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Comparative analysis of local populations' perceptions of socio-economic determinants of vegetation degradation in sudano-guinean area in Benin (West Africa)

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Perceptions of socio-economic determinants of the vegetation degradation were studied in the district of Djidja, located in the Sudano-Guinean area in Benin. The socio-economic surveys aimed to collect perceptions of farmers, ranchers, loggers and charcoal producers on socio-economic determinants of degradation of vegetation cover. These perceptions have been analysed by factorial analysis. By decreasing order of importance, agriculture, logging, charcoal production, hunting and farming have been recognized by local actors, as key socio-economic factors, determining vegetation degradation. However, a cross-reading of all stakeholders' perceptions displayed an opposition of perceptions between farmers and breeders. The interplay between socio-economic determinants renders tedious the identification of the core element, responsible of the degradation of vegetation cover.

Key words: Perceptions, local actors, socio-economic determinants, vegetation degradation, Benin.

INTRODUCTION

Nowadays, human activities are one of the principal causes of recent evolution of vegetation in Africa, which is characterized by a drastic decline of vegetation cover (Shearman et al., 2009; Sounoun et al., 2007; Oloukoï et al., 2006; Carr et al., 2005). Degradation of vegetation and forest resources has become one of today's environmental problems in developing countries, especially in Africa (Chazdon et al., 2009; UNEP, 2008; UN, 2005). This degradation of vegetation cover contributes significantly to global change because the vegetation is one of the principal components of environmental system. It also plays an important role in climate change, as shown by studies assessing the impact of land use changes on general circulation models (Corgne, 2004). The combined effects of natural and anthropogenic processes are often considered as the main causes of degradation of vegetation cover (Lambin et al., 2003). Beyond these general considerations, it is now important and urgent to focus the analysis of the causes of vegetation degradation on human being aspects and the related economic logic since that the share of man in the process of degradation of the vegetation cover is increasingly recognized. Indeed, it is recognized that the poverty of rural people largely dependent on forest resources for their livelihoods is one the significant cause of vegetation degradation (Bertrand et al., 1999).

In Benin, as in most of African countries, socio-economic activities such as agriculture, breeding, logging, harvesting of medicinal plants have grown without environmental aspects considerations and led to an alarming degradation of vegetation cover (UNEP, 2008). The rate of degradation of vegetation cover at the national level is estimated at 70,000 ha per year (FAO, 2002). This national rate of decline in vegetation cover could hide deeper local disparities. Thus, studies carried out by Arouna et al. (2009) from the archives of remote

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sensing in Djidja District, known as the breadbasket of the central and southern parts of Benin showed that the area of natural vegetation cover decreased from 88.42% in 1986 to 43.77% in 2006 while fallows and fields rose from 7% in 1986 to 52% in 2006. Hence, the trend of the evolution of vegetation types in this District of the Sudano-Guinean area is essentially regressive. At this rate, we could predict the total loss of vegetation cover in the next two decades if the aforementioned trend is maintained. It is therefore relevant to understand the direct and indirect causes of vegetation degradation at local level.

Most studies on the causes of the degradation of vegetation in Benin (Orékan, 2007; Sounon et al., 2008; Oloukoï et al., 2006) concluded that this deterioration is due to anthropogenic activities based on data from the remote sensing and field observations without asking the opinion of local people who experience this phenomenon daily; this fact gradually lead to build common sense knowledge (Caillaud, 2010) which come up to be important for the participatory management of natural resources. Therefore, the aim of this study is to analyze the perceptions of local people on socio-economic determinants of vegetation degradation. Indeed, perception is a biophysical and cultural faculty that links the living world action to environment by means of senses and individual or collective ideologies. The protection of nature has become an area of inquiry in social psychology, and many studies tried to understand how individual attitudes towards the protection of nature are formed for and how these attitudes could explain ecological behaviour (Caillaud, 2010) and other aspects of environmental degradation (Ni Dhubháin et al., 2008). With respect to the awareness of the role that man plays today in the vegetation degradation, the need to preserve the vegetation passes by the perception of socioeconomic factors of the vegetation degradation. In other words, what are the socio-economic determining factors of degradation of the vegetation at local people level? What are the activities that contribute most to the degradation of vegetation? Is there a reciprocal indictment of different and competing users of vegetation or a share of responsibility?

The overall objective of this study is to analyze the perception of local people on the socio-economic determining factors vegetation degradation. The hypothesis underlying this study states that agriculture is the primary socio-economic determining factor of vegetation degradation in the District of Djidja which is primarily an agricultural area.

MATERIALS AND METHODS

Presentation of the study area

Djidja is the largest District in the Zou Department located in the southern part of Benin (Figure 1). It covers 2,184 km² or 41.66% of the total area of the Department. The climate is sub-equatorial in the south and tending to the sudanese in the north characterized by a bimodal rainfall regime in the south and a unimodal in the north. Analysis of the rainfall of the past 30 years shows that the total annual rainfall amounts vary from less than 700 to 1400 mm. The maximum value of rainfall was recorded in 1999 and the minimum value in 1983. The average value of rainfall turns around to 1120 mm.

The morphopedological landscape is formed by lands bar in the south and crystal peneplains in the north. In this climate and morphopedological context, a diversified hydrographical network of rivers has been established and the most important are Zou and Couffo Rivers. The Djidja District is located in the phytogeographical district of dense dry forests, gallery forests and woodlands (Adomou et al., 2006). On the combined effect of several factors, including anthropogenic factors (Afouda et al., 2003), there is no primary vegetation in the District of Djidja. It is noticed a patchwork of crops and fallows with savannas that dominate the vegetation. The main vegetation types in the District of Djidja are shrub savanna, tree savanna, savanna woodlands, woodlands and narrow riparian forests. Other units of land use such as palm groves, teak plantations, the mosaic of fallow and fields are also sometimes encountered. From 1986 to 2006, vegetation types of Djidja District have undergone significant spatiotemporal changes (Figure 2). The study of Arouna et al. (2009) showed that in 1986 the dominant vegetation types were made of tree and shrub savanna on 62% of area of the District, followed by woodland and savannas woodland (23%). Two decades later, the map of the study area is dominated by fields and fallow lands covering 52% of the area followed by tree savannas and shrub savannas (37%). Between these two periods, the phenomenon of conversion of vegetation type is marked by the complete transformation of the dry forest in other units of land cover. Thus, the dry forest in 1986, which occupied an area of 16.50 km^2 has totally disappeared. Riparian forests have decreased by 47.40% with an average annual rate of spatial expansion of 3.21%. The area of woodland and savanna woodland dropped from 498.88 to 114.80 km^2 or a decrease of 76.98%. These vegetation types are those that have experienced significant decrease, beside the total disappearance of dry forests. The area of tree and shrub savannas has decreased from 62 to 37%. The decline of vegetation types has been accompanied by an increase in anthropogenic formations. In short, the area of natural vegetation types decreased from 88.42% in 1986 to 43.77%. The evolutionary trend of vegetation in the District of Djidja is essentially regressive. It is therefore important to know how local people perceive the causes of this rapid change in vegetation cover over the past two decades.

Demographic data

The results of the three population censuses (INSAE, 2004, 1994, 1988) show that the population of the District of Djidja increased from 43,870 in 1979 to 50,629 in 1992 to reach 84, 590 in 2002, meaning an increase of 92.81% within 24 years. The size of this population has almost doubled in the interval of two decades. Regarding the rate of population growth (INSAE, 2002), in the year 2025 the District will count 146,328 inhabitants.

Economic activities

To meet the needs of this largely rural population development activities are based on natural resources' exploitation: agriculture, breeding, logging and charcoal production. Agriculture is still dominated by palm groves in the southern part of the District, the farming of peanut in the centre and cotton production undergoing a drastic decline in recent years in the north. The cattle and small livestock breeding are practiced. Cattle breeding are mostly

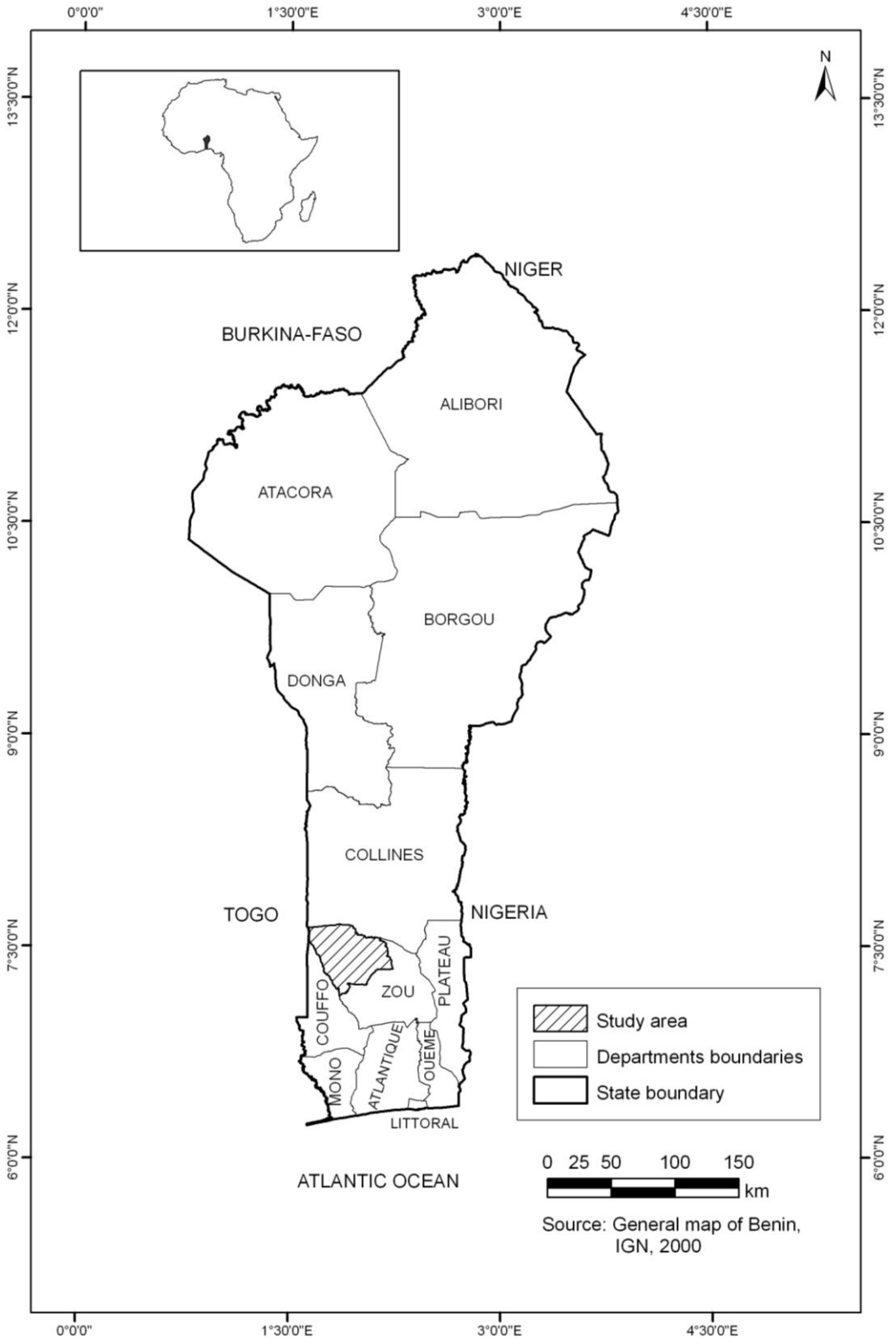

Figure 1. Location of study area.

practiced by the Fulani and some are transhumant while others have settled down. Djidja District is therefore known as a reception for transhumant from Togo, Niger and the northern part of Benin. The availability of pasture in savannas and water points along the

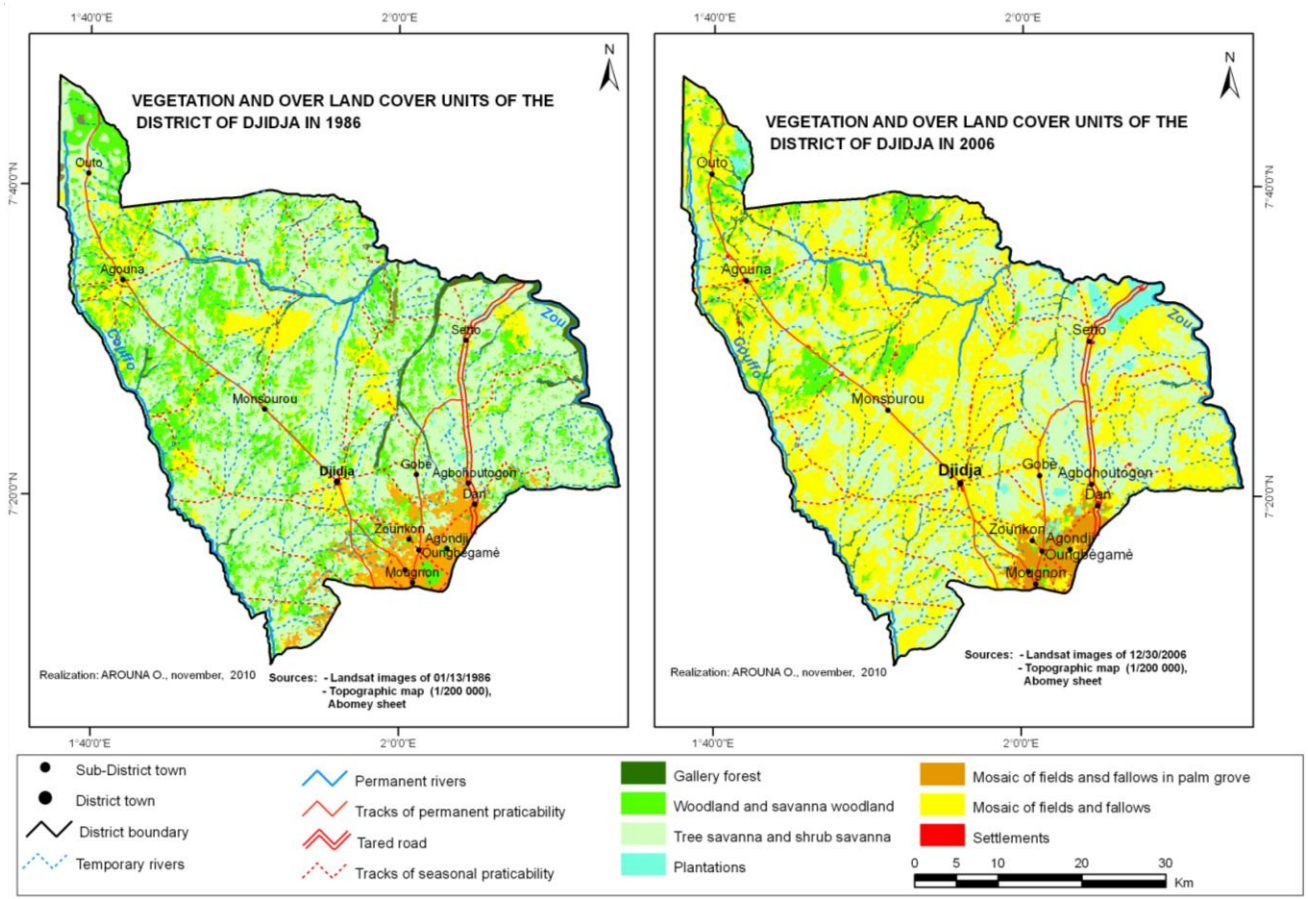

Figure 2. Vegetation and over land cover units of District of Djidja in 1986 and in 2006.

river are the factors which contribute to such activity. Coexistence between pastoralists and farmers is hard and often generate conflicts since they are two competing activities relative to land use. The timber logging is well developed in this District. Most loggers reside in urban centres like Bohicon and Abomey cities while valuable timber species namely: *Khaya senegalensis*, *Pterocarpus erinaceus*, *Afzelia Africana, Diospyros mespiliformis, Pseudocedrela kotschyi* and even *Daniellia oliveri* and *Anogeissus leiocarpa* are exploited in all vegetation types even in riparian forests, despite the prohibition by the forestry regulation in Benin (RB 1993, 1996. Although their fragmentation by agriculture (through the technic of slash and burn cultivation), overgrazing and wildfires, vegetation types are subject to charcoal production.

Sampling and data collection

The main actors surveyed are those whose activities are related in one way or another to vegetation. They are mainly farmers, ranchers, loggers and charcoal producers. Since the statistics on these actors are not available, the sample size to investigate at the level of each category of actors has been determined by the following formula (Dagnelie, 1998):

$n = 4P (1-P) / d^2$

Where P is the proportion of each category of actor

Table 1. Distribution of the different actors surveyed.

Actors	STD	SMD	SPD
Farmers	87	87	87
Cattle breeders	55	55	55
Charcoal producers	35	35	35
Loggers	30	30	30
Total	207	207	207

STD: Sector where the vegetation is much degraded. SMD: Sector where vegetation is moderately degraded (MDS). SPD: Sector where the vegetation is little degraded.

obtained from an exploratory survey: d is the margin of error, between 0 and 20%. A total of 621 individuals were surveyed in three sectors and thus, 207 actors per sector when considering three levels of degradation of vegetation: the area of vegetation highly degraded (STD), the area of vegetation moderately degraded (SMD) and the area where vegetation is less degraded (SPD) (Table 1).

The surveys were conducted in localities within the three sectors. With the support of local authorities, the different actors were identified. Four questionnaires were developed for the four categories of actors. These questionnaires were intended to farmers, ranchers, loggers and charcoal producers. The preferred mode of interview is the interview led by investigator and specifically the face-to-face because it achieves a highest rate of response to the greatest number of questions (Ghiglione and Matalon, 1978; Combessie, 2001). The interest points of these questionnaires are the collection of activities that degrade the vegetation. The views of the stakeholders were collected on the activities contributing to vegetation degradation. The focus points in the questionnaires of different actors, aim at obtaining a cross-perception of all stakeholders whose activities affect the degradation of the vegetation.

Data processing

The calculation of frequencies and factorial analysis are the main methods of analysis through SPSS software (Statistical Package for Social Sciences) and MINITAB software. The frequencies of the different perceptions of socio-economic determining factors were calculated. These frequencies of perception of a category of actors related to a socio-economic factor represent the scores of this socio-economic factor in the degradation of vegetation from the view point of populations. Histograms were then built from these scores, to show the level of contribution of each socio-economic determinant of vegetation degradation according to population.

To better analyze the perception of socio-economic factors of different actors, factorial analysis were performed. The factorial analysis is a multivariate analysis technique, which aims to describe the relationship between terms of two sets of characters in a contingency table (Glèlè and Kokodé, 2004). This multivariate analysis technique displayed a cross-reading of the perceptions of all actors through the three sectors.

RESULTS

The socio-economic determinants of vegetation degradation are actually the socio-economic activities that directly affect vegetation and contribute to change its structure. These are agriculture, breeding, logging and charcoal production. These socio-economic determining factors have been analyzed at two levels: perception of the socio-economic determinants by category of actors and a cross analysis of the perception of all actors.

Perception of the socio-economic determinants of vegetation degradation by the farmers

The perception of the socio-economic determinants of degradation of the vegetation by farmers is presented in Figure 3. Most of the farmers believe that the charcoal production, logging, breeding and hunting and at a least extent, agriculture have negative impacts on vegetation. For these farmers, charcoal production, logging and breeding are especially the main causes of degradation of the vegetation. For them hunting is seen as a major source of degradation of the vegetation, as hunters in search of animal to shoot, kindle fires, that decimated vegetation over large areas. They think that farming is also a cause of degradation of vegetation cover but not to the same extent to other activities. They justify this by suggesting that farmers who use fertilizers can practice intensive agriculture and contribute little to vegetation degradation. One wonders if the classification of agriculture as the least cause of the degradation of vegetation by farmers themselves is not a strategy to deny their own responsibility.

Perception of the socio-economic determinants of vegetation degradation by the cattle breeders

Through their activities, the cattle breeders are in contact with natural vegetation that makes to have knowledge of the state of vegetation as they look for permanent pasture. Breeders believe that agriculture is first and foremost primary cause of the decline in vegetation cover, followed by logging and charcoal production (Figure 4). On the contrary, hunting and livestock hold the least share in vegetation degradation. The fact that more than 90 % of breeders felt that their own activities degrade less vegetation could be seen as an escape from responsibility.

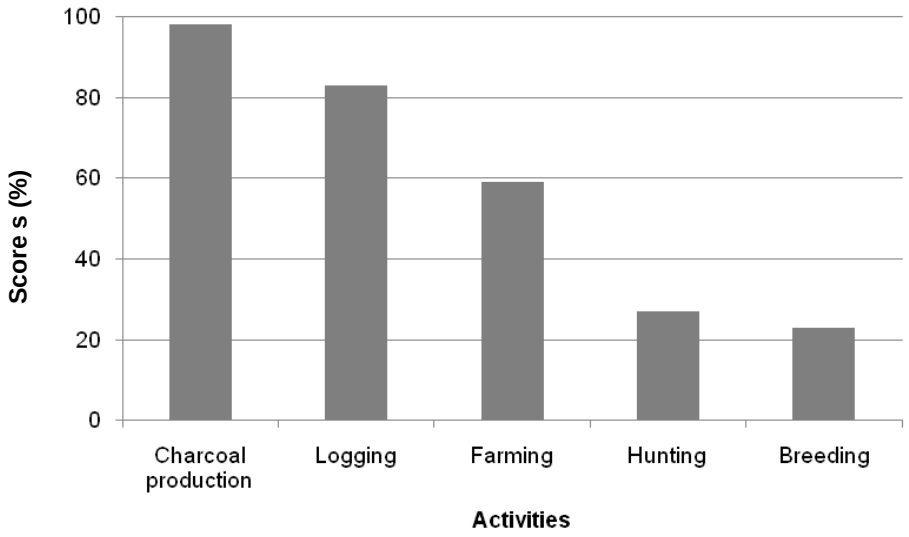

Figure 3. Perceptions of the socio-economic determinants of vegetation degradation by the farmers.

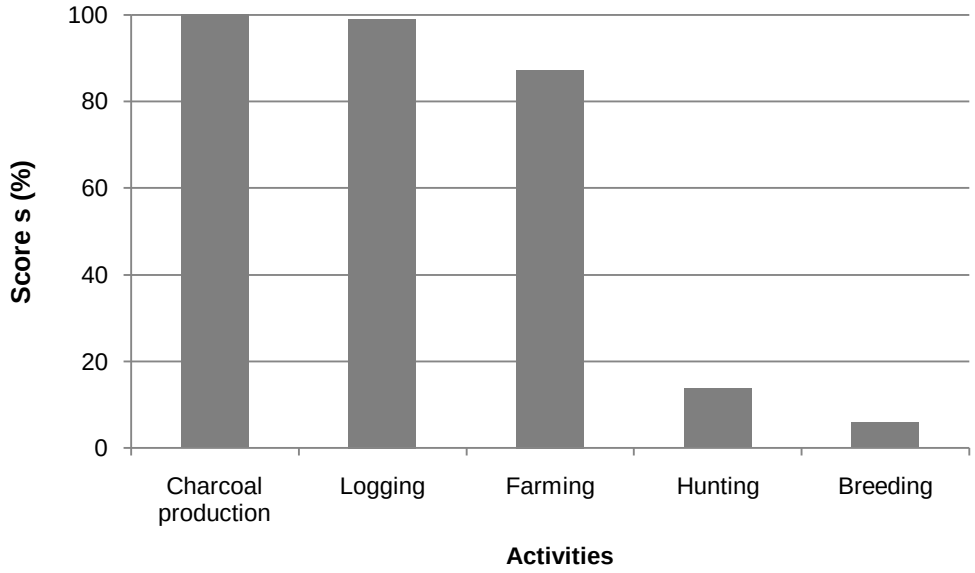

Figure 4. Perceptions of the socio-economic determinants of vegetation degradation by the cattle breeders.

Perception of socio-economic determinants of vegetation degradation by loggers

Logging concerns the cutting of timber and timber service. Forest loggers perceive that agriculture is the primary cause of degradation of vegetation cover (Figure 5). Then, charcoal production and logging which are also recognized as important causes of degradation of vegetation cover regarding their very high scores. Hunting and breeding cattle contribute little to vegetation degradation according to forest loggers.

Perception of the socio-economic determinants of vegetation degradation by charcoal producers

The charcoal production is the exploitation of wood to get charcoal by using fire as carbonizing agent. Like other actors except the farmers, charcoal producers believe that agriculture is the first destructive activity of vegetation cover (Figure 6). Unlike the loggers, charcoal

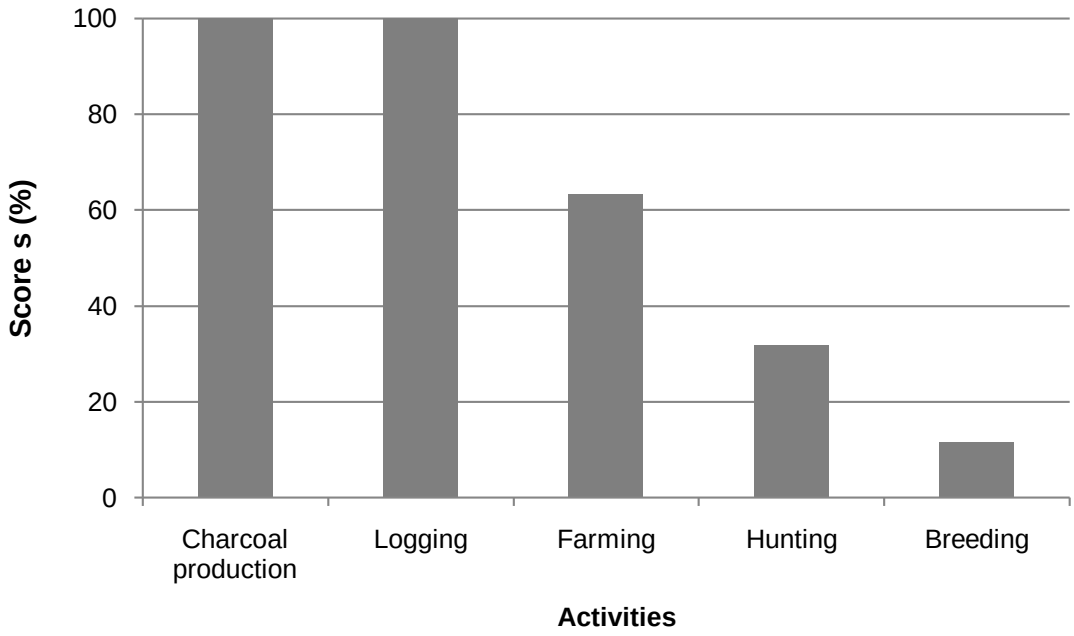

Figure 5. Perceptions of the socio-economic determinants of vegetation degradation by the loggers.

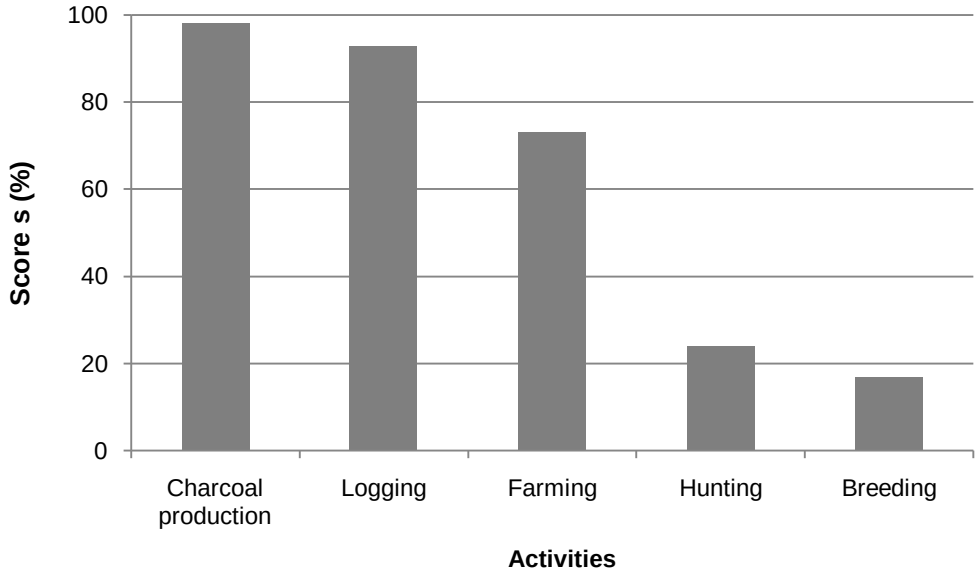

Figure 6. Perceptions of the socio-economic determinants of vegetation degradation by the charcoal producers.

producers think that logging is the second cause of vegetation degradation after agriculture. They think that their activity comes in the third position in terms of factor of degradation of vegetation cover. Like all other actors except the farmers, charcoal producers believe that cattle breeding and hunting contribute little to vegetation degradation.

Cross-reading of the perceptions of all the actors

To better describe the perception of actors, a factorial analysis has been conducted with the number of actors who considers each activity as a source of vegetation degradation. The results of this analysis indicate that the first two axes explain 94.8% of the information obtained,

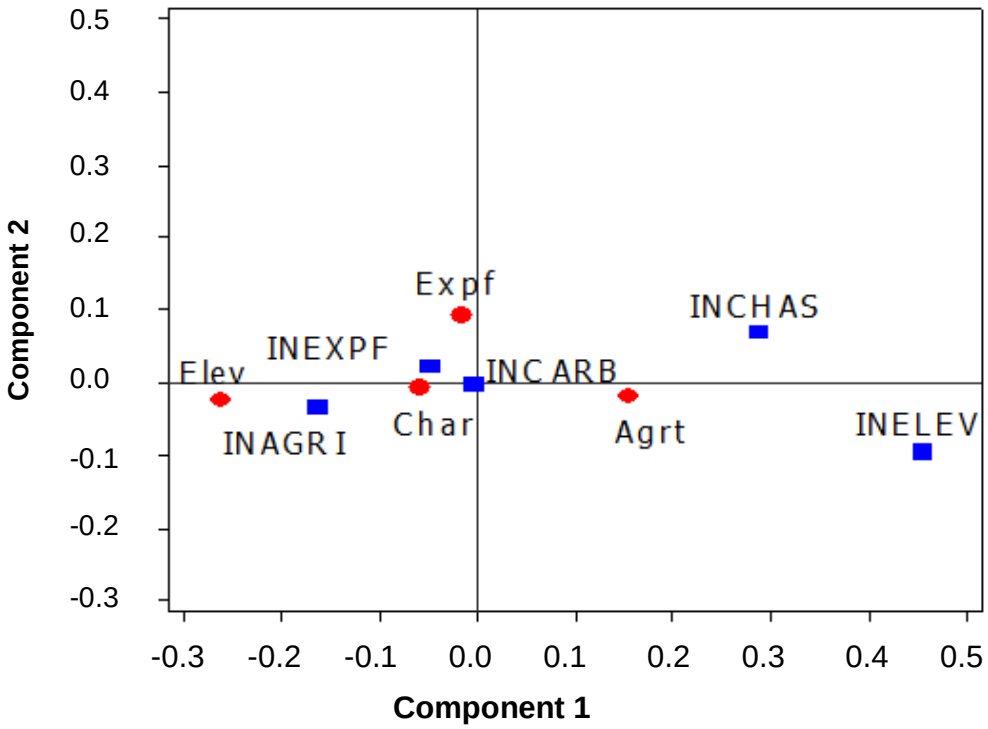

Figure 7. Projections of the perceptions of the socio-economic determinants of all the actors in the system axes 1 and 2. INAGRI: Farming; INEXPF: Logging; INCARB: Charcoal production, INELEV: Breeding; INCHASS: Hunting; Elev: Breeders perceptions; Char: Charcoal producers perceptions; Expf : Loggers perception ; Agrt: Farming perceptions.

this is more than enough to make a good synthesis of information. We note that axis 1 (Figure 7) relates mainly to actors such as ranchers and farmers on one hand, and activities such as livestock, agriculture and hunting in other hand. Following the axis 2 (component 2) is formed by forestry and hunting activities. The projection of the modalities of answer in the system of factor axes indicates a conflict of perception between breeders and farmers concerning the activities that contribute most to the degradation of the vegetation. This raises the persistent problem of conflicting relationships between farmers and breeders. It results from the analysis that most of the farmers think that hunting and breeding constitute the greatest threats on vegetation, while breeders think otherwise by asserting that agriculture is rather the greatest factor impacting negatively on vegetation. More fundamentally, agriculture, charcoal production and logging are seen as the most important causes of degradation of vegetation by most of the actors except the farmers.

To understand the perceptions of stakeholders in considering the level of vegetation degradation (severely degraded sector, moderately degraded sector and sector slightly degraded), a factorial analysis was performed on data taken at these three sectors level with different activities (Figure 8). Thus, pictures the projection of different sectors of degradation and the different activities that can have negative impacts on vegetation. The results of this analysis show that the first two axes explain 100% of the information collected, with Axis 1 explains 91.09% of the information. An examination of Figure 8, shows that on axis 1, hunting (INACH) is seen as the major cause of vegetation degradation by the actors of the moderately degraded sector (SMD), charcoal production and logging are considered as the main causes of vegetation degradation in the slightly degraded sector (SPD) and agriculture and breeding are considered as the major factors of degradation of vegetation in severely degraded sector (STD).

DISCUSSION

Agriculture, logging and charcoal production are the main socio-economic determining factors of vegetation degradation according to local perceptions. Then, breeding and hunting follows. The importance of these last two activities as well as that of agriculture has changed within farmers. Definitely, three categories of actors (breeders, loggers and charcoal producers) out of four believe that agriculture is the first direct cause of degradation of vegetation cover. Cultivation techniques including agricultural clearing of vegetation cover bare wood of various sizes. Sounon et al. (2007) summarized

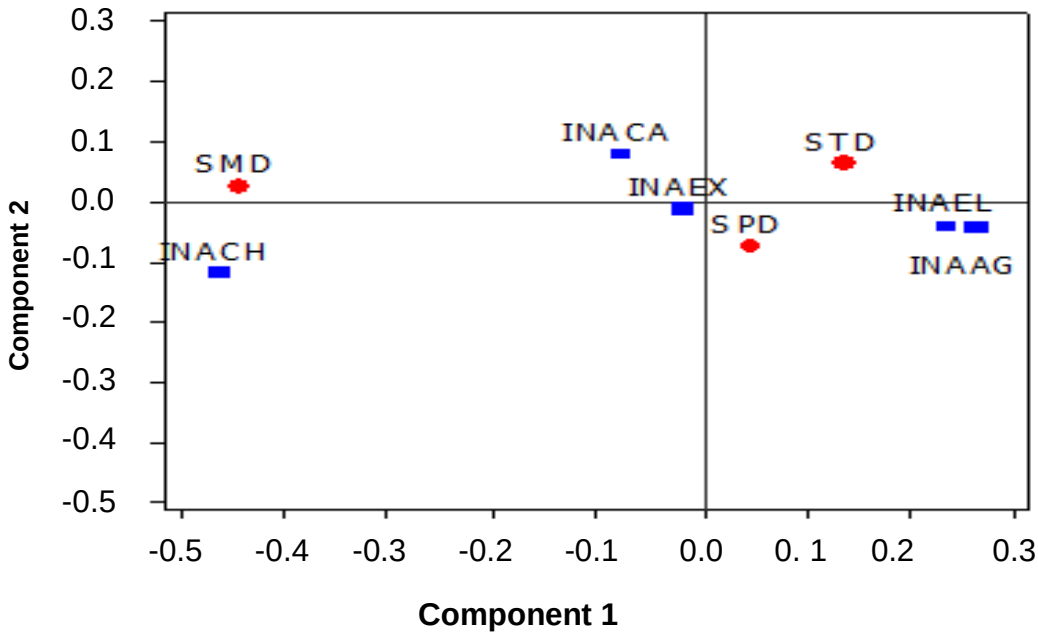

Figure 8. Projections of the socio-economic determinants of vegetation degradation and the different sectors in the system axes 1 and 2. INAGRI: Farming; INEXPF: Logging; INCARB: Charcoal production, INELEV: Breeding; INCHASS: Hunting SMD: Secteur moyennement dégrad; SPD: secteur peu dégradé; STD: Secteur très dégradé STD: Sector where the vegetation is much degraded, SMD: Sector where vegetation is moderately degraded, SPD: Sector where the vegetation is little degraded.

this situation by noting that once a site is cleared, trees and shrubs are destroyed to pave the way for crops to get as much as possible the sunlight. Cropping areas are almost devoid of timber, except a few and so sparse number spare for socio-economic reasons (Sodhi et al., 2008), by summing up the impact of human activities on vegetation types on the basis of 150 scientific articles have concluded that agriculture is the first activity disturbing the entire ecological balance, beyond the vegetation degradation.

Carbonization (charcoal production) and logging are also recognized by local people. Agriculture, logging and charcoal production are the main socio-economic determining factors of vegetation degradation according to local perceptions. Then, breeding and hunting follow. The importance of these last two activities as well as that of agriculture has changed within farmers. Definitely, three categories of actors (breeders, loggers and charcoal producers) out of four believe that agriculture is the first direct cause of degradation of vegetation cover. Cultivation techniques including agricultural clearing of vegetation cover bare wood of various sizes. Sounon et al. (2007) summarized this situation by noting that once a site is cleared, trees and shrubs are destroyed to pave the way for crops to get as much as possible the sunlight. Cropping areas are almost devoid of timber, except a few and so sparse number spare for socio-economic reasons (Sodhi et al., 2008), by summing up the impact of human activities on vegetation types on the basis of 150 scientific articles have concluded that agriculture is the first activity disturbing the entire ecological balance, beyond the vegetation degradation.

Carbonization (charcoal production) and logging are also recognized by local people as important determinants of vegetation degradation. Loggers and charcoal producers cut valuable species without taking into account, the legal size (minimum diameter) and the time period frequency for logging (Afouda et al., 2003). These activities entail the establishment of a network of trails all over inaccessible vegetation types and therefore, give easily access to farmers and loggers. At the end of logging, farmers, breeders and firewood gatherers take possession of the land and turn it into another type of land use (Roper, 1999). Foresters recognize that the volume of timber harvested is proportional to the area of cropping and land clearing (Monnier, 1981). The logging and charcoal production by destroying trees and shrubs encourage land clearing for agriculture and other uses.

The negative impact of cattle breeding on the vegetation appears to be insignificant by all actors except the farmers. Although Boutrais (1992), by studying the impact of livestock on ecosystems, has concluded that a moderate family of breeders use space, 50 times more than its equivalent family of farmers in Cameroon. Moreover, the bulk of the forage feeding cattle during the dry season is mainly given by fodder woody species (Feoli et al., 2003; Arouna, 2002). The woody stratum as a stability element of the vegetation is so severely

disturbed. The share of livestock in vegetation degradation appears to be more significant in contrast to local actors' perceptions.

Hunting contributes to the degradation of vegetation cover through vegetation fires put on by hunters and poachers to release the game-rich environments. These delayed wildfires often destroy vegetation at a large scale.

In total, the socio-economic determinants of vegetation degradation according to the perceptions of local people are agriculture, logging, and charcoal production, breeding and hunting. Among these factors, agriculture ranks first. These perceptions are confirmed by the results of the factorial analysis. The two first axes of factorial analysis explained more than 90%, this indicates a good synthesis of information. The opposition in perception between farmers and cattle breeders is an indicator of concurrent use of land by these two categories of actors (Arouna, 2002). The change in perception of the most important determinant in considering the level of vegetation degradation by area, revealed by the factorial analysis can be interpreted as the dominance of these socio-economic activities by areas.

Conclusion

Local perceptions of the socio-economic determinants of degradation of vegetation cover are agriculture, charcoal production, logging, breeding and hunting. The logging and charcoal production while contributing to the degradation of vegetation cover, promote farming by facilitating access to relatively closed areas through forest tracks. Farming and hunting respectively through the pruning of tree fodder and the use of fire to clear the game areas are also socio-economic factors of degradation of vegetation cover. The interactions between these socio-economic factors make it difficult to find out the share of each factor in the degradation of vegetation cover. Considering the importance of these socio-economic activities to meet the vital needs of the local people, it is necessary to include these different activities within the general framework of regional planning in taking into account population growth, poverty, demand for agricultural products and other resources that are the underlying factors of vegetation degradation.

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