

Perception and Resilience Strategies of Livestock Farmers and Agro-Pastoralists Affected by Climate Change: *Case of the urban commune of Tera, Niger*

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Abstract

This study aimed to identify and strengthen the resilience of livestock and agro-pastoralists in the face of changing climatic conditions. The study was conducted in the urban commune of Tera. The methodological approach consisted of desk research and data collection. In order to find the number of households to be surveyed in the selected camps, the method of taking a sample (8%) of the target households is adopted. In total, forty-eight (48) herders and agro-pastoralists are selected. The analysis of the perception of the herders and agro-pastoralists on the climate trend showed a decrease in the amount of rainfall (94% of respondents), increasingly high temperatures (92%) and an increase in strong and sandy winds in all seasons (96%). The disappearance of plant cover was the main cause of climate change according to 79.2% of respondents. The impacts of climate change are numerous. Pastoral resources (water and fodder) have been greatly reduced. The health of the animals has been affected, as has their production. Strategies have been developed by farmers and agro-pastoralists to reduce or anticipate the negative effects of climate change. According to some respondents, the strategies have not fully met expectations.

Keywords: agro-pastoralist, pastoralist, adaptation, climate change, vulnerability, resilience, tera

1. Introduction

Globally, climate change (CC) is considered one of the most serious threats to sustainable development with expected adverse effects on the environment, human health, food security, economic activity, water resources and other natural resources. African countries are particularly vulnerable to CC due to geographical conditions that make them more exposed to climatic hazards, their low incomes, and greater dependence on sectors (agriculture, livestock, forestry, water, etc.) that are sensitive to climatic hazards. For the IPCC (2007), these sectors include food and water. West Africa, and in particular its Sahelian part, is not only an arid zone, but has also experienced climatic disturbances in recent decades (Madiodio, 2007). Thus, between the early 1970s and the mid-1990s, the African Sahel experienced the longest climate changes ever observed anywhere in the world during the 20th century (Hulme et al., 2001). In fact, over the past thirty years, a rainfall deficit of around 30% has been observed in the Sahelian countries and a dramatic drop in the flow of certain rivers, including the Niger River, the main water resource for the country.

Like the Sahelian countries, Niger, which is located in the heart of the Sahel, is confronted with poverty and climate change, which is manifested by extreme weather phenomena such as frequent floods, recurrent droughts, locust invasions, violent winds and heat waves that affect the living conditions of the population. Indeed, over the last

few decades, drought episodes and/or more intense and frequent climatic phenomena have had consequences on peasant societies, which have seen their yields decrease significantly. In Niger, for example, 1984, 1987, 1996, 2000/01, 2004, 2010 and 2012 were years of food crises due mainly to climate risks (World Bank, 2013). The last three of these food crises affected 30%, 20% and 50% of the country's population respectively.

Problem of agro-pastoral livestock development is not only present in Niger and the Sahel, but in many developing countries, according to a study by CIRAD (2006). In Niger, the persistence of drought cycles in pastoral areas has had two consequences. Firstly, a large number of herders have migrated from the pastoral zone to the agricultural zone and are settled there almost permanently (Sourabie et al., 1994). Moreover, at the height of these droughts, the deterioration of the terms of trade at the expense of the herders led to numerous transfers of livestock ownership from nomadic and transhumant populations to sedentary populations. Today, nearly 60% of the national livestock population is in agricultural areas. These are mainly cattle and small ruminants. The lack of grazing areas and the low nutritional value of available agricultural residues, which characterise the pastoral zone, do not allow the livestock living there to fully express their genetic potential (Kayouli et al., 1994). In the dry season, from October to the beginning of June, the animals feed mainly on bush straw and crop residues such as rice straw and millet or sorghum stalks. Dominant characteristic of these roughages is their low intake, low digestibility and low nutritional value, particularly in nitrogenous matter. This results in chronic undernourishment, which is reflected in (i) Growth difficulties in young animals; (ii) Weight loss in adults; (iii) Decreased meat and milk production; (iv) Decreased working capacity (stamina and power) for draught animals; (v) Predisposition to diseases (Kayouli et al., 1994).

Poverty affects 70% of Niger households, with the severity varying according to the area and region. In rural areas, 75% of households are poor compared to 48% in urban areas. In addition, the country is experiencing a rapid increase in population with a growth rate of 3.3% per year (NSI-Niger, 2012). For future, climate scenarios predict an increase in temperature and a decrease or increase in rainfall depending on the area (Hermann and Hutchinson, 2005). This will lead to an increase in extreme phenomena such as droughts and anthropic pressure on natural resources due to the acceleration and amplification of land degradation.

It is reported in the literature (Cheik Tidjane et al., 2011) that the populations of the Sahel, who are those who suffer the most from the effects of climate change, have for generations had a significant capital of experience, knowledge and skills to adapt their activities on which they depend to ensure their survival. For a sustainable response to climate change, it is therefore necessary to mobilize the expertise of grassroots communities. This study aims to understand the perceptions of agro-pastoralists on climate change and, on the other hand, to analyze their vulnerability and the adaptation strategies developed to cope with the new climatic conditions.

2. Material and Methods

2.1. Presentation of the Study Area

This study is conducted in the Urban Commune of Tera located in the heart of the department of the same name in the Tillabéri region (Figure 1). It is located between latitudes 13° 00' North and 10° 24' East longitude and covers an area of 2,380 km².

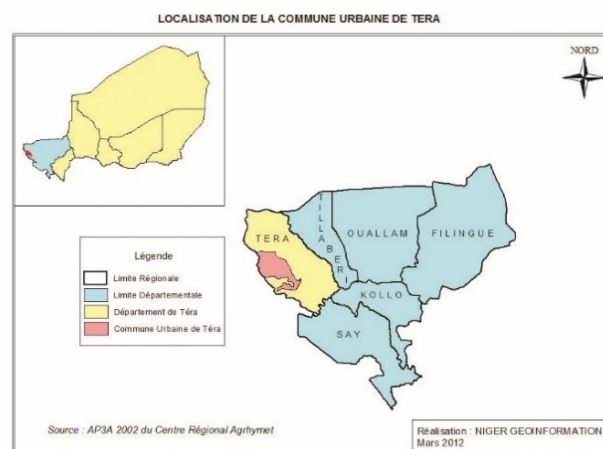


Figure 1. Geographical Location of the Urban Commune of Tera

- Climate

Climate of the Urban Commune of Tera is of the Sahelian type characterised by a short rainy season and a long dry season. The maximum temperature varies from 35.69 to 38.35°C and the absolute annual minima were 22.6°C in recent years. Annual rainfall had varied between 271.1 and 763 mm over a 15-year period from 2006 to 2020. It should be noted that the variability of rainfall affects pastoral resources in the study area.

- Vegetation

Natural vegetation cover (dry formations on degraded soils, dunes and wetlands on hydromorphic zones) provides animals with different fodder species in the dry and rainy seasons. Indeed, the dominant species on dry formations on degraded soils and dunes are *Combretum glutinosum*, *Acacia seyal*, *Balanites aegyptiaca*, *Piliostigma reticulatum*. For wet formations on hydromorphic zones, the main species are *Acacia nilotica*, *Mitragyna inermis*, *Anogeissus leocarpus*, *Ziziphus mauritiana*. Herbaceous strata dominated by species such as *Cenchrus biflorus*, *Aristida mutabilis*, *Zornia glochidiata*, *Alysicarpus Ovalus*, *Dactyloctenium aegyptium*, *Brachiaria spp.*

2.2 Equipment

In order to carry out this work and achieve the objectives, the following materials were used: (i) Survey forms to collect data from farmers and agro-pastoralists; (ii) A GPS to take the geographical coordinates of the camps concerned;

2.3 Methods

2.3.1 Data Collection

Regarding the perception of climate change, the vulnerability of the livestock sector and the resilience strategies of livestock keepers and agro-pastoralists in the villages and hamlets of the urban commune of Tera, the method used to collect data is based on surveys and field observations.

-  Sampling

- Choice of villages and hamlets


The Urban Commune of Tera has nineteen (19) villages and several agro-pastoral hamlets. It was therefore necessary to find discriminating criteria to reduce their number. Thus, based on the presence of many herders and agro-pastoralists, and the number of livestock, four (4) camps are selected to carry out the surveys: Arboudjé, Sassa, Djamossi and Gorougaro.

- Determining the size of sample

To find the number of households to be surveyed within the selected camps, we used the method of Palenfo, (2013) which consists of taking a sample of 8% of the target households. Table 1 shows the households in the selected settlements. The choice of households within each settlement was made at random using the list of heads of households of pastoralists and agropastoralists in the settlement concerned.

Table 1. Distribution of Sample by Camp

Camp	Population	Households	Households surveyed
Djamossi	630	90	7
Arboudjé	2156	308	125
Sassa	861	123	10
Gorougaro	490	70	6
Total	4137	591	48

-  Conduct of the survey

- Survey tools used

The tool used to record the data was the survey form (questionnaire). An individual questionnaire is administered to each randomly selected livestock or agro-pastoralist household.

- Conduct of the survey


The survey is conducted in two (2) stages:

- *1st stage:*

A pre-survey, which consisted of testing the individual questionnaire in a camp. This pre-test made it possible to perceive the shortcomings of the questionnaire and to have a small idea of the population on which the study will be conducted. The difficulties linked to the questionnaire are corrected to adapt it to the level of education of the respondents.

- Stage 2:

The individual survey, which consisted of administering the questionnaire to each randomly selected household with a view to ascertaining its perception of climate change, assessing the impacts of CC on livestock production and inventorying its adaptation strategies to cope with it.

 Observations

In parallel with this survey, observations were made in the field to supplement the survey data. The data from the observations provide a much deeper understanding of the adaptation strategies developed to cope with climate change.

2.3.2 Data Processing

The data collected in this study was entered into Excel and then subjected to statistical analysis. The following software packages were used in this study. These were: SPSS 20 for the analysis and statistical processing of survey results. It was used to determine the number and percentage of producers with a particular answer for each question, and to calculate the averages of certain results.

3. Results

3.1 Respondent Variables

The sample surveyed covered almost all the ethnic groups in Téra, including Songhai, Gourmantché, Peulh, Tuareg and Arabs, and consisted of 10 pastoralists and 38 agropastoralists (Table 2). The age of the people surveyed varies from 18 to 70 years and therefore includes all age groups, notably young people, adults and the elderly. This will allow us to have the perception of climate change by the different classes, its impacts on pastoral resources and the adaptation strategies of these herders.

Table 2. Size and Ethnic Composition of the Sample

Villages	Ethnics					Pastor	Agro-Pastor	Total
	Gourmantché	Touareg	Peulh	Arabic	Songhai			
Djamossi	4	0	3	0	0	0	7	7
Arboudjé	0	3	11	11	0	5	20	25
Sassa	2	0	5	0	3	4	6	10
Gorougaro	2	0	4	0	0	1	5	6
Total	8	3	23	11	3	10	38	48

3.2 Respondents' Perception of Climate Variability from 1997 to the Present

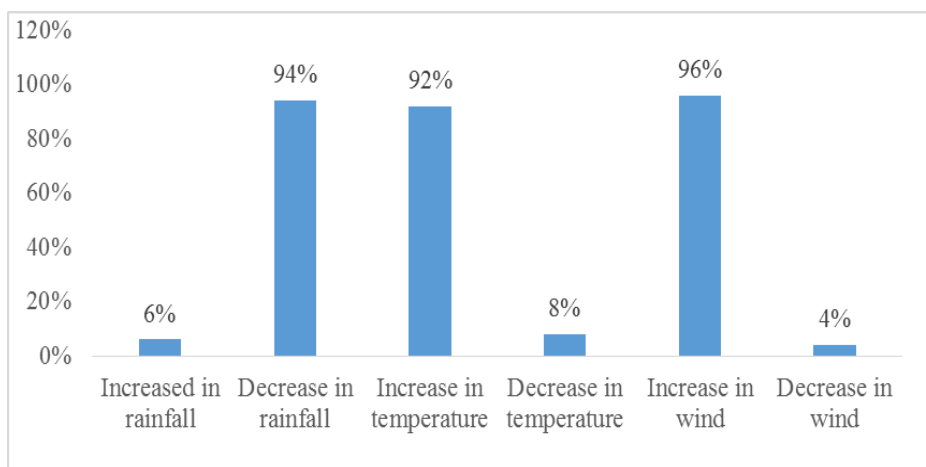


Figure 2. Perception of Climate Change by the Local Population

The analysis of the figure shows that 94% of the surveyed population have observed a decrease for rainfall.

With regard to temperature, 92% of the respondents have observed increasingly higher temperatures nowadays. This could be explained by the decrease in the cold season by about 3 months and the increase in hot extremes during all seasons.

Concerning the wind, 96% of the respondents also noted an increase in strong, sandy winds in all seasons, which often bury the fodder. Given the high proportion of the surveyed population with poor perceptions of climatic parameters, it can be said that the evolution of the climate from 1997 to the present day is characterised by a deterioration in the quality of the rainy seasons with impacts on the livestock sector.

3.3 Causes of These Changes

As regards the causes of these climatic changes, the answers given by the respondents are many and varied. Indeed, table 3 shows that the disappearance of vegetation cover was the main cause of climatic changes (79.2%) in the urban commune of Tera. The scarcity of rainfall and environmental degradation also played a role in climate variability to different degrees, respectively in the proportions of 37.5% and 29.2%.

Table 3. Causes of Climate Change

Table 3: Causes of climate change	Number of respondents/total staff	Percentage (%)
Environmental degradation	14/48	29.2
Disappearance of vegetation	38/48	79.2
Scarcity of rainfall	18/48	37.5
High temperature	4/48	8.3
Strong win	6/48	12.5
Drought	5/48	10.41

3.4 Impacts of Climate Change (CC)

➤ Impact on zootechnical parameters

Climate change has had an impact on pastoral activity, where a change is observed in certain zootechnical parameters such as the duration of first calving, the interval between calvings, frequency of abortion and growth rate. Table 4 shows the distribution of respondents' opinions on zootechnical parameters. Analysis of the data after the survey revealed that 75% of the sample noted an increase in the duration of parturition in all species of animals, while 6.2% indicated that the duration was unchanged. This increase in duration was also observed between births by 64.6% of the surveyed population. Farmers also noted frequent cases of abortion, especially in small ruminants, due to the increase in temperature. The CC did not spare the growth rate (weight evolution).

Table 4. Impact of Climatic Changes on Zootechnical Parameters

Parameters	Age of first birth		Calving interval		Number of abortion		Weight development	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Increased	36	75	31	64.6%	37	77.1	4	8.3
Decreased	9	18.8	14	29.2	11	22.9	43	89.6
Unchanged	3	6.2	3	6.2	0	0	1	2.1
Total	48	100%	48	100%	48	100%	48	100%

➤ Impact on animal health

For 56% of respondents, climate change has increased the deterioration of animal health in recent years (Fig 3). On the other hand, it is also apparent from this figure (Figure 3) that 42% of the respondents have noted an improvement in the condition of the animals and 2% have noticed no change in the health status of the livestock.

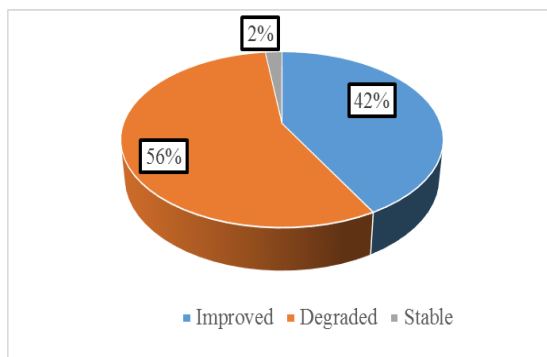


Figure 3. Animal Health Status

➤ Impact on animal mortality

For livestock farmers and agro-pastoralists, the disruption caused by the climate has led to mortality in the herds of the urban commune of Tera. Analysis of the data obtained during the course of this study revealed high mortality rates (83.3%; 75%; 72.9%) at birth, among young and adult animals respectively (Figure 4). In the same vein, some respondents observed the opposite, i.e. a decrease (14.6%; 22.9%; 12.5%) in the same categories of animal species. Another part of the surveyed sample stated that the mortality rate for these animal species remained stable, at 2.1% for births and juveniles and 14.6% for adults.

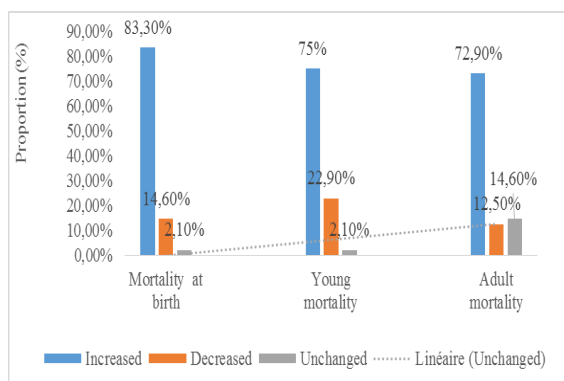


Figure 4. Effect of Climate Change on Mortality

State of current pastoral resources compared to previous years. According to respondents, pastoral resources (watering points and grazing areas) have been strongly impacted by climate change, notably the early drying up of watering points and the reduction in available fodder (Table 5).

Table 5. Status of Pastoral Resources

Findings	Water resources
Improved	14.5%
Degraded	81.3%
Stable	4.2%
Total	100%
Findings	Fodder resources
Improved	8.3%
Degraded	91.7%
Stable	0%
Total	100%

It should be noted that the animals in the urban commune of Tera were fed by land and air grazing according to all respondents (100%).

- Sources of watering for animals

To meet the water needs of their livestock, farmers have diversified their watering sources (Table 6). During the dry season, permanent water sources (permanent ponds, wells and boreholes) were very popular, whereas temporary water sources (semi-permanent ponds) were less popular because they dried up quickly. Farmers used wells (100%), semi-permanent ponds (85.4%), boreholes (20.8%) and permanent ponds (6.25%), overburdened lowlands (24.8%) and dams (14.3%).

Table 6. Sources of Water and Fodder for Animals

Water supply sources	Percentage (%)
Permanent ponds	6,25
Semi-permanent ponds	85,4
Wells	100
Boreholes	20,83
Source of fodder supply	Percentage (%)
Land grazing	100
Aerial grazing	100

➤ Observation on the quality of fodder resources

The study also looked at the impact of CC on the evolution of fodder quality. The results in Table 7 indicate that climate change has seriously affected the quality of fodder resources (87.5% of respondents).

Table 7. Impact of Climate Change on Fodder Quality

Findings	Quality Fodder resources
Increased	10.4%
Decreased	87.5%
Unchanged	2.1%
Total	100%

➤ Impact of climate change on livestock maintenance costs.

During the investigations, 87.5% of the respondents stated that CC has caused additional burdens for the maintenance of their herds. Conversely, 12.5% of the surveyed population indicated the opposite.

Relations between farmers and livestock keepers

The climatic changes have not spared social cohesion either. Indeed, this study revealed that community life has been affected. More than half of the respondents (56.4%) indicated that relations between farmers and herders had not changed, while 39.6% had noticed a change in inter-community life. Respondents who noticed a change in relations between farmers and herders gave a number of causes (Table 8).

Table 8. Causes of Change in Farmer-Herder Relations

Causes	Percentage (%)
Transformation of pastoral areas into fields and housing	63.1
Disappearance during the winter season of the passage corridors	15.8
Conflict between breeders and farmers	15.8
Breeders turned into farmers	5.3

➤ Impact of climate change on the price variation of livestock and livestock products

- Livestock products

Table 9 shows that the products (milk and meat) have been affected by CC.

Table 9. Impact of Climate Change on Livestock Products

Period	Findings	Percentage (%)
Past	Increased	66.7
	Decreased	41.7
	Unchanged	0
Nowadays	Increased	50
	Decreased	50
	Unchanged	0

➤ Causes of livestock losses recorded by respondents

Table 10 shows the various causes of livestock losses among the surveyed populations.

Table 10. Causes of Livestock Losses

Factors	Percentage (%)
Floods	64.6
Droughts	87.5
Bush fires	37.5
Epizootics	93.8

3.1.5 Adaptation Strategies of Pastoralists and Agro-Pastoralists to Cope with Climate Change

The adaptation strategies developed by livestock farmers to cope with the new climatic conditions were of several kinds. They included different practices related to the management of water resources, fodder for livestock and methods of combating different diseases. Table 11 shows the strategies mentioned by the respondents to mitigate the effects of climate change.

Table 11. Developed Strategies

Factors	Strategies	Percentage (%)
Floods	Enclosure	14.6
	Keeping animals on high ground	64.6
	Monitoring	6.3
Bush fires	Enclosure	4.2
	Monitoring	25
Epizootics	Decoction of plants	56.3
	Use of natron	12.5
	Use of oil in case of swollen bellies	4.2
	Oil + natron	4.2
	Charcoal + butter	2.1
Drought	Veterinary care	
	Scarring	68.8
	Transhumance	14.6
	Destocking of animals	87.5
	Fodder storage	35.4
		68.8

The study revealed that these vulnerable populations, following climate change, received support from the government and/or NGOs. The different types of support are: (i) livestock feed (100% of respondents), (ii) cash transfer (14.6% of respondents), (iii) reconstitution of livestock (14.6% of respondents).

4. Discussion

4.1 Perception of Climate Change

In numerous writings (Djohy et al., 2017; Dayamba et al., 2019; Abdou et al., 2020; Idrissou et al., 2020; Djohy et al., 2021), it is widely reported that rising temperatures, poor spatio-temporal distribution of rainfall and strong winds continue to be the main indicators for the perception of climate change. Belonging to the Sahelian band, the perceptions of herders and agro-pastoralists in the Téra Urban Commune corroborate those described in the literature. Indeed, the information gathered from the interviewees suggests that the evolution of the climate has resulted in a decrease in rainfall, an increase in temperature, and violent winds over the last fifteen years in the locality of Téra. The results obtained in the course of the present work were in line with those found by several authors (Ouedraogo, 2010; Kate et al., 2015; Djohy et al., 2017; Dayamba et al., 2019; Abdou et al., 2020; Idrissou et al., 2020). Generally speaking, Niger is a country in which, although there are surplus periods for rainfall, droughts are also chronic and repetitive. Tera zone located in the southern band of Niger, has almost the same climate as the northern region of Benin, which observes alternating periods of surplus and deficit, linked to droughts and rainfall surpluses (Boko et al., 2012; Djohy, 2015). On a continental scale (African continent), works (Lema and Majule, 2009; Wongtschowski et al., 2009) have led to similar observations in the present study.

4.2 Causes of Climate Change

The imbalance in the atmosphere is undoubtedly the result of human action (anthropogenic causes) and nature itself (IPCC, 2014). In terms of anthropogenic causes, it is stated in the literature that the increase in greenhouse gases as a result of human activities traps some radiation (IPCC, 2013; IPCC, 2014). This causes the surface temperature to rise until a new equilibrium is found. As a result, global warming has been observed in recent decades.

For nature, it is noted that natural factors external to the climate system such as volcanic activities, the emission of solar energy and the earth's orbit around the sun that can alter the climate (IPCC, 2013). The agricultural community is one of the main victims of the consequences of the above-mentioned causes that have been repeatedly cited as the cause of climate change. Agricultural activities regularly pay a heavy price for storms due to income losses resulting from damage to livestock and crops (Gastineau and Soden, 2009). For the elements that make up the environment (fauna, flora, terrestrial and aquatic environment) the expectations are serious because of the destruction of forests and pollution as an indirect effect. The results of the present work corroborate those obtained by Abdou et al, 2020 and by Djohy and Bouko, 2021.

4.3 Impacts of Climate Change

- Impact on zootechnical parameters

According to the responses of the respondents, it was noted during this study that in the urban commune of Téra, zootechnical parameters were affected by the new climatic conditions. Indeed, these parameters (age at first birth, interval between births, abortions) have increased. For growth, a slowdown in weight evolution was observed. Tahirou (2019) observed these non-encouraging results in the urban commune of Filingué (in Niger) during a study. According to some studies, abortion is an event that can occur because of a rise in temperature and the lengthening of the animals' travel time in search of pasture (Lemaire et al., 2006; VSF, 2015).

The information gathered from the respondents suggests a marked slowdown in the growth rate of the animals and a drop in milk production, particularly in cattle. Here again, the fairly extensive experimental studies conducted in the area (Chanono, 2003) focus only on seasonal variations in performance. Inter-annual variations in performance, which are the most appropriate for elucidating the impact of environmental dynamics, have not been addressed. Little research has been carried out on the subject in this area and therefore little data is available to compare the results of the present study with measured performance. The establishment of a regular monitoring system for the evolution of the animals' reproductive and production performance is necessary to confirm with greater precision the indicators of farmers' perception of the evolution of performance mentioned in our study.

- Impact on animal health

It is often said that health is priceless. According to the respondents, the situation is bitter insofar as 56% of the sample of the population that participated in the survey indicated that the health status of the animals had deteriorated considerably. This health deficit has resulted in mortality in the herds. Such a situation inevitably increases the vulnerability of low-income people for subsistence. In a study, Djohy and Bouko (2021) noted a similar situation among pastoralists in the northern part of Benin.

- The main epizootic diseases that are most frequent in the study area

Climatic changes are phenomena that have many corollaries. The consequences include the appearance of numerous diseases in both humans and animals. As far as animals are concerned, the survey revealed numerous pathologies in the study area. As a reminder, these diseases are: (1) foot and mouth disease, (2) digestive disorders, i.e. diarrhoea, (3) symptomatic anthrax, (4) respiratory infections, (5) scabies, (6) anthrax. In the course of his work, Tahirou (2019) identified the following diseases in the commune of Filingué: Scabies, Foot and Mouth Disease, Lumpy skin disease, Rinderpest, Contagious bovine pleuropneumonia. According to these respondents, climatic changes have contributed to the emergence of these diseases.

- The state of current pastoral resources

According to the farmers and agro-pastoralists, pastoral resources (water and fodder) have been declining over the years as a result of climate change. The watering points for animals have been degraded and some, such as ponds, are not very effective. Apart from that, wells and boreholes have enabled farmers to ensure water supply.

The shortening of the rainy season by 2 to 3 months, a late start and an early end affects all pastoral resources (watering points and grazing areas). In fact, the rainy season, which used to start in the 6th or 7th month of the agricultural calendar, nowadays only starts in the 8th or 9th month. According to these respondents, it is also marked by dry spells of varying length, often lasting up to 21 days, as opposed to just 7 days in the past. These long dry sequences result in a stunted herbaceous carpet with a very low cover and an early drying of the herbaceous carpet. It also leads to an early drying up of surface water, making it difficult for the animals to drink. Herders perceived important changes in the dynamics of pastoral resources. As with all natural resources, the production of fodder species in the Sahel generally declines in the dry season. In such dry conditions, the link between aridity and restriction of nitrogen and mineral nutrition of forage species has been shown (Lemaire et al., 2006). In a year of significant water deficit, a decrease of more than 50% in forage production is observed (Ruget et al., 2006).

Generally, that fodder production is closely linked to climatic conditions (rainfall and temperature). While decreasing temperatures cause a fodder deficit (Lema and Majule, 2009), high temperatures cause evaporation, evapotranspiration of plants and increase the probability of severe droughts (IPCC, 2007). To summarise the impact of CC on pastoral resources, the literature on the subject (Wongtschowski et al., 2009; Kate et al., 2015; Djohy et al., 2017; Abdou et al., 2020; Djohy and Bouko, 2021) is unanimous in stating that pastoral resources (water and fodder) are threatened by climate risks. This threat affects both the quantity and quality of these resources.

- Impact of climate change on livestock maintenance costs

In the course of its evolution, climate change has not spared anything. Economies have been impacted. Indeed, the destruction of shelter for both humans and animals, or the transport that provides supplies, can contribute to a weakening of low incomes. Thus, the interruption of traffic (road, rail, air) can result in costs, losses or disruption of important activities, such as livestock farming (Gerber, 2012). In addition, the water, telephone and electricity networks are interrupted to varying degrees with each storm. This can lead to a temporary paralysis of economic life.

- Impact of climate change on livestock products

The study by Tahirou (2019) conducted in the urban commune of Filingué (Niger) showed that the drop in milk production could be linked to the lack of fodder, but it could also be due to a proliferation of certain arthropods such as ticks that attach themselves to the cows' udders. The work of these authors (Lemaire et al., 2006; IPCC, 2007; VSF, 2015) corroborates that of Tahirou (2018) and confirms the results obtained in the course of this work. The development of insects in recent years is favoured by the rise in temperature (Hinsa, 2013; Cheng et al., 2014)

- Relationships between farmers and herders

Climate change has led to a reduction in the area of natural grazing, and there is evidence that this is likely to continue with the further decrease and irregularity of water availability. Flooding combined with the consequences of water and wind erosion is a major driver of grazing losses. These phenomena could force livestock to migrate, leading to conflicts with other stakeholders (farmers, herders and fishermen). The impact of these changes on livestock farming is observed at three levels: zootechnical parameters, health and the burden of maintaining livestock (Hinsa, 2013).

4.4 Adaptation Strategies of Farmers and Agro-Pastoralists to Cope with Climatic Changes

Faced with these imbalances, i.e. climate change, farmers, pastoralists and agro-pastoralists have developed initiatives to reduce or eradicate the effects of CC. Around the world, initiatives are underway to prevent the

management of forage systems. One example is the Information and Monitoring of Prairie Objectives (ISOP) system proposed by Ruget et al. (2006). This is a system that estimates the interannual variability of production for each forage region and the evolution over the year of this production, in relative value compared to the 'normal' production of the same area at the same date.

In the urban commune, the people interviewed in this study indicated the measures they have taken to counteract the adverse effects of CC. The common practices encountered on the farms are: storage of fodder, especially crop residues, destocking of animals, diversification, mobility, especially transhumance, and veterinary care.

For livestock farmers and even agro-pastoralists in the Sahel, the storage of fodder (hay, bush straw, crop residues) is the key measure to anticipate the lean season. This observation has been made by these authors (Djohy, 2015; Touré, 2015; Dayamba et al., 2019; Abdou et al., 2020)

The orientation of pastoralists towards agriculture (diversification), not to say conversion to farming, is a strategy that allows these pastoralists not only to meet their consumption needs but also to have crop residues for animals (Nori et al., 2008). The breeding of certain animal species such as small ruminants (sheep and goats) constitutes a source of financial income that contributes to the reconstitution of the herd of large ruminants (Malonine, 2006).

Transhumance is a common practice for pastoralists in arid and even arid zones. This old practice allows them to compensate for the fodder and water deficits caused by climatic hazards. This type of displacement is reported in the Sahelian strip, particularly in the eastern part of Burkina Faso, as indicated by these authors (Ouédraogo, 2008).

The results of this study showed that climatic changes that lead to poor access to water and fodder resources for animals expose animals to diseases. To this end, actions have been planned. Pastoralists and agro-pastoralists in the urban commune of Téra, as well as those in other regions of Niger, the Sahel and even the world, use appropriate means. It is reported in the literature that the Fulani often use medicinal plants (Byavu et al., 2000) and modern methods (Abdou et al., 2020) such as antibiotics and trypanocides (Dia and Desquesnes, 2003) in the treatment of various bovine pathologies. However, a question arises. Are these strategies effective and will they be able to meet the expectations of producers (livestock farmers and agro-pastoralists)?

5. Conclusion

In the urban commune of Téra, which served as the field for the study, it is important to emphasise that climatic changes are a reality. In this Sahelian zone, climatic parameters are subject to great interannual variability. Data from various studies around the world confirm the perception of pastoralists and agro-pastoralists in the commune where this study is conducted.

Climate change is the result of human actions (deforestation, greenhouse gas emissions). Nature, through volcanic emissions, contributes to the warming of the atmosphere. The combination of these factors will affect the beings (animals and plants) that live on planet earth. Pastoral resources have been degraded considerably. As a result, there has been a decline in animal production (milk and meat) and a deterioration in the health of animals with the appearance of pathologies.

Faced with all these environmental constraints and difficulties, the pastoralists and agro-pastoralists of the urban commune of Téra have taken initiatives (transhumance, storage of fodder, destocking of animals, veterinary care with traditional and modern medicines, diversification of occupations) to mitigate the effects of climatic changes. However, it has been noted that these measures do not meet the expectations of these populations to curb the scourge. For this reason, the present report suggests further investigations on the subject.

List of Abbreviations: CC: Climate Change. NSI-Niger: National Statistical Institute, Niger

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