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Fodder species dynamics and detour for the invasive species *Senna obtusifolia*: a changing diet in the Burkinabe Sahel

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Abstract
the Sahel region is experiencing a glaring fodder deficit. For about three decades, pastoralists have been struggling to feed their livestock adequately. Despite the pastoral reserves that have been created to improve the availability of pastoral resources in the area, the problem of fodder species deficit remains a major concern. Herbaceous species, which were previously socially untapped and not palatable to livestock, will be the object of new food covetousness. This article analyses the socio-ecological motives for the disinterest in certain species at a given time and the motives that have given rise to the new social and animal covetousness towards these same species. Indeed, the integration of Senna obtusifolia in current social and animal habits in the Sahel is a direct consequence of the disappearance of herbaceous species of high social and pastoral value such as Andropogongayanus, Pennisetumpedicellatum, Setariapimula, Heteropogoncontortus and Dactylocteniumaegyptium. Semi-structured interviews, casual conversations, group interviews, ethnographic observations and ethnobotanical surveys were used to collect data.
Key Words: Pastoralism, Fodder Resources, Food Habituation, Resilience Strategies, Burkina Faso

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I. INTRODUCTION

Fodder deficits during the scarce time of the year have increased dramatically over the past years in the African Sahelian zone(Zampaligré and Schlecht 2018). This situation is more tense and worrying at the end of the year. at the end of the dry season (Linstädter et al. 2013). Given the close socio-ecological interrelationships, this fodder deficit profoundly affects the functioning of local production systems.(Safriel et al. 2005, Linstädter et al. 2016, Martin et al. 2014). Several themes on strategies for adaptation and resilience of local populations in the face of changes in their ecosystems have been widely discussed.(Niamir-Fuller 1999, Müller et al. 2007, Reid et al. 2008, Reid et al. 2009, Martin et al. 2014, Martin et al. 2016). However, the way fodder deficits influence agropastoral practices, and how they modify resilience mechanisms of pastoral systems is still poorly understood. The structure and functioning of these systems are sometimes correlated with the availability or accessibility of natural resources. And it is in this perspective the issue of the recent social and animal covetousness of *Senna obtusifolia,*a species classified as unpalatable by Hiernaux& al. (2016), is raised. That is why this analysis focuses on the renewed interest for*Senna obtusifolia*, a very little known and less exploited species three decades ago which is now at the center of ecosystem needs and concerns. This objective investigates the socio-ecological implications of *Senna obtusifolia* in local ecosystems. In other words, it seeks to analyze the motives that led to the change in perceptions about the species and its social and animal exploitation.The core of this analysis is therefore theinterdependency between the dynamics of fodder resources – disappearance or decrease– and the genesis of recognition behavior of previously unexploited plants, in this case *Senna obtusifolia.*

II. MATERIAL AND METHODS

Study area

The Sahel region of Burkina Faso is an ecological zone located between 14°02' latitude North and 0°02' longitude West. The thermal amplitudes generally range from 15°C to 45°C. The average interannual rainfall is 464.5mm; the rainy season generally starts in June and usually ends in September (Ouédraogo 2012; Bonkian& al. 2017). Vegetation essentially consists of grassy and shrubby steppes (Kiéma& al. 2014). This region has been an area with a strong pastoral propensity. Today, populations associate pastoral activity and cereal cultivation for a more resilient social life (d'Aquino 1998; d'Aquino 2000).

Several ethnic groups (Fulbe, Bella, Moose, Gourmantché, etc.), mainly pastoralists,agropastoralists and farmers, live in this area. This study focused on the pastoral groups, the Fulbe and the Bella, because they represent the key actors as regard the question its deals with. The Fulbe,made of the Férobé and the Gaobé,are

said to originate from Mali. They had a domestic group at their service called Matubè or Rimaïbé.Until now, this name is still used even though Férobé and Gaobé no longer exercise any form of slave domination over them. The Bella, a sub-group of the Tamasheks, is a Sahelian people from North Africa.Like the Matubè, they were at the Touaregs service, anothersub-group of the Tamasheks.

This research was carried out in the localities within or surrounding the following pastoral reserves:CeekolNagge, Sambonaye, Kugari. These pastoral zones were chosen because they share the same phytoclimatic reality. Furthermore, the involved communes and villages represent the eco-geographical areas not yet badly affected by the terrorism.

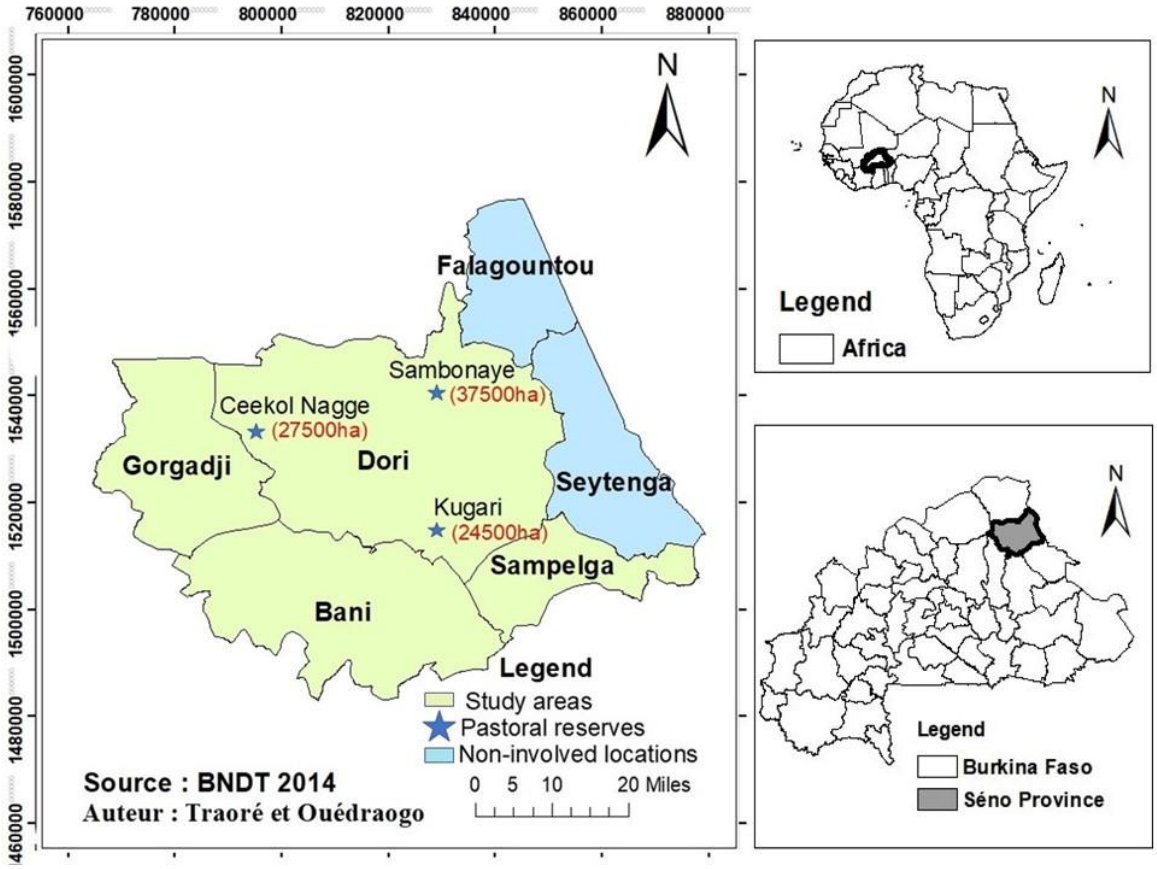

Figure 1: Sahel zone, province of Seno

III. METHODOLOGY

This study used mainly qualitative data collection techniques. The surveys were mainly conducted between November 2018 and November 2019. We collected data from local populations, private organisations (heads of pasture restoration organisations), government structures (foresters, heads of livestock structures, municipal councillors) and local notables (traditional chiefs, chairmen of village development committees). The principle behind the choice of these actors lies in the fact that they have either a direct or an indirect link with pastoralism.

Data collection techniques include semi-structured interviews, group interviews, ethnographic observations and ethnobotanical surveys. We conducted semi-structured interviews with individual as well as with groups. Group interviews were conducted with groups of herders. The places of individual or group exchanges were diverse: at the concessions, in the pastures, at the water points and fields. A total of twenty-seven individual interviews and three group interviews were conducted.

The interviews focused on the evolution of pastoral practices, habits and values in relation to the dynamics of fodder species (disappearance, regression and proliferation). This change in the pastoral system most often refers to initiatives aimed at adapting to the evolution of the phytogeographical context. The ethnobotanical survey has solidly supported the analysis by leading us to the discovery of several species of high social and forage value. Thanks to this technique, we identified them by name (local and scientific names) and explored their role in local taxonomy and symbolism. The observations focused on the fodder potential of pastures and pastoral reserves, and more specifically on the physiognomy of pastures in the rainy season. They were conducted in the pastures, in the fields but also around the concessions. We compared the observational

data with local discourse, which made it possible to reconstruct the logics of the actors linked to the subject of the study. Data collection took more or less the form of a "qualitative inventory" of forage species. Pastoralists or agropastoralists and agro-ecological actors are invited to name the species that have disappeared or regressed, those that have maintained a constant dynamic over the last three or four decades and those that are currently expanding in their pastures. Among these species, respondents were asked to indicate those with low or high forage value in local ecosystems. In addition, our ethnobotanical observation and survey sessions helped to directly identify several herbaceous species in the landscapes and to question their forage and/or social importance.

IV. RESULTS

Currentlivestockfeeding initiatives

Many plant species are currently in danger of extinction or regression in the Sahelian zone of Burkina Faso. The concern to revitalize pastoral activity in this zone with strong pastoral propensity by restoring it to its former vitality has prompted herders to adopt other feeding strategies – in addition to natural standing grass – for livestock. For example, the establishment and conservation of hay banks has become a common practice among several Sahelian pastoralists. Two objectives motivate this practice and two types of actors are involved. Some (the herders) seek to solve the problem of lack of fodder, particularly during the dry season from March to June. Others, who generally do not own livestock, seek to earn an income by selling the hay when standing grass becomes scarce during the long dry season. It ends when the period of abundant rainfall arrives. The popularity of this mowing or conservation is particularly evident for species that are very well fed. The establishment of hay banks represents a new way of feeding livestock. The scarcity of fodder has led herders to resort to this practice, which they have just initiated. This has increased competition for grass in the region. In addition to this practice, pastoralists also use cereal residues to feed their livestock during the dry season.

Several pastoralists have chosen to turn to cereal cultivation in the Sahel. Extreme rainfall failures explain the interest in this agricultural practice. Since its advantages are multiple, we are only interested in stored crop residues. Indeed, the current turnaround in the processes of herbaceous species justifies this practice of conserving cereal residues as illustrated in this interview extract:

We are currently obliged to conserve crop residues to compensate for this fodder deficiency. Look at the roofs of the houses, there are millet stalks preserved everywhere (...). We are obliged to keep millet stalks to feed our animals during the lean season (M. M., indigenous Fulani, farmer, 57 years old, Sambonaye, 21/11/2018).

The rarefaction of herbaceous species with high fodder potential in ecosystems reflects a decrease in plant diversity. Under these conditions, cereal residues - millet stalks, peanut and bean tops, etc. - have been reduced. - Under these conditions, cereal residues - millet stalks, peanut and bean tops, etc. - provide excellent forage for livestock. The motivations for conserving crop residues are not financial, or at least rarely are. In addition to these grasses and cereal residues for livestock feed, there are also oil cakes. When pastoralists use cakes, they have to mobilize a lot of financial resources to dispose of them. The correlations between the fodder deficit and the mobilization of finances for the acquisition of cottonseed cake are explicitly presented in the following excerpt:

It is because the animals lack grass that cotton cake still has to be purchased to compensate. I am 66 years old. When I was young, I didn't even know what cakes are. (...) There was enough grass. The main concern is the lack of grass only there. We didn't even know what it was like to feed an animal using cotton cakes, grain residues or hay. We didn't even know what it meant to feed cattle because there was fodder in the pastures. The use of cottonseed cake as cattle feed here is less than 10 years old. Today you are obliged to buy cotton cake as a feed supplement, otherwise the cattle die (A. A., allochton Bella, farmer, 66 years old, Hoggosambowel on 17/11/2018).

In normal situations, livestock feed is based on the ingestion of standing grass. However, recent rainfall failures have gradually led to the disappearance of the less resistant grasses. Herders are now forced to compensate for the fodder deficit by buying cotton cake. According to their perceptions, the climatic conditions used to be more favorable to pastoral practice, but no longer are. The direct consequence of this significant decline in fodder resources is the mobilization of herders' finances, most often resulting in the sale of several head of livestock.

Social perceptions on the expansion of Senna obtusifolia

Senna obtusifolia is very abundant in the pastures of the Burkinabe Sahel. In spite of this abundance, breeders have not sought to valorize it and have not developed a conservation strategy for this fodder species. There are two main reasons for this: its great abundance and accessibility, but also and above all, its low fodder value. While some respondents remain favorable to its expansion in their environments, others consider it a negative phenomenon. Thus, social contradictions surround its expansion. Those in favor of its expansion

maintain that in a context of ecosystem degradation, any natural resource capable of facilitating a more resilient existence is a good to be valued:

It is not that we do not like *Senna obtusifolia* or that we are not concerned about its expansion. It is something that is invasive and hinders the development of other species; when you consider all this, it is worrying. But you have no choice, given the circumstances. During the dry season, it is only *Senna obtusifolia* that manages to save our animals because people mow other species of fodder to sell. But no one can remove the *Senna obtusifolia*to sell it, its leaves will fall off when it starts to dry. It is this species that helps our animals to survive during the dry season (L. B. H., Peulh, farmer, 67 years old, Ourou Longa on 19/11/2018).

The populations are aware of the advanced degradation of soils in their regions and their unsuitable state for the regeneration of several herbaceous plants. For this reason, some respondents are more favorable to the occupation of rangelands by *Senna obtusifolia*. This species has succeeded in modifying tastes and socio-cultural habits and has established itself as a resource to be relied on in the future.

Ingestion of Senna obtusifolia in the Sahel

Although *Senna obtusifolia* is an abundant species in the Sahel, it has only recently expanded by about a decade. The depletion of well-palatable forage species has changed the approach of animals and humans to this plant. In our various conversations with pastoralists, it is clear that animals only consume *Senna obtusifolia* when forced to do so. In other words, this grass is not a fodder resource coveted by livestock. However, during the first months and the first rains of the rainy season, it remains the only species they have to rely on to survive the famine. Moreover, at the end of the rainy season, *Senna obtusifolia* remains the only one to last in the pastures. The animals are forced to ingest it because there is no more selection to be made. Because of the fodder deficit, the cattle and the local population integrate *Senna obtusifolia* into their habits. The fodder poverty of the ecosystems offers them practically no alternative.

Small ruminants, especially goats and sheep, graze *Senna obtusifolia* especially when its leaves and pods dry out. Large livestock such as cattle and camels do not appreciate it as fodder. But the increasing scarcity of fodder resources in recent years has reduced almost all appetites for the species. When more appetizing forage species are available, *Senna obtusifolia* is neglected. Livestock behavior changes as resources increase or decrease. Therefore, logically, animals in different localities have different reactions to the same species of grass:

The animals in Tinakof, for example, do not have the same feeding behavior as those in the Dori region or elsewhere; you will notice that animals here despise *Senna obtusifolia*. But if you go to Tinakof as soon as the first rains come, the animals start grazing it because they have no choice. That's it! So it's a bit like that. Animals have been used to this diet, especially sheep (K. A., researcher at INERA, 50 years old, Ouagadougou, 19/10/2018).

This habituation to this fodder diet naturally imposed itself on the animals. Three decades earlier, *Senna obtusifolia* was very little known, almost untapped and unpalatable. Today, it is at the heart of the needs and concerns of ecosystems. The fundamental reason for listing *Senna obtusifolia* as a forage species is the glaring lack of nutritious forage resources. This situation has exacerbated famine and changed the feeding habits of animals. *Senna obtusifolia* is known as a welding feed. Its nutritional potential can only be seen when animals and humans have no other choice when it comes to meeting their dietary needs. *Senna obtusifolia* is very abundant in the pastures of the Burkinabe Sahel. In spite of this abundance, breeders have not sought to valorize it and have not developed a conservation strategy for this fodder species. There are two main reasons for this: its great abundance and accessibility, but also and above all, its low fodder value. While some respondents remain favorable to its expansion in their environments, others consider it a negative phenomenon. Thus, social contradictions surround its expansion. Those in favor of its expansion maintain that in a context of ecosystem degradation, any natural resource capable of facilitating a more resilient existence is a good to be valued:

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V. DISCUSSION

Recent livestock feeding practices,the motives for change

The use of crop residues or cotton cake in cattle feed in the Sahel does not represent a situation of intensification of the pastoral system in the sense of Moritz (2012). It is just a means of strengthening resilience. Indeed, fodder decreases as the rainy season advances (Babatoundé et al. 2010). In order to optimize their energy balance, we refer to The *Optimal Forage Theory* (Dumont 1995; Roguet et al. 1998), animals have to move constantly during this period of diminishing forage in the pastures. The principle of mobility is very relevant for livestock. However, they are now confronted with the problem of space. There is also the increase in the number of families who necessarily need to define a territory, a place of residence and probably land rights.

The decrease in herbaceous fodder justifies the initiative to store crop residues or buy cotton cake during the dry season. These local livestock feeding strategies are not conducive to large-scale livestock farming. On the contrary, the era of large herds seems to be over and the reason is simple: pastures are now very poor. Herds of cattle of a certain size are driven to nearby or distant pastures by dedicated herders. Some herders attribute the reduction of their herds to the lack of grass in quantity and quality. The synthesis of the phenomenon is as follows: poor grazing due to insufficient rainfall has led people to develop fodder conservation strategies. Given the influence of the bad rainy seasons, particularly on the quantity of fodder, they now resort to cake to compensate for the deficit. A whole adaptation mechanism is being put in place (Lemaire 2008).

The notion of food habituation

The fodder deficit is very high in the Sahelian part of Burkina Faso. In these circumstances, animals and populations tend to fall back on available species. For this reason, interest in certain plant species that were previously neglected is growing logically. When species coveted by pastoralists or populations become extinct, the survival instinct leads them to turn to other species previously unused. It is in this context that the issue of *Senna obtusifolia* is defined and analyzed. *Senna obtusifolia* has a long history in pastures. However, it was not consumed or eaten. The integration of the species into the fodder diet and feeding behavior of populations is a direct consequence of the disappearance of socially and pastorally useful species. By using this species, livestock and populations strengthen their defense and resilience mechanisms.

Kiéma et al (2008) have worked on the forage value of *Senna obtusifolia* and their work tends to enhance its value as livestock feed. This initiative to enhance the value of the species is truly noble. Apart from such an initiative, the abundance of this species does not really benefit either the livestock or the populations in any significant way. Even if animals are forced to ingest it due to fodder constraints, they do not make it a fodder of choice because *Senna obtusifolia* remains a species with a "low ingestion value" (Babatoundé et al. 2010). Periods of famine are presented as a situation of compromise or minimal contentment in which livestock are forced to ensure their survival and reproduction (Roguet et al. 1998) by ingesting such species.

VI. CONCLUSION

Environmental dispositions determine in one way or another the behavior of animals and domestic groups in a given ecosystem. As environmental entities evolve or change, the behavior of livestock and social groups change accordingly. These behaviorsare either planned according to available or accessible natural resources –notably plant species – or informed by the dynamics of these resources. The consumption of *Senna obtusifolia* are the very issues that we describe as unprecedented.Its integration into the feeding habits of livestock and even populations can be explained by the very advanced rarefaction of socially and pastorally coveted herbaceous species.

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