# FARMER-HERDER CONFLICT, LAND REHABILITATION, AND CONFLICT PREVENTION IN THE SAHEL REGION OF WEST AFRICA

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ABSTRACT The increase in the human population has led to dramatic consequences in Sahelian countries, including food shortages, farmland expansion, and conflicts over land and natural resources. Currently, more farmers and herders in south-central Niger try to use the same land, making it very difficult for herders to find suitable grassland for grazing during the rainy season. Fulbe and Tuareg herders graze livestock on the barren plateau to avoid damaging crops, and the farmers plant millet on land with fertile soil. Particularly during harvest season, the relationship between farmers and herders deteriorates due to livestock-induced crop damage. Hausa elders and pastoral Fulbe or Tuareg individuals living in the village have engaged in negotiations to avoid direct confrontations between herders and farmers. The disputed issues involve whether crop damage was caused by cattle and, if so, whether it was intentional or the result of carelessness by the herdsman. Hausa society has set the rate of cash compensation for intentional crop damage at *ramuko* and that for crop damage attributable to carelessness at *bana*, which is half of *ramuko*. The rate applied in particular cases is determined by negotiations between farmers and herders. If negotiations are broken off, some herders or farmers may resort to violence, and the situation can escalate into murder.

This paper discusses an approach to land rehabilitation and conflict prevention used in south-central Niger, which involves using trash for land rehabilitation, in terms of the indigenous knowledge and daily practices of Hausa farmers. The author built two 50 × 50-m fenced plots with Hausa and Fulbe villagers and brought urban trash to the degraded land, which had been communal pastureland used by herders. Then, the author asked individuals to manage the fenced pastureland and to graze livestock inside of this land. This practice can be useful for preventing livestock-induced crop damage and conflict between farmers and herders.

Key Words: Livestock-induced crop damage; Hausa; Fulbe; Tuareg; Niger; Desertification; Indigenous ecological knowledge.

## INTRODUCTION

The Sahel countries have experienced rapid population growth. On an annual basis, the population of Senegal has increased by 2.4%, that of Mali by 3.3%, that of Burkina Faso by 2.8%, and that of Niger has increased by 3.7% (United Nations, 2010). At this rate, the population is estimated to double in 31 years in Senegal, 23 years in Mali, 27 years in Burkina Faso, and 20 years in Niger. Indeed, the growth rate in Niger is the third highest in the world. In 2010, its

population was 16 million, and the UN has estimated that this figure will increase to 30 million in 2030, with a population density of 30 to 80 people per $km^2$.

This rapid population increase, the lack of agricultural technology, and overgrazing are causing land degradation in the Sahel area (Ayatunde, 2000; Mortimore & Turner, 2005; Tschakert, 2007). Land degradation, or desertification, has led to crop failures, food shortages, malnutrition, and financial hardship for the Sahelian nations. The Sahel drought of 1972–1974 and the resulting resource crisis have been analyzed in terms of five dimensions: drought, poor food supply, inadequate livestock management, environmental degradation, and poor coping skills at the household level (Mortimore & Adams, 2001).

These population increases have had dramatic effects, leading to food shortages, farmland expansion, and conflicts over land and natural resources. The use of land for cultivation has expanded at the expense of its use for other purposes, a trend that cannot be justified in terms of a gradual expansion of cultivation to increasingly marginal land that is less suitable for cultivation due to its biophysical properties or its distant location (Reenberg et al., 1998). Farmers in Sahel claim that the ratio of cultivated to fallow fields has increased between the mid-1980s and the present, and the fallow periods are too brief to allow for the recovery of sufficient fertility, a problem that has not escaped the attention of farmers (Wezel & Haigis, 2002).

Although West African herders and farmers have long coexisted in symbiotic relationships that have persisted through both peaceful and contentious encounters, reports of violent clashes between these two groups are becoming more frequent (Moritz, 2010). A better understanding of these conflicts in West Africa is urgently needed, as they are likely to increase and become violent (Hussein et al., 1999; Turner et al., 2011). Two causes of farmer-herder conflict have been cited: competition for access to increasingly scarce productive resources and the failure of the local adjudicative mechanisms (traditional institutions) to resolve the tensions created by this competition (Hussein et al., 1999).

Farmers and pastoral people are increasingly trying to make use of the same land. The demand of cities for crops and meat induces many producers to maintain large herds and to expand farmland. The availability of road transportation enables delivery of even fragile resources to remote markets and locations that are difficult to reach (Blench, 1996). Livestock are increasingly owned by either farmers or urban-based investors, with both groups having little knowledge or cultural pride in livestock husbandry. Sahelian grasslands are very sensitive to persistently high grazing pressure. The reduced herd mobility associated with the reduction in the quantity and quality of the labor used for herding is likely to have environmental repercussions (Turner, 1999). The quest for greener pastures by herdsmen usually brings them in contact with the sedentary population who are involved in crop production. In most cases, this contact results in an invasion of the farmland worked by the sedentary group, and the ensuing conflicts are often violent and long lasting (Obioha, 2008).

Conflict management is a growing and increasingly sophisticated theoretical and practical domain, and it would behoove rural development practitioners to

draw on this expertise (e.g., Cousins, 1996). Five phases of conflict have been identified: conflict formation, conflict escalation, conflict endurance, conflict improvement, and conflict transformation. These phases suggest that different approaches involving different processes and procedures should be used to deal with different situations. The author attempted to prevent conflict between farmers and herders based on an understanding of local institutions and farmer-herder relationships. This paper aims to elucidate the conflicts between farmers and herders over land use, especially those related to livestock-induced crop damage, and to introduce a land-rehabilitation plan for regreening pastureland, enhancing the livelihood of the people, and preventing conflict in south-central Niger in the Sahel region of West Africa.

## RESEARCH AREA

The research area was X village, Dogondoutchi region, Department of Dosso, Republic of Niger (Fig. 1). This village is located 7 km from the town of Dogondoutchi, which is the center of administrative and economic activities. The altitude of the village is 240 m, and it had a population of 280 individuals in 41 households in 2000 and 390 individuals in 60 households in 2010. Hausa farmers constitute the main ethnic group. Herders occupy three households (two

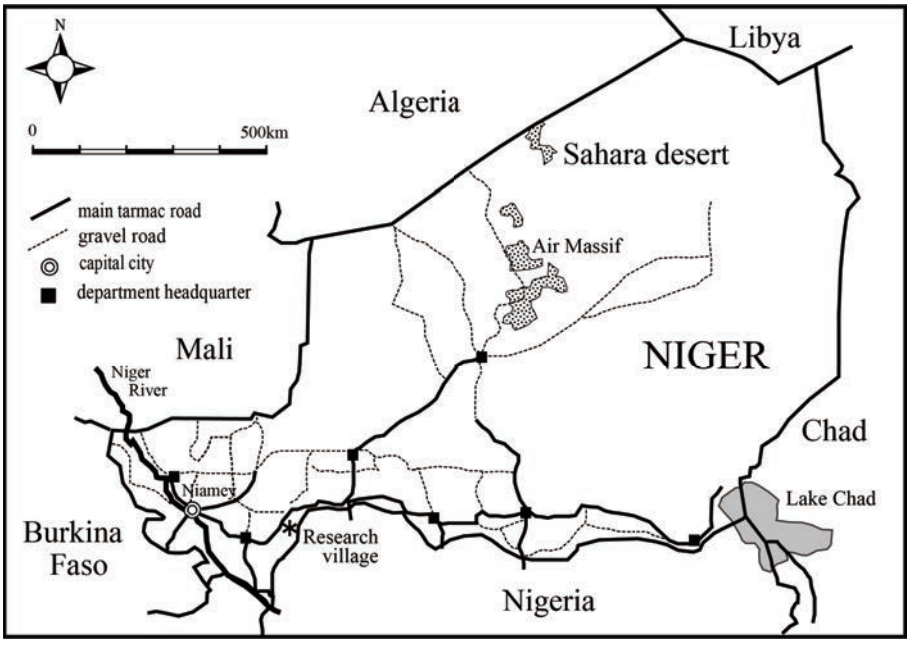


**Fig. 1.** Research area

Fulbe and one Tuareg). I have been visiting this village for academic research since 2000.

We measured rainfall, temperature, and wind starting in November 2002. The Intertropical Convergence Zone (ITCZ) moves northward from June to September, bringing rain to the Sahel region. At times, heavy rain has caused flooding in various areas of the Sahel region. The rainy season in the research area is short, consisting of three to four months during the period of June to September (Fig. 2). The national meteorological station in Dogondoutchi started taking measurements in 1923, and the average annual precipitation the last 30 years was 446 mm.

The dry season lasts for the eight months from October to May. The maximum temperature usually exceeds 35°C from October to November and from February to May. The minimum temperature is below 20°C in the morning and increases rapidly immediately after sunrise. Thus, the daily temperature varies substantially.

Wadis (seasonal drainages) flow from east to west at the north and south sides of the village. Water flows immediately after rainfall. According to metrological measurements, the village is sometimes exposed to violent winds, stronger than 20 m/s, immediately before rainfall. When the wind speed exceeds 10 m/s, it blows east, east-northeast, and southeast. During the dry season, a dry-hot wind,

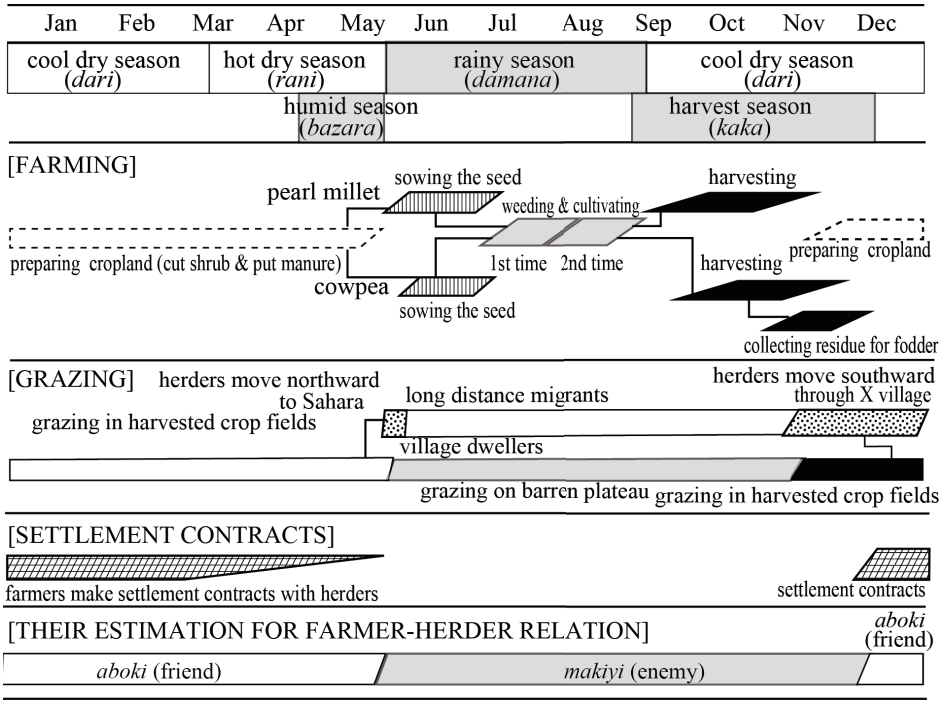


**Fig. 2.** Crop and livestock calendar

known as Harmattan, blows eastward, creating a cloud of sand dust blowing toward the east.

The soil in the research area consists of Arenosols (Food and Agriculture Organization of the United Nations & United Nations Educational, Scientific and Cultural Organization, 1971) and is sandy, with poor organic materials, organic nitrogen, and phosphoric acid. This soil is distributed over a wide area of central Mali, southern Niger, and northern Chad.

In terms of village life, the Hausa people farm pearl millet and cowpeas during the rainy season and raise cattle, horses, goats, sheep, and donkeys as supplementary subsistence activities. When they face food shortages, they sell their livestock at the market, which is 7 km from the village. Hausa villagers engage in various economic activities, serving as butchers, barbers, blacksmiths, shop owners, and so on. During long dry seasons, most Hausa men emigrate to domestic urban areas or to cities in neighboring Nigeria, Benin, Cote d'Ivoire, Mali, and Gabon to work in small businesses or private mines for cash income.

## SYMBIOTIC RELATIONSHIP BETWEEN FARMERS AND HERDERS

Hausa farmers sow pearl millet and cowpea seeds in the middle of June, and they weed from July to the middle of September (Fig. 2). They harvest millet between mid-September and the end of October. Hausa people talk about their relationships symbolically, "Fulbe are good friends (*aboki*) during the dry season, but become our enemies (*makiyi*) during the rainy season." Although access to farmland is strictly restricted to land owners during the rainy season, it is open for public use during the dry season. After the farmers finish harvesting all the crops, including cowpea leaves and millet stems for fodder, the herdsmen can use the farmland for grazing livestock during the dry season.

Historically, the sedentary farmers have established socioeconomic relationships with the nomads in the Sahel region for purposes of subsistence (Adamu, 1978; Baier, 1980; Oyama, 2002). There are two main ethnic groups of herders, the Fulbe and the Tuareg. The Fulbe usually graze cattle, goats, and sheep and live throughout the Sahel region, in Senegal, Mali, Niger, Chad, and Cameroon. The Tuareg are also herders, but they graze camels as well as goats and sheep. The farmers obtain milk and livestock products in exchange for crops, woven clothes, wooden and iron products, and weapons.

Hausa farmers and Fulbe herders have established a contract governing livestock grazing. After Fulbe herders lost their livestock during the severe droughts of 1972–73 and 1984–85, they began to live in Hausa villages to maintain their livelihood. Fulbe living in Hausa villages are known as *Fulani gari* in the Hausa language and *Fulbe shile* in the Fulbe language. Both *gari* and *shile* mean "village." The Hausa have entrusted their livestock to some pastoral Fulbe, who graze the farmers' livestock on a daily basis.

At the end of the rainy season, the pastoralists move southward from the Sahara Desert, passing through X village from November to January. Some of

these pastoralists are nomads who move their settlements throughout the year. These individuals are known as *Fulani daji* in the Hausa language and *Fulbe ra'de* in the Fulbe language. Both *daji* and *ra'de* mean "bush." The remaining pastoralists live in and graze livestock near the village. The fertile ground surrounding the village is covered with farmland, and it is very difficult for herders to find suitable grassland.

After the Hausa farmers finish harvesting crops, both types of herders, i.e., village Fulbe and bush Fulbe, seek to establish contracts with farmers to camp on their farmland for a few weeks to several months. As Ayantunde (2000) has reported, they stay in such camps during the night and graze their livestock around the camp during the day. The farmers provide substantial meals and pay bonuses after the contracts end. In this way, domestic animals provide excreta, which improve the fertility of the soil (Harris, 1999; Shinjo et al., 2008). As a result of this popular custom followed by the farmers and herders in Sahel region, herders receive millet and money from the farmers according to the number of livestock and the duration of the settlement.

## FARMER-HERDER CONFLICTS

Nowadays, it is very difficult for herders to find suitable grassland for grazing during the rainy season, as farmers cultivate millet on the land with fertile soil. Cattle want to eat the crops, but the herdsmen must prevent them from doing so. They pay the most attention to the cattle's grazing behavior during the rainy season to avoid conflict with the farmers. To avoid livestock-induced crop damage, Fulbe herdsmen graze the livestock on the barren plateau during the rainy season (Fig. 3).

A Fulbe herdsman, Mr. A of X village, cared for 27 cows, including two of his own, in 2011. Only 25 cows are owned by Hausa villagers, who contracted with Mr. A, who also owned 20 sheep and goats, to graze them. He and his sons grazed cows, sheep, and goats every day, and they were responsible for maintaining the health of the villagers' livestock.

Every June, at the beginning of the rainy season, Mr. A consulted the cow owners about two different types of grazing: long-distance grazing, which occurs near the Sahara Desert, and village grazing. Mr. A delegated authority for grazing the cows to a relative, who took the cows beyond the agricultural boundary to a location near the Sahara Desert. Although such long-distance grazing near the Sahara Desert offers access to good pastureland, it also involves risks related to robbery and potentially fatal illnesses. Farmers also cannot obtain milk from their cows during long-distance grazing. When cow owners choose village grazing, cattle are deprived of good pastureland, as there is a dramatic shortage of grassland near the village. However, they are able to monitor the health of their cows and obtain milk on a daily basis. Under these conditions, farmers kept half the morning milk and gave other half of the morning milk and all the evening milk to Mr. A.

**Fig. 3.** Livestock grazing on the barren plateau (August 2008)
It is very difficult for herders to find suitable grassland during the rainy season.

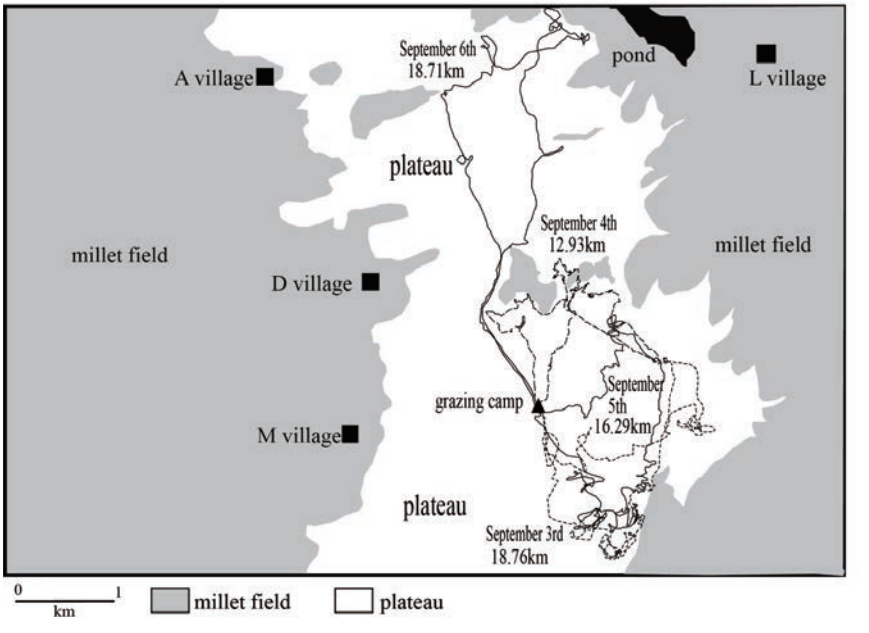


**Fig. 4.** Grazing routes of a Fulbe herdsman and his cattle herd during harvest season (four days: September 3 to 6, 2011)
The author asked Mr. A to carry a GPS (Garmin Etrex Legend HCx).

During the 1950s, farmland was sparsely distributed throughout the grassland. Both grassy and fallow land were abundant near the village, and herders used the grassland for grazing livestock throughout the year. Due to rapid population growth, the area covered with farmland has expanded, and the size of fallow areas has gradually decreased. In 2011, all the arable land was cultivated for millet farming. During the rainy season, especially the harvest season, herders must seek suitable grassland near farmland. Indeed, Mr. A walked 18.76 km on September 3, 12.93 km on September 4, 16.29 km on September 5, and 18.71 km on September 6 to graze livestock. He grazed cattle near the farmland, but the cattle did not enter the fields (Fig. 4).

Farmers are rude to herdsmen when they find cattle grazing near their farmland. Farmers have particular disdain for young herdsmen. Farmers harass Fulbe herdsmen, especially young men or boys, for grazing cattle near their farmland. Some farmers even throw stones at them, and the herders endure insults and harassment from Hausa farmers during the rainy season.

During the harvest season (*kaka* in the Hausa language), from the middle of September to the beginning of November, farmers create around 400 millet panicles, which they leave outside storage huts in the form of bundles (Fig. 5). At this time, the relationship between farmers and pastoral people becomes tense. During harvest season, the herdsmen graze the livestock at night to let them satisfy their hunger. At around 10:00 p.m., livestock herds start moving from the pastoral camp, and the herdsmen follow them toward the harvested millet

**Fig. 5.** Harvest season (November 2010)
Farmers placed millet bundles outside the storage huts. Tensions regarding livestock-induced crop damage increased.

fields. During such nighttime grazing, the herdsmen sometimes lose sight of their livestock in the darkness. The young Hausa farmers sleep near the millet bundles on their farmland to prevent crop damage by standing guard. Some farmers are ready to fight herdsmen entering the farm, and they carry knives, hatchets, swords, bows and arrows, slingshots, and muskets.

Case 1: Damage to harvested millet

On one night in November 2010, two Hausa friends visited my house and complained that the cattle of a Fulbe herder had eaten their crops, damaging 14 of the 20 bundles they had harvested. On the following day, however, a Fulbe individual insisted that the cattle had eaten only half a bundle, because Hausa young men had been watching the millet during the night. The accused Fulbe herder had already left the site.

One day after the crop damage, the male Hausa elders met to discuss the crop damage and interviewed only the victim, my Hausa friend. The Fulbe herdsman was not there because he had fled the village in fear of a Hausa attack. The elders decided that 14 bundles of millet had been damaged, and they ordered the Fulbe herdsman to provide compensation in the form of 50,000 CFA (100 USD) in cash. They informed the herder of their decision, giving him one week to comply. The herder sold his livestock to pay the compensation.

According to Fulbe herders, Hausa farmers have become poor because they lack sufficient farmland. They inherit small patches of farmland from their fathers and try to trick herdsmen into paying compensation for crop damage by intentionally placing millet bundles on the farmland and allowing the livestock to eat them. They then demand money from herdsmen as compensation.

In contrast, Hausa farmers emphasized the intentional nature of the damage inflicted by herders due to their livestock feeding strategies. According to the farmers, the herders have become malicious because they cannot use the farmland, which offer betters grazing, during the harvest season. Disputes between farmers and herders about whether crop damage is intentional or accidental have become very serious.

Case 2: Negotiations regarding cash compensation for crop damage

During the rainy season, when Hausa villagers find livestock without herdsmen on their farmland, they catch the livestock and bring them to the village. In October 2011, Mr. X captured 69 goats and sheep on his farmland.

Two days later, a Tuareg man, Mr. Y, came to the village to retrieve his livestock. Direct negotiations between pastoral people and Hausa farmers tend to escalate into heated arguments that sometimes result in murder. The Hausa elders and a Tuareg herder living in the village joined the negotiations regarding crop damage. In this case, the mediators heard explanations from both sides, i.e., the alleged victim, Mr. X, and the alleged perpetrator, Mr. Y. The victim requested 750 CFA per sheep or goat as crop damage, which is the usual rate, but the assailant begged for a reduction. A Tuareg mediator, Mr. Z, translated

Tuareg into Hausa and helped Mr. Y negotiate a lower compensation payment.

The mediators (*mai gyara*) are selected from among the parties' *suluhu*, the Hausa word for acquaintances, and the role of mediators is very important in achieving compromise and reconciliation (*gyara*). Although the Tuareg and Fulbe residents of the village did not know all the herdsmen, they tried to support the perpetrator, concluding that Mr. X had finished harvesting almost all his crops at the time of the incident and that the goats did not damage the crops. As a result, they reduced the compensation to 500 CFA (one USD) per sheep and goat. Finally, both Mr. X and Mr. Y. reached an agreement about the compensation.

In Hausa society, two rates are used to calculate the cash compensation for livestock-induced crop damage, *ramuko* and *bana*. *Ramuko* is used for cases in which livestock are followed by herdsmen and the crop damage is regarded as intentional. In such cases, the compensation rate is 4,000 CFA per head of cattle and 1,500 CFA per sheep or goat. The aforementioned livestock-induced damage to millet bundles that occurred during the harvest season was regarded as intentional, and compensation was at the *ramuko* rate.

In the other case, compensation was in the form of *bana*, as the livestock were not followed by herdsmen and the damage was apparently the result of carelessness. Indeed, animals walk around without herdsmen, especially at night. In this case, the compensation rate was half that of *ramuko*, 2,000 CFA per head of cattle and 750 CFA per sheep and goat. For example, the compensation for crop damage inflicted by 30 cattle in the case of *ramuko* would be 4,000 × 30 = 120,000 CFA (240 USD). The rate of compensation, *ramuko* or *bana*, is reviewed in meetings of Hausa and Fulbe chiefs and the elder Hausa village headmen every June before farmers sow seeds.

Disputes between farmers and herders about the appropriate compensation rate for livestock-induced crop damage often became heated, and village herdsmen act as mediators to avoid direct negotiations between farmers and herders. As the Fulbe and Tuareg herders cannot fully understand the Hausa language, the village herders serving as mediators also translate Hausa into the language spoken by the accused to explain the disputes. When no village herders are available, Tuareg villagers serve as mediators for Fulbe perpetrators, and Fulbe villagers act as mediators for Tuareg perpetrators.

According to village herders, it is very difficult to mediate disputes when the accused has fled the farmland. In such cases, the cash compensation requested by the farmer is granted, and the accused herders must pay this amount to the extent possible by selling their livestock or borrowing money from their relatives.

## LAND REHABILITATION TO CREATE PASTURELAND

The major cause of farmer-herder conflict is livestock-induced crop damage, especially during the rainy and harvest seasons. Moreover, the amount of crop

**Table 1.** Chemical properties of millet fields, degraded land, and urban trash

| | pH | Total | | C/N | Exch.Base cmol(+)/kg | | | P (mg/kg) |
|---|---|---|---|---|---|---|---|---|
| | $H_2O$ | N(%) | C(%) | | Na | K | Ca | |
| Rural Area | | | | | | | | |
| Pearl millet field | 6.4 | 0.01 | 0.12 | 12 | 0.01 | 0.04 | 0.4 | 8 |
| Degraded land | 4.4 | 0.01 | 0.09 | 9 | 0.02 | 0.12 | 0.2 | 7 |
| Urban Area | | | | | | | | |
| Urban trash | 7.4 | 0.17 | 2.27 | 13 | 0.75 | 0.31 | 37.4 | 365 |

Source: Oyama (2007).

damage has been increasing, and although no formal statistics of cases and conflicts are available, the author has observed crop damage in X village every year since 2010. Rapid population growth and farmland expansion have reduced the amount of suitable grassland available to herders, and competition over land resources between farmers and herders has intensified in densely populated regions.

In 2010, the author started a pilot project designed to prevent livestock-induced crop damage and farmer-herder conflicts. This project was based on the indigenous knowledge of Hausa farmers about regenerating degraded land. The Hausa people place trash from homesteads or urban areas on the farmland to improve soil conditions and crop yields (Oyama & Mammane, 2010; Oyama, 2012). It is believed that plastic bags, sandals, metal dishes, and pots are valuable anti-desertification methods. The urban trash contained 17 times the amount of nitrogen, 25 times the amount of carbon, 38 times the amount of sodium (Na), eight times the amount of potassium (K), nine times the amount of calcium (Ca), 46 times the amount of phosphate (P), compared with the most fertile farmland in the village, as well as a slight trace of alkaline (Table 1). The toxic content, including heavy metals, had already been analyzed in terms of EU environmental standards, and the author will present these results in subsequent papers. However, the urban trash collected from this land satisfied the EU standards.

Since 2003, the author has conducted repeated *in situ* experiments to examine the revegetation effects of urban trash input on the solid sedimentary layer of degraded land. This use of urban trash was based on the indigenous knowledge and daily practices of the Hausa people, and I intended to use this land-rehabilitation approach to prevent farmer-herder conflicts in the region. This section briefly introduces the results of the revegetation experiment and discusses the pilot project for conflict prevention in the Sahel region.

In August 2008, a 45-m (north to south) by 50-m (east to west) area was designated and enclosed with barbed wire to keep people and livestock out (Oyama, 2012). We divided this areas into five 4 × 30-m plots. All plant species in the enclosed spaces were identified, and the air-dried weight of each was measured. The cut plants were not returned to the plots, but were used as valuable livestock feed, as is the common practice with plant cuttings. For comparison, no trash was scattered on Plot 1. Plot 2 was scattered with 600 kg

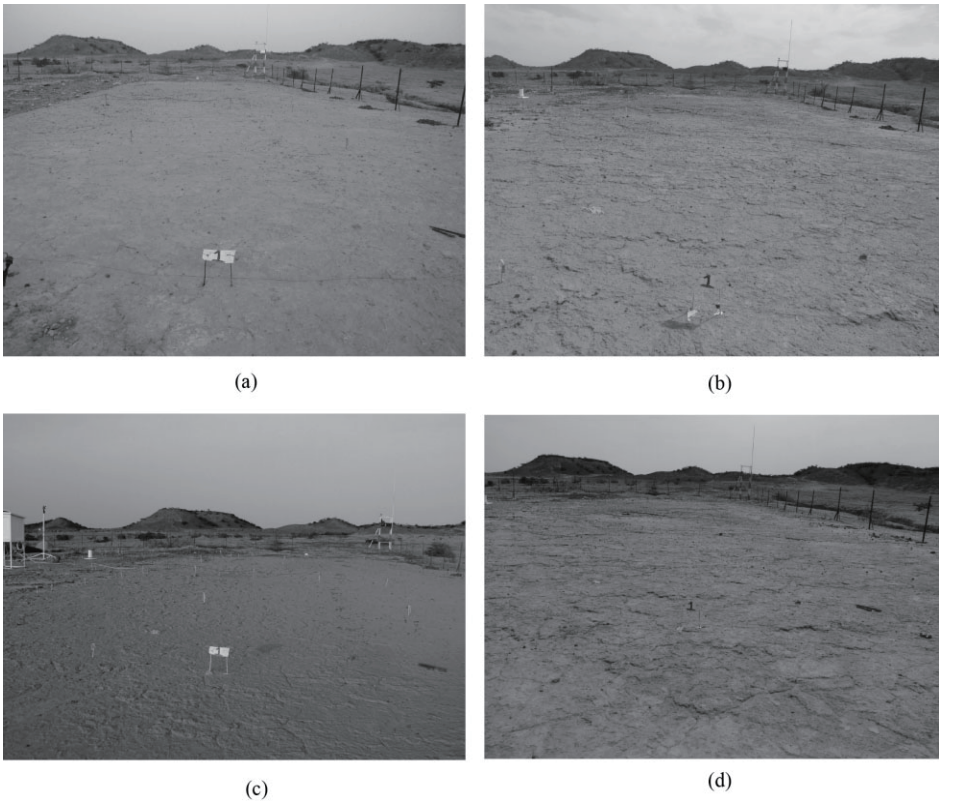


**Fig. 6.** Experimental plots for urban trash input (Plot 1) for 0 kg/m$^2$
(a) November 2008; (b) first year, November 2009; (c) second year, August 2010; and (d) third year, September 2011.

(5 kg/m$^2$) of urban trash, Plot 3 with 1,200 kg (10 kg/m$^2$), Plot 4 with 2,400 kg (20 kg/m$^2$), and Plot 5 was scattered with 5,400 kg (45 kg/m$^2$) of urban trash. The trash was brought by tractor from the town of Dogondoutchi, located 7 km from the village. The trash contained much sand, plant residue from livestock feed, livestock excreta, used plastic bags, old cloth and sandals, and broken pots and plates. To accurately consider the effect of such trash on land degradation, the author left the nonorganic matter in the trash.

After the trash was scattered, no planting was conducted in the plots so we could observe plants growth and soil changes. Plot 1, which had no trash input, showed neither visible changes nor plant growth over a three year period (Fig. 6). Plot 2 contained 16 plant species weighing 310 g (26 kg/ha) after one year, four plant species weighing 34 g (3 kg/ha) after two years, and no plant growth after three years. Plot 3 had 16 plant species weighing 4,003 g (334 kg/ha) after one year, 12 plant species weighing 1,002 g (84 kg/ha) after two years (an obvious reduction compared with the previous year), and three plant species

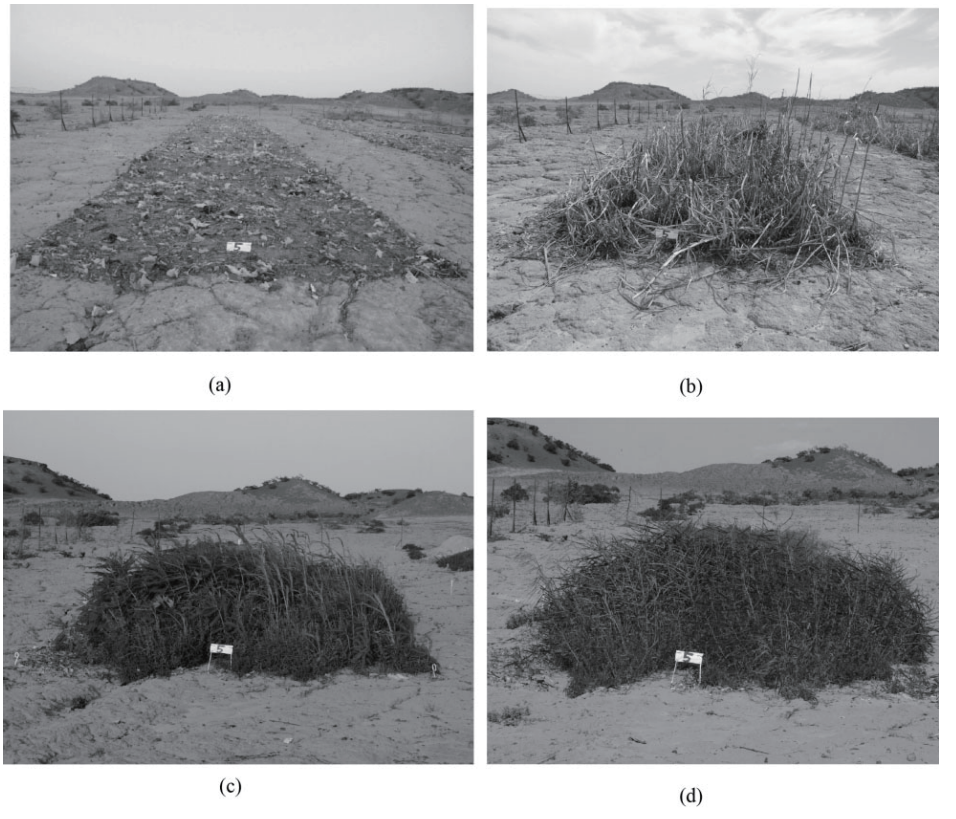


**Fig. 7.** Experimental plots for urban trash input (Plot 5) for 45 kg/m$^2$
(a) November 2008; (b) first year, November 2009; (c) second year, August 2010; and (d) third year, September 2011.

weighing 535 g (45 kg/ha) after three years. Plot 4 contained many plant species. After one year, the plot contained 35 species weighing 59,547 g (4,962 kg/ha); after two years, it had 17 plant species weighing 37,903 g (3,159 kg/ha); and after three years, it had 16 plant species weighing 15,674 g (1,306 kg/ha). Plot 5 contained 17 plant species weighing 43,847 g (3,654 kg/ha) after one year, 18 species weighing 10,800 g (900 kg/ha) after two years, and 13 plant species weighing 9,099 g (758 kg/ha) after three years (Fig. 7). According to the Fulbe herders and Hausa farmers, all the plants were suitable for use as livestock fodder (Table 2).

The idea of using urban trash for land rehabilitation was derived from the indigenous knowledge and daily practices of the Hausa farmers living in south-central Niger. Nowadays, they frequently carry trash to degraded land on their farms. When they notice a reduction in soil fertility, they either contract with the Fulbe and Tuareg herders to stay at their homestead so that their livestock excreta can improve their soil or they scatter trash onto their fields for the same

**Table 2.** Plant growth on Plot 5 (urban trash input 45 kg/m$^2$) Air dried weight: kg ha$^{-1}$

| No. | Plant species | Hausa name | Preference of livestock* | 1st year after | % | 2nd year after | % | 3rd year after | % |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *Pennisetum glaucum* | *hatsi* | ++ | 3496.42 | 95.7 | 64.58 | 7.2 | | |
| 2 | *Schizachyrium exile* | *kyasuwa* | ++ | 51.00 | 1.4 | 83.75 | 9.3 | 119.50 | 15.8 |
| 3 | *Borreria radiata, B. stachydea* | *kumuguduwa* | ++ | 38.08 | 1.0 | 128.50 | 14.3 | 197.92 | 26.1 |
| 4 | *Hibiscus sabdariffa* | *sure, yakuwa* | ++ | 35.58 | 1.0 | 79.58 | 8.8 | | |
| 5 | *Amaranthus* spp. | *rukubu* | ++ | 12.92 | 0.4 | 9.58 | 1.1 | 5.67 | 0.7 |
| 6 | *Cenchrus biflorus, C. prieurii* | *kalengia* | ++ | 6.50 | 0.2 | | | | |
| 7 | *Corchorus tridens* | *koku* | - | 2.50 | 0.1 | 0.67 | 0.1 | | |
| 8 | *Portulaca oleracea* | *halusin sa* | ++ | 2.25 | 0.1 | 42.08 | 4.7 | 50.67 | 6.7 |
| 9 | *Dactyloctenium aegyptiun* | *atuku* | ++ | 2.25 | 0.1 | | | 73.42 | 9.7 |
| 10 | *Cynodon dactylon* | *halkiya* | + | 1.50 | 0 | | | | |
| 11 | not identified | *masun katangare* | + | 1.42 | 0 | | | | |
| 12 | *Commelina forskalaei* | *balasa* | ++ | 1.25 | 0 | | | | |
| 13 | *Nothosaerva brachiata* | *ranje* | ++ | 0.67 | 0 | 12.50 | 1.4 | 0.42 | 0.1 |
| 14 | *Commelina benghalensis* | *balasa kura* | ++ | 0.58 | 0 | | | | |
| 15 | *Sida cordifolia* | *garmani* | ++ | 0.58 | 0 | | | | |
| 16 | not identified | *yare* | - | 0.25 | 0 | 4.83 | 0.5 | 84.42 | 11.1 |
| 17 | *Jacquemontia tamnifolia* | *kukumbara* | ++ | 0.17 | 0 | | | | |
| 18 | *Indigofera prieureana* | *kyamuro* | ++ | | | 370.83 | 41.2 | 211.08 | 27.8 |
| 19 | *Gynandropsis gynandra* | *ranje daji* | + | | | 22.92 | 2.5 | 1.92 | 0.3 |
| 20 | *Digitaria longiflora* | *birbirwa* | ++ | | | 21.33 | 2.4 | | |
| 21 | *Acanthospermum hispidum* | *kashin yau* | - | | | 21.33 | 2.4 | | |
| 22 | *Alysicarpus rugosus* | *gadagi* | ++ | | | 15.67 | 1.7 | 1.25 | 0.2 |
| 23 | *Celosia trigyna* | *nannafa* | ++ | | | 14.83 | 1.6 | | |
| 24 | *Sesamum alatum* | *ramutin bariwa* | + | | | 3.75 | 0.4 | | |
| 25 | *Cymbopogon giganteus* | *sabre* | ++ | | | 2.67 | 0.3 | | |
| 26 | *Tephrosia purpurea* | *masa* | - | | | 0.58 | 0.1 | | |
| 27 | *Indigofera tinctoria* | *baba* | - | | | | | 8.17 | 1.1 |
| 28 | *Brachiaria xantholeuca* | *hatsin tsutsu* | ++ | | | | | 3.00 | 0.4 |
| 29 | *Zornia glochidiata* | *maras* | ++ | | | | | 0.83 | 0.1 |
| | Total | | | 3653.92 | 100 | 900.00 | 100 | 758.25 | 100 |

plot area: 120 m$^2$ (4 × 30-m)
*: Interviews with a pastoral Fulbe individual and a Hausa farmer about the plant preferences of cattle, sheep, and goats.
++: very favorable; +: favorable; -: unfavorable

purpose.[1] According to observations of plant growth on the experimental plots, the critical amount of urban trash needed to rehabilitate land was at least 20 kg/m$^2$ arranged so that it was approximately 2 cm thick. After two years, the plant growth began to deteriorate. To maintain plant productivity using urban trash, it is necessary to continuously input trash or livestock dung to compensate for the nutritional depletion resulting from plant removal and soil erosion.

In 2011, all civil services were halted under the military regime, and local governments lost their funding. As result, government trash-collection services were not available, and we entered into an agreement with a local mayor of Dogondoutchi to collect some of the urban trash. In March of 2012, we collected a total 100 tons of urban trash and hired tractors to transport it so as to continue the land rehabilitation of the 50 × 50-m pastureland. The author asked a Fulbe herdsman, Mr. A, to collect and sow plant seeds that would be useful for the site.

The author arranged for photographs to be automatically taken by an interval camera every hour during the day. After the rain started in the middle of June, the photos show the regenerating grassland, which the author planned to use as pastureland for herders living in the village. According to the Fulbe herdsmen, most of the grasses growing on land containing the livestock dung and trash were crops and other useful plants, including pearl millet, cowpeas, and pumpkins.

On September 7, 2012, during harvest season, when the tension between farmers and herders typically escalates, we invited Mr. A, a Fulbe herdsman, a

**Fig. 8.** Creating the fenced pastureland with urban trash (September 2012)
The herdsmen living in the village can use it freely. They arranged to use it for a night kraal, which provided livestock dung to enhance the fertility of the soil.

Tuareg woman, and their livestock to the fenced pastureland (Fig. 8). The Fulbe herdsman took care of the village livestock as well as his own. At that time, the livestock included 11 cows, 45 sheep, and 120 goats. According to the photos taken by the interval camera, the livestock stayed inside the fenced pastureland for 14 days.[2] Although the livestock had eaten all the grass by November 2, Mr. A kept the livestock inside of the fenced pastureland during the night until November 30 to provide animal excreta to maintain the soil fertility balance. This decision was made independently by Mr. A, to whom the author granted authority to manage the pastureland. According to Mr. A, the soil in the fenced pastureland would easily deteriorate when the livestock ate the grass, depleting the nutritional value of the fenced pastureland. He claimed that the addition of livestock excreta was necessary to sustain the fenced pastureland.

This practice was of benefit not only to Fulbe herdsmen but also to the Hausa livestock owners who resided in the village. The Fulbe herdsmen grazed both their own livestock and that owned by Hausa farmers. The fenced pastureland created from urban trash helped to maintain a distance between farmers and herders and prevented livestock-induced crop damage during the harvest season. We were also able to feed and fatten the livestock with high-quality fodder.

## SUMMARY AND IMPLICATIONS FOR CONFLICT PREVENTION

Traditionally, nomadic herders and farmers living in villages establish mutually beneficial relationships. Although farmer-herder relationships have historically involved periodic violent conflicts, they are also characterized by symbiotic, non-violent interactions and complementarity (Hussein et al., 1999). Both sides recognize that farmer-herder relationships are positive during the dry season but that they deteriorate during the rainy season. Although farmers and herders need to support each other by entering into settlement contracts, competition between farming and livestock rearing usually occurs in the form of livestock-induced crop damage, which is the most important precipitant of the farmer-herder conflicts in the communities of the Sahel region of West Africa.

In Mali, the customary pastoral leaders lost power and wealth to previously underprivileged farmers (Benjaminsen & Ba, 2009). According to Benjaminsen & Ba (2009), this was primarily the result of national policies and laws prioritizing agricultural development involving the large-scale conversion of dry-season pastures to rice fields at the expense of pastoralism. At my research site in southern Niger, the population increase and the introduction of a cash economy and market activity led to the expansion of farmland, which resulted in a drastic shortage of grassland during the rainy season. The herdsmen of X village were forced to find suitable grassland for their livestock. Fulbe and Tuareg herdsmen constitute a minority in Hausa society. The herdsmen living in Hausa villages lost their livestock as a result of severe droughts, and they now take care of livestock owned by Hausa individuals to earn a living.

Although the farmlands are open to the public and all herdsmen can freely use them to graze livestock during the dry season, their use is strictly restricted to the landowners during the rainy season. As a result, it is very difficult for herders to find suitable grassland near the village. According to previous studies (Turner et al., 2011), one-third to three-quarters of the farmer-herder conflicts in southern Niger are associated with livestock-induced crop damage involving local Fulbe herders. Moreover, approximately half of these cases involved herders who were hired to herd village livestock.

At the end of harvest season, the land around X village becomes open to the public, including herders. When the season changes, many cases of livestock-induced damage to millet bundles occur every year. Although no formal statistics about crop damage and violent clashes are available, the number of such cases around the research village has increased since 2010. During the rainy season, livestock-induced crop damage has led to further deterioration in the relationship between farmers and herders. There were three primary types of crop damage. First, damage occurred when herdsmen lost sight of their livestock during the night. Second, farmers harassed young herdsmen and unilaterally made claims of crop damage. Third, herdsmen intentionally grazed their livestock on farmland, which damaged crops.

Moritz (2006) noted that policies aimed at preventing farmer-herder conflicts, such as decentralization, co-management, strengthening traditional institutions, pastoral livelihoods of Fulbe and Tuareg, and the designation of land-use zones are doomed to fail if they do not consider the politics underpinning this longstanding conflict. Sending cattle into farmland is a deliberate feeding strategy used by herders in the Sahel to deal with the dry season; under these circumstances, a good herder is single minded and takes care of his animals even when it means destroying farmers' crops. The increased proximity of grazing livestock and farmland has resulted primarily from the expansion of the areas used to grow crops, as there is no evidence of large increases in the number of livestock in the communities.

To prevent livestock-induced crop damage and farmer-herder conflicts, the author, with the cooperation of both farmers and herders in the village, created a fenced pastureland using urban trash. This land-rehabilitation pilot project was based on the daily activities and indigenous ecological knowledge of the Hausa people. The Fulbe herdsmen were pleased with the species of grass created from the urban trash (Table 2). As Sanon et al. (2007) noted, herdsmen are knowledgeable about the availability, nutritional value, and use of fodder. The herdsmen used the fenced area, which was managed by local communities, including Fulbe and Tuareg herdsmen, for a night kraal and maintained their distance from the farmers during harvest season. Greater local autonomy may improve resource management by drawing on local knowledge (Turner, 1999).

This paper identified two ways in which the "rebuilding pastureland project" was effective for conflict prevention. First, we enabled herdsmen to manage the livestock appropriately and provided higher-quality pastureland. During harvest season, herdsmen do not need to graze at night, and they can sleep near the

fenced pastureland. This strategy maintains the distance between farmers and herders and avoids both crop damage and the frustration experienced by both groups during the rainy and harvest seasons. Second, we increased the security of marginalized pastoralists by reducing conflicts. As Raleigh (2010) noted, the governments of Sahelian countries tend to negotiate with larger groups to prevent violence, but this potentially exacerbates the risk to marginal groups by ignoring local issues, such as access to resources. In southern Niger, livestock are owned by both herdsmen and farmers. Both groups can benefit from the new pastureland and develop institutions and trust based on their common interest in resolving problems related to crop damage.

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NOTES

(1) The author identified seven related effects of urban trash on land rehabilitation (Oyama 2012): (a) Low mounds with intricate elevations were created on flat trapped sand and organic matter blown in by strong winds. (b) The termite shelters located over organic matter have concentrated amounts of organic matter, and the termites elevate the small-grain clay and silt in the soil and mix them with wind-blown sand. (c) The termite tunnels penetrate the sedimentary layer, which allows the infiltration of rainwater. (d) An aggregated soil structure is created as termites solidify grains of sand with their saliva when they build shelters over the organic matter. (e) The urban trash and excreta are neutral in relation to the soil acidity (pH 4.5) of the degraded land. (f) The urban trash adds nutrients to the soil. (g) The urban trash contains many seeds of edible material, including pearl millet, *Hibiscus subdarefa*, *Balanites aegyptiaca*, and plants favored as feed for livestock.

(2) The Fulbe herdsman, Mr. A, grazed the livestock inside the fenced pastureland for a total of 14 days: September 7 and 28 and October 22 to November 2, 2012. On October 25, he returned 33 sheep and 79 goats to their owners, as the grazing contract had ended, and he was afraid the livestock would be lost or stolen. When the herdsmen returned from long-distance grazing, many livestock and herdsmen passed through X village, and they faced the risk that their livestock would be lost or stolen. After the livestock had eaten all the fodder on November 2, Mr. A kept 11 cows, 12 sheep, and 42 goats inside the fenced pastureland during the night until November 30 with the intent of adding the animal excreta to the soil in the pastureland. Starting on December 1, he moved with the livestock to the farmland of a Hausa villager to fulfill a settlement

contract. At that time, the he did not need to fear crop damage and could graze the livestock without difficulty.

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