LAND COVER CHANGE AND THE ROLE OF FARMER GROUPS IN ENVIRONMENTAL CONSERVATION AND LIVELIHOOD IMPROVEMENT: THE CASE OF MBINGA DISTRICT, TANZANIA

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Abstract

Natural environment and socio-economic dimensions are interdependent because people get their basic needs from the environment, and inversely, for the integrity of the environment to be sustained, livelihood practices must become environmental friendly. Deterioration of environment and livelihoods interests in the Matengo highlands in Mbinga district triggered farmer-based initiatives through the facilitation of external based development partners. However, while farmers have organised themselves into groups in attempt to address the experienced livelihood-environment challenges since 2002, scant information exists on the role of farmers' groups in that regard and hence this is the rationale for the present article. Using satellite images the article first substantiates the contention on deterioration of the natural environment by estimating the change in forest cover. Then, the role of farmers' groups in improving the livelihood and conserving the environment is unveiled through focus group discussion, key informant interviews, informal interviews and observation methods. Consequently, recommendations are given as a way forward for improving the harmony between livelihood integrity and the sustainability of the natural environment.

Key Words: *Matengo highlands, farmer groups, environmental conservation, livelihood improvement*

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INTODUCTION

The world progressively experiences environmental degradation which is becoming more perceptible among researchers, decision makers and policy makers (CEEST, 1999). In Africa, especially the humid tropics, environmental degradation is largely due to unsustainable resource use practices including forest degradation, poor farming, overgrazing and overexploitation of wood resources. Certainly, environmental degradation threatens the livelihoods of people especially residents of developing countries. Highland areas are among the agro-ecologies experiencing this problem. Itani (1998) echoing Kjekshus (1977), Pratt and Gwyne (1978) and Pomeroy and Service (1986), contends that environmental degradation from unsustainable agricultural practices is a serious problem in mountainous areas that experience heavy rains. In such environments, the removal of vegetation cover can lead to serious erosion if the land is poorly cultivated such that it may become barren within several years (Nindi, 2007).

Environmental degradation has also been experienced in the Matengo highlands situated in Mbinga district in Tanzania. The highlands are densely populated with approximately 100 – 120 persons/km^2 compared to the district's population density of 73.1 persons/km^2 (Census, 2012), and are characterized by rugged landscape and steep slopes as well as intense and erratic rains that last from November to May of the following year (MWARP, 1998). Since the late 1980s, these highlands have been facing undue pressure primarily due to severe deforestation from extensive and uncoordinated farming activities in a form of slash-and-burn agriculture (Nindi, 2007; Nindi and Itani, 2008). These activities have considerably increased environmental degradation and hence decline of both natural resource and agricultural prosperity and thus dwindling local people's livelihoods. To adapt to the livelihood deterioration and environmental degradation problems, smallholder farmers in the Matengo highlands have initiated various strategies including formation of farmer groups for undertaking collaborative environmental conservation and livelihood improvement.

Environment and livelihood dimensions are interdependent and sustainability of one of these dimensions therefore is affected by that of the other (McCornick et al., 2003; Dixon, 2005). Social actors need the environment for both tangible and intangible benefits. Among the tangible benefits are the direct livelihood services and goods from the environment. Activities such as beekeeping, agriculture, fish farming, livestock keeping and others need the integrity of the environment as the raw materials and inputs for these such as water, air, minerals, fodder and so forth are obtainable from the environment. As such, the World Commission

of Environment and Development (WCED) of 1997 emphasizes on ensuring that the environment should be conserved and sustained so that as the human beings obtain their present livelihood needs through management of environmental resources they should not compromise these resources to ensure that the future generations also will get their livelihood needs through wise utilization of the same environmental resources. Hence, local interactions and influences between environment and livelihood dimensions and the role of social actors in mediating these interactions are important for gaining knowledge, and enhancing the harmony between social actors and the environment on which these actors obtain their livelihoods (Brundtland et al., 2012). This is important for promoting sustainable interactions between humankind and the environment, and therefore the Matengo highlands are used as the case study to acquire insights on these interactions.

This paper determines the role of farmer groups in environmental conservation and livelihood improvement. Matengo highlands are located in Mbinga District, Ruvuma region, the south-western part of United Republic of Tanzania, between longitudes 34^{o} 24'E and 35^{o} 28'E and latitudes 10^{o} 15'S and 11^{o} 34'S. Two villages namely Kindimba and Kitanda located 22 km apart were purposively selected for this study. Kindimba village was selected because it is one of the oldest villages in the highlands and is located in the mountain area sub-ecological zone (about 2000 m.a.s.l), while Kitanda was relatively a new village situated in the rolling hills north sub-ecological zone of the Matengo highlands (between 900-1500 m.a.s.l), and is inhabited by immigrants mainly from the mountain area. Both villages had relatively long history, since 2002, on issues pertaining to farmer group organisation in relation to environmental conservation and livelihood improvement.

Subsistence rain-fed agriculture is the mainstay of the Matengo farmers' economy in both villages. Smallholder farmers in these villages largely cultivate coffee, tobacco and wheat as cash crops whereas maize, beans and recently cassava serve as food-cum-cash crops. The farmers also keep limited number of livestock, mainly cattle, goat, pigs and chicken through tethering and/or free range and occasionally zero or indoor grazing.

METHODOLOGY

A cross-sectional research design was used wherein data were collected once at a single point in time from the two studied villages (Bailey, 1994), and multiple-methods-methodology was employed to guide this study. Data collection methods included satellite image analysis, focus group discussions, key informant

interviews, informal discussions and observations. Satellite images for the years 1984, 1989, 1991, 1994 and 2000 were analyzed for vegetation cover change for both villages and their results presented in tables. Then, five farmer groups from each village were selected for interviews using simple random sampling technique. First, all farmer groups that existed in the villages were listed (20 and 12 farmer groups in Kitanda and Kindimba villages respectively) and, using simple random sampling, five groups were selected from each village. Two interviews, one in each village were then held with farmer group representatives. Each farmer group was represented by five members namely the chairperson, secretary, treasurer and two randomly selected ordinary members, making a total of 25 interviewed members in each village. Besides, two focused group discussions (FGDs), one in each village were conducted with the secretariat of farmer groups' umbrellas. Ten members of farmer groups' umbrella from each village were involved in the FGDs. Two sets of checklist questions were used to collect information; one set was employed for farmer groups' representatives and the other for the secretariat of farmer groups' umbrella. Field observation and informal discussions were used as data collection methods at all times during data collection process.

Data for land cover changes were obtained from satellite images and were estimated with the aid of Microsoft Excel computer programme whereas qualitative data gathered through farmer groups' interviews, FGD, observations and informal interviews were subjected to content analysis technique. Qualitative data were first broken into themes and patterns were established and the information was organised in keeping with the aims of this study.

RESULTS AND DISCUSSION

Land cover change in the study areas

The extent and trends of vegetation cover degradation extracted from satellite images of the years 1984, 1989, 1991, 1994 and 2000 for Kitanda and Kindimba villages (the study area) are presented in Tables 1 and 2, respectively. Table 1 shows that, land area covered by trees dropped from over 80 percent in 1984 to less than 20 percent in 2000 in Kitanda village. In contrast, in the same village, the grass cover area increased from less than 12 percent in the year 1984 to more than 70 percent in the year 2000, indicating unprecedented conversion of tree cover to grassland largely due to expansion of cultivation activities in these rolling hills.

Table 1: Land cover changes (%) in Kitanda village extracted from satellite image analysis

Periods	Tree cover	Burnt area	Grass cover
1984	≥ 80	≤ 5	≤ 15
1989	≤ 70	≥ 5	≥ 25
1991	≤ 50	-	≥ 55
1994	≤ 40	≤ 5	≥ 55
2000	≤ 20	≥ 10	≥ 70

Analysis of satellite images of Kindimba village (mountain area) presented in Table 2 shows stabilisation of tree cover for long time. Equilibrium had been reached through long time habitation largely due to agroforestry practice in coffee farms and establishment of *Eucalyptus* woodlot. Further, Table 2 indicates that from the year 1994 tree cover showed slight downscale changes and the decline was attributed to conversion of a few remained fallow and woodland to crop fields after economic crisis in Matengo highlands since 1990s. Lack of ample agricultural land for expansion within the mountain area could have contributed to the low vegetation change within the mountain sub-agro-ecological zone. The area is also densely populated up to 120 persons per km^2 as reported by DALDO office (2001) and Nindi (2004; 2007) and hence does not accommodate further settlement establishment and/or agricultural expansion.

Table 2: Land cover changes (%) in Kindimba village extracted from satellite image analysis

Periods	Tree cover	Burnt area	Grass cover
1984	≤ 30	-	≥ 75
1989	≤ 40	-	≥ 60
1991	≤ 40	-	≥ 60
1994	≤ 45	≤ 5	≥ 55
2000	≤ 35	-	≥ 60

Reading from Table 1, one can conclude that land use in rolling hills of the Matengo highlands has changed significantly especially since 1980s. Nindi (2004; 2007) and Mhando (2005) attribute this situation to the economic destabilization faced by the Matengo farmers since the mid-1980s, especially after the introduction of trade liberalization of the domestic coffee marketing which led to the collapse of the Mbinga Cooperative Union (MBICU). According to these authors the collapse of MBICU negatively impacted the ability of the Matengo farmers to access chemical fertilizers, which supported crop production in their discrete mountain farm plots. Interviews with farmer group representatives and FGDs confirmed that coffee economy, the major cash economy, has supported the Matengo and their agricultural systems for many

years. At most of the times, MBICU ensured farmers with reliable input supply up to farm level and market hence stable farm production was incentivised not only for coffee but also for other food crops. Nindi (2007) reports that for several years, inputs bought from income earned through selling coffee has supported production of food crops in discrete farm plots in the Matengo highlands. Thus, as a result of decline in coffee economy, farmers from mountain area had to invade adjacent frontiers in the rolling hills, and Kitanda village (part of these rolling hills) was not spared in this invasion. Mhando (2005) contends that tumbling of the coffee production and its marketing systems from 1980s led to the vast and abrupt creation of new farms on virgin land in adjacent frontiers in the rolling hills where the use of agro-chemicals was not necessary.

FGD and informal discussions also confirmed that recent unprecedented deforestation of the rolling hills was largely due to influx of the Matengo immigrants from the mountain area after the collapse of coffee economy. According to Nindi (2007; 2008) in the new land, farmers from mountain area largely conducted extensive agricultural practices of slash-and-burn on steep and rugged slopes. Coupled with intense and erratic rains, the author maintains, these practices provoked not only vegetation clearing but also intensive soil erosion and sediment runoff to river valleys. This was also observed by Itani (1998) who asserted that the removal of vegetation cover results into surface soil erosion which is exacerbated by unsustainable farming practices resulting into barren soil within several years.

According to focus group discussion conducted in Kitada village, prior to mid 1980s, the Matengo people had adaptive mechanism of migrating to frontiers when population was against the carrying capacity in the mountain area. Normally, after 3 to 4 generations, a Matengo extended family would allow some of the family members to migrate to 'new land' and open new farms, then, live there permanently. In the new land, they initially practiced slash-and-burn agriculture and later resorted to their permanent intensive indigenous pit cultivation system locally termed as *ngolo* (MWARP, 1998, Nindi, 2004).

It was also learnt during FGDs that tree cutting to open new farms in the rolling hills leads to forest degradation. It was further mentioned that new farms in rolling hills were opened up not only by the inhabitants of the rolling hills and immigrants from mountain area alone, but also by urban-based farmer inhabitants from Mbinga Town. District officials (key informants) claimed that fast population growth at Mbinga Town also contributed to the debilitating vegetation cover in the rolling hills. For instance, by 1978

population of Mbinga Town was only 7,308 but reached 25,416 in 2002 (Mbinga District Council, 1997; National Bureau of Statistics, 2003) and most of them (86%) were immigrants (Mbinga District Council, 1997). Most of these immigrants and original inhabitants were urban based farmers, thus, they demanded land for cultivation as well as supply of forest products mostly from adjacent rolling hills. This abrupt population increase of Mbinga town was partly due to increased number of petty traders and artisan-mining activities that concentrated in the district since the end of 1980s. Economic liberalization likewise promoted free trading, a phenomenon which brought a number of petty traders of second hand clothing (*mitumba*), shops, kiosk, and restaurants in Mbinga Town.

According to Mbinga District Council (1997) about 64% of Mbinga town dwellers were farmer-based inhabitants and utilized farms and obtained fuel wood and timber from the same rolling hills, consequently affecting tree cover in the area. Cool climate and lack of power supply exacerbated the situation further as more fuel wood was needed for heating as well. Such an abrupt influx of immigrants in a non-electrified town of Mbinga certainly resulted into deforestation in the woodland forests. It could therefore be surmised from above that environmental degradation in Matengo highlands was also a result of urban-rural interplay rather than exclusively rural-rural interactions.

It was as well revealed during FGDs that most tree species degraded as a result of new farms establishment included[1] *Brachystegia spp*. (Miombo), *Parinari curatelifolia* (Mbula), *Uapaka kirikiana* (Msuku), *Pterocarpus angolensis* (Mtumbati) and important grasses cleared were *Hyparrhenia* spp. (Mapelele) and *Brycharia* spp. Tree species ruined from lumbering were *Khaya anthotheca* (Muwawa), *Harungana madagascariensis* (Mchai), *Erythrophleum africanum* (Mpuga) *Breanardia africana* (Mgwina), and *Pericopsis angolensis* (Muwanga). Tree species most affected by fuelwood demand include *Parinari curatellifolia* (Mbuni), *Syzygium cordatum* (Mnyonyo), *Pericopsis angolensis* (Muwanga), *Brachystegia spiciformis* (Mzombo) and *Faurea speciosa* (Mteteleka). One elderly person in Kitanda village commented that due to intense deforestation in the rolling hills, nowadays people make charcoal even from mango trees i.e. *Mangifera indica* (Muembe), the tree species which in the past was not meant for that purpose.

It can be summarized that tree cover degradation under the influence of trade liberalization has recently been severe in rolling hills e.g. Kitanda village than in mountain area e.g. Kindimba village. The most

[1] Scientific names italized and local names in brackets

driving factor to fast deterioration of tree cover in the rolling hills could therefore be the tendency of establishing new food crop farms especially by mountain immigrants as well as Mbinga town dwellers who manage such farms on temporal basis. This could be ascertained by increased percentage of grass cover, which also represents food crop farms. However, the agro-forestry practice in coffee farms, if continued, would in future conserve the environment in the Matengo highlands as was seen for the case of Kindimba village.

Farmers' groups and environmental conservation

Based on interviews with farmer groups' representatives and FGD with leaders of farmers' group network, effective farmer groups formation in the study villages trace back to 2002 when one farmer group (Ujamaa) was formed in Kitanda village with the founding objectives of environmental conservation and livelihoods improvement through fish farming. The emergence of farmer groups in the study villages was also influenced by a project on sustainable rural development which was implemented from 1999 to 2004 by Sokoine University of Agriculture Centre for Sustainable Rural Development (SCSRD). Among its activities, the project integrated socio-economic and environmental conservation initiatives. Farmer groups involved in this study, their memberships, year of establishment and activities are presented in Table 4.

Based on Table 3, three activities namely fish farming, tree planting, and beekeeping were common in seven out of the ten groups indicated in the table. Fish farming was the initiator activity that mobilised formation of groups. Initially (in 2002), there was one group (parent group) namely *Ujamaa* (literary meaning socialism) which was formed in Kitanda village based on farmers' need to practice fish farming. As these farmers asked Sokoine University of Agriculture researchers (who were then implementing a project on sustainable rural development) to bring them fish fingerlings, the researchers linked this need with sustainable supply of water from water sources which, at that time, were experiencing degradation. Farmers were thus advised to consider integrating water sources conservation, forest management and fish farming because pisciculture requires sustainable supply of water. Two approaches were suggested for forest conservation, that is, through promoting natural restoration of the degraded forest areas and through tree planting. Natural forest restoration meant foregoing other socio-economic uses; therefore, alternative eco-friendly livelihoods were required. As such, beekeeping was started. To incite the sense of ownership of the activities, *Ujamaa* group was assigned the responsibility of paying for the fish fingerlings by providing

fish fingerlings to another group that would emerge at later time, free of charge. The *Ujamaa* group became the local teacher for other groups that formed later which were mainly mobilised by fish farming.

Table 3: Studied farmer groups, their years of establishment and activities

Village	Farmer Group	Membership			Year established	Activities
		M	F	Total		
Kitanda	*Ujamaa* (socialism)	8	7	15	2002	1, 2, 3, 4, 6
	Familia (Family)	8	7	15	2003	1, 2, 3, 4
	Vumilia (Be patient)	7	5	12	2003	1, 2, 3, 4, 5
	Ushindi (Victory)	0	20	20	2004	6*
	Mundeki (A place name)	6	2	8	2004	1, 2, 3, 6
Kindimba	*Jiokoe* (Save oneself)	6	9	15	2003	1, 2, 3, 4
	Ondoa Umaskini (Eradicate poverty)	15	4	19	2003	1, 2, 3
	Women SACCOS	0	5	5	2005	6*
	Amani (Peace)	9	12	21	2004	1, 2, 3, 4, 6
	Jikwamue (be successful)	11	13	24	2004	3,4,6
	Total	70 (45.5)	84 (54.5)	154 (100)		

Numbers in parentheses are percentages * Women Farmer Group whose activity was dairy cattle keeping only

Key for activities: 1 = Fish farming; 2 = Tree planting; 3 = Beekeeping; 4 = Crop farming; 5 = hydro-milling; 6 = other activities (Chicken and Pigs husbandry, Pasture production, Manure and Local brewing)

This parent group informed new groups that the pre-requisite for being provided with fish fingerlings was to put in advance strategies for ensuring sustainable water supply. Also, *Ujamaa* group assigned the responsibility to the young group (which it provided with fish fingerlings) of providing fish fingerlings to the next formed group but after such newly formed group had understood and expressed willingness to integrate fish farming with environmental conserving activities especially tree planting. Consequently, out-scale of integrated environmental conservation and livelihood activities occurred from one group in Kitanda village to various groups within the village, and up-scale occurred wherein the activities transcended the Kitanda village boundaries to Kindimba village through farmer to farmer exchange visits. Each group at

later stage established other activities but the critical aspect of ensuring sustainability of socio-economic and environmental interests was adhered to.

Deriving from above, short-term socio-economic incentives are crucial when envisaging long-term ecological benefits. According to Guo (2010), projects and policies that marginalize livelihoods of the poor people result in the long term instability of both livelihood and environment. By the same token, we argue, the livelihood benefits which are to be realised within a short time should not compromise those to be achieved in the long run. As such, strategies towards attaining environmental and socio-economic interests need to be harmonised. For example, fish farming motivated formation of farmer groups for socio-economic reasons but it in turn acted as an incentive for farmers to embark on environmental conservation initiatives through tree planting (Table 4) and forest restoration to ensure sustainable supply of water for fish farming. Forest management consequently led to rationality of another environmental friendly socio-economic activity, that is, beekeeping.

In agreement with findings from the present study, Arroyo (2008) provides empirical evidence on interdependencies between livelihoods and conservation dimensions towards promoting sustainable tourism management. Focusing on community-based tourism activities, the author observed that ecotourism projects that integrated subsistence aspects in their conservation agenda resulted into creating the incentives and stimulating the morale that won local people's support and enhanced community's ownership and active participation which positively contributed towards the attainment of project goals. Woodhouse (2012) argues that failure of some development projects rests on their lack of acknowledging the role of social and cultural dimensions in their field of operationalization. Studying the role of Buddhism in sustainable environmental management, Woodhouse unveiled the inseparable linkages and mutual influences among state, religious and market rationalities imperative for realisation of environmental and livelihoods interests.

Contrary to the findings presented in this study, Khatri (2009) observed conflict between development and conservation goals. Assessing the payment for ecosystem services (PES) project in Nepal, this author revealed that implementation of the development targets impaired the conservation interests. In particular, the construction of road infrastructure using the PES money resulted into soil erosion. However, the author was aware that the problem was not with the PES itself but was related to institutional factors such as poor

and skewed implementation of plans that disrupted a planned balance between development and conservation, as well as the exclusion of important stakeholders such as local people that resulted into lack of the incentive to undertake sustainable development and conservation activities.

Natural resource encroachment for socio-economic uses can hardly be controlled unless alternative ways are devised. In the study area, farmers raised trees not only for conservation of water sources but also for meeting socio-economic needs such as supply of construction materials and firewood (Table 4). The logic of integrating socio-economic and environmental rationales was crucial for creating a system which is sensitive of both ecological and development outcomes. Franciosi et al (2004) view agriculture as having multifunctional roles including natural, environmental, social, and economic implications. These roles can for simplicity be categorized under environmental conservation (natural and environmental dimensions) and livelihood improvement (social and economic dimensions). The authors are aware of inextricable relationship between livelihood improvement and environmental conservation interests and the potential conflicts existent in this interaction.

Table 4: Indigenous tree species planted in Kindimba and Kitanda villages by 2005

Local name	Botanical name	Major uses
Mdhambarau pori	*Syzygium guineense*	Conservation of water sources
Muwawa	*Khaya anthotheca*	Conservation of water sources
Msindano	*Pinus patula*	Timber, landscape conservation
Mwanga	*Pericopsis angolensis*	Timber, fuelwood supply, agroforestry
Mtela wa mbamba	*Rauvolfia caffra*	Conservation of water medicinal, timber
Mzombo	*Brachystegia spiciformis*	Fuelwood, building poles
Mtumbati	*Pterocarpus angolensis*	Conservation of water sources, medicinal, agroforestry, timber
Mdonga	*Strichnos cocculoides*	Fruits, fuelwood, building poles
Mnyenda	*Bridellia micrantha*	Conservation of water sources
Mkaranga mti	*Macadamia spp*	Alternative cash crop to coffee
Mtanga	*Albizia schimperiana*	Soil fertility conservation and shade in coffee plantation

In the similar vein, Rudi et al (2012) started their article by questioning as to whether achievement of sustainable development and improvement of environmental standards were mutually exclusive, and whether the two could be combined. These authors along their concluding remarks showed that the two targets were both important, and could be connected and reconciled, and showed how such mediation

could be attained. While the authors observed that the potential solutions were founded into efficient and eco-friendly technologies, they expressed the high cost involved in ensuring the adoption of such technologies, but, they contended, such costs could be shared by the government through provision of subsidies. This is echoed by Kaihura et al (2006) who, though argue in favour of the priority for investing into environmental conservation initiatives at community, district and national levels, assert that local people are incapable of carrying the burden on their own. The authors, therefore, argue for the necessity of government to provide incentives to improve environmental conservation, for national and global interests.

Livelihood improvement

As introduced in the preceding sections, environmental conservation activities incentivise local people when such activities provide social actors with short term needs while anticipating long term benefits. Farmers become demotivated and lose patience to wait for long term benefits if their present needs are not met. While this thinking has to be considered in development planning, it is imperative to ensure that realisation of short term benefits does not compromise the attainment of environmental friendly long term ecological and socio-economic benefits. In similar vein, farmers become more motivated to engage with environmental conservation activities when socio-economic benefits are sustainable. In Mbinga district, among the micro-projects, which were implemented by farmers, was a hydromill project. This project was a linking incentive by bridging environmental conservation with people's livelihood needs because it motivated local people to plant trees in and around the water sources as the project was driven by hydropower as its fuel. Also, this project resulted into multiplier effects by creating employment such as small business and triggering engagement into livestock keeping, and consequently enhancing incomes. Figure 1 indicates increase in income for the period of three consecutive years from the hydromill project.

Nonetheless, long-term sustenance of benefits from integrated environment and livelihoods dimensions needs knowledge. Because benefits accrued from diverse environmental conservation and livelihood activities must be managed appropriately and profitably to incentivise positive sustainability of those activities, farmers' power in terms of, among others, possessing proper financial management skills is important. Some farmer groups such as *Ujamaa* and *Ushindi* in Kitanda village manage their funds appropriately through opening bank account as a way of using the account as collateral for accessing credits from banks. According to Mbinga community bank, after every group member has deposited Tshs. 5,000 (4 USD), any of them is eligible to access a bank loan of up to Tsh 50,000 (40 USD). As such,

environmental conservation and livelihood activities can enable the community to raise funds which they can use as collateral for accessing loans from banks and consequently promote the attainment of both environmental conservation and livelihood interests. This is a new type of the rural micro-finance arrangement and the villagers can access loans without any other collateral because their deposits in the group's account guarantee them. Farmers have at least attained a breakthrough threshold because for an extended temporal scale, financial institutions have been reluctant to give loans to poor people especially when collateral is missing (Berger, 1989; Albee, 1994).

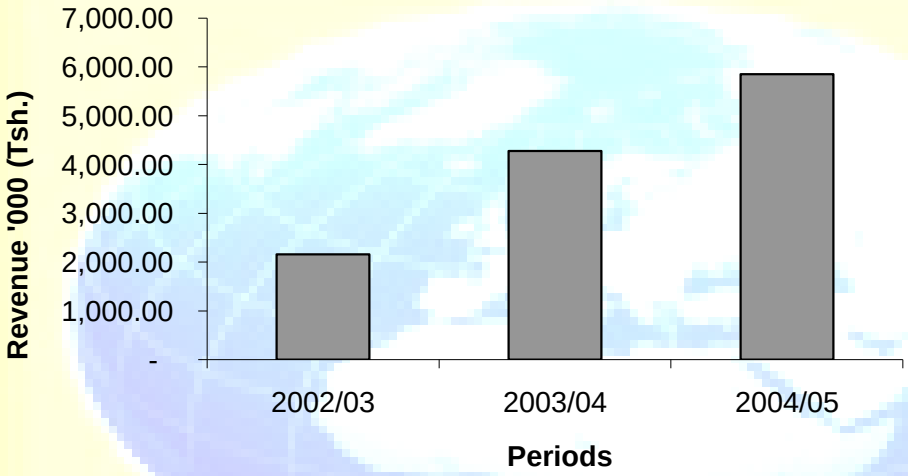

Figure 1: Revenues (Tshs.) accrued from hydro-mill project at Kindimba village

Conclusion

Generally, forest cover dropped from over 80 percent in the year 1984 to less than 20 percent in the year 2000 while grass cover increased from less than 12 percent in the year 1984 to more than 70 percent in the year 2000, indicating unprecedented conversion of tree cover to grassland largely due to expansion of agricultural activities. However, in mountainous areas some equilibrium was reached through long time habitation largely due to agro-forestry practice in coffee farms and establishment of *Eucalyptus* woodlots. As a result of environmental degradation, through the facilitation of external-based development partners, farmers organised themselves into groups and devised various initiatives for the aim of conserving the environment and improving the livelihoods.

Livelihood improving and environment conserving roles played by farmers groups included fish farming, beekeeping, tree planting, and natural forest restoration. Farmers' groups out-scaled and up-scaled these activities by sharing practices, knowledge and materials among older and younger groups within and outside their village boundaries. Integration of livelihood and environmental conservation activities served as incentives for continued engagement with environmental conservation. The logic of marrying socio-economic and environmental rationales was crucial for creating a system which is sensitive of both ecological and development dimensions.

Because sustainability of environmental and socio-economic rationales needs continued investment, farmers' used their groups as instruments for developing skills on appropriate management of funds through opening bank account and using the account as collateral for accessing credits from banks. This was a new type of the rural micro-finance arrangement and the villagers could access loans without any other collateral because their deposits in the group's account guaranteed them.

Recommendation

Efforts of local government are required to promote and support farmers' initiatives of conserving the environment and improving their livelihoods because the presence of and backstop from external based development partners is short lived. Because the farmers have acquired the awareness on the rationality of integrated and interdependence nature of livelihood and environmental rationales, their efforts need to be facilitated so that to promote virtuous cycle towards the two ends. Through such efforts, environmental conservation will be enhanced by improving forest cover through tree planting and forest restoration while at the same time promoting incentives through eco-friendly livelihood activities such as beekeeping and fish farming, and providing skills for profitable and sustainable management of the livelihood benefits realised from the micro-projects.

Because the interaction between socio-economic and environment dimensions is never static but always such interplay has potential for being transformed at diverse spatial and temporal scales, further research on dynamics of the linkages between livelihood and environmental rationales along the space of place and time in the initiatives undertaken by farmers in the Matengo highland is imperative. Such research may concretize the field realities as crucial inputs towards strategies for furthering positive interplay between environmental conservation and livelihood improvement at different community organisation levels.

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