



**Responsible Land Governance:  
Towards an Evidence Based Approach**  
ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY  
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**HERBICIDES INDUCE TERRITORIALIZATION AND ARE WEAPONS IN  
FARMER–PASTORALIST INTERACTIONS IN NORTHERN BENIN**

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# Responsible Land Governance: Towards an Evidence Based Approach

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## Abstract

Science and technology studies have shown that technologies acquire varied meanings and uses in different socio-economic and political settings. Moreover, political ecologists have demonstrated that pastoralists' restricted access to grazing land results from various territorialization processes coming from above or from below, embedded in unequal power relations between actors. Combining these two perspectives, our ethnographic study based on long-term fieldwork revealed that herbicides are technologies that have significantly transformed land-use practices and induced more conflict between landusers. Pastoralists are losers in herbicide-based territorialization processes, leading to greater marginalization and exclusion. The paper highlights the role of herbicides in generating practices of land control and in degrading relations between rural neighbors.

**Key Words:** Benin, Fulani, Herbicides, Pastoralism, Territorialization



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## Introduction

Political ecology is an approach widely used in social sciences to analyze the unequal power relationships that govern various spatial control strategies (Robbins, 2012). When power plays favor a particular socio-professional fringe that succeeds in controlling access to natural resources and thereby excluding other actors from use, territorialization politics offers a conceptual framework for deciphering and understanding these mechanisms. Several studies have discussed the socio-economic and political dynamics that generate various forms of territorialization within rural communities. Territory-making politics are seen as based on territorial strategies deployed by competing actors who produce boundaries to control some spaces and achieve some effects they desire (Vandergeest & Peluso, 1995; Peluso, 2005; Poutier, 2005; Chauveau et al. 2006; Bassett & Gautier, 2014; Audouin & Gonin, 2014; Gonin, 2014). There are two kinds of territorialization described in the literature: territorialization from above and territorialization from below.

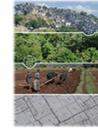
In the first case, the State with possible support of international partners takes control of resources under various conservation and management policies. This is the case of various policies oriented towards heritagization, creation of game parks and promotion of ecotourism in some East African countries such as Tanzania (Homewood & Rodgers, 2004; Hodgson, 2011; Gascon, 2014). This same logic had also governed the “fortress policy” in Benin in the 1980s–1990s, when the State owned the resources and used all forms of violence to regulate and control access (Akouehou, 2004; Pochet, 2014).

In the second case, territorialization results from unintentional or deliberate actions of local actors engaged in strategies that allow them to afford more margins of maneuver in a context where resources once unlimited increase in value or become scarce due to various endogenous or exogenous drivers. A widely reported case in the scientific literature in recent years has been the planting of cashew trees, which is developing in a context of economic globalization but is increasingly serving as means of spatial control in various agropastoral zones in Sub-Saharan Africa (Audouin & Gonin, 2014; Gonin, 2014). It should be emphasized that, in both cases, whether the territory-making politics is initiated from above or produced from below, the State plays an important role through its rural policies and development interventions which directly or indirectly appear to weaken social balances and generate asymmetrical



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power relations between rural actors (Vandergeest & Peluso, 1995; Bassett & Gautier, 2014; Gonin, 2014).

The analysis of territorialization politics from below becomes very relevant in a context where the State, in a dynamic of developing rural territories and improving the national economy, carries out multiple rural policies that are very little integrated as a whole. In Benin, the agricultural mechanization and modernization, which started in the late 1990s, continued in the following decade by making various agricultural technologies (e.g. tractors, pesticides) widely available in rural areas throughout the country. We hypothesized that the advent of new technologies in the agricultural sector could also be accompanied by major changes in the relationships of local socio-professional groups with land, as well as in the coexistence between them.

The degeneration in relations between farmers and pastoralists in northern Benin is not a new phenomenon. Conflictual coexistence emerged from the polarization of livelihoods following the introduction of draft power, inducing the ending of livestock contracts and the beginning of market orientation of farmers in the 1980s–1990s. All these have weakened the mutual dependencies between *people of land* and *people of livestock*. Therefore, the reciprocal security attached to their symbiotic relationship collapsed (De Haan et al. 1990; De Haan, 1997; Van Driel, 1997; 1999; 2002). The role of technologies in the transformation of human–environment as well as human–human relationships was already clearly well established in these studies. Our research goes beyond this perspective to scrutinize how technologies, by transforming the power relations among rural actors in their quest for wellbeing, are also reshaped both in their meanings and in the uses made of them by these actors. In order to achieve this, we have also drawn inspiration from science and technology studies (STS), which – alongside political ecology – allows us to take the posture that technologies gain diverse meanings and uses depending on the context in which they have been promoted (Latour, 1986; 1990).

The study analyzed the impact of the technologies on power relations between rural actors. This paper focuses on the appropriation of herbicides and its impacts on the livelihoods of rural actors. Specifically, we first sought to understand the socio-technological and institutional processes through which weed-controlling technologies have become embedded in agricultural practices and land management at local level. We then examined how the use of herbicides in farm operations influenced power relations and farmer–pastoralist coexistence.



## Research setting and methods

This study was conducted in Gogounou District (Figure 1), generally regarded as the national window of pastoralism in Benin. It is located in the province of Alibori, which is the most important pastoral production area of the country, with the largest population of livestock and Fulani pastoralists. The area of Gogounou is estimated at 4910 km<sup>2</sup> located in the cotton agro-ecological zone of northern Benin and bordered by two forest reserves: *Trois-Rivières* Classified Forest in the East and *Alibori-Supérieur* Classified Forest in the West. These forest reserves cover 1772 km<sup>2</sup>, about 36% of the communal land. The municipal development policy document stipulates that 1705 km<sup>2</sup>, or 35% of local land, is land for crop farming, while 1235 km<sup>2</sup>, or 25% of local land, would be for livestock grazing (PDC<sub>2</sub>, 2010).

The local population has grown from 27,830 in 1979 to 117,793 in 2013 (INSAE, 2013). This is made up mainly of Bariba farmers, who constitute about 51% of the population and are engaged in cotton production as main cash crop, but they also produce grains including maize, sorghum and millet. The second largest ethnic group in the district is composed of Fulani pastoralists, who have been settled there for decades and who, in their great majority, combine small-scale crop farming with mobile cattle herding through seasonal transhumance in areas that are relatively favorable for access to pasture. The coexistence between these two groups within a context where priority is given to cotton production is a major issue with regard to the prevailing land-use practices and the forms of relationships existing between the actors.

Our mixed methodological approach reconciled GIS-based analysis tools and ethnographic methods for analysis of forms of livelihoods and power relations between actors involved in access and control of natural resources. We first did a diachronic analysis of the land-cover change in Gogounou over 30 years, especially between 1982 and 2012. Land-use and land-cover changes were captured and analyzed using satellite images provided by the National Center for Remote Sensing and Ecological Monitoring (CENATEL). These remote-sensing data were supported by ethnographic data collected through intensive fieldwork over ten months between July 2013 and October 2014. Through participant observation and various types of interviews, Bariba crop farmers and Fulani pastoralists were followed in all their production practices, and their power relations and livelihood trajectories were traced.

[Figure 1]



### **Regression of savanna in favor of croplands**

The diachronic analysis of land-cover change in Gogounou shows that the biggest changes in the spatial units are in the savanna and cultivation areas (Figure 2). The tree and shrub savannas decreased drastically from 337,827 ha in 1982 to 197,893 ha in 2012, in favor of the cultivation areas (mosaics of croplands and fallowlands) that increased from 58,754 ha in 1982 to 199,364 ha in 2012. Built-up land and plantations also increased over the last 30 years, but are not the object of attention in this paper, which focuses on the dynamics of cropland expansion and land control. The dramatic increase in the amount of land used for cropping and fallowing occurred through continuous clearing of the savanna.

[Figure 2]

### **Political ecology of pastureland encroachment**

Linking the people to the pixels (McCusker & Weiner, 2003) enables a better understanding of the socio-economic and political realities that underlie the changes revealed above by the remote-sensing technologies. Therefore, we will first of all introduce some public policies related to agricultural development, before showing how they have contributed to generating territorialization practices from below. Their influences on power relations between local socio-professional groups will then be discussed.

### **Motorization of small-scale agriculture in question**

Agricultural mechanization has been a reality in Benin since the second half of the 1990s, when the governmental Program for the Professionalization of Agriculture in Benin (PPAB), endowed with support from French Cooperation and professional groups of French farmers, prompted the creation of cooperatives for the use of agricultural equipment (CUMA). A CUMA is conceptually an associative platform made up of ten members able to mobilize a budget of 10 million CFA francs for farm equipment consisting of a 30-60 tractor, a plow and a 3-ton trailer (Balse et al. 2015a). This socio-technological innovation has led to major transformations in farming practices in many regions of Benin. The members of the CUMAs are able to increase their crop areas by up to 6.4 times after the introduction of the tractor (Balse et al. 2015a; 2015b). The saving of time and labor at the time of sowing encourages this significant increase in cultivated areas, while at the same time increases the need for manpower for maintaining and



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harvesting the crops, for which wage labor is called upon and has become increasingly scarce and expensive. As a result, the motorization of solely the plowing operation is accompanied by mitigated effects on production and income. However, there was a positive correlation between membership in CUMA and improvement in productivity per family asset in farming households, and in the trend towards specialization of farms in cotton or maize production (Balse et al. 2015b). This way of modernizing small-scale family farms was advertized by the national network of CUMAs in Benin in one of its fact sheets in terms that the use of tractors in a cooperative framework increases crop areas, yields, farm incomes, agricultural investments, schooling of children and the overall living conditions of farmers and their families (CUMA-Benin, 2014).

The success of the CUMAs as depicted above then inspired the entire agricultural modernization policy, which attempted to duplicate this model throughout the country under the Program of Promotion of Agricultural Mechanization (PPMA) from 2007 onwards. Within this context, about 300 tractors were distributed throughout Benin for the benefit of individual farmers, organized farmer groups, agricultural training centers and youth groups organized as part of a program to integrate young people into agriculture (Saizonou, 2009). Access to the tractor is even made easier for farmers since it is subsidized at 50% of its real price, and the payment is spread over four years (*ibid*). In 2010, the Regional Union of CUMAs in Borgou and Alibori Provinces (URCUMA B/A) counted approximately 109 CUMAs with about 953 farmers cultivating about 10,119 ha of land (CUMA-Benin, 2015). Similar dynamics in other agricultural regions of the country increased the agricultural mechanization rate to about 17% in 2010 compared to 1% in 2006 (Agro-Benin, 2011). In fact, individual equipment acquisitions, machinery sharing between CUMAs and social network members, and plowing service delivery has strongly embedded the tractor into agricultural practices with an increase in cultivated areas in various districts of Benin (Saizonou, 2009; Gibigaye et al. 2010; Balse et al. 2015a).

In April 2014, there were in Gogounou District 15 CUMAs, of which nine were actually equipped in the context of the PPMA<sup>1</sup>. Other tractors were privately owned by various political and associative leaders and the municipality of Gogounou, which also had three tractors for plowing service delivery. Two groups composed of about 115 young farmers were also set up on about 170 ha of land for rice and maize production mainly (Extension Service of Gogounou District, 19/08/15). The advent of the tractor, the

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<sup>1</sup>According to a study by Ligan-Topanou et al. (2015), at least 19 farms have benefited from the PPMA equipment in Gogounou District.



promotion of shared mechanization and the strengthening of youth entrepreneurship have become major drivers affecting the forms of access and use of land in Gogounou District.

### **Cropping practices and agricultural expansion in Gogounou**

Several types of crops are grown in Gogounou (Figure 3). Cotton is the main cash crop in the country and thus the top priority of the government. In recent years, the cultivation of maize has been added; this is the country's main food crop, benefiting from policies geared towards food security. The development of the maize sector is also the result of successive crises in the cotton sector, as well as the regional context favorable to the export of maize from Benin with its corollary of speculation on prices at specific periods of the year. The introduction of improved varieties and the increased production in the northern regions offer opportunities for Benin maize to compete in the West African space (Baco et al. 2009; Diallo et al. 2012). All these reasons justify that cotton and maize are the two main crops of Benin in general and of Gogounou in particular.

Changes in areas of main crops in Gogounou from 1996 to 2013 show that the cotton area increased considerably from 1996 to 2009 before experiencing a sinusoidal evolution from 2009 to 2013 due to various organizational and institutional crises that will be briefly discussed later in this article. The major cereals, namely maize, sorghum and millet, globally skyrocketed by quadrupling their overall area, which increased from 7258 ha in 1996 to 28,525 ha in 2013. Rice, which is mainly rainfed grown in wetlands quadrupled in area, which was 1258 ha in 2013 compared to 338 ha in 1996. Sorghum doubled in area, estimated at an average of 3541 ha in 2013. Millet, which covers an average annual area of 123 ha, remained constant during the period in question. Roots and tubers including cassava, yam and sweet potato did not significantly change in their area, which averaged annually 2664 ha between 1996 and 2013. Leguminous crops such as cowpea, groundnut, voandzou and soybean maintained their overall area of 2358 ha per year, as was also the case for vegetables, namely okra, chili pepper, tomato, sesame and squash, whose area was stabilized around 457 ha per year from 1996 to 2013. It appears overall that no crop has really decreased in area. Rather, most of the cultivated crops have significantly increased in area and the others have remained constant. The main factor of land demand by farmers has been the expansion of cotton and grain, especially maize and rice, over the past decades. This partly explains the high pressure observed locally on land and the reduction in pastureland.



The comparison of the above-mentioned evolution of the agricultural areas with the improvement in production and yields shows interesting dynamics as shown in Figure 4. While the total annual area of all crops together more than doubled between 1996 and 2013 from 24,783 ha to 50,475 ha, production also increased significantly from 37,842 tons to 98,375 tons. However, the agricultural yield remained invariably equal to two tons per hectare over the whole period under consideration. This constancy in the value of product per land unit, despite the drastic increase in cultivated area, shows clearly that agricultural extensification remains the main agricultural strategy locally implemented by farmers. The advent of tractors has not generally improved the agricultural productivity in Gogounou, as is extolled in the propagandist discourses and reports. It is in this context that the alarming use of herbicides that pollute the environment and undermine the agro-ecological sustainability of family farms has become a major issue in development territories (Ligan-Topanou et al. 2015). We will now show the institutional context of promotion of chemical weedkillers as well as the place they occupy in agricultural practices and their effects on the interactions between the major social groups of Gogounou.

[Figure 3]

[Figure 4]

### **Labor shortage, weeding technologies and dynamics of territorialization**

As we have shown above, the use of the tractor for plowing alone as well as the dynamics of agricultural extensification in progress locally, generate major labor deficits. Labor has become increasingly difficult to acquire. The situation is acute in a context where the improvement in child schooling has limited the availability of family labor. Children were heavily involved in many farming activities including plowing, weeding and harvesting. Additional labor is required to cover not only the agricultural operations other than plowing, but also additional increments of sown area that the gains in time and labor have enabled farmers to achieve. The scarcity of labor is an undeniable reality in the particular case of Gogounou District, where the number of children enrolled in primary school increased from 5718 in 2000–2001 (46% female) to 14,132 (53% female) in 2013–2014<sup>2</sup>, a growth rate of 147%, due to the success of the education policies supported by development partners. Balse et al. (2015a) reported that each member of the CUMA households studied in northern Benin now took care of 4.2 ha of land compared to 1.7 ha

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<sup>2</sup> These data come from the database of the Gogounou School Authority in 2014.



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previously, despite the external wage labor that farmers have to mobilize to meet their overall labor needs. Herbicides have become an important alternative for many farmers to deal with this labor issue.

Herbicides were introduced in Benin in the 1980s through various action-research programs aimed at solving problems of labor shortage, which had a negative effect on the hand-weeding operations and thus created a bottleneck in the agricultural calendar (Atachi, 1979; Gaborel & Fadoegnon, 1991; Marnotte, 1994). Weed-control chemicals were adopted by farmers and their use has spread mainly in the cotton sector, which is the most organized agricultural sector in which farmers can receive inputs through a credit mechanism. Those farmers who do not produce cotton and cannot afford to buy inputs in cash rely instead on their cotton-producing neighbors who develop various practices to divert the inputs for other purposes (see Kherallah et al. 2001).

In spite of the already remarkable presence of herbicides in farming systems in Benin in general and in cotton-producing areas in particular, the recent spread of these products is the result of the breakdown of the public-private partnership through which the cotton sector was managed since the economic liberalization which took effect from the 1992–1993 crop year onwards. In the 1980s, the State had the monopoly to supply seeds and inputs, training and advisory services, to purchase products, to gin and export cotton fiber. In the 1990s, however, private operators and their professional associations were gradually granted the sector. The input policy implemented thereby includes three phases under the control of the public authority: i) importers of cotton inputs enjoy a tax-free regime, which is not the case for other crops; ii) the government subsidizes cotton inputs to enable farmers to acquire them at reduced single prices; and iii) inputs are made available to farmers on credit through a strategy that allows for recovery at the time of selling the crop. This complex process and the control mechanisms in place prevent the invasion of illegal input flows (Kherallah et al. 2001).

But the whole system collapsed because of the various conflicts of interest that began to weaken it from 2003 to reach the highest point in 2012. Opposition between ginners, protests by importers against contract-awarding processes and cleavages within farmer organizations contributed to the emergence of informal input flows. In the same vein, and with further political motives, the Benin government under the guise of institutional reforms proceeded to the de-liberalization of the sector (CTA, 2008; Gbeffo, 2012; Meenink, 2013a; 2013b). This breakdown of the public–private partnership opened the way for the emergence of new private wholesalers and local retailers who invested in supplying products of all kinds, imported especially from Nigeria and Ghana and dumped them without any controls into different



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agricultural regions of the country. The herbicide, which was accessible only to a category of farmers under conditions that did not allow everyone to have it (at least not officially) became – in these anarchic conditions – accessible to all at low prices never offered before. In the course of this research, we observed that the one-liter herbicide cans provided by the Gogounou agricultural extension services at 5,000–8,000 CFA francs (US\$ 10–16)<sup>3</sup> could be easily purchased at local roadsides, in local markets and even from street vendors canvassing villages at a price of 2,000–4,000 CFA francs (US\$ 4–8). Several young people and unemployed graduates who had found employment opportunity in this business even offered their clients various measures for acquisition of the herbicides on credit.

Chemical weedkillers that emerged as a solution to labor problems in the area also offered various opportunities for farmers who appropriate them to achieve various other objectives. The herbicides have completely changed the existing farming practices and have become more successful means of carrying out farming operations, increasing agricultural acreage and improving farm incomes. The monitoring of agricultural activities and the estimation of the costs of operations from soil preparation to the marketing of maize in two systems, one using herbicides and the other not using them (Table 1), reveals that – in the short term – the herbicide-based maize cropping system is the more profitable for farmers. Several activities such as soil preparation and even fertilization are now carried out using different types of herbicides. Weeding, which was one of the most difficult operations in the cropping process, is now less difficult and requires less labor. The optimal use of herbicides in the cropping process brings a profit of at least 35,000 CFA Francs (US\$ 70) per hectare of land compared to the farmers who did not use these chemicals and worked their fields according to the old cropping practices. The perception of this profit explains why very few farmers were willing to forego the use of these products, which they also perceive as saving farmers from many problems. The herbicides, alongside the tractor, alleviate labor needs, although our field observations revealed that the labor saved through the use of these technologies was constantly reinvested in the search for more land, leading to an increase in cultivated area.

[Table 1]

A gender dimension in these uncontrolled uses of herbicides is that women derive considerable benefits from these products, which are very empowering to them in their own farming dynamics and their position in relation to men in their society. A Bariba woman farmer from Gounarou village pitifully

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<sup>3</sup> In this paper, 1 US dollar corresponds to 500 CFA francs.



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declared that “*banning herbicides means killing women*”. Several resourceful youngsters in the big cities of northern Benin are also returning to villages where they now have the ease of using tractors and herbicides to cultivate large areas. They often return early from the fields in the middle of the day to rove around the urban space of Gogounou, where they can afford various adventures worthy of their status as city-dwellers. Thus, herbicides contribute to this upgrading of the agricultural function evoked by Balse et al. (2015b) concerning the use of tractors and the advent of the CUMAs. This offers a new perspective on the issue of youth mobility and job creation in rural areas.

In addition to solving labor problems, increasing farm holdings, generating profit and upgrading farmer status, herbicides play an important role in land control in Gogounou District. In this context of strong pressure on land, which has also become more valuable and highly prized, pastoralists suffer severely from the acquisition of rangelands for cultivation, leasing or sale by farmers. Several farmers use these products to grab some plots adjoining their own fields. These devious practices are silent and succeed very often, as it has become commonplace for farmers to apply herbicides on uncultivated areas surrounding their fields as part of a pest-controlling strategy. Spraying chemical weedkillers on uncultivated or presumably “ownerless” land does not *a priori* point to any land grabbing, but it ends up being so in cases of abuse where some farmers impose their position of power over other farmers and pastoralists claiming ownership of their land.

The type of territory-making developed by some farmers through the use of herbicides also receives response from the victims and from others who fear being abused as well. As a result, it has become a practice in Gogounou District that large landlords and absentee landowners demand the spraying of herbicides on their uncultivated plots in order to maintain their ownership right. The Fulani pastoralists find themselves caught between a stone and a hard place, as they are increasingly losing land that is grabbed by the farmers who call on their customary right as first-comers in the area, and moreover the pasturelands are being sprayed with chemicals. In addition to the incidental poisoning of herds, for example with polluted water, herbicides may also be used in setting up ambushes against a targeted cattle herd. During the fieldwork, we observed cases of poisoning of cattle and small ruminants belonging to Fulani households as a result of intentional herbicide application. Herbicides have become chemical weapons that play an increasingly important role in the interactions between farmers and pastoralists. Our interlocutors acknowledged that the abundance of herbicide use in the region has also been accompanied by an increase in farmer–herder conflicts.



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This does not mean that there are no longer any forms of cooperation between these two groups or that the pastoralists do not use these chemicals themselves. In this article, we highlight the involvement of weed-control chemicals in land-tenure control, territorialization and deterioration of neighborhood relations between social groups. Nevertheless, there are still forms of cooperation between these two groups and the pastoralists also resort to the use of these same chemical products, if necessary, within the framework of their own territorialities, which will not be discussed here.

Herbicides, like all other technologies (see Latour, 1986; Pfaffenberger, 1992; Wajcman, 2000) have undergone a renegotiation of their significances and uses in the hands of farmers. From weed-killing and labor-saving technologies, they have been translated into technologies for ensuring rapid agricultural extensification, land control and tenure security.

In the light of the local strategies to which they give rise – in line with the rationale of spatial control – herbicides have become tools for territorialization from below (Bassett & Gautier, 2014; Gonin, 2014). They are also being used as a technological weapon to take advantage in land and social conflicts opposing farmers to the Fulani pastoralists, who seem to be losers in this technological trajectory. The farmers' ability to use herbicides against pastoralists and their herds improves the farmers' position of power and gives them an important advantage in their territorial control strategies. All this leads to very negative impacts on the livelihoods of pastoralists, some of whom had to leave the region to take refuge elsewhere in the country or across borders into Togo and Ghana. We concur with Bassett and Gautier (2014) that *“the processes of territorialization, whether driven from above or from below, play out in a terrain of social differentiation that results in landscapes of opportunity for some and impoverishment for others”*.

## **Conclusion**

Our analysis of local power games under the influence of agricultural technologies promoted through Benin's rural development policies reveals that stronger pressure on land has occurred and has generated various practices of territorialization of local land to the detriment of pasturelands. As shown in the various uses made of herbicides by farmers, we confirmed in this study that, according to local contexts, social actors are producers of meanings for the technologies of which they make various uses with the aim of achieving objectives specific to them. We observed that weedkillers have completely changed local land-use practices and led to more conflicting interactions between landusers. Socioeconomic



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inequalities are more evident, since dependence on natural resources remains the preferred means by which pastoralists preserve their livelihoods. This confirms that technologies in a globalized world have unpredictable paths, leaving the human–human and human–nature interactions in great uncertainty. The manufacturers and promoters of herbicides have certainly never provided instructions for any of the uses observed locally. Improvement of pastoral livelihoods requires a new approach to land governance and harmonization of rural development policies in Benin.

The regime currently in power and resulting from the presidential elections of March 2016 has decided to resort again to the private businesses in the management of the cotton sector. This institutional change in the overall framework for the provision of agricultural inputs and the control of illegal flows could induce new dynamics in the forms of land control and modify power relations. In any case, the priority given by public policies to agricultural production to the detriment of pastoralism will continue to place the Fulani pastoralists in a marginal position with regard to access to land and productive resources. We strongly encourage the adoption of the pastoral code in preparation for better consideration of pastoralism by public policies. However, this should not be seen as a panacea for solving all the problems faced by the Fulani pastoralists in northern Benin or for the final pacification of the conflictual relationships between farmers and pastoralists. The promotion of social dialogue between actors must remain one of the priorities to pursue at both local and national levels.

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**List of tables:** Table 1: Main maize cropping options in Gogounou

Table 1: Main maize cropping options in Gogounou

Maize farming without herbicides		Maize farming with herbicides	
Activities	Average cost/ha (CFA franc)	Activities	Average cost/ha (CFA franc)
Land preparation	15,000	First herbicide spraying ( <i>kpake</i> <sup>4</sup> )	7,750
Plowing	27,500	Plowing	27,500
Seeding	10,000	Seeding	10,000
First hand-weeding	11,000	Second herbicide spraying ( <i>tangi</i> <sup>5</sup> and/or <i>dame</i> <sup>6</sup> )	2,750
Mineral fertilization	32,000	Mineral fertilization	32,000
Second hand-weeding	11,000	Third herbicide spraying ( <i>tangi</i> )	2,750
Third hand-weeding	11,000	-	-
Harvesting	12,000	Harvesting	12,000
Shelling	11,250	Shelling	11,250
Packaging	8,000	Packaging	8,000
Handling/ transportation	30,000	Handling/ transportation	30,000
Marketing	412,500	Marketing	412,500
Profit	233,750	Profit	268,500

Source: Fieldwork in Gogounou, 2013–2014

<sup>4</sup> *Kpake* are non-selective field-clearing herbicides used to prepare land by weeding out all types of vegetation. The glyphosate-based herbicides such as Kalach, Sharp, Herbextra etc. belong to this group of weedkillers.

<sup>5</sup> *Tangi* or *yangatime* are selective pre-emergence weedkillers used to control specific crop weeds (in maize, cotton, rice, yam, etc.) or particular types of weeds. They are generally conceptualized as having dual weed-killing and soil-fertilizing functions. The herbicides used in maize production with name like Amino-force, Atrazforce, Bic, Hervextra, Heabesta, etc. are part of this group.

<sup>6</sup> *Dame* are systemic herbicides used for their anti-germinative effects on weeds. Their compacting effect on soil as perceived by farmers is well appreciated by them, since it hinders a rapid emergence of weeds to compete with the crops. Some post-emergence selective herbicides are sometimes placed in this category. Atraz50FW is the most known herbicide of this group and is considered by farmers as also having fertilizing effects.



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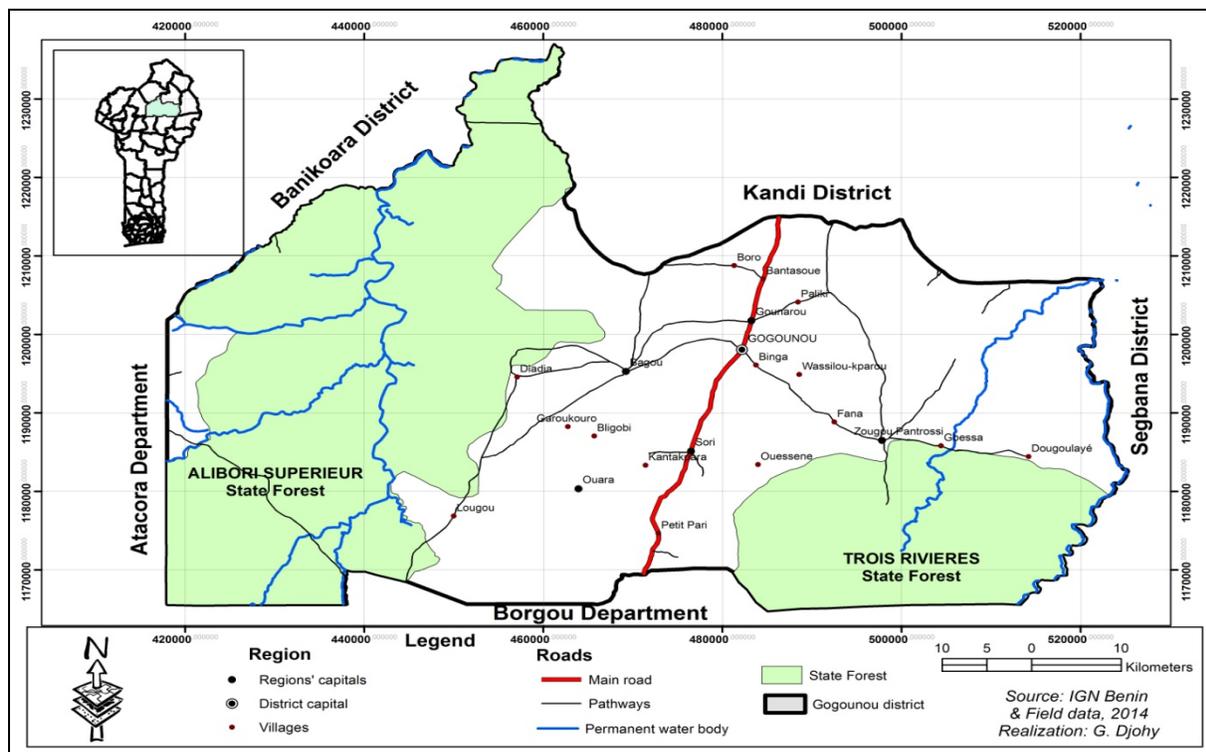


Figure 1: Study area location



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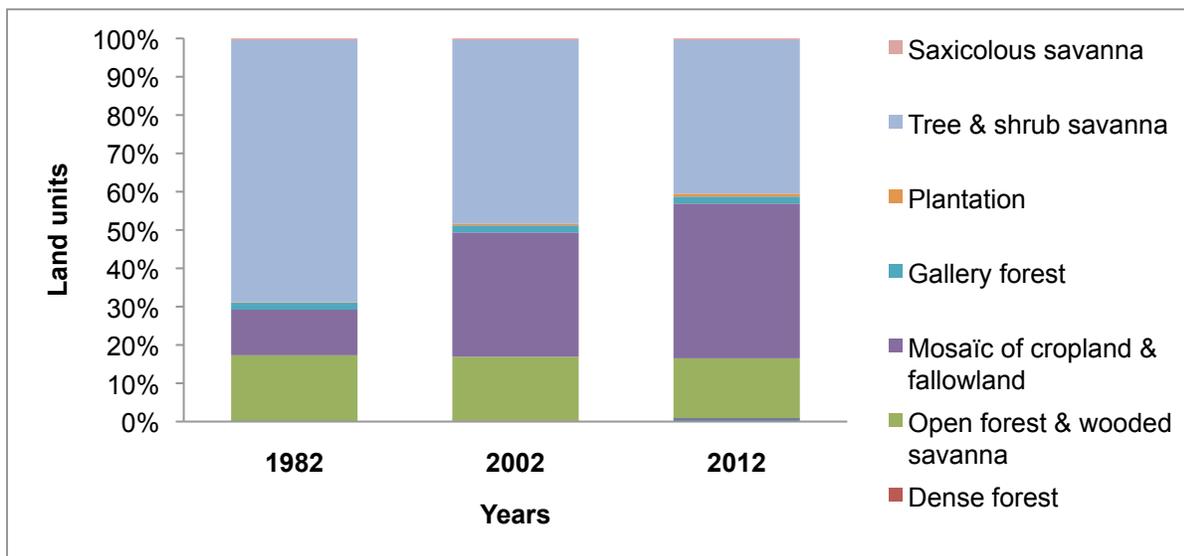


Figure 2: Distribution of land cover in Gogounou (1982–2012) (Source: satellite images by CENATEL/Benin)

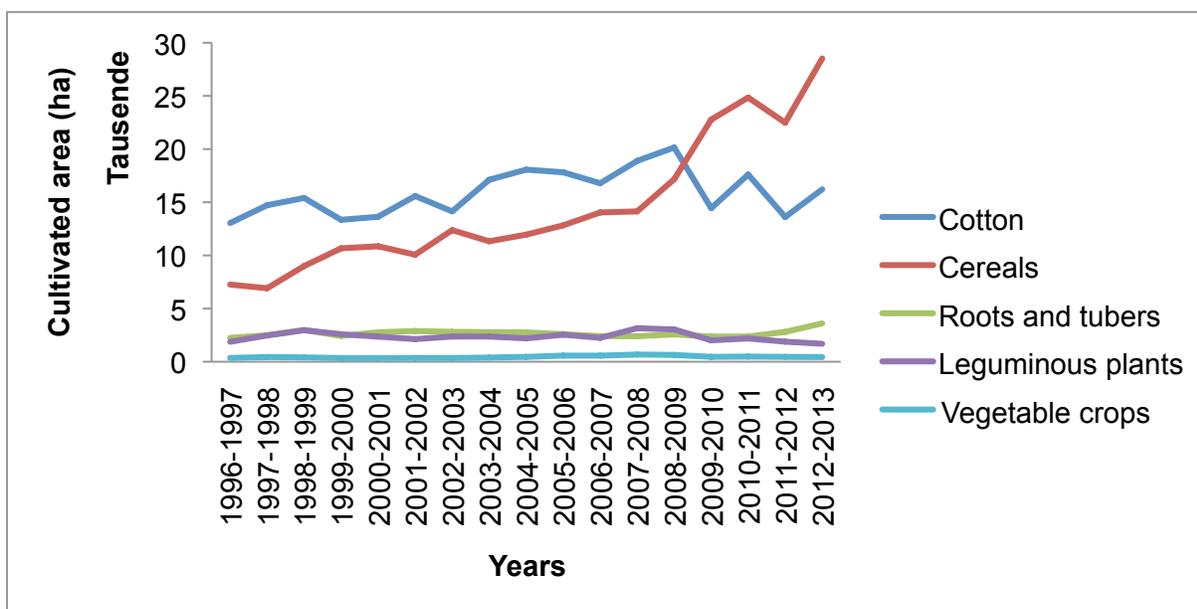


Figure 3: Evolution of crop areas in Gogounou from 1996 to 2013 (Source: CARDER Borgou/Alibori database, 2014)



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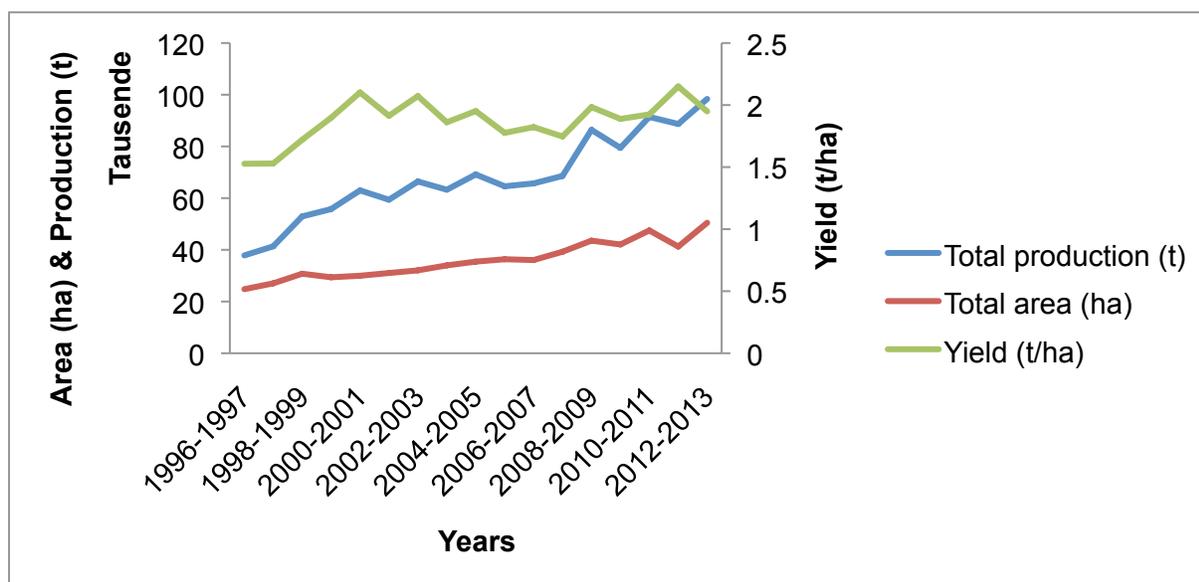


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