Why Combine Private and Communal Tree Management? A Case-Study Based in Majawanga (Gairo, Tanzania)

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Abstract: *Despite the focus on the importance of trees in Africa and the many projects that try to improve their management, there is very little research and few development projects which address tree related problems in a holistic manner. With respect to forest management arrangements, focus tends to be either exclusively on community forestry, or on private tree planting. Such a divided focus makes it difficult to understand the complementarities and possible synergetic effects of these two approaches in solving common problems and improving local livelihoods. The present article argues that interdisciplinary projects are needed to develop a holistic approach to tree management*

and to improve the use of trees. This argument builds on the results from the PETREA (People, Trees and Agriculture) research programme in Majawanga (Gairo, Tanzania). In this village, private and collective tree management is characterized by very different uses, opportunities and problems. Common woodlands play an important role in providing villagers with Non-Timber Forest Products (NTFP) from indigenous species that are important for local livelihoods as they provide food, medicine, and grazing areas. The constraints linked to the management of common woodlands pertain to group dynamics and resemble, at first glance, a "tragedy of the commons" as described by Hardin (1968). Private tree planting, on the other hand, provides both local services (including providing fruits, firewood or securing boundaries between fields) and cash from the selling of poles. The constraints characterizing private tree management are linked to land-tenure, tree seedling cost and season for planting. Land tenure is of paramount importance as trees cannot be planted on borrowed or rented land, or at the expense of cropland needed to sustain the household. The season for planting seedlings is a constraint because of a conflict with labour demands for crops needed to survive. Despite being characterized by very different uses and constraints, the management of private and common trees also share common constraints as both require that grazing is under control and that there exist clear rules and efficient institutions able to solve management conflicts. Both types of management should therefore be analyzed together as improving one can help relieve the pressure on the other.

Key words: Participatory Forest Management – Community Forestry – Private tree planting – Reforestation - Interdisciplinarity - Tanzania

1. Introduction

Trees are useful to people for many different reasons. They provide firewood, timber, fruits, medicines, wild vegetables, fodder for animals, shade, and material for various tools. They can fulfil different ecological functions such as securing water sources, preventing soil erosion, enhancing soil fertility, providing habitat for various animals that can also be valuable (game, bees, etc). When these products are commercialised, trees provide an important source of income or an important way of saving expenses since people can access products that they would otherwise have to buy on the market. Trees are therefore the focus of many development and research projects, including our own.

Improving tree management is a goal that is shared by many research projects around the globe. Given the widely publicized debates about deforestation, desertification, global warming, the loss of biodiversity, and with widely publicised events such as the Rio convention or the Kyoto agreement, forestry is an increasingly popular research topic. Yet, generally speaking, research on agroforestry focuses either on community forestry or on private tree planting, but very seldom on both – although some studies arguing that different tenure systems are a key factor in tree management have been published (Goebel et al. 2000; Fortman and Nihra 1992). From Tanzania, a wealth of publications can be found that deal with Participatory Forest Management (PFM) (Brockington 2007, Lund and Nielsen 2006, Meshack *et al.* 2006, Topp-Jørgensen *et al.* 2005, Wily 1997 and 2001, Wily and Dewees 2001, Ylhäisi 2003). But such publications focus exclusively on common woodlands and they fail to see the importance that the private plantation of trees can have on such activity. There are also many publications dealing with private tree planting (Chamchama et al. 1998; Aalbæk 2001; Nieuwenhuis and O'Conner 2000; Wellendorf et al. 1994, Karachi *et al.* 1997, Nyadzi *et al.* 2003, Ramadhani *et al.* 2002), but by focusing exclusively on the benefits deriving from planting (mainly) exotic species or on the constraints linked to it, they fail to see the synergy that such activity might have with community forestry. Some studies deal with both exotic and indigenous tree species discussing, for example, the choice of species to be produced in nurseries or the impact that such choices might have on biodiversity (see for example Newton 1996). But these studies focus more on private tree planting than on the problems relating to common woodland. As we can see, few studies develop a holistic approach to trees and study tree management on both private and common lands.

In the present article, we argue that the management of common trees and of private trees can benefit from being addressed together, as they are complementary. We will first show that the management practiced in private and common lands usually concern different trees that satisfy different needs for different users. We will then argue that both types of management are characterized by different problems and constraints but that they share some common points and all require strong institutions able to solve land conflicts. Our discussion integrates results from the entire PETREA team of researchers and constitutes, in itself, an interesting example of the holistic understanding that such an interdisciplinary team can produce.

2. Methods

Field research was conducted by an interdisciplinary team of researchers, using a variety of methods. The methods were primarily chosen on a mono-disciplinary basis in that each researcher used the methods characterising his/her academic background. Interdisciplinarity was achieved by having researchers help each others and getting thereby acquainted with new methods, and through intensive discussions aiming at integrating the different results in a holistic understanding of the problem. A baseline survey was conducted with 68 households in which every fifth household was systematically selected from the village register so as to get general information about household income and agriculture. After this survey another 60 households were systematically selected for a questionnaire on tree planting and ownership. A quantitative ethnobotanical survey was conducted with 27 farmers to determine the local use and relative importance of trees growing in the village, in private fields and in the common village woodland. One study identified and quantified the plant species found in the diet of cattle and goats. Another study investigated the quantitative and species differences in dung beetle populations in woodlands and maize crops. An experiment was conducted to identify constraints to agricultural production and measure the potential of planting different tree species on field boundaries. Moreover, 42,000, 36,000 and 20,000 seedlings were distributed, free of charge, to farmers in 2003, 2004 and 2005 respectively, and the rate of survival of seedlings distributed in 2004 were measured after six months and after one year. Although this was originally thought of as a gift to villagers to thank them for their participation in the research project, it became an experiment in itself yielding interesting research results. PRA workshops were conducted separately with groups of men and women in order to discuss constraints on tree planting, activity calendars, and to produce matrix rankings describing the local use of tree and shrub species. Participatory wealth ranking was conducted with 12 informants to rank 128 households in two sub-villages. The village, its fields, grazing areas and common woodlands were mapped with GPS. Qualitative interviews with a variety of stakeholders (government officials, local leaders, farmers, both among men and women, elders and youth, cattle owners or not, land-rich or land-less) provided information on local opportunities and constraints for improving access to tree products in Majawanga.

3. The Need for Trees in Majawanga

The village of Majawanga is found in the Gairo division (Morogoro district), a semi-arid area situated at 1,500 metres of altitude and receiving between 500 and 600 mm of erratic, seasonal rain per year. Although the area used to be occasionally grazed by herders, the first permanent agriculturalist settlers established their households in the 1930s, in a landscape that was dominated by dense woodland. The village grew slowly, through natural demographic growth and migration, under the authority of the chief of Gairo. Things accelerated dramatically when Majawanga was officially recognised as a village in 1971-72 as a result of Operation *Vijiji*, which was part of President Nyerere´s *Ujamaa* policies[1]. Kaguru people from different places in Gairo volunteered to form a village and cleared 300 acres of woodland. Later on, neighbouring people who were reluctant to participate in the collective dynamics and preferred to stay on their own were forced to move and join others. The village council reserved land by creating three grazing areas (two small forests, one grassland), some areas for residence, sport, and official buildings. The rest of the land was allocated to newcomers, who received generally,usually, at least three acres of land, although some of the people living in the area before the Ujamaa policy got more.

With the villagisation policy, the woodland that originally covered most of Majawanga was cleared to make room for the new migrants. Population growth meant that shifting cultivation was no longer

possible, since all farming land was allocated. Continuous cultivation, without using manure or fertiliser, led to a degradation of soil fertility – the yield of cultivated maize is today an average of between 0.5 and 1 ton/ha (Chamchama et al. 1998) which is lower than the average yield of 1.5 ha found in the rest of Tanzania (Kaliba et al. 1998), and much lower than 2.8 tons of maize per ha documented in Zimbabwe in a similar environment and climate (Campbell et al. 1998). The combined problems of land pressure and decreasing soil fertility in Majawanga have led the majority of the households to establish farm plots away from the village. Population pressure is also increasing in the more fertile areas outside of Majawanga, and the annual land rent has increased from TSH 1000 in 1993-1994 to TSH 5,000 per acres today. This implies a real increase of about 200%, given the inflation rate of 258% in this period (NBS 2005). Land scarcity has led to increasing pressure on common woodland, both from individuals trying to privatize it through creating new farmland, and from people relying on common land for subsistence.

Land conflicts have developed with the increasing population and farming pressure. From the 1980s onwards, an informal land market has developed on the fringe of the law since people seldom have secure land titles that can officially be transferred. Land transactions tend to be hand-written on papers held by the person who acquired the land. Parallel to this trend, conflicts also resulted from the weakening of matrilineages and the strengthening of inheritance from father to son.

The rapid concentration of human and cattle populations brought about another problem, as the existing common pastures and forests have come under increasing pressure for grazing use. While the existing common woodlands used for grazing areas found within Majawanga may contain sufficient biomass to maintain and increase the livestock herd after the rainy season, it is insufficient in the dry season. As a result, a majority of herders rely on pastures found in neighbouring villages to graze their cattle (Gervin 2003: 84). In order to protect the remaining woodland, the village council has prohibited the cutting of trees, including for firewood. However, the prohibition is by no means respected in any of the common areas. With access to a degraded forest areas and few privately planted trees per household, village residents need to buy firewood or to travel long distances to neighbouring villages to collect it. The shortage of firewood is so acute that those who cannot afford to buy wood from neighbouring villages have to burn maize stems or cobs, or cow dung to cook food. The poorest help others to separate their grain from the maize cobs and receive only the cobs as salary, used as second-rate fuel.

The common woodland areas in Majawanga are too small to be the only source of fuel for the villagers. The three closest common woodlands were measured to be 1.3 ha, 57 ha and 18 ha. Given the rainfall of max. 600 mm/year the aboveground woody biomass in undisturbed condition may be estimated to approximately 50 tons/ha (Frost, 1996). According to Frost (1996:28), the annual increment of the woody-plant biomass will be less than 3-4% in mature miombo woodland stands, implying that the total annual increment in the three closet woodlands will be approximately 150 tons. A rule of thumb estimate of 1.0 m^3 wood fuel per capita annual subsistence use in rural areas is widely used (HIMA 1991:20, Koppers 2002:5, Matthews 2001:211). However, in a study from Morogoro, Luoga *et al.* (2000:248) found a higher annual subsistence use of firewood of 1.5 m^3 per capita. Using the lowest value of 1.0 m^3 per capita and a density for dry miombo woodland wood of 0.600 tons/m^3 as reported by Hofstad (1997:23), the annual per capita consumption of firewood in Majawanga is estimated at 0.6 tons. Thus, the annual increment of approximately 150 tons only suffices to cover the subsistence consumption of approximately 250 of the more than 2,000 villager inhabitants.

These figures must be seen as rough estimates. The biomass is probably much lower than 50 tons/ha since the woodlands in Majawanga are degraded. Data collected by one author from two plots of 5,000 sq. meters in each forest support this view by showing that the common woodlands of Majawanga (in Kwa Malundo, Kwa Lembile and Madali) have fewer trees taller than five meters per acre than in the neighbouring common woodlands of Lobiro and especially in the woodland of Kisitwi where cattle have been prevented from grazing the area since 1990, and where the mature tree vegetation is much denser than in most other common woodlands found in the region (see figure 1). This low figure is confirmed by a recent study made in the Gairo

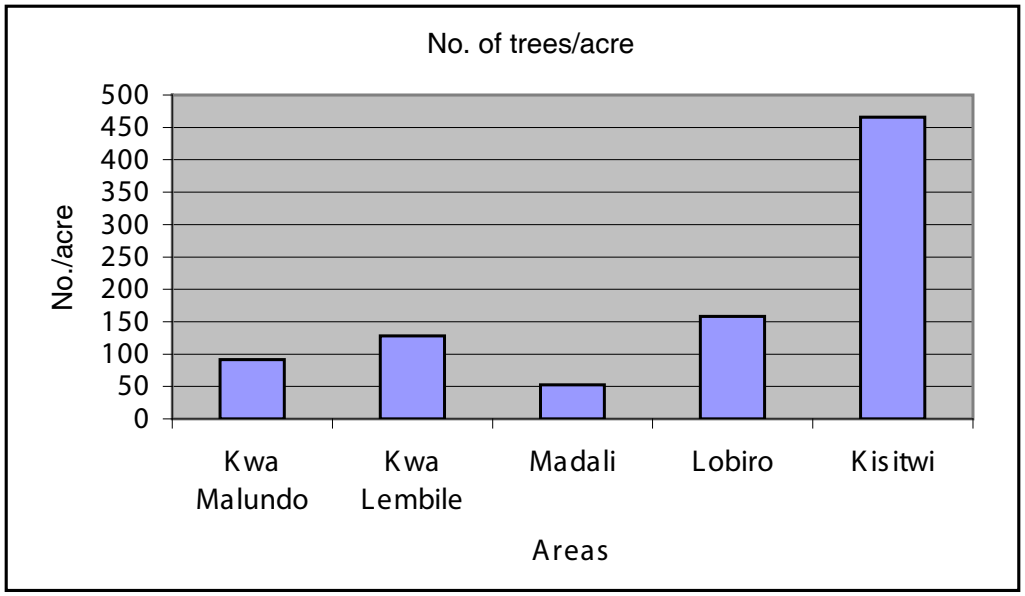

Figure 1: *Average number of trees above >5 cm diameter at breast height per acre in different common woodlands in Majawanga and in neighbouring villages.*

division suggesting that the mean volume of wood in Majawanga woodlands is probably below 20 m3/ha (Moyo 2005). In a separate study carried out by two of the authors, 42 plots with a total of 3600 sq. meters were surveyed throughout the three woodlands within Majawanga. In this study all woody vegetation was identified and the height classified within a circular plot. The Madali common woodland area had more than double the woody species diversity of the Lembile forest and eight times the species diversity of the Malundo forest (133 stems/ 100 sq. meters in Madali against 21 stems/100 sq. meters in Malundo). However, most of the woody species growth was less than three meters, suggesting the regrowth of invading species. Madali area is devoid of any big trees, is small and is under pressure from farmers who create fields in the area, but it is also considered as good for grazing and it is important for the livestock of Majawanga because of the open low vegetation and grass ground cover that provide more and better quality fodder biomass than the more mature forests. Kwa Malundo and Kwa Lembile, on the contrary, still have large trees (mainly *Acacia*) and thorny bush, but the grass coverage has disappeared in many places and the bare soil is being eroded. This may be due to natural succession where the increased leaf biomass from the mature trees intercept sunlight and reduce ground cover, or it may be due to grazing, or differences in soil type, topography or micro- climate. Although these common woodlands have become less attractive for grazing livestock than previously, they remain heavily used since they surround a salt lick that is used not only by village herders, but also by herders from different neighbouring communities.

As must be clear from the above discussion, there is a serious lack of trees in Majawanga today. The existing common woodlands cannot cover all the needs of villagers, and the scarcity of wood and fodder is likely to increase in the area, imposing longer transport and higher costs on the Majawanga villagers when fetching firewood or grazing cattle. Trees have become scarce and consequently a valuable resource that has a high potential for development. One can distinguish two ways of increasing the quantity and quality of trees locally: planting new trees and improving the management of existing trees. These two options tend to be associated with two different kinds of land use, since planting trees is generally done on private land while management of existing vegetation is a concern in common woodlands. Moreover, they tend to concern different trees species, as privately planted trees are primarily of exotic origin while trees found on common woodland are mostly indigenous species. A quantitative ethnobotanical survey showed that people in Majawanga use over 100 different tree species that cover a wide range of needs (Krogh *et al.* 2005, Theilade *et al*. 2007 and Theilade *et al*, this issue). These studies show that exotic and indigenous species rank quite differently according to the type of use and according to the tenure system and that

both indigenous and exotic trees and management play an important role in local livelihoods. In what follows, we will discuss both the potential of developing private and common forestry, and the different constraints linked to it.

4. Potential of Planting Trees in Private Woodlots

Planting trees in private woodlots can help address some of the fuel wood problems of Majawanga. Getting firewood from planted trees would help eliminate the burden of collecting it eight to ten kilometres away and eliminate the need to pay a tax for wood collection to the neighbouring community. People who do not have access to an ox-cart might be able to save expensive transportation costs. Moreover, it would constitute a more efficient source of fuel than the dry cow dung or the maize stalks that the people who do not have access to an ox-cart and do not have enough money to buy firewood are forced to use. Finally, more firewood would relieve the pressure on remaining forested areas of the region, and allow for other uses than being burnt as fuel. It would also allow people more time for other productive activities, such as farming. But firewood is not the only tree use in which people are interested. The results of a questionnaire conducted in 2003 on 60 informants who planted some of the 42,000 seedlings that were distributed free of charge by our project is summarized in table 1. This shows that even though firewood is the most mentioned use for the distributed trees, several other uses are also ranked high.

Other tree-related needs than firewood can also be important, according to the livelihood strategyies of the respondents. Some concentrate on livestock, others on farming, craftsmanship or traditional healing. Others prefer to plant trees that provide fruit, firewood, or fencing. Trees were valued highly by people with a weak land claim for their value in increasing land tenure security. All these aspects influence the value conferred to trees.

The fact that people feel it necessary to graze their cattle in neighbouring villages supports the assumption that there is a shortage of fodder during the dry season. Planting trees that provide firewood and fodder during the dry season could provide the basis for more sustainable integrated woodland grazing management. It would increase access to feed, as well as allow farmers to increase animal production and derive greater benefit from their cattle (access to milk, manure, draught power). Experiments are currently being conducted to measure the relative benefit of interesting indigenous species that could be promoted as fodder.

Table 1: Tree species selection criteria by local informants in Majawanga (N=60 informants)

	Percentage responses by farmers on major uses of the tree species they have planted					
Tree Species planted	*Gliricidia sepium*	*Eucalyptus camaldulensis*	*Eucalyptus tereticornis*	*Acacia polyantha*	*Azanza garckeana*	*Ranking*
Farmers tree selection criteria						
Fire wood	14%	12%	39%	40%	8%	1
Building poles	-	58%	47%	-	-	2
Fodder	55%	-	-	-	23%	3
Fruits	-	-	-	-	52%	4
Soil fertility improvement	20%	-	-	14%	15%	5
Timber (sawn timber)	-	28%	12%	-	-	6
Shade	-	-	-	31%	-	7
Wind break	7%	-	-	12%	-	8
Drought resistance	4%	-	-	-	-	9
Medicinal	-	2%	2%	-	-	10
Bee hives	-	-	-	3%	-	11
Protect the environment	-	-	-	-	2%	12
Total	**100**	**100**	**100**	**100**	**100**	**-**

Trees could also be instrumental in helping to address the acute soil-fertility problem. Research was undertaken to identify multi-purpose species that provide a wide range of services (fodder, firewood, timber) and that also have a positive impact on soil fertility. However, as trees compete with food crops for light and water, too many trees would inevitably impede agriculture, and the integration of forestry and agriculture should therefore be carefully planned (Norgrove 2003). Planting trees at the border of fields constitutes an interesting option, as it could limit competition with agricultural plants (while possibly having a beneficial impact on soil fertility). It could also play a role in integrated pest management (diverting pests from agricultural products), or in providing more security toclarity about? fields' boundaries, helping people to address some aspects of land-conflicts. Out of the different tree seedlings distributed freely by the PETREA team, it appears that farmers perceive Eucalyptus and Acacias to be more appropriate for field borders than Guava (which needs humid soils to grow) or Gliricidia, as can be seen in figure 2.

Sisal and euphorbia species are already used in Majawanga as a means to create fences and keep cattle out of housing or farming areas. These species are not particularly valued for any other use, although

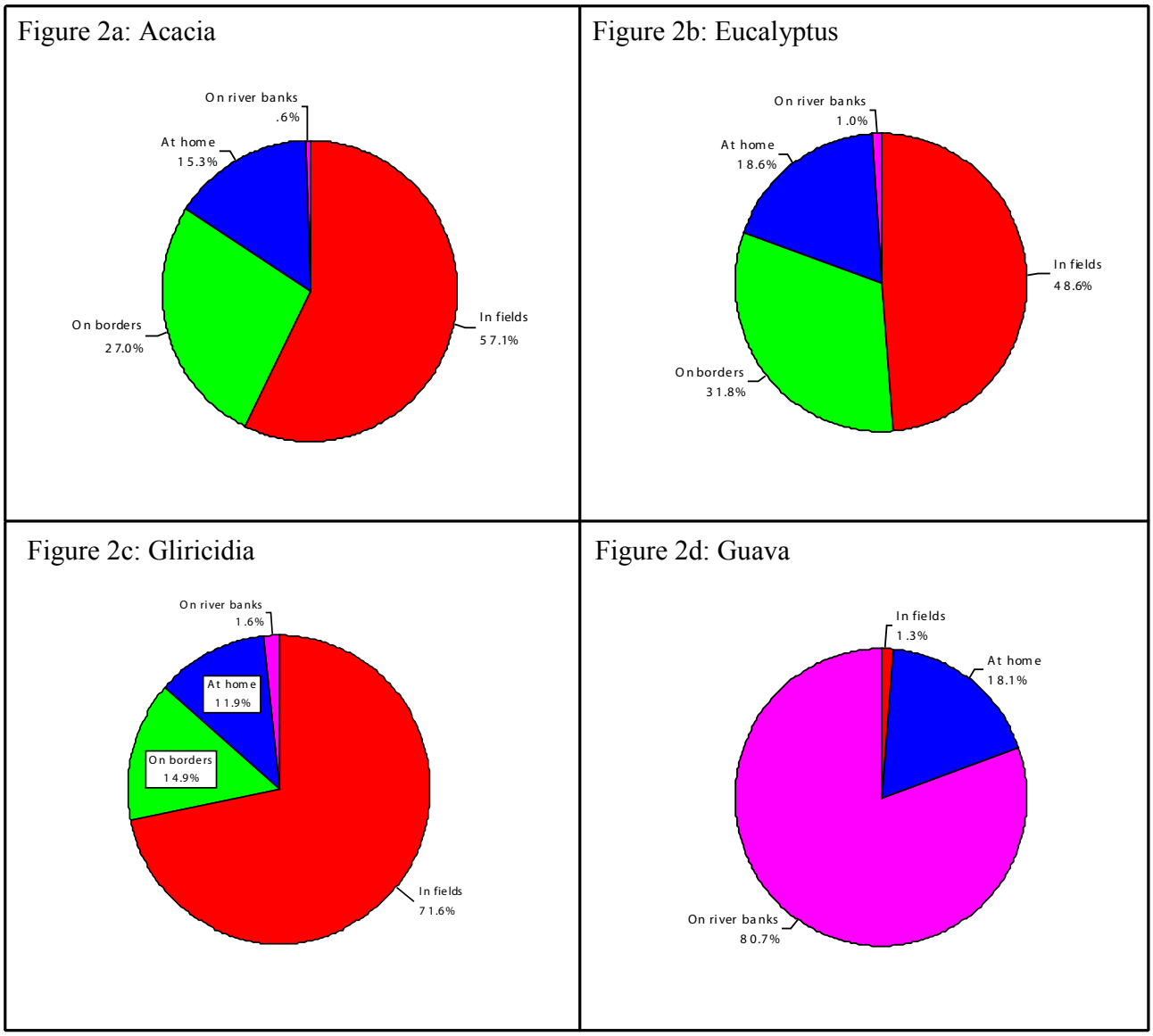

Figure 2: *Proportion of tree seedlings planted in fields, on field borders, at home and on river banks in January 2004 (N = 96 informants)*

sisal gives some very low quality poles. Sisal has a negative impact on soil fertility and the sap of and smoke from euphorbia can be an irritant. Proposing more useful species for fencing needs was met positively by farmers and some have already tried fences of acacias. However, the efficiency of these trees as fences is lower than for euphorbia and sisal.
People derive non-timber forest products from *all* indigenous species, typically found in common woodlands. Given the decrease in area and loss of valued species found in the common woodlands, some important and specialised needs can no longer be met locally. Some traditional healers, for example, need to travel far distances to find species that have disappeared locally. There is therefore potential to promote the planting of species for specialised uses. An example of this is the success of the exotic neem tree (*Azadirachta indica*), used primarily as a source of medicinal products but also appreciated as a source of timber. Indigenous species are currently not available in tree nurseries, which typically promote exotic species rather than indigenous ones. Generally speaking, exotic species are preferred because they provide a more secure tree-tenure than indigenous species, and because they are fast growing and provide cash, usually through selling poles or timber.

Poles are in high demand locally, and fetch a high price. Planting trees for poles can therefore not only address the shortage of building or craft material, but it can also help increase the income of farmers. Those few villagers who have already invested in large tree plantations have generally chosen to plant trees that give timber or poles, because of a positive cost/benefit ratio (saving time and investment, increasing income) when compared to other agricultural activities.
Promoting tree planting on private land requires identification of the species that is best suited to people's needs and to the local constraints. It is necessary to realise that different people have different needs and livelihood strategies. Therefore, a proposal including a variety of solutions addressing a variety of local needs is appropriate, so that all kinds of actors can use trees to improve their livelihoods.

5. Constraints of Private Woodlots

There are, however, constraints to developing tree planting on private land. First, seedlings are usually not free of charge, but cost 100 to 150 shillings each in Gairo. In a questionnaire survey asking respondents how many trees they would plant if they were given the seedlings free of charge and how many they would plant if they had to buy the seedlings at 100 shillings, only four exotic species, mainly appreciated as a source of cash, got a good score both as free or bought seedlings: *Eucalyptus spp.*, mmelea (*Melia azadirach*), mlonge (*Moringa oleifera*) and msaji (*Tectona grandis*). As shown in figure 3, the constraint of price was less important for Eucalyptus (a drop of only 40%) than for the other three species (a drop of 65 to 80%). This seems to indicate that if people plant mainly exotic species, it is not because they are the only ones available in local tree nurseries (as suggested by Mosse 2001:

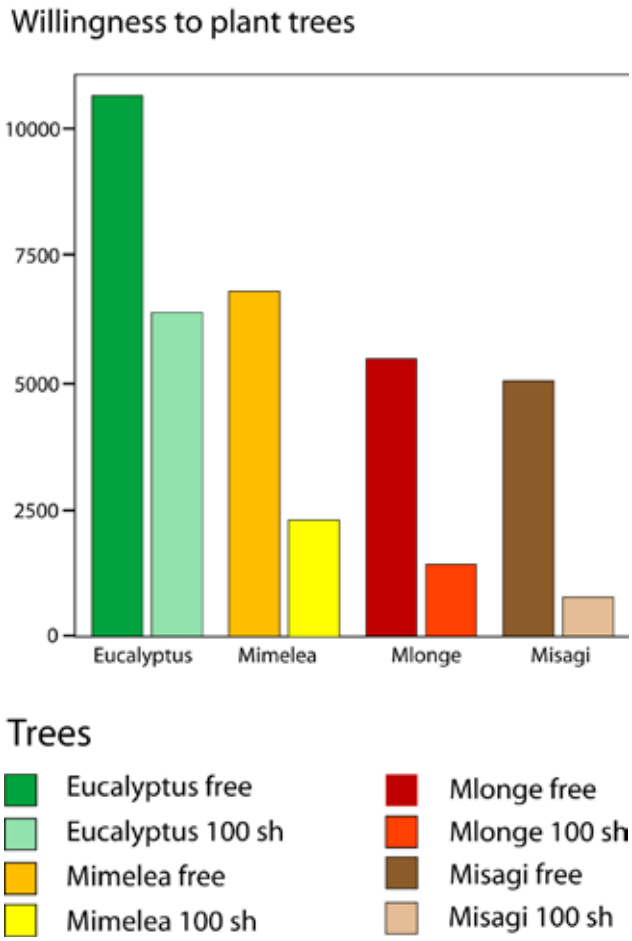

Figure 3: *Total number of trees that informants would like to plant (sum of answers for 60 informants): Eucalyptus spp., mimelea (Melia azedirach), mlonge (Moringa oleifera) and misaji (Tectona grandis). For each species, one distinguishes between the willingness to plant if seedlings are given free of charge, and if seedlings have to be purchased at the price of 100 shillings (N = 60 informants).*

21), but it is rather due to their own choice, based on a cost-benefit analysis.

The interest for *Tectona grandis* (Teak) is probably based on unrealistic hopes, as it does not grow well in the area due to low rainfall. *Moringa oleifera* can grow in Gairo but cannot produce good timber or fuel wood. It was introduced in Gairo to produce seeds for oil extraction, but the market did not materialise and farmers are now starting to lose interest in it.

Buying the seedlings is not the only cost. The transport of seedlings can also be an obstacle, depending on the location of seedlings available for purchase. A number of organisations (mainly church-based) used to bring seedlings by trucks to distribute or sell in villages, but they could not cover all villages at the same time, and they sometimes arrived in Majawanga when it was already late in the season and therefore too dry to plant seedlings. The lack of water makes watering trees difficult in Majawanga, and requires that seedlings are planted at the beginning of the rainy season, which is often a problem since it is also the time when labour is in highest demand for agriculture. Guava seedlings, moreover, need to be either watered regularly during the first year or planted in humid terrain, close to river banks, in order to survive. The lack of water also prevents the establishment of a tree nursery within the village itself, precluding this as a solution to transport problems[2]. The fact that tree seedlings need to be planted at the beginning of the rainy season constitutes in itself a serious constraint since this is the busiest time for agriculture. The time spent in tree planting is therefore time diverted from agriculture, when labour constitutes a bottleneck. Moreover, the beginning of the rainy season is also the "hungry season", when there is often a shortage of food as the previous harvest has been consumed and the next has not been harvested yet, and when there is a general lack of money – what is left being used to buy food rather than seedlings. Given the price of seedlings, the labour and transport cost, and the likelihood that many seedlings will not survive, it is no surprise that the most popular trees are fast growing species providing timber or poles, fetching the highest price locally.

The rate of seedlings that survive or have the potential to survive depends on when seedlings are planted, on the amount of rain, the type of terrain, soil fertility and defoliation by insects or herbivores (see table 2). As our experiment on tree planting showed, different tree species respond differently to these constraints. For example, *Acacia sp.* and *Gliricidia sp.* survived better than any of the other species offered, as they were less affected by drought and termites. The survival rate also depends on grazing management, as cattle and goats browsing a young tree can kill the seedling by browsing or trampling on it. To prevent this, actions can be designed to protect the plant, or restrict the animals from access to young trees or both. Planting trees therefore requires either keeping livestock away from the planted area, or protecting the seedling with thorns, bricks, etc. (relatively easy to do for a few seedlings but difficult to do for many of them). Few fields are fenced, and unless all cattle herders are aware that seedlings have been planted within a field or unless the farmers stays near his field to keep cattle away, damage is likely to happen. There are, each year, many cases of cattle destroying tree seedling, sometimes under the surveillance of a herder. Such conflicts seldom reach the village council, however, since they are often among people who are related and who prefer to solve the problem amicably (Gervin 2003: 42).

The existence of such conflict indicates that cattle herding and tree planting, as done today, are seen

Table 2: *Survival of species distributed in January 2004, measured seven and eleven months later (N informants = 96)*

	Number planted in January 2004	Rate of survival in July 2004	Rate of survival in November 2004
Gliricidia	2729 (100%)	2020 (74%)	1565 (57,3%)
Eucalyptus	9663 (100%)	6372 (65,9%)	5165 (53,4%)
Acacia	4261 (100%)	3145 (73,8%)	2548 (59,8%)
Guava	1720 (100%)	1153 (67%)	789 (45,9%)
Total	18383 (100%)	12690 (69%)	10067 (54,8%)

as competing activities. This is confirmed by several informants reporting that cattle owners resent the planting of trees in fields because it prevents the free access of cattle to crop residues. Grazing is also mentioned by a majority of informants (66%) as the most important constraints for tree planting, the second constraint being drought (16%) (Ngaga et al. 2003: 15). Interviews on conflicts between herders and farmers having planted seedlings in their fields show that many herders consider the planting of trees on other people's private land as a hindrance of cattle browsing in fields after harvest. This might partly explain why cattle owners plant fewer trees than the farmers who do not own cattle, although they control an average of 50% more land than farmers who do not own cattle (see figure 4). However, this does not mean that livestock owners are not knowledgeable about the benefits from trees. On

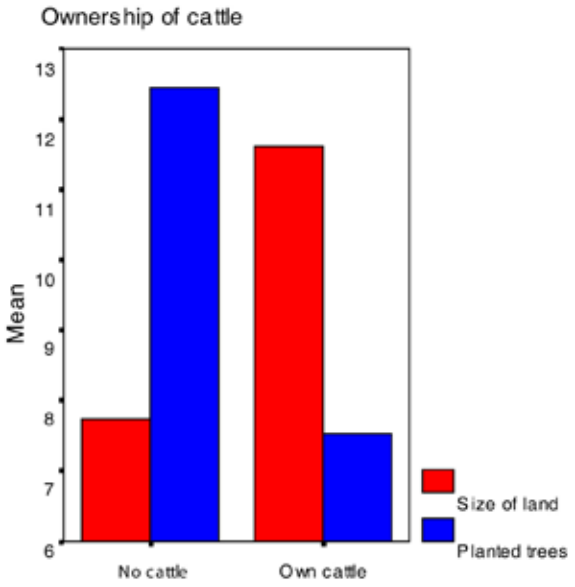

Figure 4: *Average size of land farmed (in acres) and average number of trees planted according to households that either do not own any cattle or that do own cattle (N= 60 households, p<0,05)*

the contrary, livestock owners could identify more trees and tree-uses in both communal woodlands, homesteads, and fields in and around the village and generally valued trees higher than villagers without livestock (Theilade et al, 2007). Possibly, livestock owners have better access to both common tree resources and trees retained on their land holdings. Most major livestock owners live in the sub-village closest to the woodlands and furthermore have the advantage of owning ox-carts to transport woodland resources to their household or market. Therefore they do not have the same incentives to invest in tree planting as less well-off farmers. It might, however, be just a question of time before they change their mind, as some livestock owners came forward at the end of the project to say that although they used to lack interest in tree plantation, they now realised, from watching their neighbours, the great potential of such investment (Theilade et al. this volume).

During the PETREA experiment led by Prof. Mugasha, in which about 100,000 seedlings were distributed in Majawanga, the problem of destruction of planted trees by grazing was addressed by the village council. The council authorized heavy fines for any damage done by grazing to planted seedlings. As can be seen in table 2, the survival rate of the seedlings planted by the villagers in such conditions suggests that cattle destruction of seedlings can be managed so that over 50% of the seedlings survive. Another way to address this problem would be to find tree species that are of interest for cattle herders. Gliricidia can be such an option, and this species has been distributed to farmers by the PETREA team. However, many farmers find this species unpractical as a source of fodder since the leaves have to be dried and mixed with another type of food (such as grains or maize stalks) before they can be eaten by livestock. Moreover, Gliricidia needs to be coppiced regularly.

Tenure problems might be an opportunity for tree planting. Some of the villagers expressed a desire to plant trees as a way to gain more secure rights on the land that they use, especially exotic species since it is an unmistakable sign of human investment. But land tenure is also a constraint since those who challenge users' land rights tend to refuse tree planting. As a rule, people who borrow or rent land are not allowed to plant trees. There are, however, conflicts regarding unclear land ownership. Someone who got land from his or her maternal uncle and wants to plant trees is likely to have problems with the uncle's children, who might oppose tree planting. In the conflicts that we documented, the village council ruled in favour of the actual user rather than of the "heirs". Another type of tenure conflict exists between the village council and a few households that, due to exceptional circumstances, were temporarily allowed to stay within Madali, an

area reserved for forest products and grazing. Forty three ha. were gazetted for the original Madali forest. Only 1.3 acres of communal grazing forest (only 3% of the original area) existed in 2005, as measured by the PETREA team. Likewise, the other two common woodlands within Majawanga, Lembile and Malundo have seen their area reduced by 59% and 43% respectively. Homesteads and adjacent croplands occupy the land previously designated as communal grazing forestland. The problem is that the temporary authorisation tends to become increasingly permanent as time goes by. Some of the households living in that area and under constant threat of being expelled, took advantage of the PETREA project to plant tree seedlings around their homesteads in order to gain more rights on the area they now occupy. This strategy builds on the hope that it will be more difficult for the village council to ask them to leave if they have perennial crops, especially if these crops are given by a project working in close collaboration with, and having the full support of the village council. There is therefore an upcoming conflict between private tree planting and communal forest management.

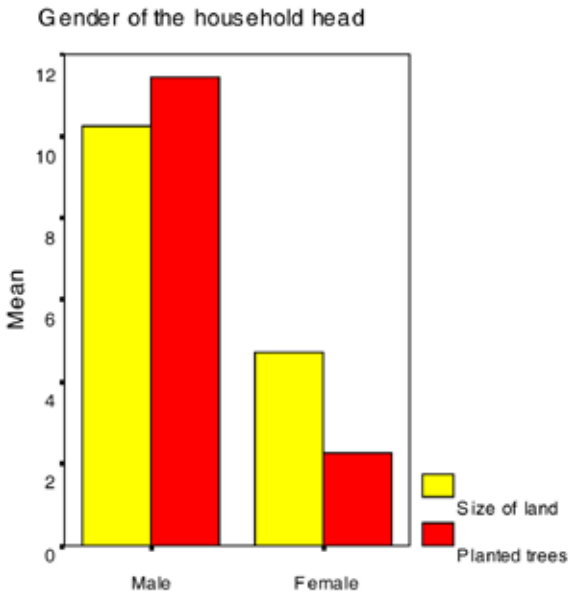

Figure 5: *Average size of land farmed (in acres) and average number of trees planted according to households that either do not own any cattle or that do own cattle (N = 60 households, p<0,05).*

Tenure conflicts between genders constitute another constraint for tree planting. Women have much less access to land than men. A woman usually gets land either through her husband or through male relatives. But even though she can use land for agricultural purposes, she is often prevented from making long-term investments, such as planting trees, on the land because she is expected to leave the land to her husband if she becomes divorced or to her relatives if she remarries. Although it is relatively difficult to measure tree planting differences related to gender within married couples, a comparison of different types of households (see figure 5) shows that male headed households plant in average five times more trees than female headed households. This can be explained by the fact that female-headed households have less land, and by the fact that female-headed households (and women, in general) have less secure tenure on the land that they use.

To sum up, planting trees on private woodlots requires that the ownership of land is clarified, at least at the local level. If trees are planted on contested land, it is likely to trigger tenure conflicts. Secondly, given that most agricultural land is used for grazing during the dry season, that most fields are not fenced, and that tree seedlings are usually browsed by livestock, an understanding must be found with livestock holders. Of course, these two constraints require strong and efficient institutions to manage conflicts. A third constraint is the lack of water for the seedlings. This requires careful planning of the planting of the seedlings, which must take place at the beginning of the rainy season. Moreover, as labour and cash are also important constraints during the beginning of the rainy season, caution must be taken to adapt the price and quantity of seedlings provided to such constraints. A credit scheme could be an option, but this should be carefully designed since benefits from trees are first realized after a while and are therefore not compatible with short-term loans. Finally, planting trees on private lands to provide sufficient amounts of tree products for a household is only an option for those who have access to sufficient amounts of land.

6. Potential of Common Woodlands

In the following, the potentials and constraints for collective forest management will be described in order to illustrate the differences and the complementarity between the management of common

woodlands and of private tree planting. We will only cover the general aspects of the discussion, since it has been developed in more detail in other papers (see Theilade *et al.* as well as Nathan *et al.* in this volume).

The three common woodlands in Majawanga (Madali, Kwa Lembile and Kwa Malundo) play an important role in the local livelihoods, as they host a great variety of (mainly indigenous) species that play an important role for local livelihoods, not least for grazing animals (Krogh *et al.* 2005, Theilade et al. 2007 and Theilade et al, this issue). People use trees as firewood, timber, domestic utensils, medicine and fruits. Trees and shrubs can play an important role as fodder for livestock, or in the collection of honey (an activity that is economically important for several villagers). Woodlands can also act as biodiversity reserves that can make vulnerable livelihoods more resilient. For example, in times of shortage due to drought or pathogen infestation, poor households fall back on wild foods from the woodlands for survival (Groombridge 2000). Another important direct use of high value of these common woodlands is extraction of medicine plants that are important due to the lack of alternative medicinal care and the high costs of prescription drugs. A more indirect use of these woodlands' is due to their biodiversity. The woodlands function as a sanctuary for wild animals and insects which often play an important role in the agricultural system in terms of pollinating crops, acting as pest control agents or immobilising organic waste and maintaining the soil fertility (Samways 1994, Nielsen 2007). These areas thus contain an important potential in addressing people's needs. As few indigenous trees are planted by Tanzanian farmers (Aalbæk 2001), the sound management of common woodlands seems to be the best option left to secure the continued presence of a diversity of trees able to cover a variety of local needs.

As argued earlier in this paper, however, the woodlands of Majawanga are depleted and only provide few of the above mentioned benefits in scarce amounts. Although the woodlands are protected by local regulations prohibiting the cutting of branches and trees and agricultural encroachment, the regulations are not respected as can be seen by the diminished area and by the fact that all remaining trees bear cutting scars as measured by a Petrea team in 2005. The causes for the fewer and less diverse woody vegetation lie, according to interviewed villagers, in the over-use of timber and firewood, as well as in the overgrazing and soil-trampling in the Kwa Malundo and Kwa Lembile area. The comparison between woodlands (figure 1) shows the enormous difference between the areas with regards to number of tall trees and indicates the potential of the common woodlands in Majawanga if a sounder management could succeed in regenerating the woody vegetation.

Most informants stressed the importance of conserving *all* species in common woodlands, as every one of them has uses. Moreover, many informants (especially village elders and village council) expressed a grave concern for the degradation and the conservation of Majawanga's woodlands. Thus the diversity of tree species is valued and the need to conserve or regenerate forests is acknowledged by the villagers. Yet, several valuable tree species were already extinct locally (Theilade et al. 2007 and Theilade et al., this volume). The local awareness of the problem reinforces the potential for future action research aimed at improving the management of common woodland through improving the management of grazing, fire and extraction of forest products. This being said, even if the woodlands could regenerate, they would still be unable to cover the local needs in term of firewood (see under point 3 in this paper). The management of common woodlands must therefore be complemented by private tree planting.

7. Constraints of Common Woodlands

In Majawanga, as elsewhere, management of common land is ridden with difficulties. The theory of the tragedy of the common predicts that without proper mechanisms for controlling exploitation and access, resources that are in open access will become degraded as individuals try to maximise and privatise their benefit while collectivising costs in terms of degradation (Hardin 1968). True open-access resources are quite rare as most resources are the objects of some form of control, whether from the state, a community or individuals and therefore the concept of the 'tradegy of the commons' is not always the best model to account for natural resource degradation (Behnke and Abel 1996;Abel 1997;Ostrom et al. 1999). In Majawanga, however, control works poorly and the current management system cannot prevent degradation.

The question is then: How can the current system be improved or what is the best alternative management system? Private ownership is often advocated as the best way to privatise the cost of management, making users responsible of their behaviour and encouraging them to adopt a sounder management (Hardin 1968). If the premise is to preserve trees in Majawanga because they cover important local needs, private ownership is probably not an option, as it would inevitably lead to transforming the forested areas into maize fields as seen with the current private encroachments in Madali common woodland.

State ownership is presented as another option to prevent the tragedy of the commons, if the State has the authority and the knowledge necessary to make sound decisions and implement them (Hardin 1968). However, the top-down paradigm of forestry management, in which rules are defined and implemented by the forestry department, has shown its limits. Such an approach, by taking management away from local actors, removes both individual and collective responsibility and incentives in sustaining the resources. This approach has witnessed so many failures that most programmes on forest management nowadays focus on the importance of local initiatives (Arnold 1998; Ostrom 1999). It is generally acknowledged that effective management requires that local actors are made responsible for managing the resources they depend on and that sound community forest management as a minimum requires that communities are enabled to make informed choices and collectively bear the cost/reap the benefit of their actions (e.g. Chambers 1994, Ostrom 1990 and 1999; Wily 1997, Andersen 2005: 108).

But the new focus on participatory forest management, even though it is supported by a change in legislation that eases and strengthens the management of forest land at the village level (e.g. GOT 2001, 1999, 1998; Wily & Dewees 2001), is not devoid of difficulties (see also Nathan *et al.* (this volume). Controlling access to and exploitation of resources, and finding the right balance between cost and benefit sharing among stakeholders requires institutions that work. This implies, among other things, that the managers must be seen as legitimate and must have the authority to enforce clear and agreed-upon rules on resources that are well defined (Ostrom 1990). This is difficult in Majawanga. First, the resources are not well defined, as they are the object of long standing boundary disputes between Majawanga and neighbouring villages. It is more difficult to develop a sustainable management of a common area when two different village councils claim control over that area. Secondly, even if the villagers consider the elected village councils legitimate, and even if, as in the case of Majawanga, these councils have the formal authority to manage common lands, the village councils do not necessarily actively manage their common resources in a sustainable manner. On the one hand, many people are related to one another in villages and it is more difficult to take action against one's relatives. On the other hand, even when action is taken and fines are given, trespassers can refuse to abide by the sentence. The case then needs to be referred to the district level, which does not always support village council decisions. Third, management rules are not always clear, known by everyone, or enforced. It is unclear, for example, whether cattle herders from neighbouring villages have legal claim to graze their cattle in Majawanga or not. More than half of the three common forest areas have been cleared for agriculture despite rules against tree cutting. There is a discrepancy between written rules and unwritten consensus or common practise (Gervin 2003: 64-5; 71-7). Although the village has the responsibility to implement a number of specific rules defined at the district level, these rules are seldom enforced, as the resolution of conflict in reality depends more on consensus and local power relations than on written rules and legal processes (*ibid.*: 108). Finally, as neighbouring people take their livestock to the salt lick within the Majawanga woodlands and as people from Majawanga use forested and grazing areas of neighbouring villages, community based management requires extensive coordination of the different village councils within a "regional" (supra-village) management authority.

Another important constraint to consider when dealing with common woodlands is that different people have different stakes. The existence of a diversity of insects (pollinating crops, acting as pest control agents or immobilising organic waste) might be more important than trees for some farmers. People who collect honey depend on the existence of tall trees but may not be particularly concerned with ground cover biomass or woody shrubs that are nutritious for livestock. Access to firewood and

to wild vegetables or fruits is more important for women than for men (Andersen 2005: 74). Access to biodiversity is more important for those who rely on a wide range of non-timber forest products, such as traditional healers or craftsmen. For the 55% of households that own some livestock (according to the household survey), access to grazing and water is paramount. Those who own livestock are generally among the richest and most influential people. As can be seen in figure 6, people locally perceived to be "rich" (47% of the population) own much more cattle and goats/sheep than people perceived to be "average" (41% of the population). Those considered to be 'poor' (12% of the population) own almost no livestock. As a result, any attempt to severely restrict access to common woodlands may be resented by the richest and most powerful households of the village, and to be therefore met with strong resistance.

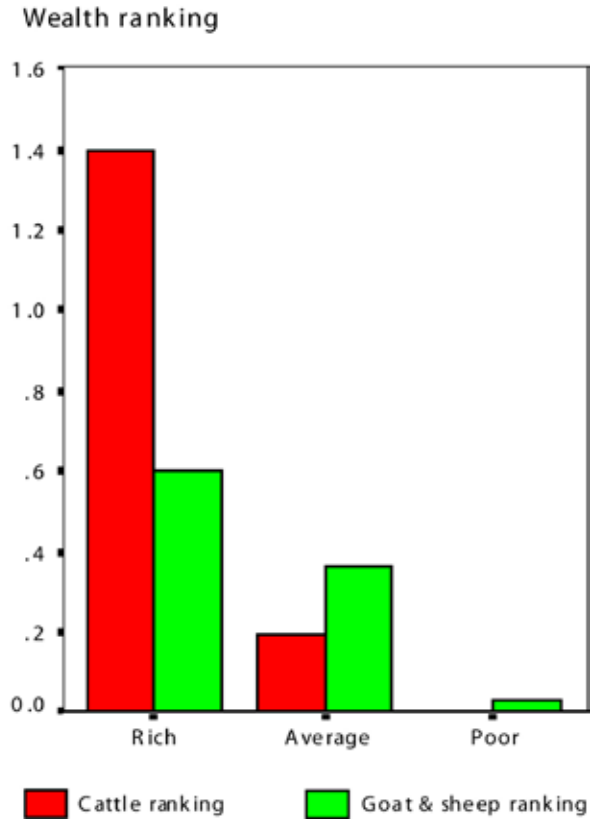

Figure 6: *Relation between the amount of cattle and small ruminants and the percieved socio-economic status of households. This graph is the result of a participatory wealth ranking conducted with 12 informants (6 each from two sub-villages, 3 men and 3 women interviewed first separately then together). The wealth of 128 households (in 2 sub-villages) was ranked according to 3 criteria (poor, average and rich), and according to the amount of cattle or small ruminants owned (0 = none, 1 = some, 2 = many).*

To sum up, a better management of common woodlands requires the existence of legitimate and efficient institutions that are backed up by the State when they enforce laws preventing agricultural encroachment and control tree felling or grazing. Unless careful measures are taken, replanting trees in a common area is likely to meet the classical problems of common forests: being unmanaged, eaten by goats or burnt by bush fires. Likewise, without careful considerations, limiting the use of common lands is likely to be resisted by those who have most to lose from it. Any new management plan must carefully take into account all stakeholders and analyse who might win or lose from a change in the management plan. If no "win-win" situation can be found, in which everybody would benefit from a change of management, difficult political decision will be needed to decide which social category (i.e. which woodland use) should be prioritised, and on which principle. Should the focus be on maximising income, the number of actors winning from change, social peace, or biodiversity? Should the focus be on men or women? On the poorest and most marginal part of population, on those who are best able to enforce the new rules, or those who are best able to add value to the change? In any case, the existence of efficient institutions as well as the collaboration of cattle herders and agriculturalists will be the key to a successful change in management.

8. Conclusion

The potential for improving tree use in Majawanga is big. The agricultural landscape is basically bereft of trees, and the remaining woodlands rapidly diminishing and degraded in comparison with an ungrazed nearby forest (in terms of the existing number and size of trees). The need for firewood, grazing, NTFP, and for increased income or expense saving through planting trees and managing tree products is very important. Increasing the number and quality of trees in the landscape can take place through two different strategies: planting new trees and improving the management of existing trees. These strategies, far from being opposites, should be seen as complementary, as they concern different species and different users. There is, however, some overlap in the use derived from trees in both situations, and improving the quantity and quality of trees in one system might reduce the pressure on trees in the other one.

As we have discussed, private tree planting and common woodlands are characterized by different constraints. However, there is also a certain overlap in the major conditions needed to improve both types of management. First, both private tree planting and the sound management of common woodland are constrained by the development of agriculture. Managing the commons supposes that private field encroachment is prevented and planting trees on private land has more chances of success if trees can be planted in such a way as they do not have a negative impact on the production of annual crops. Second, both strategies also require that tenure problems are solved, both on private land (since contested tenure prevents the planting of trees) and in common woodlands (since the boundaries are not accepted by all and are encroached). Third, both require that the grazing of animals can be regulated, at least in the early stages of private tree planting or woodland regeneration. Finally, both strategies require the existence of legitimate and efficient political institutions that are backed up by the State. Thus, although the constraints apply differently in both types of tree management, they nevertheless require broad solutions that demand similar types of action, which is another reason why private tree planting and the management of common woodland should be considered together rather than separate, as it is too often the case today.

9. Acknowledgements

The results presented were part of PETREA (People, Trees and Agriculture in Africa), an action-research project whose aim is to improve the livelihood of rural people through the increased or improved use of trees and shrubs (Nathan 2002). Research was funded by DANIDA, that we thank for its support. It was conducted in interdisciplinary teams mixing natural and social scientists, as well as Danish and Tanzanian researchers. The project consisted of two phases where the first phase (2001-2002) aimed at identifying opportunities and constraints for improving the use of tree products and the second phase (2003-2005) aimed at designing solutions to constraints. Prof. Ancelm Mugasha passed away while we were writing the present paper. We miss him deeply and would like to dedicate this article to his memory.

Notes

1 Ujamaa (a Swahili word meaning "familyhood") is the concept of African socialism which involves no theory of inevitable conflict between the "landless" and the "landed". As explained by Tanzania's former President Julius Nyerere, Ujamaa derives from tribal socialism, the foundation of which is the extended family. Nyerere wanted to enable Tanzania to produce all the food and staples it needed for its people's survival without having to "sell its soul" to Western Capitalism. The basic aim of Ujamaa was to make everyone self-sustaining. The small Ujamaa village was Nyerere's primary concern. His government attempted to persuade Tanzanians to organize themselves into co-operative self-sustaining villages. The process of creating these self-sustaining villages is known as Operation Vijiji.

2 Even if water was not a problem, establishing tree nurseries in rural areas also faces important constraints, such as the lack of planting material or the difficult access to the seeds of the trees which farmers wish to plant – mainly exotic trees producing firewood, timber and fruits (Aalbæk 2001)

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