

Taking into account local practices and indigenous knowledge in an emergency conservation context in Madagascar

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Abstract At the 5th World Parks Congress, held in Durban, South Africa in 2003, the President of Madagascar committed his government to tripling the country's protected zones over the next 5 years. The announcement reflected a desire to combine rapid conservation efforts with sustainable development. Conservationists in Madagascar focused their attention on the endemic baobab tree, *Adansonia grandidieri*. This paper aims to identify the contradictions between the political emergency of the biodiversity conservation effort and local development needs. Eighty-three semi-structured interviews were conducted in two villages near the protected area of “Baobab Alley” in the Menabe region. Malagasy conservationists believed the area's protected status would benefit the local economy through eco-tourism. However, the conservation actions undertaken there display limited understanding of local dynamics and conflict with farmers' needs. To protect the baobabs, the government has prohibited rice cultivation without providing compensation. We show that the multifunctional baobab tree is integrated into an agroforestry system and protected by farmers. Based on these results, we address the issue of how to combine conservation and local development objectives through the involvement of farmers and the recognition of local knowledge in tree management. We also demonstrate that an emergency approach to conservation is not conducive to the successful integration of conservation and development.

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Introduction

Beginning in the 1970s, criticism of conservation programmes which excluded people living in and around protected areas contributed to a growing debate over the relevance of “community-based” approaches. Interest in programmes focussed on ecosystem conservation modes which also promote sustainable development was illustrated in the 1992 Rio Declaration on Environment and Development. The increased participation of local community members appeared to be an essential condition for the success of a conservation programme (Agrawal and Gibson 1999). The advent of integrated conservation and “community-based conservation” projects testified to this will to pursue programmes in which conservation and sustainable development goals were combined (Wells et al. 1992).

A new agenda for conservation policy was set at the 5th World Parks Congress, held in Durban, South Africa in September 2003. It took into account local development needs and poverty reduction goals, announcing the emergence of a new paradigm for conservation action (Phillips 2003). The new code categories developed by the International Union for Conservation of Nature (IUCN) for protected areas—V, protected landscape, and VI, managed resource protected area—include areas modified by man on which the sustainable exploitation of resources and production activities are allowed (Locke and Dearden 2005). Protected areas are thus expected to become tools to better take into account human needs and the promotion of local economic development within conservation programmes (Locke and Dearden 2005).

In practice, however, conservation goals often still take priority over those of local development when protected areas are established, reducing participation to a means to an end (Balint 2006). To improve “community-based conservation” in and around protected areas, the social and economic costs borne by local people and conservation stakeholders must be limited by generating shared benefits that can limit conflicts between the two parties (Western and Wright 1994).

Social processes, which condition the “theoretical” success of a conservation project involving local populations, operate on a long term basis and are shaped by negotiations between different parties, the power to change rules made by outside actors, and the opportunity to bargain over these rules for each individual to defend his or her own interests (Stern et al. 2002). The establishment of true negotiation arenas is made possible on one hand by understanding local knowledge, farmers' strategies and practices, and, on the other, by integrating scientific knowledge into the definition of biodiversity management actions.

Madagascar, a biodiversity hotspot, has a long history of conservation actions, with the creation of the first nature reserves dating back to 1927 (Petit 1928). Since 1956, this network has been complemented and expanded with the support of international donors, with the World Bank in the lead (Chaboud et al. 2007); by 2001, it included nine Integral National Reserves (*Réserves Nationales Intégrales*, RNI), 15 National Parks (*Parcs nationaux*, PN) and 23 Special Reserves (*Réserves spéciales*, RS). However, international development aid has imposed conditions that leave Malagasy actors with little room to manoeuvre in terms of how to apply conservation objectives (Carret and Loyer 2003), and

require the achievement of short term results. In such a context, the establishment of protected areas where local populations play a role in renewable resource management has largely been impeded by faulty knowledge of local peoples' management and farming systems.

The Malagasy protected areas network, which initially did not include the new protected area categories meant to allow an effective association of conservation and development, was considered by the international community to be obsolete and ill-suited to the current conservation agenda (Chaboud et al. 2007). Criticism of Madagascar's protected areas system during the Durban conference led the President of Madagascar to announce the tripling of the surface areas under protection over a 5-year period. In order to pass from 1.6 million ha to the 6 million announced in this initiative, the new categories developed by the IUCN were to be used in establishing the new protected areas. The year 2003 thus marked a turning point in Malagasy environmental policy (Chaboud et al. 2007) and injected a sense of political emergency into the development of conservation actions in the country (Carrière-Buchsenschutz 2006). The public nature of the commitment and international interest in Madagascar's biodiversity is reflected in the allocation of funds for biodiversity conservation, estimated in 2005 at 80% of the budget devoted to the environment (Méral, personal communication). Thus, the expansion of the country's protected areas is taking place under the watchful eyes of conservation professionals and the international community (Borrini-Feyerabend and Dudley 2005).

Following the Durban summit, the Durban Vision Group put in place on the behest of the Malagasy president, was given the responsibility of identifying priority conservation zones and defining their management goals according to the conservation areas' potential category. The Madagascar Action Plan (MAP 2007), established immediately after the Durban conference, further testifies to the new philosophical orientation of conservation: *"We will develop industries around the environment such as ecotourism and agri-business that minimizes damage and maximizes benefits for the people and local communities."*

Our article aims to show that the context of political emergency, one shaped by the public engagement of the Malagasy government in Durban under international pressure, and the ensuing haste to establish protected areas in Madagascar, prevented the fulfillment of the development needs of the local populations living in the vicinity of protected areas and, therefore, the success of conservation projects. A study was undertaken in the Central Menabe region in two villages, Bekonazy and Andranomena, which are situated inside or close to two different conservation zones: the "Andranomena Special Reserve" and the "Baobab Alley" natural monument.

Materials and methods

Ecological and social characteristics of the study site

The Central Menabe region is located in western Madagascar between the towns of Morondava and Belo sur Tsiribihina (Fig. 1). It is characterized by a sub-arid, temperate or cool climate with a dry season of about 6 months. Annual rainfall is around 800 mm and the region is covered by a dense, dry, tropical forest (Koechlin et al. 1974). This ecosystem has been the focus of conservation actions for some time due to a high rate of deforestation and slightly more than 10% of the area was protected in 2002; this area was expected to increase to 17% following the Durban speech (Moat and Smith 2007). The forest is characterized by the presence of a very tall endemic baobab, *Adansonia grandidieri* Baill

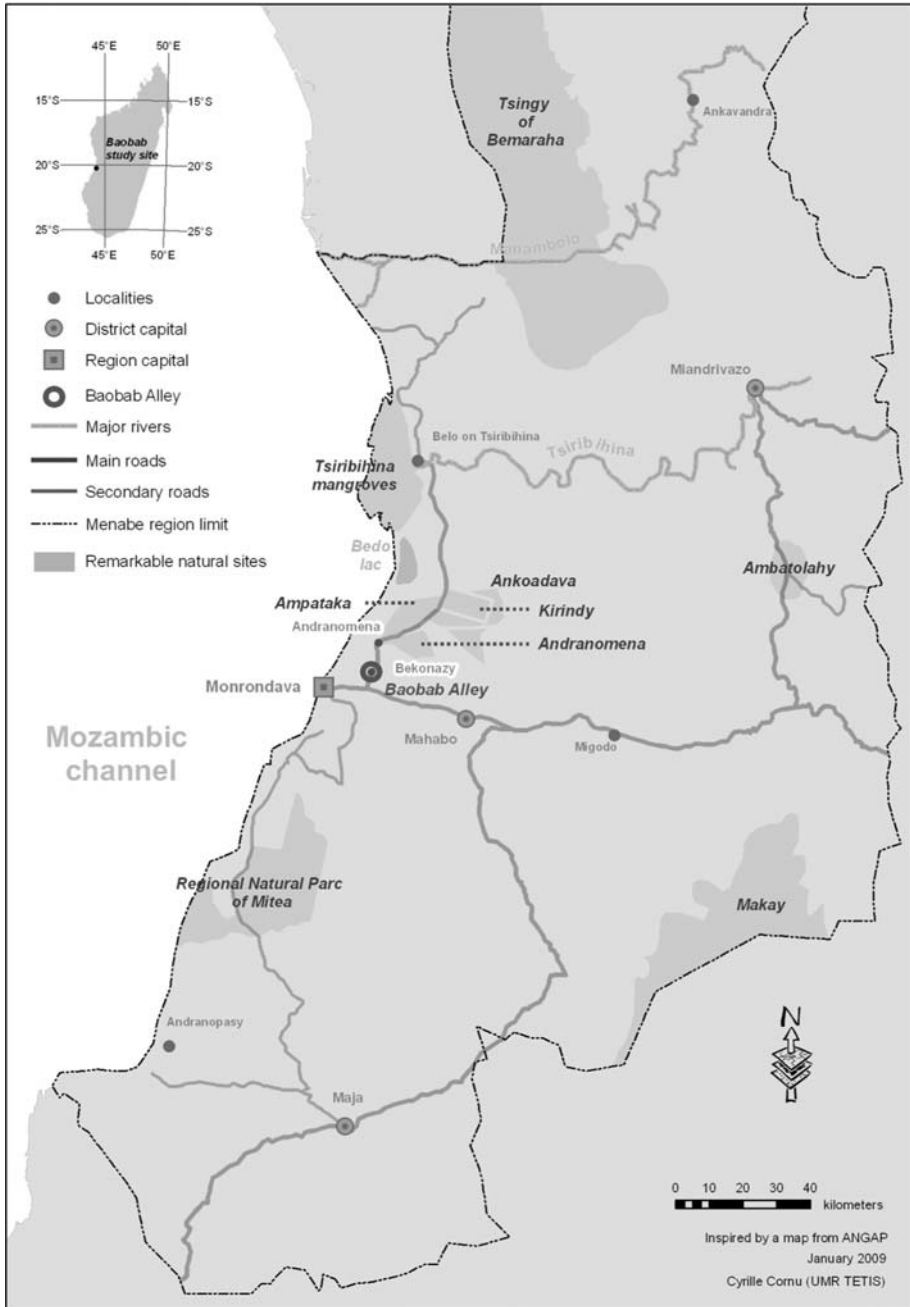


Fig. 1 Study sites location

(Bombacaceae). Although this tree is protected when lands are cleared (Koechlin et al. 1974), it is considered to be an endangered species and is on the IUCN red list. Two other baobab species also are present in the zone: *A. rubrostipa* Jum. and H. Perrier and *A. za*

Baill. The Andranomena special reserve shelters this entire biological heritage. The famous “Baobab Alley”, situated at the 15 km mark along the road (RN 8) linking Morondava and Belo sur Tsiribihina, is known for a significant concentration of *A. grandidieri*, with several stands lining both sides of the road. It is one of the most remarkable tourist sites in Madagascar. However, the site was not identified previously as having significant biological value; it was known rather as a natural curiosity. The site’s eco-tourism potential, and the threats assumed to be weighing on baobabs, have only recently drawn the attention of regional and national authorities, and it was not until 2007 that the site was classed as a “natural monument” (IUCN category 3).

The two villages studied are located on the outskirts of the Andranomena special reserve and of “Baobab Alley”. Fields for food crops were cleared in these areas to meet the needs of the local populations. Andranomena still provides a habitat for degraded, secondary forests while the land around Bekonazy resembles a tree savannah in which conspicuous surviving trees are jujube *Zizyphus* sp. (Rhamnaceae), tamarind *Tamarindus indica* L (Fabaceae) and baobab, particularly *A. grandidieri*.

The site of the Sakalava kingdom in the 17th and 18th centuries, Menabe is today a multi-ethnic region. Several waves of successive migrations have marked the history of the zone. Between 1900 and 1940, the Betsileo and the Antsaka, coming from the highlands, and the Karao and the Tandroy, coming from the south of the country, all settled in the region. They were drawn first by the economic opportunities presented by lima bean crops (*Phaseolus* sp.) and the labor needs of French colonists, and later by the 1937–1939 maize boom (Fauroux 1999). Large migrations into the region and extensive clearing of land for crops contributed to the degradation of forest resources (Fauroux 1999).

Andranomena, originally populated by Sakalava, is today a multi-ethnic village. The development of rice fields, made possible by hydraulic works in the region during the 1960s (Chazan-Gillig 1991), also contributed to the influx of migrants from different regions of the country. The village of Bekonazy was created in 1957 by Tandroy migrants who already were settled in the region. The development of slash and burn farming on this previously unoccupied area enabled a vast appropriation process of the zone. Beginning in 1980, runoff waste water from a sugar refinery also made it possible to establish rice fields there.

Survey methods

Five objectives guided the study: (1) to understand the farming systems and the role of woody and non-woody species in these systems; (2) to grasp the uses and social perceptions of baobabs; (3) to analyze the evolution of agricultural land along a longitudinal perspective of ecological and technical change; (4) to assess how farmers understand conservation and protection; and (5) to understand the impact of exogenous conservation actions on a population’s practices, on how they adapt, and on their demands.

Eighty-three semi-structured interviews were conducted with the inhabitants of the two villages between June 25 and October 9, 2008, of which 43 were in Bekonazy and 40 in Andranomena.

Three formal interviews regarding conservation actions were conducted with the managers of the protected areas: the National Agency for the Management of Protected Areas (*Agence Nationale pour la Gestion des Aires Protégées*—ANGAP), the NGO Fanamby, currently the designated manager of the “Baobab Alley” protected area and of the future, category V protected landscape of Central Menabe, and the Morondava regional delegation of Water and Forests. Interviews also were conducted regularly with ANGAP agents in Andranomena and with Fanamby officers in Bekonazy.

Once the surveys were completed, a restitution meeting was organized with the inhabitants of each village to confirm the data collected.

Finally, stakeholder maps were made in each village and GPS data were taken in agricultural zones.

First, the information collected through the 83 interviews, in the two villages, was used to analyze farming system dynamics, practices, and social perceptions of the baobab. Secondly, the 43 Bekonazy interviews were used to analyze the social and economic consequences of the creation of the “Baobab Alley” protected area.

Results

Rationale of the conservation project

The “Baobab Alley” area, a popular tourist site, was identified as endangered by the Malagasy authorities after two or three baobabs fell down over the course of several years. The presence of waste water due to a poor drainage system and the establishment of new paddy fields were held responsible for making the baobabs wither and fall (Cellule technique Baobab - Fanamby 2007). However, while biologists agree that baobabs have a weak natural regeneration capacity that could constitute a threat to the species, they have not pinpointed the factors responsible for making the trees fall. The concerns of the technical unit, however, contributed to focussing action on this particular site because of the role it plays as a regional economic development vector through tourism. Previously, this zone had never attracted the attention of ecologists. Given this context, the focus of the conservation action appears to be the tourism value of the site—not its ecologic value.

External factors, including the rules imposed by the creation of a protected area, significantly influenced changes in practices in the study zone. In 1980, the construction of a sugar refinery (SIRANAL, now known as SUCOMA) on the outskirts of the village (*fokontany*) of Bekonazy transformed farming systems. The runoff of waste water from the bleaching of sugar allowed farmers to establish rice paddies on cleared fields by digging their own irrigation systems. Agricultural practices quickly were organized around cultivating rice, which became an essential activity, while dry crops (principally cassava and maize) were grown on fields cleared by burning (*hatsake*) that had not been turned into paddies.

The first actions to protect baobabs along the “Baobab Alley” took place in 2004. Following the announcement that the waste water flowing through the sugar refinery’s drains posed a potential threat, a decree was issued forbidding the discharge of waste water. This first intervention affected agricultural activity by reducing the possibility to irrigate cultivated land. Following this decision, a “technical baobab unit” was set up to implement further action. In 2007, the green light was given for the creation of a protected area and the NGO Fanamby was appointed lead manager. From July 11th, the “technical baobab unit” began to issue official documents establishing the baobab as “a tree characteristic of forests on the west coast of Madagascar”. In these documents, the three species on the coastal plains of Morondava were identified as witnesses to deforestation, threatened by slash and burn practices and the presence of waste water due to the establishment of rice paddies and discharge from the sugar refinery. This analysis, which remained unconfirmed by biologists, contributed to the classing of the site as a natural monument. This came into effect after a temporary decree issued by MINENVEF (arrêté MINENVEF n°16231) in September 2007 whose principal component was a ban on rice cultivation.

Development objectives of the conservation project

On paper, the conservation actions adhere to the government's stance set out in the MAP promoting conservation that sustains economic development, notably through plans for ecotourism. The protection of the site thus responds directly to the objectives defined after the Durban initiative insofar as the site is considered central to the regional economy. Moreover, the “Baobab Alley” site is recognized as “a tourism attraction product”, and has been identified as an ecotourism pilot site by the Ministry of Water, Forestry, Environment and Tourism.

The establishment of the protected area was characterized by the application of a set of regulations defined by local administrative authorities to meet the twin objectives of developing ecotourism and protecting the baobabs of the Alley. The actions following the temporary protection decree concern the establishment of a development plan (still under preparation and unavailable at the time of the survey), with the definition of territorial zones in which there would be a mix of non-irrigated farming (maize, cassava, market garden produce), tourism, and reforestation activities, among others activities (verbal communication, NGO Fanamby Menabe). Alternatives agricultural activities, including market gardening and the cultivation of lima beans, also were proposed by the NGO Fanamby, funded by the Millennium Challenge Account (MCA) programme, to replace the banned rice.

According to the themes of the Presidential programme, the development of these actions must be undertaken in cooperation with “local communities”. Article 4 of the temporary protection decree, which states that “management is participatory”, is evidence of this intention. Local stakeholders, the representative of the Ministry of the Environment, Water, Forests, and Tourism, and the decentralized services of the region, village, and commune (*fokontany*) of Bekonazy are part of the steering committee shall defining the management of the protected site.

Farming system dynamics

The surveys show that farming is the major source of revenue (Table 1): 96% of the people interviewed in the two villages declare farming to be their principal source of income. Local farming systems are characterized by multiple household activities, covering 86% of those surveyed in the two villages. Crops are predominantly food crops: according to the 2001 national household survey, 68% of rice, 67% of maize, and 62% of cassava products are home consumed. Rice holds first place in the composition of monetary farm income (37% according to the national household survey). In the two areas, where the main crops were maize and cassava until the 1980s, 81% of households now focus on rice production. This trend is due to the development of irrigation opportunities with the opening of the Dabara canal in Andranomena and the supply of water from SUCOMA (sugar refinery) in Bekonazy. Today, rice cultivation predominates in Andranomena, with 80% of those surveyed cultivating the crop. In Bekonazy, however, there has been a sharp turn away from rice production. While 84% of the people interviewed said they produced rice prior to 2004, only 16% have cultivated the crop since 2004. The stakeholders' map, which was made with the farmers, shows the importance rice cultivation once had there (Fig. 2); farmers say 130 of the 320 ha in the protected area used to be rice fields.

In most local farming systems, market crops are associated with food crops. Peanuts are cultivated by 40% of those surveyed in Andranomena and 26% in Bekonazy, due to the presence of a local market and collectors from a peanut oil factory in Morondava. In

Table 1 Income generating activities in Bekonazy and Andranomena in 2008 (by % of responses in surveys conducted between June and October 2008, number surveyed: Bekonazy: 43; Andranomena: 40)

Activities	Andranomena (%)	Bekonazy (%)	
	2008	2004	2008
Agricultural activities			
Rice	80	84	16
Cassava	75	68	68
Maize	65	56	56
Peanuts	40	26	26
Lima beans	0	0	39
Market garden produce	5	2	14
Fruit (banana, mango, papaya)	7	12	12
Other agricultural products (sweet potato, sugar cane)	15	–	25
Other activities			
Charcoal	58	60	65
Fishing (lake and ocean)	22	2	2
Sale of woody and non-woody products	2	25	13
Gathering forest products (wild potatoes, yams)	15	2	2
Other activities (grocery store, evangelist)	5	2	2

Changes in Bekonazy between 2004 and 2008, activities having changed sharply highlighted in bold

Bekonazy following Fanamby recommendations, 39% of farmers now cultivate lima beans. The activity, however, has been largely compromised by the absence of buyers associated with a bad harvest. This contributes to a climate of distrust and discontent.

Market gardening is also among the activities proposed by the managers of the protected area although it was uncommon prior to 2004 (2% in Bekonazy). In 2008, the number remains small; only 5% of farmers grow market produce in Andromena. The activity is growing in Bekonazy, where six of the farmers interviewed grow market produce; however, three of them do not believe the activity can compensate the ban on rice cultivation. According to these farmers, the development of the crop is compromised by a lack of equipment and the absence of irrigation on one hand and by competition from producers located closer to the town of Morondava on the other.

Income from off-farm activities comes second after market gardening but plays a significant role in local farming systems. Fishing in the ocean and in temporary lakes is practiced by 22% of farmers in Andranomena but by only 2% in Bekonazy. The harvesting in the wild and in the fields of woody and non-woody products for personal use (construction of houses, tools) is practiced by all and the sale of these products (wood, baobab fibers) involve 13% of the people in Bekonazy and 2% in Andranomena. Charcoal production also is an important activity (Table 2), practiced by 65% in Bekonazy and 58% in Andranomena. Charcoal is made using all types of wood available, including jujube (*Ziziphus* sp.) and tamarind (*Tamarindus indica*). In Bekonazy, 57% of charcoal farmers reported an increase in charcoal sales since 2004. In 2008, 32% of charcoal farmers declare the activity to be their principal source of monetary income. About 71% of people producing charcoal in Bekonazy declare that they do this at least once or twice per month compared to 35% in Andranomena. This “fallback” activity fills the demand of urban

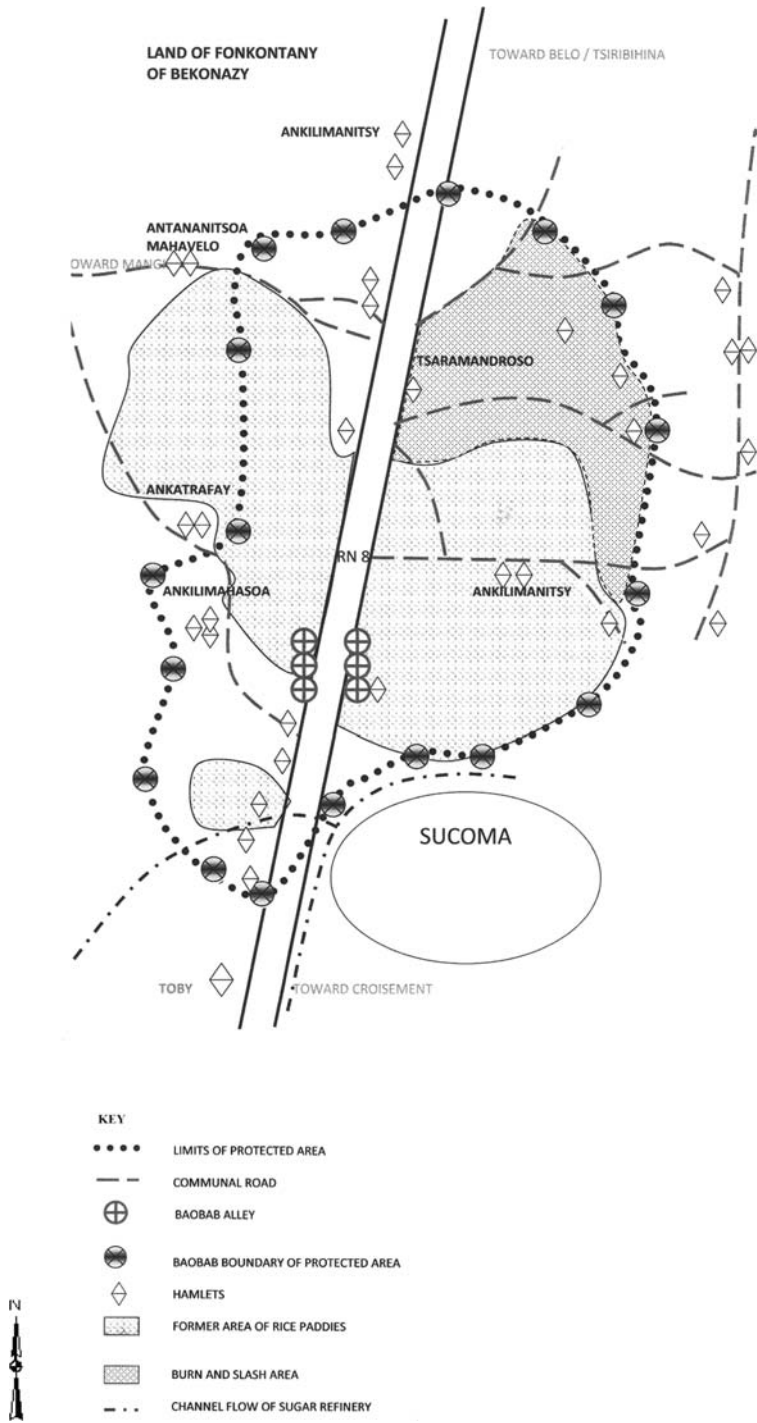


Fig. 2 Stakeholders' map of the Bekonazy commune (*fokontany*)

Table 2 Production of charcoal for sale in Bekonazy and Andranomena [% of responses in surveys conducted between June and October 2008 (number surveyed: Bekonazy: 43; Andranomena: 40)]

Frequency of charcoal production	Bekonazy (%)	Andranomena (%)
Declaring charcoal production activity	65	58
Of which		
Increased production since 2004	57	–
Declare charcoal as the principal source of revenue	32	–
Producing and selling		
1–2 times a month	71	35
1–2 times quarterly	21	–
1–2 times a year	7	–
Occasionally (when needed)	–	65

dwellers in Morondava. The sale of charcoal enables households to partially make up for inadequate income from agricultural activities.

Local knowledge and practices contributing to tree conservation

Slash and burn practices, the harvesting of woody resources for construction and charcoal have contributed to its impoverishment: all of the farmers who have lived more than 10 years in Bekonazy report the quasi-disappearance of certain species, particularly endemic species such as *Hernandia voyroni* Jum., Herandiaceae (*hazomalany*) and *Securinega perrieri* Leandri, Euphorbiaceae (*hazomena*). Villagers frequently reported the increasing difficulty to find “hardwood”, principally *Dalbergia* sp., Fabaceae (*palissandre*), *Cedrelopsis grevei* Baill., Pteroxylaceae (*katrafay*) needed for constructing houses.

However, certain species such as the baobab are protected by the farmers. The importance of baobabs to farmers is demonstrated by: (a) the presence of baobabs in the fields, (b) their conservation practices, (c) and their multiple uses and functions of the tree. For these three points, the farming system is based on agroforestry.

(1) Several species remain in the area. 298 baobabs were counted on the 320 ha of the “Baobab Alley” protected area, all *A. grandidieri* with the exception of a dozen *A. robustipila* (source: Fanamby).

(2) The surveys found evidence of baobab conservation practices (Table 3). These species are generally protected in the fields and in home gardens, with 44% of those interviewed in Bekonazy and 30% in Andranomena so saying. When land is cleared through slash and burn, adult and juvenile baobab trees are protected. As one farmer in Bekonazy said, “It is the people who destroyed the forest, but they also make stay what they want.”

(3) Baobab trees have economic functions. Numerous products are drawn from baobabs (Table 4). Dried bark is used as tiles for rooftops. Its supposed calcium content awards it an important role in traditional pharmacopeia in the form of a decoction. The fibers make ropes that are well appreciated by farmers as harnesses, for building houses, and for making mats and baskets. Villagers eat the seeds and fruits. Mushrooms collected from the trunk after a tree is felled are also eaten. Nearly all of the products have a market value and can be a source of extra income: fruits are sold to tourists on site, bark and fibers are sold on the markets in Morondava and Bemanonga, and seeds are sold to the oil production

Table 3 Factors contributing to the conservation of baobabs in Bekonazy and Andranomena, in % of responses in surveys conducted between June and October 2008 (number surveyed: Bekonazy: 43; Andranomena: 40)

Baobab conservation factors	Bekonazy (%)	Andranomena (%)
Declaring have protected baobabs when clearing land	44	30
Due to		
Traditional motivations		
Attracts rain, is the “Mother of the forest”,	21	15
Is sacred	21	8
Has an aesthetical function	11	15
Use of baobab products	5	8
Poor quality wood, pointless to fell	–	8
Respect for tradition	–	8
Is a property boundary marker	–	8
Contemporary motivations		
Has a regional economic value	31	23
Offers micro economic benefits (sales to tourists)	11	–

Table 4 Economic and non-economic uses of baobabs in Bekonazy and Andranomena, (in % of responses in surveys conducted between June and October 2008 (number surveyed: Bekonazy: 43; Andranomena: 40)

Use	Bekonazy (%)	Andranomena (%)
Symbolic function		
Sacred function	19	12
Landscape function	14	7
Mother of the forest	9	7
<i>Economic function:</i>		
Auto-consumption		
Fibers (cords)	49	47
Bark (roofing)	46	35
Bark (medicinal use)	32	35
Fruits (home consumption)	32	60
Mushrooms	12	10
Seeds (small scale oil production)	7	12
Seeds/leaves (seasoning)	5	–
Leaves (medicinal use)	–	7
Production of monetary income		
Sale of seeds	19	10
Sale to tourists	7	–
Market sales (fibers)	7	–
Ecologic function		
Attracts rain; holds water	7	7

factory in Morondava. The felling of trees to obtain large quantities of products may increase. One of those interviewed noted, “baobabs are endangered when people do not have money”.

Among its social functions, the baobab has a juridical one: in certain cases, it serves as a land tenure marker. It also has an aesthetical function: villagers consider the baobab to be a visually important element of the landscapes in which they live. They serve as area landmarks included in toponymic vocabulary (e.g., white baobabs are referred to as, “*Andrenalafotsy*”). As said by some villagers: “the baobab represents the color and the image of our village”, and “it is a decoration for the region”. The trees in the fields also are indispensable for women and children who shelter in their shade during the hottest hours of the day.

Baobabs also are reported to have ecological functions. The tree is considered to be the “mother of the forest” and the protector of other trees because it brings water and rain.

New strategies and practices around the baobab recently have developed because farmers are becoming aware of the tree’s tourism value. Several farmers noted that they themselves protect their baobabs from any kind of harvest while others have begun to grow young baobabs with the plan to sell seedlings to tourists. As some said: “It is important to conserve the baobabs because they are good for tourism, and they are a source of income for the government,” and “It is easier to preserve knowledge than to make it grow”.

Farmers’ perceptions and expectations of the conservation project

An analysis of the demands that followed the creation of the protected area in Bekonazy reveals how the project fell short of farmer expectations. In a context of emergency, rules were imposed before a cooperatively developed land use plan for the zone had been implemented, generating numerous conflicts between the managers of the protected area and the population. In general, 86% of those surveyed (37/43) underline the difficulties or discontent linked to the context of the protected area. Numerous reasons are given (Table 5).

First, 76% of those interviewed emphasize the difficulties posed by the ban on rice cultivation. Second, the suppression of access to irrigation water makes life difficult for 51% of farmers, particularly as it is not possible to develop alternative crops without irrigation. This context contributes to reduced household income, reported by 44% of the farmers. In regards to alternative crops, 25% of those interviewed reported low yields and marketing difficulties for lima beans, and insufficient equipment for lima beans and market garden produce. 16% cited a drinking water problem and 5% wanted land title deeds for agricultural fields.

Finally, farmers claim the right to manage baobab trees: “It is the population who has contributed to the conservation of baobabs”. Villagers denounce their eviction caused by

Table 5 Farmer complaints and claims regarding the protected area project in Bekonazy, in % of responses in surveys conducted between June and October 2008 (number surveyed: Bekonazy: 43)

Complaints and claims	% of responses
Declaring themselves unhappy with the situation	86
Modification of agricultural activities, abandonment of rice cultivation	76
Difficulty irrigating crops	51
Loss of income	44
Poor assistance for new crops, low yields and marketing difficulties	25
Absence of drinking water	16
Demand of land title	5

the creation of the protected area: “Today the conservation of baobabs kills farmers”. Farmers do not agree with the managers of the protected area regarding the threat posed to baobabs: 23% of those interviewed in Bekonazy say that baobabs “love water” and grow more frequently in humid zones. Likewise, during complementary interviews with 12 people in Bekonazy focused specifically on perceptions of the baobab, 9 noted that baobabs love water. They compare baobabs to “giant water hyacinths” because, like the latter, baobabs “live on water”. This issue has received little scientific attention and no conclusions consequently may be drawn. The findings, however, prompt one to question the relationship between scientific and local knowledge and call for the integration of local actors in the management of the tree.

Discussion

Among the conditions enabling a successful conservation project, Balint (2006), along with many others points to the importance of rights, governance, income, and the capacity of stakeholders. This implies that conservation goals and rules must be negotiated with the people who are the first to apply them (Western and Wright 1994). These conditions can only come together in the medium—or indeed long—term and not in a context of emergency.

Our results show that the current context does not help local development needs to be met nor, consequently, conservation to be achieved. The design of the conservation project does not appear to have been based on an analysis of an actual danger threatening the area, nor do conservation institutions officials appear to be clear about what kind of development should be fostered. In addition, we found that a lack of investigation by the managers of the protected area did not enable an understanding of local dynamics or of the local knowledge and practices contributing to tree conservation. This context hinders the integration of scientific and local knowledge that nevertheless is essential in the regulation process and in the design of management and conservation measures. Consequently, it seems fair to say that the demands and expectations from farmers diverge from those of the conservation initiative.

This final section therefore will examine the integration of development variables into conservation projects through a discussion of: (a) the creation of potential income through the development of tourism, (b) the local population’s participation in the definition of conservation objectives, (c) the acknowledgment of local knowledge.

The tourism: a risky bet

At the International Parks and Protected Areas Congress held in Caracas in 1992, tourism appeared to be a tool that could be used to combine ecosystem and biodiversity conservation objectives with those of development for local populations (Goodwin 2002). The virtuous model described by Wunder (2000) assumes that tourism fosters local development. However, this theoretical model has been little verified by facts. Chaboud et al. (2004) show that it is risky to count on economic benefits from external elements such as tourism because the activity is influenced by exogenous factors beyond the local population’s control. Local stakeholders may only have effective access to tourism income when truly cooperative governance exists and training for capacity building is provided. For example, in Anakao and Ifaty, on the west coast of Madagascar, few villagers are hired to work in the tourism infrastructure and the jobs open to them require few qualifications and

are poorly paid (Chaboud et al. 2004). In Bekonazy, while the establishment of the protected area theoretically included a local development objective in ecotourism, this has brought few economic opportunities and tourism does not appear to local people as a means to sustainable development.

Furthermore, environmental degradation does not necessarily decrease when the population has access to new sources of income. In Ifaty and Anakao, e.g., the market created by the presence of hotels contributed to an increase in fishing (Chaboud et al. 2004). In Bekonazy, nothing exists to compensate for the ban on rice cultivation, and the alternative crops proposed are ill suited due to the absence of markets. Farmers may find themselves forced to turn to new activities—such as the production of charcoal.

The participation of local people compromised by the emergency of the extension of protected areas in Madagascar

The reclassification of land following the establishment of a protected area translates into restrictions on access to the area and the use of its resources (Peters 1998). These restrictions highlight the impossibility of associating conservation with agricultural production objectives when local stakeholders are excluded from management and decision making mechanisms. However, while participatory management and integrated projects have become key themes in the conservation literature, there is a significant gap between discourse and practice (Peters 1998). In Madagascar, the sense of urgency to align with the international agenda set in Durban in 2003 helped to create a context in which the extension and creation of protected areas became an end in and of itself, compromising a truly participatory approach. Similarly, the growing influence exercised by international conservation NGOs over other donors led to the conservationist orientation of the Malagasy environmental programme (Chaboud et al. 2007), with the short term extension of protected areas.

The top down approach implemented in Madagascar forces local managers (the NGO Fanamby) to accept objectives handed down from above, leaving them with no real power to be creative and/or to negotiate. This places them in conflict with the people who have been dispossessed of their resources. To legitimize their uncomfortable position, they have developed justifications supposedly founded on scientific findings. Biologists' findings that baobab species may be threatened due to their weak regeneration (Wilson 1988) were taken up by Baobab Alley conservationists to construct a pro-conservation scientific discourse. This led to the ban on rice cultivation because the practice was judged to be harmful to baobabs, which are assumed to grow poorly in humid conditions.

The analysis of farming systems in Bekonazy and Andranomena shows that while the two systems are superficially similar, recent changes in practices in Bekonazy are linked to the creation of a protected area and the imposition of regulations that do not take into account local dynamics, especially the fact that baobab belongs to an agroforestry system. The limited understanding of local farming system and its agroforestry components plus the rapidity with which the conservation action was conducted has created an unstable context, in which the alternatives proposed by Fanamby, through the Millennium Challenge Account (MCA) programme, cannot compensate for the ban on rice cultivation.

This situation raises numerous unresolved questions linked to the difficulty of overcoming the inherent contradictions between environmental protection and economic development as well as between sustainability and emergency. A sense of emergency does not allow the adoption of a patrimonial approach (Weber 2000) that places negotiations between local stakeholders in a long term perspective. Inadequate understanding of

farming systems leads to the exclusion from conservation of people settled in the area for years and hinders the recognition of multi-challenges zones where the interests and the participation of all stakeholders can be considered (Torquebiau et al. 2002). As Druguet (2007) notes, consultation processes with stakeholders have demonstrated their effectiveness in such situations. Similarly, when conservation projects are based on the integration of development actions with environmental objectives, conflicts arising around the creation of protected areas can be avoided.

The definition of conservation objectives: toward taking into account local knowledge

Scientific ecology and traditional ecological knowledge are potentially complementary (Berkes et al. 2000). However, the contribution of local practices and knowledge to biodiversity conservation needs to be put into perspective. Local people also contribute to the degradation of natural areas. For example, while natives in New-Guinea possess detailed knowledge of plants and animals, some have and continue to have a heavy negative impact on their native biota (Diamond 1993). Yet in some cases, certain practices suggest that farmers engage in conservation or selective conservation. Practices based on local ecological knowledge can help manage disturbance and build ecological forest resilience (Holling 1986) across temporal and spatial scales. For example, in the Ntumu society of southern Cameroon described by Carrière (2002), “orphan” trees are spared and protected when forests are cleared for farming. They remain in the fields and subsequent fallows. The Ntumu people follow this practice because they believe that it will promote fallow “maturation”, with the best forest growth beneath spared trees. It was found that these isolated trees in the fields indeed help accelerate forest regeneration after slash and burn cultivation by enhancing seed rain of tree species from the forest which permit regeneration (Carrière et al. 2002). This corroborates approaches that emphasize the contribution of local practices and knowledge to the conservation and management of ecosystems (Berkes et al. 2000) and confirms that local knowledge is vital in conserving and preserving resources. Long before conservation projects existed, local populations had to maintain the sustainability of their farming systems and handle the issue of resource renewal. It is not necessary to exaggerate claims on behalf of traditional ecological wisdom (Redford and Stearman 1993), and one must keep in mind that indigenous notions of conservation practices and concepts are fundamentally different from those of Western conservationists (Roberts et al. 1995). Yet a focus on indigenous local knowledge should enable the reconsideration of the relationships between science and local empirical knowledge and facilitate dialogue between researchers, local stakeholders, and conservationists (ICSU 2002). But Callon et al. (2009) note from some recent “citizen’s juries” of various countries that such an “agora” between all the actors requires the initiative of the state.

Local knowledge about baobab trees in Madagascar covers various aspects: biology, ecological services and functions, pharmaceutical properties, as well as mechanical and physical properties. The villagers’ belief that baobabs prefer humid areas contradicts the conservationists’ view that baobabs are hygrophobic. The confrontation between the pseudo-scientific discourse put forward by the conservationists and the views of the farmers raises the following issue: at present, scientific baobab research in Madagascar, particularly on the species, *A. grandidieri*, does not examine whether baobabs have a preference for very dry or well-drained or even humid environments. Taking local knowledge into account in the management of baobabs is thus critical. The conservation

of this tree thus should rely on the integration of empirical data and, when available, data produced by scientific research (Crezé and Liu 2006), not presumptions to justify bans on practices to promote conservation. Furthermore, in terms of the substratum preferences of *A. grandidieri*, research currently being carried out by our teams tends to indicate a positive relationship between humid soils and the presence of the species: spatialized data shows that individual specimens located outside of forests are found largely around ponds, which corroborates the farmers' empirical knowledge. Consequently, data collected from farmers on the relationship between the type of substratum and the baobab should indicate new directions for further research on ecological aspects of this species of baobab. Data produced by local knowledge thus opens new research avenues.

An analysis of practices and perceptions about this tree led the species to be identified as a “cultural keystone species” (Garibaldi and Turner 2004), playing an important role within society, as much economically (raw material for food, tools, medicine) as socially (land tenure marker, sacred, aesthetical function). These functions explain the local people's management—and indeed, conservation—of the species. Moreover, the aesthetical function attributed to the baobab by the local people is in agreement with the conservation objectives of the site. In the same way, the outside reinforcement of baobab conservation practices contributes to the valorisation of the tree. The agreement between farmers' practices and conservation objectives may thus enable the real participation of local people in the development of the site.

Conservation projects can be perceived by the population as an opportunity to achieve local development objectives. However, a successful project cannot do without a democratic negotiation process involving all concerned stakeholders, including local actors. While tourism may represent a potential means to achieve this objective, the promotion of environmentally friendly farming activities also may represent a desirable alternative. Results show that the idea of crop diversification, one that represents a truly viable alternative to rice farming, is well received by farmers. Several local initiatives furthermore were noted during the surveys: for example, one person interviewed wanted to develop a camping site - an initiative today blocked by Fanamby; others signaled the possibility of commercializing market garden produce through contracts with restaurants in the town of Morondava.

One thus may note a real desire to participate on the part of the villagers who initially envisioned the conservation project as a development opportunity. They hold numerous expectations related to development, including the construction of schools for children's education, setting up wells in order to access potable water (a village association was established to realize this objective), and the further development of irrigation networks.

A preliminary understanding of the ecological, economic, social and cultural context can facilitate the development of conservation-development models adapted to individual situations. The implementation of projects over the long term is furthermore indispensable in so far as people's capacity to adapt must be taken into account (Sibelet 1995). However, this last condition generally is compromised by outside funding cycles that impose short term project deadlines. In Madagascar, the environmental programme has been centered on implementing the President's declaration since 2004, to the detriment of improving principles of natural resource governance and integrated conservation.

Conclusion

A hiatus between long term conservation and political emergency

This research was focussed on the implementation of conservation operations in a context of political emergency in the protected areas of Andranomena and Bekonazy. It found that such a context was incompatible with meeting local rural development objectives. The conservation emergency approach leads to defining new areas for conservation without benefiting from scientific ecological expertise and local knowledge, practices, and dynamics. The sense of emergency works against the sustainability of projects, particularly because it renders cooperation with local stakeholders impossible.

The management of the “Baobab Alley” ecotourism site has been defined using a “top-down” approach focused on baobab conservation objectives and does not allow for the design of multi-use areas integrating human activities with the sustainable use of natural resources. And yet farmers, who refer to the tree as “the mother of the forest”, are the first to protect baobabs on a day to day basis. Recognizing the farmers’ actual conservation of trees helps avoid a conflict between conservation and development. Such a conflict is provoked by banning essential agricultural activities—in this case irrigated rice agriculture—without a scientifically proven basis. The clash is sharpened by the optimistic forecast of a spontaneous windfall from tourism that does not actually occur. The recognition of farmer management of baobabs is essential to deflate the latent but patent conflict between the managers of the protected area and the local people. This would be the first step toward turning the two groups into official partners in conservation.

More generally, agroforestry combinations that exist in many farming systems are not sufficiently understood. In most cases, the intensification of agriculture is accompanied by a sharp reduction in trees no matter how they are planted, protected, or spared. Large agricultural development programmes often have accelerated the process of eliminating trees from fields in order to achieve higher yields. The challenge is to break down barriers between sectors in conservation policies and take trees into account as elements of local agroforestry systems. The continued presence of trees on agricultural land is the result of farmers’ strategies.

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