DECENTRALIZED FOREST MANAGEMENT IN UGANDA: LOCAL COMMUNITIES' PARTICIPATION AND FOREST SUSTAINABILITY

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ABSTRACT

Many countries, including Uganda, adopted forest decentralization as national policy for improving local people's livelihoods and promoting forest sustainability. And both local communities' participation in forest management and access to forest resources greatly impact their livelihoods. Indeed, the Uganda Forestry Policy of 2001 and the National Forestry and Tree Planting Act of 2003 stipulate improvement of livelihoods and public participation in forest management in addition to promoting forest sustainability. Despite the inception of forest decentralization in Uganda in early 2000,it was not well understood whether decentralized forest management was improving local communities' livelihoods and enhancing forest sustainability, hence this study. The objectives were to: (i) Assess local communities' participation in decentralized forest management and their access to forest resources, (ii) Stratify and quantify Uganda's forest cover extent since 2002, and (iii) Assess and map the spatial distribution of Uganda's forest cover dynamics since 2002. Social survey data collected between 1997 and 2008 by Uganda Forestry Resources and Institutions Center were subjected to descriptive and content analysis. Secondary data was also examined. Landsat Enhanced Thematic Mapper Plus imagery for 2002, 2006 and 2009 each covering 1,509,328 ha were classified using unsupervised techniques and subjected to post-classification comparison change detection. Local communities were generally not actively participating in decentralized forest management and their access to forest resources remained unchanged and mostly illegal. Forest cover declined by 4.5% between 2002 and 2006 and by 32.8% between 2006 and 2009 while overall forest cover decline between 2002 and 2009 was 35.8%. Land cover conversion from non-forest to forest and vice-versa also revealed net forest cover loss between 2002 and 2009. A visual assessment showed a clustered forest cover loss spatial distribution. Forest decentralization did not substantially contribute to local people's livelihoods and promotion of forest sustainability. There is therefore an urgent need for sustainable forest management interventions and full implementation of the Uganda Forestry Policy

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of 2001 and the National Forestry and Tree Planting Act of 2003 could be a good starting point in this endeavor.

Key words: Forest Decentralization, Local Communities' Participation, Forest cover dynamics, Landsat, Lake Victoria crescent-Uganda

INTRODUCTION

Decentralization usually refers to the transfer of powers from central government to lower levels in a political-administrative and territorial hierarchy (Crook and Manor, 1998). The goals of decentralization include provision for regional autonomy, diffusion of political and social tensions (Banana *et al*., 2004), and increasing efficiency, equity and democracy (Larson, 2005; Banana *et al*., 2004). With regard to local people, the most important goals of decentralization are enabling greater control over livelihoods and a greater share of other natural resource benefits. These are expected to be achieved through bringing government closer to the people and increasing local participation as well as government accountability (World Bank, 1988, 1997, 2000; Manor, 1999). The other goal of forest decentralization is promotion of sustainable forest management.

Many countries including Uganda adopted forest decentralization as national policy for increasing local people's access to forest resources in addition to increasing their participation in forest management, both vital prerequisites for improved local people's livelihoods. Most of Uganda's population (85.1%) is in rural areas (UBOS, 2008) and generally poor, thus heavily dependent on natural resources like forests for meeting its basic needs (Mwavu and Witkowski, 2008). These include among others medicine, crafts and furniture, food and flavoring, firewood and charcoal, building materials and timber (Kayanja and Byarugaba, 2001; MWLE, 2001, 2003; UNEP, 2008). Hence decentralization of forest management was viewed as a precondition for improved livelihoods. However, access to these products has to be done in a sustainable manner.

In Uganda, decentralization of the forest sector has been on and off since the 1940s. Banana *et al*. (2004) gives a background to the decentralization reforms of Uganda's forest sector from the 1940s to 1995, a period which has seen forest decentralization being on and off for different reasons. The most recent implementation of decentralization in Uganda came with the enactment of the Local Government Act in 1997 which decentralized all services across all sectors except forestry. This was because decentralization of forest management had been suspended in 1995 in ten districts where it had been piloted since 1993 because of the perceived lack of capacity by district councils to manage forest resources (Banana *et al*., 2004). According to Glen *et al*. (2004), the Forest Department was not delivering up to public expectations in terms of managing Uganda's forestry resources. It was characterized by lack of transport, working funds, motivation and a clear mission. This was manifested through insufficient forest protection, investments, private sector and local community involvement. As a result of a forestry sector restructuring process started around 1998, a new Uganda Forestry Policy was formulated in 2001 (The Republic of Uganda, 2001) followed by a new National Forest Plan in 2002 and enactment of The National Forestry and Tree Planting Act in 2003 (The Republic of Uganda, 2003). These new government instruments again decentralized forest management in Uganda (Banana et al., 2004; Glen et al., 2004).As a consequence, forest reserves were categorized into Central Forest Reserves (CFR) whose management mandate was vested in National Forestry Authority (NFA) and Local Forest Reserves (LFR) whose management mandate was vested in District Forestry Services (DFS) within District Local Governments. District

Forestry Services were also mandated to offer technical support to private land owners and communities in the management of forests in addition to licensing all produce from local forest reserves and private forests.

Both the Uganda Forestry Policy of 2001 and the National Forestry and Tree Planting Act of 2003 stipulate improvement of livelihoods and public participation in forest management while promoting sustainable forest management. However, since the inception of decentralized forest management around 2003, it was not well understood whether decentralized forest management was improving local communities' livelihoods and enhancing sustainable forest management in Uganda. It was therefore important to assess the impact of decentralized forest management in Uganda. The objectives were to: (i) Assess local communities' participation in decentralized forest management and their access to forest resources, (ii) Stratify and quantify Uganda's forest and other land cover extent since 2002, and (iii) Evaluate and map the spatial distribution of Uganda's forest and other land cover dynamics since 2002. Knowledge of the impacts of decentralized forest management in Uganda was hoped to enhance the contribution of decentralized forest management to local people's livelihoods and sustainable forest management.

STUDY AREA

The study area is located between 0˚8´S and 0˚42´N and between 32˚5´and 33˚32´E. It encompasses all or parts of Mayuge, Iganga, Jinja and Kamuli districts in eastern Uganda and all or parts of Kayunga, Mukono, Luwero, Kampala, Wakiso, Mpigi, Mityana, Nakaseke and Kiboga districts in central Uganda. The study covers an area of 1,509,328 ha (Fig.1). In this study, this area is referred to as Lake Victoria crescent as most of it surrounds Lake Victoria. This area was selected because of being one of the most forested but also densely populated areas with the local population heavily dependent on forest resources for human livelihood needs. This area also includes a number of sites established by Uganda Forestry Resources and Institutions Center (UFRIC) following International Forestry Resources and Institutions (IFRI) research program (Ostrom, 1998) protocols. The selected sites included Butto-Buvuma site with its associated Butto-Buvuma Central Forest Reserve and Namungo site with its associated Namungo Private Forest in Mpigi district, Masaka site with its associated Jubiya Central Forest Reserve in Masaka district and Mityana site with its associated Kajjonde Central Forest Reserve in Mityana district. Indeed, the presence of many central and local forest reserves in addition to private forests in the Lake Victoria crescent was a major justification for selection of the study area as it would facilitate the analysis of decentralized forest management with respect to each of the forest categories. It was also the area for which imagery with less cloud cover since 2002 could be obtained.

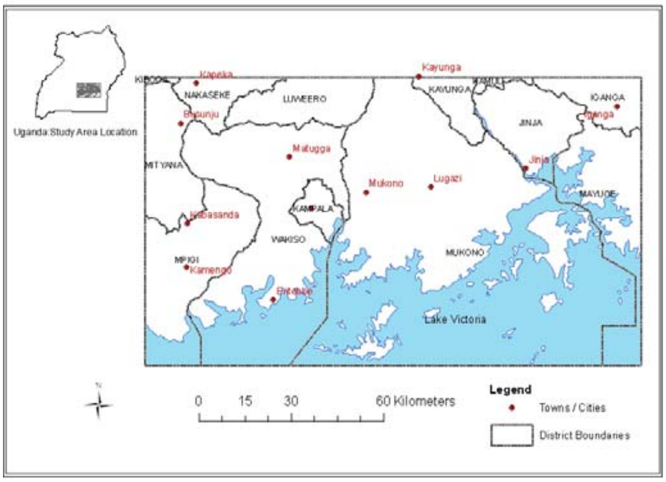

Fig.1 Study Area

DATA COLLECTION

Social data acquisition

This study utilized data collected by UFRIC based on IFRI protocols (Ostrom, 1998). The IFRI protocols allow collection of both forestry inventory and social data about forests, their users and management, although this study mainly focused on social data. Social data was collected using Participatory Rural Appraisal (PRA) methodologies including group discussions and individual interviews with local residents, officials and other relevant individuals. Secondary data was also obtained from various local and national offices. Butto-Buvuma site data was collected in 2001 and 2005 while Namungo site's data was collected in 1997 and 2004. Masaka site data was collected in 2002 and 2008 while Mityana site data was collected in 2000 and 2008. These sites were purposefully selected in such a way that each site possessed data collected before and after implementation of decentralized forest management to facilitate an evaluation of whether forest decentralization's had impacted local people's participation in forest management and / or their access to forest resources.

Variables in the IFRI database that were examined included major changes between visits and any policies (past, present or pending) affecting and or impacting utilization of forests by local users, forest user groups, forest associations and /or other governance relationships as captured on the Site Overview Form. Other variables examined were from the Forest Form and included major changes in forest system since last visit, harvesting rights of legal forest owner and rules related to maintaining and monitoring the forest. Additionally, the forester's appraisal of the overall condition of the forest in terms of commercial and subsistence values together with an assessment of the type of conservation measures adopted in relation to each forest were considered. Comments about the forester's estimate of the most serious problems the forest users and those responsible for the forest would face during the next five years and an estimate of the greatest opportunities the forest users and those responsible for managing the forest would face during the next five years were evaluated.

Despite the presence of many local forest reserves in the study area, UFRIC had not collected any data about them. As such, key informant interviews were held with people knowledgeable with local forest reserves' management and utilization. Key-informants were also interviewed about other issues including central and private forests' management and utilization, in addition to the constraints and opportunities facing decentralized forest management.

Image data acquisition

Landsat 7 Enhanced Thematic Mapper (ETM) imagery corresponding to Path 171 Row 060 (p171r060) which covers the study area (Fig.1) were obtained from United States Geological Survey (USGS). The image dates and their corresponding cloud cover percentages in brackets included 27 November 2001 (4), 09 July 2002 (5), 23 February 2005 (0), 25 January 2006 (0), 10 February 2006 (0), 28 July 2009 (13), 01 January 2009 (15), 29 August 2009 (26), 27 September 2008 (10), 16 December 2008 (43), 16 February 2008 (23) and 17 January 2009 (1).Efforts were made to obtain images with as low cloud cover as possible in addition to obtaining images from one season to reduce seasonal effects. Although some of the scenes exhibited high cloud cover, the scene portions corresponding to the study area were either clear or low in cloud cover.

DATA ANALYSIS

Social data analysis involved descriptive and content analysis. Content analysis which refers to any systematic reduction of a flow of text (recorded language) to a standard set of statistically manipulable symbols representing the presence, the intensity, or the frequency of some characteristics relevant to social science (Markoff *et al*., 1975) was deemed appropriate for assessing local communities participation in decentralized forest management and their degree of access to forest resources in addition to determining constraints and opportunities facing decentralized forest management.

Image analysis involved pre-processing and classification**.** Since all the time-series image datasets were in the same coordinate system (WGS 1984 UTM Zone 36N), no reprojection was performed. The 2002 time-series dataset was created by sub-setting the 27 November 2001 and 09 July 2002 images to extract cloud-free subsets which were then mosaicked. The 2006 and 2009 time-series data exhibited data gaps manifested as strips as a result of the failure of the Landsat 7 scan-line corrector (SLC) on May 31, 2003. Hence, the 2006 and 2009 time-series data were SLC-off. It was therefore necessary to perform gap-filling before any other processing could be performed on these images. This was done using NASA's Frame_and_Fill_win32 program (Irish 2009). The 10 February 2006 image was used as the anchor (base) image for the 2006 time-series with the 25 January 2006 and 23 February 2005 images as fill scenes 1 and 2 respectively. On the other hand, the 17 January 2009 image was used as the anchor (base) image for the 2009 time-series with the 28 July 2009, 27 September 2008, 16 February 2008, 16 December 2008, 01 January 2009 and 29

August 2009 images as fill scenes 1, 2, 3, 4, 5 and 6 respectively. All the 2009 time-series dataset fill scenes exhibited relatively high cloud cover. However, most of the cloud cover was outside the study area and therefore was not expected to greatly affect the output 2009 filled scene. The 2002, 2006 and 2009 time-series images were then subset or clipped to conform to the extents of the study area. Additionally, the 09 July 2002 image was also subset to conform to the study area.

Unsupervised classification (Jensen 1996) utilizing the Iterative Self-Organizing Data Analysis Techniques (ISODATA) was performed on each time-series image including the 09 July 2002 image. Unsupervised classification was deemed appropriate because of the inaccessibility of ground and or reference data such as aerial photographs that would aid in the selection of training points, a prerequisite for supervised classification. Unsupervised classification was implemented using ERDAS IMAGINE software version 9.2. The number of spectral classes was set to 30 with a convergence threshold of 0.95. Spectral classes were labeled and recoded to generate classified images with 3 classes (open water, forest and non-forest) and 2 classes (forest and non-forest). A majority statistical filter (3 by 3 pixels) was applied to the recoded images to reduce “salt and pepper” effect of scattered isolated pixels to create the final time-series classified images with exception of 2002 image. The 2002 final time series classified image was created by mosaicking the 2002 classified and filtered image with a subset of the classified and filtered 09 July 2002 image which further minimized cloud cover effects. Area statistics associated with the final classified images were computed.

Due to limitations with collecting in-situ field data for classification accuracy assessment, reference data was extracted from the three original time series unclassified images i.e. 2002, 2006 and 2009 (Wynne et al. 2007). This involved randomly locating 699 points within the study area. Each point was visually (manually) classified as open water, non-forest or forest with respect to each of the five original unclassified 432 false color composite images to create a classification accuracy assessment reference dataset (Lung and Schaab 2010). High resolution historical imagery from Google Earth was used in verifying the reliability of the visual accuracy assessment. This involved importing the 699 random points into Google Earth. Using the historical imagery time slider in Google Earth to select imagery that corresponded with the time series imagery, a sub-sample of the 699 points was interpreted as open water, non-forest or forest to create another reference dataset.

In conformance with standard accuracy assessment techniques, error matrices were produced and used to compute user’s accuracy, producer’s accuracy and overall accuracy for each classification. In addition, for each classification, kappa (κ) was computed to determine how much better the classification was than chance alone (Campbell 2007). The equation used for computing kappa was:

$$\kappa = \frac{Observed - Expected}{1 - Expected}$$

where: Observed = Overall value for percent correct and

Expected = Estimate of the contribution of chance agreement to the observed percent correct

In order to determine the reliability of each of the computed kappa statistic, a Z-score based on kappa variance was computed (Congalton and Green 1999). The equation used was:

$$Z_{\kappa} = \frac{\kappa}{\sqrt{\mathrm{var}(\kappa)}}$$

where: κ = kappa statistic

var (κ) = kappa variance

Change detection

Post-classification comparison change detection (Coppin et al. 2004) on a pixel by pixel basis was implemented using the binary (forest and non-forest) time series classification images to obtain spatial and quantitative information about periodic conversions of land cover from forest to non-forest and vice-versa. The time series comparisons were 2002 to 2006 and 2006 to 2009.

RESULTS

Local people's participation in decentralized forest management and their access to forest resources

In all central forest reserves, restrictions in terms of rules related to maintaining and monitoring forests existed before and even after introduction of decentralization. These rules and regulations mainly restricted the involvement of local people in forest maintenance and improvement, infrastructure changes, types of seeds or seedlings to be planted and harvesting of forest produce, especially commercial harvesting. The control of these forest activities which was initially vested in Forest Department was just transferred to National Forestry Authority after the initiation of forest decentralization. This scenario was reported in Butto-Buvuma, Kajjonde and Jubiya Central Forest Reserves.

In Butto-Buvuma Central Forest Reserve, there was some form of collaborative or joint management during the time when the defunct Forest Department was still in place but the initiative collapsed. Of recent, it was reported that NFA started a National Community Tree Planting Program (NCTPP) where the local communities were involved. However, local community member were reported to have killed the planted trees when the rainy season started in need of land for food growing. Additionally, In Butto-Buvuma and other central forest reserves, efforts to involve local communities in forest management have revolved around allocation of forest land to private individuals to establish plantation forests. However, this opportunity has been mainly utilized by people other than local community members who have the resources to develop the plantations. This is reported to have increased forest encroachment by local community members because they feel they are being alienated from forests and their resources.

Before and after introduction of decentralized forest management, the participation of local communities in the management of Namungo private forest was dependent on the wishes of the forest owner. And local communities generally had no major involvement in management of the forest except the fact that the forest owner, Mr. Namungo, granted them access to the forest for all non-commercial activities. Additionally, Mr. Namungo remained the sole decision maker with regard to what activities took place in his forest. This was, however, contrary to the National Forestry and Tree Planting Act of 2003 stipulation requiring private forest owners to liaise with DFS in the management and utilization of their forests (The Republic of Uganda, 2003).

Interviews with key-informants about local forest reserves revealed that local people were also not actively engaged in the management of local forest reserves. And in all cases, there was no clear indication of any attempts to involve local people in local forest reserves management.

Access to forest resources varied from one site to another. Results from Masaka site revealed strict enforcement of forest rules by NFA during the 2008 visit as compared to the 2002 visit. As a result, there was a decrease in illegal forest activities such as harvesting as immigrants who had exacerbated illegal forest harvesting activities departed. Additionally, the high cost of permits to legally use the forest for activities such as animal grazing led to reduced forest access and hence reduced forest use. In Mityana site, rapid forest degradation due to uncontrolled illegal forest products harvesting (timber, firewood, charcoal and sand) and cultivation in Kajjonde Central Forest Reserve by local communities surrounding the reserve was reported in the 2008 site visit as compared to the 2001 site visit. This was attributed to the absence of appropriate forest management structures. Butto-Buvuma site also continued experiencing illegal harvesting activities with even young trees (pole-sized trees) being harvested for charcoal burning and firewood after the inception of forest decentralization in 2003. These illegal activities continued despite the ban on all non-licensed commercial activities such as charcoal burning, commercial firewood and timber harvesting in all forest reserves that was in place when the forests were under the defunct Forest Department and continued to be enforced by both NFA and DFS. Indeed, the requirement of permits issued by NFA or DFS was reported as a hindrance to legally accessing forest resources as permits could only be obtained at a financial cost which most local people could not afford.

Namungo private forest was also no exception to deterioration in condition between 1997 and 2004 due to continued harvesting of timber, commercial firewood and agricultural encroachment, a manifestation of increased people’s access to forestry resources. Indeed, all local users were free to use Namungo’s private forest for non-commercial activities without seeking permission from the forest owner, Mr. Namungo. However, the introduction of decentralized forest management placed restrictions on the forest owner especially with regard to harvesting and transporting of forest products activities in that permission had to be sought from DFS. And it was generally revealed through the key-informant interviews that local people generally gained more illegal access to local forest reserves as a result of decentralization.

Despite the increased illegal access to forest resources after the institutional reforms, forest resources were less abundant. This was exemplified by Mityana's 2008 site visit in which it was reported that poverty had increased as compared to the 2002 site visit because of forestry resources over-exploitation as a result of laxity in forest management thus leading to reduced availability of forest resources.

Stratification and quantification of Uganda's forest and other land cover extent since 2002

Three land cover classes namely open water, non-forest and forest (Fig.2) were discriminated through unsupervised classification of the Landsat imagery for 2002, 2006 and 2009. A quantitative examination of the composition of each discriminated land cover class in the entire study area encompassing 1,509,328 ha revealed that forest cover ranged from 94,355 ha (6.3%) in 2002 to 60,547 ha (4.0%) in 2009. Meanwhile, non-forest cover ranged from 921,284 ha (61.0%) in 2002 to 958,141 ha (63.5%) in 2009. Open water varied from 493,689 ha (32.7%) in 2002 to 490,640 ha (32.5%) in 2009 (Table 1).

Table 1 Land cover class area composition for 1989, 1995, 2002, 2006 and 2009

Land Cover Class	2002		2006		2009	
	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
Forest	94,355	6.3	90,090	6.0	60,547	4.0
Non-forest	921,284	61.0	930,757	61.7	958,141	63.5
Open Water	493,689	32.7	488,478	32.4	490,640	32.5
Total	1,509,328	100	1,509,325	100	1,509,328	100

Accuracy assessment

Based on a visual comparison of the same 699 random points in the study area between the classified images and their corresponding original satellite images, producer's accuracy for forest class averaged 85.8% while user's accuracy averaged 89.9% for all classifications. This was in comparison with producer's accuracy for non-forest and open water classes which averaged 98.8% and 99.8% while their user's accuracy averaged 98.5% and 99.4% respectively. Overall accuracy ranged from 98.1% to 98.9%.The kappa statistic ranged from 0.95 to 0.98 for all classifications with all associated Z-scores greater than 1.96 (Table 2).

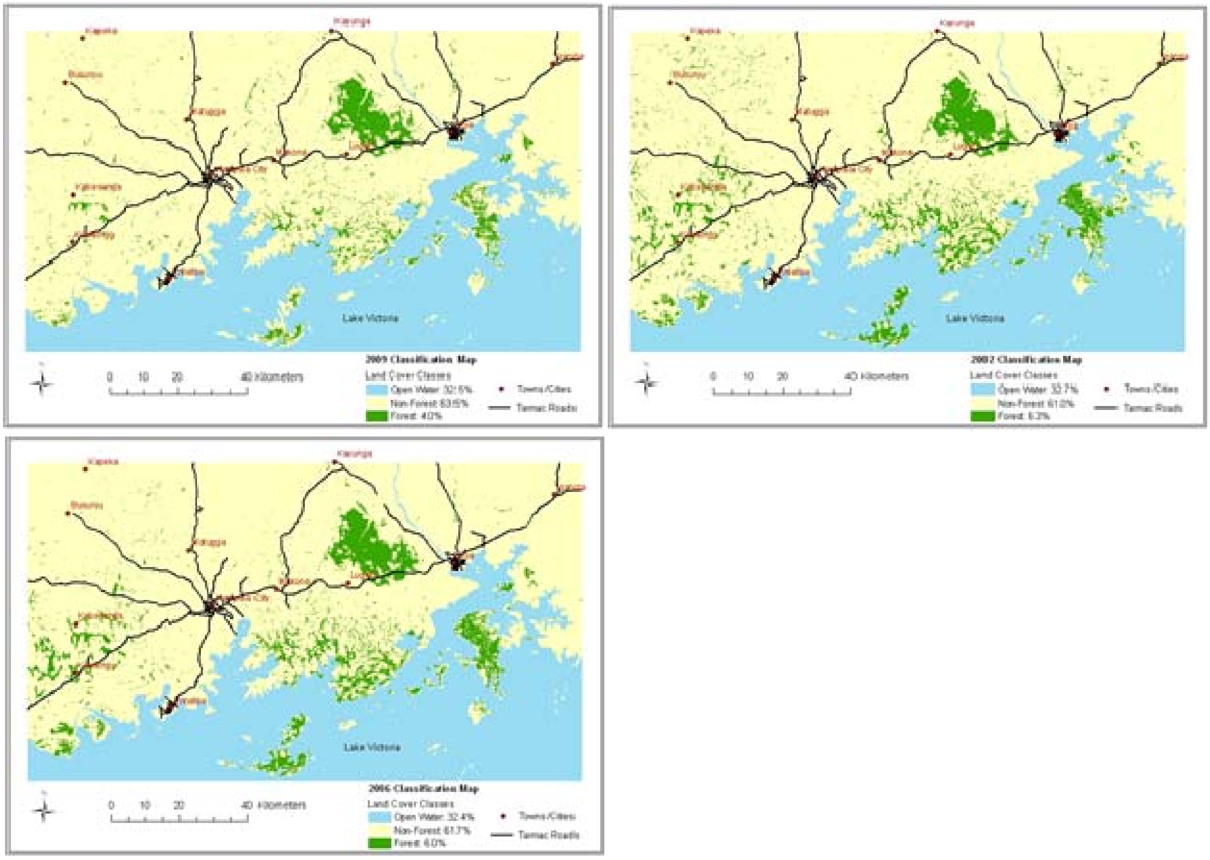

Fig.2 Land cover stratification maps for 2002, 2006 and 2009 showing Forest, Non-Forest and Open Water land cover classes

Table 2 Producer's and user's accuracies with associated overall accuracy, kappa and Z-scores for each classification

Image Date	Forest		Non-Forest		Open Water		Overall Accuracy (%)	Kappa	Z-Score
	Producer's Accuracy (%)	User's Accuracy (%)	Producer's Accuracy (%)	User's Accuracy (%)	Producer's Accuracy (%)	User's Accuracy (%)			
2002	84.3	93.5	98.8	98.1	100	99.1	98.1	0.95	31.50
2006	89.8	95.7	99.3	98.8	100	99.6	98.9	0.98	31.81
2009	83.3	80.6	98.4	98.6	99.6	99.6	98.1	0.96	29.76

Using the Google Earth interpreted points as a reference dataset, overall accuracy for the 2002 image classification was 97.7% with a kappa statistic of 0.97 and Z-score of 7.45. The overall accuracy, kappa statistic and Z-score for the 2006 and 2009 image classifications were 88.1%, 0.74, 4.83 and 91.7%, 0.91, 4.84 respectively (Table 3).

Table 3 Overall accuracy and kappa statistics for each classification

Image Date	Overall Accuracy (%)	Kappa Statistic	Z-Score
2002	97.7	0.97	7.45
2006	88.1	0.74	4.83
2009	91.7	0.91	4.84

Assessment and mapping of the spatial distribution of Uganda's forest and other land cover dynamics since 2002

A quantitative assessment of land cover conversions from forest to non-forest and vice-versa determined through post-classification change detection on the binary (forest/non-forest) classified images revealed varying trends of land cover change dynamics (Table 4). In the entire study area measuring 1,509,328 ha, 24,784 ha (1.64%) underwent conversion from non-forest to forest while 23,904 ha (1.58%) changed from forest to non-forest between 2002 and 2006. Between 2006 and 2009, 12,246 ha (0.81%) converted from non-forest to forest compared with 46,932 ha (3.11%) from forest to non-forest.

Table 4 Land cover inter-conversions between forest and non-forest classes

Land Cover Conversion	2002 to 2006		2006 to 2009	
	Area (ha)	Area (%)	Area (ha)	Area (%)
Non-Forest to Forest	24,784	1.64	12,246	0.81
Forest to Non-Forest	23,904	1.58	46,932	3.11
Net Change [a]	+880	+0.06	-34,686	-2.30

[a] Negative (-) sign depicts forest cover loss while positive (+) sign depicts forest cover gain

A spatial mapping of the inter-conversions between forest and non-forest land cover classes revealed predominantly conversions from forest to non-forest land cover (deforestation), although conversions from non-forest to forest land cover (afforestation and / or reforestation) were also present. An overlay of all the conversion maps on both the 2002 land cover classification map and county administrative boundaries map of the study area (Fig.4) revealed that deforestation mostly affected the western, southern and south eastern parts of the Lake Victoria crescent.

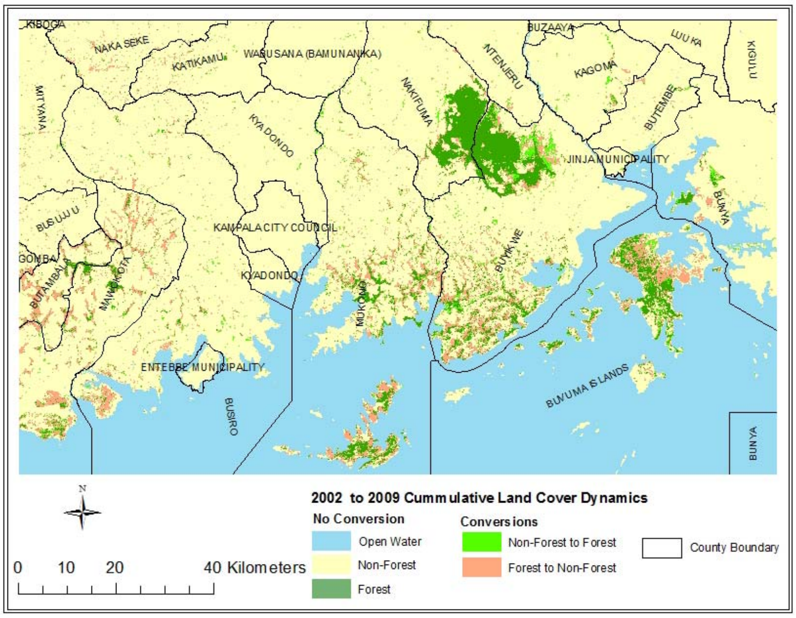

Fig.4 Distribution of cumulative land cover inter-conversions between forest and non-forest from 2002 to 2009

DISCUSSION

The various case studies revealed varied results with regard to local communities' participation in decentralized forest management and their access to forest resources. Although the Uganda Forestry Policy of 2001 **(**The Republic of Uganda, 2001) and the National Forestry and Tree Planting Act of 2003 **(**The Republic of Uganda, 2003) which set in motion forest decentralization in Uganda stipulate local people's participation in forest management such as through tree planting and collaborative forest management, there has generally been very little, if any, participation. This could be attributed to the fact that local people do not really have a clear understanding of the institutional reforms that led to forest decentralization. Thus, local people do not clearly know their rights and responsibilities with regard to their participation, yet this is a prerequisite for successful local people's involvement in forest management (Dubois, 1999). The presence of restrictions and /or rules related to maintaining and monitoring forests whose formulation did not involve local communities further hinders their participation in forest management. As such, some of the weaknesses of the defunct Forest Department such as inefficient extension work (Glen *et al*., 2004) are still plaguing the reformed forestry sector.

Most of the forest reserves were already degraded before their classification as local forest reserves with the inception of forest decentralization. This could be due to government's unwillingness to hand over forest management to local governments (Kajembe *et al*., anon). As a result, there is little incentive for local communities to participate in management of some of these forest reserves as they are viewed as having little, if any, commercial value. Even attempts by both NFA and DFS to encourage public participation in forest activities through leasing of forest reserves to them for establishment of private plantations was mostly taken up by elites from outside local communities who had resources to invest in tree planting. This subsequently increased negative attitudes towards forests among local communities as they felt alienated. Recognizing the importance of integrating local people and communities into forest management in both protected forests and private lands (Glen *et al*., 2004) and in line with both the Uganda Forestry Policy of 2001 and the National Forestry and Tree Planting Act of 2003, it is important that local people and community involvement in forest management be given the attention it deserves.

Although many Ugandans depend on forestry resources for the sustenance of their livelihoods (Mwavu and Witkowski, 2008), access to forestry resources under decentralization has been mixed as revealed by the different case study sites. The strict management that came with decentralization resulted into reduced access to forest resources from central forest reserves, especially those forest reserves which were not already degraded. Indeed, NFA is credited more with succeeding in increasing the volume of illegally harvested forest products impounded such as timber in comparison with stopping illegal harvesting of forest products. Since NFA is a self-sustaining organization, it then raises a question of whether its focus is more on generation of financial resources to sustain itself than to enhance forest conservation. Glen et al. (2004) foresaw this situation where NFA would develop a profit making focus with an increasing focus on revenue generation unless sufficient funding was availed to it from the Government and international community.

In other cases, increased forest access occurred. This could be attributed to laxity in management or even complete lack of management in some central forest reserves which led to further degradation as existing resources were unsustainably harvested under an open access environment. This laxity in management was exacerbated by political interference in forest management where granting forest access to local communities was viewed as a very important vote-winning strategy. Access to forests, especially local forest reserves, also increased because Local Government's DFS could not engage in their protection as these forests were degraded and thus with little, if any, commercial value.

Access to private forests remained generally unchanged under decentralized forest management as the decision-making powers with regard to management of the forest(s) remained with the private forest owners. This was and is contrary to the National Forestry and Tree Planting Act of 2003 which stipulates that DFS has to liaise with private forest owners so as to offer guidance to them with regard to forest management. This could be an indicator of the lack of a clear understanding of institutional reforms such as decentralization by stakeholders. Rights and responsibilities for each stakeholder should therefore be clearly defined as they are a prerequisite for successful sustainable forest management (Dubois, 1999). It was also a manifestation that some of the reforms were not implemented.

Considering all forest categories (central and local forest reserves including private forests), it could be asserted that local communities continued accessing forest resources, especially through illegal means, despite the dwindling resource base. However, their access was restricted by the inability to be fully involved in forest management as stipulated in both the Uganda Forestry Policy of 2001 and the National Forest and Tree Planting Act of 2003, which have not been fully implemented.

The failure to fully implement the reforms (forestry policy and law) by the responsible bodies could be attributed to opposition to devolution of authority, as it is equated with loss of power and status. It is therefore not surprising that there is resistance to implementation of decentralized forest management despite the enabling policy and law (Kajembe and Kessy, 2000). Additionally, the lack of resources, especially financial resources, has also hindered full implementation of forest decentralization. This is in agreement with the findings of Turyahabwe *et al.* (2009) that inadequate funding of local governments, especially from central government transfers and donations, limited the ability of government agencies such as NFA and DFS from scaling decentralized forestry activities and effecting forest monitoring and regulation of forest use. The inadequate funding could be another indicator of the lack of political will to fully implement forest decentralization.

Since forest decentralization enshrined in the Uganda Forestry Policy of 2001 (The Republic of Uganda, 2001) and the National Forestry and Tree Planting Act of 2003 (The Republic of Uganda, 2003) has the potential of promoting local communities participation in forest management in addition to enhancing sustainable forest management, it is important that it is fully implemented. This requires addressing the constraints which Turyahabwe *et al*. (2007) found including inadequate fiscal support from national government, inadequate distribution of benefits and inadequate delegation of decision-making powers over forest management to local actors. Kugonza *et al*. (2009) also recommended establishing better linkages between government agencies such as NFA and DFS with local user groups or communities who heavily depend on forest resources with the local forest users being given a much greater voice in forest management decision making.

Stratification and quantification of Uganda's forest and other land cover extent since 2002

In order to acquire land cover stratification information since 2002, image classification was deemed necessary. Although many classification approaches exist, the ISODATA unsupervised approach was used. This was because there was inadequate information to aid selection of training samples for supervised classification (Jensen 1996). Unsupervised classification of the satellite imagery facilitated discrimination of forest, non-forest and open water land cover types upon which a quantitative analysis of land cover dynamics was based.

The average overall accuracy of over 97% for all classifications based on visual accuracy assessment was a good indicator of the reliability of the classifications as there was near complete agreement between the classified images and reference dataset. The reliability of all classifications was further supported by the high kappa values ranging from 0.95 to 0.98 indicative of near complete agreement and their associated Z-scores which were all significant at the 95% level. Similar findings were obtained with Google Earth interpreted points on the 2002, 2006 and 2009 images. The observed high classification accuracy could be attributed to the fact that two of the classification classes, forest and non-forest, usually result into higher classification accuracies of over 85% (Olander et al. 2008). Additionally, open water class usually exhibits very high classification accuracies as it is easily distinguishable from other land cover classes.

These accuracy assessment results were closely consistent with the findings of Lung and Schaab (2010) in a study around Mabira Central Forest Reserve involving land cover classification in which the overall classification accuracy was 80.80% with a kappa statistic of 0.79. It could therefore be asserted that the image classifications were reliable as both visual classification- and Google Earth- based accuracy assessments were consistent.

Forest cover in Uganda’s Lake Victoria crescent declined by 35.8% between 2002 to 2009. This reduction in forest cover was also demonstrated by the reduction in number of forest validation points from 51 (7.3%) in 2002, 49 (7.0%) in 2006 to 30 (4.3%) in 2009. Furthermore, forest cover loss was reflected in the mapped forest area. These findings showing decreasing forest cover in Uganda’s Lake Victoria crescent are in agreement with Uganda’s national forestry cover statistics from Global Forest Resources Assessment data which showed that Uganda lost an average of 86,400 ha of its forest cover per year between 2000 and 2005 (FAO 2005). Similarly, Lung and Schaab (2010) analyzing land cover dynamics in and around Mabira Forest between 1973 and 2003 reported deforestation associated with agricultural encroachment and population increase.

The decline in forest cover between 2002 and 2006 of 4.5% was lower than the decline between 2006 and 2009 of 32.8%. Taking 2002 as a baseline year (before inception of forest decentralization), these results showed that decentralization did not halt forest cover loss but instead was associated with increasing forest cover loss. Hence, decentralized forest management was associated with unsustainable forest management.

Assessment and mapping of the spatial distribution of Uganda’s forest and other land cover dynamics since 2002

In order to obtain results suitable for monitoring trends in land cover dynamics, it was necessary to obtain detailed periodically-based changes showing the nature of changes instead of a binary change/no change detection associated with many change detection approaches (Coppin et al. 2004). And post-classification comparison change detection was deemed appropriate as it facilitated comparison of the classified maps on a pixel-by-pixel basis providing a change detection matrix (Coppin et al. 2004; Jensen 1996) from which “from – to” change class information was extracted.

Although both land cover conversion from non-forest to forest and vice-versa occurred between 2002 and 2009, the net change in area accounting for each land cover change revealed a net decrease in forest cover between 2002 and 2009. However, the positive change (non-forest to forest land cover) between 2002 and 2006 compared with the negative change (forest to non-forest cover) between 2006 and 2009 further revealed the continued inability of forest decentralization in enhancing sustainable forest management.

A visual assessment showed that conversion from forest to non-forest cover occurred in many counties within the Lake Victoria crescent. It was spatially clustered in counties that are known to be forested. This finding reinforces the assertion of classification consistency. On the other hand, conversion from non-forest to forest cover was widely distributed in the entire study. This conversion could either signify reforestation especially if it occurred around an existing forest or afforestation if it occurred away from an existing forest.

CONCLUSION AND RECOMMENDATIONS

Decentralized forest management was yet to substantially contribute to local people's livelihoods as local communities' participation in forest management had not been fully achieved due to the failure to fully implement decentralized forest management. Subsequently, illegal access to forestry resources seemed to even have increased from the inception of forest decentralization in 2003 to 2009, as manifested by declining forest cover. Therefore, decentralized forest management did not contribute to enhancement of sustainable forest management between 2003 and 2009. There is however potential for forest decentralization to make its contribution to local people's livelihoods if Uganda's current forest policy and law are fully implemented. This would require among other issues different stakeholders knowing their assigned rights and responsibilities within both the policy and law, as different stakeholders performing their roles will help address constraints such as inadequate fiscal support from national government, inadequate distribution of benefits and inadequate delegation of decision-making powers over forest management to local actors.

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