Tropentag 2008
University of Hohenheim, October 7-9, 2008
Conference on International Research on Food Security, Natural Resource Management and Rural Development

Using NTFPs to drive rural development without threatening biodiversity? A concrete example concerning four NTFPs in Central Menabe, Madagascar

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1. Introduction

The growing demand for food that especially affects developing countries is the result of a decrease in available arable land and demographic growth. In this context, non-timber forest products (NTFPs) could be suitable alternative foods.
NTFPs provide a safety net to the Malagasy rural populations when agricultural products are scarce (Favre 1996). In Central Menabe (west coast of Madagascar), *Dioscorea maciba* and *Tacca pinnatifida* (two tubers), *Tenrec ecaudatus* (a mammal) and honey (produced by *Apis mellifera unicolor* colonies) are the most important NTFPs for livelihoods. In this region, a protected area covering 100 000 ha of forest surrounded by 23 villages has currently been setting up; about 110 households live in each village. In order to drive rural development without threatening biodiversity, the present research firstly aims to describe the traditional management of NTFPs. In a second step, the study evaluates the current forest density of the four products, in order to deduce whether the traditional practices threaten the NTFPs in the future protected area. Thirdly, it discusses the commercial potentialities of NTFPs. The research concludes with recommendations for NTFPs' managements that are likely to meet the needs of local populations while simultaneously decreasing the pressure that the villagers' practices place on the products.

2. Methods

2.1. Traditional NTFP management

In order to understand traditional NTFP management, a social methodology of data collection was followed focusing on harvests' frequencies, quantities and modes. In seven villages of Central Menabe, 196 households were interviewed on the frequency with which they harvested NTFPs; 28 households were picked at random from each of the seven villages. In five of them, 46 additional households were interviewed on the frequencies, quantities and modes of NTFPs' harvest. Depending on the disposability of the farmers, between 5 and 13 households were randomly chosen in each village. In four of the seven villages, 9 participant observations were carried out focusing on the NTFPs' harvesting modes, quantities and frequencies by harvesting the products with the farmers.

2.2. Are NTFPs under threat from local practices?

Following the methods described above, the study assesses how much and in what way the four NTFPs are harvested by the local population. In order to analyze whether these harvesting practices threaten the NTFPs' species, the density of the NTFPs in the forest has to be estimated. These estimations were determined by means of inventories in different forest plots. For the two

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tubers, plants were counted in five plots measuring 20x20 m^2 following a transect of 2 km. In all, 8 transects (40 plots, 16,000 m^2) were traced for *T. pinnatifida*, and 4 transects (20 plots, 8,000 m^2) for *D. maciba,* which had already been studied comprehensively in previous researches (Ackermann 2003). Three local harvesters carried out the inventory of the tubers in each plot. The active honey beehives and the active burrows of the *T. ecaudatus* (tenrecs generally hibernate alone in a burrow) were counted continuously along transects measuring between 1.82 km and 4 km. 6 transects were traced for each product. Beehives were visible for a horizontal distance of 3 m (2 transects) or 5 m (4 transects). Burrows, too, were visible for a horizontal distance of 3 m. For each transect, 3 honey or 4 tenrec local hunters walked in parallel lines 10 m apart. The collected data on harvesting modes, quantities and frequencies, as well as the NTFPs' forest density estimations, were then extrapolated in order to estimate the pressure of local practices on the NTFPs in the future protected area.

2.3. Commercial potentialities of NTFPs

Questionnaires concerning the offer and demand of NTFPs were conducted in the villages and at regional markets in order to identify the tendencies of local and regional NTFP commerce. In six of the seven villages, 288 households were interviewed on their purchases and needs with regard to NTFPs. 48 households were randomly chosen in each village. 41 sellers and 29 buyers were randomly questioned at seven regional markets about the regional offer and demand of NTFPs. Depending on the disposability of the sellers and the buyers, between 3 and 18 people were interviewed at each market.

3. Results and discussion

3.1. Traditional NTFPs' management

T. pinnatifida is harvested all the year round. 53% of the harvests happen in forests and 47% in secondary formations (stdev = 45). 87% of households harvest this tuber. Each household harvests an average of 260 tubers (stdev = 155) on 54 days a year (stdev = 53), i.e., a total of 14,040 tubers per household per year. The traditional harvesting mode mainly consists of collecting the whole tuber of every visible plant.

The harvest of *D. maciba* lasts from mid-January to mid-April (3 months, stdev = 2). 47% of the harvests happen in forests and 53% in secondary formations (stdev = 43). 82% of households harvest this tuber. Each household harvests an average of 6 tubers (stdev = 3) on three days (stdev = 3) a week, i.e., a total of 18 tubers per household per week. The harvesting mode consists of collecting the whole tuber of only the biggest adults, those that aren't too deep or too twisted; sometimes it is not possible to take the whole tuber and a piece of tuber remains in the ground.

Wild honey is collected from mid-January to the end of April (3.5 months, stdev = 1.5). 78% of collections happen in forests and 22% in secondary formations (stdev = 36). 65% of households collect wild honey. Each household collects an average of 8.5 liters (stdev = 6.5) on 2.5 days a week (stdev = 2), i.e., a total of about 325 liters per household per year (cf. Box 1). A colony usually produces around 10 liters of honey. Traditionally all of the honey found in a beehive is collected and hunters usually eat the larva.

The hunt for *T. ecaudatus* lasts 3 months (stdev = 1; December and from mid-January to mid-March). 80% of the hunting is done in the forests and 20% in secondary formations (stdev = 27). 49% of households hunt tenrec. A household catches on average 5 adult animals (stdev = 5) on 1 day a week (stdev = 1) in December. From mid-January to mid-March each household catches on average 25 animals (stdev = 13) (2 adults and 23 young) on 3.5 days per week (stdev = 3.5), i.e., a total of 7 adults and 80.5 offspring per household per week. A one-year-old tenrec female is adult and rears about 14 young per year (Garbutt 1999). Traditionally, gestating females or females with very young offspring are not killed. Some older young are sometimes spared, too, as they are numerous and often flee very quickly. Animals who have dug themselves into deep

burrows are not hunted either as it would require too much work.

A key informant who harvests honey construed this activity as "wild beekeeping". He revealed that he had discovered 15 wild beehives in the forest but keeps the knowledge of the location to himself so that other honey harvesters would not find them. From each of these beehives, he harvests ten liters of the honey twice a year (he leaves a little honey for the bees and he does not eat the larva). This means that he harvests about 300 liters of honey a year.

Box 1. Quantity of forest honey hunted per year.

3.2. Are NTFPs being threatened by the local practices?

The density of each NTFP is shown in Table 1. These numbers concern natural forest formations only (not secondary formations).

	T. pinnatifida	*D. maciba*	Beehives	Burrows
Number of ad items per hectare	155.02	17.50	0.20	4.44
Number of yg items per hectare	300.61	310.00		

Table 1. Density of tubers, active beehives and active tenrec burrows per hectare. ad: plants older than 1 year, yg: plants younger than 1 year.

Following conclusions can be drawn for the future protected area (100 000 ha of forest, 23 villages, 110 households per village). Currently, farmers harvest about 36% (16 378 825 (calculated from chapter 3.1.) out of the 45 563 000 (calculated from table 1)) of the *T. pinnatifida* growing in the forest of the future protected area. This pressure is small, because even if the 46% (13 424 721 plants) of the remaining population dies after harvests, the number of more-than-one-year plants of the next year (15 759 454) remains stable (15 759 454 is almost 15 531 000, calculated from table 1.)

Farmers harvest about 13% of the *D. maciba* adult plants growing in the forest of the protected area, but no (0%) plant of less than one year are harvested. This pressure is small, because even if the 97% of seedlings die together with 46% of the remaining adult population after harvests, the number of plants of more than one year remains unchanged for the following year.

Farmers hunt honey in all (100%) beehives situated in the forest of the future protected area. If we assume that the survival ability of the *A. mellifera unicolor* colonies living in hunted beehives is greatly reduced (because all the honey is taken from a hive and the larva are eaten), the pressure on the bee colonies is very strong (Paupert Razafiarisera 2005).

In the forest of the protected area, farmers hunt about 5% of the *T. ecaudatus* adult animals before the reproduction, about 14% of the remaining adults after the reproduction and about 22% of the offspring. The pressure is small, because even if the 90% of the offspring die together with 43% of the adult population after hunts, the number of adults is stable for the next year.

3.3. NTFPs' commercial potentialities

Honey and *T. ecaudatus* are the most bought NTFPs in villages (χ^2: $p = 0.000084$; cf. Table 2). Moreover, households who usually buy NTFPs need more *T. ecaudatus* than other products (χ^2: $p = 0.03$; cf. Table 2). At regional markets, *T. ecaudatus* has a demand outstripping the most the supply (Fisher: $p = 0.042$) and is the quickest sold (χ^2: $p = 0.019$) (cf. Table 3). It leads to the conclusion that tenrec sales should be developed in villages and particularly at a regional level.

	T. pinnatifida	*D. maciba*	Honey	*T. ecaudatus*
Percentage of households buying the product	42	42	54	54
Percentage of households needing more of the product	51	55	51	62

Table 2. Description of the NTFPs' commerce at a local level.

Percentage of people who…	*T. pinnatifida*	*D. maciba*	Honey	*T. ecaudatus*
…always find the products when they want to buy it	47	71	100	0
…sell in one day all the products they bring to the markets	20	60	36	70

Table 3. Description of the NTFPs' commerce at a regional level.

3.4. Recommendations

1. To develop beekeeping in order to decrease the pressure on the *A. mellifera unicolor* colonies.
2. To increase the *T. ecaudatus* marketing by means of domestication or increasing the hunt.

4. Discussion on the recommendations and conclusion

Beekeeping presents four advantages. 1) It reduces farmers' labor costs compared to the honey hunt, 2) it is a traditional performed practice in villages, and farmers describe beekeeping as an easy activity, 3) it generates strong interest, and 4) it has a positive impact on the bee density and pollination (Ratsirarson and Silander 1996). Nevertheless, problems persist with regard to consciousness-raising and know-how.

Increasing sales of *T. ecaudatus* by the means of domestication or increasing the hunt would diversify farmers' income (Illukpitiya and Yanagida 2008). Although tenrecs were already domesticated (Louwan 1973; Eisenberg 1975), the domestication of wild animals is not traditional and not well accepted by the villagers. But so far, no effort has been made to raise farmers' awareness of the possibilities of such a scheme. The second option, i.e. to increase tenrec hunts, poses some problems. 1) It increases the villagers' labor costs, 2) hunters are legally required to buy a permit to sell wild tenrecs, what they usually don't do, 3) it would impact negatively on the wild tenrec population if hunts are increased too much, 4) it runs counter to the forest conservation message that NGOs have been trying to convey to the villagers.

In conclusion, training and technical support in beekeeping should be afforded to the local population. Studies on local tenrec domestication potentialities should be developed, as well as small-scale participative domestication trials.

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