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HUMAN USE OF NATURAL RESOURCES AND THE CONSERVATION OF THE AFROMONTANE FOREST IN MOUNT MOCO, ANGOLA

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ABSTRACT:

Afromontane forests are one of the most threatened habitats in Africa. In Angola, some of the best-known remnants of this habitat are located on the slopes of its highest mountain, Mount Moco. Here, the last 85 ha of forests are disappearing because of the impacts of a single human community (Kanjonde). The conservation of this habitat requires a comprehensive understanding of human resource uses in this area. With the objective of guiding conservation planning, surveys on the socio-economic characteristics of this population and their use of natural resources were conducted. Three activities were identified to have major impacts on Mount Moco: hunting, wood collection for fuel and construction and intentional burns. The last two were the most devastating activities for the forests. Some methods are proposed in order to minimize the impact produced by Kajonde community on Mount Moco.

Keywords: Conservation; livelihood; Montane forest; socio-economic; sustainable use.

INTRODUCTION

In Africa, the montane forests are one of the most threatened habitats by human activities. These activities have as major objective to acquire natural resources in order to fulfill the needs of a growing human population (Cropper & Griffiths, 1994; Foley et al., 2005; Southgate, Sanders, & Ehui, 1990). Therefore the fate of biodiversity depends upon the actions and impacts that human populations have on this natural environment (Gardner et al., 2009). For this reason, to achieve the conservation of these Afromontane forests is extremely important to know the demographic and socio-economic characteristics of local populations and their impact in these habitats.

The Afromontane region extends from Sierra Leone in the west to Somalia in the east, and from Sudan in the north to the southern tip of the continent in the south (White, 1978, 1981). The region is composed of a series of isolated mountains, that can be viewed as "islands" among an ocean of lower elevation habitats, which results in an archipelago-like regional centre of endemism (Cowling, Richardson, & Pierce, 2004; Scott, 1998; White, 1978). Some of the "islands" hold populations of species that can only be found in other mountain "islands", sometimes thousands of kilometers away (White, 1978).

Conservation efforts for the Afromontane region should target representative communities, giving special importance to the satellites populations, which are extremely small and being destroyed at an accelerated pace (White, 1981). This is particularly true in Angola, the smallest and most isolated Afromontane centre.

The Afromontane forest in Angola is composed of a small group of isolated forest patches in the deep ravines and slopes of mountains in the west-central highlands (Huntley & Matos, 1994). One of the best known examples of this habitat is found in Mount Moco. These forests have high biodiversity value, with an avifauna of particular significance, not only because of the presence of endemic, rare, and threatened species, but also for the presence of isolated populations of Afromontane specialists (Huntley & Matos, 1994). Among these specialist is the only viable known population of the Endangered Swierstra's Francolin (*Pternistis swierstrai*), an species endemic to Angola that is entirely dependent on this habitat (Mills, Olmos, Melo, & Dean, 2011).

In order to guide future conservation strategies for this area a comprehensive demographic and resource use surveys was conducted in the local population (Kanjonde community), in order to: i) describe the demography and socio-economy of the community, and ii) describe the natural resource use patterns that more negatively impact on the forest. Based on the results methods for minimizing human impacts on the forests and encourage sustainable use of the forest's resources are proposed.

MATERIALS AND METHODS

Study site

Mount Moco is located in the province of Huambo **(Fig 1)**. No climate information regarding the area is available, but the rainfall is within the 1400 mm isohyets (Dean, 2001). The Afromontane forest is distributed in about 30 patches, cover only 85 ha of the area. Few of these patches have areas larger than 5 ha, which makes them more susceptible to further degradation (Mills, et al., 2011). These forest patches are found on deep ravines in altitudes from 1,800 to 2,400 m (Huntley & Matos, 1994).

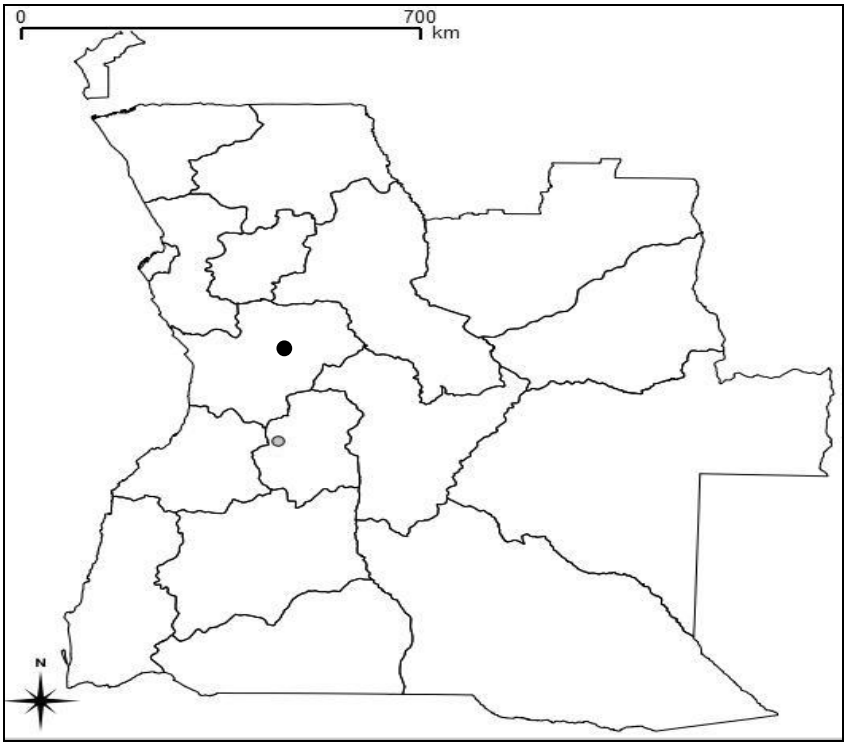

Fig 1. Location of Mount Moco (black point) in Huambo province.

Kanjonde is the only village in the area surrounding Mount Moco with easy access to the forests patches on the mountain. Kanjonde village is located at 12º 25' 41.23" S, 15º 9' 9.80" E, at an altitude of 1940 m.

Data collection

Information regarding the local population and their use of natural resources was collected through surveys during 2009 and 2010. The personal interview method was used because it is very helpful in areas where the illiteracy rate is high (United Nations, 2005).

'Open-ended' questions were used in the 2009 surveys so the interviewees could give all the possible information regarding the different issues addressed. The information collected in this survey, together with the previous knowledge of the natural area (Dean, 2001; Huntley, 1974; Huntley & Matos, 1994; Mills, et al., 2011), allowed the design of 'close-ended questions' for the 2010 surveys in order to address more specific and important issues – hunting and wood collection – affecting the conservation of this area.

Information regarding age and gender composition was collected for each household. The Standard International Age Classifications for population age and distribution recommended by the United Nations (1982) was used with slight modifications (**Table 1**). Results could be compared with other information available for Angola.

Table 1. Age groups and gender composition in Kanjonde village. Information was taken from the 2010 survey (N=260 persons). The age classification follows the United Nations guidelines (1982) except for the two first classes: infancy for the UN is < 1 year, and youth is from 1 to 14 years.

Age Group	*Male*	*Female*	*Total*
From 0- 4 years.	9.62%	15.38%	25.00%
Youth 5-14 yr.	15.77%	13.46%	29.23%
Young Adulthood 15-24 yr.	8.08%	8.08%	16.15%
Middle Adulthood 25-44yr.	11.54%	11.54%	23.08%
Older Adulthood 45-64yr.	1.15%	2.31%	3.46%
Retirement > 65 yr.	2.31%	0.77%	3.08%
Total	48.46%	51.54%	100.00%

Identification plates were used to help interviewees identify the different habitats (forest, grassland and woodland) where hunting and wood collection took place and the different animal species affected by these activities. 'Forest' was defined as the Afromontane forest patches in the deep ravines of the mountains, 'Woodland' was *Brachestygia*-dominated woodland (miombo) present in the mountains slopes before getting into higher zones or deep ravines, and 'Grassland' was the vegetation of the plain areas around and in the mountains. Animal species were scrub hare (*Lepus saxatilis*), hyrax (*Procavia* sp.), greater cane rat (*Thryonomys swinderianus*), common reedbuck (*Redunca fulvorufula*), common duiker (*Sylvicapra grimmia*), red-necked Spurfowl (*Francolinus afer*), helmeted guineafowl (*Numida meleagris*), Swierstra's francolin (*Pternistis swierstrai*), and Finsch's francolin (*Francolinus finschii*), all known to be present on the mountain.

RESULTS

The community of Kanjonde is composed of just over 300 people (2009 surveys: 59 households, 312 persons. 2010 surveys: 49 households, 260 persons).

Gender distribution is balanced, with slightly more women than men (Table 1) (men 48.46% and women 51.54%, N=260 persons). Most of the population is composed of younger age classes (54.23%, ages between 0-14 years, N=260 persons) while a very low percentage over 65 years (3.08%, N=260 persons). Each household has an average of three children (3.07 ± 1.25 children, N = 46 interviewees).

Most people in Kanjonde do not attend school and are illiterate (61.02%, N=59 interviewees), with most of those attending school rarely progressing beyond the 3rd grade.

All households in Kanjonde participate in agriculture, which is the principal economic activity, with c. 75% of the population also rearing livestock (**Fig 2**). The main crops grown are corn, beans and potatoes (26.22%, 23.11% and 20.89%, N=221 responses, as most interviewees grow more than one crop). Other crops are grown such as cabbage, onion, garlic and fruit. The principal livestock are chickens and goats (49.37% and 27.85% respectively, N=79 responses).

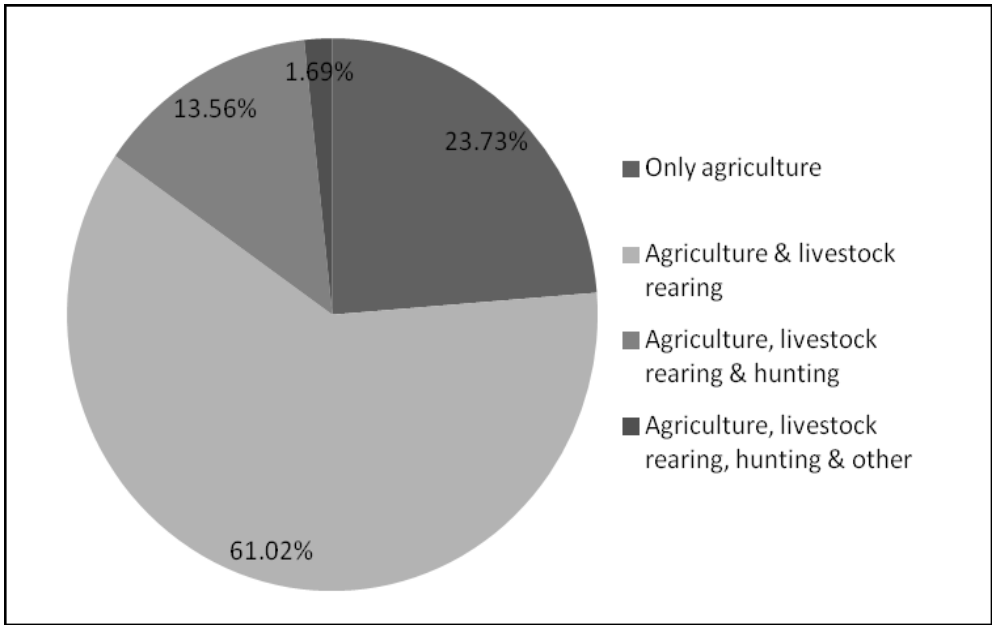

Fig 2. Economic activities in Kanjonde (N=59 interviewees).

The majority of the population uses the output of their economic activities both for self-supply and commerce (61.40%, N=57 interviewees). Nevertheless, more than ⅓ of the population farms exclusively for subsistence (36.84%, N=57 interviewees), whereas only one interviewee stated that all his products were only for sale. The population of Kanjonde usually sells their products in Ussoque (12 km away) or Balombo (42 km away) markets.

Three activities were identified as major threats to the Afromontane forest: wood collection, hunting and intentional burns. Wood is collected for (a) fuel to cook and (b) construction material used in houses. Women and/or children collect firewood, on average, four times per week (3.97 ± 1.57, 2009 survey and 3.74 ± 2.06, 2010 survey). Women usually carry one pack of wood per trip and the weight of this pack can vary greatly from one person to another (*i.e.*, old women, pregnant women, carrying farming tools, etc.; 13.75 ± 7.25 Kg, N=20 packs; range 5-28 kg). Firewood is mostly collected in the woodlands or in both the woodlands and the forests (**Fig 3**; 48.98% and 26.53% respectively, N=49 interviewees). Nevertheless some people collect firewood exclusively in the forest (18.37%, N=49 interviewees). Most of the firewood is obtained by cutting down a tree (66.13%, N=62 responses). Once the wood is dry, the tree is gradually chopped *in situ* according to what is needed.

Wood collected for construction is used in the framing of doors and windows and as roof and support beams of houses. The wood is almost exclusively collected from the forests (**Fig. 2**) (95.24%, N=42 interviewees) by cutting down a tree (85.71%, N=49 responses).

Almost half of the interviewees (42.86%, N=49 interviewees, 2010 surveys) engaged in hunting activities. Most animals are hunted for self-supply (85.71%, N = 21 interviewees), with less than 5% of hunters selling bush meat. Close to a fifth of the hunters performed this activity exclusively in the forests (**Fig. 4**), which is the most important hunting ground used by two-thirds of the hunters when combined with other habitats. The most frequently hunted prey were red-necked

Spurfowl and the greater cane rat (**Fig. 5**, 18.60% and 16.28% respectively, N=86 responses). The most common hunting methods used were traps and/or dogs. Swierstra's Francolin was also recorded to be hunted (8.14%, N=86 responses).

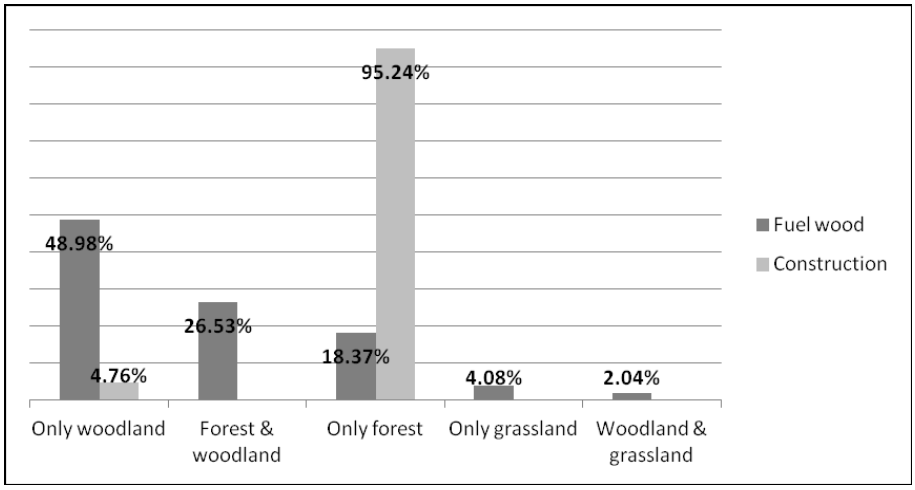

Fig 3. Habitats where local population goes to collect firewood (N=49 interviewees) and construction wood (N=42 interviewees).

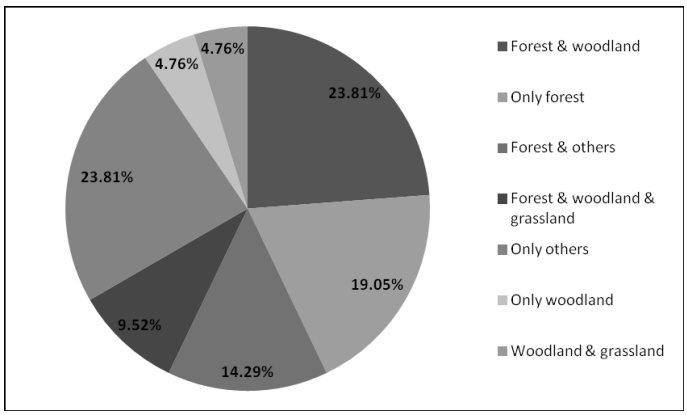

Fig 4. Habitats where hunting activities take place in Mount Moco (N=21 interviewees).

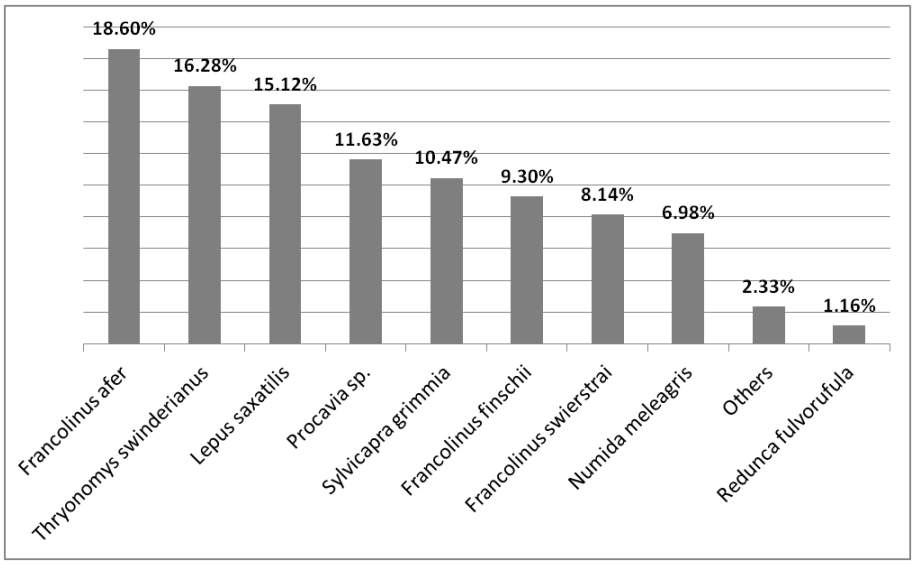

Fig. 5. Species hunted in Mount Moco. (N=86 responses, as one person hunts different animals).

Most of the Kanjonde population actively start bush fires (84.48%, N=58 interviewees). Having no access to fertilizers, burning the fields after harvest is a widespread practice used with the aim of improving soil quality and cleaning up the fields (87.76%, N=49 interviewees doing burns). Burns are performed especially in the dry season, from May to September, being June the month in which most burns occur (32.99%, N=97 responses).

DISCUSSION

Demographic and socio-economic characteristics

Kanjonde community is composed mostly of young population, aged 0-24 years (70.38%), with a very low percentage of population over 65 years. The presence of a large young population and a reduced elder population is commonly related to high fertility and low life expectancy rates, which corresponds with Angolan demographics. As a country, Angola has one of the lowest life expectancies at birth (46.8 years), but also one of the highest total fertility rates in the world (5.79 children per woman) (United Nations, 2009).

Changes in family size can affect the demand for natural resources (Brian, Aboot, & Mace, 2004). Increases in human populations living near natural areas are expected to increase the pressure, impact and degradation of these areas. In order for these populations to meet their needs, more natural resources have to be used. Sometimes the natural resources of an area can be seriously diminished by the needs of human populations living there (G. M. Green & Sussman, 1990). At Mount Moco, the total cover of Afromontane forest appears to be shrinking as a result of human activities. An elder in Kanjonde mentioned that in the recent past the forest used to be nearer to the village. Something that is reminded by the lonely fig tree (*Ficus* sp.) standing in the village.

The main economic activity performed by the population is agriculture, which represents the main and sometimes only way of subsistence for everyone. The rearing of small size livestock, such as chickens and goats, is common in the community. Even though livestock can supply a source of meat, some people engage in hunting activities especially for self-supply and probably as an easy way to get meat. These people are not exclusively hunters, as all of them grow crops as their main economic activity, and hunting is mostly performed on a weekly basis. Hunters are not selective or specialized on any particular prey. Nevertheless, as the forests are both their preferred hunting ground and the habitat of the Swierstra's Francolin, this endangered bird species is sometimes hunted.

Principal Impacts on Afromontane Forests

The grown of the population on Kanjonde is expected to seriously impact the natural habitats of Mount Moco. More farming land will need to be cleared through the plowing and slash-and-burn of natural areas (including forests). Particularly concerning is the fact that areas for new fields are sought adjacent to or in the remaining forest patches, where water is more readily available and soil fertility is higher. Uncontrolled fires from slash-and-burn and burning of grassland can also have major negative impacts in the small fragments of forest that are left, due to their very high edge/interior ratio. These uncontrolled fires destroy vegetation from surrounding grassland entering into the forests.

Wood collection and slash-and-burn agriculture came up as the most concerning activities affecting both the miombo woodlands and the Afromontane forests patches at Mount Moco. Firewood is essential for livelihood and accounts as one of the major uses of forests and woodlands in developing countries (Dovie, Witkowski, & Shackleton, 2004; Gilmour,

2005). Firewood consumption in rural areas can vary greatly according to the number of members per household. A household in sub-Saharan Africa can use 1,380-3,560 kg of wood per year (Brian, et al., 2004; Dovie, et al., 2004). The estimates obtained in this study show that a single household in Kanjonde uses up to 2,800 kg of wood per year. The exclusive dependence on wood for fuel and the lack of any viable substitutes *in situ* underlie this high wood consumption.

Firewood is mainly collected in the miombo woodland and to a lesser degree in the Afromontane forest patches, although previously this may have been reversed, until forest patches near the village had been cleared. At present, woodlands are larger and located nearer to the village, but at the same time the competition for the resources here is higher because wood collection is easier. This encourages some people to go to the forests patches even though these are further away from the village and has led to almost one fifth of the wood harvesters specializing on collecting wood from the forests only.

Bush fires are also a major threat for the forests. These uncontrolled burns often turn into large wildfires that can reach the forests patches. This was directly observed and can be deduced from the numerous scars that surround the forests and the burnt stumps inside them.

Conservation Implications

The Afromontane forests of Mount Moco constitute a major conservation priority because of their biological value, small remaining extent and the high threat levels they are subjected to. For these reasons, a proposal for the creation of a protected area has been put forward as the best way to conserve the forests of Mount Moco as early as the 1970's, when a 60 km^2 area was proposed (Huntley, 1974). Recent surveys of the area reached the same conclusion, with the additional recommendation that a buffer zone of c. 200 km^2 be implemented in order to manage human resource use in a way favourable for the conservation and expansion of the forest fragments (Mills, et al., 2011). The present study has obtained a detailed picture of the human community, its needs and its impacts on the forest, information that is essential to guide any management plan for such buffer zone.

The surveys made clear the high dependence of the Kanjonde community on the natural resources of the area. This dependence extends to the Afromontane forests where the current resource use patterns are very unlikely to be sustainable — taking into account both the population demands and the very small area of forest left. For example, this study showed that the most valuable resource provided by the Afromontane forests is timber. Today, good trees for timber (e.g. *Podacarpus* sp., *Olea* sp., *Ilex mitis*, *Syzygium guineense*) remain only in a single patch (out of 30), the largest and furthest away. This patch is now being targeted as the source of timber collection. It is therefore a safe prediction that current resource use rates will lead to the disappearance of the forests (or to a degradation level beyond recovery) in the near future. With no forests left in the area, the Kanjonde community will itself disappear, as they will be forced to move elsewhere. The community has already moved location once, within the Mount Moco massif, during the mid-20th century as a consequence of resource depletion, but no more alternatives are available within the region. Most inhabitants of Kanjonde are aware of this situation: 83% predicted that the forests will disappear as a result of their own activity (53 people interviewed on the question "Do you think that the forest you see from the village is going to disappear?"). Nevertheless, they have been unable to find strategies that could halt this, as no alternative resources for

some of their essential needs, like fuel, are present. For this reason, the conservation of the unique environment of Mount Moco — and therefore of its human population — will have to rely in long-term interventions of external organizations such as the government, NGOs or a partnership of both. These will have to focus primarily on:

i. *Reducing the human footprint on the ecosystem by reducing natural resources demand and increasing sustainable use of resources.* The main targets should be to reduce the use of firewood and the impact of uncontrolled burns. The latter will require a sustained program of agricultural extension aiming not only at decreasing the need for burns and introducing controlled-burns techniques, but also at introducing more efficient eco-agricultural techniques. The former must consist in implementing efficient ways of using fuel — away from the currently vastly inefficient practice of making fires directly on open ground. In 2010, two Vesto stoves (New Dawn Engineering, Swaziland) were demonstrated to the community that greatly appreciated them. Efforts are underway to provide a stove for each household.

ii. *Providing alternative sources for the resources that are currently sought in the forests*. In a first phase, construction material to replace timber collected from the forests could be provided to the community. A feasibility study for plantations near the village to provide timber could also be instigated.

iii. *Restoring the Afromontane forest.* The very small size of most fragments of Afromontane forest at Mount Moco makes them vulnerable to further degradation independently of anthropogenic action. It will therefore be necessary to set a reforestation program that will extend the patches if not to their past extent at least to areas that will make them significantly more resilient to change. With this objective a nursery was established next to the village in 2010, employing four young men in the village in a part-time basis.

iv. Finally, eco-tourism activities could be considered as a strategy to provide direct incentives for the community to protect the Afromontane forests. This route is made easier at Mount Moco because, being the highest point of Angola, a regular tourist flow is guaranteed from the outset.

It is not possible to achieve the conservation of Afromontane forest in Mount Moco without considering the needs of Kanjonde community. Therefore, as Grimshaw (2001) mentioned 10 years ago, "the survival of Afromontane vegetation [forest] is an ongoing struggle between the daily necessities of poverty-stricken Africa, and the values perceived by those more fortunate".

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