PARTICIPATORY FOREST MANAGEMENT FOR MORE THAN A DECADE IN TANZANIA: DOES IT LIVE UP TO ITS GOALS?

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ABSTRACT

In Tanzania, Participatory Forest Management (PFM) was introduced in order to address the challenge of deforestation which continues at alarming rate. Equally, PFM aimed to involve communities adjacent to forests in management of forest resources while at the same time accrue economic benefits. PFM consists of Community Based Forest Management (CBFM) and Joint Forest Management (JFM). CBFM takes place on village land, in forests that are owned by the village while JFM takes place in Central or Local Government forest reserves (FRs) whereby owner of the FR and adjacent communities jointly manage and share benefits accrued from the FR. This study aimed to assess the role of PFM in sustainable exploitation of forest resources, equitable economic benefits and good forest governance. Generally, the study concludes that PFM can and does contribute to sustainable utilisation of forest resources and that, households across wealth categories benefit economically from PFM. However, there is a slight tendency that the rich benefit more than the poor. Similarly, the study concludes that, while CBFM and JFM have formally established appropriate institutions for PFM, this has not promoted enfranchisement and inclusiveness. The problem of elite capture in PFM should be addressed through information and education.

Key words: Participatory Forest management, bio-physical sustainability, socio-economics, governance, Tanzania.

INTRODUCTION

Forests are naturally endowed with numerous resources that are valuable to mankind. It is estimated that forests and woodlands cover about 48 million ha in mainland Tanzania representing about 55% of the total land area (Mgoo 2013). Tanzania's forests however face many challenges including deforestation and forest degradation. Deforestation was estimated at 400,000 ha per annum between 1990 and 2013 (FAO 2011; Mgoo 2013). The underlying causes of deforestation include rapid population growth, poverty, policy and market failures (FAO 2009). FAO (2012) lists additional causes of deforestation and forest degradation which include inadequate recognition within national laws and jurisdiction of the rights and needs of forest-dependent communities and insecure land tenure.

Since early 1990s, Tanzania has made significant steps towards the improvement of management of its forest resources through the introduction of PFM which was piloted in various geographical locations including Duru-Haitemba (Northern Tanzania), Mgori (Central Tanzania) and Angai (South-Eastern Tanzania). Inspired by proceedings of PFM pilot projects, in 1998 Tanzania approved a National Forest Policy which aimed at promoting substantial change in the way forests are managed (URT 1998). The policy was followed by the enactment of the Forest Act Cap 323 [R.E. 2002] which provides legal basis for communities to own, manage, or co-manage forests under a wide range of conditions and management arrangements (URT 2002).

PFM entails two pillars namely Community Based Forest Management (CBFM) and Joint Forest Management (JFM). CBFM takes place on village land, on forests that are owned or managed by the Village Council on behalf of Village Assembly leading to Village Land Forest Reserves (VLFRs), Community Forest Reserves (CFRs) or Private Forest Reserves (PFRs) (URT 2007a). Under JFM, Village Government and Central or Local Government jointly manage and share benefits accrued from Central or Local Government's FR (URT 2007b). Forests either gazetted or in village land outside such institutional arrangement are regarded as non-PFM forests. Generally, PFM aims at contributing to (i) improved forest condition, (ii) improved livelihoods, and (iii) improved forest governance. The objectives are also referred to as PFM triple objectives.

Tanzania has seen PFM expanding rapidly for more than a decade (Figure 1). Official statistics show that by 2013 over 2,285 villages on mainland Tanzania were already involved in establishing and managing village forests covering more than 7.6 million ha (Mgoo 2013). On the other hand, by 2013 over 245 gazetted FR were under JFM arrangement covering nearly 5.4 million ha. To examine whether PFM lives to its triple objectives, literature shows that previous studies have examined the role of PFM on forest conservation (Blomley *et al* 2008, Lund and Treue 2008, Persha and Blomley 2009, Nielsen 2011), opportunity costs (Meshack *et al.* 2006), and livelihoods (Lund and Nielsen 2006, Lund and Treue 2008, Lund 2007, Vyamana *et al.* 2008, Vyamana 2009, Nielsen and Treue 2012). Other studies have examined the influence of PFM on forest governance (Goldman 2003, Mustalahti 2006, Brockington 2008, Nielsen and Lund 2012).

However, previous studies on PFM are based on fragmented objectives which have been carried out at small scale leading to disjointed results and conclusions. Accordingly, our understanding on whether PFM lives up to its triple objectives remains limited. This is why this study which covered 12 sites including 7 CBFM, 3 JFM and 2 non-PFM sites located in Eastern, Northern and Southern Tanzania was undertaken as an attempt to answer the following research questions (i) Does PFM contribute to sustainable exploitation of forest resources? (ii) Does PFM contribute to equitable economic benefits? and (iii) Does PFM promote good forest governance? The forest governance question comprises the following sub-questions: (a) To what extent do different household categories participate in PFM governance decisions? (b) How do households of different wealth categories evaluate their knowledge about PFM? and (c) How do households of different wealth categories evaluate quality and outcome of PFM rules? Answers to such questions are expected to benefit further implementation and scaling up of PFM in the country.

STUDY AREA AND METHODS

Study area

The study was implemented in 12 sites (7 CBFM, 3 JFM and 2 non-PFM forests).

Figure 1 and Table 1 summarise and show geographical locations of study sites. The sites cover different ecological zones. The sites were selected so as to ensure inclusion of a variety of ages of PFM based on year of establishment (1994 – 2008), primary forest use (commercial, subsistence) and market access (weak, strong).

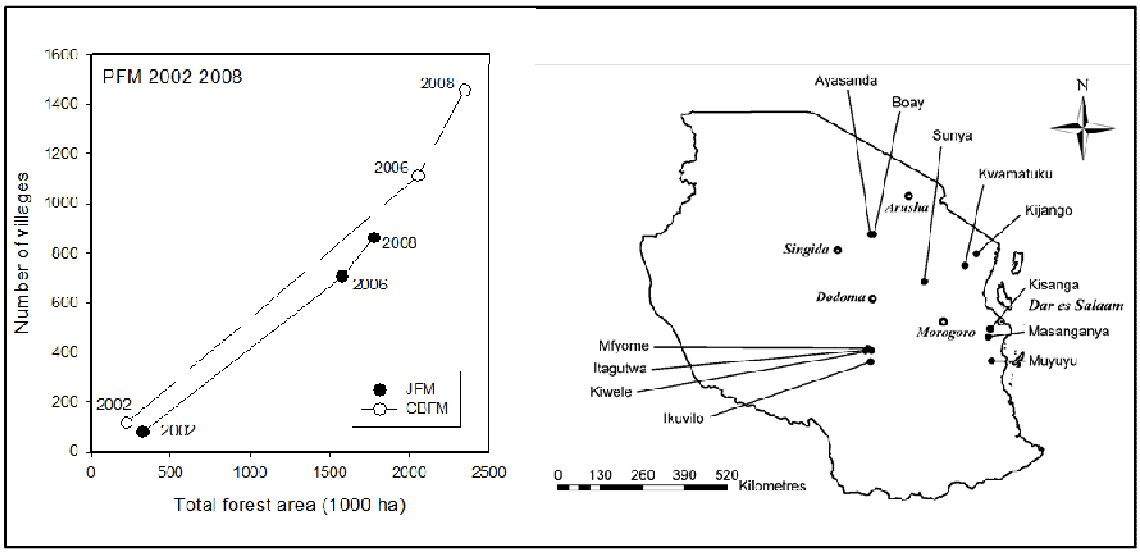

Figure 1: Development of PFM in mainland Tanzania and study sites

Methods

Data collection

Data collection was carried out in 12 forests and villages (Table 1). Data collection was carried out in the dry seasons between 2007 and 2010. The dry seasons were selected to facilitate participation of farmers who are less occupied at that time of the year. Similarly, dry seasons were considered convenient for forest inventory. The study aimed at gathering three data sets of data namely forest condition, livelihood and forest governance. The triple data sets were captured through forest and household surveys. Besides, GIS polygons for administrative wards (where PFM operates) and human population estimates based on 2002 census (NBS 2002) were acquired for the purpose of assessing sustainability of harvesting in Tanzania's PFM forests at national scale.

Forest survey

Forest condition data was collected through plot based forest survey. Such data included stem numbers, basal area, growing stock, tree size and canopy cover. Similarly, data on harvesting levels were collected through measurement and assessment of stumps.

Table 1: Study sites and basic forest attributes

	Forest Description						Geographical location		
Village name	Forest name	Vegetation type	Management system	PFM established	Forest area	No. of plots	District name	Lat. (S)	Long. (E)
Ayasanda	Duru-Haitemba	Miombo	CBFM	1994	550	20	Babati	4.38°	35.71°
Kijango	Mfundia VFR	Miombo	CBFM	2001	119	15	Korogwe	4.93°	38.59°
Kisanga	Kisanga VFR	Coastal	CBFM	1998	101	15	Kisarawe	7.01°	38.99°
Kiwele	Kidundakiyave	Miombo	CBFM	2002	4 904	69	Iringa Rural	7.59°	35.54°
Kwamatuku	Ntumbili VFR	Miombo	CBFM	2008	125	15	Handeni	5.24°	38.30°
Mfyome	Gangalamtumba VFR	Miombo	CBFM	2002	6 065	69	Iringa Rural	7.55°	35.59°
Sunya	Suledo FR	Miombo	CBFM	1994	10 000†	30	Kiteto	5.68°	37.16°
Boay	Bereko FR	Miombo	JFM	2000	1 491‡	25	Babati	4.37°	35.76°
Itagutwa	Kitapilimwa	Miombo	JFM	2002	3 699	25	Iringa Rural	7.57°	35.67°
Muyuyu	Ngumburuni FR	Coastal	JFM	2004	2 999	25	Rufiji	7.89°	39.03°
Ikuvilo	Lugala MT	Miombo	Non-PFM	n/a	199	15	Iringa Rural	7.91°	35.68°
Masanganya	Masanganya FR	Coastal	Non-PFM	n/a	2 989	25	Kisarawe	7.22°	38.92°

† Total area of Suledo Forest Reserve is 167 000 ha; Sunya's part is 10 000 ha (the sampled area)
‡ Total area of Bereko Forest Reserve is 5 373 ha; Boay's part is 1 491 ha (the sampled area)

The study employed circular sample plots with a radius of 15 m (0.071 ha) for live trees and 20 m (0.126 ha) for stumps. Number of sample plots ranged from 15 to 30 per forest resulting into sampling intensity of 0.08 to 0.1 % for live trees and 0.14 to 0.17 % for stumps (Table 1). To ensure randomization, a systematic grid was created and projected on a map of each forest. Starting points were decided randomly and the remaining plots defined by the grid.

In each plot, the following data was recorded: diameter at breast height (dbh) (i.e. 1.3 m above ground) for all trees (≥ 5 cm dbh), all stumps (≥ 5 cm basal diameter) and total tree height for two trees, located nearest to plot centre and the thickest tree within a plot. Where possible, species (trees and stumps) were identified by local names. Age of stumps was assessed by local informants based on colour, degree of decay together with their knowledge on harvesting activities. Stump age was assessed based on the following categories: 1 – 2, 3 – 5, 6 – 10 and > 10 years old. The size and age of stumps were used to derive an average estimate of forest extraction for the past 10 years.

Household survey

Prior to household survey, all households in the study villages were categorised into three wealth classes namely rich, medium and poor. This was achieved through group meetings including key informants, village and sub-village leaders who, based on locally established wealth criteria, categorised each household in an updated village register. After wealth categorization by using village register, households were sampled from each wealth category. To allocate sample households in different wealth classes to make up 40 samples size, proportional sampling technique was used. Care was taken to ensure inclusion of households from different parts of the village.

In each household, the head was interviewed following a structured questionnaire based on recollection of the past year's (12 months) economic activities, specifically information about households' annual income sources including the use of environmental products. Environmental products mean non-cultivated wood and non-wood biological products (firewood, charcoal,

pole, timber, withies, wild fruit, mushrooms, etc.) derived from PFM and non-PFM forests, farmland including fallows and non-forest, non-farmland areas such as open savannah. Other elicited data included those aimed at answering research questions on livelihood (annual income by sources) and forest governance.

To estimate woody biomass annual out-take by village members from inventoried PFM and non-PFM forests, all local units of woody biomass (head load, bag of charcoal, pole and plank) were measured in metric value (Kg and m^3) and later converted into round wood equivalent through literature based conversion factors. This was done through measurement of 176 bags of charcoal and 154 planks in Iringa, Manyara, Pwani and Tanga while 288 head loads of firewood and 346 poles were measured in villages where the study was carried out.

Data analysis

Analyses were carried out using a combination of Microsoft access, excel and SAS 9.2 statistical software.

Forest condition data

Estimation of standing and harvested biomass based on forest survey involved the use of local, forest specific regression models relating stump diameter to dbh and total tree height in combination with Malimbwi's (1994) volume model for miombo woodlands. Estimates of harvested biomass use based on household data were derived by using conversion factors developed from measurements in this study as well as available literature. Estimation of harvesting sustainability and potential of PFM to meet local demands for wood involved the use of field data from 16 permanent sample plots of sizes ranging from 0.04 to 0.9 ha. These data were used to estimate growth of miombo woodlands compared with published data (Chidumayo 1998, Malimbwi *et al*. 2005). Where the estimated harvesting rates exceeded the assumed growth rate, extraction levels were deemed unsustainable.

To assess sustainability of harvesting in Tanzania's PFM forests at national scale, the national survey of PFM status in the country was imported into GIS. This enabled linking of PFM forests to GIS polygons for administrative wards and human population estimates of 2002. By extrapolating the wood consumption needs of the human population within selected wards based on field survey data, and the estimated forest growth rates, it was assessed whether the individual PFM forests might be large enough to meet subsistence demands for wood in that area, should all other sources of wood be exhausted. The results provide a simple estimate of whether PFM forests are capable of supplying the wood requirement to associated communities without compromising their long-term survival.

Livelihood and forest governance data

Livelihood and governance data analysis was preceded by standardisation of wealth classes across sites from local interview wealth categorization to asset based. This was done in order to allow comparability across sites. After that, all Tanzanian Shilling values were converted to USD PPP (Purchasing Power Parity). All income values (USD PPP) were further standardized to adult equivalent units (AEU) as described by Cavendish (2002) in order to account for differences in household composition and size. Environmental income is derived from both cash and subsistence environmental products. Since governance questions appeared to be sensitive to discuss, not all respondents answered all questions. The associated limitations were overcome by turning answer categories into binary

variables i.e. YES/NO and further analysed employing Pearson correlation techniques.

RESULTS AND DISCUSSION

Does PFM contribute to sustainable harvesting of forests?

Results show that the mean volume of the growing stock varies considerably between forests from a minimum of 12 m^3ha^{-1} to a maximum of 185 m^3ha^{-1} across all the forests with no apparent, significant difference between PFM and non-PFM forests (Table 2). The current condition of the individual forests is partly determined by exploitation which took place before the establishment of PFM e.g. Kitapilimwa and Ntumbili or by the forests' proximity to large urban areas which are likely to be under considerable pressure due to high market forces e.g. Kisanga, Masanganya and Ngumburuni.

Table 2: Forest stocking and extraction of wood resources

Village	Forest	Management regime	Forest stocking			Wood extraction ean volume ($m^3ha^{-1}yr^{-1}$)
			Stem density ($stemsha^{-1}$)	Basal area (m^2ha^{-1})	Volume (m^3ha^{-1})	
Muyuyu	Ngumburuni	JFM	448	16.7	185	2.160
Itagutwa	Kitapilimwa	JFM	751	6.6	32	0.029
Boay	Bereko	JFM	613	9.8	77	1.060
Mean			*604*	*11.1*	*98*	*1.1*
Ayasanda	Duru-Haitemba	CBFM	468	10.9	86	2.770
Sunya	SULEDO	CBFM	375	6.8	48	0.240
Kijango	Mfundia	CBFM	3504	13.0	65	0.870
Kisanga	Kisanga	CBFM	352	2.4	12	2.960
Kiwele	Kidundakiyave	CBFM	779	9.1	47	0.004
Kwamatuku	Ntumbili	CBFM	320	5.5	35	1.240
Mfyome	Gangalamtumba	CBFM	988	11.6	63	0.160
Mean			*970*	*8.5*	*51*	*1.2*
Ikuvilo	Lugala Mt.	Non-PFM	777	7.8	34	0.410
Masanganya	Masanganya	Non-PFM	460	9.7	95	6.740
Mean			*619*	*8.8*	*65*	*3.6*

Data from stump survey show that harvesting is taking place in all study forests regardless of management regime. Harvesting rates are highly variable, in four forests namely Duru-Haitemba (2.77 $m^3ha^{-1}yr^{-1}$), Kisanga (2.96 $m^3ha^{-1}yr^{-1}$), Ngumburuni (2.16 $m^3ha^{-1}yr^{-1}$) and Masangaya (6.740 $m^3ha^{-1}yr^{-1}$) exceed sustainability level of 1.5 $m^3ha^{-1}yr^{-1}$ (Table 2). With the exception of Duru-Haitemba, other forests with high level of extraction (Kisanga, Ngumburuni and Masanganya) are close to Dar es Salaam, the commercial city of Tanzania. Findings from this study are in line with previous studies in Tanzania which have documented devastating forest impacts due to the demands of Dar es Salaam and other cities (Malimbwi *et al.* 2005, Ahrends *et al.* 2010, Pfliegner 2011).

Based on stump survey, in other forests (Kidundakiyave, Gangalamtumba, Sunya (SULEDO), Kitapilimwa and Lugala Mt.) which apparently are located in remote areas, extraction of wood resources appears to be sustainable (Table 2). Although wood extraction takes place in Kidundakiyave and Gangalamtumba

VLFRs, results indicate that forest management system controlled by effective and committed local leaders is effectively managing harvesting intensity. The abundance of forest resources which surround households in Sunya plausibly explains the relatively low wood-outtake by villagers from the Sunya forest. Bereko and Kitapilimwa both JFM forests are utilised below sustainability level of 1.5 $m^3ha^{-1}yr^{-1}$ (Table 2). Introduction of PFM in Bereko has served as a catalyst for controlled harvesting while the same has improved forest protection in Kitapilimwa and based on stem density, the forest is currently regenerating (Table 2) indicating that the forest is recovering from previous disturbance. Lugala Mt., a non-PFM forest shares many features with Kitapilimwa (a JFM forest) whilst Ikuvilo's forest is poorly stocked most likely due to heavy harvesting in the past. A recent reduction in harvesting explains the observed widespread regeneration (Table 2). Overall, from the forest stocking and annual removal data, it suffices to deduce that wood resource harvesting in decreasing intensity follows the following order non-PFM, JFM and CBFM. This categorically demonstrates the role of PFM in contributing to improved forest condition. Findings from this study support Blomley *et al*. (2008)'s conclusion that PFM is showing signs of delivering impact in terms of improved forest condition in Tanzanian forests.

Data from household survey revealed that on average wood consumption is about 0.7 m^3 annually per capita. When annual per capita wood consumption of 0.7 m^3 is used on the sample of 116 wards in the hypothetical scenario, assuming that PFM constitutes the only remaining forest resources, only 29% (34 out of 116 wards) would have access to at least 0.7 ha per capita which is needed if the increment is 1.0 $m^3ha^{-1}yr^{-1}$. Should the growth be at 2.0 $m^3ha^{-1}yr^{-1}$, 47% (55 out of 116 wards) would have access to the needed 0.35 ha per capita or more. Therefore, if an average village inhabitant in Tanzania requires around 0.7 m^3 wood per annum in order to meet his or her wood requirements and the forests in Tanzania grow at 1.0 $m^3ha^{-1}yr^{-1}$ to 2.0 $m^3ha^{-1}yr^{-1}$, then every villager requires 0.35 to 0.7 ha of forest for sustainable utilization. This estimate provides a simple rule of thumb for estimating the size of forest area required to meet peoples' demands of wood resources in future. Based on the derived estimate, it is likely that many, if not the majority of existing PFM forests are too small to supply villagers with the needed wood resources.

Does PFM contribute to equitable economic benefits?

To answer the question on the role of PFM in improving economic status of people, data were analysed by wealth category which are summarised in Table 3. Stratifying the analysis into different wealth categories aimed at examining if PFM contributes to equitable economic benefits. Data in Table 3a shows that all households depend on agriculture and business as their sources of income. However, in absolute terms, agriculture and business are significantly more important to the rich category than the poor. Environmental income which mainly comes from PFM forests is the third important source of income for the rich and the medium category while it is the second most important source of income for the poor. However, in absolute terms, environmental income contributes about USD PPP 35 per AEU for all wealth categories (Table 3a). This suggests that, environmental income is important for all wealth categories. Results further demonstrate that there is no clear difference on the contribution of environmental income between CBFM and JFM for all wealth categories. Despite that, JFM contributes slightly higher to the poor than CBFM. Generally, this shows both

PFM pillars, CBFM and JFM play an important role in livelihoods of forest dependants and that findings from this study are in line with previous studies reported in Tanzania and beyond where PFM is being practiced (Lund and Treue, 2008; Vyamana *et al*. 2008; Pfliegner, 2011; Gobeze *et al*. 2009).

Table 3a: Importance of income sources by wealth category

WG	Forest regime	Agricultural income		Livestock income		Wage income		Business income		Environmental income	
		USD PPP AEU^{-1}	%	USD PPP AEU^{-1}	%	USD PPP AEU^{-1}	%	USD PPP AEU^{-1}	%	USD PPP AEU^{-1}	%
R	CBFM	301	48	162	7	35	7	345	53	40	16
	JFM	194	34	213	16	14	14	151	22	33	14
	Non-PFM	96	36	15	26	1	3	124	26	25	9
	Mean	*240*	*42*	*150*	*13*	*24*	*8*	*260*	*41*	*36*	*14*
M	CBFM	161	48	46	6	24	9	102	19	35	18
	JFM	90	34	35	9	24	12	103	28	32	18
	Non-PFM	126	50	34	12	27	10	41	13	35	16
	Mean	*137*	*45*	*41*	*8*	*24*	*10*	*92*	*20*	*34*	*17*
P	CBFM	99	39	23	13	37	14	58	13	37	21
	JFM	56	29	14	8	23	14	69	19	37	34
	Non-PFM	91	38	12	24	24	8	16	9	37	20
	Mean	*87*	*36*	*19*	*14*	*31*	*13*	*54*	*14*	*37*	*24*

WG = Wealth category, R = Rich, M = Medium and P = Poor, AEU = Adult Equivalent Unit

The 14% contribution of environmental income to the rich category compared to 17% and 24% for the medium and poor category respectively is likely to suggest that forests which are the prominent source of environmental income are of no greater importance to the rich category (Table 3b). However, this would be wrong since data in Table 3 reveal that livestock is the second most important source of income to the rich, contributing USD PPP 150 per AEU compared to USD PPP 41 per AEU and USD PPP 19 per AEU for the medium and the poor respectively. The reason for this is that forests are important livestock grazing area across PFM and non-PFM sites. Moreover, qualitative data shows that a common strategy for rural households to improve their economic status is to purchase livestock as an investment which particularly the case when agriculture yields surplus. Such strategy would be difficult to pursue in the absence of forests as grazing areas.

Table 3b: Importance of environmental products

Forest regime	Timber	Charcoal	Firewood	Other products	Cash	Subsistence
	%	%	%	%	%	%
CBFM	2.3	6.6	91.0	0.2	7.6	92.4
JFM	0.6	1.8	95.3	2.3	2.3	97.7
Overall mean	*1.7*	*4.9*	*92.5*	*0.9*	*5.8*	*94.2*

Table 3b summarises results on the importance of environmental products. These demonstrate that both CBFM and JFM contribute significantly more to subsistence income than cash income with firewood by far being the most important environmental income. Similar results were observed in a previous study by Njana *et al.* (2013).

Does PFM promote good forest governance?

In this study, whether PFM in the form of CBFM or JFM promotes good forest governance was assessed by asking households a series of governance related questions. According to Kjaer (2004), governance means setting of rules, application of rules and enforcement of rules. Accordingly, forest governance is the process that shapes the rules, their application and enforcement including adjudication. Similarly, good forest governance contributes to whether PFM objectives (forest condition and livelihoods) are met. Positive answers including "*yes*", "o*k*" or "*to some extent*" to the questions in Tables 4-6 were tested for correlation with wealth class by comparing each of the three categories with the combination of the two others. Significant positive correlations at 1%, 5% and 10% levels are coded as '↑↑↑', '↑↑' and '↑' respectively. Down pointing arrows indicate negative correlation.

Tables 4 - 6 show that in CBFM sites, the poor households generally participated less in, think they know less about and are less satisfied with PFM rules while the almost exact opposite was the case for the richest households.

Results on various forest governance questions are summarised in Tables 4, 5 and 6. Arrows indicate correlation between wealth categories and forest governance questions when all households across CBFM and JFM sites respectively are considered. When all wealth categories are compared in CBFM sites, results show that the rich participated significantly (p < 0.01, 0.05, 0.1) more than medium and poor households in PFM governance (Table 4). Conversely, no correlation was observed between wealth category and participation for most of governance questions in JFM except that rich households participated significantly more than medium and poor households at 10% level of significance (Table 4). This suggests that, irrespective of management regime, the rich households as opposed to the medium and poor have a greater control of forest institutions at local level because they are more involved than the other wealth categories and therefore play key role in local forest institutions.

Results presented in Table 5 summarise knowledge of PFM by households in different wealth categories. The results show that while in JFM sites no correlation existed between wealth categories and questions on knowledge of PFM, in CBFM sites rich households have significantly more knowledge of PFM than medium and poor households (Table 5). Worth noting in this case is 1% significance good overview of income and expenditure of the environmental/forest committee among the rich households (Table 5).

Table 4: Involvement in PFM governance

Governance related questions (involvement in governance and monitoring of decision-makers)	CBFM sites (n = 280)			JFM Sites (n = 120)		
	Poor (n = 112)	Medium (n = 112)	Rich (n = 56)	Poor (n = 48)	Medium (n = 48)	Rich (n = 24)
Did someone from your household participate in electing the first committee?			↑			
Did you/your household participate in developing the first set of PFM rules?	↓↓↓		↑↑			↑
Do you participate in general meetings that include issues of PFM?	↓↓↓		↑↑↑			
Have you participated in PFM related training?	↓↓↓		↑↑			
Do you monitor decisions of the committee by reading minutes?	↓↓		↑↑↑			

Results also show signs of elite capture in CBFM sites whereby rich households are more informed about PFM than the medium and poor households while no similar pattern of results were observed in JFM sites.

Table 5: Knowledge of PFM

Governance related questions (Perceptions of own knowledge level)	CBFM sites (n = 280)			JFM Sites (n = 120)		
	Poor (n = 112)	Medium (n = 112)	Rich (n = 56)	Poor (n = 48)	Medium (n = 48)	Rich (n = 24)
Do you think that you know enough about forest management to participate?	↓↓↓		↑			
Do you have a good overview of incomes/expenditures of the committee?	↓↓		↑↑↑			

With respect to rules, transparency and accountability, a similar pattern of results is observed whereby in JFM almost no correlation was observed between questions on rules, transparency and accountability and wealth categories (Table 6). Two issues showed positive correlation; firstly rich households think that they have been able to influence present PFM rules significantly more than the medium and poor households at 10% significance level (Table 6). Secondly, rich and medium wealth categories were in favour of how PFM money is spent at 5% and 1% significance respectively (Table 6). A similar pattern of results is observed in CBFM sites, rich households compared to medium and poor, are significantly happier with changes in PFM rules, ability to influence PFM rules, transparency and accountability of local PFM institutions (Table 6).

Generally, results on forest governance show that, there is elite capture in CBFM forests. These findings are comparable with previous results reported by Vyamana *et al.* (2009) in Tanzania and Malla *et al.*

(2003) in Nepal. Malla *et al*. (2003) concluded that poorer households were found to benefit significantly less than wealthier households and in some cases may even have been directly disadvantaged by the advent of community forestry in their villages.

Table 6: Rules, transparency and accountability

Governance related questions	CBFM sites (n=280)			JFM Sites (n=120)		
	Poor (n=112)	Medium (n=112)	Rich (n=56)	Poor (n=48)	Medium (n=48)	Rich (n=24)
Are you happy with the most recent change in PFM rules?			↑↑			
Do you think that you have been able to influence present PFM plan/rules?			↑			↑
Do you think that the present PFM plan/rules consider all villagers' needs?			↑↑			
Do you think that decisions made by the committee are clearly communicated to the villagers?	↓↓		↑↑			
Do you think that incomes/expenditures are clearly communicated to the village?			↑			
Do you think that the committee spends money in a sensible manner?	↓↓↓		↑↑↑	↓↓↓	↑	↑↑
On the whole, do you trust the committee?	↓					

Therefore, elite capture may lead to economic differentiation among households at local level since involvement in decision making directly affect distribution of economic benefits and hence livelihoods.

CONCLUSIONS AND RECOMMENDATIONS

Generally, the study concludes that PFM can and does contribute to sustainable utilisation of forest resources. In all except Ayasanda (Duru-Haitemba, CBFM), villagers' harvesting rates were below the forests' regenerative capacity. This closely agrees with common pool resource management theory which suggests that *if* downwardly accountable local forest institutions get legally secure, long term, exclusive and enforceable rights to forests where sustainable management is economically feasible *then*, providing a reasonable system of checks and balances is in place, harvesting rates are likely to be guided by the limits of sustainability. However, irrespective of formal management regime (CBFM or JFM), forests close to market centres (e.g. Dar es Salaam) are at risk of being heavily exploited.

Linking field data to the national PFM database enabled construction of the first estimates of potential sustainability of biomass from PFM forests to villages across the country. This shows that if all villages' woody biomass needs were to be

derived exclusively from PFM forests, most (at least 53%) of these would be too small. Accordingly, if towns and cities were also to be supplied on a sustained yield basis, this would require substantially larger PFM forests.

While all wealth categories benefit economically from PFM, there is a slight tendency that the richest benefit more than the poorest. Since the poorest households have generally participated less in PFM activities, they feel that they know less about and are less satisfied with PFM rules - particularly in areas where CBFM is implemented. Thus it seems likely that there is an elite capture problem in economic benefits at the local level which deserves further future attention.

The study nevertheless sees that PFM is a cost effective and efficient approach which should be ideal for development partner support as it incurs some initial costs (mapping of areas for PFM and establishment of village-level environmental committees) while the maintenance costs (forest management) are small. Hence, the Government of Tanzania should promote and expand PFM particularly in remote areas where CBFM or JFM institutions are able to control access to the forests. Accordingly, PFM forests should be large and close enough to village settlements in order to make the economics of sustainable utilisation attractive.

The study also concludes that environmental income is significantly important to all wealth categories contributing 14% of rich, 17% of medium and 24% of poor households' total annual income. In addition, all households irrespective of wealth category derive almost equal values from the environment (USD PPP 35 per AEU). More than 90% of this contribution to rural incomes comes from firewood and escapes official national accounts. Similarly, the study concludes that, PFM forests provide opportunities for economic diversification and improvement for rich and medium households' economic welfare through livestock keeping. Since environmental income contributes significantly to rural income, the study recommends that environmental income becomes part of the official Gross Domestic Product statistics in Tanzania.

Regarding forest governance, the study concludes that while CBFM and JFM have formally established appropriate institutions for PFM, this has not promoted enfranchisement and inclusiveness. This is evident whereby in CBFM forests, elites particularly the rich have captured decision making processes (e.g. making of PFM rules) and more informed/involved in PFM governance than medium and poor wealth categories. In JFM forests where the Government dictates the rules, elites who constitute the rich have a control on common funds. The problem of elite capture in CBFM suggests consolidation of pre-PFM power structure at village level. In a true democracy, the majority can only be manipulated by a minority if the majority are illiterate and ignorant of rule and regulations. Accordingly, elite capture in PFM should be addressed through information and education such that the poor and to some extent the medium households may enhance their share of income through democratic processes.

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