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Contribution Behaviour Towards Collective Management of Common Pool Forest Resources in Western Kenya

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Introduction

Kenya has a forest cover of 1.7% and the rate of deforestation and degradation is still high. Of great interest nationally and internationally, is Kakamega forest in western Kenya due to its richness in biological diversity (Muller and Mburu, 2008). The forest cover has declined from 24,798 ha in 1933 when it was gazetted to 11,848 ha in 2004 mainly due to illegal activities such as logging and charcoal burning as well as pressure from the surrounding communities who depend on it for their livelihoods (BIOTA, 2004; Muller, 2007). Unless this trend is slowed and reversed, livelihood sources of many of the poor communities living around the forest would be reduced and green house gas emissions from forest loss would contribute to global warming. One of the commonly cited reasons for the continued deforestation is the lack of involvement of the local communities by the central government in managing forest resources adjacent to them (Lung and Schaab, 2006; Guthiga, 2007). To address this, the government of Kenya revised and enacted a new forestry policy in 2007 to provide for the involvement of adjacent communities through collaborative forest management (CFM). Specifically, the government transfers forest user rights to the local communities through organized community forest associations (CFAs) who have a viable/approved forest management plan. In the event that the government confers a CFA the rights to manage specific parts of the forest, those forest areas technically assume some 'common property characteristics' and may become victims of Hardin's tragedy of the commons (1968) due to free riding behaviour and over exploitation. For CFM to be successful, community members should behave cooperatively yet literature indicates that this is not always the case as communities are not composed of homogeneous groups who act in the interest of the larger society (Ostrom, 1999; Plummer and Fennell, 2006). The presence of institutions can shape and enhance cooperation under strategic interactions involving the management of the commons (Ostrom, 1990). Available evidence from laboratory experiments shows that sanctioning rules can significantly improve cooperation among participants (Fehr and Gachter, 2000; Fehr and Rockenbach, 2004; Gürerk *et. al.,* 2006). Therefore the key question is: What would be the likely behavioral patterns (cooperation levels) of individual households regarding the conservation of common pool forest resources under different institutional arrangements in the field setting?

Methodology

Field-based economic experiments have been shown as powerful methodological tools for capturing many behavioral aspects of interest like cooperation within the context of iterated

strategic interactions (Axelrod, 1997; Gintis, 2002; Carpenter, *et al.,* 2005; Axelrod, 2006). In order to analyze and understand the level of cooperative behaviour and institutions to control un-cooperative behaviour, we conducted economic experiments using 133 randomly[1] selected household heads from villages surrounding Kakamega forest in western Kenya. In the experiments, participants were first randomly put into two groups and each person was endowed with 10 money units (MUs) from which they were instructed to contribute any amount ranging from 10 (everything) to 0 (nothing) towards a group conservation kitty. For instance, an individual who contributes x MUs would have kept (10-x) MUs for himself. Each group's aim should be to have as much funds as possible in their group kitty for purposes of financing conservation activities of their hypothetical common pool forest resource. The pay-offs (each MU had a value[2] Ksh 1 or US $ 0.01) were designed such that pay-offs were highest per group member if each contributed everything (i.e. 10 MUs) to the kitty and vice versa. To calculate individual pay-off after each round, the total contributions (y) per group were doubled (2y) (i.e. earned an interest of 100%), and then shared equally amongst all the group members (n) to get the individual dividends from the group (2y/n). In this case the individual pay-off (which was paid in Kenya shillings at the end of all the 12 rounds) becomes the sum of the amount of tokens he kept for himself and the dividends from the group i.e. (10-x) + (2y/n). Twelve rounds of the game were played under two scenarios: without sanctioning rules (rounds 1-6) and with sanctioning rules (rounds 7-12). Under the sanctioning scenario, a subject who contributed more than five tokens (> 5) was considered a cooperator while whoever contributed 5 and less tokens was regarded as a defector (non-cooperator). In each round, a non-cooperator was punished by way of deducted 2 MUs from his pay-offs. Records of individual contributions per round were displayed on a flipchart using secret IDs allocated to each participant. An analysis was done for both socioeconomic characteristics of the participants and (non) cooperative behaviour using the SPSS (version 17) program. Summary results are presented in the form of tables and graphs.

Results and Discussion

Table 1 presents some of the key socioeconomic variables in this study. The mean age of the participants was 45 years while the the average household size was 5. This poses challenges in terms of land holding for future generations given the fact that the main source of land in the area is through inheritance. This in turn leads to land subdivision, low food production and productivity due to shortened or no fallowing of land to regain fertility since use of chemical fertilizers is still low. Additionally, the large families in western Kenya in general and Kakamega in particular have lead to a lot of pressure being exerted on forest resources mainly through extraction and conversion (for farming) a phenomena that threats the existence of biodiversity and contributes to global warming. The education level was very low (8 years) which is equivalent to a primary school certificate. This high illiteracy level leaves many households with the option of the low earnings from the informal and subsistence farming sector. Average land holding per head was less than 1 acre (0.7 acre) while the major household asset in the study area was livestock with each household owning on average 4 cows (3.6 livestock units). Livestock units at the household level were calculated using the following equivalents: cattle (cow/oxen) = 1, donkey = 1.2, sheep/goat = 0.1, pig = 0.2 and chicken = 0.02 (Karugia *et. al.,* 2006).

[1] This study was conducted within the framework of the third phase (Oct 2007-Sept 2010) of the Biodiversity Monitoring and Transect Analysis (BIOTA) Project which is funded by the Germany Federal Ministry of Education and Research (BMBF). The sampled households (23 females and 110 males) for the experiments came from 223 households whose socioeconomic data was collected (and therefore available) through an intensive household survey conducted by Guthiga (2007) and Wambua (2006) during the second phase of BIOTA project.

[2] The exchange rate used was Ksh 75 against the US dollar

Table 1: Major socioeconomic characteristics of the households

Variable	Mean	Std. Dev.	Min	Max
Age of the household head (Years)	44.77	9.43	22.00	60.00
Size of the household	5.37	1.78	2.00	10.00
Education of the household head (Years)	7.65	3.29	0.00	16.00
Land per-capita (Acres)	0.71	0.64	0.05	5.33
Distance to the forest (Km)	3.51	1.89	0.10	8.00
Livestock units	3.51	3.02	0.00	15.20
Value of forest products	2,617.85	10,838.85	0.00	88,800.00
Income per-capita	21,663.82	22,806.50	1,460.00	108,871.40

N = 133

Overall annual per-capita income was Ksh 21,664 (US $ 288.85) per annum with the mean per-capita income for the poor (63% of the households) being Ksh 8,273 (US $ 110.30) and the non poor (37% of the households) being Ksh 44, 620 (US $ 594.93) (Table 2). In terms of livelihood sources, Kakamega forest was relatively more important to the poor than to the non-poor whose share of total household income was 5% and 2% respectively. Employment (formal, informal and self) and farm income (crops and livestock products) contributed about 25% and 65% to overall income. This underscores the importance of farming and the potential threat to forest land in the face of population increase.

Table 2: Relative share (%) of various sources to total annual household income

	Below poverty line (poor)[3]	Above poverty line (non-poor)	All
Income source	n = 84 (63.2%)	n = 49 (36.8%)	N = 133 (100%)
Employment (%)	20.92	31.27	24.73
Farm (%)	67.94	58.74	64.55
Forest products (%)	4.71	1.52	3.53
Other (%)	6.43	8.47	7.18
Total	100.00	100.00	100.00
Income per-capita (Ksh)	8,272.73	44,619.98	21,663.82

There was a significant difference (p = 0.000) between mean contributions without sanctioning rules (5.13 MUs) and with sanctioning rules (7.31 MUs) (Table 3). In other words the presence of sanctioning rules increased voluntary contributions for conservation from 51% to 73% by reducing free riding behaviour. This underscores the importance of sanctioning rules and their enforcement if high cooperative levels are to be expected under social dilemma situations like the conservation of common pool resources. Some of the reasons cited for keeping about 50% of the tokens for themselves under the non sanctioning scenario included buying food for the family and payment of fees among other basic household requirements. Hence participants were trying to strike a balance between private (household) and social (communal) needs.

[3] The rural poverty line used was Ksh 52 (US $ 0.70) per day. The rural and urban poverty lines in Kenya is Ksh 1,565 (US $ 20.87) and Ksh 2,913 (US $ 38.84) per person/month respectively (Republic of Kenya, 2008). This translates into Ksh 18,780 (US $ 250.40) and Ksh 34,956 (US $ 466.08) per person/year for rural and urban areas respectively.

Table 3: Mean contributions without (rounds 1-6) and with sanctioning rules (rounds 7-12)

Variable	Mean	Std. Dev.	Min	Max
Contributions without rules (tokens)	5.13	2.18	0.10	9.83
Share of contributions without rules (%)	51	22	7	98
Pay-offs without rules	15.09	2.17	9.67	20.50
Contributions without rules (tokens)	7.31	2.27	1.33	10.00
Share of contributions with rules (%)	0.73	0.23	0.13	0.99
Pay-offs with rules	17.28	2.30	10.33	22.33

N = 133

Mean contributions and pay-offs followed a similar trend (Figure 1) i.e. whenever contributions in a particular round increased, the payoffs also increased and vice versa. For example in round 6, an increase in contributions from 5.7 MUs to 6.8 MUs lead to an increase in pay-offs from Ksh 15.0 to Ksh 16.2. This supports the individual rational (maximizing) behaviour where an increase in the individual's expected stream of net benefits from a shared resource would lead to the active participation (devotion of time and resources) of the individual in the conservation activities and efforts of the resource.

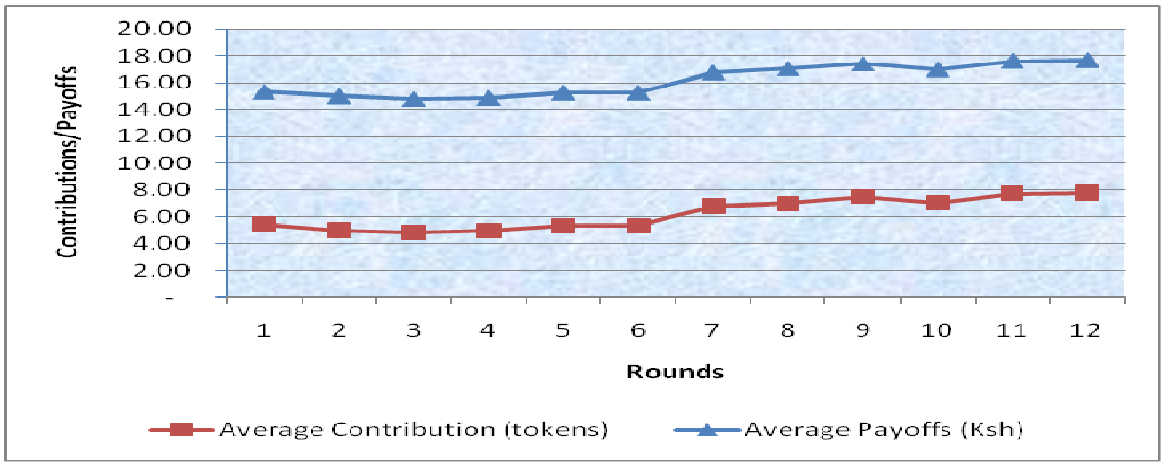

Figure 1: Relative trends of individual contributions and corresponding payoffs over the 12 rounds

An analysis of the cooperation levels shows that sanctioning rules lead an increase of cooperators from 50% to 81% (Table 4). Further, these results imply that even without punishment rules, cooperative behaviour could be expected in Kakamega district and that by virtue of having in place sanctioning rules, 100% cooperation should not be anticipated either. This means that even under unlikely situation of perfect monitoring, the society would have to come to terms with some level of free riding behaviour. In such a situation, the community could either device some way of limiting the access to and use of the common resource access by free riders who don't reform after several warnings or keep raised the sanctioning level (cost) to the level that instills the expected norm among most if not all the community members.

Table 4: Mean contributions by cooperators (> 5 tokens) and defectors (5 and less tokens) without (rounds 1-6) and with sanctioning rules (rounds 7-12)

		N	%	Mean	%	Std. Dev	Min	Max
Without rules	Cooperators	67	50.4	6.9	69.1	1.2	5.2	9.8
	Defectors	66	49.6	3.3	33.3	1.2	0	5
	Total	133	100	5.1	51.3	2.2		
With rules	Cooperators	107	80.5	8.2	82.2	1.4	5.2	10
	Defectors	26	19.5	3.6	35.8	1.1	1.3	5
	Total	133	100	7.3	73.1	2.3		

Conclusions and Policy Implications

By virtue of using actual stakeholders as subjects, field experimental results fill an important void left by lab experiments whose main subjects are usually students. Results show the importance of sanctioning institutions as well as a high probability of a free rider being caught in enhancing cooperative behaviour in social dilemma situations. Results also revealed the importance of interactions among well known participants like relatives, neighbours, and villagers in stimulating cooperative behaviour either for purposes of establishing/maintaining good reputation or fear of being segregated by the larger community in general social and cultural events. Great care must however be taken while generalizing the results because free riding behaviour may take place at night like charcoal burning and logging when monitoring is low. Further, cases of corruption between free riders and monitoring agents (e.g. forest guard) may lead to the persistence of free riding behaviour and eventual degradation of the resource in question. Under such circumstances, a holistic approach may need to pursued in order of reduce the degradation of the resource. For instance, the government may support, facilitate and coordinate a community-based monitoring team which works in harmony with the government hired monitoring agents who in most cases are from outside the community.

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