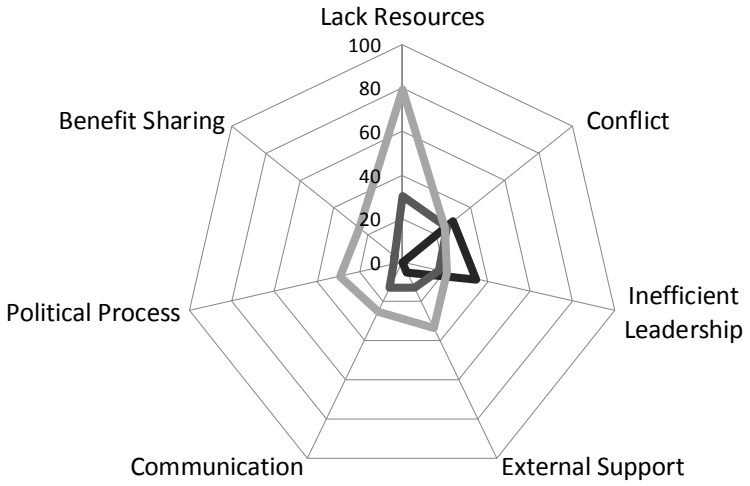


Figure 5. Percentage of respondents citing each issue of governance as a challenge for achieving forest protection, by stakeholder group (Black 'Villager'; Grey 'Village Council'; Light grey 'Management Officials').

Shortage of Resources for Forest Protection

Governance issues were cited by nearly all management officials (92%), indicating these encompass the most important challenges for forest protection to this stakeholder group. 79% of all management officials interviewed stated the main challenge for forest protection was a lack of resources, both in financial and material terms such as transport and equipment, and a shortage of manpower [W2, DV1,2, D1,3,4,5,6,7, R1,2,3, S1, N1, T1,2, NGO2,3, FG1]. This issue was mostly cited by Government officials, with those from all administrative divisions from the Ward to National level reporting such problems. This lack of resources was acknowledged to result in poor enforcement of rules and regulations within Government-managed forests. Villagers were said to be aware of the rules in place regarding access-restrictions, but it was perceived that these were mostly disregarded given villagers were also aware that few, if any, patrols took place [DV1, D3, R2]. Limited resources within TANAPA for National Park protection was raised to a lesser extent. The main issue cited being the difficulty in effectively addressing the needs of the many communities surrounding UMNP, and limited TANAPA resources for this as funds are shared across the country's National Parks [T1]. However, Government lack of resources was perceived

to directly impact TANAPA's protection efforts. Both TANAPA respondents stated the need to monitor forests beyond their border given the level of "destruction" within Government-managed forests, and the potential for this to spread into the National Park [T1,2].

This problem of lack of funds was mentioned by two Government officials as the motivation for initialising PFM across the country. With a deficiency in the Government's ability to protect forests, the responsibility was passed to the local communities [D1, R1]. As one Regional official stated, "*It is the cost implication, every forest has to have forest guards and they should be paid, but if you involve local communities there is no need for forest guards expect for maybe one forest officer who makes the link between the village and Government. Because these forests are very big you might need more than five forest guards, but by involving local communities you cut the costs – free labour!"* [R1]. However, relaxed enforcement of forest rules and regulations was apparent in two of the PFM villages, with villagers stating little consequence of being caught in the forest, whereas enforcement within the National Park was perceived by some as too strict, in turn creating problems of conflict with allegations of beatings and even killings by TANAPA forest guards [V1,9,12].

Such governance issues challenging forest protection were mostly reported by management officials, however the deficit in resources for implementing forest protection was also perceived as an issue by 30% of village council respondents. Lack of resources was cited as a big challenge for effective village-level forest monitoring across all villages, including those involved in PFM [SVC2, VEC1,4,5, VC2,4,5]. Enforcement of rules within forests under PFM was a challenge for environmental committees as they did not have the right equipment for patrols, and were not able to deter poachers carrying weapons [VEC5,4]. Effective enforcement was not the only consequence of this challenge, with the perception that lack of funds for 'front-line' forest officers within villages leads to distrust and thus potentially corruption in the long-term [VEC4].

Dependence on External Support

At the Management level the problem of limited resources was linked to that of external support, as "*Most of the forest programs are funded by donors, so that is a challenge in terms of sustainability"* [NGO2]. Limited Government funds coupled with the loss of external support has led to difficulty in enforcing management, particularly supporting PFM processes in the long-term given the otherwise reliance on voluntary enforcement by villagers [D2,3,7, R1, T1,2, NGO1,2]. The process of formally establishing PFM was reported to be very long, creating issues in its implementation given donor-led projects are relatively short and management plans for long-term viability are rarely put in place [DV1, D2,5, R1,2, N1, NGO2]. Nevertheless benefits received

from external sources were noted, with assistance from TANAPA and WWF in the form of VEC training, seeds, and tree planting equipment [SVC4, VEC3,7]. However, all of these respondents stated that once this external support was withdrawn, local efforts to maintain such projects were halted.

Ineffective Leadership at the Local Level

Management officials also highlighted inadequacies in leadership at both the local and management level, with high-turnover of village leaders blamed for poor implementation of forest management in the long-term [D5, R3], and inefficient enforcement of rules and regulations within Government administrations cited [S1, NGO1]. Problems in the communication of forest management were also identified, with officials stating the channels of command between administrative divisions were confusing and there was a lack in follow-up when issues are raised to higher management [W1, DV2, D5, R2, N1, S1]. Village council members also perceived such issues in communicating with management officials, with complaints that Ward and Division officials were rarely seen in the village and difficult to contact [SVC4, VEC4, VC5]. Related leadership issues were also cited by village council members in three of the five study villages, all in reference to the VEC being inactive and powerless to affect change [VEC1,6, SVC3,4]. Only in one of these three villages was the VEC responsible for forest protection through CBFM, with no village council member citing poor leadership of any other forest management sanctioning authority at the management Level. Villagers also perceived inefficient leadership at the village-level to be an issue for achieving forest protection [V5,6,7,9,12,17,20]. Poor leadership hampered efforts to convey problems to "top management", and removing such leaders was difficult [V5]. In one village this issue created conflict as leaders were accused of stealing village contributions for development projects, and respondents cited a total lack of trust in their leaders but an inability to change them [V5,6,7].

Challenges Arising Through Conflict and Benefit Sharing

Management officials reported conflict associated with ill-feeling arising from restricting local access to forest resources, especially with recent immigrants to the area [D7, R2,3]. Achieving equitable sharing of forest-related benefits was also perceived as a challenge by a quarter of management officials, with few benefits reaching the village level and hampering villager support for forest protection [D4,5, R1,2, T1, NGO2]. Challenges arising through conflict were also cited by 26% of village council respondents. In particular, council respondents cited inequitable distribution of revenue collected through infringements of forest use rules and regulations, with complaints that neighbouring villages benefited more, leading to distrust and dissatisfaction with

management [SV2, VEC2,7]. This issue of benefit sharing was more explicitly cited by one VEC leader who perceived no benefit from forest fines at the village level, with this only going to higher management authorities [VEC6]. Two village council respondents cited conflict arising through the enforcement of forest-access restrictions by TANAPA, with little village-level consultation [SVC4, VEO4]. In one PFM-engaged village, a VEC member described conflict arising though the enforcement of forest borders, with settlers living in designated village forest reserves demanding compensation for re-settlement that cannot be afforded [VEC7]. Such difficulty in enforcing land use plans resulted from the length and cost of the process, stalled by slow approval from the District Government [VEC6]. In agreement with village council members, villagers also perceived the distribution of revenue raised through forest-fines to be unfair across all forest-adjacent villages [V5,6,7,8]. However, villagers didn't perceive any issue of lack of resources for forest management, or cite problems specific to communication or political process. Villagers perceived the biggest challenge of governance to be difficulties with internal village leadership rather than specifics of management for forest protection.

Local Dependency Challenging Forest Protection

Five specific issues regarding forest dependency were perceived by respondents as a challenge of forest protection (1) Unclear or abused land use plan (Land Use); (2) Lack of alternatives to forest resources as an energy source (Energy Source); (3) Specific difficulties with tree planting initiatives (Tree Planting); (4) Pressure exerted by increasing population and non-local individuals (Population Increase); and, (5) the problem of poverty (Poverty). The importance of each of these issues varied by stakeholder group (Figure 6).

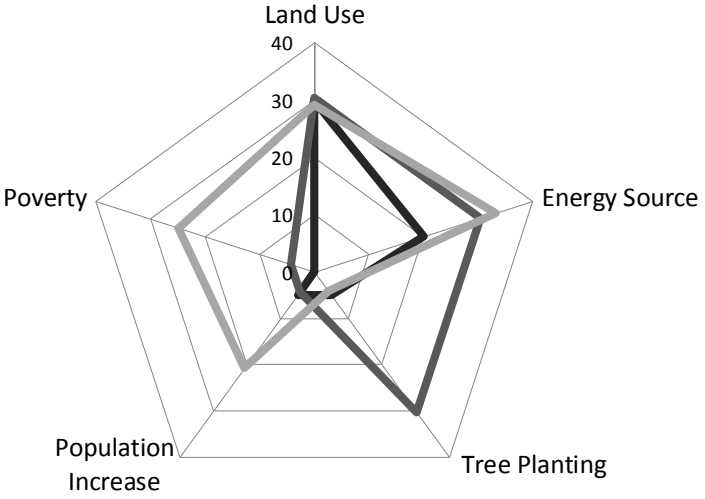


Figure 6. Percentage of respondents citing each issue of forest dependency as a challenge for achieving forest protection, by stakeholder group (Black 'Villager'; Grey 'Village Council'; Light grey 'Management Officials'). Note axis scale 0-40%.

Availability of Energy Alternatives

Management officials perceived local dependency on forest products for energy, in particular firewood and charcoal, and a lack of alternatives to these as the most important issue within this theme [D1,4,5,7, R2, N1, T2, NGO2]. Given this dependency it was argued that enforcement alone cannot work, and incentives through the provision of alternatives to firewood and charcoal are needed to alleviate the associated degradation within forests [D7, N1]. However, electricity and technology for alternative fuels such as biogas are expensive and beyond the means of most villagers [R2], and providing alternatives in rural areas is difficult when charcoal is the main source of domestic energy even in urban areas [NGO2]. Village council members in three of the five villages also recognised the dependence of local villagers on forest products, stating that the need for cooking energy surpasses efforts to enforce forest protection [SVC3, VEC2,6, VEO5, VC2]. Restricting the use of such resources impacts household welfare through reduced cooking fuel availability and thus food consumption [SVC4], as one village council member states, "*We will only be happy if we are allowed to use the resources provided by God"* [VCM1]. A fifth of villagers specifically identified the challenge of sourcing alternatives to forest products for energy, citing difficulty in sustaining their forest product needs given there were not enough trees outside forested areas to do so [V8,10,16,18]. One villager thanked the Government for distributing seedlings to the village, yet was concerned they would not sustain the village for long [V8].

Limitations Due to Land Use and Tree Planting

Both the use of fuel-efficient stoves and the planting of woodlots by households were considered the best options available to reduce local forest dependency by management officials [W4, D7, NGO2]. However these present further challenges in terms of land use, with particular problems of poorly implemented or abused village land use plans cited [DV1, D3,6,7, R3, T2, NGO2]. Tree-planting at the local level was reported to be poorly adopted [W4], with officials aware of local complaints regarding no space for tree planting given the expansion of farming within villages, and no planning of land set aside for forest product cultivation [D6,7, R3]. Land is quoted as being scarce and pressures great, with complications of compensation arising when implementing a land use plan in an already-occupied area [T2]. In addition it was indicated this challenge is augmented by conflicting land-use policies such as 'Kilimo Kwanza' ('Agriculture First'), a national resolve to modernise and commercialise agriculture in Tanzania, with one official perceiving these as opposing each other, making the problem of using land to plant trees for domestic consumption difficult to resolve [NGO2].

Village councillors also recognised the need to plant trees to alleviate dependence on forests and provide an alternative source of energy [SVC2, SVC4, VEO3, VC1,3,4,5], yet all went on to state poor adoption of tree planting activities within their village and the need for further distribution of free seedlings. The biggest limitation was the absence of available land on which to plant enough trees [SVC2,4, VEC2,3, VEO4, VCM1, VC3]. Increase in sugarcane planted within villages without any clear land-use plan was a commonly cited issue [SVC2,4, VEC2, VEO4, VC3], with one complaint of land earmarked for tree planting being sold to sugarcane growers by leaders without village consent [SVC2]. In agreement with other stakeholders, villagers cited the availability of land and alternatives to forest-resources for energy as the most important issues within this theme. Villagers stated they had been told to plant trees by the village council and management officials, however the availability of land to do this was the biggest limitation for them doing so [V5,6,8,9,14,16]. Again, prolific and indiscriminate cultivation of sugarcane was blamed for the limitation on land availability [V5,6,8], with this also linked to the problem of poor leadership due to the sale of land parcels without consent [V5].

Another particular barrier to the success of tree planting projects in the local area was the use of woodlots as a commercial enterprise rather than for domestic use [NGO2, R3], for example "*Nobody used their planted trees for firewood, rather they sold it to local brew makers and brick makers. So the hypothesis that providing villagers with firewood will stop them from entering the park* (UMNP) *was not proved, because people continued to depend on the park to collect their*

firewood once per week…Now the ban (on firewood collection from within UMNP) *is enforced, it is time to re-encourage tree planting activities because now people are in serious need and will respond"* [NGO2]. This observation linking back to the challenge of local awareness, and the difficulty in changing local perceptions that forest resources will always be freely available.

Population Increase and Poverty

A quarter of management officials stated that the challenge of forest-dependency was inextricably linked to the problem of local poverty [D5,7, R2,3, T2, NGO2]. For any substantial shift from forest-dependence, income generating activities are needed [R2]. However, the challenge of alternative income streams was also associated with population increase in the area, especially with an influx of migrants attracted by the region's fertile land [R3]. This increase in numbers not only adds pressure on already limited resources, but on existing local education and training programs for effective forest management, given the perception that degrading activities by immigrants are increasing given lack of local awareness of or disregard for forest protection [T1, NGO1, R3]. However, only one villager perceived this challenge as being linked to population increase, "*The population is increasing therefore people need more farms, and people are not using resources sustainably"* [V12]. Similarly, only one village councillor stated a problem with non-residents, with it being difficult to enforce forest rules and regulations on individuals who do not always live in the village [VC5]. Only one village council respondent specifically linked the challenge of forest-dependency to poverty, with the low economic position of villagers resulting in an ability to use existing alternatives such as electricity [VEO5]. However, no villager linked these issues to the problem of poverty.

Discussion

Comparison of stakeholder perceptions in our study area indicates a disconnect between stakeholder groups, and a division in responsibility for forest protection. Village councils were identified by villagers as the main source of forest-related information, and thus act as the main body of connection between villagers and management officials. However, poor attendance by both villagers and management officials in village meetings suggests a point of disconnect between the stakeholder groups. Such disconnect might explain the low awareness of forest management sanctioning authorities found in the study area, especially for forests under participatory management (Latham et al. Chapter 3). Similar findings have previously been reported in Tanzania, with villagers as a group were considerably less well-informed than other

stakeholders concerning changes in forest policy, particularly in reference to CBFM and JFM (Robinson and Maganga 2009). Low-levels of social cohesion within villages is suggested by low levels of trust, deterioration of social values and ineffective leadership reported by villagers and village councils. This presents important implications for successful forest protection given the association between such village-level characteristics and positive management of the commons (Chhatre and Agrawal 2009; Gutierrez et al. 2011; Persha et al. 2011). VECs in the study villages were viewed as powerless to affect change, even those that were directly responsible for forest management through CBFM, challenging the efficacy of forest protection by community-led processes. Indeed, that villagers themselves did not cite any issues such as training and fires as challenges for forest protection suggesting such management specifics are not perceived to be within their remit or power.

Examination of stakeholder perceptions suggests that the meetings and training approach to management implementation is limited in its effectiveness, with more novel methods of social engagement needed. While villagers recognised training and support had been received, its reach across whole communities was arguably limited. The important role of social learning for collaborative management of natural resources has been identified, requiring joint problem solving, trust and reciprocity of information between management agencies and local resource users, to develop common purpose and collaborative relationships (Schusler et al. 2003; Berkes 2009). Berkes (2009) argues that only through successive rounds of learning and problem solving, can nascent collaborative management relationships become adaptive collaborative management in time. Such an approach is arguably not limited to collaborative management alone, as the process of social learning and engagement is equally relevant in communities impacted by top-down management regimes, given the potential to address socially contested forest access restrictions created by such exclusionary management.

Alleviating Local Forest-Dependency

While the challenge of alleviating forest dependency was the least cited of the three themes identified, the issues raised permeate all cited challenges for forest protection. The biggest limitation cited by all stakeholders was the availability of energy alternatives to alleviate this dependency. Tree planting projects were established and continued in the area by WWF prior to the National Park designation in 1992, however adoption of tree planting activities within villages was low (Bancet 2007). Findings here suggest this low uptake is due to a myriad of socio-economic factors, primarily due to perceived long-term return of tree planting competing with the short-term value of cash or food crops. Findings emphasise the need to design management

plans that complement local contexts, as such capacity-building in local communities is associated with successful outcomes (Brooks et al. 2012). This need was exemplified in one village, where the unaddressed issue of water shortage was perceived to hinder the well-intended tree planting projects in place.

Increasing population growth in the area places increased demand on already pressured land availability, heightening the challenge villagers face in meeting demand for vital fuel resources (Gorenflo and Orland 2013, Latham et al. Chapter 4). All stakeholders were largely in agreement regarding the problem this poses for forest protection, however no suggestions were made to address this. At the village-level concern was for meeting forest resource needs given forest access restrictions, with this need perceived to surpass attempts to protect the forest. At the management level the failure of tree planting projects was placed within villages, with difficulty in changing villagers' perception that forest resources were freely available and 'God given' cited, suggesting efforts to alter resource use practices were futile unless resource access was no longer an option for villagers. Such challenges are linked to those cited regarding education and the need to emphasise the importance of planning for the future within villages. Consensus or compromise in perceptions between village-level and management stakeholders, regarding the resource problems being addressed, will need to be reached before successful management can be achieved (Adams et al. 2003). While issues pertaining to education were perceived to be the biggest challenge for forest protection by all interviewed stakeholders, divisions in the apportioning of responsibility for the problems raised were apparent, signifying a disconnect in accountability between stakeholder groups. All stakeholders agreed that low villager awareness for the importance of and methods for forest protection was an important challenge, however villagers perceived improving education as the responsibility of management whereas management officials did not cite this as their failure.

Monitoring and Enforcement for Effective Forest Protection

Monitoring and enforcement of forest management is vital if its conservation aims are to be achieved (Chhatre and Agrawal 2008), however standardised indicators to monitor progress were not used by any stakeholders. This is especially relevant for PFM forests, for which VECs stated they needed training to apply such measures. This issue is linked to the main challenge cited by Government officials as being one of limited human and financial resources for effective protection. This being evidenced in officials' perceptions that villagers were aware that limited monitoring and enforcement takes place, allowing opportunity for non-compliant resource use. Indeed, low levels of compliant resource use by households harvesting from all three PFM forests

has been found in the study area (Latham et al. Chapter 4). TANAPA officials did not report similar problems, indeed a lack of resources was only cited as being a problem for their community outreach programs given the difficulty in assisting all of the communities that border the National Park. Again, this is reflected by the extraction activities of households utilising the National Park, as those households were largely compliant with the rules and regulations in place (Latham et al. Chapter 4). However, Government shortfalls in forest protection were stated to directly impact TANAPA, by their need to monitor the forest beyond their borders. Thus, challenges for forest protection are not contained within forest boundaries, further highlighting the need for a landscape approach to conservation planning that incorporates the needs and opinions of multiple stakeholders (Robinson et al. 2011, Latham et al. Chapter 4).

Importantly, shortfalls in Government resources were suggested by some officials to be the motivation behind PFM establishment, essentially limiting the need for multiple forest officers at the local level by placing the responsibility for forest management in the hands of local communities. Thus, implying local people are viewed as an additional labour source for forest protection. However, the shortage of resources is directly linked to failure to effectively monitor and protect forests by Government officials, yet this issue is expected to be remedied by placing responsibility at the village level where the knowledge and resource base is even further limited. The disparity in accountability is heightened, as villagers are perceived to be an auxiliary of, rather than complementary to, efforts to achieve forest protection. Such transfer of accountability to local communities without the necessary institutional reinforcement, such as through social learning and empowerment, increases the burden on local people and their vulnerability (Ribot 2004). Without such mechanisms the cost of monitoring and enforcement only passes to the lowest administrative division, and shortfalls in such management remain unaddressed. Indeed, VECs engaged in PFM indicated a difficulty in enforcing rules and regulations in village forest reserves due to limited funds to do so, with one respondent suggesting this encouraged dissatisfaction and corruption at the village level, as people are expected to monitor voluntarily. Economic modelling has shown that without external funds for enforcement it is very difficult to significantly reduce the number of people extracting resources from PFM forests (Robinson and Lokina 2011). These challenges present important implications for management effectiveness, especially given previous findings that suggest household use of the JFM forest in the study area was on a needs basis, unrestricted by management rules and regulations (Latham et al. Chapter 4). As Robinson and Lokina (2011) note, the question of incentives for villagers to participate in JFM in particular are not adequately addressed by policy makers, as after JFM introduction

villagers are not only expected to no longer utilise the forest but also to incur the costs of protecting it.

Externally Driven, Top-Down Management

As reflected here, Government funds for forest protection in Tanzania are limited, and so most management initiatives at the Government level are driven by donor support. All three PFM villages in the study area were established with the assistance of external agencies. While external support is vital for establishing forest protection, difficulty arises when the lack of long-term management plans hinders the sustainability of management (Hoehn and Thapa 2009). To maintain both social and ecological success in the long term, management interventions must be accompanied by broader packages of prolonged support, to enable communities to develop the skills and means necessary for such outcomes (Huby and Stevenson 2003). Findings here indicate that management plans were hard to maintain once external support was removed, suggesting poor implementation within communities to establish the mechanisms for community-led processes, such as empowerment and accountability, that continue once this support is removed. The challenge noted here that PFM is a long process to implement from initiation to ratification, but externally driven projects often conclude before this process is finalised.

Previous analysis within the villages engaged in PFM in our study area found villagers often identified village councils as responsible for management rather than themselves, implying continued top-down control albeit at the lowest administrative level (Latham et al. Chapter 3). This is in fact also suggested here, with the costs of management placed within village councils rather than through the engagement of the community as a whole. Thus, with resources even more limited at this level, the difficulty lies in achieving success where other stakeholders could not. Again, the issue of educating villagers for the importance of forest protection is important, as only when villagers perceive the direct link between themselves and the common resource will protection through voluntary engagement become effective. In Tanzania, as in many other less developed countries, local Governments lack the financial and human resources needed to effectively protect forest resources (Burgess et al. 2013). Findings here are not intended to criticise the efforts of such bodies, especially given the complexity and resource demands of the task, however they do identify a disconnect between Government and village level. If villagers are to effectively take on the responsibility for the forest, more effort is needed to facilitate that process.

Implications for Forest Protection

Analysis of stakeholder perceptions highlights an important difference between stakeholders, namely the division in accountability for forest protection. At the village level the biggest issue is that of education, raising awareness for the importance of protection and methods to achieve it such as through tree planting, that are perceived to have little short-term rewards. At the managerial level the biggest issue is a lack of human and financial resources to enforce management and provide local training, hence the dependence on external support that is itself limited by the time and labour intensive effort needed to achieve long-lasting social and ecological success. Emerging policies to reduce emissions from deforestation and degradation (REDD+) provide hope for the conservation of forests, as a new source of financial resources to achieve conservation aims. However, there remains concern whether the sizeable resources attracted can fix the governance gaps in forest management (Corbera et al. 2010). It is postulated that community inclusion in REDD+ monitoring will overcome concerns regarding the social implications of such an initiative, with many countries intending to implement REDD+ policies through participatory forest management plans (Danielsen et al. 2010; Larrazabal et al. 2012). Findings here indicate forest resources cannot be effectively managed without suitable analysis of the local context, and communities need to be sufficiently empowered to realise their stake in the resource and manage it accordingly. Finances generated through REDD+ initiatives linked to PFM might sufficiently incentivise such empowerment (Robinson et al. 2013). However, to achieve success, such financial benefits will have to outweigh the opportunity and transaction costs involved in management, and be felt equitably across the community (Meshack et al. 2006; Blomley et al. 2008; Anderson and Mehta 2013). In addition, local resource needs will still need to be met, and it is vital that the processes hindering villagers to meet such needs are addressed if REDD+ policies are to achieve permanence, avoid leakage, and contribute to poverty alleviation (Latham et al. Chapter 4). Emphasis needs to be placed on adopting novel approaches to achieving social cohesion and empowerment within communities, and as such policies need to integrate communities into forest management as part of the solution, and not the problem.

Conclusion

Examination of stakeholder perceptions across multiple levels of forest governance identified disconnect between stakeholder groups, and a division in accountability for forest protection. Other than human and financial resource shortages within Government, management officials mostly cited the challenges for forest protection being at the village level, with limited villager

understanding of and motivation for important forest protection. However, villagers themselves agreed education for such issues was needed, but that this was the responsibility of management. Findings suggest the meetings and training approach to management implementation within villages is limited in its effectiveness, and more novel approaches for social engagement are necessary. Disparity in accountability is amplified when villagers are perceived as an auxiliary of, rather than complimentary to, forest protection. Focus ought to be placed on facilitating villagers to be effectively accountable for forest protection, as empowerment at the local level will aid long-term management success once external support is removed.

Acknowledgements

This study was conceived by J.E.L., who collected and analysed field data and prepared the manuscript. The work was supervised by S.M.S and A.R.M, with thanks to Steve Cinderby at Stockholm Environment Institute, York, for assistance with preparation of methods and data handling. Research was carried out with funding from the Economic and Social Research Council (ESRC) with the permission of the Tanzania Commission for Science and Technology (COSTECH permit number 2011-60-NA-2010-205), with ethical approval from the University of York Environment Department Ethics Committee. Thanks to all village councils and villagers for allowing research to be conducted within all five villages, and to all management officials that took part in interviews. For research assistance in the field, translation and transcription thanks to Mohamed A. Kambi. Thanks also to Nizar Kilale for assistance with transcribing. Thanks also to assistants in each village, Ladislaus Mkatihela, Shafii Rashidi, Katenga Henry, Joseph Damiani Nyambi and Hassan Pamuhi. Thank you to Phil Platts for assistance with cartography and the Udzungwa Forest Project for logistical support in the field.

References

Adams, W.M., Brockington, D., Dyson, J., Vira, B., 2002. Analytical framework for dialogue on common pool resource management, In Common Pool Resource Policy Paper 1.

Adams, W.M., Brockington, D., Dyson, J., Vira, B., 2003. Managing tragedies: understanding conflict over common pool resources. Science 302, 1915-1916.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: the role of community in natural resource conservation. World Development 27, 629-649.

Anderson, J., Mehta, S., 2013. A Global Assessment of Community Based Natural Resource Management: Addressing the Critical Challenges of the Rural Sector, In Report prepared by the International Resources Group (IRG) for the United States Agency for International Development (USAID). Washington, DC.

Bancet, A., 2007. Questioning livelihoods, ideologies & practices of environmentalism in Africa through an ethnographical comparative survey. Study case of the adjacent populations of the Udzungwa Mountains National Park in Tanzania, In Paper for presentation at the Workshop on: How Does Environmental Governance Affect the Poor? Global and Local Forces Shaping Poverty Alleviation in Africa. Oxford University Centre for the Environment, 25th January.

Berkes, F., 2004. Rethinking community-based conservation. Conservation Biology 18, 621-630.

Berkes, F., 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. Journal of Environmental Management 90, 1692-1702.

Blomley, T., Iddi, S., 2009. Participatory Forest Management in Tanzania: 1993 - 2009. Lessons Learned and Experiences To Date., Ministry of Natural Resources and Tourism, Forestry and Beekeeping. Dar es Salaam.

Blomley, T., Lukumbuzya, K., Brodning, G., 2011. Participatory Forest Management and REDD+ in Tanzania. World Bank. Washington DC.

Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N., 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. Oryx 42, 380-391.

Blomley, T., Ramadhani, H., 2006. Going to scale with participatory forest management: early lessons from Tanzania. International Forestry Review 8, 93-100.

Brooks, J.S., Waylen, K.A., Mulder, M.B., 2012. How national context, project design, and local community characteristics influence success in community-based conservation projects. Proceedings of the National Academy of Sciences of the United States of America 109, 21265-21270.

Brown, K., 2003. Three challenges for a real people-centred conservation. Global Ecology and Biogeography 12, 89-92.

Bryman, A., 2012. Social research methods. 4th edition. Oxford University Press, Oxford, United Kingdom.

Burgess, N.D., Malugu, I., Kinyau, N., Sumbi, P., Kijazi, A., Komba, R., Harrison, P., Lazier, J., Williams, A., Mbwambo, Z., 2013. How are coastal forests being protected? The coastal forest reserve network and its management., In The Arc Journal. Issue No. 28. Tanzania Forest Conservation Group (www.tfcg.org).

Cairns, R., Sallu, S.M., Goodman, S., 2013. Questioning calls to consensus in conservation: a Q study of conservation discourses on GalÃ¡pagos. Environmental Conservation, 1-14.

Chhatre, A., Agrawal, A., 2008. Forest commons and local enforcement. Proceedings of the National Academy of Sciences 105, 13286-13291.

Chhatre, A., Agrawal, A., 2009. Trade-offs and synergies between carbon storage and livelihood benefits from forest commons. Proceedings of the National Academy of Sciences 106, 17667.

Cinner, J.E., Pollnac, R.B., 2004. Poverty, perceptions and planning: why socioeconomics matter in the management of Mexican reefs. Ocean & Coastal Management 47, 479-493.

Corbera, E., Estrada, M., Brown, K., 2010. Reducing greenhouse gas emissions from deforestation and forest degradation in developing countries: revisiting the assumptions. Climatic Change 100, 355-388.

Danielsen, F., Skutsch, M., Burgess, N.D., Jensen, P.M., Andrianandrasana, H., Karky, B., Lewis, R., Lovett, J.C., Massao, J., Ngaga, Y., Phartiyal, P., Poulsen, M.K., Singh, S.P., Solis, S., Sørensen, M., Tewari, A., Young, R., Zahabu, E., 2010. At the heart of REDD+: a role for local people in monitoring forests? Conservation Letters 4, 158-167.

FAO, 2010. Global Forests Resources Assessment 2010, In Food and Agricultural Organisation of the United Nations. Rome, Italy.

Gelcich, S., Edwards-Jones, G., Kaiser, M.J., 2005. Importance of Attitudinal Differences among Artisanal Fishers toward Co-Management and Conservation of Marine Resources. Conservation Biology 19, 865-875.

Goodman, L.A., 1961. Snowball sampling. The annals of mathematical statistics 32, 148-170.

Gorenflo, L.J., Orland, B., 2013. Human Resource Demand and Biodiversity Conservation at Udzungwa Mountains National Park, Tanzania: Challenges and Opportunities through Community Design, In Proceedings of the Ninth TAWIRI Scientific Conference, 4th-6th December 2013, Tanzania.

Gutierrez, N.L., Hilborn, R., Defeo, O., 2011. Leadership, social capital and incentives promote successful fisheries. Nature 470, 386-389.

Hoehn, S., Thapa, B., 2009. Attitudes and perceptions of indigenous fishermen towards marine resource management in Kuna Yala, Panama. International Journal of Sustainable Development & World Ecology 16, 427-437.

Huby, M., Stevenson, S., 2003. Meeting need and achieving sustainability in water project interventions. Progress in Development Studies 3, 196-209.

Kellert, S.R., Mehta, J.N., Ebbin, S.A., Lichtenfeld, L.L., 2000. Community Natural Resource Management: Promise, Rhetoric, and Reality. Society & Natural Resources 13, 705-715.

Kideghesho, J.R., RÃ¸skaft, E., Kaltenborn, B.P., 2007. Factors influencing conservation attitudes of local people in Western Serengeti, Tanzania. Biodiversity and Conservation 16, 2213-2230.

Larrazabal, A., McCall, M.K., Mwampamba, T.H., Skutsch, M., 2012. The role of community carbon monitoring for REDD+: a review of experiences. Current Opinion in Environmental Sustainability 4, 707-716.

Larson, A.M., Ribot, J.C., 2007. The poverty of forestry policy: double standards on an uneven playing field. Sustainability Science 2, 189-204.

Larson, A.M., Soto, F., 2008. Decentralization of natural resource governance regimes. Annual Review of Environment and Resources 33, 213-239.

Marshall, A.R., 2008. Ecological Report on Magombera Forest. WWF Tanzania.

McClanahan, T.R., Cinner, J., Kamukuru, A.T., Abunge, C., Ndagala, J., 2009. Management preferences, perceived benefits and conflicts among resource users and managers in the Mafia Island Marine Park, Tanzania. Environmental Conservation 35, 340-350.

Meshack, C.K., Ahdikari, B., Doggart, N., Lovett, J.C., 2006. Transaction costs of community-based forest management: empirical evidence from Tanzania. African Journal of Ecology 44, 468-477.

Milledge, S.A.H., Gelvas, I.K., Ahrends, A., 2007. Forestry, governance and national development: lessons learned from a logging boom in southern Tanzania, In TRAFFIC East/Southern Africa.

Mwangi, E., Wardell, A., 2012. Multi-level governance of forest resources (Editorial to the special feature). International Journal of the Commons 6, 79-103.

Ostrom, E., 2003. How types of goods and property rights jointly affect collective action. Journal of Theoretical Politics 15, 239-270.

Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B., Policansky, D., 1999. Revisiting the commons: local lessons, global challenges. Science 284, 278.

Persha, L., Agrawal, A., Chhatre, A., 2011. Social and Ecological Synergy: Local Rulemaking, Forest Livelihoods, and Biodiversity Conservation. Science 331, 1606-1608.

Platts, P.J., Burgess, N.D., Gereau, R.E., Lovett, J.C., Marshall, A.R., McClean, C.J., Pellikka, P.K.E., Swetnam, R.D., Marchant, R.O.B., 2011. Delimiting tropical mountain ecoregions for conservation. Environmental Conservation 38, 312-324.

QSR International Pty Ltd, 2012. NVivo qualitative data analysis software. Version 10.

Rantala, S., 2012. Knowledge and brokerage in REDD+ policy making: A Policy Networks Analysis of the case of Tanzania., In Sustainability Science Program Working Paper No. 2012-13. Sustainability Science Program, Kennedy School of Government, Harvard University, Cambridge, MA, USA, and Center for International Forestry Research (CIFOR), Bogor, Indonesia.

Redford, K.H., Sanderson, S.E., 2000. Extracting humans from nature. Conservation Biology 14, 1362-1364.

Ribot, J.C., 2004. Waiting for democracy. The politics of choice in natural resource decentralization. World Resources Institute Washington, DC.

Ribot, J.C., Lund, J.F., Treue, T., 2010. Democratic decentralization in sub-Saharan Africa: its contribution to forest management, livelihoods, and enfranchisement. Environmental Conservation 37, 35-44.

Robinson, E.J.Z., Albers, H.J., Meshack, C., Lokina, R.B., 2013. Implementing REDD through Community-Based Forest Management: Lessons from Tanzania. Natural Resources Forum 37 141–152.

Robinson, E.J.Z., Albers, H.J., Williams, J.C., 2011. Sizing reserves within a landscape: The roles of villagers reactions and the ecological-socioeconomic setting. Land economics 87, 233-249.

Robinson, E.J.Z., Lokina, R.B., 2011. Efficiency, enforcement and revenue tradeoffs in participatory forest management: an example from Tanzania. Environment and Development Economics 1, 1-19.

Robinson, E.J.Z., Maganga, F., 2009. The implications of improved communications for participatory forest management in Tanzania. African Journal of Ecology 47, 171-178.

Schreckenberg, K., Luttrell, C., Moss, C., 2006. Participatory forest management: An overview. Overseas Development Institute.

Schusler, T.M., Decker, D.J., Pfeffer, M.J., 2003. Social learning for collaborative natural resource management. Society & Natural Resources 16, 309-326.

Smith, M., Milic-Frayling, N., Shneiderman, B., Mendes Rodrigues, E., Leskovec, J., Dunne, C., 2010. NodeXL: A free and open network overview, discovery and exploration add-in for Excel 2007/2010, http://nodexl.codeplex.com/, from the Social Media Research Foundation http://www.smrfoundation.org.

Strauss, A., Corbin, J., 1990. Basics of qualitative research: Grounded theory procedures and techniques. Sage Publications, Newbury Park, CA.

Tomicevic, J., Shannon, M.A., Milovanovic, M., 2010. Socio-economic impacts on the attitudes towards conservation of natural resources: Case study from Serbia. Forest Policy and Economics 12, 157-162.

UNEP-WCMC, 2010. The World Database on Protected Areas (WDPA). Cambridge, UK: UNEP-WCMC. URL http:/www.wdpa.org.

Vermeulen, S., Sheil, D., 2007. Partnerships for tropical conservation. Oryx 41, 434-440.

Vyamana, V.G., 2009. Participatory forest management in the Eastern Arc Mountains of Tanzania: who benefits? International Forestry Review 11, 239-253.

Wells, M., Brandon, K., 1992. People and parks: linking protected area management with local communities. The World Bank, Washington DC.

WWF, 2006. Mpango wa matumizi bora ya ardhi ya kijiji: Kijiji cha Tundu, wilaya ya Kilosa. Halmashauri ya kijiji cha Tundu.

Xu, J., Ribot, J., 2004. Decentralisation and accountability in forest management: a case from Yunnan, Southwest China. The European Journal of Development Research 16, 153-173.

6 General Discussion

The Udzungwa Mountains National Park

This thesis examined the implementation of different interventions to conserve and manage tropical forests from the community perspective, to provide direction for the sub-national implementation of global policy. In Chapter 2, a critical review of the history of tropical forest conservation and management interventions provided the background to the adopted approach in this thesis. Three repeated failures of interventions were identified: low appreciation by management for the heterogeneity of target communities and dependence on forest resources; low levels of community inclusion and participation in management; and a continued deficit in clearly defined social and economic indicators of intervention success. Given these identified concerns, metrics that can be used to evaluate implementation of tropical forest conservation and management interventions from the community perspective were suggested. Using a case-study approach in Tanzania, these metrics were investigated individually in Chapters 3-5. Chapter 3 measured local awareness of and inclusion in forest management regimes, and identified predictors of this awareness; Chapter 4 investigated the impact of access restrictions on household ability to meet fuelwood needs and potential consequences for leakage and local welfare; and Chapter 5 examined cross-stakeholder perceptions of the main challenges facing forest protection at the sub-national level, identifying disconnect between stakeholders and division in accountability for forest protection. The following discussion synthesises key findings of these chapters in light of the three barriers to intervention success, outlined in Chapter 2. I begin by addressing each in turn, I then make recommendations for future research, and I conclude by discussing the implications for forest conservation and management in Tanzania and for future REDD+ policies.

Community Heterogeneity and Dependence on Forest Resources

The need for forest management implementation to account for heterogeneity in communities was confirmed in Chapter 3, given the variation in regime awareness observed in the study area. However, this heterogeneity could not be explained in a predictable way, given no household characteristics, except for distance to the forest, were found to significantly influence this variation. In fact, variation in awareness was best explained by the management regime itself, with findings in particular suggesting poor implementation of JFM in the area. If identification of particular household socio-economic predictors of awareness had been possible, recommendations for the targeted communication of forest management regimes within communities could have been made. As such, it was suggested that the communication of forest management regimes needs to be conducted in a transparent and uniform manner across whole

communities, to ensure clear and consistent regime awareness at the local level. Such awareness-raising across communities is important if the aims of forest conservation and management are to be achieved, given previously documented evidence for the positive association between regime awareness and compliance (Nkonya et al. 2008). Findings are also important for the ability of management regimes such as PFM to meet stated social and ecological aims, given existing concerns for inequitable benefit transfer in PFM (Shackleton et al. 2002; Vyamana 2009; Kumar 2002). Addressing this problem is undoubtedly extremely complex, yet it depends on ensuring transparent and downwardly accountable community institutions in PFM implementation (Anderson and Mehta 2013). This would suggest that differences in management regime awareness within a community might result in equivalent differences in benefits received. Both Chapters 3 and 5 indicate low levels of transparency and downward accountability in our PFM case studies, thus reducing the effectiveness of these regimes, as indicated by the low levels of compliance observed in Chapter 4.

Heterogeneity in forest utilisation was also found in our study area, with household size and wealth found to predict perceived need for, and consumption of, firewood (Chapter 4). In this chapter the importance of forest management planning to account for local forest dependence and resource needs was identified, given concerns for leakage and welfare impacts in the area. Such findings reinforce the need for forest conservation and management interventions to adopt a landscape approach in planning, as highlighted by Robinson et al. (2011). However, findings also suggest management must also account for variation of resource needs within a community if compensation is to be awarded or alternatives provided. Examination of NTFP use has previously found such associations between household socio-economic characteristics, such as wealth, and forest product dependence (de Merode et al. 2004; Adhikari et al. 2004). Again the potential for inequitable benefit transfer is identified, if resource-poor households do not have access to enough alternatives to meet their needs. Recognition by National Park management for local dependence was evidenced by the establishment and continuation of tree planting projects in the area, however, accountability for the poor adoption of these projects was divided (Chapter 5). Giving increasing land use pressures in the area (Gorenflo and Orland 2013), it is increasingly urgent that resource alternatives be provided. Forest management that continues without such efforts creates high potential for leakage to less-well protected areas, such as the JFM forest or Transition forest in this study area, or significant detriment to local welfare in already impoverished communities.

Community Inclusion and Participation in Forest Conservation and Management

Low levels of participation in the management of the CBFM and JFM forests was observed in the study area (Chapter 3). Findings support previous criticism of participation often being only instrumental in design (Kellert et al. 2000; Vermeulen and Sheil 2007; Larson and Soto 2008), and might explain the low levels of compliance with these regimes observed in Chapter 4. Analysis of stakeholder perceptions in Chapter 5 provided insight into these findings, with disconnect between stakeholders and differences in accountability for forest protection. Such differences are manifest in the perception held by some management officials that villagers are the cause of, rather than the solution to, challenges to achieve forest protection. For example, a worrying disregard for the role of local empowerment through participation in forest management was observed, with participation in fact perceived by management officials as an effective way to plug existing resource shortages within Government. This, coupled with evidence for low levels of participation suggests management continues to be centralised in practice and participation is only in promise, a worrying trend observed elsewhere (Ribot et al. 2006; Benjaminsen and Svarstad 2010). Natural resource decentralisation will only increase the burden on local people if management transfer is made without the necessary financial or institutional support (Ribot 2004). Local people cannot be perceived as mere labour, but rather as stakeholders that can be empowered to manage the resource themselves given the opportunity (Chapter 5).

Awareness for, and compliance with, National Park management was observed in the study area (Chapters 3 & 4), and it is clear that TANAPA have a strong presence in the area through their community outreach programme. While local participation in top-down forest governance structures is not required, lack of community consultation can create socially contested resource constraints (Chapter 5), the impact of which might not just be applicable to the National Park given the potential for leakage (Chapter 4). Enforcement of rules and regulations has been highlighted as necessary if the ecological aims of forest protection are to be achieved (Chhatre and Agrawal 2008; Pelkey et al. 2000). Based on levels of compliance (Chapter 4) and villager awareness (Chapter 3), rules regarding the National Park were best enforced and those for the JFM forest the least, of the forests in the study area. For communities to effectively enforce PFM forests, external funds are needed to finance such protection and incentivise participation (Robinson and Lokina 2011). However, notwithstanding such financial incentive, findings indicate that social incentive must also be provided to directly link communities with their common resource through empowerment and accountable village institutions (Chapter 5).

Evidence for improved forest condition with PFM exists in Tanzania, (Blomley and Ramadhani 2006; Blomley et al. 2008; Blomley and Iddi 2009), and although the impact on livelihoods remains less well understood (Vyamana 2009), the approach is generally thought of as successful in the country. However, the case may be made that evidence for success may be based on example areas of high external support and research interest. Limited socio-economic investigations have been made in the villages used in this case study, with most research focus in the area ecologically-related given the high biodiversity value of the Eastern Arc Mountains. Given the importance of external support in the area (Chapter 5), it might be argued that the villages engaged in PFM here are an example of lower external support and research interest, and lower performance. However, to arrive at such a conclusion will require further analysis and comparison of PFM sites across the country.

Socio-economic Indicators of Intervention Success

As summarised here, examination tropical forest conservation and management interventions in this case study reflect a continuation of the repeated failings highlighted in Chapter 2. While the findings of this thesis cannot be directly attributed to management impact on forest condition or local livelihoods, the metrics identified here can be used to indicate management implementation success at the local level. This is especially true if such measures are adopted across a broader spatial and temporal scale. For example, scaling up the approach to include more villages adjacent to forests under the same management regime will allow for greater variation in household socio-economic characteristics by regime. Given this, heterogeneity in community awareness can be more easily identified, and used to improve management implementation through targeted communication. Measuring household firewood sufficiency is also a useful tool in identifying the potential for leakage and welfare impacts within a landscape, and if measurements are continued over time, the impact of access restrictions can be directly attributed to household welfare. This measure also provides a potentially useful metric of regime compliance, as a lack of management constraint is indicated if households are able to meet their resource needs within protected forests. As discussed in this thesis, analysing these measures at the local level can be used to indicate principles of good governance such as transparency, inclusion and accountability. While these measures do not indicate socio-economic outcomes of management, they do indicate the principles that have been identified as key to achieving effective forest conservation and management (Skutsch and McCall 2010; Corbera and Schroeder 2011; Kanowski et al. 2011; Barr and Sayer 2012; McDermott et al. 2012).

Reducing human behaviour down to easily measurable components is susceptible to over-simplification. For example, attributing awareness to particular socio-economic characteristics can only be understood and qualified if such analysis is accompanied by detailed qualitative investigations, as indicated in Chapter 5. However, I argue that such identification of indicators is necessary if management impact is to be measured at the local level, as it is only through the identification and repeated measurement of indicators that change in outcome can be observed.

Recommendations for Future Research

As already suggested, scaling up the measurement of forest management regime awareness is recommended to allow for observation of greater heterogeneity in household socio-economic characteristics by regime. This might allow for identification of demographics within a community at which management communication can be more effectively targeted, to ensure consistent regime awareness across households. In addition, ecological measures of forest condition are needed within each study forest, to allow for comparison with management effectiveness as indicated by findings in this thesis. With additional temporal measurements, it can be determined whether effectiveness indicated here is reflected in changes in forest condition over time.

Given the ban on firewood collection in the National Park was imposed during fieldwork, it is if vital and timely to continue analysis of firewood sufficiency in these villages, to measure the impact of increased restrictions on local welfare or leakage to other forests. This is especially relevant for the nearby JFM forest given low levels of rule compliance found in this research, and for the transition forest which continues to be formally unprotected. Given the implications for leakage, and local dependence on firewood as a source of fuel, I suggest priority be given to providing alternatives to forest resources to local communities in the area. Findings suggest greater focus needs to be applied to educating villagers on the importance of such alternatives, and changing current perceptions that forest resources will always be freely available. To do so, novel engagement methods are necessary to empower communities to feel the long term benefits of such approaches. In addition, greater enforcement of rules and regulations is needed, especially in the JFM forest. This could be achieved by strengthening the link between district government and villagers engaged in JFM, however resources to fund monitoring costs at the local level will be needed.

Implications for Tropical Forest Conservation and Management, and REDD+

The results of this thesis further emphasise the need for a landscape approach in the sub-national implementation of tropical forest conservation and management policy (e.g. Robinson et al. 2011). Such an approach is necessary if the benefit of forest protection in one area is negated by displaced resource extraction to elsewhere. History demonstrates that the conservation and management of tropical forests needs to account for the social dimensions of forest-adjacent communities (Chapter 2). Despite protection, resource needs will still need to be met and it is vital that these are considered at the landscape level, especially as the varied governance frameworks of forest management currently prevalent creates potential for multiple actors, with multiple agendas, to be working within such a landscape. Difficulty however arises at determining the limits of such a landscape, especially given the waves of forest degradation observed from Tanzania's largest city Dar es Salaam (Ahrends et al. 2010).

These concerns are particularly pertinent in light of developing REDD+ policies, as even if carbon accounting is conducted at the national level, its success will depend on the ability to alter resource user behaviour at sub-national project sites (Hayes and Persha 2010). If the carbon benefits of REDD+ policies are to be meaningful and permanent, leakage will have to be accounted for. The consistent failure of forest management regimes to account for the impact of changes in forest protection and resource access on local welfare will likely continue with REDD+ policies, if they do not resolve these issues of incentives and behaviour change. Changing such behaviour can be costly, depending on the costs of opportunities forgone by communities in supporting forest protection, and so finances generated by REDD+ must exceed these costs on top of the transaction and implementation costs that are inherent with such a complex mechanism. Fisher et al. (2011) recommend that REDD+ policies be implemented alongside measures to alleviate forest dependency, such as through the use of fuel-efficient stoves and raising agricultural yields, and estimate that REDD+ policies remain feasible despite the costs such measures incur. Indeed, it is vital that such measures are incorporated into developing REDD+ policies, however there is growing concern that such vital inclusion of local social dynamics and resource needs is being overlooked, given the carbon-based focus of forest projects (Leggett and Lovell 2012). Despite repeated evidence of trade-offs in forest management and difficulty in achieving developmental and conservation success, the assumption remains that the financial incentive provided by REDD+ will address previous failings in intervention success.

The findings of this thesis are particularly relevant for REDD+ policy given current discussions surrounding REDD+ implementation are based on existing decentralisation reforms (Irawan and

Tacconi 2009; Hayes and Persha 2010; Phelps et al. 2010; Larrazabal et al. 2012). Low levels of participation, as indicated in the study area, are of concern for the social safeguards of any payment-based policy, given the potential for inequitable benefit sharing with disproportionate awareness of, and participation in, management amongst communities. Findings here indicate forest resources cannot be effectively managed without suitable analysis of the local context, and communities need to be sufficiently empowered to realise their stake in the resource and manage it accordingly. Finances generated through REDD+ initiatives linked to PFM might sufficiently incentivise such empowerment (Robinson et al. 2013). However, to achieve success, such financial benefits will have to outweigh the opportunity and transaction costs involved in management, and be felt equitably across the community (Meshack et al. 2006; Blomley et al. 2008; Anderson and Mehta 2013). In addition, local resource needs will still need to be met, and it is vital that the processes hindering villagers to meet such needs are addressed if REDD+ policies are to achieve permanence, avoid leakage, and contribute to poverty alleviation (Chapter 4).

Emphasis needs to be placed on adopting novel approaches to achieving social cohesion and empowerment within communities, and as such policies need to integrate communities into forest management as part of the solution, and not the problem. Greater consideration for the concept of 'community' needs to be afforded (Agrawal and Gibson 1999), as it is much easier to integrate community conservation into discourse, whether through national policy or donor-led projects, than it is to achieve in practice. In such cases, decentralisation is only in promise and recentralisation the norm (Ribot et al. 2006; Benjaminsen and Svarstad 2010). This thesis has presented the complexities of effective forest management decentralisation, however growing evidence for the conditions under which participation has been shown to work offers hope. If policies seriously address problems of weak institutions, low transparency, accountability and participation the multiple benefits of forest conservation and management can be realised. Future policies to conserve and manage tropical forests must support such principles of good governance otherwise current failures, as outlined here, will only be exacerbated.

Conclusion

This thesis aimed to evaluate global policies to conserve and manage tropical forests from the local socio-economic perspective, to inform future implementation of policies such as REDD+. By adopting novel approaches to evaluate management implementation at the local level, this thesis has contributed to understanding of the local processes that might influence management success. Strategic questioning at the local community level, as determined in this thesis, can be a

useful tool to identify principles of good forest governance. By scaling up such an approach, it is suggested that these measures can be used to identify specific heterogeneity within communities, to achieve more targeted management planning. Continuing such analyses on a temporal scale can allow management and conservation practitioners to realise improvements in implementation over time. Strategies to conserve and manage tropical forests must account for the perspectives and needs of forest-adjacent communities if the multiple ecological, social and economic benefits are to be realised. It is hoped the information presented in this thesis might therefore prove useful for tropical forest management and conservation strategies, given suggested measures of evaluating implementation success. This thesis provides the first step in determining what works where, for whom, and why, as opposed to focussing on what the 'silver bullet' for tropical forest conservation and management might be.

References

Adhikari, B., Di Falco, S., Lovett, J.C., 2004. Household characteristics and forest dependency: evidence from common property forest management in Nepal. Ecological Economics 48, 245-257.

Agrawal, A., Gibson, C.C., 1999. Enchantment and disenchantment: the role of community in natural resource conservation. World Development 27, 629-649.

Ahrends, A., Burgess, N.D., Milledge, S.A.H., Bulling, M.T., Fisher, B., Smart, J.C.R., Clarke, G.P., Mhoro, B.E., Lewis, S.L., 2010. Predictable waves of sequential forest degradation and biodiversity loss spreading from an African city. Proceedings of the National Academy of Sciences 107, 14556-14561.

Anderson, J., Mehta, S., 2013. A Global Assessment of Community Based Natural Resource Management: Addressing the Critical Challenges of the Rural Sector, In Report prepared by the International Resources Group (IRG) for the United States Agency for International Development (USAID). Washington, DC.

Barr, C.M., Sayer, J.A., 2012. The political economy of reforestation and forest restoration in Asia-Pacific: Critical issues for REDD+. Biological Conservation 154, 9-19.

Benjaminsen, T.A., Svarstad, H., 2010. The Death of an Elephant: Conservation Discourses Versus Practices in Africa. Forum for Development Studies 37, 385-408.

Blomley, T., Iddi, S., 2009. Participatory Forest Management in Tanzania: 1993 - 2009. Lessons Learned and Experiences To Date., Ministry of Natural Resources and Tourism, Forestry and Beekeeping. Dar es Salaam.

Blomley, T., Pfliegner, K., Isango, J., Zahabu, E., Ahrends, A., Burgess, N., 2008. Seeing the wood for the trees: an assessment of the impact of participatory forest management on forest condition in Tanzania. Oryx 42, 380-391.

Blomley, T., Ramadhani, H., 2006. Going to scale with participatory forest management: early lessons from Tanzania. International Forestry Review 8, 93-100.

Chhatre, A., Agrawal, A., 2008. Forest commons and local enforcement. Proceedings of the National Academy of Sciences 105, 13286-13291.

Corbera, E., Schroeder, H., 2011. Governing and implementing REDD+. Environmental Science & Policy.

de Merode, E., Homewood, K., Cowlishaw, G., 2004. The value of bushmeat and other wild foods to rural households living in extreme poverty in Democratic Republic of Congo. Biological Conservation 118, 573-581.

Fisher, B., Lewis, S.L., Burgess, N.D., Malimbwi, R.E., Munishi, P.K., Swetnam, R.D., Turner, R.K., Willcock, S., Balmford, A., 2011. Implementation and opportunity costs of reducing deforestation and forest degradation in Tanzania. Nature Climate Change 1, 161-164.

Gorenflo, L.J., Orland, B., 2013. Human Resource Demand and Biodiversity Conservation at Udzungwa Mountains National Park, Tanzania: Challenges and Opportunities through

Community Design, In Proceedings of the Ninth TAWIRI Scientific Conference, 4th-6th December 2013, Tanzania.

Hayes, T., Persha, L., 2010. Nesting local forestry initiatives: Revisiting community forest management in a REDD plus world. Forest Policy and Economics 12, 545-553.

Irawan, S., Tacconi, L., 2009. Reducing Emissions from Deforestation and Forest Degradation (REDD) and decentralized forest management. International Forestry Review 11, 427-438.

Kanowski, P.J., McDermott, C.L., Cashore, B.W., 2011. Implementing REDD+: lessons from analysis of forest governance. Environmental Science & Policy 14, 111-117.

Kellert, S.R., Mehta, J.N., Ebbin, S.A., Lichtenfeld, L.L., 2000. Community Natural Resource Management: Promise, Rhetoric, and Reality. Society & Natural Resources 13, 705-715.

Kumar, S., 2002. Does "Participation" in Common Pool Resource Management Help the Poor? A Social Cost-Benefit Analysis of Joint Forest Management in Jharkhand, India. World Development 30, 763-782.

Larrazabal, A., McCall, M.K., Mwampamba, T.H., Skutsch, M., 2012. The role of community carbon monitoring for REDD+: a review of experiences. Current Opinion in Environmental Sustainability 4, 707-716.

Larson, A.M., Soto, F., 2008. Decentralization of natural resource governance regimes. Annual Review of Environment and Resources 33, 213-239.

Leggett, M., Lovell, H., 2012. Community perceptions of REDD+: a case study from Papua New Guinea. Climate Policy 12, 115-134.

McDermott, C.L., Coad, L., Helfgott, A., Schroeder, H., 2012. Operationalizing social safeguards in REDD+: actors, interests and ideas. Environmental Science & Policy 21, 63-72.

Meshack, C.K., Ahdikari, B., Doggart, N., Lovett, J.C., 2006. Transaction costs of community-based forest management: empirical evidence from Tanzania. African Journal of Ecology 44, 468-477.

Nkonya, E., Pender, J., Kato, E., 2008. Who knows, who cares? The determinants of enactment, awareness, and compliance with community Natural Resource Management regulations in Uganda. Environment and Development Economics 13, 79-101.

Pelkey, N.W., Stoner, C.J., Caro, T.M., 2000. Vegetation in Tanzania: assessing long term trends and effects of protection using satellite imagery. Biological Conservation 94, 297-309.

Phelps, J., Webb, E.L., Agrawal, A., 2010. Does REDD+ Threaten to Recentralize Forest Governance? Science 328, 312.

Ribot, J.C., 2004. Waiting for democracy. The politics of choice in natural resource decentralization. World Resources Institute Washington, DC.

Ribot, J.C., Agrawal, A., Larson, A.M., 2006. Recentralizing while decentralizing: how national governments reappropriate forest resources. World Development 34, 1864-1886.

Robinson, E.J.Z., Albers, H.J., Meshack, C., Lokina, R.B., 2013. Implementing REDD through Community-Based Forest Management: Lessons from Tanzania. Natural Resources Forum 37 141–152.

Robinson, E.J.Z., Albers, H.J., Williams, J.C., 2011. Sizing reserves within a landscape: The roles of villagers reactions and the ecological-socioeconomic setting. Land economics 87, 233-249.

Robinson, E.J.Z., Lokina, R.B., 2011. Efficiency, enforcement and revenue tradeoffs in participatory forest management: an example from Tanzania. Environment and Development Economics 1, 1-19.

Shackleton, S., Campbell, B., Wollenberg, E., Edmunds, D., 2002. Devolution and community-based natural resource management: Creating space for local people to participate and benefit? Overseas Development Institute. Natural Resource Perspectives, Number 76. Programme for Land and Agrarian Studies.

Skutsch, M.M., McCall, M.K., 2010. Reassessing REDD: governance, markets and the hype cycle. Climatic Change, 1-8.

Vermeulen, S., Sheil, D., 2007. Partnerships for tropical conservation. Oryx 41, 434-440.

Vyamana, V.G., 2009. Participatory forest management in the Eastern Arc Mountains of Tanzania: who benefits? International Forestry Review 11, 239-253.

Appendices

Appendix I. Village focus group questionnaires

Appendix IA. Village focus group questionnaire – English version

BASIC INFORMATION

Name of village:		
Name of main respondent		
Position of main respondent in village:		
Date and Start Time:		
Name of Interviewer:		
GPS location of village administrative centre:	Longitude: Latitude: Altitude:	
Current season: *(Tick appropriate)*	Wet	Dry

Who is present for the interview?

Name	**Age** *(years)*	**Gender** *(0=male; 1=female)*	**Education** *(number of years completed)*	**Main occupation** *(Code, below)*

Comments: *Please use this space for any interesting observations made before the interview took place*

Tasks for getting the village meeting underway:

- **Explain who is conducting the research and its goals (read from statement provided)**
- **State that we intend to conduct this meeting now to gather information on the village and its dependence on natural resources**
- **Explain that men and women will be split into separate groups and meetings held separately for each, but at the same time.**
- **Explain that if at any point they have an opinion or comment they would like to voice they are free to do so, our questions act as guidelines only (please note any comments/opinions in the comment boxes provided)**
- **Explain the guarantees of anonymity and confidentiality, and our distinctness from any official natural resource organisation**
- **Ask for permission to conduct the interview and to take pictures**

A. Demographics

1.	In what year was the village established?	
2.	How many people currently live in this village?	
3.	How many households are there in this village?	
4.	What is the total land area of the village? *(in hectares if known, otherwise the distance from one end of village to the other in km)* ****Mark village boundaries on map****	
5.	How many people lived in this village 5 years ago?	
6.	How many households were there in this village 5 years ago?	
7.	What are the reasons why people have moved to this village in the last 5 years?	
8.	What are the reasons why people have left the village in the last 5 years?	

9.	How many different groups (ethnic groups/tribes) are living in this village?	

B. Infrastructure

1.	Is there a working health centre in the village? ***Mark on map****	
2.	If **'no'** do people in the village have access to health services in another village or town nearby? ***Mark on map****	
3.	Is there a traditional healer in the village?	
4.	Is there a working primary school in the village? ***Mark on map****	
5.	If **'no'** do people in the village have access to a primary school in another village or town nearby? ***Mark on map****	
6.	Is there a working secondary school in the village? ***Mark on map****	
7.	If **'no'** do people in the village have access to a secondary school in another village or town nearby? ***Mark on map****	
8.	Is there a road within the village that is useable by vehicles all year round? *(not a road inside the village only but one that connects the village to other areas/villages)* ***Mark on map****	
9.	If **'no'** what is the distance in kilometres to the nearest road useable by cars during all seasons?	
10.	What is the distance from the village administrative centre to the nearest market? *(in km, and minutes of walking)* ***Mark on map****	
11.	Is there a railway or other major transport route near/within this	

	village? ***Mark on map****	
12.	Do you have a church and/or mosque in this village? ***Mark on map****	
13.	Does the priest of this church and/or imam of this mosque live in this village? If **not**, where do they live and how often do they visit?	
14.	What is the name of the nearest forest to the village? ***Mark on map****	
15.	Are there any other areas of forest nearby that provide the village with natural resource? ***Mark on map****	
16.	Are there specific grazing areas in this village? ***Mark on map****	
17.	Are there specific areas for crop fields in this village? (Or are shambas scattered around households)? ***Mark on map****	
18.	How do households in this village access water? (e.g. village well, household wells...) ***Mark on map****	
19.	Please rank the relative importance of the various aspects of your livelihood *(Per participant, P1, P2, P3...) rank the different aspects: 1=most important to 7=least important)*	

Aspect of livelihood	***Rank importance***									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Agriculture/Crops										
Livestock										
Income from business/labour										
Water										
Firewood										
Wild food										
Medicine										

Other (specify)										

20.	What makes these aspects so important?	
21.	Does this ranking change in a bad year?	

C. Wages and prices

1.	What was the typical daily wage rate for unskilled agricultural casual adult male/female labour in this village over the last year? *(TSh/day)*		**Male**	**Female**
		Maximum		
		Minimum		
2.	What is the main staple food in the village?			
3.	What were the low and high prices of a kilogram of the main staple food during the last year? *(TSh/kg)* *(Indicate unit used if different from Kilogram)*		**Low**	**High**
4.	What are the low and high sale values of one hectare of good agricultural land in the village? *(land that is not degraded and not too steep, is suitable for common crops and is within 1km of the main road or settlement – TSh/hectare*		**Low**	**High**

D. Perceptions on well-being

1.	In this village, what are the characteristics of a household that has better than average well-being? *List all the codes that apply, not in rank order. Code list below.*	1.
		2.
		3.
		4.
		5.

Codes: definition of wellbeing	
1 = sufficient food to eat	6 = ownership of livestock
2 = good quality house construction material	7 = good health

3 = access to electricity	8 = outside employment
4 = good education	9 = self-sufficiency (no need for outside employment)
5 = ownership of transport items (motorbikes, bikes, cars)	10 = other, specify:

E. Risk

			No	**Yes, a little**	**Yes, a lot**
1.	Has the village faced any of the following crises over the past 12 months? *(Tick as appropriate)*	1. Flood and/or excess rain			
		2. Drought			
		3. Wild fire			
		4. Widespread crop pest/disease and/or animal disease			
		5. Human disease			
		6. Political/civil unrest			
		7. Influx of migrants			
		8. Wildlife predation on livestock			
		9. Conflict over forest resources			
		10. Land conflict within village			
		11. Land conflict with neighbouring village			
		12. Bridge/road washed out			
		13. Harassment by outside authority			
		14. Other, specify:			

F. Forest and land cover/use

1. Fill in the table below and ****mark on the map**** the land categories and ownership in the village (*Ownership categories defined below table)*

Land category	**Total area**	**Ownership *(hectares)***

	(ha)	State	Community	Private	Open access
Forest:					
Natural forest					
Managed forest					
Plantations					
Agricultural land:					
Cropland					
Grazing pasture (natural or planted)					
Agroforestry					
Silvipasture (trees & grazing)					
Fallow					
Other land categories:					
Shrubs					
Grassland					
Residential areas, buildings					
Wetland					
Other, specify:					
Total Land:					

Description of ownership	
State ownership	The formal owner is the state at national or regional level, and there is some degree of rules enforcement.
Community ownership	The formal owner is the community, and there is some degree of rules enforcement.
Private ownership	The formal owner is private entities (individuals or companies), and there is some degree of rules enforcement.
Open access	The formal owner is either the state, community or private entities (and in a few cases no formal owner), and there is no enforcement of rules of access and use.

2. Does the village practice any form of active and deliberate forest management? *(Tick as appropriate and ****mark on map**** areas where management takes place)*

Type of management	No, not at all	Yes, but only a little	Yes, very common
Planting of trees			
Cutting down undesired (competing) trees			
Protecting areas of the forest for natural resources			
Protecting areas of forest for particular environmental services, like water catchment			
Establishing clear use rights for a limited number of people to particular forest products (e.g. honey trees)			
Education about forest management			
Enacted bylaw (e.g. no bush burning in or near forest)			
Mapping/inventory forest resources			
Other, specific:			

G. Forest resource base

			Resource type				
			Fire-wood or charcoal	**Timber or other wood**	**Food from the forest**	**Medicine from the forest**	**Other**
1.	What is the most important product (in each resource type) for the well-being of villagers *(name)*						
2.	How has the availability of this product changed over the past 5 years? (*increased, about the same, decreased)*						
3.	If the availability of this product has **declined**, what are the	**Reason**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**
		1. Reduced forest area due to small-					

	reasons? *(please rank the top 3 reasons, leave the rest blank)*	scale clearing for agriculture					
		2. Reduced forest area due to large-scale projects (plantations, new settlements etc)					
		3. Reduced forest area due to people from outside buying land and restricting access					
		4. Increased collection of product due to villagers collecting more					
		5. Increased use of product due to more people from other villages collecting more					
		6. Restrictions on use by central or state government (e.g. for forest conservation)					
		7. Local restrictions on forest use (e.g. community rules)					
		8. Climatic changes (e.g. drought)					
		9. Other, specify:					
4.	If the availability of this product has	**Reason**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**
		1. Less clearing of forests for					

	increased, what are the reasons? *(please rank the top 3 reasons, leave the rest blank)*	agriculture					
		2. Fewer villagers collecting/collecting less					
		3. Fewer people from other villages collecting/collecting less					
		4. Reduced use from large-scale commercial users/projects					
		5. Changes in management of forests					
		6. Climatic changes, e.g. more rainfall					
		7. Forest clearing that increases supply of product (e.g. firewood)					
		8. Tree planting					
		9. Other, specify:					
5.	What action would be most important to increase the benefits from the product *(please rank the top 3 reasons, leave the rest blank)*	**Action**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**	**Rank 1-3**
		1. Better access to the forest/product (i.e. more use rights to villages)					
		2. Better protection of forest/product (to avoid overuse)					
		3. Better skills and knowledge on how to collect it/use it					
		4. Better access to credit and equipment					
		5. Better access to markets					

		6. Invest in planting trees/forest product					
		7. Develop forest user groups/collective action in harvesting					
		8. Control fire					
		9. Other, specify:					

Comments on rankings – why this choice?	
Question number	**Comments**

H. Forest services

1.	Has the village received any direct benefits (in cash or in kind) related to forest services over the last year?	
2.	If the village has received payment, please indicate the amount the village has received and what for.	
3.	Has the village received any forestry-related external support (technical assistance/maps) from government, donors, NGOs over the last year?	

Comments: *Please use this space for any interesting observations made during and/or after the interview*

Appendix IB. Village focus group questionnaire – Kiswahili version

BASIC INFORMATION

Jina la Kijiji		
Jina la mhusika mkuu wakujibu maswali.		
Nafasi ya mjibu maswali kijijini.		
Tarehe na muda wa kuanza.		
Jina la mfanya usaili.		
Mahali kilipo kituo cha utawala cha kijiji kwenye GPS.	Longitudo: Latitudo: Umbali kutoka usawa wa bahari:	
Msimu wa sasa: (Weka alama ya pata panapohusika)	Mvua:	Ukame:

Who is present for the interview?

Jina:	**Umri:** *(miaka)*	**Jinsia:** *(0=me, 1=ke)*	**Elimu:** *(idadi ya miaka aliyomaliza*)	**Kazi anayofanya:** (ufunguo, chini)

Comments:
Tafadhali tumia nafasi kuandika chochote ulichoona kabla ya kuanza kwa usaili.

Tasks for getting the village meeting underway:

- **Explain nani anafanya utafiti na nini malengo ya utafiti huo (soma kwenye maelezo uliyopewa)**
- **State ueleze kuwa tunakusudia kufanya mkutano sasa kwalengo lakukusanya taarifa kwenye kijiji na utegemezi wao kwenye rasilimali asili.**
- **Explain Ueleze kuwa wanaume na wanawake watagawanywa kwenye makundi tofauti, na watahojiwa tofauti lakini kwa wakati mmoja.**
- **Explain Ueleze kuwa wanaruhusiwa kutoa maoni au mapendekezo muda wowote wakijisikia kufanya hivyo, maswali yetu yapo tu kama muongozo (tafadhali andika maoni/mapendekezo kwenye viboxi ulivyopewa)**

- **Explain Ueleze kuwa tunaweka siri kubwa ya taarifa zao wanazotupa na haitatokea kujulikana sehemu yoyote ile na tupo tofauti kabisa na maafisa wa misitu na rasilimali zingine za asili.**
- **Ask Tunaomba ruhusa ya kufanya mkutano na kuchukua picha.**

A. Demographics

1.	Mwaka gani kijiji kilianzishwa?	
2.	Je, watu wangapi wanaishi kijijini hapa?	
3.	Je, kijiji kina nyumba ngapi?	
4.	Kijiji kina eneo lenye ukubwa gani (kwenye heka kama inajulikana, vinginevyo urefu wa kijiji kutoka nyumba ya kwanza hadi ya mwisho kwa km? **** weka mipaka ya kijiji kwenye ramani ****	
5.	Watu wangapi waliishi kijijini hapa miaka 5 iliyopita?	
6.	Je, kulikuwa na nyumba ngapi miaka 5 iliyopita?	
7.	Nisababu zipi zilisababisha watu kuhama kijiji hiki kwa kipindi cha miaka 5 ilioyopita?	
8.	Nisababu zipi zilisababisha watu kukiacha kijiji hiki kwa kipindi cha miaka 5 iliyopita?	
9.	Je, kuna makundi mangapi ya watu (makabila) yanayoishi kijijini hapa?	

B. Infrastructure

1.	Kuna kituo cha afya kinachofanya kazi kiijijini hapa? *****weka alama kwenye ramani*****	
2.	Kama '**hapana'** wanakijiji wanapata huduma za afya kwenye kijiji cha kingine au mji wa karibu? ***** weka alama kwenye ramani*****	
3.	Kuna mganga wa jadi kijijini hapa?	
4.	Kuna shule ya msingi inayofanya kazi kijijini hapa? ***** weka alama kwenye ramani*****	
5.	Kama '**hapana'** wanakijiji wanapata huduma ya shule ya msingi kwenye kijiji kingine au mji wa karibu? ***** weka alama kwenye ramani*****	
6.	Kuna shule ya sekondari inayofanya kazi kijijini hapa? ***** weka alama kwenye ramani*****	
7.	Kama '**hapana'** wanakijiji wanapata huduma ya sekondari kwenye kijiji kingine au mji wa karibu? ***** weka alama kwenye ramani*****	
8.	Je, Kuna barabara kijijini hapa ambayo inapitika kwa magari katika kipindi chote cha mwaka? (Siyo barabara ya ndani ya kijiji tu, lakini hata zile zinazounganisha kijiji/ mji kimoja hadi kingine)	

	***** weka alama kwenye ramani*****	
9.	Kama **'hapana'**kuna umbali gani kutoka barabara ya karibu inayotumika misimu yote ya mwaka? ***** weka alama kwenye ramani *****	
10.	Kuna umbali gani kutoka kituo cha utawala cha kijiji kwenda kwenye soko la karibu?(kwenye km, na dakika za kutembea) ***** weka alama kwenye ramani *****	
11.	Je, kuna reli au miundombinu mingine mikubwa ya usafirishaji ipitayo ndani ya kijiji au karibu na kijiji? ***** weka alama kwenye ramani *****	
12.	Je, kuna kanisa na/ msikiti kijijini hapa? ***** weka alama kwenye ramani*****	
13.	Je, askofu wa kanisa na/ imamu wa msikiti wanaishi kijijini hapa? Kama **'hapana',** wanaishi wapi na mara ngapi wanatembelea maeneo hayo?	
14.	Nini jina la msitu wa karibu na kijiji ***** weka alama kwenye ramani*****	
15.	Je, kuna maeneo mengine ya misitu ya karibu ambayo yanakipatia kijiji rasilimali za asili? ***** weka alama kwenye ramani*****	
16.	Je, kuna maeneo maalumu ya malisho kijijini hapa? ***** weka alama kwenye ramani *****	
17.	Je, kuna maeneo maalumu ya mashamba kijijini hapa? (Au mashamba yametawanyika kwenye maeneo ya makazi? ***** weka alama kwenye ramani *****	
18.	Je, ni jinsi gani nyumba zinapata maji kijijini hapa? (mfano: visima vya kijiji, visima vya majumbani..) ***** weka alama kwenye ramani *****	

19.	*Tafadhali weka alama ya umuhimu kwenye namna tofauti za kujikimu na maisha (Kwa mshiriki, P1, P2, P3…) Weka alama kwenye namna tofauti: 1=muhimu sana, 7=muhimu kidogo sana*

Vigezo vya kujikimu na maisha	***Weka alama ya umuhimu***									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Kilimo/ mazao.										
Mifugo.										
Kiato kutoka kwenye biashara/ kazi.										
Maji.										
Kuni.										
Chakula cha msituni.										
Madawa										
Mengineyo(eleza)										

20.	Nini kinafanya vigezo hivi kuwa muhimu?	
21.	Je, alama hizi zinabadilika kwenye mwaka mbaya?	

C. Wages and prices

1.	Nini kima cha kila siku cha mshahara kwa mtu mzima ambaye hakusoma ambaye kaajiriwa kwenye kilimo awe me/ke kijijini hapa kwa mwaka uliopita? (Shs/ kwa siku)		**Mwanaume**	**Mwanamke**
		Kiwango cha juu		
		Kiwango cha chini		
2.	Nini chakula kikuu cha kila siku kijijini hapa?			
3.	Nini kilikuwa kiwango cha chini na cha juu cha bei ya chakula kikuu kwa kilo moja kijijini hapa kwa kipindi cha mwaka uliopita? (Shs/ kilo) *(Onesha kitivo kilichotumika kama ni tofauti na kg)*			
			Chini.	Juu.
4.	Nini thamani ya mauzo ya chini na ya juu ya ardhi nzuri ya kilimo ya heka moja kijijini hapa? *(ardhi ambayo haijaharibika na haiko kwenye muinuko , inanayofaa kwa mazao yanayopatikana kijijini hapa na lipo umbali wa km moja toka barabara kuu au maneo ya makazi)-Shs/ heka*		Chini.	Juu.

D. Perceptions on well-being

1.	Katika kijiji hiki, nini tabia ya nyumba yenye maisha bora kuliko wastani wa maisha? *Orodhesha alama zote zinazotumika, siyo kwa oda maalumu. Alama zipo chini*.	1.
		2.
		3.
		4.
		5.

Alama: maana ya kujikimu kimaisha	
1 = Chakula cha kutosha cha kula.	6 = kumiliki mifugo
2 = Matirio bora na mazuri yakujengea nyumba	7 = afya bora
3 = Kupata umeme	8 = kazi za nje
4 = elimu bora	9 = kujiweza mwenyewe (hakuna haja ya kazi za nje)
5 = Umiliki wa kifaa cha usafirishaji (pikipiki, baiskeli, gari)	10 = Nyingine, eleza

E. Risk

			Hapana	**Ndio, kidogo**	**Ndio, sana**
2.	Kijiji kilipatwa na majnga yafuatayo katika kipindi cha miaka 12 iliyopita? *(Weka alama panopofaa)*	15. Mafuriko na /au mvua nyingi sana			
		16. Ukame			
		17. Moto wa msituni			
		18. Wadudu wanaoharibu mazao kuenea kwa kiasi kikubwa/ magonjwa na/ au magonjwa ya wanyama			
		19. Magonjwa ya binadamu			
		20. Vurugu za kisiasa/ au maandamano ya raia			

		kwakuishinikiza serikali.			
		21. Wingi wa wahamiaji			
		22. Wanayama pori kula mifugo ya wanakijiji			
		23. Migogoro kwenye rasilimali za misitu			
		24. Migogoro ya ardhi kijijini			
		25. Migogoro ya ardhi na kijiji cha jirani			
		26. Daraja/ au barabara kuondolewa na maji (mafuriko)			
		27. Kubugudhiwa na mamlaka ya nje			
		28. Mengineyo, eleza.			

F. Forest and land cover/use

3. ***** Weka alama kwenye ramani *****

Kigezo cha ardhi	**Eneo lote(kwa heka)**	***Umiliki (heka)***			
		Hali	**Jamii**	**Binafsi**	***Upatikanaji wa wazi***
Misitu:					
Misitu ya asili					
Misitu inayotawaliwa					
Mashamba makubwa					
Eneo la kilimo:					
Ardhi ya kulima					
Eneo la malisho (la asili au lakupndwa)					
Kilimo na misitu kwa pamoja					
Eneo la miti na malisho					
Eneo lisilo limwa					
Vigezo vingine vya ardhi					
Vichaka					
Ardi yenye nyasi					
Eneo la makazi, majengo					
Ardhi oevu					
Nyenginezo, eleza.					
Ardhi yote kwa ujumla:					

Maelezo ya umiliki	
Umiliki wa serikali	Mmiliki anayetambulika ni Serikali katika ngazi ya kitaifa au kimkoa, na kuna kiasi Fulani cha kutiliwa mkazo kisheria.
Umiliki wa jamii	Mmiliki anayetambulika ni jamii, nakuna kiasi Fulani cha sheria kutiliwa mkazo.
Umiliki wa watu binafsi	Mmiliki anayetambulika ni mtu binafsi(mtu au kampuni), makuna kiasi Fulani cha sheria kutiliwa mkazo.

Maeneo ya wazi	Mmiliki anayetambulika anaweza kuwa serikali, jamii au mt binafsi (na mara chache sana kutokuwa na mmiliki), na hakuna sheria inayomzuia mtu kufika na kutumia eneo hili.

4. Kijiji kinatenda aina yoyote ya utawala wa makusudi wa misitu (Weka alama ya pata kwenye sehemu yoyote unayoona inafaa) ***** Weka alama kwenye ramani *****

Upandaji wa miti	**Hapana, hapana kabisa**	**Ndio, lakini kidogo**	**Ndio, inafanyika sana.**
Ukataji wa miti isiyohusika (miti inayoshindana na miti ya asili)			
Maeneo yanayolindwa ya misitu kwa rasilimali za asili			
Maeneo yanayolindwa ya misitu kwa shughuli maalumu za huduma za mazingira, maeneo ya kuvuta maji			
Kuanzisha haki zilizo sahihii kabisa kwa idadi ya watu maalumu kwenye mazao ya misitu (mafano; asali)			
Elimu kuhusu utawala wa mazingira			
Iliyopitishwa kisheria (mafano: hakuna luchoma moto ndani au nje ya msitu)			
Kuchora ramani au kuhesabu rasilimali za msitu.			
Mengineyo, eleza.			

G. Forest resource base

			Aina ya rasilimali				
			Kuni au mkaa	**Mbao au aina zingine za miti ya mbao**	**Chakula kutoka kwenye misitu.**	**Dawa kutoka kwenye misitu.**	**Mengineyo.**
1.	Nini ni zao la muhimu sana (kwenye kila aina ya rasilimali) kwa maisha ya wanakijiji *(taja)*						
2.	Je, jinsi gani upatikanaji wa mazao haya ulibadilika katika kipindi cha miaka mitano iliyopita? (imeongezeka, ipo sawa, imepungua)						
3.	*Kama upatikanaji wa mazao **umepungua,** nini sababu? (Tafadhali weka nafasi tatu za juu, acha zilizobaki wazi)*	**Sababu**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**
		10. Kupungua kwa misitu ni kunatokana na kukata miti kwa ajili ya kupata sehemu ya kilimo cha jembe la mkono					

		(kidogo)					
		11. Kupungua kwa misitu ni kunatokana na kukata miti kwa miradi kikubwa (mfano: mashamba makubwa, makazi)					
		12. Kupungua kwa misitu ni kunatokana na watu kutoka nje ya kijiji kununua ardhi na kuzuia watu wasifike eneo hilo.					
		13. Kuongezeka kwa makusanyo ya mazao kutokana na wanakijiji kukusanya zaidi.					
		14. Kuongezeka kwa matumizi ya mazao kutokana na vijiji vya jirani kukusanya zaidi.					
		15. Kukataliwa kisheria na serikali au serikali kuu.(mfano: kwa uhifadhi wa misitu).					
		16. Kukataliwa na kijiji kwa matumizi ya msitu huo (mfano: sheria za					

		kijiji/ jamii)					
		17. Mbadiliko ya tabia nchi (mfano: ukame)					
		18. Mengineyo , eleza.					
4.	Kama upatikanaji wa mazao **umeongezeka** , nini sababu? (Tafadhali taja nafasi tatu za juu, acha zilizobaki wazi.)	**Sababu**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**
		10. Kutokatwa kwa miti (msitu) kwa ajili ya eneo la kilimo.					
		11. Wanakijiji wachache kukusanya/ makusanyo machache.					
		12. Wanakijiji wachache kutoka vijiji vya jirani kukusanaya / makusanyo machache.					
		13. Kupungua kwa matumizi makubwa ya biashara/ miradi.					
		14. Mabadiliko kwenye utawala / uongozi wa misitu.					
		15. Mabadiliko ya tabia nchi (mfano: mvua nyingi)					
		16. Kukatwa kwa miti na kufanya ongezeko la usambazaji wa mazao (mafano: kuni)					
		17. Upandaji miti					
		18. Mengineyo , eleza.					

5.	Hatua gani ni ya muhimu sana kuchukuliwa kuongeza faida kutoka kwenye mazao (Tafadhali, taja sababu tatu, acha wazi nafasi zengine)	**Hatua**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**	**Nafasi 1-3**
		10. Njia bora za kufikia misitu/ mazao (mfano: matumizi ya haki sana kwa kijiji)					
		11. Ulinzi bora wa misitu/ mazao (mfano: kukinga kutokana na matumizi yasiyo na manufaa)					
		12. Ujuzi na elimu bora jinsi ya kukusanya/ kutumia.					
		13. Njia rahisi za kupata vifaa na mikopo.					
		14. Njia rahisi za upatikanaji wa masoko.					
		15. Uwekezaji kwenye upndaji miti/ mazao ya misitu.					
		16. Kuandaa watumiaji wa misitu/ hatua za pamoja kwenye makusanyo.					
		17. Kujikinga na moto					
		18. Mengine, eleza.					

Maoni kwenye nafasi-kwanini chaguo hili?	
Namba ya swali	**Maoni**

H. Forest services

1.	Je, kijiji kimepokea faida yoyote ya moja kwa moja(kwa pesa au kwa namna nyengine) inayohusiana na uhifadhi wa misitu kwakipindi cha mwaka mmoja uliopita?	
2.	Kama kijiji kilipokea malipo, tafadhali taja ni kiasi gani kijiji kilipokea na ilitumikaje/ au ni yanini?	
3.	Je, kijiji kilipokea aina yoyote ya mchango wa nje unaohusiana na misitu (usaidizi wa kiufundi,/ ramani, kutoka serikalini, wahisani, asasi kutoka kipindi cha mwaka mmoja ulipoita.	

Comments: Tafadhali tumia sehemu hii kwa chochote ulichoona kipindi cha na/ au baada ya usaili.

Appendix II. Household Structured Questionnaires

IIA. Wet season household structured questionnaire (English version)

BASIC INFORMATION

Name of village:	
Household code:	
Date and Start Time:	
Name of Interviewer:	
GPS location of household:	Longitude: Latitude: Altitude:
Distance of household from centre of village:	Minutes of walking: Km:
Wet Season	

Who is present for the interview?

*Only the head of the household should answer all questions. Identify this person in the list below with an asterix **

Name of attendee(s)	Relationship to household head	Age (approx)	Sex (M or F)

Tasks for getting the interview underway:

- **Read the following to the respondent:**
  This research is being carried out by Julia Latham from the University of York in the UK for a student project. This research is looking at how people use natural resources and local opinion on the way that forests are managed, and how forests can be managed to suit the needs of local people. Please note that this is an independent student project, we are in no way affiliated with any official organisation in Tanzania and all of your answers and opinions will be kept anonymous. The information you give us will be used to understand how your community uses resources and how management of natural resources can be improved to suit the community's needs. For the project to have maximum benefits for you and your community it is important that the information you provide is accurate. It will not be possible to identify you individually from the information presented in subsequent reports and you will get into any trouble for any information you give.
- **State that we intend to conduct this interview now, and then again in November 2011**
- **Ask for permission to conduct the interview**

A. Household composition

1. Who are the members of this household?

The household is defined as all the people usually living together in this dwelling and sharing expenses.

(Emphasise anonymity; no names will be given in subsequent reports. Do not pressure people for names if they are reluctant, they are not necessary).

	Name of household member	**Relation to household head** *(Code A)*	**Age** *(years)*	**Gender** *(0=male 1=female)*	**Education**		**Main occupation** *(Code B)*
					number of years completed	Form level completed	
1.		1					
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14							

*Codes: **A.** 1= head of household; 2=spouse (legally married or cohabiting); 3=son/daughter; 4=son/daughter in law; 5=grandchild;* 6*=mother/father; 7=mother/father in law; 8=brother or sister; 9=brother/sister in law; 10=uncle/aunt; 11=nephew/niece; 12=step/foster child; 13=other family; 14=not related (e.g. hired help)*

B. *1=farmer; 2=wage employee; 3=self-employed (non-farm); 4=child; 5=student; 6=other (specify)*

****The following questions should be answered by the household head only****

2.	What is the marital status of the household head? *Codes: 1=married and living together; 2=married but spouse working away; 3=widow/widower; 4=divorced; 5=never married; 9=other, specify:*	
3.	Was the household head born in this village? *If **'yes'** go to Q.5. If **'no'** specify village and district born in:*	
4.	If 'no' when did the household head move here and why?	
5.	What tribe/ethnic group does the household head belong to?	
6.	Was the spouse (wife/husband) born in this village? *(yes, no, or no spouse in the household)*	
7.	How many years has the spouse lived in this village? *(if no spouse move to next section)*	

B. Land

1. Please indicate the amount of land (in hectares) that you currently own and have rented in/out

Category		**1. Area** *(ha)*	**2. Ownership** *(code-tenure)*	**Main products grown/harvested in the past 12 months (Max 3)**		
				Rank1	**Rank2**	**Rank3**
Agricultural Land	Fallow					
	Crops					
	Agroforestry					
	Silvipasture (trees & grazing)					
	Pasture (natural or planted)					

Forest land	Natural forest					
	Managed forests					
	Plantations (woodlot)					
Other:	Residential, shrubs, wetland					
Total land owned (sum of above)						
If any of the above land is rented out how much?						
Land rented in (not included in the land above)						

Code-tenure: 1=Own (freehold); 2=Own (leasehold); 3=Rented; 4=Customary; 5=Other (specify)

Explanations:

Crops *include annual and perennial crops*

Agroforestry *is a combination of trees (fruit, timber, etc.) and crops, including home gardens.*

Silvipasture *is the practice of combining forestry and grazing of domesticated animals in a mutually beneficial way.*

2.	How was the major part of your owned land obtained?	
3.	Do you need more land for agriculture/grazing?	
4.	Have you ever tried to get more land for agriculture/grazing?	
5.	Were you successful? Why?	
6.	Have you sold or lost land while you have been living in this area? If yes, Why?	
7.	What was the total number of hectares planted by this household during this wet season?	
8.	What crops are you growing?	
9.	Will you sell these crops or are they only for household consumption?	
10.	Which crops do you sell?	
11.	How much of these crops do you sell	

C. Assets and Savings

1.	How many buildings is your household composed of?	
2.	What is the type of material of (most of) the walls?	
3.	What is the type of material of (most of) the roof?	
4.	How often do you need to replace the materials of (most of) the walls?	
5.	How often do you need to replace the materials of (most of) the roof?	

6. Please indicate the number and value of implements and other large household items that are owned by the household

Item	**Number of units owned**	**Total value in TSh (current sales value of all units, not purchasing price)** ***Tick appropriate***				
		0 – 25,000	**25,000 – 50,000**	**50,000 – 75,000**	**75,000 – 100,000**	**More than 100,000**
Car/truck						
Tractor						
Motorcycle						
Bicycle						
Mobile phone						
TV						
Radio						
Stove for cooking (gas or						
Fuel-efficient stove						
Refrigerator/freezer						
Chainsaw						
Plough						
Shotgun/rifle						
Wooden cart or						
Furniture						
Water pump						
Solar panel						

Others *(list)*						

7. Please give details on your livestock

Type of livestock	**Number owned**	**If you have to sell now what is the average price per individual (TSh)**
Chickens		
Eggs per day		
Goats		
Goat milk (litre) per day		
Cattle		
Milk (litre) per day		
Duck		
Pig		
Sheep		
Geese		

8. Please indicate the proportion of cash and non-cash income from various sources:

We would like to understand the various sources of income, in cash or in kind, and including own production, that your household lives on. What are the main sources of income for this household and please rank their importance.

Rank	**Source of income (please list)**

9.	Does your household have access to savings or credit?	
10.	If you have access to credit, would you be interested to borrow?	
11.	If you could borrow money, how much would you borrow and what would you use it for?	
12.	How much is the average monthly income of all household members including you? *If not per **month** specify if weekly or yearly*	
13.	Have you experienced any high cash expenses during this wet season? *If **'yes'** why?*	
14.	What is the household's source of money for one-off expenses such as marriage, building a house, a funeral, medicinal treatment etc	

D. Food security

1.	How many meals does your household usually have per day on a typical day?	
2.	Have you had problems with satisfying the food needs of the household during this wet season?	
3.	If **yes**, for how many months and why?	
4.	How do you compare the overall financial situation of the household with one year ago?	
5.	What is the source of your food?	

	List main food products and source	

E. Energy use

1.	How many times does your household cook during the day?	
2.	What kind of fuel do you mostly use for cooking *List in rank order*	
3.	Where do you source the fuel(s) you use for cooking?	
4.	How much of this fuel(s) do you use in one month during the wet season?	
5.	What is your source of energy for lighting during the night?	
6.	Are there any alternatives to these fuels? Are they available to you?	
7.	Do you own a fuel-efficient stove?	
8.	If **yes** how did you obtain your fuel-efficient stove?	
9.	Did you have to pay for your fuel efficient stove? *If **yes** how much?*	

F. Water resource

1.	How do you obtain your water for domestic use?	
2.	How do you obtain your water for agricultural use?	

3.	How do you obtain your water for livestock use?	
4.	Has availability of water changed over the past 5 years? *If **'no'** go to next section*	
5.	If **yes** how has it changed?	
6.	How has your household responded to this change?	

G. Forests near your household

1. Please list the names of the forest(s) that are near your household and the distance they are from your household.

Name of forest	Distance from household	
	Km	Minutes walking

2. Do you use these forests for gathering natural resources? If **yes**, please explain which resources you collect. If **no**, please explain why you do not use this forest. *(Descriptive answers only, quantities not needed here)*

Name of forest	**YES** I use this forest to collect the following resources:	**NO** I do not use the forest because:

H. Forest Resources

1. Please indicate any forest-related products your household has collected during this **current wet season**?

Product	How often did members of your household make a trip to collect [*product*] per month?	How far do you have to travel to collect the [*product*]?		On an average trip, how much of the [*product*] did your household collect?	Where does your household collect the [*product*]? ***(What is the name of the forest?)***	On an average trip, how long did it take to collect the [*product*] ? (*minutes*)	During this wet season, which months do your household collect [*product*]	Do you have to pay any transport or labour costs to collect [*product*] How much?
		km	minutes					
Dry Firewood *(bundle)*								
Live firewood *(bundle)*								
Charcoal *(Bag)*								
Wood for charcoal making *(no. of*								

Building poles *(no. of*								
Wood for timber *(no. of*								
Poles for tools *(no. of*								
Medicine herbs *(no. of*								
Wild fruits *(no. of*								
Grasses *(no. of*								
Honey *(Litres)*								
Wild meat *(Kg)*								
Wild vegetable *(no. of bags)*								
Mushrooms *(no. of*								
Rope *(bundle)*								

2. Please indicate how much forest-related product you sold or consumed during the **current wet season**?

Product	How much does your household **sell** of [*unit of product*] per month?	How much does your household **buy** of [*unit of product*] per month?	How much does your household **consume** of [*unit of product*] per month?	How far do you have to travel to BUY/SELL the [*product*]?		Has availability of the [*product*] changed over the years?	What is the trend for requirement of [*product*] by your family over the years?	What is the current price of [*unit of product*]?
				km	mins	***1=declined 2=same 3=increased***	***1=declined 2=same 3=increased***	

Dry Firewood *(bundle)*								
Live firewood *(bundle)*								
Charcoal *(Bag)*								
Wood for charcoal making *(no. of logs)*								
Building poles *(number)*								
Wood for timber *(no. of logs)*								
Poles for tools *(number)*								
Medicine herbs *(handful)*								
Wild fruits *(no. of bags)*								
Grasses *(bundle)*								
Honey *(Litres)*								
Wild meat *(Kg)*								
Wild vegetables *(no. of bags)*								

Mushrooms *(no. of*								
Rope *(bundle)*								

3. Please indicate how much forest-related product your household **needs** during this current wet season.

Product	How much does your household **need** of [*unit of product*] per month?
Dry Firewood *(bundle)*	
Live firewood *(bundle)*	
Charcoal *(Bag)*	
Wood for charcoal making *(no. of logs)*	
Building poles *(number)*	
Wood for timber *(no. of logs)*	
Poles for tools *(number)*	
Medicine herbs *(handful)*	

Wild fruits *(no. of bags)*	
Grasses *(bundle)*	
Honey *(Litres)*	
Wild meat *(Kg)*	
Wild vegetables *(no. of bags)*	
Mushrooms *(no. of bags)*	
Rope *(bundle)*	

4.	If you indicated a decline in any of the above forest products over the years, how has your household responded to this decline in availability?	
5.	Has your household planted any woodlots or trees on farm over the past 10 years? *If 'no' go to Section H.*	

6.	If **'yes'** what are the main purpose(s) of the trees planted? *Please rank the 3 most important responses*	**Purpose**	**Rank 1-3**
		Firewood for domestic use	
		Firewood for sale	
		Fodder for own use	
		Fodder for sale	
		Timber/poles for own use	

I. The nearest forest

1.	What is the name of the nearest natural or managed forest to your household?	

2.	In your opinion how would you describe the condition of this forest? *(Tick one option)*	☐ Very sparse ☐ Somewhat sparse ☐ Normal for this area ☐ Somewhat abundant ☐ Very abundant
3.	Does the forest provide your household with any benefits? *If **'yes'** please describe benefits*	
4.	Is that forest which is nearest to your homestead also the forest from which you get the most benefits from in total? *If **'no'** ask for name of forest*	
5.	Does the forest bring any negative effects to your household? (e.g. crop raiding) *If **'yes'** please describe costs*	
6.	Is this forest managed by anybody/by a group/by an organisation?	
7.	If **'yes'**, who manages the forest?	
8.	Do you know if there are any rules or restrictions on the way people use the forest? *If **'yes'** please describe restrictions*	

	*If **'no'** go to Q15.*	
9.	Who makes such rules about forest use?	
10.	Has anybody in your household taken part in making the rules regarding forest use?	
11.	Do you think such rules regarding forest use are necessary to maintain the forest?	
12.	How would you change the rules on forest use, if you could?	
13.	What happens if you do not follow the rules regarding forest use?	
14.	Do you have to pay a fine if you do not follow the rules regarding forest use? *If **'yes'** who does the fine go to & what do you think the money is used for?*	
15.	Do you know of anybody or any groups that do not follow the rules regarding the use of the forest? **You do not need to name anybody and this information is in strict confidence.** *If **'yes'** describe what that person/group did*	
16.	If you had an issue regarding the forest and/or rules of forest use, who would you talk to?	
17.	Do you think people benefit more from the forest if the village itself were involved in creating rules of forest management?	
18.	Do you know of any village where the villagers are involved in the management of the forest? *If **'yes'** what is the name of this village?*	

J. Any other forest

1.	Previously we asked about the forest nearest to your household, has your household ever benefited from any other forest? *If **'no'** go to next section*	
2.	What is the name of this forest and how far away is it from your home?	Name: Distance minutes: Distance km:
3.	In what way did that forest benefit your household?	
4.	Is that forest managed or owned? *If **'no'** go to Q6.*	
5.	If **yes** who owns or manages the forest?	
6.	How do you think management of any forest should be changed if you could decide?	

K. Local groups and social organisation

1. Are you or is anyone in your household a member of any groups, associations or organisations?

☐ YES ☐ NO

*If **'yes'** fill in the details below. If **'no'** go to Q15.*

Household member *(Use relation to household head*	**Name of Organisation**	**Type of organisation** *(Use code below)*	**Degree of Participation** *(Use code below)*	**Rank order of importance of group to household**

if they don't want to give their name)				

Type of Organisation Code				***Degree of Participation code***	
Farmer's group	1	Natural Resource Committee	12	Leader	1
Cooperative	2	Religious group	13	Very active	2
Trader's association/business group	3	Political group	14	Somewhat active	3
Professional Association	4	Youth group	15	Not active	4
Trade Union	5	Women's group	16		
Credit/finance group	6	Parent's group	17		
Water/Waste group	7	School Committee	18		
Village association	8	Health Committee	19		
Village Council	9	Sports group	20		
Non-Governmental Organisation	10	Other (Specify)	21		
Forest User Group	11				

The following questions relate to the **TOP 3** ranked groups/organisations that are most important to the household only (as ranked in the above table)

		Top 3 organisations		
		1	**2**	**3**
1.	Name of organisation			
2.	Why did you join the organisation?			
3.	Did you have to pay any fees to join the organisation? *If **'yes'** how much?*			
4.	Are there any rules for joining the organisation?			
5.	Overall are the same people members of these groups or is there little overlap?			
6.	Are group members mostly of the same extended family?			
7.	Are members mostly of the same religion?			

8.	Are members mostly of the same gender?			
9.	Do members mostly have the same occupation?			
10.	Are members mostly from the same age group?			
11.	Do members mostly have the same level of education?			
12.	How does the group usually make decisions?			
13.	How effective is the group's leadership?			

14.	Do you think that by belonging to this group you have acquired new skills or learned something valuable?			

The following questions discuss the life in this village:

15.	Do you know everyone that lives in this village?	
16.	Are you happy living here?	
17.	Have you joined together with others in the village to address a common issue in the past year? *If **'no'** go to Q.19*	
18.	If **'yes'** were you successful in resolving the issue?	
19.	Overall, how would you rate the spirit of participation in this village?	☐ Very low ☐ Low ☐ Average ☐

		High ☐ Very high
20.	How much influence do you think people like yourself can have in making this village a better place to live?	☐ A lot ☐ Some ☐ Not very much ☐ None

Please tell me whether in general you agree or disagree with the following statements
(Tick one box per statement)

	Statement	**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**
1.	Most people in this village are honest and can be trusted				
2.	People are always interested only in their own welfare				
3.	Members of this village are more trustworthy than others				
4.	If I have a problem there is always someone to help me				
5.	I pay attention to the opinions of others in the village				
6.	Most people in this village are willing				

	to help if you need it				
7.	This village has prospered in the last 5 years				
8.	I feel accepted as a member of this village				

Checklist for bringing the interview to an end

- **State that you have asked the last question and the interview has come to an end**
- **Remind the respondents that this information will be used for student research and no immediate benefits can be provided**
- **Ask the respondents if they have any questions about the interview or about the research project**
- **Remind the respondents that we will be interviewing them again in November 2011**
- **Remind the respondents of the guarantee of anonymity and confidentiality**
- **Express your thanks to the household for taking part in the research and for sharing their valuable time**

Evaluation by interviewer

1.	How long did the interview take?	
2.	During the interview, did the respondent smile or laugh? *Codes: 1= neither laughed nor smiled (sombre); 2= only smiled; 3=smiled and laughed; 4= laughed openly and frequently.*	
3.	Based on your impression and what you have seen (house, assets, etc.), how well-off do you consider this household to be compared with other households in the village? *Codes: 1=worse-off; 2=about average; 3=better-off*	
4.	How reliable is the information on **forest collection/use** provided by this household? *Codes: 1=poor; 2=reasonably reliable; 3=very reliable*	

5.	If the forest information is not so reliable (code 1 above), do you think the information provided overestimate or underestimate the actual forest use? *Codes: 1=underestimate; 2=overestimate; 3= no systematic over- or underestimation; 4=don't know*	

Comments: *Please use this space for any interesting observations made during and/or after the interview*

IIB. Wet season household structured questionnaire (Kiswahili version)

BASIC INFORMATION

Jina la kijiji:		
Namba ya nyumba:		
Tarehe na muda wa kuanza:		
Jina la mfanya usaili:		
Mahali ipatikanayo kaya kwenye GPS.	Longitudo: Latitudo: Umbali kutoka usawa wa bahari:	
Umbali wa kaya kutoka katikati ya kijiji:	Dakika za kutembea: Km:	
Msimu ulipo: *Weka alama ya pata panapohusika.*	Unyevu nyevu	Kiangazi/pakavu

Nani yupo kwa ajili ya usaili?

*Mkuu wa kaya tu ndiye anayetakiwa kujibu maswali yote. Mtambue mtu huyu kwenye orodha ifuatayo kwa kuweka nyota **

Jina la msaidizi (wasaidizi)	Uhusiano na mkuu wa kaya	Umri (kisia)	Jinsia (ME au KE)

Tasks for getting the interview underway:

- **Read**

Utafiti huu unafanywa na Julia Latham kutoka chuo kikuu cha York, Uingereza kama mradi wa mwanafunzi. Utafiti huu unaangalia ni jinsi gain watu wanatumia rasilimali za asili na maoni ya wanakijiji juu ya utawala/ uongozi wa misitu, na jinsi gani misitu iweze kutawaliwa/ kuongozwa ili kukidhi mahitaji ya wanakijiji. Tafadhali jua kwamba huu ni utafiti wa mwanafunzi unaojitegemea, na kwanamna yoyote ile hatuna uhusiano na mashirika yoyote rasmi ya Tanzania na majibu yenu yote na maoni yatakuwa ni siri kubwa kwetu. Maelezo mtakayotupa yatatuwezesha kujua ni jinsi gani jamii yenu inatumia rasilimali za asili na jinsi gani uongozi wa rasilimali za asili unaweza kuboreshwa ili kukidhi mahitaji ya jamii. Kwa mradi kuwa na faida kubwa kwako na kwa jamii yako ni muhimu sana maelezo unayotoa yawe sahihi. Itakuwa sio rahisi kuwatambua mmoja mmoja kwenye taarifa ambazo zitakuwa zinatoka na hautapatwa na matatizo yoyote kwa maelezo unayotoa.

- **State Tumepanga kufanya usaili huu sasa, na tena baadae mwezi wa kumi na moja, 2011.**
- **Ask Omba ruhusa kufanya usaili.**

A: Jumla ya watu kwenye kaya

2. Nani wanaoishi kwenye kaya hii?

Kaya inatafsiriwa kama watu wote wanaoishi kila siku kwenye nyumba moja na wanaogawana gharama. (Sisitizia usiri; hakuna jina litakalotokea kwenye taarifa yoyote ile. Usiwalazimishe watu kutaja majina yao kama hawataki, sio muhimu sana).

	Jina la mtu anayeishi kwenye kaya.	**Uhusiano na mkuu wa kaya** *(Namba A)*	***Umri*** *(miaka)*	***Jinsia*** *(0=ME 1=KE)*	**Elimu**		**Kazi kubwa anayofanya** *(Namba B)*
					namba ya miaka aliyomaliza	Vidato alivyomaliza	
1.		1					
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14							

Codes: ***A.*** *1=mkuu wa kaya; 2=mchumba (kuoana kisheria au kuishi pamoja); 3=mtoto wa kiume/ wa kike; 4=mtoto wa kiume wa kambo / mtoto wa kike wa kambo; 5=wajukuu;* 6*=mama/baba; 7=mama/baba wa kambo; 8=kaka au dada; 9=shemeji wa kiume au wa kike; 10=mjomba/ shangazi; 11=mpwa wa kiume/ mpwa wa kike; 12=mtoto wa kambo/ wa kulea; 13=familia nyngine; 14=hakuna mahusiano(mf: msaidizi wa ndani)*

B. *1=mkulima; 2=kibarua wa muda; 3=aliyejiajiri mwenyewe (asiye mkulima); 4=mtoto; 5=mwanafunzi; 6=wengineo(elezea).*

****Maswali yafuatayo yanatakiwa yajibiwe na mkuu wa kaya tu ****

2.	Je mkuu wa kaya ameoa? *Codes: 1=ameoa na wanaishi pamoja; 2=ameoa lakini mkewe anafanya kazi sehemu ningine; 3=mjane; 4=ameachika; 5=hajawahi kuoa; 9=mengineyo (elezea):*	
3.	Mkuu wa kaya alizaliwa kijijini hapa? *Kama '**ndio'**nenda Q.5. Kama '**hapana' eleza** kijiji na wilaya alipoaliwa**.***	
4.	Kama 'hapana' lini mkuu wa kaya alikuja hapa na kwanini?	
5.	Ni kabila gani mkuu wa kaya anatokea?	
6.	Je mwanandoa (mke/ mme) amezaliwa kijijini hapa? *(ndio, hapana,au hakuna mwanandoa kwenye kaya).*	
7.	Je, ni miaka mingapi mwanandoa ameishi kiijini hapa? (kama hakuna mwanandoa, nenda kwenye sehemu nyengine).	

B: Ardhi

2. Tafadhali onyesha kiasi cha ardhi (kwa hekari) ambayo kwa sasa unamiliki au umekodi.

Aina		**1. Eneo (hekari)**	**2. Umilikaji** *(namba ya umiliki)*	**Mazao makuu yaliyolimwa/ kuvunwa miezi**		
				Nafasi 1	**Nafasi 2**	**Nafasi 3**
Ardhi ya kulima	Eneo lisililimwa					
	Mazao					
	Kilimo na misitu					
	Miti na malisho					
	Eneo la malisho (laasili au lakupandwa)					
Ardhi ya misitu	Msitu wa asili					
	Msitu unaotawaliwa					
	Mashamba makubwa					
Mengineyo	Makazi, vichaka, ardhi oevu, eneo/ ardhi yenye nyasi nyingi.					
Jumla ya ardhi inayomilikiwa (jumla ya hapo juu)						
Kama kuna ardhi hapo juu imekodishwa ni shilingi ngapi inagharimu						
Ardhi iliyokodishwa (ambayo haikijumuishwa hapo juu)						

1=umiliki (umiliki wa bure); 2=Umiliki (kukodi); 3=Kupanga; 4=Kawaida; 5=Mengineyo (elezea).

Maelezo:

Mazao *ijumuishe ya muda mrefu(mwaka) nay a muda mfupi (miezi kadhaa)*

Kilimo na misitu *ni mchanganyiko wa miti (miti, matunda, n.k) na mazao, ikijumuisha bustani za nyumbani.*

Misitu na Malisho ya wanyama wa nyumbani *ni mchanganyiko wa misitu na wanyama wafugwao nyumbani kwakupeana faida kotekote.*

2.	Ni kivipi sehemu kubwa ya ardhi yako unayomiliki ilipatikana?	
3.	Je, Unahitaji ardhi zaidi kwa kilimo/ malisho ya wanyama?	
4.	Ulishawahi kujaribu kupata ardhi ya ziada kwa kilimo/ malisho ya wanyama?	
5.	Je, Ulifanikiwa? Kwanini?	
6.	Ulishawahi kuuza au kupoteza ardhi wakati ulipokuwa ukiishi katika eneo hili?	
7.	Nini jumla ya hekari zilizopandwa na kaya hii katika msimu huu wa mvua?	

8.	Mazao gani unayopanda?	
9.	Utayauza mazao haya au ni kwaajili tu ya matumizi ya kaya?	
10.	Ni Mazao gani unayouza na kwa shilingi ngapi?	
11.	Ni kiasi gani cha mazao hayo unayauza?	

C. Mali na kuweka.

1.	Je, kaya yako inamajengo mangapi?	
2.	Ni vitu/ matirio gani uliyotumia kujengea ukuta (hasa kwa kiasi kikubwa)?	
3.	Ni vitu/ matirio gani uliyotumia kujengea paa (hasa kwa kiasi kikubwa)?	
4.	Ni mara ngapi unahitaji kufanya ukarabati wa ukuta (hasa kwa kiasi kikubwa)?	
5.	Ni mara ngapi unahitaji kufanya ukarabati wa dari (hasa kwa kiasi kikubwa)?	

9. Tafadhali onyesha idadi na thamani ya vifaa na vitu na vitu vingine vikubwa vinavyomilikiwa na kaya.

Aina ya kifaa/ kitu.	Kiasi cha idadi inayomili kiwa.	***Jumla ya thamani kwa Shilingi. (Thamani ya mauzo ya vitu vyote kwa sasa , sio bei ya kununulia)***				
		0 – 25,000	**25,000 – 50,000**	**50,000 – 75,000**	**75,000 – 100,000**	**Zaidi ya 100,000**
Gari/ gari kubwa ya mizigo						
Trekta						
Piki piki						
Baiskeli						
Simu						
Luninga						
Redio						
Jiko la kupikia (la gesi au la umeme)						
Jiko sanifu						
Jokofu						
Msumeno wa kukatia mbao						
Jembe la plau						
Bunduki						
Toroli au mkokoteni						
Fanicha						
Pampu ya maji						
Vifaa vya Umeme wa jua						

Mengineyo *(taja)*						

10. Tafadhali tunaomba maelezo ya kina kuhusu mifugo yako.

Aina ya mfugo	**Idadi inayomilikiwa**	**Kama ingekuwa uuze sasa hivi ni kiasi gani ingegarimu kwa mmoja?**
Kuku		
Mayai kwa siku		
Mbuzi		
Maziwa ya mbuzi (kwa lita moja) kwa siku.		
Ng'ombe		
Maziwa (kwa lita moja) kwa siku.		
Bata		
Nguruwe		
Kondoo		
Bata maji		

11. Tafadhali onyesha mapato yako unayopata kwa pesa taslimu na ambayo sio kwa pesa kutoka kwenye vyanzo tofauti:
Tungependa kufahamu aina tofauti za mapato, kwa pesa taslimu au kwa namna, na ikijumuisha mazalisho binafsi, ambayo kaya yako inaishi kutegemea rasilimali hizo. Nini chanzo kikubwa cha mapato kwa kaya hizi na tafadhali elezea nafasi yake ya umuhimu.

Nafasi ya umuhimu	**Chanzo cha mapato (tafadhali elezea)**

9.	Je, kaya yako inapata nafasi ya kuweka na kukopa?	
10.	Kama unapata nafasi ya kukopa, utakuwa upo tayari kuchukua mkopo?	

11.	Kama ungekopa pesa, ni kiasi gani ungekopa na ungefanyia nini?	
12.	Nini wastani wa mapato ya wanakaya wote kwa mwezi ukiwemo wewe pia? *Kama sio kwa mwezi, elezea kama ni kwa wiki au kwa mwaka*	
13.	Umeshawahi kupatwa na gharama zozote zile za kipesa katika kipindi hiki cha msimu wa masika? *Kama **'ndio'** kwa nini?*	
14.	Nini chanzo cha pesa cha kaya kwa shughuli/ matumizi ya mara moja kama vile ndoa,kujenga nyumba, mazishi na matibabu n.k	

D. Upatikanaji wa chakula

1.	Je, kaya yako inapata milo mingapi kwa siku moja?	
2.	Ulishawahi kupatwa na tatizo lakutoiridhisha familia yako kwa mahitaji ya chakula katika kipindi hiki chote cha masika?	
3.	Kama **'ndio'**, kwa miezi mingapi na kwanini?	
4.	Je, nivipi unaweza kulinganisha hali ya kifedha ya kaya yako katika kipindi cha mwaka mmoja uliopita?	
5.	Nini chanzo cha chakula? *Orodhesha mazao makuu ya chakula na vyanzo*	

E. Matumizi ya nishati

1.	Ni mara ngapi kaya hii inapika kwa siku nzima?	
2.	Ni nishati ipi mnayoitumia kwa kupikia? *Orodhesha kwa utaratibu maalum kuanzia inayotumika sana mpaka inayoumika kidogo.*	
3.	Je, wapi unaipata nishati unayoitumia kwakupikia?	
4.	Je, nikiasi gani cha nishati hii unaitumia kwa mwezi mmoja kwa kipindi cha masika?	
5.	Nini chanzo cha nishati yako ya mwanga katika kipindi cha usiku?	
6.	Je, kuna njia mbadala wa nishati hizi? Na vipi, zinapatikana kiurahisi kwako?	
7.	Je, unamiliki jiko banifu?	
8.	Kama **'ndio'** ulipataje hili jiko banifu?	
9.	Ilikuwa lazima ulipie jiko banifu?	

	*Kama **'ndio'** ni shilingi ngapi?*	

F. Vyanzo vya maji

1.	Jinsi gani unapata maji kwa matumizi ya nyumbani?	
2.	Je, ni jinsi gani unapata maji kwa matumizi ya kilimo?	
3.	Je, ni jinsi gani unapata maji kwa matumizi ya mifugo?	
4.	Je, upatikanaji wa maji umebadilika kwa kipindi cha miaka 5 iliyopita? *Kama **'hapana'** nenda kwenye sehemu nyingine.*	
5.	Kama '**ndio'** ni vipi ilibadilika?	
6.	Ni vipi kaya yako ilikabiliana na mabadiliko haya?	

G: Msitu karibu na kaya yako

1. Tafadhali taja jina (majina) ya msitu ulio karibu na kaya yako na umbali ulipo kutoka kwenye kaya yako.

Jina la msitu	Umbali kutoka kwenye kaya	
	Km	Dakika za kutembea

2. Je, unatumia msitu huu kukusanya rasilimali za asili? Kama **ndio,** tafadhali elezea rsilimali gani unayokusanya. Kama **hapana,** tafadhali elezea kwa nini huutumii msitu huu. *(Majibu tu ya kwa ujumla, idadi haihitajiki hapa)*

Jina la msitu	**NDIO;** Natumia msitu huu kukusanya rasilimali zufuatazo:	**HAPANA** Situmii msitu huu kwasababu:

H. Rasilimali za misitu.

4. Tafadhali onyesha kama kaya yako imekusanya mazao yoyote yanayohusiana na misitu katika **kipindi hiki cha masika.**

Mazao	Mara ngapi watu wa kaya wanakwenda kukusanya *(mazao kwa mwezi)*	Ni kwa umbali gani unatembea kwenda kukusanya *(mazao)?*		Kwa wastani wa safari moja, kwa kiasi gani cha *(mazao)?* Ambacho kaya yako inakusanya ?	Ni wapi kaya yako inakusanya *(mazao)?* ***(Nini jina la msitu)***	Kwa wastani wa safari moja, inachukua muda gani kukusanya *(mazao) kwa (dakika)?*	Katika msimu huu wa mvua, ni mwezi upi kaya yako inakusanya *(mazao)*	Je, unatakiwa ulipie usafiri au gharama zozote za kazi kwa kukusanya *(mazao) ni kiasi/ shilingi ngapi?*
		km	dakika					
Kuni zilizokauka (kwa mzigo mmoja)								
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*								
Mkaa *(elezea kama ni gunia au kisalfeti au ni mfuko/ mifuko ya Rambo)*								
Miti kwa kuchoma mkaa *(idadi ya miti)*								
Miti ya kujengea *(idadi)*								
Miti kwa ajili ya mbao. *(idadi)*								
Miti kwa ajili ya nyenzo/ vifaa *(idadi)*								
Miti shamba kwa ajili ya dawa (kwa mkono)								

Matunda pori *(idadi ya mifuko)*								
Nyasi *(kwa mzigo mmoja)*								
Asali *(kwa lita moja)*								
Nyama pori *(kwa Kg)*								
Mboga pori *(idadi ya mifuko)*								
Uyoga *(idadi ya mifuko)*								
Kamba *(kwa mzigo mmoja)*								

5. Tafadhali onyesha ni kiasi gani cha mazao yanayohusiana na msitu umeuza au umetumia katiaka **kipindi hiki cha sasa cha mvua**.

Mazao	Kiasi gani kaya yako **inauza** *(kiasi cha zao) kwa mwezi?*	Kiasi gani kaya yako **inanunua** *(kiasi cha zao) kwa mwezi?*	Kiasi gani kaya yako **inatumia** *(kiasi cha zao) kwa mwezi?*	Je, ni umbali gani unatembea kuuza /kununua (zao) hilo?		*Je, upatikanaji wa (zao) umebadilika kwa miaka?* ***1=Imepungua 2=ipo vile vile 3=Imeongezeka***	Je, nini mtiririko wa mahitaji *(zao)* katika familia yako kwa miaka? ***1=Imepungua 2=ipo vile vile 3=Imeongezeka***	Nini bei ya sasa ya *(zao kwa moja)?*
				km	daki ka			
Kuni zilizokauka *(kwa mzigo mmoja)*								
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*								

Mkaa *(elezea kama ni gunia au kisalfeti au ni mfuko/ mifuko*								
Miti kwa kuchoma mkaa *(idadi ya miti)*								
Miti ya kujenge a *(idadi)*								
Miti kwa ajili ya mbao. *(idadi)*								
Miti kwa ajili ya nyenzo/ vifaa *(idadi)*								
Miti shamba kwa ajili ya dawa *(kwa mkono)*								
Matunda pori *(idadi ya mifuko)*								
Nyasi *(kwa mzigo mmoja)*								
Asali *(kwa lita moja)*								
Nyama pori *(kwa Kg)*								
Mboga pori *(idadi ya mifuko)*								

Uyoga *(idadi ya mifuko)*								
Kamba *(kwa mzigo mmoja)*								

6. Tafadhali onyesha ni kiasi gani cha mazao yanayohusiana na msitu unahitaji katika **kipindi hiki cha sasa cha mvua**.

Mazao	Kiasi gani kaya yako **inahitaji** *(kiasi cha zao) kwa mwezi?*
Kuni zilizokauka *(kwa mzigo mmoja)*	
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*	
Miti kwa kuchoma mkaa *(idadi ya miti)*	
Miti ya kujengea *(idadi)*	
Miti kwa ajili ya mbao. *(idadi)*	
Miti kwa ajili ya nyenzo/ vifaa *(idadi)*	
Miti shamba kwa ajili ya dawa (kwa mkono)	
Matunda pori *(idadi ya mifuko)*	
Nyasi *(kwa mzigo mmoja)*	
Asali *(kwa lita moja)*	
Nyama pori *(kwa Kg)*	

Mboga pori *(idadi ya mifuko)*	
Uyoga *(idadi ya mifuko)*	
Kamba *(kwa mzigo mmoja)*	

3.	Kama umeonesha kupungua kwa mazao ya misitu kwenye sehemu yoyote hapo juu kwa miaka, ni jinsi gani kaya yako ilikabiliana na tatizo hilo?		
4.	Je, kaya yako imepanda miti au ina shamba la miti katika kipindi cha maka 10 iliyopia? *Kama '**hapana'** nenda sehemu H.*		
5.	Kama **'ndio'** nini lengo la miti hiyo iliyopandwa? *Tafadhali panga majibu matatu ya kwanza ya muhimu.*	**Lengo**	**Nafasi 1-3**
		Kuni kwa matumizi ya nyumbani	
		Kuni kwa kuuzwa	
		Mabaki ya mazao kwa ajili ya malisho ya wanyama; kwa matumizi binafsi.	
		Mabaki ya mazao kwa ajili ya malisho ya wanyama; kwa ajili ya kuuza.	
		Mbao/ fito za kujengea kwa matumizi binafsi	

I. Msitu wa karibu

1.	Nini jina la msitu wa karibu wa asili au ambao unatawaliwa kutoka kwenye kaya yako?	
2.	Kwa maoni yako, unamaoni gani juu ya hali msitu huu? *(Weka alama ya pata kwenye sehemu moja)*	☐ Umetawanyika ☐ Umetawanyika kwa kiasi fulani ☐ Upo sawa kwa eneo hili ☐ Kwa kiasi Fulani uko mwingi ☐ Uko mwingi sana
3.	Je, msitu huu unafaida yoyote kwa kaya yako? *Kama 'ndio'tafadhali elezea faida zake.*	
4.	Ni msitu huo ambao upo karibu na wewe ndio unaokupatia faida kwa ujumla? Kama ***'hapana'*** uliza jina la msitu.	

	5.	Je, msitu nakuletea athari hasi zozote (mfano: mazao kuharibiwa na wanyama). Kama ***'ndio'*** tafadhali elezea gharama.	
	6.	Je, msitu huu unatawaliwa na mtu yeyote/ au kwa kikundi/ shirika?	
	7.	Kama ***'ndio'*** nani anayemiliki msitu huu?	
	8.	Je, unafahamu kama kuna sheria zozote zilizowekwa au vikwazo vyovyote juu ya watu wanavyotumia msitu. Kama ***'ndio'*** *elezea vikwazo* Kama *'hapana' nenda Swali 15.*	
	9.	Nani ambaye anatengeneza sheria za matumizi ya msitu huu?	
	10.	Je, kuna mtu yeyote kutoka kaya yako alishirikishwa kwenye kutengeneza sheria juu ya matumizi ya msitu huu?	
	11.	Unafikiri sheria hizo kuhusiana na matumizi ya maumizi ya msitu ni za muhimu kwenye kutunza msitu?	
	12.	Ki vipi ungebadilisha sheria yam situ, kama ungepata nafasi ya kubadilisha?	
13.		Nini kinatokea kama hukufuata sheria zinazohusiana na matumizi ya msitu?	
14.		Je, inakulazimu ulipe faini kama hukufuata sheria zinazohusiana na matumizi ya msitu? Kama '***ndio'*** je unafikiri ni nani ambaye unafikiri anachukua pesa hiyo na je unajua jinsi inavyotumika?	
15.		Je, unafahamu mtu yeyote au kikundi cha watu ambao wanakiuka sheria hizi za matumizi ya misitu? **Hauhitaji kumtaja mtu yeyote yule na maelezo haya yatawekwa siri kubwa.** *Kama **'ndio'** elezea jinsi gani mtu huyo au kikundi hicho cha watu wanafanya.*	
16.	Kama una tatizo lolote kuhusiana na msitu, ni nani ambaye utaongea naye?		
17.	Je, unafikiri watu wangefaidika sana na msitu kama kijiji kingehusishwa kwenye utengenezaji wa sheria juu ya utawala wa misitu?		
18.	Je, unafahamu kijiji chochote ambacho wanakijiji wake wanahusishwa kwenye utawala/uongozi wa misitu? *Kama **NDIO** nini jina la kijiji hiki?*		

J. Msitu mwingine wowote

1.	Mwanzoni, tulikuuliza kuhusiana na msitu ambao upo karibu na kaya yako, je kaya yako imefaidika na msitu mwingine wowote? *Kama **hapana** nenda sehemu nyingine.*	
2.	Nini jina la msitu huu na je ni umbali gani upo kutoka nyumbani kwako?	Jina: Umbali kwa dakika: Umbali kwa km:
3.	Je, ni kwa njia zipi msitu huo unafaidisha kaya yako?	
4.	Je, msitu huo unatawaliwa/ongozwa au unamilikiwa? Kama ***hapana*** nenda kwenye Q6.	
5.	Kama ***ndio*** nani anaumiliki au kuutawala?	
6.	Je, ni vipi unafikiri utawala au uongozi wa msitu wowote ubadilishwe kama ungekuwa uamue?	

K. Makundi ya kijiji na utawala/uongozi wa kijamii

2. Je, wewe, au kuna mtu yeyote kwenye kaya yako ambaye ni mwanachama wa kikundi, jumuiko au kamati yoyote?

☐ NDIO ☐ HAPANA

*Kama '**ndio'** jaza katika jedwali chini. Kama 'hapana' nenda swali la 15.*

Wanachama wa kaya *(Tumia mahusiano na mkuu wa kaya kama hawataki kutaja majina yao)*	**Jina la kamati**		**Aina ya kamati** *(Tumia namba zilizopo chini)*	**Kiasi cha ushiriki** *(Tumia namba zilizopo chini)*	**Weka nafasi ya umuhimu ya kikundi cha kaya**
Aina ya namba ya kamati				***Namba ya kiasi cha ushiriki***	

Kikundi cha wakulima	1	Kamati ya Rasilimali za asili	12	Kiong ozi	1
Ushirika	2		13	Kipo hai sana	2
Shirikisho la wafanyabiashara/ kikundi cha biashara	3	Kikundi cha dini	14	Kiasi Fulani kipo hai	3
Shirikisho la wataalamu	4	Kikundi cha siasa	15	Hakipo hai	4
Umoja wa wafanyabiashara	5	Kikundi cha vijana	16		
Kukopa/ Kikundi cha biashara	6	Kikundi cha wanawake	17		
Maji/ Kikundi cha uchafu	7	Kikundi cha wazazi	18		
Shirikisho la kijiji	8	Kamati ya shule	19		
Halmashauri ya kijiji	9	Kamati ya afya	20		
Shirika lisilokuwa la kiserikali	10	Kikundi cha michezo	21		
Kikundi cha utumiaji wa msitu	11	Nyingine (eleza)			

Maswali yafuatayo yanahusiana na makundi yaliyochukua nafasi **3 ZA JUU** /kamati ambayo ni muhimu kwa kaya tu (kama yalivyopewa nafasi kwenye jedwali hapo juu)

		kamati 3 ya juu		
		1	**2**	**3**
1.	Jina la kamati			
2.	Kwanini ulijiunga na kamati?			
3.	Je, kuna ada yoyote ya kulipa ili ujiunge na kamati? Kama ***'ndio*** ' ni kiasi gani?			
4.	Je, kuna sheria zozote ili kujiunga na kamati?			
5.	Kwa ujumla kuna watu wanachama ni wale wale wa vikundi hivi au kuna muingiliano?			
6.	Je, wanachama wa kikundi wengi wanatoka kwenye familia moja (ukoo mmoja)?			

7.	Je, wanachama wengi wanatoka kwenye dini moja?			
8.	Je, wanachama wengi wanatoka kwenye jinsia moja?			
9.	Je, wanachama wengi wanafanya kazi inayofanana?			
10.	Je, wanachama wengi wana umri unaofanana?			
11.	Je, wanachama wengi wana elimu moja/ inayofanana?			
12.	Ni kivipi daima kikundi hiki hufanya maamuzi?			
13.	Ni kivipi uongozi wa kikundi ni mzuri?			
14.	Je, unafikiri kwamba kuwepo kwenye kikundi hiki kumekufanya upate ujuzi au kujifunza kitu fulani cha thamani?			

Maswali yafuatayo yanajadili maisha ya kijiji hiki:

15.	Je, unawafahamu watu wote wanaoishi kijijini hapa?	
16.	Je, unafuraha kuishi hapa?	
17.	Je, umejiunga na watu wengine kijijini hapa kuelezea matatizo katika kipindi cha miaka iliyopita? Kama '***Hapana'*** nenda kwenye swali la 19.	
18.	Kama ***'ndio'*** mlifanikiwa kutatuwa tatizo?	

19.	Kwa ujumla, ni kivipi ungeelezea/ ungepima utamaduni wa kushirikiana kijijini hapa?	☐ Upo chini sana ☐ Upo chini ☐ Wastani ☐ Upo juu ☐ Upo juu sana
20.	Ni kiasi gani cha ushawishi unafikiri mtu kama wewe uwe nayo ili uweze kufanya kijiji hiki sehemu nzuri ya kuishi?	☐ Mwingi ☐ Kiasi ☐ Sio sana ☐ Hakuna

Tafadhali niambie kwa ujumla kama unakubali au unakataa kwenye maelezo yafuatayo
(Weka alama ya pata kwa kila maelezo)

	Maelezo	**Nakubali sana**	**Nakubali**	**Nakataa**	**Nakataa sana**
1.	Watu wengi kijijini hapa ni wa kweli na unaweza kuwaamini				
2.	Watu wanajali tu mambo yao binafsi				
3.	Watu wa kijiji hiki ni wakweli kuliko watu wengine				
4.	Kama nina tatizo daima kuna mtu wa kunisaidia				
5.	Ninasikiliza maoni ya watu wengine kijijini hapa				
6.	Watu wengi kijijini hapa wapo tayari kukusaidia kama ukihitaji				
7.	Kijiji hiki kimefanikiwa katika miaka 5 iliyopita				
8.	Nahisi kukubalika kama mwanakijiji wa kijiji hiki				

Orodha ya kuleta usaili mwishoni

- **Sema kwamba umeuliza swali la mwisho na usaili umeishia hapo**
- **Mkumbushe muulizwa maswali kwamba maelezo yatatumika kama utafiti wa mwanafunzi na hakuna faida ya haraka ambayo inaweza kutolewa**
- **Muulize Muulizwa maswali kama anaswali lolote kuhusiana na usaili au utafiti kwa ujumla.**
- **Mkumbushe muulizwa maswali tutawafanyia usaili tena mwezi wa 11.**

- **Mkumbushe muulizwa maswali kwamba tunazingatia usiri**
  - **Elezea shukurani zako kwa kaya kwa kuchukua sehemu ya utafiti huu na kubadilishana muda wao wa muhimu.**

Tathmini ya msaili

1.	Usaili ulichukua muda gani?	
2.	Katika kipindi cha usaili, msailiwa alitabasamu au kucheka *Codes: 1=Hakucheka wala hakutabasamu; 2=Alitabasamu tu; 3=alitabasamu na kucheka; 4=.alicheka kwa uwazi na mara nyingi*	
3.	Kutokana na hisia zako na kile ulichokiona (nyumba, mali, n.k), Ni kivipi unaweza kulinganisha hali ya uwezo wa kaya hii na kaya nyingine kijijini hapa? *Codes: 1=mbaya sana ; 2=ilikuwa kama wastani; 3=nzuri sana*	
4.	*Je, ni kwa kivipi maelezo ni sahihi yaliyotolewa na kaya hii kuhusiana na ukusanyaji misitu au utumiaji?* *Codes: 1=mbaya; 2=sahihi kiasi; 3=ni sahihi sana*	
5.	Kama maelezo yam situ sio sahihi (namba 1 juu), unafikiri maelezo yaliyotolewa yamezidi au hayajazidi matumizi ya msitu kiasilia. *Codes: 1=Hayajazidi; 2=yamezidi; 3=hakuna yaliyopungua; 4=sijui*	

Maoni: Tafadhali tumia nafasi hii kwa kitu chochote kilichovutia wakati na/ au baada ya usaili.

IIC. Dry season household structured questionnaire (English version)

BASIC INFORMATION

Name of village:	
Household code:	
Date and Start Time:	
Name of Interviewer:	
Dry Season	

Who is present for the interview?

*Only the head of the household should answer all questions. Identify this person in the list below with an asterix **

Name of attendee(s)	Relationship to household head	Age (approx)	Sex (M or F)

Tasks for getting the interview underway:

- **Read the following to the respondent:**
  This research is being carried out by Julia Latham from the University of York in the UK for a student project. This research is looking at how people use natural resources and local opinion on the way that forests are managed, and how forests can be managed to suit the needs of local

people. Please note that this is an independent student project, we are in no way affiliated with any official organisation in Tanzania and all of your answers and opinions will be kept anonymous. The information you give us will be used to understand how your community uses resources and how management of natural resources can be improved to suit the community's needs. For the project to have maximum benefits for you and your community it is important that the information you provide is accurate. It will not be possible to identify you individually from the information presented in subsequent reports and you will get into any trouble for any information you give.

- **Ask for permission to conduct the interview**

A. Interview details

1.	Name of household head	
3.	Name of main respondent (*If different from household head)*	
4.	Main respondent relationship to household head *(Use Code below)*	

***CODE: 1**= head of household; **2**=spouse (legally married or cohabiting); **3**=son/daughter; **4**=son/daughter in law; **5**=grandchild; **6**=mother/father; **7**=mother/father in law; **8**=brother or sister; **9**=brother/sister in law; **10**=uncle/aunt; **11**=nephew/niece; **12**=step/foster child; **13**=other family; **14**=not related (e.g. hired help)*

****The following questions should be answered by the household head only****

B. Land

1.	What was the total area planted by this household during this Dry season? *Indicate whether hectares or acres*	
2.	What crops are you growing?	
3.	Will you sell these crops or are they only for household consumption?	

4.	Which crops do you sell?	
5.	How much of these crops do you sell? *In bags or Kgs*	
6.	Have you planted trees on your land or around your household for use as timber/fuelwood? *Yes or No*	
7.	If **No**, why not? ***Then move to next section***	
8.	If **Yes**, how many trees have you planted? And, can you name the species of tree?	
9.	Where did you obtain the seedlings from?	
10.	Did you have to pay for these seedlings? If yes, how much?	
11.	Do you have a certificate of land ownership? If **NO** go to question 13.	
12.	If **YES** where did you get the certificate from and when?	
13.	Do you know who is responsible for allocating land in this village?	

C. Assets and Savings

1.	Have you experienced any high cash expenses since we last conducted this questionnaire in your household? *Yes or No* *If **'No'** go to next section*	

2..	How did you pay for these expenses?	
3.	In your household, do you receive money from friends/relatives living elsewhere? *Yes or No* *If **NO** go to next section*	
4.	If **YES:** How much do you receive and how often?	

D. Food security

1.	Have you had problems with satisfying the food needs of the household since we last conducted this questionnaire? *Yes or No* *If '**No'** go to next section*	
2.	If **yes**, for how many months and why?	

E. Energy use

1.	What kind of fuel do you mostly use for cooking *List in rank order*	
2.	Where do you source the fuel(s) you use for cooking?	
3.	How much of this fuel(s) do you use in one month during the DRY season?	
4.	**If you own a fuel-efficient stove**, how often do you use it?	

F. Forest Resources

7. Please indicate any forest-related products your household has collected during this **current DRY season**?

Product	How often did members of your household make a trip to collect [*product*] per month?	How far do you have to travel to collect the [*product*]?		On an average trip, how much of the [*product*] did your household collect?	Where does your household collect the [*product*]? ***(What is the name of the forest? – MARK ON MAP)***	On an average trip, how long did it take to collect the [*product*]? (*minutes*)	During this DRY season, which months do your household collect [*product*]	Do you have to pay any transport or labour costs to collect [*product*] How much?
		km	minutes					
Dry Firewood (*bundle*)								
Live firewood (*bundle*)								
Charcoal *(Bag)*								
Wood for charcoal making *(no. of*								
Building poles (*number*)								
Wood for timber (*number*)								
Poles for tools (*number*)								
Medicine herbs (*bundle*)								
Wild fruits *(no. of*								

Grasses *(bundle)*								
Honey *(Litres)*								
Wild meat *(Kg)*								
Wild vegetable *(no. of bags)*								
Mushroo ms *(no. of*								
Rope *(bundle)*								

8. Please indicate how much forest-related product you sold or consumed during the **current DRY season**?

Product	How much does your household **sell** of [*unit of product*] per month?	How much does your household **buy** of [*unit of product*] per month?	How much does your household **consume** of [*unit of product*] per month?	How far do you have to travel to BUY/SELL the [*product*]?		What is the current price of [*unit of product*]?
				km	mins	
Dry Firewood *(bundle)*						
Live firewood *(bundle)*						
Charcoal *(Bag)*						
Wood for charcoal making *(no. of logs)*						

Building poles *(number)*						
Wood for timber *(no. of logs)*						
Poles for tools *(number)*						
Medicine herbs *(handful)*						
Wild fruits *(no. of bags)*						
Grasses *(bundle)*						
Honey *(Litres)*						
Wild meat *(Kg)*						
Wild vegetables *(no. of bags)*						
Mushrooms *(no. of bags)*						
Rope *(bundle)*						

9. Please indicate how much forest-related product your household **needs** during this **current DRY season.**

Product	How much does your household **need** of [*unit of product*] per month?

Dry Firewood *(bundle)*	
Live firewood *(bundle)*	
Charcoal *(Bag)*	
Wood for charcoal making *(no. of logs)*	
Building poles *(number)*	
Wood for timber *(no. of logs)*	
Poles for tools *(number)*	
Medicine herbs *(handful)*	
Wild fruits *(no. of bags)*	
Grasses *(bundle)*	
Honey *(Litres)*	
Wild meat *(Kg)*	
Wild vegetables *(no. of bags)*	
Mushrooms *(no. of bags)*	

Rope *(bundle)*	

G. Village Life

The following questions discuss the life in this village

1. Information flow within the village

a.	How do you get information regarding developments and issues within your village?	
b.	Do you talk to other members of your village about the forest or forest-related matters? *Yes or No* ***If NO go to question G.1. f.***	
c.	Who in the village do you speak to? *List names and/or position in village*	
d.	What kind of information do you discuss?	
e.	How often do you discuss forest-related matters with this person/these people?	
f.	Do you ever discuss forest-related matters with people from outside of your village? *Yes or No* ***If No go to Question G.1. j***	

g.	What are the names of these people and what position do they hold?	
h.	What do you discuss with these people?	
i.	How often do you speak to them?	
j.	Do you feel you need more information regarding forest-related matters?	
k.	In your opinion, what is the most important problem/issue that the village is currently experiencing?	

2. Village Public Meetings:

a.	How often does this village hold public meetings or committee meetings?	
b.	What do you think are the purpose of these meetings?	
c.	Do you attend village public meetings or committee meetings? *Yes or No*	
d.	If **NO:** why not? *If **No**, go to next section G.3.*	
e.	If **YES:** how often do you attend?	

f.	If **YES:** Do you contribute to discussion regarding village matters in these meetings?	
g.	If **YES:** Do you feel you have influence on decisions made in these meetings?	

3. Village Development Contributions:

a.	In this village do you have to pay Village Development Contributions? *Yes or No*	
b.	How much do you have to pay and how often?	
c.	What do you think this money is spent on?	
d.	Do you think these contributions are fair?	
e.	Do you feel the money is well-spent?	
f.	What happens if you cannot afford to pay the contributions?	

Please tell me whether in general you agree or disagree with the following statements *(Tick one box per statement)*

Statement		**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**
1.	I am satisfied with the current level of access to the forest for resources that I have				
2.	I would like to see this village managing the forest by itself				

3.	I am satisfied with the way the forest is managed				
4.	I would like more information regarding the forest and how it is managed				
5.	I think the forest should be better protected				
6.	I am satisfied with the current leadership in this village				
7.	I am satisfied with my level of influence over decision-making in this village				
8.	I prefer to use firewood as fuel rather than charcoal				
9.	I prefer to use my traditional stove rather than my fuel-efficient stove				
10.	I would be unhappy if the forest was destroyed because				

	of local resource use within the next 20 years.				

Checklist for bringing the interview to an end

- **State that you have asked the last question and the interview has come to an end**
- **Remind the respondents that this information will be used for student research and no immediate benefits can be provided**
- **Ask the respondents if they have any questions about the interview or about the research project**
- **Remind the respondents of the guarantee of anonymity and confidentiality**
- **Express your thanks to the household for taking part in the research and for sharing their valuable time**

Evaluation by interviewer

1.	How long did the interview take?	
2.	During the interview, did the respondent smile or laugh? *Codes: 1= neither laughed nor smiled (sombre); 2= only smiled; 3=smiled and laughed; 4= laughed openly and frequently.*	
3.	Based on your impression and what you have seen (house, assets, etc.), how well-off do you consider this household to be compared with other households in the village? *Codes: 1=worse-off; 2=about average; 3=better-off*	
4.	How reliable is the information on **forest collection/use** provided by this household? *Codes: 1=poor; 2=reasonably reliable; 3=very reliable*	
5.	If the forest information is not so reliable (code 1 above), do you think the information provided overestimate or underestimate the actual forest use? *Codes: 1=underestimate; 2=overestimate; 3= no systematic over- or underestimation; 4=don't know*	

Comments: *Please use this space for any interesting observations made during and/or after the interview*

IID. Dry season household structured questionnaire (Kiswahili version)

BASIC INFORMATION

Jina la kijiji:	
Namba ya nyumba:	
Tarehe na Muda wa kuanza:	
Jina la Mfanyausaili:	
Kiangazi/pakavu	

Nani yupo kwa ajili ya usaili?

Mkuu wa kaya tu ndiye anayetakiwa kujibu maswali yote.

*Mtambue mtu huyu kwenye orodha ifuatayo kwa kuweka alama ya nyota **

Jina la msaidizi (wasaidizi)	Uhusiano na mkuu wa kaya	Umri (kisia)	Jinsia (ME au KE)

Tasks for getting the interview underway:

- **Utafiti huu unafanywa na Julia Latham kutoka chuo kikuu cha York, Uingereza kama mradi wa mwanafunzi. Utafiti huu unaangalia ni jinsi gani watu wanatumia rasilimali za asili na maoni yawanakijiji juu ya utawala/ uongozi wa misitu, na jinsi gani misitu iwezekutawaliwa/ kuongozwa ilikukidhi mahitaji ya wanakijiji. Tafadhali jua kwamba huu ni utafiti wa mwanafunzi unaojitegemea, na kwanamna yoyote ilehatunauhusiano na mashirika yoyote rasmi ya Tanzania na majibu yenu yote na maoni yatakuwa ni siri kubwa kwetu. Maelezo yatawezesha kujua ni jinsi gani jamii yenu inatumia rasilimali za asili na jinsi gani uongozi wa rasilimali za asili unaweza kuboreshwa ilikukidhi mahitaji ya jamii. Kwa mradi kuwa na faida kubwa kwako na kwa jamii yako ni muhimu sana maelezo unayotoa yawe sahihi. Itakuwa sio rahisi kuwatambua mmoja mmoja kwenye taarifa ambazo zitakuwa zinatoka na hautapatwa na matatizo yoyote kwa maelezo unayotoa.**
- **Omba ruhusa kufanya usaili.**

A. Maelezo ya Usaili

1.	Jina la mkuu wa kaya	
3.	Jina la msailiwa mkuu tofauti *(kama ni tofauti na mkuu wa kaya)*	
4.	Uhusiano wa msailiwa mkuu na mkuu wa kaya *(Tumia alama zifuatazo)*	

***Codes**:**1**=mkuuwa kaya; **2**=mchumba (kuoanakisheria au kuishipamoja); **3**=mtotowakiume/ wa kike; **4**=mtotowakiumewakambo / mtotowa kike wakambo; **5**=wajukuu;**6**=mama/baba; **7**=mama/baba wakambo; **8**=kaka au dada; **9**=shemejiwakiume au wa kike; **10**=mjomba/ shangazi;**11**=mpwawakiume/ mpwawa kike;**12**=mtotowakambo/ wakulea; **13**=familianyngine; **14**=hakunamahusiano(mf: msaidiziwandani)*

****Maswali yafuatayo yanatakiwa yajibiwe na mkuu wa kaya tu ****

B. Ardhi

1.	Heka ngapi kwa ujumla zilipandwa na kaya hii katika majira haya ya kiangazi. *(Onyesha kama ni hekari au ekari)*	
2.	Unapanda mazao gani?	
3.	Utayauza mazao haya au ni kwa ajili ya matumizi ya nyumbani tu?	
4.	Mazao gani unayauza?	
5.	Ni kiasi gani cha mazao utayauza? *(kwa kilo au kwa gunia)*	
6.	Umepanda miti katika nyumba yako au kuzunguka nyumba yako kwa ajili ya mbao/ kuni? *Ndio au Hapana*	
7.	Kama **Hapana,** Kwanini? ***(Kisha endelea sehemu nyingine)***	
8.	Kama **NDIO,** miti mingapi umepanda? Na je, unaweza kutaja aina ya miti hiyo?	
9.	Umepata wapi miche ya kupanda?	
10.	Ilikuwa lazima ulipie miche hii? Kama **NDIO**, Shilingi ngapi?	

11.	Je, una hati ya kumiliki ardhi? Kama **HAPANA**, nenda swali la 13	
12.	Kama **NDIO**, wapi uliipata hiyo hati na lini?	
13.	Unamfahamu nani anayehusika kutoa ardhi kijijini hapa?	

C. Mali na Kuweka.

1.	Umeshawahi kupatwa na gharama zozote tangu mara ya mwisho tulivyofanya dodoso hili kwenye kaya yako? *(Ndio au Hapana)* *Kama '**HAPANA'**, nenda sehemu ifuatayo*	
2..	Ulizilipaje gharama hizi?	
3.	Katika kaya yako, unapokea pesa kutoka kwa marafiki, ndugu wanaoishi sehemu nyingine? *(Ndio au Hapana)* *Kama '**HAPANA'**, nenda sehemu ifuatayo*	
4.	Kama **NDIO**: shilingi ngapi unapokea na kwa mara ngapi?	

D. Upatikanaji wa chakula

1.	Ulishawahi patwa na tatizo la kutoipatia kaya yako mahitaji ya chakula cha kutosha tangu tulivyofanya dodoso la mwanzo? *Ndio au Hapana* *Kama '**HAPANA'**, nenda sehemu ifuatayo*	
2.	Kama **NDIO**, kwa miezi mingapi na kwanini?	

E. Matumizi ya nishati

1.	Ni nishati ipi mnayoitumia kwa kupikia? *Orodhesha kwa utaratibu maalum kuanzia inayotumika sana mpaka inayoumika kidogo.*	
2.	Je, wapi unaipata nishati unayoitumia kwa kupikia?	
3.	Kiasi gani cha nishati hii unaitumia kwa mwezi kwatika msimu huu wa KIANGAZI?	

4.	**KAMA UNAMILIKI JIKO BANIFU**, mara ngapi unalitumia.	

F. Rasilimali za misitu.

10. Tafadhali onyesha mazao yoyote ya msitu unayokusanya kwenye kaya yako katika msimu huu wa sasa wa KIANGAZI?

Mazao	Mara ngapi watu wa kaya wanakwenda kukusanya *(mazao kwa mwezi)*	Ni kwa umbali gani unatembea kwenda kukusanya *(mazao)?*		Kwa wastaniwa safari moja, kwakiasi gani cha *(mazao)* Ambacho kaya yako inakusanya?	Ni wapi kaya yako inakusanya *(mazao)?* ***(Nini jina la msitu) NA WEKA ALAMA KWENYE RAMANI***	Kwa wastani wa safari moja, inachukua muda gani kukusanya *(mazao) kwa (dakika)?*	Katika msimu huu wa **KIANGAZI**, mwezi gani kaya yako inakusanya (*mazao*)	Je, unatakiwa ulipie usafiri au gharama zozote za kazi kwa kukusanya *(mazao)ni kiasi/ shilingi ngapi?*
		km	dakika					
Kuni zilizokauka *(kwa mzigo mmoja)*								
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*								
Mkaa *(elezea kama ni gunia au kisalfeti au nimfuko/ mifuko ya Rambo)*								
Miti kwa kuchoma mkaa *(idadi ya miti)*								
Miti ya kujengea *(idadi)*								
Miti kwa ajili ya mbao. *(idadi)*								
Miti kw aajili ya nyenzo/ vifaa								

Miti shamba kwaajili ya dawa (kwa mkono)								
Matunda pori *(idadi ya mifuko)*								
Nyasi *(kwa mzigo mmoja)*								
Asali *(kwa lita moja)*								
Nyama pori *(kwa Kg)*								
Mboga pori *(idadi ya mifuko)*								
Uyoga *(idadi ya mifuko)*								
Kamba *(kwa mzigo mmoja)*								

11. Tafadhali onyesha kiasi gani cha mazao yanayohusiana na msitu kaya yako imeuza au kutumia katika **msimu wa sasa wa KIANGAZI**?

Mazao	Kiasi gani kaya yako **inauza***(kiasi cha zao)kwa mwezi?*	Kiasi gani kaya yako **inanunua** *(kiasi cha zao)kwa mwezi?*	Kiasi gani kaya (*kiasi cha zao) kwa mwezi?*	Je, niumbali gani unatembea kuuza /kununua (zao) hilo?		Nini bei ya sasa ya*(zao kwa moja)?*
				km	dakika	
Kuni zilizokauka *(kwa mzigo mmoja)*						
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*						
Mkaa *(elezea kama ni gunia au kisalfeti au nimfuko/ mifukoya Rambo)*						

Miti kwakuchoma mkaa *(idadi ya miti)*						
Miti ya kujengea *(idadi)*						
Miti kwa ajili ya mbao. *(idadi)*						
Miti kwa ajili ya nyenzo/ vifaa *(idadi)*						
Miti shamba kwa ajili ya dawa *(kwa mkono)*						
Matunda pori *(idadi ya mifuko)*						
Nyasi *(kwa mzigo mmoja)*						
Asali *(kwa lita moja)*						
Nyama pori *(kwa Kg)*						
Mboga pori *(idadi ya mifuko)*						
Uyoga *(idadi ya mifuko)*						
Kamba *(kwa mzigo mmoja)*						

12. Tafadhali onyesha ni kiasi gani cha mazao yanahusiana na msitu kaya yako **inahitaji kwa msimu huu wa <u>KIANGAZI</u>**.

Mazao	Kiasigani kaya yako **inahitaji***(kiasi cha zao)kwa mwezi?*
Kuni zilizokauka *(kwa mzigo mmoja)*	
Kuni zilizohai (endelevu) *(kwa mzigo mmoja)*	
Miti kwakuchoma mkaa *(idadi ya miti)*	
Miti ya kujengea *(idadi)*	
Miti kwa ajili ya mbao. *(idadi)*	
Miti kwa ajili ya nyenzo/ vifaa *(idadi)*	
Miti shamba kwa ajili ya dawa *(kwa mkono)*	
Matunda pori *(idadi ya mifuko)*	
Nyasi *(kwa mzigo mmoja)*	
Asali *(kwa lita moja)*	
Nyama pori *(kwa Kg)*	
Mboga pori *(idadi ya mifuko)*	
Uyoga *(idadi ya mifuko)*	
Kamba *(kwa mzigo mmoja)*	

G. Maisha ya Kijijini

Maswali yafuatayo yanajadili maisha ya kijiji hiki.

1. Taarifa zinavyoenea ndani ya kijiji

a.	Unapataje taarifa juu ya maendeleo na mambo mengine ndani ya kijiji chako?	
b.	Unaongea na wanakijiji wenzio kuhusiana na misitu au mambo yanayohusu misitu. *Ndio au Hapana* ***Kama <u>HAPANA</u> nenda swali G.1.f***	
c.	Nani kijijini unayeongea naye? *Orodhesha majina na/ au nafasi aliyonayo kijijini.*	
d.	Ni aina gani ya taarifa mnazojadili?	
e.	Mara ngapi mnajadili mambo yanayohusu misitu na mtu/ watu hawa?	
f.	Ulishawahi kujadili mambo yanayohusu misitu na watu wanaotoka nje ya kijiji? Ndio au Hapana ***Kama <u>HAPANA</u> nenda swali la G.1.j***	
g.	Majina wa ya watu hawa ni yapi na wana nafasi gani?	
h.	Mnajadili mambo gani na watu hawa?	
i.	Mara ngapi unaongea na watu hawa?	
j.	Je, unahisi unahitaji taarifa nyingi kuhusiana na mambo ya misitu?	
k.	Kwa Maoni yako, lipi ni tatizo/jambo kubwa la muhimu ambalo linaikumba kijiji kwa sasa?	

2. Mikutano ya hadhara ya kijiji:

a.	Mara ngapi kijiji hiki kinaitisha mikutano?	
b.	Nini lengo la mikutano hii ya hadhara unafikiri?	
c.	Utahudhuria mikutano hii ya hadhara? *Ndio au Hapana*	
d.	Kama **HAPANA**: kwanini? ***Kama HAPANA nenda swali la G.3***	
e.	Kama **NDIO**: mara ngapi unahudhuria?	
f.	Kama **NDIO:** unachangia majadiliano yanayohusu mambo ya kijiji katika mikutano hii?	
g.	Kama **NDIO:** unahisi una ushawishi katika maaumuzi yanayotolewa katika mikutano hii?	

3. Michango ya Maendeleo ya Kijiji:

a.	Katika kijiji hiki, unatakiwa ulipie michango ya maendeleo ya kijiji? *Ndio au Hapana*	
b.	NI kiasi gani unatakiwa ulipie na ni mara ngapi?	
c.	Unafikiri pesa hii inatumikaje?	
d.	Je, unafikiri michango hii iko sahihi?	
e.	Unafikiri pesa hiyo inatumika vizuri?	
f.	Nini kinatokea kama hukuweza kulipa mchango huo?	

Tafadhali niambie kwa ujumla kama unakubali au unakataa kwenye maelezo yafuatayo
(Weka alama ya pata kwa kila maelezo)

Maelezo		Nakubali sana	Nakubali	Nakataa	Nakataa sana
1.	Ninaridhika na upatikanaji (uendaji) msituni/ rasilimali za msitu ninazonazo.				
2.	Ningependa kuona kijiji hiki kinamiliki msitu chenyewe.				
3.	Nimeridhika na jinsi ya msitu inavyotawaliwa.				
4.	Ningependa kufahamu taarifa nyingi za misitu na jinsi inavyotawaliwa.				
5.	Nafikiri misitu inatakiwa ilindwe vizuri.				
6.	NImeridhika na uongozi wa kijiji wa sasa.				
7.	Nimeridhika na kiwango change cha ushawishi juu ya utoaji wa maamuzi kijijini hapa.				
8.	Ninapenda kutumia kuni kama nishati ya kupikia kuliko mkaa.				
9.	Nigependa kutumia jiko langu la asili la kupikia kuliko jiko banifu.				
10.	Ningekuwa mwenye huzuni kama msitu ungeharibiwa kwasababu ya rasilimali za asili zakutumika ndani ya miaka 20 ijayo.				

<u>Orodha ya kuleta usaili mwishoni</u>

- **Sema kwamba umeuliza swali la mwisho na usailiu meishia hapo**
- **Mkumbushe muulizwa maswali kwamba maelezo yatatumika kama utafiti wa mwanafunzi na hakuna faida ya haraka ambayo inaweza kutolewa.**
- **Muulize Muulizwa maswali kama ana swali lolote kuhusiana na usaili au utafiti kwa ujumla.**
- **Mkumbushe muulizwa maswali kwamba tunazingatia usiri**
- **Elezea shukurani zako kwa kaya kwa kuchukua sehemu ya utafiti huu na kubadilishana muda wao wa muhimu.**

Tathmini ya msaili:

1.	Usaili ulichukua muda gani?	
2.	Katika kipindi cha usaili, msailiwa alitabasamu au kucheka *Codes: 1=Hakucheka wala hakutabasamu; 2=Alitabasamutu; 3=alitabasamu na kucheka; 4=.alichekakwauwazinamaranyingi*	
3.	Kutokana na hisia za kona kile ulichokiona (nyumba, mali, n.k), Ni kivipiunawezakulinganishahali ya uwezo wa kaya hii na kaya nyingine kijijini hapa? *Codes: 1=mbaya sana; 2=ilikuwa kama wastani; 3=nzurisana*	
4.	*Je, nikwa kivipi maelezo ni sahihi yaliyotolewa na kaya hii kuhusiana na ukusanyaji misitu au utumiaji?* *Codes: 1=mbaya; 2=sahihikiasi; 3=nisahihisana*	
5.	Kama maelezo yam situ siosahihi (namba 1 juu), unafikiri maelezo yaliyotolewa yamezidi au hayajazidi matumizi ya msitu kiasilia. *Codes: 1=Hayajazidi; 2=yamezidi; 3=hakuna yaliyopungua; 4=sijui*	

Maoni*: Tafadhali tumia nafasi hii kwakituchochote kilichovutia wakati na/ au baada ya usaili.*

Appendix III. Guidelines for semi-structured interviews with stakeholders.

IIIA. Semi-structured interview guidelines for management officials

BASIC INFORMATION

Name of group/organisation:	
Name of Interviewee:	
Date and Start Time:	
Name of Interviewer:	
Interviewer Observations:	

RESPONDENT INFORMATION

Name	**Age** *(years)*	**Gender** *(0=male; 1=female)*	**Education** *(number of years completed)*	**Position in organisation**	**No. of years in position**	**Contact information** **(email/phone)**

A. About the group/organisation

1. What is your role within this group/organisation?
2. Please briefly describe this organisation and what it is responsible for.
3. How many years has this organisation had its present structure?
4. How does this organisation carry out most of the functions assigned to it?

5. Are the activities of this organisation supervised by a higher authority?

6. Can an external or higher-level organisation remove the decision maker(s) in this organisation?

7. In the last 5 years, how many leaders (officials) has this organisation had?

8. How many people work for this organisation?

B. About the group/organisation's work in the forest

1. Which forest does this organisation work in? Check if they work in any of the other forests in our survey, ask each question for each forest.

2. How long has your organisation been working in the forest? Are there any other organisations working in this forest also? Who is primarily responsible for the management of this forest? Are the roles of each organisation clearly defined?

3. Where is your head office located?

4. Does this organisation have to report to any higher authority regarding this forest in particular? If yes, please describe the chain of command regarding the forest management. If no, who in this organisation is the highest authority on this forest?

5. Which other organisations do you think you interact with the most with regard to the forest? How often do you communicate? By which means do you communicate most (email/face to face/telephone...)

6. What is the purpose of your organisation's work in the forest?

7. Please describe the management strategy in place for this forest. Who was involved in devising this management strategy?

8. What were the reasons for initiating this management strategy in this forest?

9. What are the aims of this management strategy for a) the forest, and b) the surrounding communities? Do you have copies of management plans/ONOD plans I could have? (Obstacles and Opportunities for Development)

10. Are you responsible for making rules regarding the forest? If not you, who is?

11. Have there been any major changes in the way this forest is managed in the past few years? Please describe.

12. What benefits, local and global, do you think the forest provides?

13. Does your organisation carry out activities aimed at enhancing any of these benefits?

14. Does your organisation work in any of the villages surrounding the forest? Which ones? Are the villagers dependent on the forest for their well-being?

15. Please mark on this map the boundaries of the forest(s) and surrounding villages that your organisation works in.

16. Do you personally think the management of the forest has been successful so far? In what way?

17. What improvements do you personally think could be made?

18. What have been the biggest challenges associated with this management, in your opinion?

19. Has the forest condition changed in the past few years/since management began?

20. Have the surrounding villages changed in the past few years/since management began?

21. How long do you think this organisation will be involved in managing this forest? Are any large changes planned for the future?

22. How is this management strategy funded? Do you have problems with funding the management?

23. What steps were involved in setting up this management strategy?

24. Do you liaise with any villagers regarding the forest management? If yes, anyone in particular? Who? Why them?

25. Are there any future plans for increasing or decreasing the level of village involvement in the management of the forest?

26. Does your organisation employ any villagers in forest management activities? If yes, who and from which village? What requirements did they need to gain this employment?

27. Does your organisation provide information to local forest users on a regular basis? How? What? How often?

28. Can the villagers access the forest to gather natural resources?

29. Are there specific areas from which the resources can be collected?

30. Are there restrictions on who collects resources, or how much can be collected or when? Please describe.

31. Do you charge people in cash/kind to collect resources?

32. How are rules relating to forest resources enforced? Do people break these rules? What are the consequences of breaking such rules? If fines are given, where does the money go?

33. Do any funds from the management of the forest reach the local community? How much and what is this for?

34. How do you think the local villagers feel about the way in which this forest is managed?

35. How would a local forest user express their needs and concerns to your organisation?

36. Do you think your organisation needs better funding or assistance to manage the forest? In what way and from whom?

37. Are there any conflicts between this organisation and another regarding the way the forest is managed? Please describe. How do you resolve these conflicts?

38. Does your organisation keep records of its activities in the forest?

C. Social network information

39. If you need information on the forest or it's management, who would you talk to?

40. How often do you speak to this person?

41. Where do you think they get their information from?

42. Do they ever come to you for information or advice?

43. How long have you known them?

44. Do you trust them?

IIIB. Semi-structured interview guidelines for Village Environmental Committees (VECs)

BASIC INFORMATION

Name of group:	
Date and Start Time:	
Name of Interviewer:	
Interviewer Observations:	

RESPONDENT INFORMATION

Name	**Age** *(years)*	**Gender** *(0=male; 1=female)*	**Education** *(number of years completed)*	**Position in VNRC**	**No. of years in this position**	**Contact Information (email/phone)**

A. About the group/organisation

1. When was this committee *(from here on referred to as 'group')* established?
2. Please explain the events that led to the establishment of this group, who was most responsible for its formation (e.g. government mandate, community decision, outside NGO etc)?
3. Please briefly describe this group and what it is responsible for.
4. How many members does this group have? How did they become members? Are both men and women members of the group?

5. How does this group carry out most of the functions assigned to it?

6. Are the activities of this group supervised by a higher authority? ? If yes, please describe the chain of command regarding the forest management.

7. As the group developed, what sort of help has it received from outside individuals or groups? Has it received advice and/or funding or other support from the government? What about from non-government sources? How did you get this support? Who initiated it? How was the support given? What benefits and limitations has the organisation derived from this support?

8. Who is the leader of this group? Who decided on that leader? Can an external or higher-level organisation remove the decision maker(s) in this group?

9. In the last few years, how many leaders (officials) has this group had?

10. How often do you hold group meetings? Are they well-attended? What do you usually discuss in these meetings?

11. What is this group's main source of income?

12. Do you feel this group needs more support? From who and in what way?

13. How would you like to make this group more effective?

14. Do you think the benefits of this group spread to the rest of the village?

B. About the group/organisation's work in the forest

1. Does your group only work in this village forest? If not, where else does it work and why?

2. Please mark on this map the boundaries of the forest(s) and the village.

3. In your personal opinion what condition is the forest in?

4. What benefits, local and global, does your organisation think the forest provides?

5. Does your organisation carry out activities aimed at enhancing any of these benefits?

6. How long has your group been working in the forest? Are there any other organisations working in this forest also? Who is primarily responsible for the management of this forest? Which other groups do you think you interact with the most with regard to the forest?

7. What is the purpose of your group's work in the forest? Please describe the management strategy in place for this forest.

8. Have there been any major changes in the way this forest is managed in the past few years? Please describe.

9. Do you think the management of the forest has been successful so far? In what way? What have been the biggest challenges associated with this management?

10. Has the forest condition changed since it started to be managed by your group?

11. Has the village changed since you started to manage the forest?

12. How long do you think this organisation will be involved in managing this forest? Are any large changes planned for the future?

13. Do you have influence with outside groups regarding the way in which the forest is managed?

14. Would your group benefit from some other form of assistance to manage the forest? In what way and from whom?

15. Are there any conflicts between this organisation and another regarding the way the forest is managed? Please describe. Have you tried to resolve these issues? How? How might you?

16. Does your organisation keep records of its activities in the forest?

17. Are you responsible for making rules regarding the forest? If not you, who is?

18. In your opinion are villagers in (this village) dependent on the forest for their well-being?

19. Do villagers collect resources from the forest? What? Are there restrictions on who collects resources, or how much can be collected or when? Do people have to pay fees for collection? Has allocation of forest resources to the village changed in the past few years? If so, how?

20. Do you think rules are easy to understand and fair? Why?

21. In your opinion, are villagers aware of rules that guide the use of forest resources? Do villagers know about the VNRC? How does your group pass information on to the rest of the village about the forest?

22. How are rules relating to forest resources enforced? Do people break these rules? What are the consequences of breaking such rules? If fines are collected, where does the money go?

23. How would a villager express their needs and concerns to this group?

24. Are there individuals in this group who do not participate in rule-making for the forest? If yes, how would you describe these individuals, why do they not participate?

25. How do you think the local villagers feel about the way in which this forest is managed?

26. Are there other villages that harvest from this forest? Do they have the right to? Does this create conflict with the villagers?

C. Social network information

27. If you need information on the forest or it's management, who would you talk to?
28. How often do you speak to this person?
29. Where do you think they get their information from?
30. Do they ever come to you for information or advice?
31. How long have you known them?
32. Do you trust them?

IIIC. Semi-structured interview guidelines for villagers

BASIC INFORMATION

Name of village:	
Date and Start Time:	
Name of Interviewer:	
Position in village:	
No. of years in position:	
Interview observations:	

RESPONDENT INFORMATION

Name	**Age** *(years)*	**Gender** *(0=male; 1=female)*	**Education** *(number of years completed)*	**Main occupation** *(Code, below)*

Code: 1=farmer; 2=wage employee; 3=self-employed (non-farm); 4=child; 5=student; 6=other (specify)

2. Were you born in this village? *If **'yes'** go to Q.6*
3. How long have you lived in this village?
4. Where were you living before you moved to this village?
5. Why did you move here?
6. Do you live in this village all year round? *If **'yes'** go to next section*
7. Where else do you live and why?

A. About the village

1. Do you feel there is a sense of community in your village?
2. Is the village happy with its current way of life? Why?
3. Is this a good year or a bad year for the people in this village? Why?
4. Do people in this community work together to achieve common goals?
5. Do you feel you trust people in this community?
6. Has the community seen any big changes in the past few years? In what way?
7. Are the roads and communal buildings in your village in good condition?
8. Do you think the roads and communal buildings in your village have changed in the past few years? How did this change happen and how has this affected you?
9. What small businesses are there in your village? Are you involved in any of these?
10. Has the skill set of the community changed in the past few years? In what way?
11. Do you know of any community groups or organisations that exist in this village related to **Natural Resources only**? Can you list them?
12. How do people in this village become involved in these groups/organisations?
13. What natural resources do the village use?
14. Is the community dependent on these natural resources?
15. Are these resources easy to obtain?
16. Has any land use planning been carried out in your village? If yes, by whom? Has this affected you?

B. About the forest

These questions are about the specific forest for each village i.e. UMNP, Magombera, etc. Make clear which forest we are referring to.

1. How would you describe the condition of the forest?

2. What do you think affects the condition of the forest?

3. How has the forest changed in the past few years? What is the reason for this change?

4. Do you think this is important?

5. How do you think the forest condition can be improved?

6. Have you ever done anything to try and improve the condition of the forest?

7. Does the forest provide the village with any benefits?

8. Does the forest have any negative impacts on the village?

9. Does the forest provide the village with natural resources? What?

10. Do you think the village is dependent on these resources?

11. Are there villagers or group members that have better access to the forest and its resources than others? Who? Why?

12. Has the availability of these resources changed in the past few years? Why?

12. What would the village do if these resources were no longer available? Are there alternatives?

13. Have you tried to find alternatives to forest resources yourself? (e.g. grown woodlot/distributed seedlings/sought help from external authorities)

14. What do you think limits the village's ability to find alternatives to forest resources?

    Do people in this village ever get together to talk about issues related to the forest and how it is used?

15. Are there restrictions on how the forest is used? What are they?

16. What do you think about these restrictions? Do they affect people in the village?

17. Does anybody monitor these restrictions in the village or in the forest?

18. What happens if rules relating to forest resource use are broken?

19. If fines are charged for breaking the rules, who collects these? What is the money used for?

20. Do other villages use the forest? How does this affect you?

21. Does the forest have cultural and/or historical value to you?

22. Do you or anyone in this village use another forest nearby? Where? Why?

C. About forest management

1. Do you think a person or a group is responsible for managing the forest? Who? How are they appointed?

2. Who is the person/group that manages the forest responsible to?

3. How do you think this management has affected you?

4. What do you think is the purpose of the forest management?

5. Do you ever have contact with the management group? Why? What for?

6. Do you ever get any employment from the forest management group? Do others in the village? In what way?

7. Does the village ever receive any benefits from the management?

8. Does the management have any negative impacts on the village?

9. Has the way that you use the forest changed since the management group was created?

10. Do you think the village is responsible for looking after the forest? If not, should the village be responsible for looking after the forest?

11. Are you interested in how the forest is managed? How do you get information on the forest?

12. Are there particular people in the village who you rely on for information relating to the forest and/or the way it is managed? List the top 5 people. What information do these people provide?

13. If you wanted to complain or suggest improvements about the way the forest is managed, who would you first talk to? How do you think they could help? Do you think you could change the way the forest is managed?

14. Do you have the authority to change the way the forest is managed? Does anyone in this village have that authority? Who in your opinion should have that authority?

15. Do you regularly receive information regarding the forest? From who?

16. Would you like to know more about the forest and how you can help to manage it or improve it?

37. How do you rate your influence on decisions that are made regarding the way the forest is managed?

D. Social network information

38. If you need information on the forest or it's management, who would you talk to?
39. How often do you speak to this person?

40. Where do you think they get their information from?

41. Do they ever come to you for information or advice?

42. How long have you known them?

43. Do you trust them?

Appendix IV. Household variables coded from household questionnaire data.

Variables summarised by village (n=100 households/village). For continuous variables, numbers shown indicate mean value, with 95% bootstrapped confidence intervals in parenthesis and range in italics. *Continued below*.

Village	Age of household head (years)	Gender of household head	Education (years) of household head	Occupation of household head	Household head born in village	Household Size (number of residents)	Proportion of female residents
Magombera	44.15 (+3.07, -2.99) *18-79*	Male: 77 Female: 23	6.05 (+0.41, -0.45) *0-11*	Farmer: 90 Self-employed: 1 *NA*: 9	Yes: 19 No: 81	3.14 (+0.44, -0.41) *1-12*	41.76 (+6.6, -6.54) *0-100*
Sonjo	49.57 (+3.35, -3.28) *19-84*	Male: 80 Female: 20	5.19 (+0.55, -0.57) *0-12*	Farmer:97 Self-employed: 1 *NA*: 2	Yes: 25 No: 75	4.78 (+0.51, -0.48) *1-14*	48.74 (+4.97, -5.04) *0-100*
Kiberege	46.30 (+2.22, -2.12) *21-79*	Male: 85 Female: 15	6.93 (+0.43, -0.45) *0-12*	Farmer: 98 Self-employed: 1 Wage-employed: 1	Yes: 54 No: 46	4.11 (+0.36, -0.35) *1-10*	46.31 (+4.71, -4.75) *0-100*
Signali	45.26 (+2.34, -2.25) *23-75*	Male: 91 Female: 9	5.77 (+0.50, -0.52) *0-12*	Farmer: 98 Pastoralist: 2	Yes: 56 No: 44	5.47 (+0.4, -0.36) *1-14*	47.81 (+3.49, -3.47) *0-83*
Tundu	46.91 (+2.88, -2.87) *18-81*	Male: 89 Female: 11	6.1 (+0.4, -0.3) *4-14*	Farmer: 96 Self-employed: 1 Wage-employed: 1 Student: 1 Teacher: 1	Yes: 78 No: 22	4.23 (+0.48, -0.44) *1-14*	47.68 (+4.18, -4.28) *0-100*

Appendix IV. *Continued.*

Household variables coded from household questionnaire data, summarised by village (n=100 households/village). For continuous variables, numbers shown indicate mean value, with 95% bootstrapped confidence intervals in parenthesis and range in italics.

Village	Number of social group memberships	Area land owned (hectares)	Main house material	Total asset value (*1000 TSH)	Number of income sources	Stove ownership	Owns woodlot or planted trees	Main energy source
Magombera	0.42 (+0.13, -0.12) *0-2*	3.51 (+0.72, -0.59) *0.25-26.5*	Brick: 50 Mud: 48 *NA*: 2	4.85 (+4.85, -3.75) *0-160*	1.42 (+0.11, -0.11) *1-3*	Yes: 17 No: 83	Yes: 53 No: 45 *NA*: 2	Firewood only: 88 Charcoal only: 12 Both: 0
Sonjo	0.45 (+0.13, -0.12) *0-3*	4.71 (+0.74, -0.71) *013-14.25*	Brick: 81 Mud: 6 *NA*: 13	121.85 (+36.55, -33.15) *0-920*	1.96 (+0.12, -0.12) *1-4*	Yes: 62 No: 38	Yes: 35 No: 58 *NA*: 7	Firewood only: 60 Charcoal only: 2 Both: 38
Kiberege	0.2 (+0.08, - 0.08) *0-1*	5.20 (+0.90, - 0.77) *0.5-30*	Brick: 89 Mud: 11	867.6 (+134.05, -123.20) *0-3000*	1.63 (+0.12, - 0.12) *1-3*	Yes: 16 No: 84	Yes: 20 No: 75 *NA*: 5	Firewood only: 22 Charcoal only: 9 Both: 68 *NA*: 1
Signali	0.25 (+0.09, -0.08) *0-1*	12.61 (+3.71, -2.97) *0.5-112*	Brick: 77 Mud: 22 *NA*: 1	353 (+60.55, -57.3) *0-1270*	1.3 (+0.1, -0.09) *1-3*	Yes: 60 No: 40	Yes: 86 No: 6 *NA*: 8	Firewood only: 58 Charcoal only: 0 Both: 42
Tundu	0.59 (+0.16, -0.15) *0-3*	5.63 (+1.35, -1.20) *0.25-30.5*	Brick: 97 Mud: 3	409.9 (+97.4, -87.45) *0-2775*	1.23 (+0.09, -0.09) *0-3*	Yes: 57 No: 43	Yes: 38 No: 49 *NA*: 13	Firewood only: 5 Charcoal only: 14 Both: 81

1 Tanzanian shilling was equal to mean 0.000635 US dollars during the period of data collection.

Appendix V. Correlograms

Correlograms used to asses degree of spatial variation in raw and modelled data for Chapters 3 & 4.

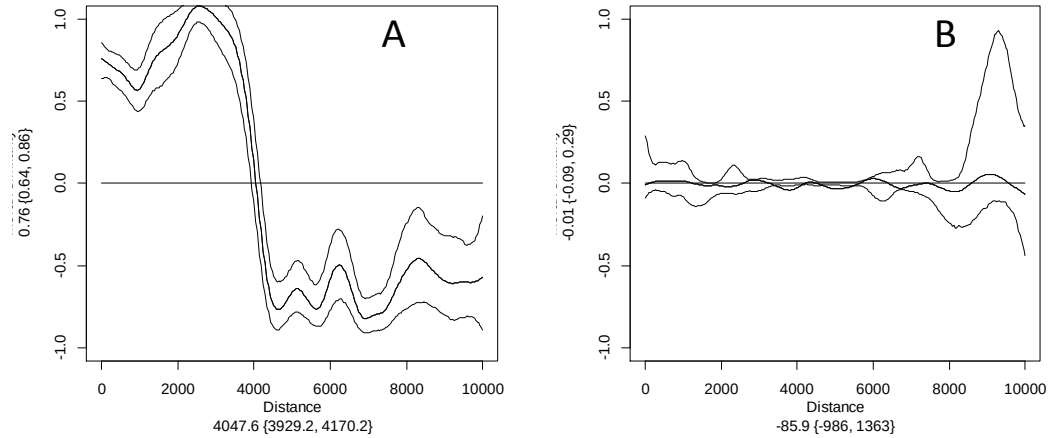


Figure V.1. Spline correlogram with 95% pointwise bootstrap confidence intervals, of Chapter 3 (A) raw binary true/false 'aware' data and (B) the Pearson residuals from the minimum adequate logistic regression model, including the reduced set of explanatory variables, fitted to the data (Model 1).

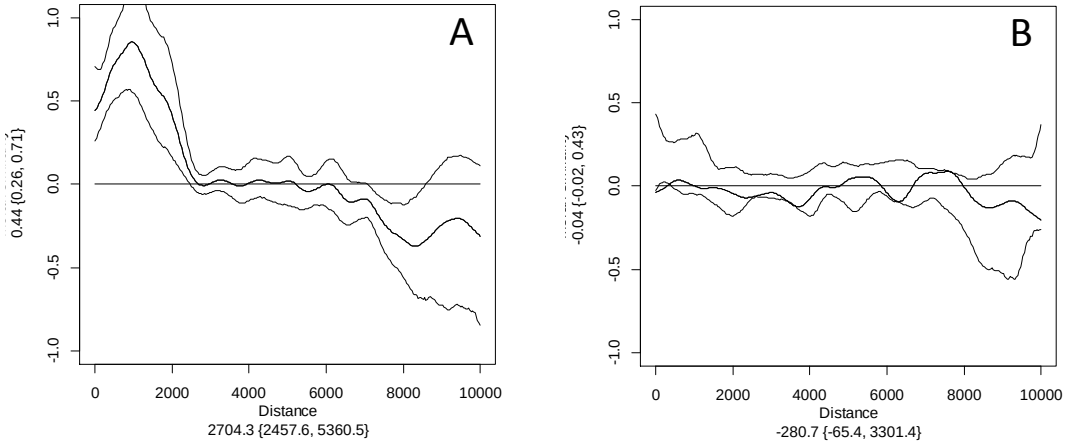


Figure V.2. Spline correlogram with 95% pointwise bootstrap confidence intervals, of Chapter 4 (A) raw 'need' data (cube root bundles/month) and (B) Pearson residuals from the minimum adequate 'need' GLM, including the reduced set of explanatory variables, fitted to the data (Need Model).

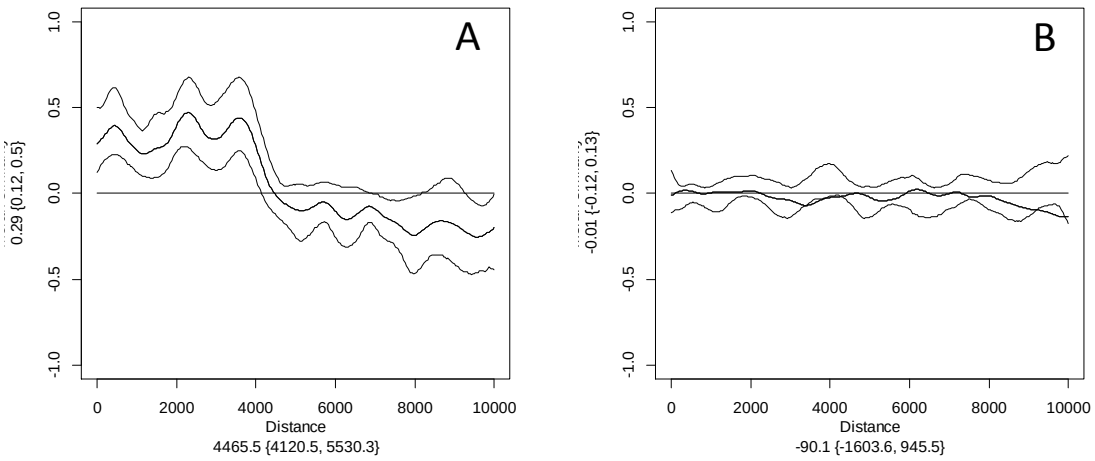


Figure V.3. Spline correlogram with 95% pointwise bootstrap confidence intervals, of Chapter 4 (A) raw 'consume' data (cube root bundles/month) and (B) Pearson residuals from the minimum adequate 'consume' GLM, including the reduced set of explanatory variables, fitted to the data (Consume Model).

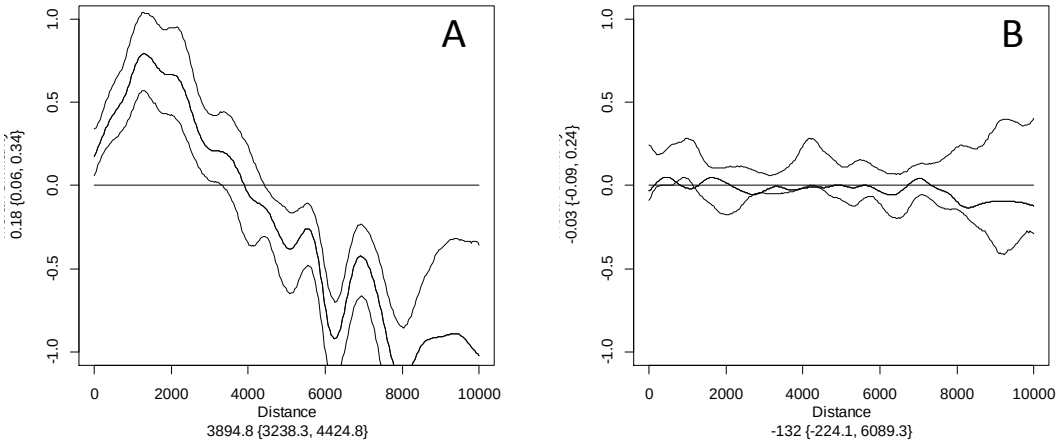


Figure V.4. Spline correlogram with 95% pointwise bootstrap confidence intervals, of Chapter 4 (A) raw 'satisfaction' data (cube root bundles/month) and (B) Pearson residuals from the minimum adequate 'satisfaction' GLM, including the reduced set of explanatory variables, fitted to the data (Satisfaction Model).

The Udzungwa Mountains at dusk