

Full Length Research Paper

Vulnerability of agro-pastoral farms to climate change in Dakoro

Sidibe Boubacar Roukayatou^{1*}, Lawali Sitou² and Ali Mahamane³

¹Département de Biologie, Faculté des Sciences et Techniques, Université Dan Dicko Dankoulodo de Maradi, Maradi, Niger.

²Département de la Sociologie et d'Economie Rurale, Faculté d'Agronomie et de l'Environnement, Université Dan Dankoulodo de Maradi, Maradi, Niger.

³Département de Biologie, Facultés des Sciences et Techniques, Recteur de l'Université de Diffa, Niger.

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In Niger, climate change affects the majority of the population, especially the rural communities. The present study intends to contribute to the understanding of the actual perception of climate changes by the population along with the degree of apprehensiveness of the population regarding the climatic manifestations described by scientists. To this end, two communities have been targeted in the Department of Dakoro. The data from the study were mainly obtained by collecting quantitative and qualitative information on the community perception of the impacts of climate change and variability. The results of this scientific contribution demonstrate once again the link between the experiences of producers and scientific evidence. Thus, perceptions of the phenomenon of climate change are very diverse and vary according to the communities and their level of vulnerability. The impacts listed include drought, rainfall deficit, rising temperatures and decreasing soil fertility. The rainfall deficit associated with the decline in soil fertility and the resurgence of crop pests weakens the agricultural sector. The livestock system is highly vulnerable to recurring forage deficit, drought, and degradation of grazing areas and, above all, animal theft, which reflects the increased poverty in the area. Further research on the characterization of adaptation strategies to the impacts experienced by producers will be appropriate.

Key words: Vulnerability, climate change, agro-pastoral, Dakoro.

INTRODUCTION

The earth has always experienced climatic fluctuations per cycle of global warming and cooling. Thus, through

the Intergovernmental Panel on Climate Change (IPCC / IPCC) assessment report, the influence of anthropogenic

*Corresponding author. E-mail: roukaya_boubacar@yahoo.com.

actions on climate variability has improved, and it confirms that, human actions have led to global warming (IPCC, 2007). Climate change and variability are real threats to people in developing countries. It has therefore been recognized that Africa in general and the Sahel countries in particular are among the areas most vulnerable to the effects of climate change (CRA, 2009). This vulnerability can be explained by the strong dependence of the economies of these countries on activities sensitive to climate change which otherwise will suffer because of their weak technical, institutional and financial capacities.

Niger with an area of 1 267 000 km², one of the largest countries in West Africa, due to its enclavement and its very variable climate, suffers the full impact of variability and climate change (CRA, 2009). In recent decades, Niger has recorded agricultural and fodder production every three years below the needs of the population, with successively -20 kg / inhabitant in 2000 to 2001, -40 kg / inhabitant in 2004 to 2005 and -28 kg / inhabitant in 2009 to 2010.

In Niger, climate change affects the majority of the population, especially the rural communities. In this sense, in 1995, the country launched the process of drafting and adopting a national environment plan following the Rio de Janeiro Summit, its Initial National Communication (CNI) as well as its National Strategy and Plan of Action on Climatic Change and Variability (SNPA/CVC) in 2003. Niger subsequently elaborated and submitted for funding, in accordance with the Marrakesh accords and the National Adaptation Program of Action (NAPA), which aims to contribute to the transfer of technologies for both mitigation and adaptation to climate change priority needs and needs of the country, which deals with the adverse effects of climate change on vulnerable populations in the perspective of sustainable development (SE/PNEDD, 2008). In a report by NAPA (2006), it is clear that the Department of Dakoro, our study area, is among the areas vulnerable to climate variability and change in Niger. Indeed, SIFEE (2009) reports that the agro-pastoral systems of the Department of Dakoro were experiencing a progressive degradation of the ecosystems (Tarka Valley).

The present study on the vulnerability of producers in Dakoro describes local perceptions and the adaptation of producers to the impacts of climate change. The document is structured around three main points: the first deals with the conceptual framework in which we expose the problem and review some policies on climate change. First is a brief summary of the study area and data collection methods and tools. The second presents the results referring to peasant perceptions of the impacts of climate change. In this part of the analysis, we first analyze natural factors of vulnerability to climate change and then discuss the socio-economic vulnerability

characteristics of the localities studied.

MATERIALS AND METHODS

Study area

Dakoro Department is located in the Northern part of Maradi region of Niger. It covers an area of approximately 12670 km² and borders Bermo Department in the North, Guidan Rounndji Department in the south, Agadez region in the east and Tahoua region in the west. According to the 2012 population census, the department has an estimated population of 631,429 with an average annual growth rate of 4.1% (INS, 2013). This population is predominantly composed of Hausa, Tuareg and Peulhs (Figure 1).

The department of Dakoro is classified among the departments with high climate vulnerability (Tsemogo, 2012). Dakoro Agro-pastoral ecosystems are experiencing progressive degradation due to both natural and man-made factors. The gradual leaching of agricultural soils and wind activities expose them to the silting phenomenon (SIFEE, 2009).

Data collection

Two communes were targeted in the department of Dakoro for the conduct of this study. The data from the study were mainly obtained by collecting quantitative and qualitative information on the community perception of new agricultural practices and strategies adopted to address the impacts of climate change.

Sampling

To determine the sample, we used various criteria (age, sex, household membership, level of vulnerability, etc.). A total of 258 producers were surveyed, including 165 from Azagor and 93 from Bader Goula.

The study took into account the age aspect with 178 respondents who are under 50 years and 80 who were over 50 years. Given the inequality in enrollment between male and female heads of households and gender mainstreaming, the vast majority of respondents, that is 194 men were compared with 64 women. Social categorization was based on four criteria of vulnerability (availability of land, socio economic activities, cultural values, livestock capital, family burden) pre-established by the population with the support of the Adaptation Learning Program (ALP) project: A (Vulnerable), B (Moderately vulnerable), C (Very vulnerable) and D (Extremely vulnerable) (Tsemogo, 2012; Care International, 2010). Thus, the sample included 90 extremely vulnerable household heads, 77 highly vulnerable households, 52 heads of moderately vulnerable households and 39 vulnerable households.

As for the occupational categories, the choice was random. It should be noted, however, that the focus has not been selective, so no distinction of age or social category has been made. This means that the choice of our sample fits perfectly into the dynamics of a combination with the probabilistic method. It is basically trying to put in place new causes to observe new realities.

Collection tools

The tools used in this study were individual questionnaires, focus groups, problem trees and interviews with technical services, CSOs / NGOs working in the field. These tools were validated after several meetings with the project team members to clarify the

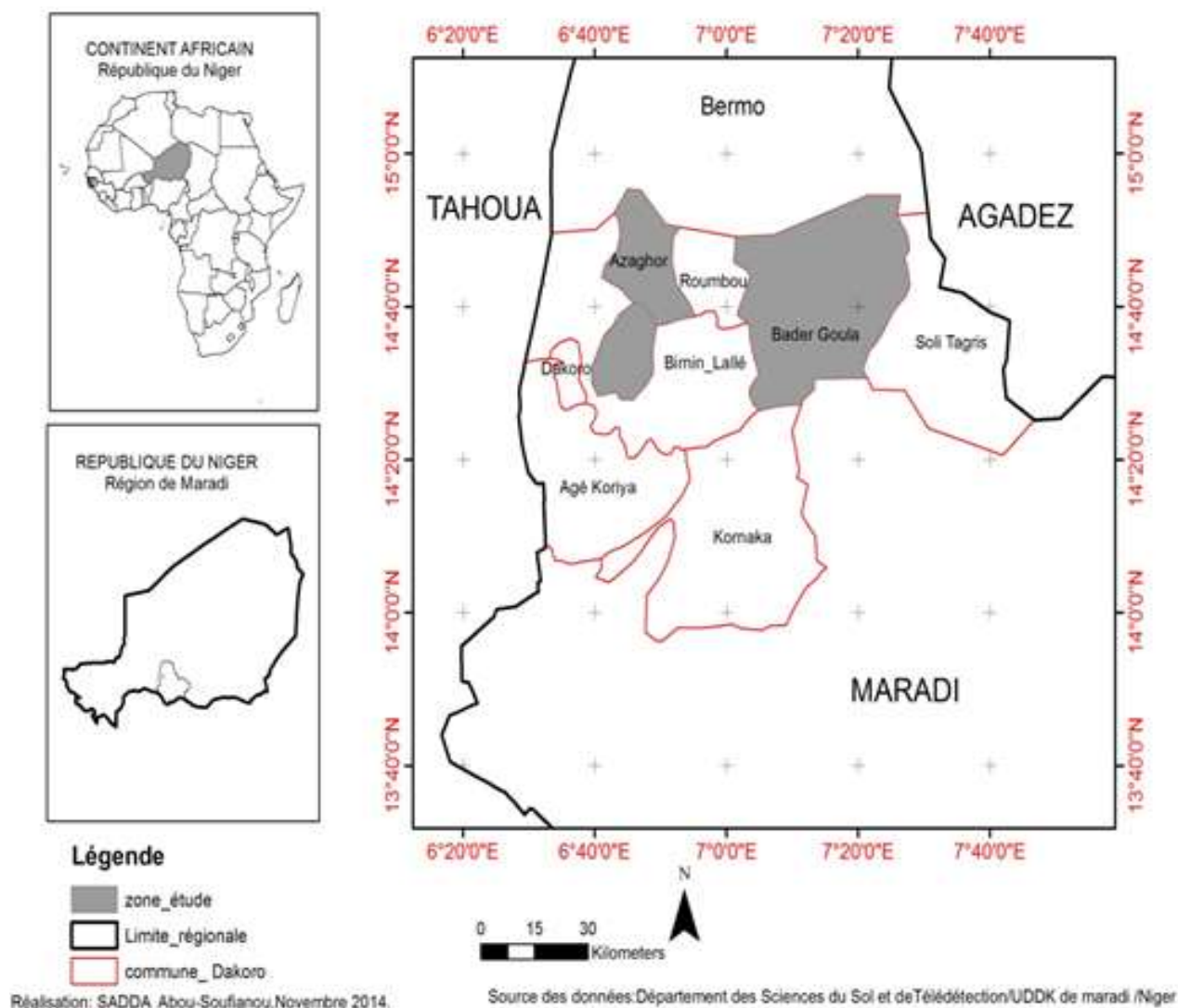


Figure 1. Map of Dakoro Department showing target communes.

different points and allow their good administration to get the target populations. A preliminary evaluation of the tools in a community was mainly aimed at judging the relevance and feasibility of the various guides at the end of which several points were readjusted and refined. The data collection tools were developed on the basis of several indicators. These indicators relate in part to the socio-economic situation of the respondent. A distinction has been made between the number and duration of seasons today as compared to 20 years ago. Through this comparison, the dynamics of impacts on the various environmental components (air, soil, water, animal and plant species, household economies, social relations) between the two periods are identified.

In each community focus groups, women and men were facilitated with 8 to 10 people per focus. In total, a total of 16 focus groups were carried out. This initial work allows to enrich and to diversify the quality of the answers, to arrive at a finer analysis of the results. The problem tree was administered from the focus group to highlight the vulnerability of the breeding system.

Data processing and analysis

After the data collection in the field, we analyzed the various tools. Two types of analyzes were used to exploit this data collected using the SPSS 16.0 software. The variables analyzed are producer perceptions and producers' vulnerability indicators supported by direct evidence and observations, to confirm these perceptions. Basically, these different analyzes have highlighted the illustrations and the diversity of the testimonies of the populations encountered. Descriptive statistics conducted in Microsoft excel 2010 were used to summarize the data.

RESULTS AND DISCUSSION

Producer vulnerability

Vulnerability is not limited to the manifestation of a level of

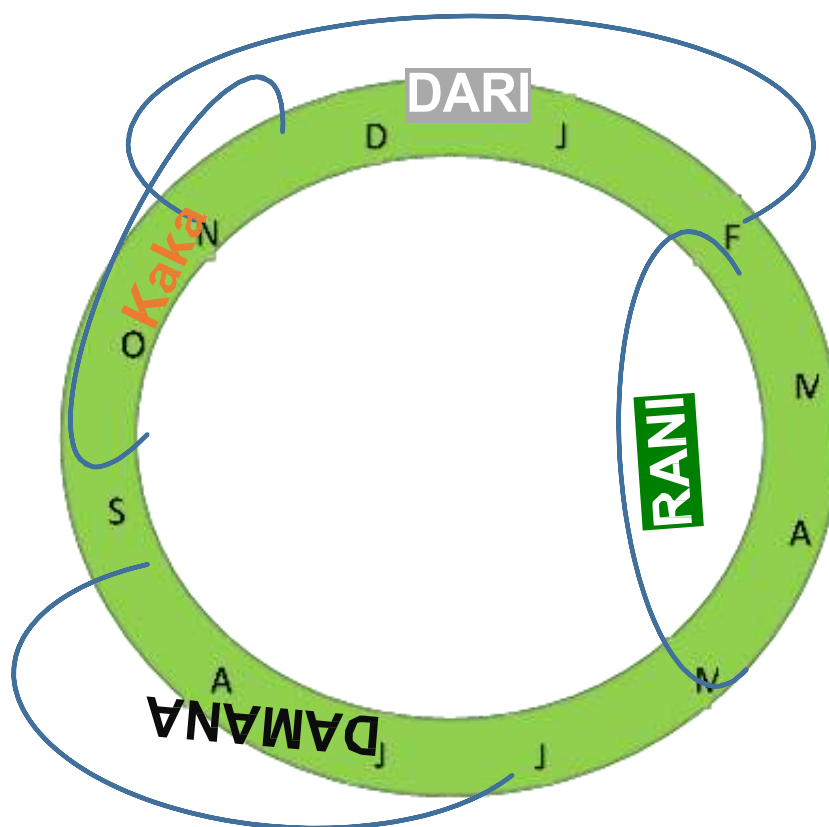


Figure 2. Seasonal calendar.

poverty, it is multifaceted. It varies according to the socio-economic and agro-ecological characteristics of agricultural holdings. The results of the study allowed us to identify four (4) dimensions of vulnerability:

1. Environmental dimension of agro-pastoralist vulnerability

In Dakoro Department, more than 90% of climate vulnerability factors are caused by natural phenomenon: rainfall deficit, increase in temperature, drought and the frequency of lime and violent winds. The analysis of the peasant perception of diversity and the evolution of seasonal variability has revealed a profound change in the length of the seasons. In all communes of Dakoro, the agricultural calendar is divided on four major seasons: dry or "Rani", harvest or "Kaka", winter or "Dari" and rainy or "Damana" season. This result support the data of Lawali (2011) obtained in Tchadoua (Maradi) department (Figure 2).

(a) *Dari*: Commonly known as the cold and dry season, which extends from November to February, this season

is characterized by low temperatures, conditions favorable to the practice of irrigated crops.

(b) *Rani*: Period from the end of the cold season (February) to the arrival of the first rainy days (June) is marked by high temperatures up to 42°C. This is the period during which exodant go to urban centers.

(c) *Damana*: This season extends from the beginning of the first rains (June) to the harvest period (September), it is the rainy season.

(d) *Kaka*: This is a short period between the rainy season and the beginning of the cold season, commonly known as the harvest period. It is characterized by an abundance of food and pasture; in this sense, there are widespread damage caused by several conflicts between farmers and breeders.

In terms of climate change, more than 90% of household heads have extended the length of the warm season, while the rainy season is shortening its duration. According to the respondents, winter appears to be unchanged except there is a discrepancy and sharp decrease in excessively low temperatures in Dakoro area (Figure 3).

Analysis shows that rainfall is no longer regular in time

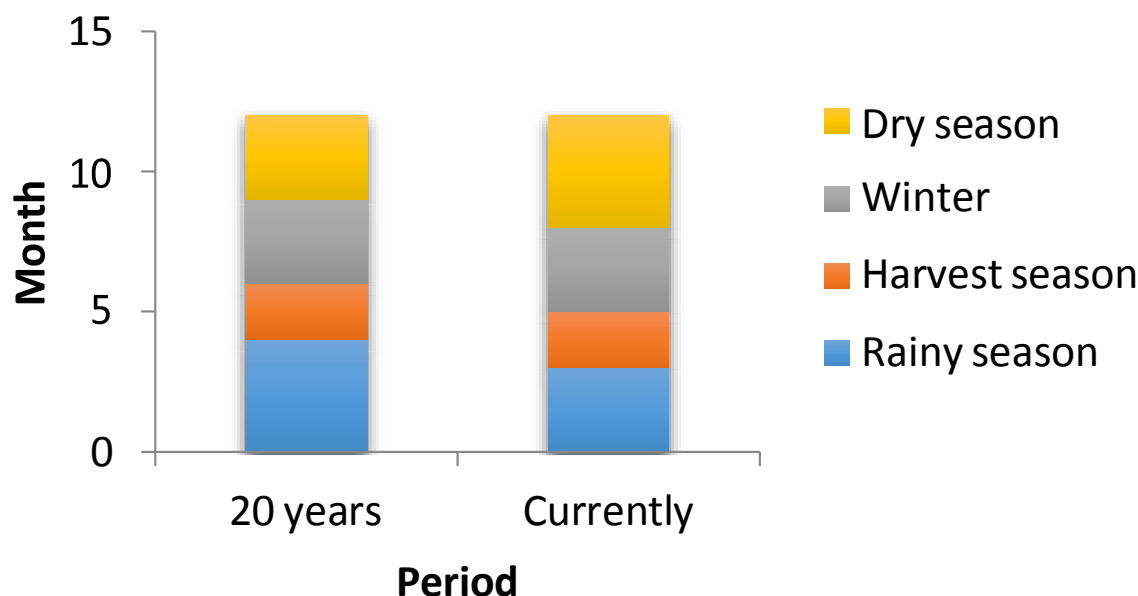


Figure 3. Variation of the duration of the seasons over a period of 20 years.

and space. The rains that began between May and June are now recorded in the second half of July at the beginning of August. In Bader Goula, during the winter season the first rains were recorded in June and spread out until September. At the same time in Marafa (Azagor commune), the first rains fell only in late August and intense rains were recorded in September and October.

Moreover, in most of the areas, the first rains were recorded in April and extended until October, but almost half of the rainfall rains fell in August (197.5 mm in 12 days). The periods of intense heat are characterized by maximum temperatures of up to 50°C in the months of March and April. As a result, 80% of respondents recall that during the dry and cold season, low temperatures occasioned a circle around the fire to warm up and nowadays temperatures are no longer freezing. Thus, result confirms that Tsemogo (2012) describes the shortening of the rainy season that the populations perceive in Dan Sarko communes (Dakoro). These results are also, similar to the study of Mkoka (2008), which explains that in recent years in Malawi, the seasons have lost their regularity in almost all regions of the country. Rainfall is sometimes one month late or stops early.

What are the consequences of the seasonal variation on the production potential? On the edaphic plane, the perceptions of the producers reveal a multitude of natural and anthropic causes (Figure 3), which contribute to the decline of fertility. The soil has suffered the most dramatic decline in fertility for 20 years, moving from "very fertile" to a "non-fertile" state as a farmer puts it:

"Before we did not plow more than twice. Another farmer supports this opinion. According to him: "as soon as we sowed, we went to pasture and returned only to reap the good production, this is no longer the case."

Thus, excessive logging and inadequate rainfall coupled with overexploitation of agricultural land has led to a significant reduction in yields. Deficient irrigation subjects the crop to water stress, sometimes throughout the period of decline, which can cause a drop in yield (Mkoka, 2008). In Dakoro, this drop in yield led more than half of the farmers to abandon the maize crop in view of its demand for water and nutrients through the use of fertilizers. A study found that the 2012 drought in the US Midwest reduced the expected maize crop by 25%.

Cultures are also attacked by crop pests that appear to be related to climatic variability and the appearance or disappearance of certain crop pests such as *Gerbillus nigériaen*, *Heliocheilus albipunctella*, *Pachnoda interrupta*, *Passer luteus* and *Quelea quelea*. Farmers' perceptions and expertise allow them to assume that, higher temperatures will increase the fertility and growth rate of insect pests and the frequency of epidemics. These perceptions support IFRI's (2009) research which indicates that higher temperatures reduce crop yields while causing weed and parasite proliferation.

2. Early drainage of water points

Another element of producer vulnerability is the scarcity of water. The depth of the water table varied between 20

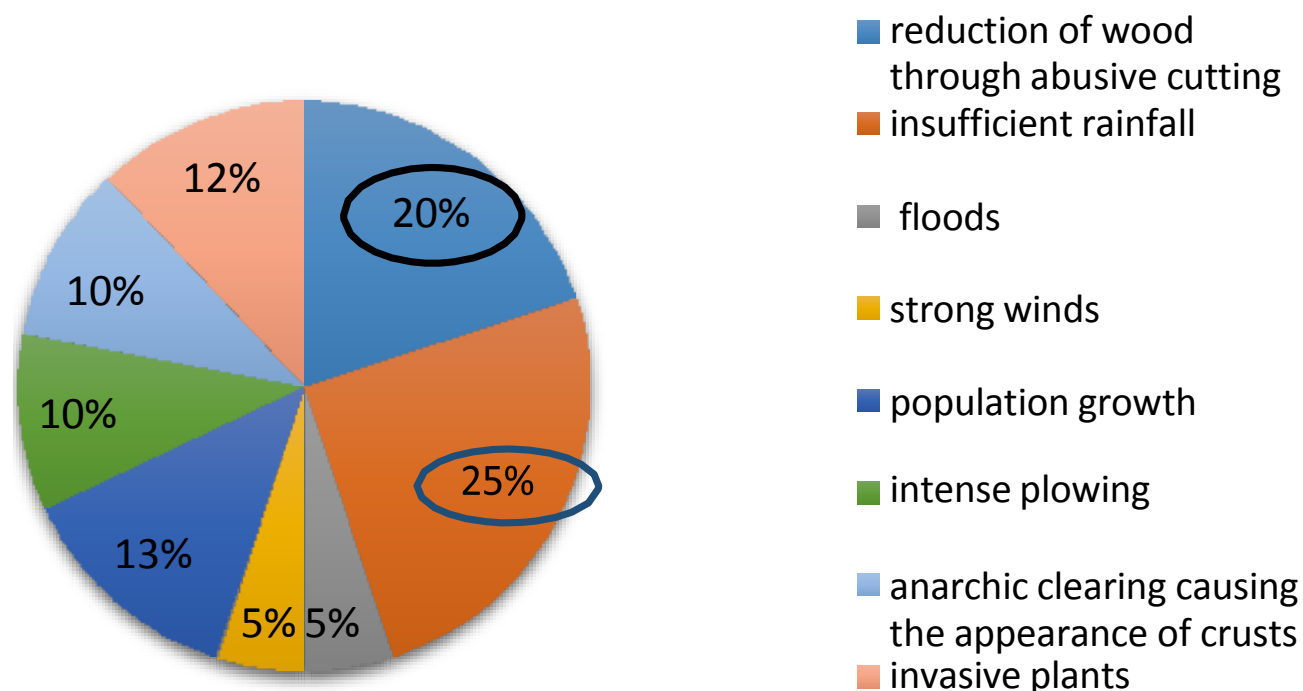


Figure 4. Causes of declining soil fertility.

and 80 m. The amount of recharge of the wells depends on the precipitation recorded. The spatio-temporal irregularity of precipitation causes a lowering of the water table. Water, a free-access resource becomes the object of speculation and monetarization in the pastoral zone. In addition, all these water resources are threatened with silting and / or rapid drying which modify their regime.

Climatic variability and floristic distribution: Climate change has had a real impact on the floristic distribution. Many species have disappeared and the landscape is completely transformed, as one of the interviewed farmer pointed out: "When we were little, we dared not go more than 100 m from the dwellings without soliciting the company of an older brother because the trees were less than 50 m from the huts and stretched as far as the eye could see. Then, one could count more than 400 trees per hectare unlike today that one can see a village from more than 1 km away". Figure 5 describes species that have disappeared over the years.

Species sensitive to the impacts of climate change are severely affected because they do not tolerate rainfall deficit and decrease soil fertility. Thus, species such as *Hyphaene thebaica*, *Schlerocarya birrea* and *Commiphora africana* are threatened with extinction in the Dakoro area). These species are considered by villagers to be the most sensitive to the impacts of climate

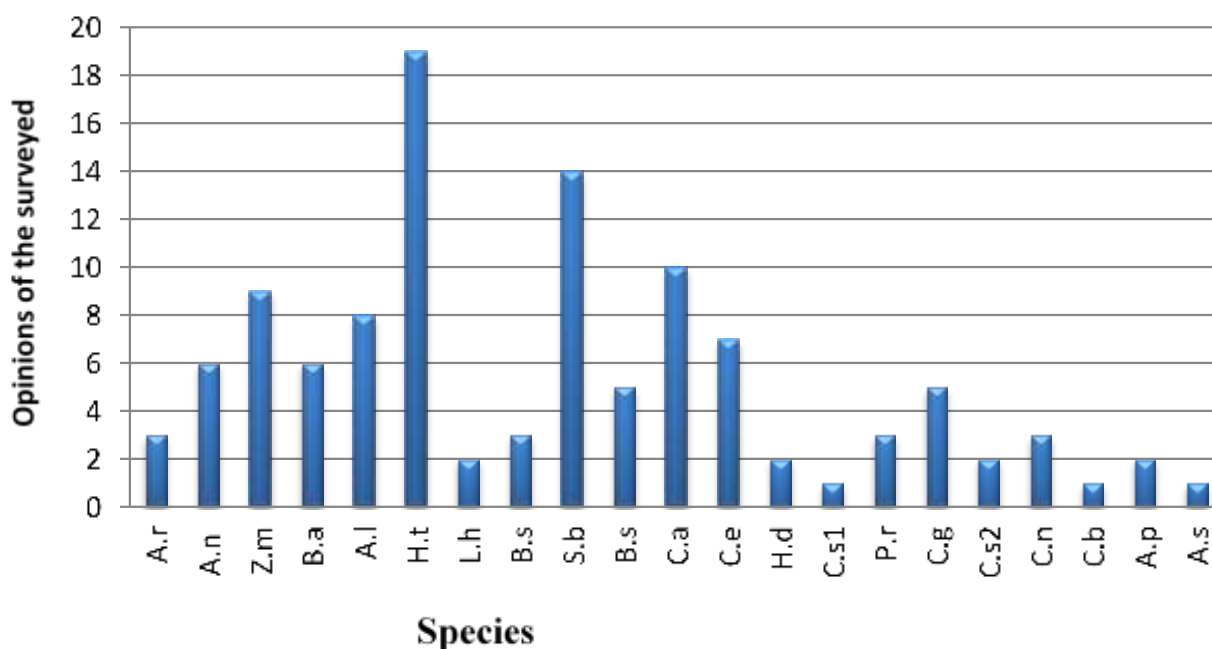
change because they cannot tolerate rainfall deficit and decrease soil fertility (Figure 4).

This perception supports the research of the clearing house of information on biodiversity in Niger, which in 2008 already listed the latter as a species threatened with extinction. *Acacia senegal*, *Cenchrus biflorus*, and *Hyparrhenia dissoluta* are highly endangered. The few remaining samples are resistant to rainfall deficit, degraded soil and, above all, anthropogenic activity in the south of the department, whereas they are almost non-existent towards the north.

3. Socioeconomics dimension of the vulnerability of agro-pastoral farms

In terms of population distribution, the Nation Statistic Indices (NSI) surveys (2013) point out that the Dakoro Department has the highest human concentration of about 18% in the Maradi region. With a population of 5565 and 68,203 inhabitants, respectively in Azagor and Bader Goula, the population pyramid of these districts has a narrowed structure and a gender imbalance with a high proportion of women and young people. Demographic pressure is identified as a pressing factor in the basic livelihoods of agro-pastoralists.

Polygamy is one of the primary drivers of the rising demography in these countries, and majority of the



A.r: Acacia radiana

A.n: Acacia nilotica var adensoinia

Z.m: Ziziphus mauritiana

B.a: Balanites aegyptiaca

A.l: Acacia laeta

H.t: Hyphaene thébaica

L.h: Leptadenia hastata

P.r: Piliostigma reticulatum

C.s2: Cassia singueana

A.p: Andropogon pseudapricus

C.a: Commiphora africana

H.d: Hyparrhenia dissoluta

C.e: Ctenium elegans

C.n: Combretum nicranthum

S.b: Sclérocarya birrea

C.b: Cenchrus biflorus

B.s: Boscia salicifolia

C.g: Combretum glutinosum

A.s: Acacia senegal

C.s1: Cymbopogon schoenanthus

Figure 5. Species that disappeared in the study area.

producers (89%) belong to the socio-ethnic group Hausa. With two, three or even four wives, polygamy thus accentuates the maternity of women in view that each co-wife aspires to have the most heirs who must possess a subsistence capital. This leads to the division of land so that each heir can benefit from an agricultural operation. The land is no longer left fallow because of land saturation to meet ever-demanding needs.

4. Ceremonial practices vulnerability factors

In the Hausa society, traditional ceremonies are usually exorbitantly expensive and often above the means of the household head. Inter and intra-community social relationships influence a strong mobilization of friends

and relatives to the ceremony and large attendance means more guests to feed. These obligations sometimes make the host sell his land and / or animals in order to be able to afford the ceremony. The average cost of wedding ceremonies is around 550,000 FCFA, or about 840 €, which is very expensive for a household head who lives on less than one euro a day.

Rural exodus: Vulnerability or adaptation strategy?:

Practiced by 15.4% of the producers, the end of the rural works offers the able-bodied men the possibility of migrating towards the receptive zones (Maradi, Nigeria, Libya, Ivory Coast, and Benin), in the quest for greener pastures.

This practice makes the family of the emigrants vulnerable. This is because when the husband goes

away without news or sending money back home, women must be resourceful (Maja-Maja) in order to meet the needs of children. As a result, the entire society becomes more vulnerable to disorderliness.

Discrimination and social: A tiny fringe of the community (5%), in particular the "Black Tuaregs", still admit to living at the mercy of their masters "White Tuareg". The surprising thing is that these black Tuaregs consider this practice as hereditary and dependent on the social system. As a result, slaves do not have access to social benefits such as access to land and livestock. Lack of land / livestock capital coupled with poverty and societal marginality and increases the vulnerability of producers to the impacts of climate variability. Of course, even people living in certain opulence suffer the multifarious effects of vulnerability; these categories nicknamed "the haves" have effective coping mechanisms, which remain the most destructive of the natural ecosystems through their lifestyles. According to a black Tuareg:

"I have no plots of land to cultivate, I just raise my master's animals and carry out all the tasks he requires, and thus I make a living to meet the needs of my family. My children and my wife also work with me and offer the same services to the children and the wife of my master. We are never consulted in the event of decision-making but we are proud of this life because without them life will be difficult for us as they have the money and power".

Fragility of livelihoods: The main economic activities of the communities include agriculture, livestock, trade and crafts. In Azagor, livestock is practiced by 72% of the producers. On the other hand, in the commune of Bader Goula, agriculture is the first economic activity practiced by almost 86% of households. The main crops are millet, sorghum, cowpea and very low groundnut. This agriculture still retains an extensive character, remaining mainly manual using rudimentary tools (for example hilaire and daba).

Moreover, farmers face the problem of selling their products to neighboring markets or to Dakoro due to lack of access, despite low yields due to seasonal variability. Their added value is diminished by the fact that it is the traders who move from terrain to terrain to stock up that make the most profit. These results corroborate with Sabo (2010), which describes the suffering of producers as to the flow of their products of survival. Trade is developed in the municipality of Azagor by lack of market.

Shopkeepers and street vendors buy their goods from the weekly market in Dakoro or in the town of Bader Goula, where commercial activities are intense (practiced by 35% of producers). Even though craftsmanship still

retains a rudimentary character, it remains an important income-generating activity, particularly in the community of Makeraoua (Bader Goula commune) where women engage in mat making and pottery.

In recent years, communities have been under recurrent pressure on their livelihoods. 20 years ago, 97% of farmers lived solely on income generated by agriculture. Today, only 69% of producers are self-supporting. Crop yields decreased drastically from 100 boots / ha (1500 kg / ha) 20 years ago to less than 50 boots / ha (750 kg / ha). If this trend continues, less than 20% of the farmers will harvest 50 boots / ha by 2030. 20 years ago, 75% of the cattle farmers managed to meet almost all their needs with proceeds from livestock, this estimated that about 31% of those who manage to meet the few family needs over a period did not exceed 6 months.

Pastoral resources are heavily threatened by overgrazing and advancing on the agricultural front. Indeed, today beyond the northern limit of the crops defined by Law 61-05 of May 21, 1961, there are new fields. The agricultural front has thus reduced pastoralists by 50 km to the north since 1970s (Hammel, 2001). This compromises the proper functioning of livestock farming, which also suffers disruption in its mobility.

Twenty years ago, majority of producers had mixed herds (cattle, sheep, goats, camels, asins, etc.). Nowadays, the phenomenon of sedentarisation of pastoralist communities is being generalized in places, with the creation of villages whose livestock farming is specially oriented towards sheep and goats: almost half of the producers have no cattle or camels. The equines exist only among the chiefs of Peulh or Tuareg villages. Our results have illustrated that sheep, cattle and goats are more affected by the effects of the changes. These animals have a selective diet with fodder in quantity and in appreciable quality and are less resistant to drought, forage deficit which are very sensitive to epizootics. Camels have a coarse diet, usually consisting of aerial fodder.

The mortality rate due to lack of forage has increased from 5 to 20% in 20 years. In fact, the recurrence of climatic sequences and the shift of the rainy season make the most stunted animals vulnerable (Bonnet and Guibert, 2012). Another factor of vulnerability is the theft of animals causing ethnic conflicts. The main perpetrators are the nomads who come to water their cattle at water points, benefiting from the precarious nature of the conditions that nature impose on the victims (Becerra, 2012). The poor distribution of precipitation, the degradation of water quality and the lowering of the water table had already been demonstrated in 1999 in a study by Madiodio et al. (2004) study on "Reducing West Africa's Vulnerability to Climate Impacts on Water Resources, Wetlands and Desertification", points out that

the influence of drought on the acceleration of deforestation and desertification, and by the effect of bumerang in deforestation will accentuate the persistence of the droughts.

Conclusion

The results of this scientific contribution demonstrate once again the link between peasant experiences and scientific evidence. The rainfall deficit associated with the decline in soil fertility and the recrudescence of crop pests weakens the agricultural sector. The livestock system is highly vulnerable to recurrent forage deficits, drought, degradation of grazing areas and, above all, theft of animals, which reflects the increased poverty in the area.

The vulnerability of the two sectors mentioned above (agriculture and livestock farming) is accentuated by the galloping demography, creating new needs to be met and thus new threats to be faced. The research perspectives would identify strategies for adaptation and resilience to these multiple impacts to climate change and variability.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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