

Rural Communities' Perceptions of Climate Change and Its Impacts on Their Livelihood in Southeastern Niger

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Authors' contributions

This work was carried out in collaboration among all authors. Authors IIM and BI designed the study, wrote the protocol, collected the data and performed the statistical analysis. Authors IIM, HR and MM wrote the first draft of the manuscript. Authors AM and MS managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Climate change exacerbates ecosystem degradation in Sahel where rural communities are highly dependent on natural resources and ecosystem services for their livelihoods. In order cope with the adverse effects of climate change by developing climate adaptation strategies, there has been a need to understand how communities perceive the change or variability in their local climate and how this change could affect their livelihood. This paper aims to examined rural communities' perceptions about climate change in the commune of Chetimari located in the region of Diffa, southeastern Niger. It investigated particularly: 1) how communities' perceptions of climate change? 2) What are the impacts of climate change on the livelihood of communities? And 3) What do elements and options to detect abrupt change points in annual precipitations and both annual maximum and minimum temperature? Survey data were collected from October to November 2018 from 101 households (15% of the total households in the study area) in three villages. Multiple

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correspondence Analysis (MCA) and Factorial Correspondence Analysis (FCA) were performed with XLSTAT to analyzed data from survey. Meteorological data including Monthly precipitation from 1981 to 2017, and Monthly temperatures (maximum, minimum) from 1986 to 2017 of the Diffa meteorological station were analyzed using R to perform the Man Kendal trend test and the Pettit test for detection of abrupt changes in the series. Results showed that community perceptions on temperature increase (not for precipitation) trends as indicators of climate change are in agreement with meteorologically observed trends. The findings showed that people in this zone are aware of climate change that they see as increase in maximum and minimum temperature, decrease in rainfall, frequency of extreme events (drought and flood), dry spells, decrease in number of rainy days, strong winds etc...Results revealed the most significant impacts of climate change affecting the livelihood of rural communities in this area. These are higher risk of crop damage from drought, farmer and herder conflict frequency, drying up of wells, food shortage/insecurity, silting pools, decline in soil fertility and livestock production, silting pasture areas, frequency of livestock diseases, increased weed and invasive species, livestock mortality. The perception of the climate change and its impacts on the main socioeconomic activities vary from a village to another, according the sexes and age ranges.

We conclude that communities are relatively aware about the climate change issue. For a better management of climate-induced risks in the study area we stress the need to improve the awareness of climate change within the rural community by improving the availability and the quality of relevant climate information.

Keywords: Climate Change; Commune of Chetimari; Niger; Rural community's perception.

1. INTRODUCTION

Climate change exacerbates ecosystem degradation which in turn affects terrestrial, freshwater and marine ecosystems services, functioning, composition, and structure [1,2,3]. In developing countries, particularly in sub-Saharan Africa rural communities are highly dependent on natural resources and ecosystem services for their livelihoods. Indeed, climate change is expected to have more severe impacts on these developing countries, especially those with a climate-sensitive economy such as Sahel [4,3,5]. The vulnerability of rural communities to the adverse effects of climate change increases due to their heavy dependence on rainfed agriculture in sub-saharan Africa [6,7]. In Sahel, increased drying linked with higher temperatures and decreased precipitation has contributed to higher frequencies of drought conditions since 1970 [8]. The National communication reports on the assessment of impacts, vulnerability, mitigation and adaptation to climate change clearly indicated that Niger has been experiencing a variety of climatic hazards, which include intense rainfall, floods, seasonal droughts, multi-year droughts, dry spells, strong winds [9,10]. Drought conditions result in decreased agricultural productivity, cattle decimation, southward people migration resulting in recurrent conflicts between herders and farmers [8]. In order to cope with these adverse effects of climate change, it appears very

important to assess the awareness of rural communities about climate change and its numerous impacts upon different survival activities.

Meteorological data were used to assess and understand climate variability, and to what extent changes in climatic conditions undermine the resilience of local communities (and their livelihoods). Such data are being used as well for helping them adapt to the adverse consequences of these changes [11]. However, there was limited information available with regards to the local communities' perceptions of shifts in climate, their own vulnerability, and their coping and adaptation practices. Thus, Awareness and self-reported knowledge about climate change have drawn the attention of the scientific community and have been rising over the last three decades. In numerous developed countries, such as the United States and some European countries, awareness of "climate change" and "global warming" has become nearly universal [12,13,14,15]. However, this trend is not observed in developing countries where most of people still have little or no information related to climate change [13]. In these developing countries, the degree of awareness may vary from urban to rural area.

There is evidence that community members are conscious of changes in climatic conditions. The United Nations Framework Convention on

Climate Change (UNFCCC, 1994) noted that humans are quick to observe any changes in their local environment because their livelihoods, culture, spirituality and social systems are connected to their local environment. Bomuhangi et al. [16] assert that human perceptions of change in climatic parameter are very significant as they could provide insight and complete the information provided by meteorological data. The knowledge on changes in weather from local communities could be used to develop community specific adaptation strategies to climate change [17]. Thus, This paper aims to investigate and understand rural communities' perception of climate change and its impacts on their livelihood: The framework applied here addresses three questions: 1) How communities' perception of climate change 2) What are the impacts of climate change on the livelihood of communities 3) What elements and options to detect abrupt change points in annual precipitations and both annual maximum and minimum temperature.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the commune of Chetimari which is located in the region of Diffa in South-East of Niger with an area about 2566 Km². The population is estimated at 69,091 inhabitants, including 34,702 men (50.22%) and 34,389 women (49.78%), mainly composed of the Kanuri, Fulani and Hausa ethnic groups (RGPH 2011). The climate is semi-arid. It is characterized by a severe, drought-prone dry season of 8–10 months and only 3–4 months of rainfall (June to September), peaking in August, with a high spatial, inter- and intra-annual variability. In the study area, the minimum and maximum temperatures rarely exceed 20.73°C and 36.92°C respectively. Mean annual precipitation is about 316.17 mm/year. Total rainfall at a given site varies from year to year with a coefficient of variation of 25–30% (Barbé and Lebel, 1997). The vegetation cover is characterized by the tree layer dominated in the northern part by thorny trees (eg *Acacia raddiana*, *Balanites aegyptiaca*.) and in the southern part, ie along the Komadougou one finds Sudanian species such as the *Tamarindus indica*, *Diospiros mespilliformis*, *Acacia nilotica*, and *Adansonia digitata*.. The shrub layer is dominated by *Ziziphus mauritiana*, *Leptadenia pyrotechnica* and the herbaceous layer of annual plants such as *Cenchrus biflorus*,

Alisicarpus ovalifolus, and *Tribulus terrestris* [18].

Sandy soils in the northern part, mainly sandy to loamy sandy soils in the center and silty clay soils observed in the Komadougou valley and ponds [18]. This region is characterized by high agricultural and pastoral activities. Two types of agriculture dominate: rainfed agriculture and irrigated agriculture. In general, the commune has a deficient cereal production. Rainfed crops are increasingly neglected in favor of irrigated crops less dependent on climatic hazards. Irrigation is practiced along the banks of the Komadugu River and ponds in the southern band of the Commune; pepper and rice are the main cultivated crops [18]. Livestock is after agriculture the second udder of the economy of the communities. It is extensive and practiced by almost the entire population. The livestock is estimated at 173188 heads [18]. The northern part is dominated by large ruminants while the small ruminants are everywhere in the commune. Pastoral infrastructures consist of veterinary stations, slaughterhouses and vaccination parks. There are 117 livestock corridors of which only 3 are materialized [18].

Fishing is one of the main economic activities in the commune of Chetimari. It is practiced mainly by the population living the surroundings of Komadugu River. The dominant fish species are: *Clarias* sp. commonly called catfish, *Tilapia* sp or carp of its common name and *Heterotis niloticus*. It is practiced in a rudimentary way, by using tools such as gill nets, and nets [18].

2.2 Data Collection and Analysis

To conduct this study, two categories of data primary (social) and secondary data (meteorological) were collected from two sources questionnaire and climate records respectively. The data collection were carried out during two months from October to November, 2018. To collect the primary data, a survey was conducted using a questionnaire dealing with perceptions of climate change and the perceived impacts of climate change on indigenous livelihood resources. Some questions were: in what month did the rainy season start and end 30 years ago? What is the frequency of flood and drought 30 years ago? What are the consequences of these events on your activities? Are dry spells more and more frequent? Is it getting hotter during the day? What do you think

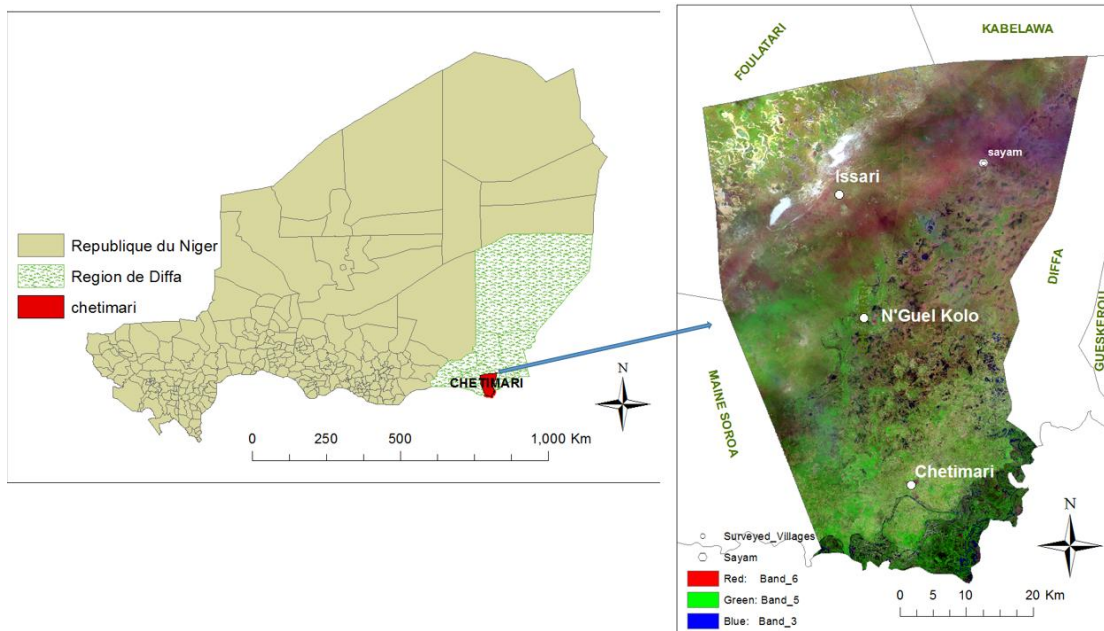


Fig. 1. Location map of the study area

about the mortality of your livestock 30 years ago? To do this, the commune was divided into 3 sub-zones according to the main activity performed by the majority of populations. Therefore, there was south sub-zone characterized by fishing and irrigation, central sub-zone where agro pastoralism activities are mainly practiced and north sub-zone where populations rely only on pastoralism activities for their livelihood. In each sub-zone a village was selected randomly. So, these villages are: Chetimari, Issari and N'Guel Kolo in south, central and north sub-zones respectively. The sample size was determined by calculating 15% of the total households in the study area. Thus a total of 101 households were surveyed (29 in Chetimari, 34 in Issari and 38 in N'Guel Kolo). In addition, households where the head-of-household are at least 30 years old were retained for the survey because we are dealing with climate change. For the ethical clearance, the purpose, risks, and benefits of the study were explained to all the head of the villages and the participants. In addition, all participants were assured that the participation was completely voluntary.

With regards to the secondary data, meteorological data were acquired from the National Directory of Meteorology. These were Monthly precipitation from 1981 to 2017 and Monthly temperatures (maximum, minimum) from

1986 to 2017 of the Diffa meteorological station (Station closest to our study area).

Data from questionnaire were analyzed using XLSTAT and R software. Descriptive statistics were run to generate frequencies and percentages. This allowed comparison of different study parameters among villages. Multiple Correspondence Analysis (MCA) was performed to understand how communities' perception of climate change varies from one village to another. Factorial Correspondence Analysis was run to see the impacts of climate change on the livelihood of communities in the three villages.

For the climatic data analysis, a nonparametric approach developed by Pettitt (1979) was adopted to detect abrupt change points in annual precipitations and both annual maximum and minimum temperature. With regards to trends detection on these variables Mann-Kendall test (1945) was applied. Both tests were performed using XLSTAT and using R package Hmisc [19].

3. RESULTS

3.1 Socio-economic Characteristics of Surveyed Households

The sample surveyed was divided into three age groups dominated by young people aged 30 to

45, followed by the age group 46 to 60 and lastly the group of 61 to more (Table 1). The age of the respondents varied from 30 to 72 with an average of 43 years. The maximum number of years of experience was 43 years and the average was 21 years old (Table 1).

Table 1. Descriptive statistics of the surveyed sample and analyzed variables

Variable	Modalities	Total	%
Village	Chetimari	29	28.7
	N'Gelkolo	38	37.6
	Issari	34	33.6
Age	30-45	62	61.3
	46-60	31	30.6
	61-more	8	7.9
Sexe	F	47	46.5
	M	54	53.4
MRRS	DK	7	6.9
	N	50	49.5
	Y	44	43.5
RS_Var	DK	7	6.9
	N	1	0.9
	Y	93	92.07
LongRS	DK	9	8.91
	N	80	79.2
	Y	12	11.8
Incr_NRD	DK	7	6.9
	N	48	47.5
	Y	46	45.5
Incr_RI	DK	8	7.9
	N	49	48.5
	Y	44	43.5
Flood_F	DK	46	45.5
	N	7	6.9
	Y	48	47.5
DS_F	DK	9	8.9
	N	14	13.8
	Y	78	77.2
Long_DS	DK	8	7.9
	N	23	22.7
	Y	70	69.3
Wind_I	DK	7	6.9
	N	30	29.7
	Y	64	63.3
DN_W	DK	9	8.9
	N	9	8.9
	Y	83	82.1

MRRS= More Rains in Rainy Season; RS_Var= Rainy Season Variability from a year to another;
 LongRS= Rainy Season more and more long;
 Incr_NRD= Increase in Number of Rainy Days;
 Incr_RI= Increase in rain intensity; Flood_F= Flood Frequency; DS_F= Dry spells during rainy season;
 Long_DS= Long Drier Season; Wind_I= Strong Wind;
 DN_W=days and nights are becoming warmer
 M= Male; F= Female; Y= Yes; N= No; DK= Don't Know

3.2 Perception on Change in Climatic Parameters

An increasingly frequent and violent flood was observed in the study area, especially in the southern part. This disaster was highly relevant to irrigated crop sites and villages along the Komadougou Yobe river, according to 47.5% of respondents (Table 1). The results revealed that more than 77% of the consultants stated that the dry spells are becoming more frequent and long, sometimes reaching more than two decades (Table 1). About 83% of the respondent stated that the maximum and minimum temperature increase gradually (Table 1). Up to 80% of those surveyed agree on the progressive shortening of the rainy season. The length of the rainy season has reduced from 4 to 3 months. Moreover, 93% of the respondent notice that rainfall varied from one year to another and from one locality to another and in general the quantity and intensity of rainfall gradually decrease (44% of respondents). It should be noted that heavy rains were sometimes observed at the beginning and the middle of the rainy season, according to 44% of respondents (Table 1).

Multiple Correspondence Analysis results applied on the variables about the perception of climate change showed that the first three MCA dimensions explained 54.01 % of the variability among households. Dimension one, two and three contributed with 33.66%, 12.56%, and 7.78% of the inertia respectively (Fig. 2). The two first dimensions were retained for the analysis.

Multiples Correspondence Analysis results on the relationship between perception variables of climate change and villages showed that in dimension 1 most respondents from N'Guelkolo who age ranges are 30-45 year-old and more than 60-year-old don't know about variability of rainy season from year to another, more rainfall in rainy season, increase in number of rainy days, Increase in rainfall intensity, Flood Frequency, long drier season, strong wind and days and nights are becoming warmer (Fig. 3, Table 2).

However, the dimension 2 represents the village of Issari and Chetimari oppositely. In contrast to Issari village, respondents from Chetimari dominated by age range 46-60-year-old think that the rainy season has been more and longer with increase in rainfall intensity leading to a flood frequency. But they don't perceive a strong intensity and a longer dry season. Moreover, in

Issari village community perceived variability in rainy season with a frequency of dry spells during the rainy season. They also notice that days and nights have become warmer, dry season appear longer, and wind speed has increasing (Fig. 3, Table 2).

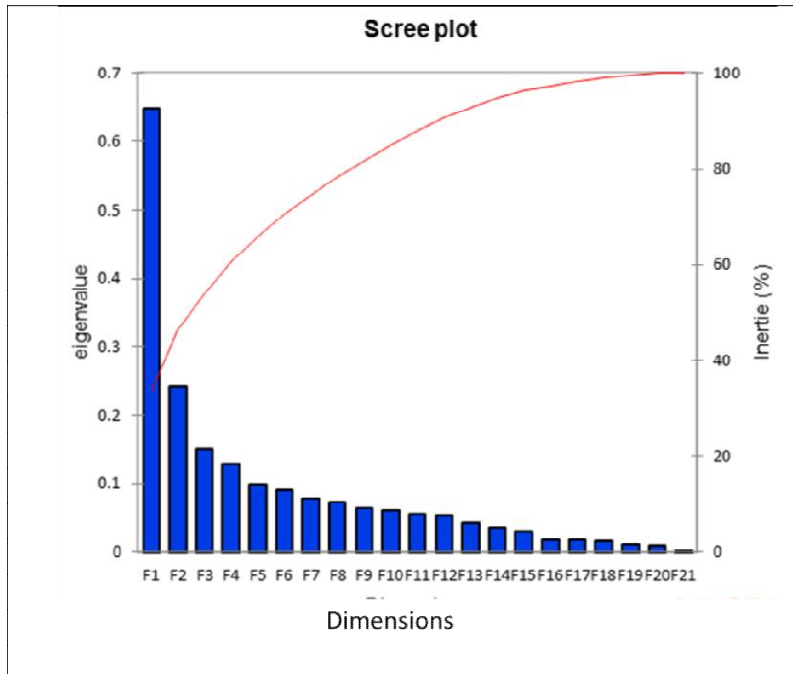


Fig. 2. Plot of the MCA eigenvalues and cumulative percent of inertia

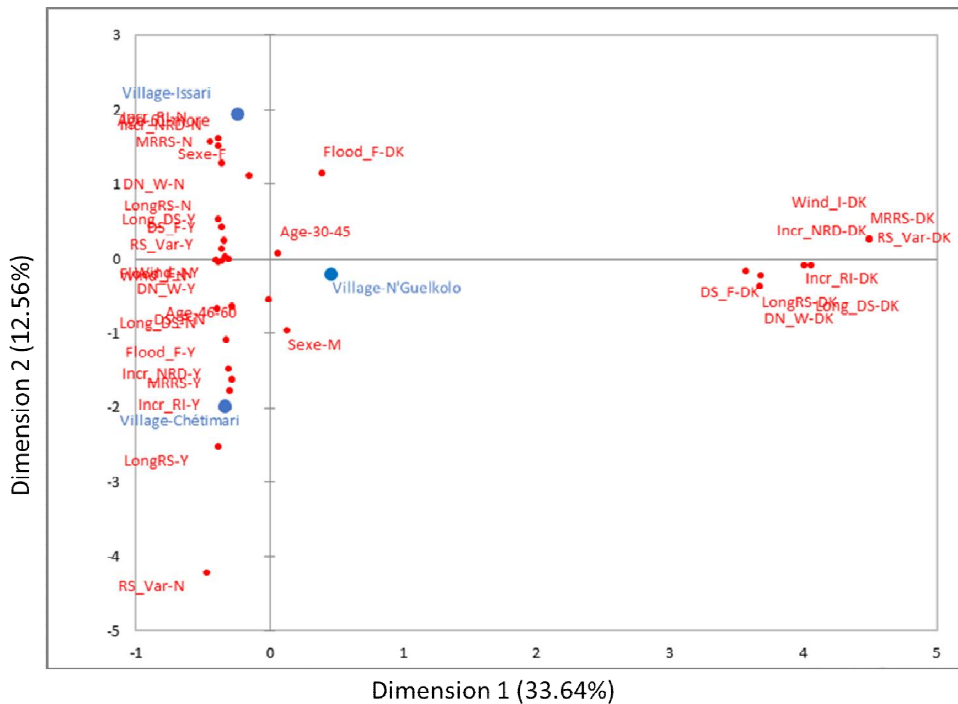


Fig. 3. Result obtained from MCA showing the relation between villages, age ranges, sexe and perception of climate changes

Table 2. Relative contributions of the variables to the 3 first dimensions of the MCA

Categories	F1	F2	F3
Village-Chétimari	0.23	8.80	1.38
Village-Gelkolo	0.61	0.13	2.27
Village-Issari	0.14	9.74	7.17
Age-30-45	0.02	0.02	2.62
Age-46-60	0.00	0.71	1.07
Age-61-more	0.12	1.51	6.10
Sex-F	0.08	4.46	2.43
Sex-M	0.07	3.89	2.12
MRRS-DK	10.75	0.03	0.01
MRRS-N	0.49	6.18	1.43
MRRS-Y	0.31	7.42	1.72
RS_Var-DK	10.75	0.03	0.01
RS_Var-N	0.02	1.36	1.03
RS_Var-Y	0.79	0.01	0.01
LongRS-DK	9.25	0.09	0.01
LongRS-N	0.77	1.08	0.12
LongRS-Y	0.14	5.84	0.93
Incr_NRD-DK	10.75	0.03	0.01
Incr_NRD-N	0.54	8.38	3.43
Incr_NRD-Y	0.28	9.17	3.71
Incr_RI-DK	9.76	0.01	0.00
Incr_RI-N	0.55	9.73	2.15
Incr_RI-Y	0.30	10.63	2.45
Flood_F-DK	0.55	4.52	6.89
Flood_F-N	0.09	0.00	1.67
Flood_F-Y	0.38	4.30	4.31
DS_F-DK	8.72	0.02	0.04
DS_F-N	0.09	0.44	12.62
DS_F-Y	0.77	0.11	2.48
Long_DS-DK	10.05	0.01	0.02
Long_DS-N	0.26	0.80	6.88
Long_DS-Y	0.60	0.29	2.39
Wind_I-DK	10.75	0.03	0.01
Wind_I-N	0.34	0.01	5.67
Wind_I-Y	0.47	0.00	2.76
DN_W-DK	9.28	0.04	0.01
DN_W-N	0.10	0.19	10.83
DN_W-Y	0.81	0.01	1.25

MRRS= More Rains in Rainy Season; RS_Var= Rainy Season Variability from a year to another; LongRS= Rainy Season more and more long; Incr_NRD= Increase in Number of Rainy Days; Incr_RI= Increase in rain intensity; Flood_F= Flood Frequency; DS_F= Dry Sequencies Frequency during rainy season; Long_DS= Long Drier Season; Wind_I= Strong Wind; DN_W=days and nights are becoming warmer; M= Male; F= Female; Y= Yes; N= No; DK= Don't Know

3.3 Historical Rainfall and Temperature Trends and Abrupt Change in Time Series

The analysis of rainfall data on the series 1981-2017 using the test of Pettitt indicated an abrupt change in 2002 (Fig. 4a). There was a significant average increase of 78 mm of rain between the series before and after the abrupt change (Fig. 4a). The Mann-Kendall test showed a

return to better rainfall conditions after 1987 (Fig. 4b).

The application of the Pettitt test on the annual average maximum temperature of the study area for the period 1986-2017 showed that no significant abrupt change was detected in the series. Nevertheless, there was a sharp decrease in temperature to 2.21°C between 1998 and 1999. It can be noted that the 1990,

2007 and 2010 are the hottest years. However, a slight increase in temperature was observed in the series (Fig. 4c).

And as for the average annual minimum temperature for the same period, the application of the test revealed a significant abrupt change in 2004 thus dividing the series into 2 sub-series. An increase of 0.53°C is observed between the series before and after the rupture. A temperature decrease of 1.88°C was observed between 1997 and 1998, followed by an increase in the minimum temperature up to 2017 (Fig. 4d).

3.4 Climate Change Effects on Agricultural, Pastoral and Fishing Activities in Chetimari

Factorial Correspondence Analysis (FCA) applied to the matrix (village and perception of impacts of climate change) reveals the following

results: F1 and F2 provide 73% and 27% of information respectively. On the axis1 it was observed that the higher risk of crop damage from drought, farmer and herder conflict frequency, drying up of wells leading to increased number of drilled wells, decline in crop yield, decreased fish production, and extinction of some fish species are much more perceived in the zone of (South zone) Chetimari. Whereas respondents in N'Guelkolo (Central zone) highlighted as impacts of climate change, food shortage /insecurity, silting pools, decline in soil fertility, decline in livestock production, increased weed, and silting pasture areas. In the northern part (Issari) respondents notice and link to climate change the frequency of livestock diseases, the decline in livestock production, the increased weed and invasive species, the livestock death, the silting pasture areas and a very lower satisfaction of need from their activities (Fig. 5 and Table 3).

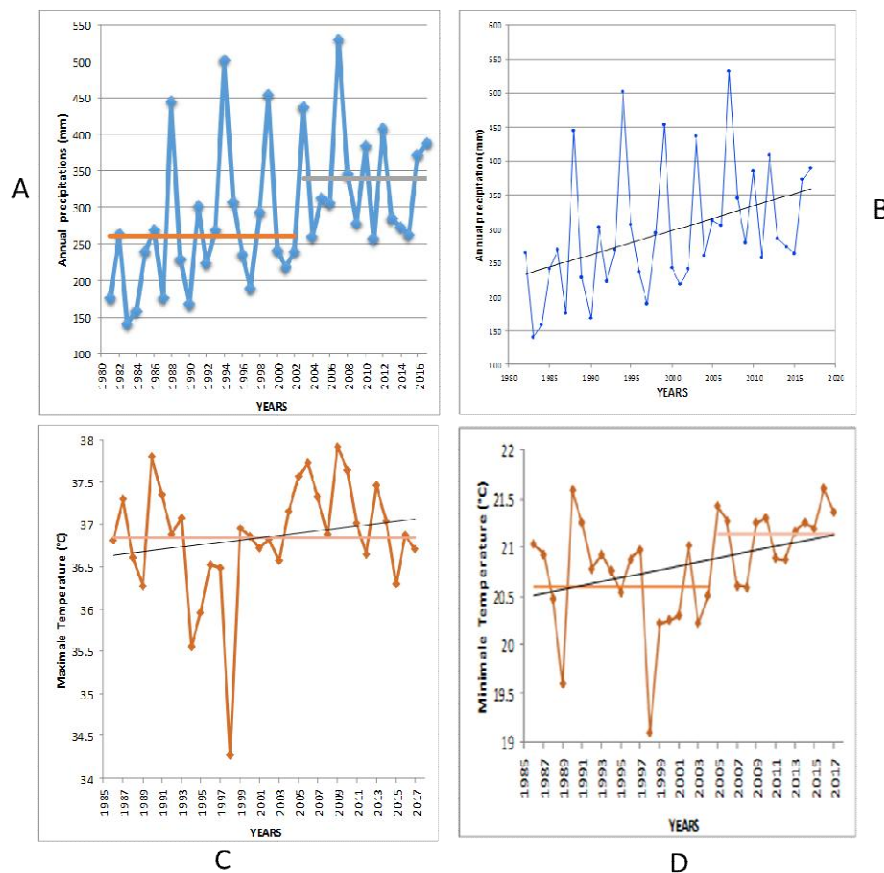


Fig. 4. Trends and abrupt changes detection

A= Detection of abrupt change annual precipitation data series 1981 to 2017; B= Detection of trend in data series of annual precipitation 1981 to 2017;

C= Detection of abrupt change of Maximum temperature 1986 to 2017; D= Detection of abrupt change of Minimum temperature 1986 to 2017 from the station of Diffa

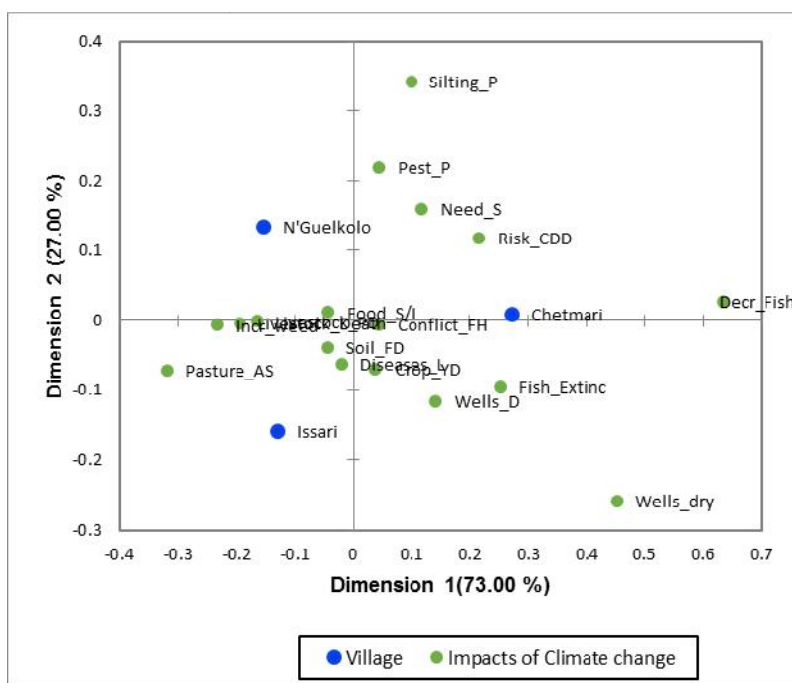


Fig. 5. Result obtained from FCA showing the relation between villages and communities perception of impacts of climate change on their livelihood

Food shortage /insecurity=FS/I; Higher risk of crop damage from drought=HRCDD; FH=Farmer and Herder Conflict Frequency; Need_S=Need satisfaction; Diseases_L=frequency of livestock diseases; Increased number of drilled wells=Wells_D; Silting pools=Silting_P; drying up of wells=Wells_dry; Decline in soil fertility=Soil_FD; Decline in crop yield=Crop_YD; Increased pest pressures=Pest_P; decline in livestock production=Livestock_PD; Death of livestock due to shortage of fodder and water= Livestock_Death; Increased weed = Incr_weed; silting pasture areas= Pasture_Silt; Decreased fish production= Decr_Fish; Extinction of fish species=Fish_Extinc

Table 3. Relative contributions of the variables to the 2 dimensions of the FCA

	Relative weight	D1	D2
Food_S/I	0.077	0.004	0.001
Risk_CDD	0.043	0.053	0.043
Conflict_FH	0.085	0.004	0.000
Diseases_L	0.079	0.001	0.021
Need_S	0.032	0.012	0.058
Wells_D	0.060	0.031	0.057
Silting_P	0.045	0.012	0.374
Wells_dry	0.038	0.205	0.181
Soil_FD	0.090	0.005	0.010
Crop_YD	0.073	0.003	0.025
Pest_P	0.054	0.003	0.187
Livestock_PD	0.081	0.057	0.000
Livestock_Death	0.059	0.057	0.000
Incr_weed	0.059	0.083	0.000
Pasture_AS	0.077	0.205	0.027
Decr_Fish	0.022	0.226	0.001
Fish_Extinc	0.024	0.039	0.015

Food shortage /insecurity=FS/I; Higher risk of crop damage from drought=HRCDD; FH=Farmer and Herder Conflict Frequency; Need_S=Need satisfaction; Diseases_L=frequency of livestock diseases; Increased number of drilled wells=Wells_D; Silting pools=Silting_P; drying up of wells=Wells_dry; Decline in soil fertility=Soil_FD; Decline in crop yield=Crop_YD; Increased pest pressures=Pest_P; decline in livestock production=Livestock_PD; Death of livestock due to shortage of fodder and water= Livestock_Death; Increased weed = Incr_weed; silting pasture areas= Pasture_Silt; Decreased fish production= Decr_Fish; Extinction of fish species=Fish_Extinc

4. DISCUSSION

Global appreciation of climate change remains diverse and multidimensional. Thus, it appears that rural communities' perceptions of climate change are related to weather and their dependence on the environment. For these communities, the experiences lived in contact with the environment and which have been capitalized on endogenous knowledge, allow them to have a reading of the climate and to go to the evidence of a modification of the latter. Communities characterize climate variables such as precipitation, temperature, and extreme events because they affect their activities. In fact, decrease in precipitations and increase in temperature (both maximum and minimum) observed by rural communities in the commune of Chetimari which were in agreement with the results of some studies [20,21], in which it was revealed that since the end of the 1960s, the Sahelian region has been seriously affected by drought and diminution of rainfall both in intensity and duration. This perception of the communities confirms once more the report of CILSS [22] in which it notified that, during the second half of the 20th century, the Sahel experienced a sharp decrease in precipitation with a clear rupture in the years 1968-1972. The significant reduction in rainfall was evident in the Sahel. It has resulted in a historic process of climate dryness characterized by the severe droughts of the 1970s and 1980s. This finding is generally in line with the data gathered at 3 meteorological stations in Northern Benin, which showed a downward trend in rainfall [23]. However, the Mann Kendall statistical test carried out from the annual precipitation data of meteorological station of Diffa reveals that there is no significant trend in this time series from 1981 to 2017. This was contrary to the revelations of surveyed communities. This situation is similar to the results of the study conducted by Rodrigue DIMON [24] on the rainfall data of the village of Alfakoara, where it has been shown that there is no significant trend in the analyzed time series. This discrepancy between climate data analysis and communities' perceptions of climate change could be explained by the fact that the climate data processed are not specific to the villages surveyed. Indeed, the large variability in annual rainfall amounts could give the impression of a declining rainfall trend for communities.

In addition, the rise in temperatures revealed by the communities is in line with the climate data analysis of this variable. It is consistent with Sarr's [25] research work, where temperatures in

West Africa, and particularly in the Sahel, have been shown to have evolved somewhat faster than the global trend, with increases ranging from 0.2°C to 0.8°C per decade since the late 1970s in the Sahel-Saharan, Sahelian and Sudanian zones. The observed increase is however greater on the minimum temperatures (up to 1°C) than on the maximum (up to 0.5°C). Similar statements of awareness by farmers about climate change have been reported in many studies conducted in Africa [26,27].

Climate change affects by many ways the livelihood of the communities in the commune of Chetimari. According to the rural communities the agricultural productivity decreases leading to food insecurity. Indeed, they mentioned a considerable increase of the crop pests such as: the locusts, the caterpillars, the leaf miner, the grain-eating birds. Crop pests significantly contribute to the yield decrease. This figure is in line with the results of Coulibaly [28] which showed that the attacks of pests (such as the leafminer) increase, because of the high frequency of dry spells of more than 7 days. Moreover, we argue that in this region agricultural activities are highly threatened by the insecurity from the sect Boko Haram. In addition, in this Sahelian zone livestock is highly threatened by climate change, according to information collected from most of the populations surveyed. According to them, the livestock reproduction rate has decreased; the livestock mortality rate has increased due to lack of pasture accompanied by heavy rains at the beginning of the rainy season. In fact, the area of Issari recorded the loss of hundreds of livestock in 2018 due to these heavy rains at the beginning of the rainy season. Pasture areas are not only threatened by silting but also by species less/non palatable to livestock. These results are consistent with that of Antonino [29] who showed that the livestock sector is also threatened by climate change, especially in rainy years with a deficit. Regarding fisheries, climate change seems to affect the quantity of fish. In fact, the quantity of fish has decreased considerably in rivers in recent years that could be attributed to rapid evaporation of water in dry season.

5. CONCLUSION

This study has explored how changes in local climate were perceived by rural communities in the commune of Chetimari in Southeastern Niger, as well as how these changes could affect their livelihoods with emphasis on the main socioeconomic activities. Although there is

limited meteorological evidence of significant change in terms of annual precipitation from 1981 to 2017, the findings showed that people in this zone were relatively aware of climate change that they see as increase in maximum and minimum temperature, decrease in rainfall, frequency of extreme events (drought and flood), decrease in number of rainy days, and increase in frequency of strong wind.

The perception of the climate change and its impacts on the main socioeconomic activities vary from a village to another, according to the sexes and age ranges. The study allowed to discover the most significant impacts affecting the livelihood of communities in this area which were: higher risk of crop damage from drought, farmer and herder conflict frequency, drying up of wells, food shortage/insecurity, silting pools, decline in soil fertility, decline in livestock production, silting pasture areas, frequency of livestock diseases, increased crop pests and non-palatable species, livestock mortality. For a better management of climate-induced risks in the study area we stress the need to improve the awareness of climate change within the rural community by improving the availability and the quality of relevant climate information.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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