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A cautionary note for forest landscape restoration in drylands: cattle production systems in northwest Madagascar's dry forests

Renaud Randrianasolo^a, Patrick Ranjatson^a, Rebecca McLain ^b, Andisoa Nomenjanahary^a, and Claude Germier Oginot Manasoa^a

^aEcole Supérieure des Sciences Agronomiques, University of Antananarivo, Antananarivo, Madagascar;

^bGovernance, Equity, and Well-Being, Center for International Forestry Research, Bogor, Indonesia

ABSTRACT

Multiple global initiatives are underway to restore the world's forests, and more recently, its rangeland ecosystems. Tenure security has been identified as a key enabling factor for successful restoration initiatives. However, in Madagascar, a global biodiversity hotspot, dry forests are considered unoccupied and unowned, even where communities have long-established claims under customary tenure systems. Collective tenure recognition efforts are underway, but limited knowledge on agropastoralist cattle production strategies hampers efforts to develop well-informed tenure reforms. Our qualitative study helps fill this knowledge gap by documenting cattle raising strategies among agropastoralists in northwestern Madagascar, as well as the core elements of semi-extensive and extensive pasturelands. Our analysis reveals the presence of four distinct cattle raising strategies in the study area but suggests that cattle raisers are transitioning away from extensive cattle production toward semi-extensive and intensive alternatives in response to high risk of cattle theft and expanding human settlement. Although our study focuses on Madagascar, the issues we raise are relevant to ongoing efforts throughout sub-Saharan Africa to engage agropastoralists in dry forest restoration and support their livelihoods.

KEYWORDS

dry forest; savanna woodlands; cattle production; restoration; agropastoralist; sub-Saharan Africa; collective tenure; rangelands

Introduction

Worldwide, nearly 10 million ha per year were deforested between 2015 and 2020, and the global forest cover has declined by 178 million ha since the 1990s ([FAO and UNEP] Food and Agricultural Association and United Nations Environment Programme 2020). The reduction in forest cover has numerous negative ecological and social impacts, including lower biodiversity, increased soil erosion, sedimentation of water ways, increased greenhouse gas emissions, and reduced food security for many of the world's forest-dependent populations (Gichuki et al. 2019). Over the past two decades, forest landscape restoration (FLR) has emerged as an important strategy for reversing deforestation and land degradation on a global scale, with a target to restore 350 million ha by 2030 under the United Nations' Bonn Challenge (Gichuki et al. 2019). In sub-Saharan Africa, FLR initiatives will inevitably need to incorporate dry forests and woodlands (hereafter dry forests) which cover roughly 17 million km² and provide homes and livelihoods to more than 505 million people

CONTACT Rebecca McLain  rebecca.mclain@gmail.com  Center for International Forestry Research, Bogor, Indonesia

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(Chidumayo and Marunda 2010). In addition to protecting soil from erosion and providing fuel, construction materials, and food, dry forests are critical pasturelands for domestic livestock, including cattle, sheep, and goats (Chidumayo and Marunda 2010). However, most FLR initiatives currently emphasize tree-planting as the primary solution to restoring degraded and deforested lands, a significant percentage of which are naturally occurring grassy biomes (Veldman et al. 2015). If implemented on a global scale, FLR initiatives pose a significant long-term threat to dry forest pasturelands and the people who rely on them for livestock production unless they are restructured to incorporate restoration strategies appropriate for grassy biomes (Vetter 2020). As the United Nation's Decade for Ecosystem Restoration initiative gets, Dudley et al. (2020) call for improving knowledge about the world's remaining natural grasslands and savannas, incorporating rangelands into restoration programming, and identifying ways that pastoralists' ecosystem knowledge and practices can contribute toward the achievement of restoration objectives.

Evidence suggests that secure tenure is a critical enabling factor for successful FLR implementation (McLain et al. 2018). However, in many sub-Saharan Africa countries, dry forests are considered unoccupied and unowned, even where communities have long-established claims under customary tenure systems (Wily 2021). In Madagascar, a globally important biodiversity hotspot and whose government has committed to restoring 4 million ha by 2030, dry forests make up a significant portion of lands targeted for restoration (Lacroix et al. 2016). Governance of these spaces remains a challenge for the Malagasy government, and most wooded pastureland is managed collectively by cattle raisers under customary tenure systems (Randrianasolo 2020; Manasoa 2021). Madagascar's 2005 Land Law (Loi N° 2005-019 du 17 octobre 2005 fixant les principes régissant les différents statuts des terres) recognises customary tenure for untitled privately held lands, but a subsequent law (Loi N° 2006-031 du 24 November 2006 fixant le régime juridique de la propriété foncière privée non titrée) explicitly excluded extensive pasturelands (pâturages très étendus) from inclusion in this category. Madagascar's national government is developing legislation to recognise customary tenure of collectively held lands, but it is unclear whether pasturelands covering large areas will be included. Moreover, scientific evidence on Madagascar's pastoral spaces and cattle production systems to inform such legislation is limited and focused primarily on production systems in the south (i.e., Saint Sauveur 1996, 2007; Moizo 2003; Goetter 2015; Feldt and Schlect 2016) and west (i.e., Fauroux 1989a; Taillade 1997). Cattle production systems in the dry forests of northwestern Madagascar, which is among the areas targeted as a priority for FLR (Lacroix et al. 2016), have not been studied. As a result, legislation that seeks to recognise collective tenure for pasturelands risks taking a one-size-fits-all approach that may not account for regional and ethnic differences. As a first step toward expanding the knowledge base for legislative reforms aimed at securing collective tenure for pasturelands, we examine how cattle raisers in Boeny Region in northwest Madagascar organise pastoral spaces and cattle production strategies in the area's dry forest. Although our focus is on Madagascar, the issues we raise are relevant to ongoing conversations throughout sub-Saharan Africa on the need to support agropastoralist livelihoods and engage agropastoralists in dry forest restoration.

Materials and methods

Our research took place in six rural communes (Mariano, Betsako, Ambalakida, Katsepy, Tsaramandroso, and Ankijabe) in Boeny Region in northwestern Madagascar (Figure 1).

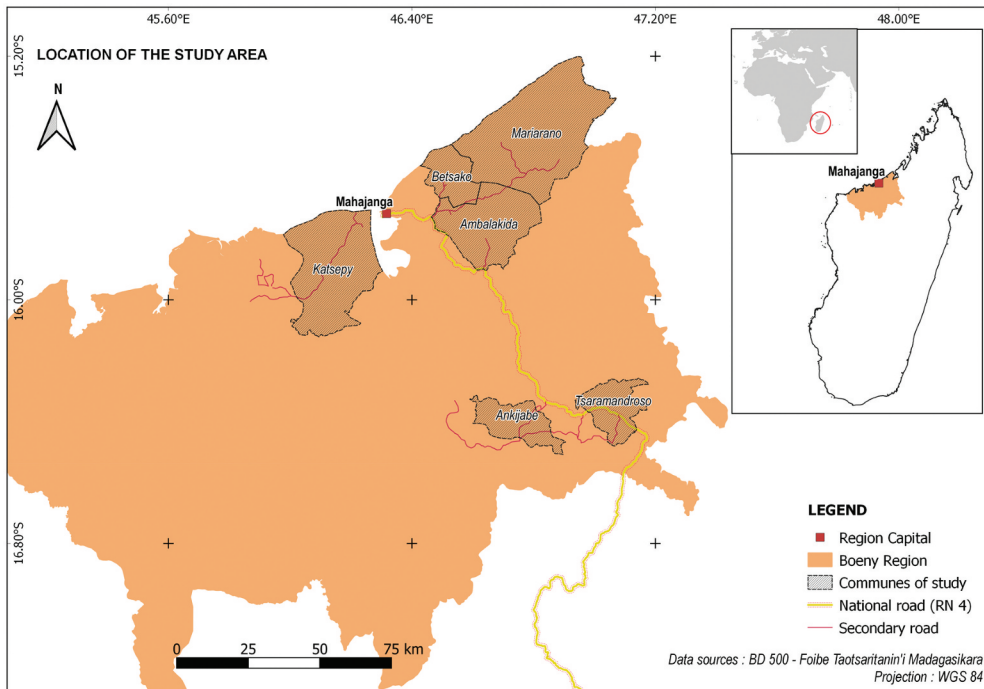


Figure 1. Location of the six communes included in the study site

Communes are decentralized territorial administrative units and are composed of multiple fokontany, the state administrative unit closest to rural populations. Fieldwork was carried out over a total of 3 months and 10 days between October 2018 and February 2021. Data was collected through 183 key informant interviews, 47 focus groups and 23 direct observations. Topics covered in the interviews and focus groups varied depending on the key informants' and participants' areas of expertise but included: land uses in the commune; location, ecological characteristics, and tenure of pasture lands; organization of cattle production systems; conflicts and conflict resolution mechanisms related to pasture lands; and impacts of state laws and bureaucratic practices on pasture use and cattle production systems. Key informants included commune and fokontany leaders, customary authorities, ombiasy (traditional healers), mpan-donaka (zebu tamers), national park agents, cattle herders, and women association leaders. Focus groups were structured to include a broad range of individuals likely to be active in or affected by cattle production activities, including local government leaders, traditional farmers, cattle raisers, in-migrants, and cattle herders. The focus groups included a range of age groups and women as well as men. The data was analyzed through a process of initial coding using key themes and then triangulating data from the different sources (key informant interviews, focus groups, direct observation, documents) to develop a description of the different types of pastoral spaces and cattle production systems in the study area. Manasoa (2021) and Randrianasolo (2020) provide additional details about field data collection and analysis.

Results

Study context

The dominant cattle species in Madagascar is *Bos taurus indica*, or zebu. In 2020, the country had an estimated 9 million head of cattle, a figure that likely underestimates the actual numbers (FAO 2021). For many Malagasy, cattle are valued primarily as signifiers of social status and for use in ritual sacrifices for funerals and other life cycle ceremonies, and only secondarily for their meat and other products (Hänke and Barkmann 2017). Nearly three-quarters of the cattle in Madagascar are raised in the Island's southern and western pastoral zones (MAEP 2004). Our study focuses on Boeny Region, which is in the northern portion of Madagascar's vast western pastoral zone.

Boeny Region covers roughly 30,000 km² and had a human population estimated at 931,171 in 2016 ([INSTAT] Institut National de la Statistique 2019). The region is sparsely settled, with a population density of 30/km². The region has a dry tropical climate, with a 7-month dry season and a 5-month rainy season (Conservation International-Madagascar 2014). Most of the land cover is natural habitat that has been subject to varying degrees of anthropogenic disturbance; permanent farmland and built-up areas together occupy just 13% of the land area ([ONE] Office National pour l'Environnement 2019). Woody savannas comprise roughly 46% of the region's natural habitat; raffia palm forests 20%, and dry dense forests 15%; other land cover types include mangrove forests, grassy savannas, and wetland complexes ([ONE] Office National pour l'Environnement 2019). Agriculture, including raising cattle, is the predominant source of livelihood for three-quarters of the region's inhabitants ([ONE] Office National pour l'Environnement 2019). A variety of ethnic groups now inhabit the region, but the area was historically dominated by Sakalava and Tsimihety, both of which traditionally have relied on pastoralism or agro-pastoralism for their livelihoods. Members of both ethnic groups, value cattle primarily for the prestige they confer on their owners and for use in ritual sacrifices and as draft power; their meat, hides, and milk are of secondary importance (Wilson 1967; Fauroux 1989a). The cattle population in Boeny Region was estimated at 400,000 in 2016 ([ONE] Office National pour l'Environnement 2019). Two-thirds of agricultural households in the region raise cattle, with the average number of head per household estimated at 14 (MAEP 2007).

Types of pastures: key elements and functions

In the Boeny Region, livestock owners use two terms – *tany firaofana* and *kijana* – when referring to pasturelands used for grazing zebu.

Tany firaofana

The term *tany firaofana* designates an area used as a day pasture for zebu. The term combines the words *tany*, or land and *firaofana*, or grazing reserve. In Boeny, the *tany firaofana* is an extensive expanse of wooded savanna dominated by the grassy species, *Heteropogon contortus* and dotted with small ponds or lakes, referred to locally as *matsabory*. In Mariarano, Betsako, Ambalakida and Katsepy Communes, stands of *Bismarckia nobilis* (Arecaceae) dot the savanna landscape (Figure 2). In Tsaramandroso and Ankijabe Communes, which are located further inland, *Zizyphus mauritiana* (Rhamnaceae) replaces *Bismarckia nobilis* (Figure 3).



Figure 2. Pastureland in Mariarano dominated by *Bismarckia nobilis*

Herders take zebu to the *tany firaofana* during the morning, monitor them during the day and bring the zebu back to the village at night. When grazing in the *tany firaofana*, zebu may travel as much as several kilometers a day in search of fodder and water. The distance covered by the animals depends on the quantity and quality of the fodder available, which in turn depends on the seasonal cycle. As a result, *tany firaofana* boundaries are neither exact nor fixed. Nonetheless, local inhabitants can readily identify approximate boundaries using hills, streams, rivers, and other natural features as landmarks. The daily activities of the zebu in the *tany firaofana* revolve around the *matsabory*, which may be either periodic or permanent water sources. During the height of the dry season, the herds wander much further in search of water. Although the *tany firaofana*'s main use is as a pasture, it is a multi-functional landscape in the sense that all community members have the right to fish in the *matsabory*. They also have rights to gather *Bismarckia nobilis* leaves for thatching roofs, harvest wood from *Zizyphus Mauritania* to make charcoal, and collect food and medicinal plants, as well as dry wood for fuel.

Kijana

Kijana is the other term used to refer to pastureland in Boeny Region. The term *kijana* refers to pastureland that includes designated sites where zebu are gathered, either at night to rest or during the day to be counted. The gathering sites are known as *tany*



Figure 3. Pastureland in Tsaramandroso dominated by *Zizyphus mauritania*

fananganan'aomby in Ambalakida and Betsako Communes and *kijan'aomby* in Mariarano, Katsepy, Tsaramandroso, and Ankijabe Communes. *Tany fananganan'aomby* is a combination of the words *tany* (land), *fananganana* (gathering), and *aomby* (zebu). *Kijan'aomby* combines the words *kijana*, (unenclosed resting site) and *aomby* (zebu). *Kijan'aomby* refers to the areas where zebu gather to rest during the night, whereas *tany fananganan'aomby* is a broader term that refers more generally to areas where zebu gather. However, a *kijan'aomby* is also where the herd is gathered periodically so that the owner can verify the number of zebu present. In practice, the terms *tany fananganan'aomby* and *kijan'aomby* refer to the same place. To avoid confusion, in the remainder of this article we use the term *tany fananganan'aomby*, rather than *kijan'aomby*.

As noted previously, the *tany firaofana* portion of a *kijana* is a vast savanna dotted with *matsabory* and stands of *Bismarckia nobilis* or *Zizyphus Mauritania*. In contrast, *tany fananganan'aomby* (and *kijan'aomby*) are wooded spaces such as the isolated natural forest stands that the locals call *tsitokotokon'ala*. A *tany fananganan'aomby* forms an imperfect circle around a tree, known as the *vody kijana*, which means the base or pillar of the *kijana*. The cattle raisers hold ceremonies known as *joro kijana* at the base of the *vody kijana* (Figure 4). *Joro kijana* are sacred rituals in which zebu raisers request permission from the spirits that own and inhabit unoccupied land to use the land as a *tany fananganan'aomby*, ask for the spirits' blessing so that their zebu herds remain healthy and grow in number, or thank the spirits for their blessing.



Figure 4. *Vody kijana* with zebu skull indicating that the *joro kijana* ritual has taken place

Composed of trees, shrubs, and unvegetated areas, the *tany fananganan'aomby* offer shade and coolness for the herd. They also are a source of construction wood for local households. In most cases, *tany fananganan'aomby* are located near *mat-sabory*. Even though the *tany fananganan'aomby* cover much smaller areas than the *tany firaofana*, their boundaries are also fluid since the radius of the imperfect circle formed around the *vody kijana* varies with the size of the herd. The *tany fananganan'aomby* are generally located several kilometers away from villages. This protects the zebu raisers and their families, as well as other villagers, from attacks by zebu thieves.

Over time, zebu raisers in some parts of our study area have abandoned the practice of keeping zebu in *tany fananganan'aomby* at night. Insecurity linked to the theft of zebus in the area is commonly cited as a reason for abandoning the practice. The establishment of human settlements near a *tany fananganan'aomby*, with the subsequent risk of cattle damaging crops, is another reason cited for abandoning it. When *tany fananganan'aomby* have been abandoned in an area, the locals sometimes use the term *tany firaofana* rather than *kijana* to refer to the areas where zebu are pastured. However, in most cases, locals continue to use the term, *kijana*, even after the *tany fananganana'aomby* have been abandoned, a practice that contributes to the confusion as to what a *kijana* is.

Zebu production strategies

We identified four distinct zebu production strategies in the study area. These are known locally as *aomby asesy*, *aomby tondraka*, *aomby malia*, and *aomby soavaly*.

Aomby asesy

The *aomby asesy* production strategy consists of letting zebu graze in the *tany firaofana* during the day and returning them to the village at night. Etymologically, *aomby asesy* comes from the words *aomby* or zebu and *asesy* or accompanied step by step. The daily routine of the zebu consists of four activities or stages, hence the name *aomby asesy*. In the morning, they are brought from the villages to the *tany firaofana*, where they forage at will. Between the hours of 11:00 and 13:00, the zebu are brought to a *matsabory* to drink, after which they resume grazing. In the late afternoon, between 16:00 and 17:00, the zebu are brought back to the villages. In addition, the herder may take the herd by a *matsabory* so that the zebu can have a second drink on the way home. Once back in the village, the zebu are kept in fenced areas called *vala* (Figure 5).

Herders, or *tsimanaja* are generally hired by the zebu owners to accompany the zebu to and from the village and to monitor them while they are grazing (Figure 6). *Tsimanaja* are typically men and can be either family members or employees. They can also be children, young people, or elderly people. If they are employees, their



Figure 5. *Vala* where *aomby asesy* are kept at night



Figure 6. *Tsimanja* with *aomby asesy*

remuneration may consist of one or two zebus depending on how fast the herd increases, or they may be paid in cash. Although the number of zebu in a herd varies, study participants indicated that an *aomby asesy* herd typically has about 50 head of zebu.

The *aomby asesy* system in the Boeny region can be considered a semi-extensive zebu production system. The animals graze at will under the guidance of herders in the *tany firaofana*. The resources offered by this system vary from one commune to another and from one *fokontany* to another and even from one sector to another within the same *fokontany*. In the Betsako Commune's seat, the *tany firaofana* is in the northwestern part of the *fokontany* and its *matsabory*, as well as the fodder grasses, dry up during the height of the dry season. To avoid traveling several kilometers each day to find watering points, the herders in this village let the *aomby asesy* graze in the *baiboho*, or seasonally flooded lowlands where rice or market vegetables are grown in the wet season. Further south in Analatelo *fokontany* in Katsepy Commune, the *tany firaofana* for the Antanambao and Bedo sectors, as well as that of the *fokontany*'s seat is in the southern part of the *fokontany*. This *tany firaofana* also has no permanent *matsabory*. However, instead of letting the herds graze in the *baiboho* during the dry season, herders in Analatelo bring their herds to a *tany firaofana* located in the northern part of the *fokontany*.

Aomby tondraka

Unlike the *aomby asesy* strategy in which zebu use only the *tany firaofana*, the *aomby tondraka* production strategy makes use of both the *tany firaofana* and the *tany fananganan'aomby*. Etymologically, *aomby tondraka* comes from the words *aomby* (zebu) and *tondraka* (flooded; poured out without care). The term used in Boeny Region to describe this production strategy varies by the ethnic group. The Sakalava use the term *tondraka*. In communes with a mix of ethnic groups, the term *tobaka* is used, and the Tsimihety use the term, *hary*, which means wealth.

The *aomby tondraka* system is a purely extensive production system. The zebu remain in the *kijana* overnight, often for days and weeks at a time. Members of the herd are collected and returned to the village only for vaccinations or when they are to be sold in the local market. Some zebu owners with *aomby tondraka* hire a *tsimanaja*; others let their herd wander freely. In most cases, the zebu owners undertake the task of verifying the number of animals themselves. Verification can take place weekly, bi-weekly, or even monthly, depending on the owner. However, because of the long distances involved to gather up the herd, as well as for safety reasons, most zebu owners conduct head counts twice a month.

According to local zebu raisers, zebu who are allowed to wander freely are in better health, and as a result, the herd increases very quickly. In Malagasy society, where zebu production is extremely important for social status as well as economic reasons, social status and prestige is linked to the size of one's herd. The value of a zebu also differs depending on the shape of the hump, horns, colors, and the patterns on the zebu's body, as certain characteristics are required for ceremonial uses (Fauroux 1989b). The link between zebu and social status is reflected in the Tsimihetys' use of the term *aomby hary* rather than *aomby tondraka* when referring to this extensive zebu production strategy. The Malagasy word *hary* is the root of the word *harena* which means wealth. Thus, the larger a person's *aomby tondraka* herd is, the wealthier others perceive them to be. For zebu raisers, the *aomby tondraka* are equated with wealth because a few or several heads can be sold when cash is needed (i.e., to purchase land, a house, or a vehicle; or to pay for medical expenses).

Zebu raisers in the Bedo sector of Analatelo *fokontany* in Katsepy Commune, practice a form of production that is a mixture of *aomby asesy* and *aomby tondraka*. In Bedo, a *tsimanaja* accompanies the zebu as in the case of *aomby asesy*. However, the zebu are not brought back to the villages at the end of the day nor are they penned up in the *vala* located in the villages. But unlike the *aomby tondraka*, the zebu in the Bedo sector do not gather in the *tany fananganan'aomby* at night. Instead, they are penned up in *vala* located in the *tany firaofana*, a few minutes' walk from the villages. The *tsimanaja* build camps near these *vala*, where they stay the night to guard the zebus.

Aomby malia

A third zebu production strategy known as *aomby malia* involves letting the zebu run wild. *Aomby malia* comes from the words *aomby* (zebu) and *malia* (wild). According to the zebu raisers interviewed, the animals become wild because their owners let them graze on their own with very infrequent checks such that they become unaccustomed to being around humans. The zebu left on their own multiply much faster than the *aomby tondraka*, creating a herd of their own called *malia*. Local diviners, however, attribute the return to a wild state to *tsignintany*, the spirits who are considered the real owners of unoccupied land, re-taking possession of the zebu.

The *aomby malia* graze day and night in the *kijana*. Because they are descended from *aomby tondraka*, they have owners. However, to control their *aomby malia*, the owners must capture and tame them. *Aomby malia* owners regain control over their zebu by hiring *mpandonaka*, or sorcerers specialised in the taming of zebus¹. The *mpandonaka* use a mixture of witchcraft and other techniques, including smoky fires, that gradually tame the animals. Prior to the taming process, the zebu raisers who keep their herds in the same *kijana* hold a meeting during which the *mpandonaka* explains how the *donaka* or taming process will be carried out. Among the Bara in the Zombitse-Vohibasia forest complex, cattle taming is known as *donaky*; among the Sakalava in the Menabe Region, it is known as *donake* (Taillade 1997). In Boeny Region, during the meeting with the *mpandonaka*, the zebu raisers agree upon who will have property rights to the animals that will be tamed. If there are no objections, the taming activities, which last several months or even a year, can begin. According to zebu raisers in the study area, the main risk associated with owning *aomby malia* is the potential for social conflict among the zebu raisers themselves. This is because the *aomby malia* give birth to generations of *aomby malia* to which no zebu raiser has a clear ownership claim. The conflicts over *aomby malia* ownership may last a long time. In the Antsiatsiaka *fokontany* in Betsako Commune, for example, two owners of very large herds claimed to be the owner of the same herd of *aomby malia*. The conflict over the herd persisted until the day that one of the owners died.

***Aomby soavaly*²**

The *aomby soavaly* strategy involves keeping zebu whose purpose is to pull carts carrying people and goods or work the rice fields. *Aomby soavaly* combines the words *aomby* (zebu) and *soavaly* (horse) and means zebus that play the role of horses. The daily life of the *aomby soavaly* is often very busy, and farmers must always have them readily accessible. Consequently, *aomby soavaly* do not graze in the *tany firaofana* or in the *kijana*, which are usually located some distance from the villages. Instead, they are tied to stakes in open parcels of land located a few minutes from the villages and where they can find grass to feed on. The Sakalava also use the term *aomby mirohy* to designate *aomby soavaly*. *Aomby mirohy* comes from *aomby* (zebu) and *mirohy* (tied), hence meaning zebus that are tied.

Aomby soavaly owners either take care of the zebu themselves, hire a *tsiminjaha*, or assign a child of the family to do that work. In the morning, the zebu are fed rice straw before being taken to the plot where they will be tied to a stake. Once the zebu are tied, the caretaker returns to his or her daily tasks. Around noon, the caretaker drives the zebu to the *matsabory* and then takes them back to a parcel (sometimes changing parcels and sometimes not) to graze. Towards the end of the day, the caretaker collects the *aomby soavaly* and brings them back to the villages. Once in the villages, the *aomby soavaly* are tied to stakes called *moko* rather than kept in the *vala* with the *aomby asesy*.

Categories of Zebu raisers

In the study area, zebu owners are grouped by locals into three main categories: *mpanan'aomby* are cattle raisers who own less than twenty head of *aomby tondraka*, *manomboka fantatr'olo* own between twenty and fifty head, and *mpanarivo* own more than fifty head of *aomby tondraka*. *Mpanarivo* translates literally as those who have thousands of cattle. The term *mpanarivo* is used to refer to those with a large number of cattle, regardless of whether

they actually own more than a thousand head. Not only are *mpanarivo* respected for their wealth, but they are also feared since some of them are instigators of cattle thefts (Fauroux 1989b, 1991). In practice, in Boeny Region *mpanarivo* may have hundreds, but not thousands, of cattle. However, the size of the *aomby tondraka* herds for the three cattle owner categories may vary. In Maevarano *fokontany* of Tsaramandroso Commune, a man perceived as the *mpanarivo* of the *fokontany*, owns as many as 200 head of *aomby tondraka*. The other zebu raisers in the *fokontany* own between thirty and sixty heads of Zhu and are categorised as *manomboka fantatr'olo*. In the Antsiatsiaka *fokontany* of Betsako Commune, the local *mpanarivo* owns about 80 heads of *aomby tondraka*. The other zebu raisers in Betsako own between 10 and 40 head and are categorised as *mpanan'aomby* or *manomboka fantatr'olo*.

Discussion

Diverse pastoral spaces

Our study identified three distinct types of pastoral spaces in use by cattle raisers in Boeny Region. These include *tany firaofana*, pasturelands where cattle graze freely during the day and are accompanied by a herder; *kijana*, extensive pasturelands where cattle graze freely but remain day and night, and where the herds may or may not be taken care of by a herder; and small plots of open land near the villages where draft animals are staked during the day. These findings support previous work by Saint Sauveur (2007) among the Bara in southern Madagascar but also reveal some differences. Saint Sauveur (2007) describes the village territories of the agropastoralist Bara as consisting of a small area devoted to crops and an extensive area, the *tanin'aomby*, reserved for grazing cattle. They distinguish between pastures that are close to the village and more distant pastures, typically located in forested areas, that include cattle camps, known as *toets'aomby*, where herders stay with the cattle. Additionally, there are places where cattle gather (*kija*) and paths (*kizo*) along which cattle circulate between pastures belonging to different lineages. In the Menabe Region of western Madagascar, Fauroux (1989a) found that Sakalava agropastoralists also refer to the area where cattle are pastured as *tanin'aombe*, a space which they view as distinct from *kija*, or places where the herds rest (Fauroux 1989a). The *kija* in Menabe appear to be the equivalent of *tany fananganan'aomby* (or *kijan'aomby*) in Boeny. Taillade's (1997) research on Sakalava agropastoralists in Menabe Region highlighted the importance of *kitobokala*, or forest Islands, for the shade and shelter they provided cattle. Taillade noted that each *tanin'aomby* had several *kitobokala*, and cattle raisers considered them sufficiently important to protect them from forest fires. Neither Fauroux (1989a) nor Taillade (1997) described the use of specific pathways devoted to cattle circulation in Menabe Region. We also did not find evidence of specific pathways for cattle circulation in the communes included in our study.

The role and place of the dry forest in Boeny's cattle production systems

Fauroux (1989a) and Saint Sauveur (1996) identify nutritious and abundant forage, watering points, and forest patches as three essential elements of rangelands where cattle are left day and night, findings which our research supports. In Madagascar, the general view among

individuals with limited direct exposure to cattle production systems is that a *kijana* is any savanna, wooded or otherwise, where cattle graze. However, this view conflates two very different pastoral spaces: the *tany firaofana* and *kijana*. The two spaces are similar in that they both require the presence of fodder, in the form of grasses and the leaves and pods of indigenous trees and shrubs, as well as water sources, typically in the form of small lakes or ponds. However, a *kijana* also requires the presence of sheltered spaces, in the form of isolated stands of trees or forest patches, so that the cattle have shade during the day and a place to rest at night. Our study indicates that in Boeny Region, dry forests play a particularly important role in the *aomby asesy*, *aomby tondraka* and *aomby malia* production systems. In all three systems, scattered trees and forest Islands provide cattle with browse, as well as shade and shelter from the wind and rain. In addition, for the *aomby tondraka* and *aomby malia* systems, forest Islands provide cattle with shelter at night. Moreover, as in western and southern Madagascar, cattle raisers in Boeny Region see a strong spiritual connection between their cattle and the forest, as evidenced by the *joro kijana* ritual that calls for the *tsignintany* or spirits of the land to protect the cattle, and by the *donaka* ritual that tames wild cattle by releasing them from the *tsignintany*. Our findings concur with Vall and Diallo's (2009) conclusion based on work in Burkina Faso that the term pasture is inadequate for describing such pastoral spaces, and that it is more appropriate to speak of a pastoral unit, which includes a grazing area and areas where zebu gather at night. The policy implication is that efforts to recognise collective tenure of pasturelands in dryland forests must incorporate definitions of pasturelands that include, at a minimum, grassy areas for grazing, forest Islands and dispersed trees for shelter and shade, and watering points.

Zebu production and theft prevention strategies

We identified four distinct zebu production strategies in northwestern Madagascar existing along a continuum from very intensive to very extensive. The *aomby soavaly* system, which is used for draught animals, is at the most intensive end of the continuum; the *aomby malia* system, in which the cattle are intentionally left to run wild, is at the most extensive end. The *aomby asesy* and *aomby tondraka* systems are located in between the two ends of the continuum. Randriamiharisoa (2009) describes a similar cattle production system among the Bara in southern Madagascar. Among Bara pastoralists a system known as *arakandrovy* or *miarakandro* involves a herder accompanying the cattle to nearby pastures during the day and bringing them back to the village at night; the *midada* system consists of leaving the zebu to graze freely in more distant rangelands. The Bara also keep zebu used for draft power staked out in parcels near villages. Some Bara cattle raisers also intentionally let their zebu run wild. Saint Sauveur (1996, 2007) states that Bara herders who have access to forest pasture generally do not keep their herds in areas equivalent to the *tany fananganan'aomby* found in Boeny Region, preferring instead to let them run wild as a means of theft prevention. Moizo (2003) reported that Bara cattle raisers kept their herds in wooded areas because they believed that the forest spirits protected the animals from thieves. Additionally, it is more difficult for thieves to lead the herds through forested areas since the cattle are less likely to remain in a group. Some Sakalava cattle raisers in Menabe Region also let their herds run wild as a theft prevention measure (Fauroux 1989a). However, another rationale among the Bara and the Sakalava for letting cattle

run wild is that such animals are viewed as possessed by forest spirits, which makes them more desirable as ritual sacrifices (Saint Sauveur 2007). Similarly, the Sakalava and Tsimihety cattle raisers in Boeny Region believe that *tsignintany* are present in uninhabited places, including savannas, forests, and water bodies, and that cattle kept in such places are protected by those spirits.

Transitioning from extensive to semi-extensive Zebu production systems

Forest patches do not always function as effective theft deterrents, as evidenced by the recent abandonment of *tany fananganan'aomby* by some cattle raisers in Boeny Region in preference for using *tany firaofana*. The abandonment of more distant pastures and the shift toward the use of day pastures only has also been documented as an alternative theft reduction strategy among the Bara in the south (Saint Sauveur 2007) and the Sakalava in the west (Fauroux 1989a). In Katsepy Commune, we encountered an intermediate form between *aomby asesy* and *aomby tondraka* livestock systems. Because of the risk of theft and associated potential for violence, the cattle raisers in this commune no longer use the *tany fananganan'aomby* in the savanna nor do they use the *vala* in the villages. Instead, they have built *vala* in the *tany firaofana*, which is located not too far from nor too close to the villages, where the zebu are kept penned up at night. The zebu in Katsepy Commune are now effectively half-*asesy* and half-*tondraka*. The transition from the use of extensive forms of cattle production to more intensive strategies in our study site aligns with observations of intensification elsewhere in sub-Saharan Africa, whether due to population pressure (Moritz 2012), land use and climate change (Ouédraogo et al. 2021), cattle commodification (Schareika et al. 2021) or policies disfavoring extensive production (Gonin and Gautier 2015).

Conclusion

Our study illustrates the variety of cattle raising systems that are used in northwestern Madagascar, and the diversity of pastoral spaces that occur within Boeny Region's dry forest ecosystems. The more extensive *aomby tondraka* system appears to be gradually shifting toward a hybrid of the *aomby tondraka* system and the more intensive *aomby asesy* system. However, in both systems, as well as for the *aomby malia* system, secure access to the forage, watering points, and shelter that the region's dry forests provide, is critical. However, even though Madagascar's 2006 Land Law recognizes customary tenure claims to untitled private property, access to pasturelands located in dry forest is by no means secure for those who have access to those lands through customary tenure systems. Indeed, the explanatory memo to Madagascar's 2006 Land Law explicitly excludes extensive pasturelands from untitled private property. Under customary tenure rules, the practice of grazing of cattle in the *tany firaofana* and *kijana*, and the completion of the *joro kijana* ritual by which cattle raisers establish a claim to a *tany fananganan'aomby*, are clear and locally legitimate indicators that those lands are in productive use (i.e., for cattle production), and therefore, in the eyes of local inhabitants, owned. Yet because both *tany firaofana* and *kijana* occupy extensive areas, under current national law by default they fall within the state public

domain rather than customary ownership. The lack of recognition of these lands as collectively held under customary tenure rules places them at risk of being expropriated for other uses incompatible with their current vocation as pasturelands.

Previous work in Boeny Region (McLain et al. 2019) suggests that FLR initiatives that encourage tree-planting on lands incorrectly presumed to be unowned or unused are among the activities that pose a very real threat to pasturelands, and ultimately agropastoral livelihoods. Ramprasad et al.'s (2020) research on the impacts of tree-planting initiatives on pastoralists in India and Davis and Robbins (2018) examination of post-colonial afforestation policies on rural livelihoods in Africa and India show that northwestern Madagascar is not unique in this respect. Ramprasad et al. (2020) recommend that planners work with pastoralists to develop afforestation strategies that support, rather than undermine, their continued access to high-quality grazing areas. We suggest that providing policy makers and FLR planners with a better understanding of how extensive and semi-extensive cattle production systems are organized, the spaces in which they occur, and the resources that must be present for them to be viable is another important step toward creating the enabling conditions for dry forest restoration initiatives that will enhance the resiliency of agropastoralist and pastoralist livelihoods.

Notes

1. The *ombiasy*, or traditional healers, occupy an important and central place within Malagasy societies. Nothing important is done without consulting them. They can review the past, explain the present and predict the future. Zebu owners in the northwestern Madagascar (Boeny Region) affirm that *mpandonaka* are not the same as *ombiasy*. The *mpandonaka* consult *ombiasy* before taming zebras. It is the *ombiasy* who caution the *mpandonaka* about prohibitions or *fady*.
2. *Soavaly* is from the French word *cheval*, or horse (Mullens 1876). The first horse known to arrive in Madagascar was a diplomatic gift from the English governor of Mauritius to King Radama I (Ravelomanana 2017).

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ORCID

Rebecca McLain  <http://orcid.org/0000-0001-6501-2190>

References

- [MAEP] Ministère de l'Agriculture, de l'Élevage et de la Pêche. 2007. Recensement de l'agriculture, campagne agricole 2004-2005. Tome II. Population and exploitations agricoles [Agricultural census, 2004-2005 agricultural campaign. Volume II. Population and agricultural holdings]. Antananarivo (Madagascar): République de Madagascar, Ministère de l'Agriculture, de l'Élevage et de la Pêches. Direction du Marketing et des Études Économiques. Service des Stqtistiques Agri. Accessed 26 12 2021
- Chidumayo E, Marunda C. 2010. Defining dry forests and woodlands of sub-Saharan Africa. In: Chidumayo EN, Gumbo DJ, editors. The dry forests and woodlands of Africa: managing for products and services. London (UK): Earthscan; p. 1-9.
- Conservation International-Madagascar. 2014. Ecosystem profile: Madagascar and Indian Ocean Islands. Arlington (VA): Critical Ecosystem Partnership Fund.
- Davis DK, Robbins P. 2018. Ecologies of the colonial present: pathological forestry from the taux de boisement to civilized plantations. *Environ Plan E*. 1(4):447-469.
- Dudley N, Eufemia L, Fleckenstein M, Periago ME, Petersen I, Timmers JF. 2020. Grasslands and savannahs in the UN decade on ecosystem restoration. *Restor Ecol*. 28(6):1313-1317. doi:10.1111/rec.13272.
- FAO. 2021. FAOSTAT. Crops and livestock products (Madagascar). Accessed 26 12 2021. [updated 2021 Dec 12]. <https://www.fao.org/faostat/en/#data/QCL>.
- [FAO and UNEP] Food and Agricultural Association and United Nations Environment Programme. 2020. The state of the world's forests 2020. Rome: Food and Agricultural Organization and the United Nations Environment Programme.
- Fauroux E. 1989a. Aombe: le boeuf et le riz dans la vie économique et sociale de la vallé de la Maharivo [Cattle 2: cattle and rice in the economic and social life in the Maharivo Valley]. (Antananarivo/Paris: Ministère de la Recherche Scientifique et Technologique pour le Développement (MRSTD) and Institut Francais de Recherche Scientifique pour le Développement en Coopération (ORSTOM)) Accessed 26 12 2021.
- Fauroux E. 1989b. Boeufs et pouvoirs. *Etats et Sociétés Nomades Polit Afr*. 34:63-73.
- Fauroux E. 1991. Les structures invisibles du pouvoir dans les villages sakalava de la vallée de la Maharivo. *Omal sy Anio*. 33-36:61-74.
- Feldt T, Schlect E. 2016. Analysis of GPS trajectories to assess spatio-temporal differences in grazing patterns and land use preferences of domestic livestock in southwestern Madagascar. *Pastoralism*. 6(5):1-17. doi:10.1186/s13570-016-0052-2.
- Gichuki L, Brouwer R, Davies J, Vidal A, Kuzee M, Magero C, Walter S, Lara P, Oragbade C, Gilbey B. 2019. Reviving land and restoring landscapes: policy convergence between forest landscape restoration and land degradation neutrality. Gland (Switzerland): International Union for the Conservation of Nature.
- Goetter J. 2015. The cattle raiders leave us no choice: new transhumance in the Mahafaly Plateau region in Madagascar. *Madag Conserv Dev*. 11(1):1-11.
- Gonin A, Gautier D. 2015. Shift in herders' territorialities from regional to local scale: the political ecology of pastoral herding in western Burkina Faso. *Pastoralism*. [accessed 2021 Dec 28]; 5(7):12. <https://pastoralismjournal.springeropen.com/articles/10.1186/s13570-015-0023-z>.
- Hänke H, Barkmann J. 2017. Insurance function of livestock, farmers coping capacity with crop failure in southwestern Madagascar. *World Dev*. 96:264-275. doi:10.1016/j.worlddev.2017.03.011.
- [INSTAT] Institut National de la Statistique. 2019 February. Troisième recensement general de la population et de l'habitation [Third general population and housing census]. Antananarivo (Madagascar): Republic of Madagascar, Ministère de l'Économie et des Finances, Direction Générale, Cellule Centrale d'Execution du Recensement.

- Lacroix E, Carodenuto S, Richter F, Pistorius T, Tennigkeit T. 2016. Restauration des paysages forestiers: évaluation des potentialités dans le contexte des engagements de Bonn 2.0 et de la Déclaration de New York sur les forêts: méthodologie et résultats pour Madagascar [Forest landscape restoration: valuation of the potential within the context of Bonn 2.0 and the New York declaration on forests commitments: methodology and results for Madagascar. Freiburg (Germany): Unique Forestry and Land Use GmbH. Accessed 26 12 2021.
- Manasoa CGO 2021. Modalité de gestion et de sécurisation des espaces pastoraux communautaires: cas des communes de Betsako et de Katsepy [masters thesis]. Antananarivo (Madagascar): Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques.
- McLain R, Lawry S, Guariguata MR, Reed J. 2018. Toward a tenure responsive approach to forest landscape restoration: a proposed tenure diagnostic for assessing restoration opportunities. *Land Use Policy*. accessed 2021 Dec 28:104(103748):p. 12. doi:10.1016/j.landusepol.2018.11.053.
- McLain R, Ranjatson P, Lawry S, Rakotonirina JM, Randrianasolo R, Razafimbelo NT. (2019). Tenure challenges to implementing forest landscape restoration in northwestern Madagascar. CIFOR Infobrief 273. Bogor, Indonesia: Center for International Forestry Research.
- Ministère de l'Agriculture, de l'Élevage et de la Pêche [MAEP]. 2004. Filières de l'agriculture, de l'élevage et de la pêche, et action due MAEP: filière bovin à viande [Agriculture, livestock, and fishing sectors, and MAEP actions: beef cattle sector]. Fact Sheet 201. Antananarivo (Madagascar): République de Madagascar. Ministère de l'Agriculture, de l'Élevage et de la Pêche. Accessed 26 12 2021.
- Moizo B. 2003. Perceptions et usages de la forêt en pays bara (Madagascar). *Bois et Forêts des Tropiques*. 278(4):25–37.
- Moritz M. 2012. Pastoral intensification in West Africa: implications for sustainability. *J R Anthropol Inst*. 18(2):418–438. doi:10.1111/j.1467-9655.2012.01750.x.
- Mullens J. 1876. On the origin and progress of the people of Madagascar. *J R Anthropol Inst GB Irel*. 5:181–198. Accessed 26 12 2021. <https://www.jstor.org/stable/2841393> .
- [ONE] Office National pour l'Environnement. 2019. Vulnérabilité et risques climatiques: informations récentes pour le Tableau de bord environnemental de la région Boeny [Vulnerability and climatic risks: recent information for Boeny region's environmental dashboard]. Antananarivo (Madagascar): Republic of Madagascar, Ministère de l'Environnement et du Développement Durable.
- Ouédraogo K, Zaré A, Korbéogo G, Ouédraogo O, Linstädter A. 2021. Resilience strategies of West African pastoralists in response to scarce forage resources. *Pastoralism*. accessed 2021 Dec 28:11 (16):14. doi:10.1186/s13570-021-00210-8.
- Ramprasad, V, Joglekar, A, Fleischmann, F. 2020. Plantations and pastoralists: afforestation activities make pastoralists in the Indian Himalaya vulnerable. *Ecol Soc* 25(4):1. <https://doi.org/10.5751/ES-11810-250401>
- Randriamiharisoa NA 2009. L'élevage de ruminants dans le sud-ouest Malgache face aux variabilités climatiques: cas de deux villages périphériques de la réserve spéciale de Beza Mahafaly [masters thesis]. Antananarivo (Madagascar): Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques.
- Randrianasolo R 2020. Étude des modalités de sécurisation des espaces pastoraux – cas des communes rurales de Mariarano et d'Ankijabe de la Région Boeny [masters thesis]. Antananarivo (Madagascar): Université d'Antananarivo, Ecole Supérieure des Sciences Agronomiques.
- Ravelomanana J. 2017. Les traités anglo-malgaches de 1817-1820: L'abolition de la traite des esclaves dans l'Océan Indien, un aspect des enjeux géopolitiques du XIXe siècle. *Rev Historique de l'Océan Indien*. 9:366–371.
- Saint Sauveur A. 1996. Le vol de bétail, facteur clef de l'organisation foncière et pastorale dans le pays bara (sud-ouest malgache). *J Agric Tradit Bot Appl*. 38(2):253–267.
- Saint Sauveur A. 2007. Le zebu dans le sud-ouest malgache, gardien des espaces pastoraux et des territoires ancestraux [The zebu in southwest Madagascar, caretaker of pastoral spaces and ancestral territories]. In: Dounias E, Motte Florac E, Dunham M, editors. *Le symbolisme des*

- animaux: l'animal, clef de voûte de la relation entre l'homme et la nature [Animal symbolism: animals, keystone in the relationship between humans and nature]. Montpellier (France): Institut de Recherche pour le Développement, Collection Colloques et Séminaires; p. 1047–1065.
- Schareika N, Brown C, Moritz M. 2021. Critical transitions from pastoralism to ranching in Central Africa. *Curr Anthropol.* 62(1):53–76. doi:[10.1086/713248](https://doi.org/10.1086/713248).
- Taillade J. 1997. Les éleveurs Sakalava du Menabe et la forêt. In Jean-Michel Libigre (coordinator): milieux et sociétés dans le sud-ouest de Madagascar Centre de Recherches sur les Espaces Tropicaux, Université Michel de Montaigne-Bordeaux. Colloques Îles et Archipels. 23:67–95.
- Vall E, Diallo MA. 2009. Savoir techniques locaux et pratiques: la conduite des troupeaux aux pâturages (ouest du Burkina Faso). *Nat Sci Soc.* 17(2):122–135. doi:[10.1051/nss/2009024](https://doi.org/10.1051/nss/2009024).
- Veldman JW, Overbeck GE, Negreiros D, Mahy G, Le Stradic S, Fernandes GW, Durigan G, Buisson E, Putz FE, Bond WJ. 2015. Where tree planting is bad for biodiversity and ecosystem services. *Biosci.* 65(10):1011–1018. doi:[10.1093/biosci/biv118](https://doi.org/10.1093/biosci/biv118).
- Vetter S. 2020. With power comes responsibility – a rangelands perspective on forest landscape restoration. *Front Sustain Food Syst.* accessed 2021 Dec 27:4:549483. doi:[10.3389/fsufs.2020.549483](https://doi.org/10.3389/fsufs.2020.549483).
- Wilson PJ. 1967. Tsimihety kinship and descent. *Afr.* 37(2):133–154. doi:[10.2307/1158252](https://doi.org/10.2307/1158252).
- Wily LA. 2021. Challenging the state: devolutionary tenure transitions for saving and expanding forests. *Hum Ecol.* 49(3):285–295. doi:[10.1007/s10745-021-00231-2](https://doi.org/10.1007/s10745-021-00231-2).