WHAT SCOPE FOR COLLABORATIVE MANAGEMENT AGREEMENTS TO IMPROVE ENVIRONMENTAL INCOME? THE CASE OF RWENZORI MOUNTAINS NATIONAL PARK, UGANDA[1]

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ABSTRACT

Collaborative management agreements (CMAs) between communities and government agencies managing protected areas are widely promoted as an opportunity for rural households to benefit from their proximity to natural areas. However, such agreements often have high costs of negotiation and frequently yield limited substantive benefits at the household level. Using data from a detailed quarterly income survey undertaken in six communities adjacent to Rwenzori Mountains National Park in western Uganda, this paper addresses the question: do collaborative management agreements have substantive benefits for rural households living adjacent to protected areas? The focus

of the analysis is on the role of forest income obtained from the harvesting of goods from within and outside the protected area. Households in communities with collaborative management agreements with the Uganda Wildlife Authority are compared with households in communities that do not have collaborative management agreements. A quasi-experimental research design is used: data collected in 2007 are compared with data collected in 2003 prior to the establishment of the CMAs.

1. INTRODUCTION

Collaborative management agreements (CMAs) between communities and government agencies managing protected areas are widely promoted as an opportunity for rural households to benefit from their proximity to natural areas. However, such agreements often have high costs of negotiation and frequently yield limited substantive benefits at the household level. This paper addresses the question: do collaborative management agreements have substantive benefits for rural households living adjacent to protected areas? The focus of the analysis is on the role of forest income obtained from the harvest of goods from within and outside protected areas. The working hypothesis is that participation in collaborative management agreements focused on benefit sharing leads to increased income for rural households, but that increased income is largely for subsistence use of resources. The implication is that while collaborative management agreements may contribute to the general welfare of households, they are unlikely to lead to poverty reduction for households living adjacent to protected areas.

The paper draws on the case of CMAs in Rwenzori Mountains National Park (RMNP) in western Uganda. The Uganda Wildlife Authority (UWA) has been engaged

2

in negotiating CMAs with communities adjacent to the Park for almost a decade. In recent years those negotiations have led to the establishment of pilot benefit sharing agreements between UWA and Parishes adjacent the Park.[2] The paper uses data from a detailed quarterly income survey undertaken in six communities adjacent to Rwenzori Mountains National Park in western Uganda. Households in communities with collaborative management agreements with the Uganda Wildlife Authority are compared with households in communities that do not have collaborative management agreements. Data collected in 2007 are compared with data collected in 2003 prior to the establishment of the CMAs.

The paper is organized as follows. In the following section the literature related to CMAs and changes in income is reviewed. Section 3 reviews the research design, sampling strategy, site description, and methods of data collection and analysis. In Section 4 the relationship between UWA and communities adjacent to RMNP is described with respect to various types of collaborative management agreements and the role and degree of enforcement in supporting the objectives of the CMAs. Results are presented in Section 5. The findings are discussed in Section 6.

2. LITERATURE REVIEW

There is a debate between conservations and social advocates as to the efficacy of protected area management (Wilkie et al. 2006; Adams and Hutton 2007). Sanderson and Redford (2003) suggest that the argument that conservation is bad for local people puts support for protected areas and conservation initiatives at risk. Conservationists

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[2] Parish is the second lowest administrative unit in Uganda's local government system.

argue that protected areas are essential for maintain ecological and human health, and that strict regulation of protected areas is justified on the grounds of ensuring the preservation and sustainability of wild areas (Kramer, Van Schaik, and Johnson 1997). Conversely, protected area management is contested by social advocates for a variety of reasons including: failure to address the proximate causes of environmental destruction (Duraiappah 1998); limiting or removing property rights (Colchester 2004); and the limited ability for the benefits from protected areas to actually accrue to the poorest members of society (Brockington 2003).

Wilkie et al. (2006) point out that there is limited empirical evidence to suggest that the establishment of Parks necessarily negatively impacts local people. They point to two major issues that need to be addressed to reconcile the question of the impact of protected areas on local populations. First, the value of natural resources to rural income portfolios is highly divergent. To assume that all rural households living adjacent to protected areas are highly dependent on natural resource harvested obtained from within the park is misleading. Several recent studies account for forest and other environmental income in the analysis of rural income portfolios (Vedeld et al. 2004), and several ongoing studies will contribute to the growing literature.[3] The literature suggests that the actual contribution of forests to rural livelihoods is highly varied (Byron and Arnold 1999; Wunder 2001; Vedeld et al. 2004; Chomitz et al. 2006), and that different opportunities for forest income enhancement exist both within and between communities. Second, there are considerable research design challenges associated with assessing the impact of protected areas on the welfare of local people.

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[3] The Center for International Forestry Research (CIFOR) is currently coordinating the collection of forest and livelihood data across roughly 35 sites in the low income tropics.

The majority of assessments are *ex ante* predictions or *ex post* measures of welfare. Few studies employ baseline data or control groups to assess the welfare status of people living adjacent to protected areas (Wilkie et al. 2006). This study seeks to fill that gap.

3. METHODS

3.1. Research Design

To make claims about causal relationships between collaborative management agreements and various outcomes a quasi-experimental research design is required. To understand how the management agreement has affected a particular unit of observation, be it a demographic group such as the rural poor or specific forest area, it is necessary to have data from before the reform was implemented to compare with data collected some time after implementation has taken place (Bardhan 2002). In addition, it is necessary to have a counterfactual, or a control group, to account for changes that occur due to other factors. The control group serves as an indicator of what would have happened in the absence of the agreement (World Bank 2008). This study employs a quasi-experimental research design called the nonequivalent comparison group design (Shadish, Cook, and Campbell 2002). Households in villages engaged in collaborative management agreements (i.e. treatment groups) are compared with households in villages that do not have an agreement (control group).[4]

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[4] The non-equivalent comparison group design is among the most common of quasi-experimental designs. Variants include treatment groups and untreated comparison or control groups with dependent (i.e. pre and post test data collected on the same units) and independent samples. Due to the non-equivalency of the comparison and control groups, selection bias is assumed to be present. Several

In this case the pre-agreement and post-agreement samples are independent. Household level data from the first and second time period are analyzed together as a pooled cross section.

3.2. Sampling

The data used in this paper are drawn from a larger study that includes baseline data collected by the Wildlife Conservation Society in 2003 (Bush et al. 2004); and follow-up data collected by the author (Jagger 2009).[5] The focus of the WCS study was the contribution of forests to rural livelihoods. The data used for this analysis are from one of four purposively selected forest sites from the WCS baseline survey. The number of villages included in the WCS sub-sample was 12; due to financial and logistical constraints the number of villages selected for the follow-up study was reduced to 6. Villages were randomly selected using a stratified random sampling method that took into consideration the distribution of the baseline survey villages by district in order to maximize variation across the three districts in the study (n=6 villages).[6] After the random selection was completed the location of each village was checked to ensure

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methods are available to test for both the external and internal validity of the research design (Shadish, Cook, and Campbell 2002).

[5] The purpose of the larger studies (i.e. WCS and Jagger Dissertation) was not to assess the efficacy of CMAs. However, the random draw of villages yielded an opportunity to test the effect of CMAs on rural livelihood portfolios.

[6] Three of the villages are in Kasese District, two villages are in Kabarole District, and one village is Bundibugyo District, one of the most remote and under serviced districts in the country.

sufficient geographic distribution around the National park. The random selection process yielded relatively uniform spatial distribution of villages.[7]

The baseline study involved the selection of approximately 15 households per village (n=90). To guarantee the anonymity of respondents, the WCS research team did not collect names or other unique identifiers for households. In the follow-up study the number of households surveyed in each village was increased to provide a representative sample of households within each village. Thirty households were randomly selected from each village (n=180 households). A list of households residing in each village was compiled, drawing upon information from village registers, lists provided by village leaders, and information from key informants. Polygamous households were listed according to the wife's name; each wife was considered a separate household unless key informants indicated that wives jointly undertook key livelihood activities such as cooking and cultivating. The field work for the WCS study was undertaken between September and December 2003, prior to the implementation of the current CMA agreement. The fieldwork for the follow-up study was undertaken between October 2006 and August 2007.

3.3. Study Area

Rwenzori Mountains National Park is located in the northernmost region of the Albertine Rift; the area stretching between Lake Albert and Lake Edward. The Albertine Rift is one of the most diverse ecosystems in Africa with more than 7,500 species of animals

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[7] For a detailed description of the characteristics of the forest sites included in the follow-up study see (Jagger 2008).

and plants, including many endemics.[8] Rwenzori Forest Reserve was managed by the

Forest Department until 1991 when its status was changed to National Park and

management taken over by the Uganda Wildlife Authority. The Park was designated a

United Nations Educational, Scientific, and Cultural Organization (UNESCO) World

Heritage Site in 1994 (IUCN 1994). The Park is approximately 1000 square kilometers.

The Rwenzori area has several unique features (Table 1). The Rwenzori

Mountains have been inhabited for centuries by the Bakonjo people. The Bakonjo are

found primarily in the Rwenzori Mountains, and more extensively in the eastern part of

Democratic Republic of Congo. There is very little ethnic heterogeneity in the Rwenzori

Forest Site. Due to cultural differences and the difficulty of public service provision on

the high altitude steep slopes of the Rwenzori Mountains, the Bakonjo are considered a

marginalized population. The majority of households in the Rwenzori mountains live

between 1500 and 2200 meters above sea level; they inhabit both grassland (1000-

2000 m.a.s.l.) and montane forest (2000-3000 m.a.s.l.) vegetation zones (UWA 2004).

The majority of forested land in the three districts that are included in this study is within

Rwenzori Mountains National Park.

The Rwenzori Forest Site is very large and has several major marketing centers

including the towns of Bwera, Mpondwe and Kasese in Kasese District, and Fort Portal

in Kabarole District. The majority of households in the area live in the mountains and

transport goods long distances by foot to market. There are opportunities to sell

agricultural produce in Bundibugyo Town, particularly cocoa and vanilla which are

purchased by traders. However, to obtain higher prices, and also to purchase

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[8] The Albertine Rift has been identified as an Endemic Bird Area by Birdlife International, an Ecoregion by the World Wildlife Fund, and a Biodiversity Hotspot by Conservation International (Plumptre 2002).

consumer goods, people from Bundibugyo frequently travel across the mountains to markets in Kabarole District on foot trails through Rwenzori Mountains National Park.

Forest products with significant markets include sawn wood, charcoal, *Prunus Africana,* and to a lesser extent poles, bamboo, fuel wood, baskets, and furniture. Other forest products including wild vegetables and fruits, mushrooms, medicinal plants, bush meat, mushrooms, and household implements are largely used for household subsistence, but some are sold in small quantities in village markets or at the nearest trading center. Sawn wood is produced by local pit-saw loggers on a relatively small scale, and sold in regional markets in Bwera, Kasese and Fort Portal towns. Within the communities surrounding the Rwenzori Mountains several small-scale furniture makers produce furniture for the regional market. There is an export market for the medicinal plant *Prunus africana*. However, the majority of local people are excluded from the *Prunus Africana* market as exports are controlled by large scale businesses owners with national or international connections. There is an underground market for bush meat throughout the Rwenzori Mountains. Monkeys and bush pigs which comprise the majority of bush meat consumed in the region are illegally hunted in the National Park.

Table 1: Characterization of Major Economic Activities in the Rwenzori Mountains[1]

Indicator	Description
Agro ecological	Montane system characterized by high rainfall
Altitude (m.a.s.l.)	1500-1750
Common agricultural crops	Banana; sweet potato; cassava; Irish potato; Arabica coffee; barley (at high altitudes);
Forest type	Afromontane

Major forest products harvested by rural households	Fuel wood Timber Wild foods (including meat) Ropes Bamboo Medicinal plants
Major forest products harvested by non-local extraction specialists	Prunus africana (medicinal plant)
Dominant forest authority	Uganda Wildlife Authority
Off-farm employment opportunities	Mining at Kasese Cobalt Company; Hema Cement Plant; Tourism

Sources: Author's primary data; Nzita and Miwampa (1993); and MAAIF (1995).

3.4. Analysis

Environmental income is the rent captured through consumption, barter, or sale of natural capital at the first point in the marketing chain (Vedeld et al. 2004). Environmental income comes from a variety of natural sources including: forests; lakes; wetlands; fallows; pastures etc. Income from forests and other natural sources fills important safety-net functions in times of crisis, supports the current consumption of households, and in some cases has the potential to lift households out of poverty (Angelsen and Wunder 2003).

This chapter follows the standard income definition: income is the gross value of products consumed (i.e. subsistence income) or sold (i.e. cash income) minus input costs. Following this, the value of family labor is not deducted, while the costs of hired labor are (Sjaastad et al. 2005). For the purposes of this analysis income is categorized at the landscape level. For example, products harvested from land areas classified as forests are considered forest products. Fuel wood harvested from an area under fallow would not be considered forest income, but rather classified as other environmental

income.[9] A complete income portfolio for each household is formulated by calculating

income for several disaggregated categories (Table 2). Within each income category,

where relevant respondents were asked to provide detailed information about the land

use products were harvested from, as well as to indicate whether products were used

for household consumption or for sale. Depending upon the component of the income

portfolio, variable recall periods were used (Campbell and Luckert 2002). In the follow-

up study respondents were asked to indicate the forest tenure that the product was

harvested from: private forest; community forest; or protected area (i.e. within RMNP).

Table 2: Income Portfolio Components and Recall Periods

Source of Income	Recall Period
Unprocessed forest products	30 days
Processed forest products	30 days
Fishing	30 days
Aquaculture	30 days
Other wild products (i.e. from fallows, wetlands etc.)	30 days
Wage labor	30 days
Business	30 days
Income from agriculture	3 months
Livestock	3 months
Livestock products	3 months
Other income (i.e. gifts, remittances etc.)	3 months

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[9] Fish caught from the wild are considered environmental income. Fish harvested from aquaculture ponds
are classified as agricultural income.

In addition to data used to estimate the absolute contribution of forests and other wild products to total household incomes data on household demographics; assets and resource use etc. were collected during the first quarter of the survey etc.

In order to compare incomes across households a standardized unit of measure is required. Inter-household variations in size and demographic composition are taken into account following Cavendish (2002).[10] Equivalence scale adjustments are typically comprised of three components: a time weighting equal to the proportion of the year each household member spends in the household; a nutritional weight allocated according to the age and gender of each household member; and an economy of scale weight. Unadjusted estimates of total income were divided by the household size in adjusted annual equivalents to produce total household income per adjusted adult equivalent units.[11] Adjusted annual incomes from the baseline data were adjusted to real values by multiplying incomes in 2003 by 6.38 percent which was the average rate of inflation in Uganda during the period 2003 through 2007.[12]

A major challenge for this study is that we do not have a true panel dataset with the same households both before and after the reform. The regression analysis combines the baseline data with the follow-up data to create a pooled cross section over time.[13] This data structure fits with the research design in that it assumes that

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[10] See Cavendish (2002) page 56 for a detailed discussion of adjusting crude income to adult equivalent units.
[11] Because the study area does not have a significant proportion of households with migrant laborers we assumed all individuals to be time weighted with 100 percent of their time in the household.
[12] Uganda Revenue Authority. 2007. http://www.ugrevenue.com/exchange_rates/previous.php?date=January+2008&Submit=Show. Accessed 28 January 2008.
[13] Given that this study does not use panel data (i.e. tracks the same households over time) – but rather uses pooled cross sectional data from two independent random samples, the potential effect of attrition due to factors including harassment from forest officials, economic opportunity elsewhere etc. cannot be

during each year of data a new random sample is taken from the relevant population. While pooled cross sectional data is treated as a cross sectional dataset for analysis purposes, it is important to include a dummy variable for year to account for aggregate changes over time (Wooldridge 2002).

The effect of community involvement in collaborative management on forest income is evaluated using a program evaluation technique known as the "difference-in-difference" (DID) method. The difference-in-difference method allows for the consideration of both group specific and time specific effects. Effects can be estimated using descriptive statistics (i.e. double difference mean statistics) and also econometrically (Wooldridge 2002). Table 3 summarizes the variables required to estimate the effect of the reform on livelihood outcomes.

Table 3: Variables Required to Estimate Double-Difference Mean Statistic

	Collaborative Management Agreement with UWA	Control Group (i.e. no agreement)
Before	T_{1B}	C_B
After	T_{1A}	C_A

The double difference of the means of the treatment effect is modeled as follows:

$$\textit{Treatment effect}_{\textit{(Collaborative Management Agreement)}}=(\ T_A - T_B)\text{-}(C_A - C_B) \tag{1}$$

Alternatively the difference-in-difference estimator can be used to model outcomes econometrically as follows:

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ascertained. The relatively high proportion of households that have been in the village for greater than 10 years provides assurance that the sample drawn for the follow-up study is representative of the population of households in the 2003 baseline study conducted by the Wildlife Conservation Society. Approximately 80 percent of household heads in the follow-up sample have lived in their current village for greater than 10 years.

$$Y_i = \beta_0 + \beta_1 treatment\_CMA + \beta_2 time + \beta_3 treatment\_CMA*time + \varepsilon_i \qquad (2)$$

While comparing difference- in-difference means for both group and time specific effects can provide useful information, equation 1 assumes that the implementation of the collaborative management agreement is not systematically related to other factors that affect outcome variables. In most cases the model in equation 2 is extended to include additional covariates that account for the possibility that random samples within a group have systematically different characteristics across the two time periods (Wooldridge 2002). Thus, the effect involvement in the CMA on the dependent variables of interest is modeled econometrically according to the following equation:

$$Y_i = \beta_0 + \beta_1 treatment\_CMA + \beta_2 time + \beta_3 treatment\_CMA*time + \beta_4 land + \beta_5 labor +$$
$$\beta_6 capital + \beta_7 minforest + \beta_8 village + \varepsilon_i \qquad (3)$$

$\beta_1 treatment\_CMA$ is a dummy variable that indicates where the household is in the first treatment group (i.e. in the village with the CMA). $\beta_2 time$ is a dummy variable that indicates if the household fell in the 2003 or 2007 sample. $\beta_3 treatment\_CMA*time$ is an interaction variables that indicates whether the household falls in the treatment group and in the after the reform time period. The coefficient for the interaction variable measures the magnitude of change in the independent variable that can be attributed to participation in the CMA. $\beta_4 land$ is a vector of variables that indicate the endowment of land for each household. $\beta_5 labor$ is a vector of variables that indicate the household's human capital and over all labor supply. $\beta_6 capital$ is a vector of variables that indicate

14

the household's available capital assets. $\beta_7 minforest$ is number of minutes it takes to travel from the household to the nearest forest by the most common means of transportation. $\beta_8 village$ is a vector of variables that indicate several of the fixed conditions associated with each village. ε_i is the error term which accounts for effects that are not captured by other variables.

Models with left censored dependent variables (e.g. adjusted annual household income from forests, and share of annual household income portfolio from forests) are estimated using the Tobit regression model which account for the non-linear nature of data with a significant number of zeros (Long 1997).

4. CMAS AND ENVIRONMENTAL INCOME IN RWENZORI MOUNTAINS NATIONAL PARK

The official policy regarding access to resources within the Park is that the Park is strictly off limits unless there is a formally negotiated Memorandum of Understanding between the Uganda Wildlife Authority and the Community Protection Area Institution.[14] There are two types of collaborative management agreements currently in place in Rwenzori Mountains National Park. The first is a Memoranda of Understanding between UWA and Parishes adjacent to the Park for pilot testing benefit sharing agreements for bamboo and other subsistence forest products found within the Park (Table 4). This type of agreement exists in two Parishes adjacent to the Park: Kazingo and Nsura. Nyarukamba, one of the study villages falls within Kazingo Parish. Benefit sharing agreements of this nature have the potential to benefit all members of the

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[14] Community Protected Area Institutions or CPIs were developed to link communities to the protected area administration. They are generally comprised of the Secretaries for Production and Environment from each sub-county bordering the protected area (UWA 2004).

community, though UWA emphasizes that the poorest and most vulnerable households should have priority access to benefits within the Park. Further, poorer households generally do not own their own forest plots, so they are likely to be more dependent on accessing products from within the Park.

The agreement currently in place in Kazingo Parish took several years to negotiate. The first agreement was proposed in 1994, it failed due to disputes between UWA and community members over location of the Park boundary. A second agreement signed in 1999 also failed. It was very restrictive, giving community members few substantive benefits, though it had high expectations about community contributions to monitoring activities in the Park. The current agreement was signed in 2005 and so far is working well. Key informants from UWA, as well as village and Parish leaders indicated that they were satisfied with the agreement.

The current agreement allows households to seek permission to harvest several products for subsistence use. Prior to the signing of the benefit sharing agreement inventories of bamboo, medicinal plants, honey, fuel wood, and smilax (i.e. a vine used for making traditional baskets) were undertaken to determine sustainable off take levels. Households or groups wishing to harvest products seek permission from the UWA outpost in Kazingo, which is located less than 1 km from the village center. CPIs serve as liaisons between community members and UWA. As part of the CMA households, village and parish leaders make a commitment to monitoring activities within the National Park. Nyarukamba village has responsibility for monitoring activities in the National Park in an area that is roughly six square kms immediately adjacent to the village. UWA staff monitor the area for evidence of illegal activity; especially timber

16

harvesting and bush meat hunting. If illegal activity is detected then community members risk losing harvesting privileges and could ultimately have their agreement revoked.

The second type of agreement is a "Collaborative Boundary Management Agreement" (CBMA). This type of agreement employs the *taungya* system which allows for the planting of crops one meter within the Park boundary.[15] The agreement between UWA and households with plots adjacent to the National Park serves two functions. Households granted temporary cultivation rights are expected to manage and protect the eucalyptus trees planted as a natural boundary around the Park. Second, households are expected to play a role in monitoring of activities within the forest (CBMA). These agreements are generally thought of as an initial step towards agreements that involve resource use. Two of the study villages, Masule B and Kabingo fall participate in CBMAs. Only households with plots immediately adjacent to the National Park benefit from this type of CMA.

A third opportunity for Parishes to benefit from proximity to RMNP is through revenue sharing projects. UWA sets aside 20 percent of revenues from gate receipts for allocation to Parishes living adjacent to protected areas. Parishes are required to put together proposals for the use of funds. The ability of all Parish members to benefit from the revenue sharing project is a requirement for approval by UWA. Examples of revenue sharing projects approved by UWA in 2006 in the Parish's in this study include:

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[15]Taungya is a Burmese word that means "shifting cultivation". It has been used throughout the tropics as a silviculture technique for maintaining cultivated tree crops.

afforestation, bee keeping and goat rearing initiatives; construction of multipurpose hall;

roofing and construction of classroom blocks; and purchase of parish hall furniture.[16]

Table 4: Characterizing CMAs, CMBAs and Revenue Sharing in RMNP 2006/2007 Fiscal Year

Village Name	Parish	District	Benefit Sharing MOU	Collaborative Boundary Management Agreement (Taungya)	Beneficiary of UWA Revenue Sharing Program
Kiraro	Kitholhu	Kasese	No	No	Yes
Kyanika	Maliba	Kasese	No	No	Yes
Masule B	Kilembe	Kasese	No	Yes	Yes
Nyarukamba	Kazingo	Kabarole	Yes	No	Yes
Kibwa A	Kitchwamba	Kabarole	No	No	Yes
Kabingo	Harugali	Bundibugyo	No	Yes	Yes

The relative success of CMAs is highly dependent upon the ability of the

authority in power to monitor and enforce the conditions of the agreement. UWA has

invested significant effort in the training   of community conservation and enforcement

rangers. The mandate of Uganda Wildlife Authority staff is forest and biodiversity

protection within the National Park. UWA has two types of staff at field stations:

enforcement rangers; and community conservation rangers. Because the ethnic group

that lives in the area is linguistically unique in Uganda, most UWA staff working in the

Park are from the same ethnic group (i.e. Bakonjo). To avoid creating opportunities for

collusion between forest rangers and local people, forest rangers are regularly

transferred to other field stations around the Park.

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[16] Source is UWA unpublished data on approved projects for revenue sharing around Rwenzori Mountains National Park, 2006.

The Uganda Wildlife Authority has a highly sophisticated system for collecting information about illegal activities within the Park. They have been well supported by donors and non-governmental organizations, and are using a GPS monitoring system to track illegal activities spatially. This allows them to focus their enforcement activities more effectively. Rwenzori Mountains National Park is 100,000 hectares and at the time of this research had 72 field staff or a ratio of 1 ranger for every 1388 hectares of Park, but the terrain in RMNP is only accessible by foot and is very steep.[17]

The Bakonjo people have lived in the Rwenzori Mountains for centuries. They have strong cultural tie the mountains both spiritually, and as a source of food and materials that enhance their welfare. However, activity in the Park including the illegal harvesting of timber, fuel wood, vines, hunting of bush meat etc threatens both plant and animal biodiversity. Even transiting through the Park without intention to harvest or hunt anything presents problems. People frequently transit with small livestock which threaten the health of wild populations of bush pigs, monkeys etc. In general, restrictions on harvesting low value forest products for subsistence use are not strictly enforced. Many members of communities adjacent to the Park harvest products including fuel wood, wild fruits and vegetables, mushrooms, and vines used for making Kikonjo baskets. The harvesting of sawn wood and bush meat is more strictly enforced. Many cases of informal collusion between UWA officials and rural households were observed in the study area, particularly with respect to the harvesting of subsistence products. Because the majority of UWA rangers working in the area are from the same

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[17] The ratio of staff to hectares of forest is considerable better than for most other forest types in Uganda including private forest (overseen by the District Forestry Services), and Central Forestry Reserves (overseen by the National Forestry Authority).

ethnic group, there is an element of cultural sympathy towards the needs of the Bakonjo people who have relied on harvesting and hunting within the area designated as the Park for several generations.

5. RESULTS

The focus of the quantitative analysis is on the effect of the CMA agreement between Kazingo Parish and UWA signed in 2005 on the contribution of environmental income to rural livelihoods. Of the three types of agreements between UWA and local resource users, benefit sharing agreements have the greatest potential to affect the income portfolios of rural households. The effect of participation in a formal collaborative management agreement with UWA is estimated using the difference-in-difference of means (Table 5). There have not been large changes in total annual household income in Nyarukamba Village where the CMA pilot was implemented.

Table 5: Double Difference Estimates of Impact of Collaborative Management Agreement[1,2]

Research Site	Collaborative Management Agreement with UWA		Control Group (i.e. no agreement)		Double Difference Statistic
Annual Household Total Income (UgShs.)					
Income Quartile	2007	2003	2007	2003	
	n=29	n=15	n=134	n=69	
0-25	218 841	128 292	258 623	127 480	-40 594
26-50	422 933	228 427	412 655	234 522	16 373
51-75	584 086	507 523	569 425	429 922	-62 940
76-100	970 613	927 869	1 076 318	969 289	-64 285
Average, all quartiles	628 069	465 334	557 312	437 321	42 744
Annual Household Forest Income (UgShs.)					
Income Quartile	2007	2003	2007	2003	
	n=29	n=15	n=134	n=69	
0-25	46 512	14 140	49 813	40 606	23 165
26-50	87 476	14 351	73 094	65 709	65 740
51-75	78 141	118 142	103 840	108 756	-35 085
76-100	128 134	381 674	202 664	281 406	-174 798
Average, all quartiles	93 271	139 926	103 246	123 273	-26 628
Share of Annual Household Income from Forests (percent)					
Income Quartile	2007	2003	2007	2003	
	n=29	n=15	n=134	n=69	
0-25	20.9	8.2	19.4	26.9	20.2
26-50	20.1	6.7	17.7	28.5	24.2
51-75	13.2	23.8	17.9	25.5	-3
76-100	13.5	43.5	17.9	28.2	-19.7
Average, all quartiles	16.0	21.4	18.3	27.0	3.3

1. Pre-CMA agreement estimates calculated from data collected by the Wildlife Conservation Society in 2003.
2. During the follow-up study the average exchange rate was 1 USD=1817 UgShs.

The average change in total household income for households in the CMA treatment group is approximately 42,000 UgShs or $23 USD. When the data are decomposed by income quartile there is not a discernable pattern regarding changes in total household income.

Double-difference mean statistics for both absolute and relative forest income indicate that the CMA has had an impact on the role of forests in income portfolios. While the overall effect of involvement in the CMA is limited (i.e. a decline of 26,000 UgShs. or an increase of 3.3 percent of the share of total income), there is a significant shift in the relative importance of forest income to different socioeconomic groupings of households. The general story that emerges is that poor households are obtaining more income from forests, and the relative importance of forest income to their total income is also increasing. The inverse pattern is observed for relatively wealthy households. Households in the highest income quartile have experienced considerable losses in forest income and the relative importance of forest income since 2003 prior to the implementation of the current CMA in the Parish.

An important question for this study is: What share of total forest income is coming from within RMNP? Unfortunately the baseline data used for this study could not be disaggregated by forest tenure. Data from the follow-up study are disaggregated according to whether forest income was harvested from within the National Park, or from private or community forest outside of the protected area (Table 6). Estimates for unprocessed forest products show that households in the CMA pilot Parish are obtaining a larger share of income from forests within the National Park. However, the total absolute income from unprocessed forest products for both the treatment and control groups is approximately 70,000 UgShs per household. Households from the treatment group are meeting a larger share of their unprocessed forest product needs by harvesting from within the National Park.

Processed forest products include sawn wood, household implements, wooden furniture, and woven goods including baskets and mats. Households within the treatment group derived significantly lower incomes from the National Park than households that are not part of a CMA. All harvesting for the production of higher value processed products including sawn wood is illegal without the permission of UWA officials.   The role of community members in self policing the six square kilometer area of the Park adjacent to their village is likely having an effect on harvesting patterns within the Park. The fact that there are not significant differences in income from processed forest products for which materials are harvested from private or community forest suggests that the CMA is having an effect on how households use the forest, and the degree of effort put into monitoring activities in the area they are responsible for.

Income from wild areas other than forests includes products harvested from fallows, bush land, wetlands etc. There are not significant differences in the absolute income obtained from other wild areas between the treatment and control groups. The data presented in Table 6 suggest that the CMA is having an effect on harvesting behavior that supports UWA objectives. Households in the Parish with the CMA are obtaining more subsistence forest products, and harvesting fewer materials for the production of processed forest products, which are generally illegal within the Park.

Table 6: Annual Adjusted Household Income Per Capita Income from Forests and Other Environmental Income

Adjusted	Location of Harvest	Collaborative Management Agreement with UWA	Control Group (i.e. no agreement)
Unprocessed forest products	RMNP	12 428*	4820
	Private and community forest	58 713*	67667
Processed forest products	RMNP	28 360*	61 192
	Private and community forest	25 470	23 368
Other environmental income (i.e. non-forest environmental income)	Other wild areas	45 153	50 522

1. * Indicates means for treatment and control samples are significantly different at 5 percent.

To further understand the influence of CMA agreements on household income from forests two regression models are estimated.[18] The first model estimates the conditional difference-in-difference for absolute forest income. The variable of primary interest is *CMA*time* which indicates whether the households was in the treatment group in the post intervention period. The model estimates a decline of approximately 23,000 UgShs. in forest income for treatment group households, though the finding is not statistically significant. In general this model does not explain absolute forest income very well.

The second model estimates the conditional difference-in-difference for relative forest income. The coefficient for the variable *CMA*time* indicates an increase of 4.6 percent in the share of household income from forests holding controlling for households characteristics and village level fixed effects. However, the coefficient is not significant. The two variables in the model indicating social capital (i.e. household head

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[18] Descriptive statistics for the variables used in the models are found in Appendix A.

Table 7: Conditional Difference-in-Difference Estimates of Forest Income and Share of Income from Forests, Pooled Tobit Regression Results[1]

Independent Variables	Annual Household Forest Income (UgShs.)	Share of Annual Household Income from Forests (percent)
	Full model (n=246)	Full model (n=246)
Treatment CMA	-19496.3	-19.4919***
Time	-23478.8	-8.37684***
Interaction CMA*Time	-22868.1	4.582257
Hectares of natural forest owned by household	12227.15	-0.35352
Hectares of arable land owned by household	2680.075	-0.29059
Female headed household	-31421.8	-1.34494
Household dependency ratio	-129.023	-0.00726
Education level of household head (cf. None)		
Some or completed primary	-985.981	1.227221
Secondary or above	11358.61	-2.08846
Household head has lived in village greater than 10 years	-51207.3	-6.58685*
Total value of assets, UgShs.	0.12567	4.85E-06
Total value of livestock, UgShs.	0.023956	-3.73E-06
Time to nearest forest (minutes)	-320.544*	-0.0618***
Village altitude (meters above sea level)	25.51088	0.034167**
Households/hectare in village	30661.84	-2.17008
Time to nearest market (minutes)	358.1906*	0.021162
Ethnic diversity in village (c.f. 1 ethnic group)		
2 or 3 ethnic groups	-4622.58	-11.3264***
Censored observations	19	19
AIC	24.85	8.11
BIC	4827	712
Pseudo R-Squared	0.0029	0.0235
Log-likelihood Ratio	-3038.38	-981.32

1. All models were checked for multicollinearity using the variance inflation factor (vif) test. The variance inflation factor is 2.02.

*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

longer than10 years in village, and greater ethnic diversity within the village) are

negatively and significantly correlated with a lower share of income from forests. This

finding suggests that social networks play a considerable role in the ability of households to access forest products. In both models, as expected, the time to the nearest forest is negatively and significantly correlated with forest income. Households that have to travel further to get to forests will be less reliant on them.

6. CONCLUSION

This paper explores the effect of entering in to a collaborative management agreement with the Ugandan Wildlife Authority on income portfolios of households living adjacent to Rwenzori Mountains National Park. The expectation is that benefit sharing agreements will lead to increased forest income for households.

The analysis demonstrates that while the average changes in absolute and relative forest income are not that large, decomposing the data by income quartiles reveals that relatively poor households have increased their forest income since 2003, and relatively wealthy households (i.e. those in the highest quartile) have experienced significant declines in forest income. While this trend is common to the larger sample (i.e. when considering patterns of change in the control group villages), the magnitude of the change is greater for households in Nyarukamba village.

Exploring sources of unprocessed and processed forest product income by tenure category demonstrates that treatment group households are obtaining more income from the National Park than households that are not involved in CMAs. Further, households in the treatment group are not obtaining significant income from obtaining materials for processed forest products from within the Park. The patterns in the data suggest that households are benefiting from the ability to legally harvest subsistence

forest products, and contributing to protecting Park resources through their limited use harvesting of materials for processes forest products, and their contribution to monitoring activities within the Park. These findings point to a potential win-win outcome for this particular CMA.

Regression results estimating the effect of participating in the CMA controlling for household characteristics and village level fixed effects were not significant. However, the regression results point to the importance of social capital as a determinant of forest income. The communities adjacent to RMNP are ethnically homogenous. This means that households who are new to villages, or households headed by members of other ethnic groups may find it more difficult to obtain permission to harvest forest products from forests of all ownership types including those within the National Park.

While the findings presented in this paper point the potential success of the pilot CMA with respect to raising forest income for relatively poor households, securing benefit streams of subsistence forest products for household's, and limiting illegal activity within zones adjacent to villages participating in CMAs, a few points are worth noting. First, Nyarukamba is a showcase village. It was purposively selected by UWA to pilot CMA agreements due to its willingness to work with UWA, strong leadership, history of success with projects etc. Second, the time to negotiating a functional agreement between UWA and Parish members was very long; in this case it was 11 years. The transaction costs associated with that level of negotiation are tremendous and not sustainable across all of the Parishes surrounding RMNP. Third, it is very easy for households in Nyarukamba village to obtain permission from UWA to harvest products. The outpost is located in a trading center at the base of the mountain; village

27

members pass through the trading center on a regular basis. The average distance

from village centers to UWA outposts among the 6 study villages is 5 kilometers is

considerably further and involves walking across steep terrain.

This paper uses a rigorous research design and high quality household level data

to assess the influence of a specific collaborative management agreement on the

livelihoods of the rural poor. The findings suggest that a well functioning CMA, such as

has been negotiated in Kazingo Parish in Rwenzori Mountains National park can

enhance livelihood opportunities for the rural poor.

Appendix A: Descriptive Statistics for Variables Used in Regression Analysis[1,2]

Variable	No. of obs.	Mean	Stand. dev.	Min	Max
Baseline Data (WCS 2003)					
Adjusted total income, UgShs.	83	445779	360619	43648.97	1901478
Adjusted forest income, UgShs.	83	127669	188720	0	924882
Share of income from forests, %	83	26.3	24.9	0	91.0
Natural forest owned, hectares	83	0.03494	0.14	0	0.8
Arable land owned, hectares	83	0.64	0.68	0	4
Female headed households	83	0.02	0.15	0	1
Education level of household head (cf. None)					
Some or completed primary	83	0.62	0.48	0	1
Secondary or above	83	0.18	0.38	0	1
Dependency ratio	83	158	80	0	400
Household head has lived in village greater than 10 years	83	0.90	0.29	0	1
Value of assets, UgShs.	83	46867	82579	0	340000
Value of livestock, UgShs.	83	122722	220828	0	1621000
Minutes to nearest forest	83	82	57	12	360
Follow-up data (Jagger 2007)					
Adjusted forest income, UgShs.	163	569901	386345	143171	3369500
Adjusted total income, UgShs.	163	101471	111864	0	848030
Share of income from forests, %	163	17.9	10.7	0	59.9
Natural forest owned, hectares	163	0.24	0.47	0	2.42
Arable land owned, hectares	163	1.67	1.35	0	8.90
Female headed households	163	0.11	0.32	0	1
Education level of household head (cf. None)					

Some or completed primary	163	0.50	0.50	0	1
Secondary or above	163	0.25	0.43	0	1
Dependency ratio	163	149	114	0	700
Household head has lived in village greater than 10 years	163	0.90	0.29	0	1
Value of assets, UgShs.	163	97882	128757	0	945000
Value of livestock, UgShs.	163	156969	216668	0	1550000
Minutes to nearest forest	163	58	51	0	240
Village level fixed effects					
Altitude, meters above sea level	6	1688	161	1417	1872
Households per hectare	6	0.37	0.19	0.16	0.73
Minutes to nearest market for consumption goods	6	95.60	62.31	10	195
Ethnic diversity in village (c.f. one ethnic group)					
2 or 3 ethnic groups	6	30.08	45.49	0	1

1. During the follow-up study the average exchange rate was 1 USD=1817 UgShs.
2. The dependence ratio is the number of household members under 15 years plus the number of household members over 65 years divided by the number of members between 15 and 65 years of age. The ratio is then multiplied by 100.

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