

Perception and Adaptation of Pastoralists in Tandjilé-Est Southern Chad to Climate Change



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Abstract

The study was conducted in Tandjilé Province located in South-West of Chad (9° 24'N latitude and 16° 18' E longitude). A stratified sampling technique was applied to select 122 households aged from 40 to 70 years old to investigate the effect climate change and demographic pressure on agro pastoral resources. Results revealed that majority of the respondents noted an increase in temperatures (98%) and a high frequency of violent winds (100%). All of the interviewers (100%) indicated that climate change and variability affected negatively crop and livestock production as well as the quality and quantity of animal food resources (fodder and pasture). The coping strategies adopted by herders to mitigate the effects of drought, included transhumance (96%), feed supplementation livestock (98%) and livestock diversifications (100). Climate change and variability impacts highlighted by households included increase in flood and drought occurrence and reduction of grazing areas, crop yield, and livestock productivity. Arabian zebu and sheep appear to be the most sensitive livestock species to flooding, rising temperature and humidity in Tandjilé-Est. The focus group held in six Ferricks attested the observations of the survey. It can be concluded that flooding, encroachment of pasture areas, bush fires were the main causes of forage deficit induced by climate change. It is therefore recommended that farmers, herders, local administrative and traditional authorities build resilience strategies for improved livestock production by geo-referencing of all the resource areas to specific beneficiaries.

Key Words: Tandjilé, Climate change, Agropastoral, Perception, Adaptation



**Perception et adaptation des éleveurs de la Tandjilé-Est au sud du Tchad au
changement climatique**

Résumé

L'étude a été menée dans la province de Tandjilé située au Sud-Ouest du Tchad (9° 24' de latitude N et 16° 18' de longitude E). Une technique d'échantillonnage stratifié a été appliquée pour sélectionner 122 ménages âgés de 40 à 70 ans afin d'étudier l'effet du changement climatique et de la pression démographique sur les ressources agropastorales. Les résultats ont révélé que la majorité des personnes interrogées ont noté une augmentation

des températures (98%) et une fréquence élevée de vents violents (100%). Tous les enquêteurs (100 %) ont indiqué que le changement et la variabilité climatiques ont eu un impact négatif sur la production agricole et animale ainsi que sur la qualité et la quantité des ressources alimentaires animales (fourrage et pâturages). Les stratégies d'adaptation adoptées par les éleveurs pour atténuer les effets de la sécheresse, comprenaient la transhumance (96 %), l'élevage de supplémentation alimentaire (98 %) et la diversification de l'élevage (100). Les impacts du changement et de la variabilité climatiques soulignés par les ménages comprennent l'augmentation des inondations et des sécheresses et la réduction des zones de pâturage, du rendement des cultures et de la productivité du bétail. Le zébu d'Arabie et le mouton apparaissent comme les espèces d'élevage les plus sensibles aux inondations, à la hausse des températures et de l'humidité dans la Tandjilé-Est. Le focus group organisé dans six Ferriks a attesté les observations de l'enquête. On peut conclure que les inondations, l'empiétement des zones de pâturage, les feux de brousse ont été les principales causes du déficit fourrager induit par le changement climatique. Il est donc recommandé aux agriculteurs, aux éleveurs, aux autorités administratives locales et traditionnelles d'élaborer des stratégies de résilience pour une production animale améliorée en géoréférençant toutes les zones de ressources vers des bénéficiaires spécifiques.

Mots-clés : Tandjilé, Changement climatique, Agropastoral, Perception, Adaptation

Introduction

Expansion of pastoralism in the Tandjilé savannah has gained momentum over the past 30 years. Herders manage new relationships in the new environment and have invented another pastoralism: agropastoralism. To adapt to this new context, once installed, breeders are rebuilding the herd, despite the fact that the pastoral system remains fragile as they have to fight with nature caprice (flooding), relationship with farmers, a precarious land status on the new pastures occupied by agricultural activities and city pressure make most of those pastoralists and their resources vulnerable.

Although the area is risky for breeding, the number of animals has doubled in recent years. The increase in the cattle herd is mainly explained by the arrival of pastoral breeders from the north to the south. Some of these new breeders remained mobile, while others became sedentary to varying degrees and adopted agropastoralism.

Material and methods

The sampling population investigated was extracted on the basis of the formula of Anderson *et al.*, (2015). Initial sampling targeted agropastoral settlement or villages with more than 30 years of existence. A settlement not subjected to seasonal flood and of neighbourhood to crop-farmers was selected for the survey. The agropastoralists who had more than 50 cattle has selected for the interview. A comprehensive list of agropastoral herders and crop-farmers close to one another was make.

$$\text{Anderson's formula: } X = \frac{(Z_{\alpha/2})^2 P \times (1 - P) N}{(Z_{\alpha/2})^2 P (1 - P) + (N - 1) E^2}$$

X = sample size; N = size of the grand population; P = Proportion (50%); E = Margin of error (7%); 95% confidence interval and $Z_{\alpha/2} = 1.96$.

Out a total of 110,366 households, a sample of 122 was interviewed and the interviewees were the household heads. The stratified sampling at two levels was

investigated: agropastoralists (54) crop-farmers (40), authorities and heads of agriculture and livestock service (28). The first level involved the Agropastoralist villages and ferricks and the second concerned the households.

The survey on the impact of climate change (rain fall and temperature) and demographic pressure was conducted to capture agro pastoralist's adaptation capacity. The field surveys lasted from June to October 10th, 2021 in the Tandjilé Province. Data were collected individually from heads of household whose age ranged from 50 to 70 years to understand agropastoralists perception and adaptation to climate change. Most of the respondents were over 65 years old.

Focus group interviews were also conducted in six oldest Ferrick having more households: Nao in Tandjilé center; Damndoul in the West Tandjilé; Nadji; Biri; Fort Lamy; Milmil Studies were conducted from Tandjilé Province, South-West of Chad (GPS coordinates: 9° 24'N latitude and 16° 18' E longitude). It has a surface land area of 18,045 Km² (INSEED, 2014) *in the East Tandjilé, were chosen.*

The climatic indicators considered were temperature, drought, flood frequency, rainfall distribution and Agropastoralist household perception about these climate change influences on agropastoral resources. PANA/CHAD 2010 rating scale was used to assess the impact index on resources.

Table 1: Grading Scale

Meaning occurrences of the impact	Scale
Negligible	1
Low	2
Moderate	3
Strong	4
Severe	5

Source: PANA (Programme d'Action National d'Adaptation)/CHAD 2006

To confirm the enquiry, series of meteorological data (rainfall and temperature) were obtained at the National Meteorological Agency of Chad and processed save in excel and analyses.

Results

Perception of Agropastoralists of Climate Change

The research investigated how respondents perceived the impact of climate change on rainfall, temperature and their livelihoods, especially on agropastoral resources (pasture quality, crop planting area, housing security, livestock loss, livestock diseases, harvest time, seeding, calving time and agricultural income).

Rainfall

Hundred percent (100%) of agropastoralists interviewed said that the

distribution of rain during the season was unequal.

All the agropastoralists (100%) surveyed noted that the length of the season is currently becoming shorter. Dry sequences extending from 6 to 10 days beyond are regularly observed.

Temperature and Wind

Hundred percent (100%) of the people surveyed were unanimous that it is getting hotter and this heat is observed during all seasons (dry and rainy season), the heat reigns during the day as well as at night. In Tandjilé, the two extremes of heat and rainfall is observed.

Regarding the evolution of the wind, all (100%) of the respondents said that in the past the wind was less violent before but currently the wind is more and more violent.

Extreme Weather Events

All the respondents remember the great drought of 1984 and the hunger of 1985. According to the agropastoralists, there is always instability in the climate.

During the focus group (discussion group), the agropastoralists declared a great change. There is no dew as before. "At the time during the cold period, when you go out in the morning you have the impression that it rained at night but in recent years these phenomena almost do not exist," they said.

Impact of Climate Change on Agropastoral Resources

Most of the agropastoralists (63%) encountered, indicated that climate change did not impacted the interval between two calving and does not have too much impact on the age at first parturition of small ruminants.

In cattle, more than a half of agropastoralists (55%) had noticed an impact on the age of first parturition, which shift from 3.5 years before to 5 years nowadays.

The interval between two parturitions had changed. In the past, 86% of people surveyed said that the cow could keep the calf for 1 year and be pregnant thereafter. Currently, all of people (100%) said that the calf does not grow quickly because of insufficient milk and is weaned only around the age of 2 years.

Hundred percent (100%) of respondents declared that milk production and lactation duration decreased. During the period of abundant grazing a cow produces in "restricted suckling" an average of 3 liters of milk per day more than 30 years ago and the milk was well shared between the

family and the calves, but currently milk produced by cow is less than one liter per day. In some households, the milk is totally left to the calves. The focus group carried out confirmed that 92% drop in milk production was linked, to the quality of fodder resources and parasitic infestations more specifically ectoparasites (mosquitoes and ticks) at certain times of the year. 98% believe that goats are more resistant to drought and heat, but poorly tolerate flooding.

This decrease in milk production for most agro-pastoralists is linked to the influence of climate change.

During the discussion all were unanimous (100%) that a band of mosquitoes disturbed the animals day and night. All interviewees did not see such mosquitoes in the last thirty years ago. The animals spend every night standing up if the fire is not set.

They identified ticks as the most important health issue. However, for them drought and flood can reduce considerably the availability and the quality of forage for livestock grazing, and increase livestock diseases. Livestock health data analysis shows an increase trend of ticks and mosquitoes not observed before. All agropastoralists confirmed foot-and-mouth disease at the onset of the season in the Tandjilé province.

The stress can affect livestock production. All agropastoralists reported that climate change and variability affected negatively livestock production.

In addition to this flooding forces the animals to leave the places following the destruction of the herbaceous layer of palatable plants.

There are diseases in the ferricks which are almost cyclical and return either at the beginning or at end of the rainy season in the Tandjilé Province.

The Impacts of Climate Change in Agro-Pastoralists' Livelihoods

The direct impacts of climate change and

variability that agropastoralists noted was the availability of pastoral resources. This availability is strongly affected by climate variability, and all the respondents (100%) had noted a decrease in crop yield, pasture availability and livestock productivity and soil fertility. Climate change is impacting the livestock health (89% of interviewers) and leading to the principal cause of misunderstanding (100% of respondents). Crop farmers have observed similar

impacts of climate change like agropastoralists and have highlighted its impacts on crop yield, soil fertility, and land availability.

Indices of Impact on Animal

The survey carried out in the Tandjilé province revealed that zebu Bororo is the most sensitive to the effects of climate change while donkey was designated as the most resistant (Table 2).

Table 2: Index of Impact of Climate Change on Animals (Grading Scale 1-5)

Species	Drought	Flood	Strong wind	Rain deficit	Exposure index	Rank
Bororo zebu	5	4	2	4	15	1st
Arabian zebu	4	2	4	4	14	2nd
Goat	2	5	2	2	11	3rd
Sheep	4	5	2	3	14	2nd
Assin	1	4	2	2	9	5th
Chickens	2	3	3	2	10	4th
Impact	18	23	15	17	-	-

Source: Field survey

- Indices of Impact on Agriculture and natural resources

Agriculture and grazing are more affected by the impacts of climate change (Table 3).

Table 3: Impact Index in Agropastoral Resources.

Resources	Drought	Flood	Strong wine	Rain deficit	Exposition Index	Rank
Grazing area	4	4	1	4	13	2nd
Pond	4	1	2	4	11	3rd
Rivers	2	1	2	2	7	4th
Well	4	2	1	4	11	3rd
Crops	4	4	3	4	15	1st
Livestock productivity	4	4	1	2	11	3rd

Source: Field survey

It is identified that the major impact on crop yields, reduction of grazing areas, flood in forage and drought in water resources, and livestock productivity as the major threats of climate change.

Forage resources

According to the declaration of respondents, 90% of the fodder deficit had three causes: flooding, the occupation of pasture areas by fields, the bush fires that farmers set to drive away rats and game and the fire set on the crop residues to voluntarily prevent breeders from having access to them.

“Residues were abundant in the past, but currently farmers collect and burn residues

expressly to prevent animals to get access by chasing the agropastoralists during as stated by the focus group held in the ferrick of Milmil.

Focus group Perception of climate change by agro pastoralists in the study area

The focus group carried out in the Tandjilé region revealed that climate change has negatively impacted agropastoral resources.

This, according to the heads of rural development services, is linked to the descent of transhumant in numbers, very early in the Province of Tandjilé to take advantage of fresh residues from the fields just after the harvest.

The perception of the agropastoralists of the climate varied from one area to another. However, all the agropastoralists surveyed during the focus group acknowledged that the main manifestations of the changes are: an increase in heat, a disruption of the rainy season, greater spatio-temporal irregularity of the rainfall and a greater frequency of drought pockets during the growing cycle of pasture plant. For the most part, climate change has led to the colonization of rangelands by unpalatable species and the reduction of rangelands due to the highlight of crops.

For the heads of the ferricks of Damdou II, Kourigne and Ningua the findings are the same, the ferricks are stuck to the villages. According to the focus groups carried out, all were unanimous: "our ferricks were separated from the fields and villages at tens kilometers from the city and when we graze the herd, we travel distances without seeing residential and agricultural areas and the existing sources water. Now this is no longer the case, these water resources have become special properties for fishing and market gardening purpose.

The most sectors affected by the influence of climate change remained agriculture and livestock. The observation made by the agro-pastoralists can be summed up: the reduction of certain plant species, the drop in productivity, the high mortality in the ligneous stratum between September and October causing at times the fodder deficit and the modification of the usual transhumance corridors have been noted unanimously by the agro-pastoralists surveyed.

For the heads of departments and farmers' households, local perceptions are globally unanimous in the increase in ambient

temperature and lengthening of the duration of the dry seasons (reduction in the average number of rainy days). However, perceptions related to the variation of other climatic events differ from one locality to another.

In fact, older and adults generally have the same perception on the decrease or increase in the intensity of climatic events.

The most affected sectors are agriculture through soil degradation and reduced crop yields.

Livestock is experiencing many constraints in the Province of Tandjilé, including the lack of pasture from September and October linked to floods but also to the extension of agriculture to pastoral areas and urban pressure.

Most of the people interviewed (92%) responded that livestock and population increase while cultivated areas expand. A new trend can be seen in Tandjilé, where more and more breeders are cultivating cereals and sometimes peanuts, sesames and farmers are investing in livestock with an important number of animals.

Herders and Farmers Relationships

According to the focus groups carried out, all agropastoralist (100%) were unanimous that the ferricks were separated from the fields and villages tens of kilometers from the city and when we graze the herd, we travel distanced without seeing residential and agricultural areas and the existing sources water. Now this is no longer the case, these water resources have become special properties for reasons of fishing and market gardening. At each kilometer herders face the obstacles of hectares of fields, houses and gardens. The observation made by the agro-pastoralists can be summed up: the reduction of certain plant species, the drop in productivity, the high mortality in the ligneous stratum between September and October causing at times the fodder deficit and the modification of the usual transhumance corridors have been

noted unanimously by the agro-pastoralists surveyed.

Tandjilé province have recorded hundreds of deaths in the cantons Kabalaye and Mouroum, after the murderer conflicts of recent years (2017; 2018; 2019 and 2020).

According to the agro-pastoralists (78%) met in the Tandjilé Province, climate change contributes to misunderstandings between users of natural resources. Such misunderstandings often lead to conflicts that are sometimes so violent and cause deaths on both sides.

90% of agro-pastoralists also mentioned that the use of ponds by farmers for irrigating fields in the dry season causes misunderstandings.

The breeder must bypass the trap fields and travel for miles to water his herd. The distance already covered for watering leads to an increase in expenditure linked to walking (maintenance expenditure) which means that animals in free grazing in the dry season, instead of gaining in weight gain, rather losing weight as declared the respondents during the focus group.

Conflicts between Agropastoralists and farmers in Tandjilé were frequent. 44% of

agropastoralists said that these conflicts are frequent and linked to climate change. 31% felt that conflicts linked to demographic pressure were low in the Tandjilé region unlike other southern regions. 25% of ferric agropastoralists have not experienced conflicts between users of natural resources.

More than half (87%) of the agropastoralists underlined that the most frequent conflict between agropastoralists and transhumant herders arises around water points and on rangelands.

Agropastoralists and transhumants

More than half of the agropastoralists underlined that the most frequent conflict between agropastoralists and transhumant people arises around water points and on rangelands. Transhumant herders contribute to degrading the resources strategically defended by agropastoralists around the ferricks. The other conflicts are more related to cattle rustling. The agro-pastoralists-Fulani felt that they were victims of cattle stealing organized by transhumant traders of the Arab ethnic group.

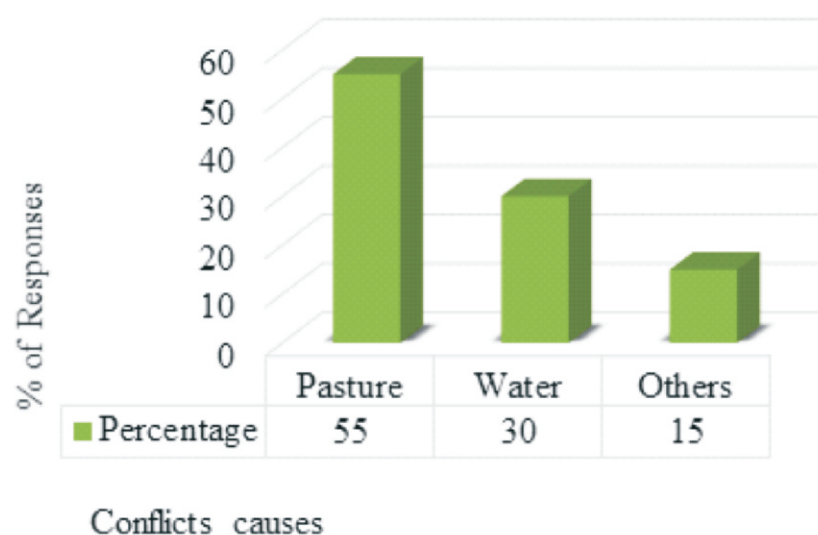


Figure 1: Distribution of Agropastoralists on the Frequency of Conflicts Around Resources Between Transhumant and Agropastoralists.

The cultivation of livestock corridors or routes, the transformation of pastures into rice fields, the devastation of fields by animals, the monopolization of pastoral water points by groups of market gardeners, the new transhumant people settle, the non-respect of transhumance calendars to facilitate agricultural activities, the anarchic creation of residential areas, management of the passage of breeders, cattle theft, alcoholism and bad trials, are the points raised during the Provincial Forum for Peace and Cohabitation peaceful which took place in June 2020 in the Tandjilé.

Those situations create misunderstandings leading sometimes to violent conflicts.

The outcome of this framework forum for consultation and peaceful cohabitation a document providing for the possible prevention and management of these conflicts by securing pastoral mobility on the basis of clear and consensual rules of access to resources and respect for transhumance.

Cropland expansion was pointed out by breeders as one of the factor which amplifies the misunderstanding.

88% of agropastoralists said they send animals on transhumance only when germination shoots are good or during periods of flooding. In Tandjilé there is a

wide variety of crops, but the most dominant are those of rice and flood recession sorghum.

For the majority of agro-pastoralists, around 30 years ago, the start of transhumance was early. But currently less than 6.02% were sending animals to fallback areas in June. Most left late between July and August. The overall return is early from October just after the last rains.

In the Tandjilé-Est department, the impact of the extension of land use on five entities was considered: housing, fields, vegetation, forest and water to make the link with the effects of climate change. In thirty years, we have seen an increase of 21.73% in cultivated areas, 12.60% in residential areas and a decrease of 4.95%, 14.22% and 46.49% in water, forests and vegetation. Weather hazards over the past three decades have had impacts on agropastoral resources. These disturbances caused considerable changes to the vegetation. Furthermore, open areas have been taken up by crops, and the reduction in perennial plant cover has led to the appearance of unpalatable plant species and a drop in diversity as well as floristic composition. Rainfall data shows a disproportionate annual change in precipitation.

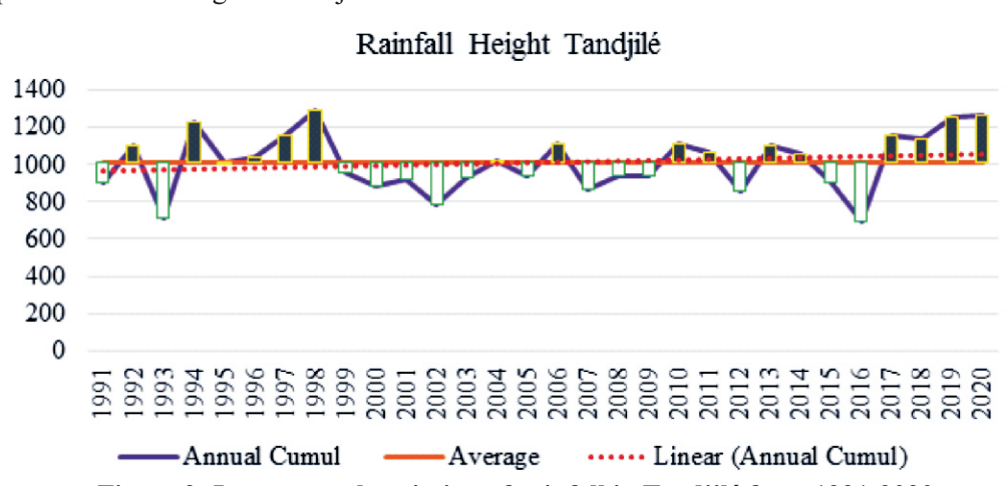


Figure 2: Inter-annual variation of rainfall in Tandjilé from 1991-2020.

The analysis of rainfall data showed an important inter-annual rainfall variation. The linear annual cumuli had increased and precisely between 2017 till 2020 rainfall record explaining the flood that agropastoralists have noted. There are also long dry periods which were very important 1999-2006 and particularly with moderate to severe droughts in Tandjilé. These

periods were known by 57% of agropastoralists known with huge impact droughts in environment and economic livelihood.

In Tandjilé province, availability of forage is most variable and is depending to climate and likely human anthropogenic activity (bush fire) figure3.

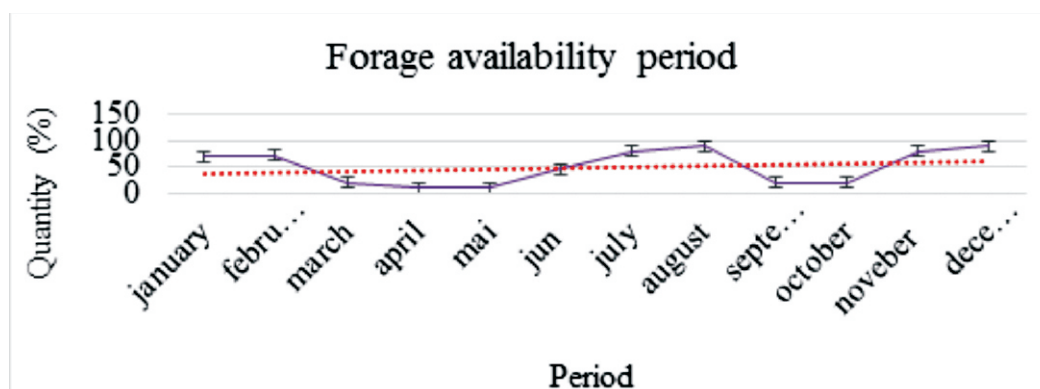


Figure 3: Seasonal availability of Fodder Availability in Tandjilé

Adaptation strategies.

Hundred percent (100%) of Agropastoralists undertook many activities and species' diversification; and also livestock transhumance but in addition they use also improved varieties of maize around there ferrick.

For some agropastoralists (86%) living in the plains of Tandjilé, they have an idea of □□the flood periods of their site. Their strategy is to leave the usual site for a few weeks to settle near the roads until the water decreased.

There are various factors undermining the adaptation of families of agropastoralists

stated by old ones, on the site for more than thirty years. The responses and strategies developed by the latter to face climatic influences always revolved around mobility, the development of certain activities such as the transport of goods by animal-drawn carts, young people converted into motorcycle taxi drivers and parents in ferricks have remained salaried shepherds (25%), paid to keep the animals of the political elites and traders of the province. It is a good deal for us without agriculture activities.

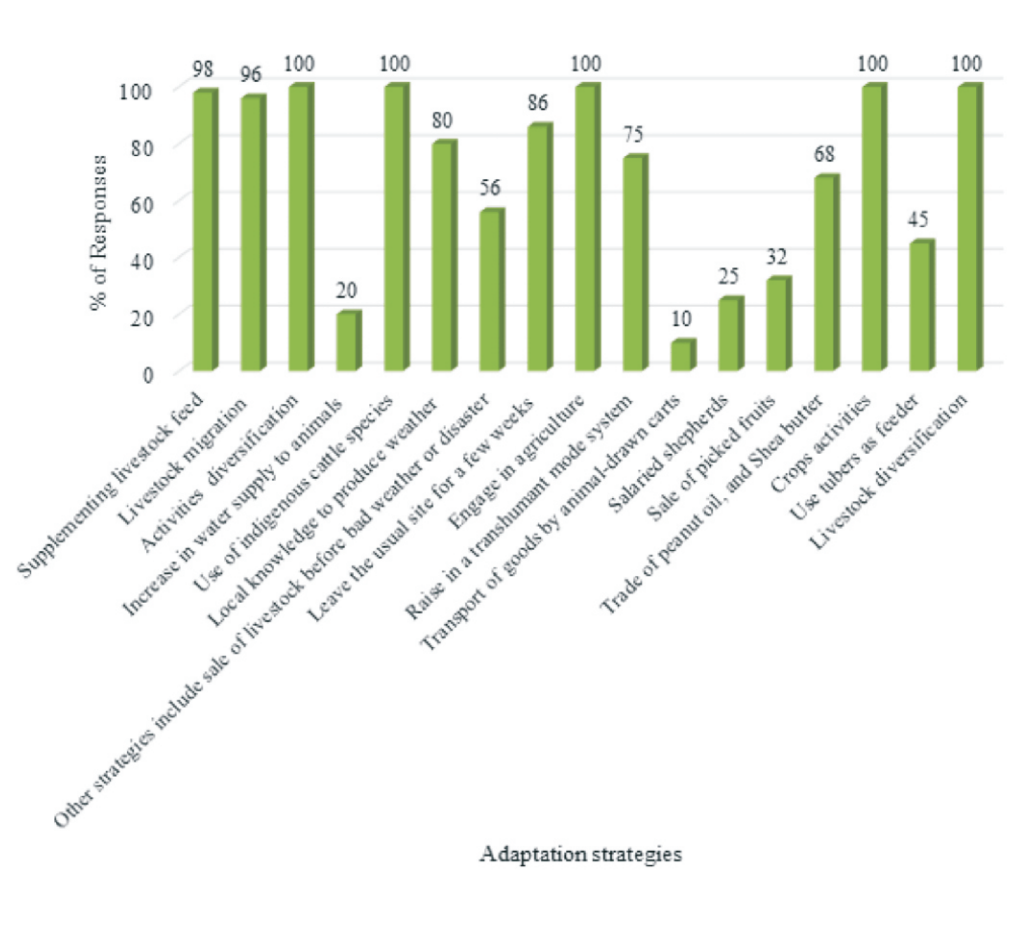


Figure 3: Agropastoralist adaptation strategy

During the survey, the chief of ferrick of Ningua declares in these terms "we lost most of our herds during the droughts of 1984 and the rest of the cattle in the resolution of conflicts and to face insecurities, which you see are the entrusted animals. Even if you have the animals I am ready to raise for you against a salary which is paid monthly at 1000F CFA per head of cattle".

The women meanwhile, in addition to the milk trade, had turned to the sale of picked fruits, the trade of peanut oil, and shea butter.

These agro-pastoralists practice agriculture on small parking plots around the ferrick

which are very profitable during the rainy season. These agropastoralists become good cereal farmers and buy back females animals with the revenue generated to reconstitute their herd.

The other populations have a purely agricultural vocation, turning to off-season crops and market gardening. There is also an intense development of fruit growing on land near water points around agropastoralists ferricks.

In summary for 96 % of agropastoralists, Cattle remains the important species according to the agropastoralists, the small ruminants are becoming more and more important because they required less water

and food and are less vulnerable to warming. For economic reasons corn and millet are the most important crops cultivated around ferrick.

Discussion

The perception of climate change by Agropastoralist in Tandjilé show 100% overexploitation of resources, severe reduction in pasture area, lack of animal gain and change in pasture composition.

85% change in forage quality. The climate variability alters plants' growth potential, deterioration of livestock feed resources and livestock's physiological response. Increasing patterns of temperature and decreasing rainfall trends is a global phenomenon, pastoral and agro-pastoral communities who rely on natural resources for livestock production rigorously feel its adverse effects. Climate variability alters the niche of forage species and may modify animal feed resources (Habte *et al.*, 2022).

More than 70% of crops lost due to flooding and 75% loss of animal lives due to drought in Tandjilé province. Habte (2022) in Ethiopia, claimed that loss of animals is associated with drought and the cumulative impacts of rainfall and surface temperature variability.

Demographic pressure has played a role in the disappearance of forage resources and influences on the areas reserved for agriculture and livestock. In 10 years we note an occupancy of 81.92% of land in Tandjilé province. (Odhiambo, 2003; Mwambashi, 2015) found that population pressure leads to increase in tensions and conflicts between farmers and pastoralist, soil erosion, and human rights abuse. According to Matimbwa (2019), the increase in population of both human and livestock depends on land resource, which itself never increases. Increased demand for land by both farmers and pastoralist as they increase in population leads to conflict.

The analysis of rainfall data shown an important inter-annual rainfall variation in

Tandjilé province those 30th last years. The finding works of Sanfo *et al.*, (2015) in Burkina shown that Climate change and variability are impacting land degradation and livestock health. Ulrichs, *et al.*, (2019) reported that climate extremes are having a significant impact on livestock productivity in Eastern and Western Africa. Increasing frequency and intensity of droughts; changes in water availability; increasing patterns of temperature and rainfall variability, all are profoundly threatening livelihoods of drought-prone areas, and the existence of arid and semi-arid remote regions. Climate change is threatening the productivity of agricultural land, by shortening growing periods and decreasing crop/pasture yields (UNFCCC, 2007).

In Tandjilé province, availability of forage is most variable and is depending to climate and likely human anthropogenic activity (bush fire). For some authors, in most sub-Saharan African production systems, fodder is abundant and may even be excessive and of sufficient quality during the rainy season, but availability and quality decline rapidly during the dry season (Nyamukanza *et al.*, 2008). Which leads to insufficient quantities of fodder for ruminant livestock.

The most sensitive to the effects of climate change are castles and sheep. The donkey, on the other hand, was designated as the most resistant in Tandjilé province.

Agriculture and grazing are most affected by the impacts of climate change. According to Hatfield *et al.*, (2014), more extreme temperature and precipitation can prevent crops from growing.

According to the focus groups carried out, 100% were unanimous and observe the pressures on agropastoral resources. The observation made by the agro-pastoralists can be summed up: the reduction of certain plant species, the drop in productivity, the high mortality in the ligneous stratum between September and October causing at times the fodder deficit and the

modification of the usual transhumance corridors have been noted unanimously by the agro-pastoralists surveyed. However for Alvare-Bertran *et al.*, (2020) farmers perceive shifts in climate differently depending on their location and agro-climatic zone. As a result, different adaption strategies are implemented by farmers according to the climatic, societal, and economic context. Survey results show that in the Sahel, climate adaptation strategies rely on traditional knowledge and experimental approaches; whereas in the Soudanian zone, where weather conditions are more favorable for agriculture, adaptation practices are market oriented.

Tandjilé province have recorded hundreds of deaths in the cantons of Kolon, Bere, Tchoua, Boulou, Mouroum and Kabalaye, after the murderer conflicts of recent years (2017; 2018; 2019 and 2020). Our results confirm the study report of Marty *et al.*, (2000) on the causes of conflicts related to pastoral mobility and mitigation measures. Conflicts between farmers and transhumant herders have become very frequent these recent years (Sougnabé, 2005). It must be recognized that farmers also harm breeders in the sense that areas formerly considered marginal are currently coveted by farmers.

According to the agro-pastoralists (78%) met in the Tandjilé Province, climate change contributes to misunderstandings between users of natural resources. Such misunderstandings often lead to conflicts that are sometimes so violent that they cause deaths on both sides. However, other studies shed light on these links between climate and conflict, by examining the effect of climatic variables, such as precipitation and temperatures, on the emergence of conflicts (Burke *et al.*, 2009; Hendrix and Glaser, 2007).

90% of agro-breeders also mentioned that the use of ponds by farmers to irrigate fields in the dry season gives rise to misunderstandings. Our result is almost similar to that of Matimbwa (2019), in

Tanzania, who 91.8% of respondents identified the search for water points and pastures as the main factor leading to the recurrence of conflicts between farmers and herders. . However, the search for water points and pastures for breeders is linked to the lack of land markers on which rural producers live.

The breeder must bypass the trap fields and travel for miles to water his herd. The distance already covered for watering leads to an increase in expenditure linked to walking (maintenance expenditure) which means that animals in free grazing in the dry season, instead of gaining in weight gain, rather fall in weight gain declared the respondents during the focus group.

Conflicts between Agropastoralists and farmers in Tandjilé were frequent. 44% of agropastoralists said that these conflicts are frequent and linked to climate change. 31% felt that conflicts linked to demographic pressure were low in the Tandjilé region unlike other southern regions. 25% of ferric agropastoralists have not experienced conflicts between users of natural resources. Mwamfupe, (2016) noted that conflicts between farmers and pastoralists have been linked to a number of drivers such as drought, land use, migration, as well as traditional beliefs and practices. Matimbwa, (2019) argues that pastoralist activities such as grazing and search for water highly cause conflicts.

More than half (87%) of the agropastoralists underlined that the most frequent conflict between agropastoralists and transhumant herders arises around water points and on rangelands. Similarly, literature has shown that competition for scarce natural resources such as water aggravates the frequency of droughts (Laiser, 2016; Falanta *et al.*, 2018). Matimbwa studies (2019), found that climate change is the main cause of drought and water scarcity, leading to conflicts between farmers and herders.

Adaptation Strategies

Agropastoralists in Tandjilé have adopted several strategies to deal with climate change (fig. 10). Coulibaly *et al.* (2022) note that agropastoralists have implemented strategies to adapt to climate change by making their activities less sensitive and more resilient to climate change, the most widespread of which are: transhumance, the recomposition of the herd, purchase of complementary feed, destocking, use of crop residues, storage of dry grass, compliance with vaccination schedules, diversification of sources of income (trade and agriculture), adoption new farming techniques (zai, ridge, half-moon) and the use of improved breeds and seeds. These strategies are almost similar to those implemented by agropastoralists in the province of Tandjilé. Overall, the adaptation results obtained in Tandjilé confirm those of other authors (Coulibaly (2021) in Mali, Ouédraogo (2010) in Burkina cited by Coulibaly (2022).), who mention that mobility, in particular transhumance, constitutes one of the adaptation strategies most practiced by pastoralists to cope with climate change. Nowadays, transhumance is still practiced, but it differs a little from that of before because the departures are early, the returns late and the distances traveled longer and longer. Zaza, *et al.* (2022) notes that mobility continues to characterize livestock systems in the Ras El Ma region in connection on the one hand with the degradation of rangelands and on the other hand with the new rules of access to food resources and fodder, in particular paying. Other coping strategies existing in fig. 10, such as the sale of milk, sale of fruit, etc. have been noted by Sarr, (2019) in Mauritania and Dangar, (2018) in Chad. These two authors are unanimous on the contribution of agro-pastoral by-products as a source of household income to increase the resilience of agro-pastoralists in the face of climatic hazards. Agropastoralists in

Tandjilé have adopted several strategies to deal with climate change (fig. 9). Zaza, *et al.* (2022), note that mobility continues to characterize livestock systems in the Ras El Ma region in connection on the one hand with the degradation of rangelands and on the other hand with the new rules of access to food resources and fodder, in particular paying. Other coping strategies existing in fig. 9 such as the sale of milk, sale of fruit, etc. have been noted by Sarr, (2019) in Mauritania and Dangar, (2018) in Chad. These two authors are unanimous on the contribution of agro-pastoral by-products as a source of household income to increase the resilience of agro-pastoralists in the face of climatic hazards.

Conclusion

Climate change undoubtedly affects the lifestyles of societies at various levels and forms from one society to another, the effects of climate change vary because economic and social vulnerabilities are different. It has identified the major impact in crop yields, diminution of grazing areas, flood in forage and drought in water resources, and livestock productivity as major threats of climate change to the sector. Arabian zebus and sheep are the most affected by the impact dictated by the influence of climate change in this part of the country.

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