

Carbon sequestration from common property resources: Lessons from community-based sustainable pasture management in north-central Mali

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Abstract

Carbon sequestration in soils has been presented as a potential mechanism to enhance productivity in semi-arid lands in Africa while contributing to the mitigation of greenhouse emissions. Most of the literature, however, focuses on assessing the capacity of existing technology to sequester carbon in soils. There is much less discussion in the literature on the social and institutional elements that need to be in place to realize the potential benefits of carbon sequestration. This paper contributes insights in this direction by analyzing a case of community-based pasture management in north-central Mali. The case study challenges common assumptions in carbon sequestration efforts, namely that land resources are devoted to a single use by resident users; have distinct boundaries and fall within identifiable territorial and administrative jurisdictions, and are subject to widely recognized claims and free of conflict. We suggest that this is not always the case. Findings indicate that carbon sequestration projects centered on rangelands need to allow for flexibility in livestock movements and resource availability and to account for the diverging interest of multiple stakeholders, including different types of pastoralists and farmers. We conclude that social capital formation and conflict management are key elements of a carbon sequestration strategy in supports of sustainable and equitable development in the Sahelian region.

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1. Introduction

The combined effect of climate change and globalization has profound implications for livelihood vulnerability in Africa (O'Brien and Leichenko, 2000). Since the Kyoto protocol opened the possibility for less developed countries to receive payments for carbon offsets based on land use, the view has emerged that African communities may

be able to benefit rather than only suffer from these global changes (Batjes, 2001; Lal, 2002; Bartel, 2004; Tieszen et al., 2004). Research has shown that in semi-arid Africa rangelands have greater carbon sequestration potential than croplands, and controlled grazing has been identified as one of the suitable management options to achieve such potential (Lal, 2002; Ringius, 2002). From those perspectives, community-based carbon projects in pasturelands could provide financial incentives to better manage natural resources, and improve agricultural production and food security in the process. Implementation of such

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projects could also strengthen rural institutions and security of resource tenure (Bartel, 2004). However, the enthusiasm for the potential benefits of carbon trading must be tempered with a realistic assessment of the capacity of African soils to effectively sequester carbon and of the complementary challenges posed by entrenched poverty and rapid population growth (Tiessen et al., 1998; Schlesinger, 2000; Ringius, 2002). There is concern that infrastructural and institutional weaknesses, poor systems of governance and political representation, and low levels of literacy and leverage among the rural poor may give rise to obstacles, abuses, conflicts (Nelson and de Jong, 2003; Smith and Scherr, 2003; Gundimeda, 2004). Likewise, the formality and complexity of carbon accounting and trade agreements may favor those with clearly defined rights to resources and with the power and capacity to enforce them (Nelson and de Jong, 2003; Smith and Scherr, 2003; Gundimeda, 2004). Experience from other carbon sequestration and environmental services projects indicates there is the need for institutional mechanisms to facilitate multi-stakeholder negotiation and conflict management while protecting the interests of minorities and marginalized groups (Asquith et al., 2002; Tipper, 2002; Smith and Scherr, 2003; Naughton-Treves, 2004; Gundimeda, 2004).

Institutional mechanisms for community participation in carbon trading will only be operational and enforceable if supported by an enabling policy environment. In many African countries this would require clarifying resource tenure and reforming regulatory frameworks and incentive structures that promote unsustainable land use dynamics (Naughton-Treves, 2004; Tschakert, 2004; Tschakert and Tappan, 2004). There would also be a need to strengthen inter-sectoral linkages in rural markets, financial institutions, and information systems (Smith et al., 2000; Nelson and de Jong, 2003; Smith and Scherr, 2003). Foreign donors and research institutions would play critical roles in promoting needed reforms, building capacity, and ensuring accountability (Nelson and de Jong, 2003; Smith and Scherr, 2003; Naughton-Treves, 2004).

All of this indicates that the success in carbon sequestration will depend on overcoming political and institutional challenges, as much as on choosing the right technology. Yet very few studies have been conducted on the social and institutional dimensions of carbon projects, particularly in semi-arid lands in Africa. Tschakert's pioneering work in Senegal (2004 and in this volume) convincingly demonstrates that farmers' ability to adopt and benefit from fertility management practices varies according to their resource endowment. It also argues that successful risk mitigation, in an environment characterized by high levels of uncertainty such as the Sahelian region, hinges on farmers' capacity to improvise and innovate, which may not be compatible with the fixity of commitments required by carbon contracts (Tschakert and Tappan, 2004).

Flexible arrangements of resource access and use, which appropriately take into account the heterogeneity of resource users, are critical for both livelihood resilience and common property resource management (Gundimeda, 2004). The literature on carbon sequestration, however tends to assume that land resources are devoted to a single use by one user group, have distinct boundaries that fall within clearly identifiable jurisdictions, and are free from conflict and contested claims. In reality these assumptions do not hold up, especially when common property resources, marked seasonal changes and mobile populations are involved, as it is illustrated in the case study presented below.

2. Methodology

This paper analyzes an experience of sustainable pasture management conducted in north-central Mali under the Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP) sponsored by the US Agency for International Development (USAID). Between 1999 and 2004, the program involved multidisciplinary research and capacity building activities in collaboration with Mali's national agricultural research organization, the Institut d'Economie Rurale (IER). The goal was to develop improved technologies and institutional capacity for community-based natural resource management (NRM) in the Niger river's floodplain (Moore, 2005). In 2002 the SANREM CRSP joined efforts with the Soils Management CRSP in a project entitled Carbon from Communities and funded by the U.S. National Aeronautics and Space Administration (NASA). The project aimed to assess the potential of improved land use systems for soil organic carbon sequestration under crop production (in southern Mali) and pasture management (in north-central Mali).

Data for this paper was collected during three field research events (July 2003, November 2003, and February 2004), which were timed to coincide with significant moments in the cycles of crop production and livestock movements through the area. The research design included open-ended interviews and focus groups with resource users at the local level, and interviews with representatives from institutions at district and regional levels. Individual and group interviews were carried out with approximately 30 key informants. Six focus groups included sedentary and migrant pastoralists from different areas, pastoralist women, community leaders, elected officials, project participants, agricultural technicians, and scientists. Interviews were also conducted with representatives of government agencies, technical services, local and international NGOs, producers associations, private sector operators, and traditional leaders. This institutional analysis focused on resource tenure legislation, land use planning, environmental governance, and conflict resolution in the context of decentralization.

3. The research context

3.1. Uses and users of agricultural and pastoral resources in Madiama

The inland delta of the Niger river in north-central Mali is a classic example of an environment subject to multiple uses supporting diverse livelihood systems. It hosts communities of farmers, pastoralists, and fisherfolk who historically have exploited the natural resources of the floodplain in complementary fashion. Pressures stemming from political, economic, and ecological transformations, though, have strained such inter-dependence (Moorehead, 1991; Turner, 1992; Davies, 1996). The research site, the Commune of Madiama, is situated on the eastern edge of the delta (Fig. 1). While it is not as well endowed in natural resources as the floodplain, it occupies a strategic position as one of the main entry points into the delta. Each year at the end of the rainy season, thousands of cattle from the entire region pass through its territory to reach the floodplain. Cattle remain there for several months, until the

onset of the new rainy season, and graze on ‘*bourgou*’ (*Echinochloa stagnina*), an aquatic plant that becomes available in the wetlands (*bourgoutières*) as the flood waters recede.

The area’s climate, typical of the Sudan-Sahel region, is characterized by a single rainy season (June to September) followed by an extended dry season (October to May). Records for Madiama show a decline in the average total seasonal rainfall during the last three decades (Badini and Dioni, 2005) (Table 1). Inter-seasonal and intra-seasonal precipitation has also become more variable, with frequent droughts (386 mm rainfall in 2002) and peaks (746 mm in 2003) (data from SANREM CRSP rain gauges provided by Oumarou Badini).

The territory of the Commune of Madiama comprises ten villages and falls within the District (Cercle) of Djenné

Table 1
Madiama average total seasonal rainfall, 1950–1969 and 1970–2000

1950–1969	1970–2000
636 mm	482 mm

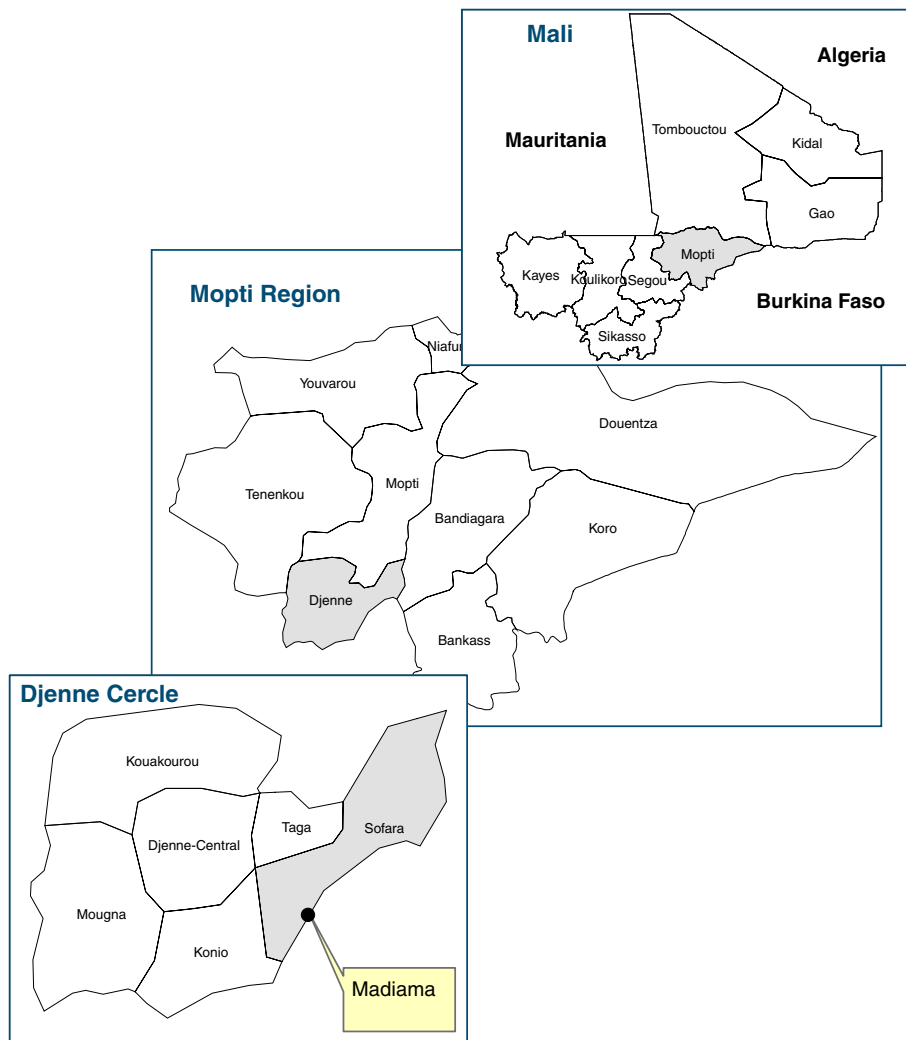


Fig. 1. Location of research site.

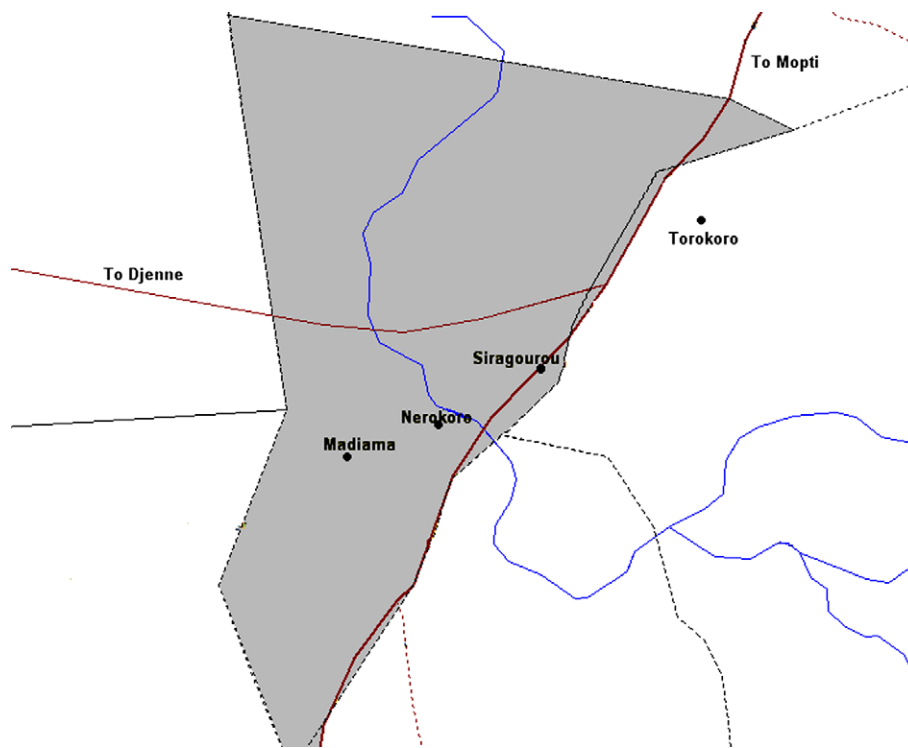


Fig. 2. Madiama commune.

and the Fifth Region of Mali (Mopti). The eastern edge of the Commune's territory borders the main northbound highway, which also marks the district and regional boundaries (Fig. 2). A population density of 47 inhabitants per km² (8,000 inhabitants over 17,000 ha) exerts considerable pressure on the Commune's land resources (Badini and Dioni, 2005). Most of the Commune's inhabitants are *Bamanan*-speaking farmers (Bambara and Marka). There is a significant minority of Peul agro-pastoralists, and smaller groups of Bozo fisherfolks and Bella agro-pastoralists (Kodio, 2002; Moseley et al., 2002).

Most arable land is currently under cultivation and under the control of local farming households, with use rights being inherited patrilineally. Village chiefs may allocate cultivation rights on unclaimed land in their village territories to outsiders who ask for it. Animal traction, introduced in the 1960s and used by 80% of farming households, has enabled farmers to cultivate larger areas to feed a growing population and to compensate for falling yields (Earl and Kodio, 2005). The main staple crops are millet and sorghum. Other crops include maize (*Zea mays*), rice (*Oryza sativa*), peanut (*Arachis hypogaea*), fonio (*Digitaria exilis*), okra (*Abelmoschus esculentus*), and dah (*Hibiscus cannabinus*). Watermelons (*Citrullus lanatus*) are gaining importance as a cash crop. Fields around homesteads and in the village are under permanent cultivation. Distant fields may be fallowed for a few years, but fallow periods have been shrinking (Crane and Traoré, 2005).

Pastoralists include sedentary agro-pastoralists and semi-transhumant pastoralists. The former reside in the

Commune for the entire year and cultivate fields in addition to rearing livestock, while the latter maintain homesteads in the Commune but spend several months elsewhere and rely primarily on livestock for their livelihood. Size of herds and connection to prominent farming households influences the differences in status among pastoralists (de Bruijn and van Dijk, 2003). Hired hands who tend other people's livestock have lower status. Livestock owners include civil servants, professionals, traders, Islamic clerics from nearby towns, as well as local farmers who increasingly invest in livestock to insure themselves against crop failure and food shortage (Turner, 1993). About 5,000 cattle and 5,000 small ruminants reside within the Commune, but the distribution of animals is uneven. For instance, there are more livestock in the agropastoral Peul village of Nerekoro (31 cattle and 7–8 small ruminants) than in other villages (2–3 cattle and 4 small ruminants) (Ballo and Ouattara, 2005). Besides local livestock, at certain times of the year, transhumant herds pass through the territory on their way to or from the delta, adding 30,000 Topical Livestock Units (1 TLU = 250 kg live weight) to the Commune's animal population.

Overall, local and transhumant pastoralists spend less time in the Commune's territory than in the past. When more abundant rainfall fed higher water levels in the river, the flooded area reached the Commune, bringing *bourgou* and water sources at closer range. Thus, local and transient livestock could graze for several months, sometimes the entire length of the dry season, without leaving the Commune. Today, local livestock must leave in search of water

and fodder for most of the dry season, while transhumant herders travel quickly through the Commune due to fear of conflict with farmers, whose fields have expanded into pastures and cattle corridor.

Madiama serves largely as a transit zone, where herds wait for the authorization to enter the delta's *bourgoutières*. The regional government authority (Governor) in Mopti establishes the date of entry to the delta after consultation with local, district, and regional stakeholders. Once permission is granted, local and transhumant pastoralists take their herds to graze on fresh *bourgou* outside the Commune, or on rice straw left in the floodplain field after harvest.

At the onset of the new rainy season, in June, the herds leave the floodplain and traverse the Commune again on their way to upland pastures where they spend the rainy season. A deadline for this exit is also established by the Governor, usually in late July, but most pastoralists leave as soon as it starts raining regularly and water in the delta starts rising to avoid exposing animals to disease and to take advantage of the more nourishing upland grasses. As planted crops begin to emerge, the Mayor of Madiama sets a deadline in consultation with village chiefs. Thereafter all local and transhumant cattle must leave the Commune and small ruminants must be tethered to prevent crop damage. Only draft oxen and milk cows remain on Commune pastures during the rainy season. Local livestock spend the rainy season in neighboring Communes or join transhumant herds on open rangelands that stretch from the eastern boundary of the Commune to the international border with Burkina Faso.

This multiplicity of users and uses results in enormous pressure on natural resources in Madiama. Declining rainfall has reduced land productivity, increasing competition for fodder and farmland. As elsewhere in the Sahel–Sudan region, agriculture is encroaching into pastureland, wetland grazing reserves, cattle corridors, and resting camp areas used by migrant herders (Dème, 1998; Hesse and Trench, 2000). Only a few pockets of dryland pasture remain in the Commune, and wetlands have all but disappeared. Kodio (2002) estimates that the Commune currently has only 13 pastures, with an average productivity of 900 kg of dry matter per hectare (which can support 3–5 TLU/ha). A remote sensing-based land use study of Madiama shows that rangelands decreased from 63 to 8 percent of the landscape while cultivated areas increased from 17 to 57 percent in the last fifty years (Wynne et al., 2005). As a result, relations between farmers and pastoralists have become more contentious, occasionally erupting into violent conflict (Ba, 2002; Kodio, 2002; Moseley et al., 2002; PAVD, 2003).

Pastureland in Madiama may be characterized as situated somewhere in between 'open access' and 'common property' regimes (Hesse and Trench, 2000). In principle, most pastureland in the Commune is open-range and can be grazed by local and transhumant livestock. There are no, village pastures, (*harima*), a more restrictive category

of pasture that enjoys some legal protection against encroachment from agriculture and is reserved for local milk cows and calves (Vedeld, 2000). In practice, however, villages maintain varying degrees of control over grazing areas in their territories. The village chief and its council decide whether outsiders can access such pastures and under what conditions. Villages that do not have pastures in their territories develop informal grazing agreements with villages within or outside the Commune that do.

After the harvest is declared officially over by local authorities, harvested fields and fallows can be accessed by both local and transhumant livestock. But some villages only allow outside herders on village fields after they have been grazed by local cattle for some time, others allow them only on distant fields (Kodio, 2002). Some farmers reserve the seed heads of millet and sorghum that have fallen during harvest, which are highly nutritious, for their own livestock. Occasionally, to ensure that their animals have priority access to the freshly harvested fields, farmers bring them back into the Commune before the authorized date, causing damage to crops that remain to be harvested for which the herders are often blamed (Ballo and Ouattara, 2005). Fluctuations in water supplies also fuel conflicts over trespassing on crop fields. Heavy rainfall may block passages, forcing herds to cross planted areas. During droughts, lack of water in the waiting zones pushes herders to cross Commune boundaries before the authorized date to bring their animals to watering points.

This account of farming and pastoral practices across the Madiama landscape shows that land is rarely devoted to a single productive purpose, i.e. agricultural or pastoral. Rather, the same area is often managed in different ways by different decision makers across the seasons. Soil fertility management and, increasingly, livelihood security depend on the integration of agricultural production and animal husbandry. In order to cope with growing uncertainty pastoralists take up farming and farmers invest in livestock.

Two implications for carbon sequestration emerge. The multifunctional, fragmented, and dynamic nature of land resource use in Madiama and in the delta region will likely make it difficult to rely on one single technology package that focuses on either crop or livestock production exclusively. Rural households adapt to climate and market risks by diversifying into an array of activities dispersed in time and space (Painter et al., 1994). Production systems, such as agriculture and pastoralism, are closely interlinked in complex dynamics of cooperation and competition (Brock et al., 2002; Williams et al., 2004). At the same time, it will be hard to allocate carbon sequestration benefits among the multiple resource users given that sequestration will result from management decisions and practices that take place at the same time or influence each other in a relay pattern. The next section shows how this diversity of land uses is matched by a multiplicity of stipulations and jurisdictions concerning pastoral resources.

3.2. Policies and institutions governing land use in the Niger delta

Multiple policies and land use governing mechanisms have accumulated over the years as different social groups sought control of the Niger's bountiful natural resources. During the 19th century, the area was part of the Peul caliphate of Hamdallahi, which instituted the Dina code (de Bruijn and van Dijk, 2001; Cissé et al., 2005). As a political and legal regulatory system, the Dina determined access to natural resources by herders, farmers and fisher-folks who lived in the delta. The territory was divided into administrative units (*leydi*) where customary leaders managed land, water, and pastures. Elders in patrilineage councils (*suudu baaba*) selected 'pasture masters' (*dioros*) who regulated schedules and itineraries for transhumance and coordinated access to the bourgoutières controlled by their lineage. Lineage members and clients had free access to those pastures according to a schedule based on seniority, while outsiders paid grazing fees that the *dioros* collected.

Today, about half of the herds that graze in the floodplain still pay fees, which vary according to herd size, area grazed, and pasture quantity and quality. The promise of monetary gain from collecting grazing fees has led to a proliferation of self-appointed *dioros* who compete with one another and sometimes even those within their own lineage (Cissé et al., 2002). This situation has prevented *dioros* from speaking with a common voice vis-à-vis the state and other stakeholders and from engaging in coordinated landscape-wide efforts to manage pastoral resources.

In the early 20th century, the French colonial administration recognized the customary jurisdiction of *dioros* over the bourgoutières and of village chiefs over village land. At the same time, though, it declared all unused and unoccupied lands (*terres vacantes et sans maître*) state-owned lands, a statute retained by post-colonial governments (Kirk, 2004). Lands under production or 'use' were recognized as 'individual' lands. 'Use' (*mise-en-valeur*) was defined as agricultural exploitation, and provided a strong incentive for farmers to clear fields to secure land rights (Brock et al., 2002; Keita, 2003). This trend was further encouraged by policies promoting cash crops (Brock et al., 2002). Government and donor support for water management infrastructure also led to a large increase of flood-fed rice cultivation in the delta, as in the Casier du Syn, which lies west of Madiama and is exploited by some of its residents (CARE, 2003). Fraught with contradictions between individual and collective rights over land and water, some of these schemes became a theatre of violent confrontations (Glenzer, 2003).

The shift from autocratic regimes to more democratic forms of governance in the early 1990s led to a diminished role of the state in NRM. Decentralization policies made Rural Communes responsible for managing natural resources within their territories and allowed them to levy taxes on them to support such functions. The central state, though, retained control of the more lucrative revenue-

producing resources, such as gazetted forests (Agrawal and Ribot, 1999; Konaté, 2003; Kassibo, 2004). As a result, most rural Communes are unable to generate the resources needed to meet their new responsibilities. Government financing can be obtained by individual Communes for infrastructural development (i.e. schools, health posts) but not for environmental management, such as the restoration of cattle corridors and watering points.

Several years after the decentralization reform was launched, the definition of Commune boundaries and jurisdictions remains a highly controversial and often unresolved issue. Decentralization did not establish mechanisms for inter-Communal coordination that are critical for the implementation and scaling up of NRM interventions including those with carbon sequestration potential. It also failed to resolve how customary areas and authorities were to be subsumed into the new local governance system. Hence, some villages were incorporated into a Commune but part of their land, over which they held customary rights, fell into another Commune where they had no electoral representation.

Decentralization freed Communes from administrative oversight by district and regional authorities but not from the guardianship, or 'tutelle' of the central state. Land use decisions continue to require the mediation of the state in multi-stakeholder consultations (*Conférence des Bourgoutières*) organized at district and regional levels to decide, for instance, when transhumant herds are allowed into the floodplain pastures. Deliberations are moderated by the *Préfet* and informed by technical reports on the state of crops, pastures, livestock health, and water sources by the Ministry of Agriculture (SLACAER, 2003). At the same time, however, the process is far less clear-cut and coordinated and dates and other agreements are often disregarded (SLACAER, 2003), with local chiefs and Mayors overriding the official decisions.

Decentralization has not clarified the role of pastoralists in natural resource management. The concern that devolution of NRM authority to territorially based Commune Councils would favor farmers at the expense of pastoralists (Benjaminsen, 1997; Hesse and Trench, 2000) led to the promulgation of a Pastoral Code in 2001 (République du Mali, Loi n. 01/004). The Pastoral Code represents a significant step forward with respect to previous legislation in that it recognizes the role of pastoralism in national development, the importance of mobility in pastoralist livelihoods, and the pressure that agriculture is placing on pastoral resources (Hesse, 2001; Konaté, 2003).

The Code, however, is not devoid of ambiguities in its provisions. The Pastoral Code envisions Communes to take responsibility for managing pastoral resources that fall within their boundaries, such as pasturelands, cattle corridors, campsites, and watering points. Yet, as the Code does not clearly define whether Communities control the bourgoutières and their substantial revenue potential, those resources remain controlled by the *dioros*. Lacking the formal titles required by the current Land Tenure Code (*Code*

Foncier et Domanial) to be recognized as the private property of the lineage, the *bourgoutières* are, in principle, public domain. As such, they fall within the Communes' jurisdiction and can be taxed, with the proceeds going to the Communes rather than to the *dioros* (Hesse, 2001; Konaté, 2003). The situation has exacerbated tensions between *dioros*, village chiefs, and Commune officials (Cissé et al., 2002). The fact that, despite efforts to involve pastoralist representatives in drafting the Code (Konaté, 2003), its provisions remain unknown or unintelligible to both pastoralists and the general population contributes to a climate of anxiety and mistrust. The text of the Code itself is difficult to obtain, even for government officials and technical services (Hesse, 2001; Moseley et al., 2002; Buhlman and Maiga, 2003). Yet, since the Code was only formulated as a general directive (*loi d'orientation*), it will be mostly up to them to interpret and implement its regulations (Winter, 2000). At the time of the research (March 2004), the Code still lacked the required implementation decree (*décret d'application*) by the Council of Ministers that would make it enforceable (still pending by the end of 2006). Pastoral leaders regarded this state of affairs as evidence of lack of political will to take a stance in favor of pastoral interests by legislators voted into office by farming constituencies.

This lack of clarity and consistency among legislative provisions creates a fertile ground for a proliferation of conflicts. A recent study of court records showed that most conflicts that occurred in Madiama in the 1990s involved farmers and pastoralists and consisted of disputes over property rights (Kodio, 2002). However, the courts remain the last resort, as most people prefer resolving disputes outside the formal justice system, which is cumbersome and expensive (Vedeld, 2000; Kodio, 2002; Cissé et al., 2002; Buhlman and Maiga, 2003). Most conflicts are still resolved by the arbitration of local leaders (*dioros*, chiefs, elders, imams), even though their authority has waned after decades of colonial and post-colonial efforts to thwart or co-opt their power (van Dijk and de Bruijn, 1995; Bingen, 2000; Vedeld, 2000). Where they existed, traditional institutions responsible for environmental management and conflict mediation, such as the *alamodiou* and *ogokana* societies among the Dogon, have also been destabilized as the management of natural resources and conflicts was shifted to the organs of the state (Konaté, 2003; Diakite and Diallo, 2004; Kassibo, 2004).

With decentralization, Mayors have replaced government authorities (*Préfets*) as official arbiters of disputes (*Officiers de Police Judiciaire*). But mayors of rural Communes are not always able to see through the maze of codes and laws relative to land tenure and natural resources (Konaté, 2003). To assist them in these functions, some Communes, often with external support, formed NRM and conflict management committees comprised of local and religious leaders and civil society representatives (Bocoum et al., 2003; Buhlman and Maiga, 2003; Hamilton and Dama, 2003). Among them was Madiama, where the

SANREM CRSP program endeavored to build technical capacity and social capital to support sustainable NRM, including carbon sequestering technologies (Moore and Cissé, 2005).

The policy and institutional ambiguities discussed in this section will likely hinder the adoption of sustainable natural resource management approaches at a landscape-level and among all resource users. The next section examines in detail an actual case of implementation of a pastureland management technology with carbon sequestration potential.

4. A case study

4.1. The SANREM CRSP sustainable pasture management experiment

The experiment aimed to test whether grazing and animal impact could contribute to improved pasture health and soil carbon sequestration. Inspired by the Holistic Management™ model developed by Alan Savory, the approach centered on the segmentation of pasture areas into plots to be grazed in timed succession. The decision relative to the appropriate time for the herd to move on to the next plot is triggered by empirical assessment of the potential for pasture regeneration rather than on a pre-determined schedule based on carrying capacity estimates (Savory, 1999; Bingham, 2005). Animals are moved off a plot before plants begin to re-grow, and return there only after re-growth is complete. The focus is on minimizing overgrazing while maximizing animal impact, including nutrients deposited in dung and urine and the effect of animal hoofs, as they break up the soil surface to allow aeration and infiltration (Savory, 1999). Pilot projects implemented in west and central Africa (Senegal and Chad) and southern Africa (Zimbabwe, South Africa) indicate that the Holistic Management™ approach has potential for increasing overall biomass and species diversity (Bingham, 2002. A short history of the West African Pilot Pastoral Program (1993–2002). Unpublished Report to the World Bank). Experiments in Sahelian rangeland also show that, contrary to conventional wisdom, frequent clipping does not reduce the production of annual grasses (Hiernaux and Turner, 1996).

Another significant difference between Holistic Management™ and conventional rotational grazing schemes is that the former moves beyond purely proposing a technical intervention, and integrates capacity building efforts to enable communities to manage the system. In Madiama, the key institutional mechanism implemented for capacity building was a Commune-level committee, the *Comité Communal de Gestion des Ressources Naturelles* (CCGRN), which was created by the SANREM CRSP with the mandate to mediate between community concerns and research activities and to advise the Mayor and Commune Council on NRM issues (Moore et al., 2005). *Comités Villageois de Gestion des Ressources Naturelles* (CVGRN) were also

established to mobilize village participation. These replicated a model tested by the World Bank-funded *Projet de Gestion des Ressources Naturelles* (PGRN), which was implemented in some of the Commune's villages in the 1990s with the goal of building community capacity to manage natural resources (Maiga, 1999). The SANREM CRSP organized training for CCGRN members and Commune leaders in the technical aspects of Holistic Management™ as well as in literacy and numeracy, financial management, conflict mediation, and environmental legislation. The CCGRN facilitated the design of a grazing plan and training of village-based monitors. The latter were appointed by the village chiefs and trained in managing the planned grazing system, with the task of overseeing the grazing schedule and ensuring compliance by herders.

The site selection process reflected some of the tensions that strain land use relations in the area. In some villages, leaders opposed participation fearing that the project would limit field expansion or catalyze conflicts over territory. Nerekoro, the Peul village which accounts for a much higher number of livestock than other villages in the Commune (about 1700 cattle compared to an average of less than 400) did not participate because of boundary disputes between its territory and Madiama village, the politically dominant administrative seat of the Commune. In the end, two pastures of about 100 hectares each were made available by the villages of Siragourou and Torokoro, which comprise a majority of *Bamanan*-speaking farmers and a minority of Peul agro-pastoralists. Those villages have little livestock of their own but their territories are crossed by important cattle trails. The chosen pasture sites were, however, far from optimal, particularly in Siragourou where pasture was quite degraded: 63% of the area was bare soil and only 36% was covered by vegetation (Ballo et al., 2004). The Torokoro pasture was in better condition, since it occupied part of a PGRN protected site, where cultivation and woodcutting had been banned for over ten years: 53% of the area was covered by vegetation and 12% by litter, and 35% was bare soil (Ballo et al., 2004). Carrying capacity was estimated at 3.5 ha/TLU/yr for Siragourou and 8 ha/TLU/yr for Torokoro (Ballo et al., 2004).

During the two years of implementation it became clear that, while the pastures could certainly be improved by animal impact, there were limitations to the numbers of animals they could support, particularly during dry periods when there was little grass to graze. For instance, because of the severe drought that affected the area in 2002, implementation of the grazing plan only started in the 2003 rainy season. The communities continued practicing the rotations well beyond the end of the project in 2004, but they did so only during the rainy season, as there was not enough fodder during the rest of the year. But since only oxen and milk cows remained in the Commune during the growing season, animal impact was far less than originally envisioned. Difficulties in accessing watering points also limited the full exploitation of the pastures by live-

stock. Nearby ponds dry up after two or three months into the dry season, after which animals must walk several kilometers into the territory of another Commune to get water. At the Siragourou site, livestock could not reach water points without crossing plots that were delimited for regeneration or fields where crops would be growing. Overall, the sites received significant animal impact (up to 4–5 herds of about 100 cattle each) only during the few weeks, in November–December, when herds crossed the Commune on their way to the delta. But some herders avoided them for fear of being accused of damaging crops, particularly in Siragourou site which was surrounded by fields.

Besides the specific patterns of land use and livestock movements, animal impact was also limited by the imposition of research concerns on project design. Thus, cattle were prohibited from spending the night on the pastures because, if unsupervised, they could wander from the designated plot into others. This rule aimed to maximize controlled conditions but contradicted local experience that corralling livestock overnight improves land quality and vegetative cover and was, therefore, often contravened. The research agenda equally constrained the flexibility of the grazing plan, which is an essential feature of the Holistic Management™ model. The regeneration potential of the system hinges on the environmental monitors' ability to make rapid adjustments to the rotation plan based on their assessment of the pastures. An initial rotation schedule was devised in the course of trainings based on herders' assessment of recovery time for pastures during an average year. It prescribed for each plot to be grazed for 12 days during the dry season and 4–6 days during the rainy season. But, while monitors were able to recognize signs of overgrazing and regeneration, they rarely modified the prescribed schedule. If pasture in one plot was exhausted before the allotted grazing period was over, animals were sent to graze outside the pasture (where, indeed, overgrazing was occurring). When monitors did make changes, they remained unsure as to whether they had the power to do so or whether they had consulted the right authority (i.e. the village chief or the CCGRN). In sum, they saw their roles more as enforcers of rules made by others than as actors empowered to make decisions.

The fact that the experiment was conducted in the context of a research agenda, which included soil sampling in the sites, fostered the perception that the planned grazing system was for another type of farm trial and hence modifications to the grazing plan had to be approved by the scientists. This impression might have been also shaped by Madiama's history as a site of conventional research and extension by IER and other organizations. The SANREM CRSP sought to promote a participatory model of research and the planned grazing activity addressed community priorities that had been elicited in the course of a participatory rural appraisal (Earl and Kodio, 2005). Yet the pressures imposed by the project's short timeframe meant that the initiative was launched before gaining full grasp of the seasonal fluctuations in resource availability and livestock

management and before establishing the conditions for full involvement of local communities.

4.2. The CCGRN as bridge between communities and Commune

Beyond the confounding role unwittingly played by the research agenda, the question of who had the authority to make decisions about pasture management in the sites was rooted in the failure to reconcile Commune structures and village-level institutions.

In some ways, the CCGRN reflected the pre-decentralization state of affairs. It reaffirmed the relevance of local communities and customary authorities, both of which had no administrative or political role in decentralized governance. The composition of the elected Commune Council was determined by party-based electoral lists, regardless of village representation. In contrast, the CCGRN membership included delegates from each village in the Commune, Village chiefs and local leaders appointed the members of the CVGRN, which made up the General Assembly from which the 18 CCGRN members were selected, as well as the monitors for the pasture experiment. Linkage to customary authorities gave the CCGRN some legitimacy at village level, which it used to mobilize local support and enforce agreements, but it also entangled the CCGRN in established power relations. For instance, its membership reflected the dominance of Madiama village, the administrative seat of the Commune. Members of Madiama's four prominent families made up one third of the CCGRN, while other villages were represented by only one or two members each.

Despite the project's efforts to protect pastoralists' interests, resident farmers dominated the CCGRN (and all other Commune-level structures). The only two Peul on the committee were individuals of relatively low status, a woman and an unmarried young man. The latter was a returned migrant who had been appointed by virtue of his literacy but had little clout in the pastoralist community. He was the only pastoralist on the sub-committee that oversaw the planned grazing, while all environmental monitors were *Bamanan*-speaking farmers. Not surprisingly, neither the grazing plan nor the pasture monitoring incorporated the pastoralists' traditional knowledge, even though such knowledge was found to be well in tune with Holistic ManagementTM principles (Jost, 2003). On the other hand, the project enforced a minimum quota of women in the CCGRN make up, but, as experience in participatory development shows, numerical representation does not always translate into equitable distribution of power (Cornwall, 2000). The women who were appointed to the CCGRN were not the most active and assertive in their communities and had little say in decision-making, given that CCGRN dealt with issues that were generally perceived to be men's domain.

Paradoxically, the CCGRN also situated itself in the framework of decentralization and the Commune's new

functions. It sought to seize the opportunities for civil society participation in local governance and to serve as a catalyst for interaction among researchers, technical services, elected officials, and local populations on NRM issues. Its mission was endorsed by the Mayor and its status as a civil society organization was legally recognized by deliberation of the *Préfet* in Djenné. Formalization at district level enabled it to be delegated certain responsibilities by the Commune, such as the organization of a campaign to implement a government ban on cutting *balanzan* (*Acacia albida*) trees.

Despite these efforts to establish its legitimacy, the CCGRN's role vis-à-vis the Commune remained ambiguous. The CCGRN's functions somewhat overlapped with those of the Commune Council's own NRM committee but understanding of its role by the general population remained low. The CCGRN Strategic Plan, formulated with CARE's and SANREM's technical assistance, did not inform the official Development Plan of the Commune (which served to leverage funds for local development projects). It was also unclear whether the CCGRN or even the Commune were legally authorized to enforce the grazing plan and collect fines on transgressions such as cutting tree branches for fodder or wood in the pasture sites. Even after decentralization, imposing sanctions remained a prerogative of the state (*Service pour la Conservation de la Nature*), although NRM enforcement is increasingly being devolved to communities by means of formal agreements (Hilhorst and Coulibaly, 1999; Hesse and Trench, 2000; Bocoum et al., 2003; PAVD, 2003; Diakite and Diallo, 2004; Kasibo, 2004). But since the CCGRN did not pursue legalization at national level, which would have entailed a lengthy and rigorous review and financial auditing, it lacked the juridical standing required to enter such agreements.

The CCGRN's poor articulation with external institutions limited its potential for expanding the geographic scope of the project. Pastoralist organizations, such as the Nerekoro herder association and the *Fakalagyal* livestock cooperative, which covered the old administrative unit (*arrondissement*) where Madiama is located, were not invited to partake in the pasture experiments. This was a missed opportunity because the leader of one of these associations, who was a member of the Commune Council of Madiama, was elected Vice President of the District Council of Djenné, and could have used his position to promote widely the pasture management approach tested in Madiama.

Supra-local pastoral institutions, such as the Djenné-based Livestock Traders Cooperative and the Union of Herders Cooperatives could have played key roles by virtue of their leaders' links with old order elites and new elected officials (i.e. Chamber of Agriculture, Reconciliation Commission, and District Council), but they were neither involved nor informed. Other significant stakeholders at district and regional levels, including environmental management and institutional capacity building projects (*Centres de Conseil Comunal*, the *Projet d'Appui au Communes*

Rurales de Mopti, and the *Projet d'Appui des Volontaires des Nations Unies à la Décentralization*), were likewise unaware of the SANREM CRSP experience in Madiama. They remained so even after an end-of-project workshop was held in Djenné in February 2004, to which they were not invited. This oversight resulted from the decentralization's emphasis on Commune autonomy, which led workshop organizers to envision 'scaling up' as an incremental process of technology transfer radiating out to neighboring Communes rather than a multi-hierarchical effort at landscape level. In line with this vision, participation of the Mayors and chiefs from neighboring Commune was prioritized over that of supra-local agencies and projects. Yet, backing by pastoral leadership and higher-level stakeholders would have been essential, not only for scaling up carbon sequestration technologies, but also for shoring up the CCGRN's capacity as a platform for consultation and conflict management.

5. Implications for C sequestration in pasturelands

The implementation difficulties faced by the CCGRN in Madiama do not necessarily invalidate the potential of the overall approach. Nor were they unique to the SANREM CRSP case. The PGRN ran into similar difficulties in mobilizing local communities (Maiga, 1999) and in ensuring meaningful participation by women (Hamilton and Dama, 2003) and of transhumant pastoralists (Bocoum et al., 2003). Other community-based NRM projects faced ambiguities relative to the official structures of the Commune (Buhlman and Maiga, 2003; Hamilton and Dama, 2003). With respect to these NGO-led efforts, the SANREM CRSP pasture management experiment added the challenge of combining participatory NRM with scientific research.

The pasture management experiment in Madiama showed that improving pasture quality and soil carbon sequestration is technically possible (Badini et al., in this volume). The potential will likely be greater if the design and implementation of similar carbon sequestration projects is informed by a good understanding of past and current land and livestock management practices, local ecology and social dynamics. The pasture management experience in Madiama makes a strong case for the importance of taking the time to gain a good grasp of those issues and to engage in adaptive management of changing conditions. For instance, the environmental monitoring system that regulates rotational grazing could have benefited from a much better integration of pastoralists' fine-tuned knowledge of pasture quality and livestock behavior. The grazing plan could have benefited from a more flexible experimental design that took into account seasonal and inter-annual fluctuations in the quantity and quality of pastoral resources. Likewise, the institutional capacity building efforts could have benefited from an analysis of the successes and failures of other community-based NRM initiatives, as well as a critical examination of the social tensions

and exclusions that were catalyzed by the project while promoting participation.

At the same time, the key to a improved natural resource management and carbon sequestration lies in the capacity to address the institutional challenges that the SANREM CRSP confronted in Madiama. Central to this effort is the need to reconcile diverse and even conflicting agendas among decision-making agents at multiple levels, including local producers, customary leaders, elected representatives, government officials, and scientists. These contradictions often result in social unrest and tension. Some tension reflects the precarious balance between the needs of pastoral and crop production in the context of mounting pressure on natural resources and greater variability of climate conditions (Brock et al., 2002). The cross-cutting nature of stakeholders' interests, which cannot be reduced to finite and self-contained categories (i.e. pastoralists vs. farmers) also creates tension. Finally, tensions result from the internal social heterogeneity of producer groups. It must be noted, for instance, that pastoralist organizations do not necessarily represent all pastoralists (for example, to be eligible for membership in the Djenné Herders Cooperative one must own at least 100 cattle). Like other range management projects in the region, pastoral organizations can operate in ways that perpetuate social inequalities among pastoralists (Douma and de Haan, 1999; van Dijk and de Bruijn, 1995).

Another set of challenges stems from the uneven incorporation of local communities and territories into larger forms of government, from pre-colonial dominions to the central state (Chaveau, 2003; Wily, 2003; Cotula et al., 2004). The legacy of this history is full of inconsistent, sometimes incompatible, resource-tenure regimes and regulations, which exacerbates the contested nature of land use in the delta region. This is not simply a by-product of the superimposition of one formal legal framework over one set of shared traditions. Rather, it results from the incorporation of a vast array of customary claims over different types and units of resources into layers of sundry sectoral codes imposed by the state.

Decentralization, with its goal of empowerment and participation, adds another level of complexity. It is widely recognized that the plurality and fluidity of traditional institutional arrangements can offer advantages in adapting to situations where uncertainty and variability prevail, such as those facing pastoralists of north-central Mali (van der Brink et al., 1995; Metha et al., 1999; Turner, 1999; Meinen-Dick and Pradhan, 2002). But with growing competition for resources and an increasingly skewed distribution of power, legal pluralism can become problematic, especially if institutional mechanisms for stakeholder negotiation, conflict mediation, and recourse are weak or inexistent (Peters, 2004; Ribot, 2004).

The challenges outlined above indicate that more than technology will be needed to harness the benefits of carbon sequestration. Institutional innovation, such as the CCGRN, will be required, particularly in situations of

policy change and legal ambiguity caused by coupled with the erosion of customary NRM institutions and the withdrawal of the central state (Kirk, 2004). The goal will be to ground the work within the emerging framework of decentralization, while also reaffirming the enduring significance of communities and customary systems for resource management. It will involve promoting meaningful representation of disadvantaged groups but engaging, as well, more powerful and better connected groups and institutions. It will demand attention to the technical competence among producer groups, but also to the need for institutional capacity building in key areas, such as environmental legislation, conflict management, and coalition building.

A considerable challenge will be to reconcile diverse objectives (scientific research, community participation, environmental conservation, or livelihood security) and integrate them in ways that enable project participants to capitalize on common goals and optimize efforts and resources. Conflicting objectives were not unique to the SANREM CRSP but have beset other community carbon sequestration projects (Asquith et al., 2002). In Madiama, the resulting ambiguity confounded the allocation of authority and accountability, so that it was never clear who could make what decision and who was responsible for what outcome. In common property regimes this uncertainty may lead to less than optimal management decisions that add pressure on surrounding resources, resulting in 'leakage' of carbon offsets (Smith et al., 2000; Richards and Andersson, 2001; Smith and Scherr, 2003).

The SANREM CRSP experience points to the need for community-based carbon sequestration projects to establish linkages with supra-local actors and networks from the onset. Given the variability of resource uses and the mobility of resource users in the region, sustainable pasture management will require landscape scale interventions. Such an approach will call for the integration of Commune level initiatives, such as the Madiama grazing plan and related institutional innovations, with other NRM efforts in the region and with decisions at higher levels of governance. The ability to articulate effectively with higher levels of organization and representation will enable local communities not only to aggregate carbon offsets but also to negotiate better terms in international carbon trading.

The insights that emerged from this case study dovetail with key lessons from analyses of collective action and common property resource management (Ostrom et al., 1999; Stein and Edwards, 1999; Beck and Nesmith, 2000; Campbell and Shackleton, 2001; Ravnborg and Westermann, 2002; Schusler et al., 2002). Civil society participation in NRM management and leadership is being encouraged by donors and development practitioners (Katon et al., 2001). Yet, while participation and leadership are prerequisites, they are not panacea. Civil society organizations can still serve exclusionary interests and may lack downward accountability (Ribot, 2004). The cre-

ation of new fora for consultation and negotiation may be needed in cases where entrenched interests control local institutions, but single-purpose structures are not likely to be sustained beyond projects (Ribot, 2004).

The critical supportive role of organizations "external" to local communities cannot be underestimated. Although decentralization is redefining the role of state in NRM, central governments have still a role to play in defining and enforcing legislation, enacting enabling policies, and upholding the interests of disadvantaged users and of future generations (Katon et al., 2001). Also, research and development agencies can make invaluable contributions by identifying and promoting effective management strategies, by devising low-cost user-friendly methods for monitoring and accounting, and by strengthening institutional capacity and participatory processes. Ultimately, however, the potential benefits of carbon sequestration will be captured only if such efforts take into account the diverse and dynamic nature of local communities and the interlocking system of social, political, and economic forces and relations in which they are embedded.

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