Comparative Assessment of Local Farmers' Perceptions of Meteorological Events and Adaptations Strategies: Two Case Studies in Niger Republic

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Comparative Assessment of Local Farmers' Perceptions of Meteorological Events and Adaptations Strategies: Two Case Studies in Niger Republic

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Abstract

Several studies on farmers' perceptions on climate variability tend to provide bulked information at either regional or national level. Assessing the disparities of skills and the strategies of adaptations among farmers across locations could be the first step towards solutions in adaption to the climate variability and change. The objective of this paper was to assess and compare local farmers' perceptions on meteorological events, adaptations and access to agricultural extension services in two agro-ecological zones, Diffa and Aguie, in Niger Republic. The results revealed that climate challenges are well distributed in both areas but, there are significant discrepancies in the perceived climate variabilities compared to meteorological observations. Respondents noted an increase in temperature which is in agreement with climatic data evidence. It was found that majority of respondents adopt crop diversification in the sense of mixed cropping as their major adaptation strategy to climate variability. However, the extent to which farmers perceived crop diversification as a climate change adaptation strategy is not a response to the subjectively perceived changes in weather patterns, but rather a traditional strategy to reduce risk and to adapt to the long-standing inter-annual and intra-annual rainfall variability in the area. The lack of sufficient educational knowledge, external support and access to information are the constraints that hindered farmers to adapt effectively and, this leads to low agricultural productivity. It is recommended to empower farmers with information, technological skills, access to heat resistant crop varieties that enable them to adapt to increasing maximum temperatures.

Keywords: adaptations strategies, climate variability, meteorological events, Niger, farmers' perceptions

1. Introduction

Agriculture is the main *source* of income for the majority of the developing world, employing about 60% of the workforce and contributing an average of 30% of gross domestic product (GDP)) in Sub-Saharan Africa (World Bank, 2013). Unfortunately, this sector is facing adverse effects of climate change. A large fraction of the population of these countries is already plagued in chronic hunger and malnutrition (Lobell et al., 2008; Schmidhuber & Tubiello, 2007) and where widespread poverty limits the capacity to cope with climate variability and natural disasters. Furthermore, according to the fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2013), changes like rising temperature and changing precipitation patterns will likely lead to an acute decline in rainfed crop production in some African countries. These changes of weather are exacerbating existing vulnerabilities of the poorest people who depend on semi-subsistence agriculture for their survival (Slingo et al., 2005; Morton, 2007).

Like most of the developing countries, Agricultural production remains the main source of livelihood for most rural communities in Niger. In fact agriculture contributed to 38.2 % to GDP (World Bank, 2012). The rural sector employs over 80% of the working population, and it is also in rural areas that the highest numbers of poor people (86%) are found (Mahama & Boulenger, 2003). Unfortunately the agriculture sector is very dependent on climate conditions which are characterized by unreliable and erratic rainfall patterns. Since 1968 there has been recurrent drought in Niger with rainfall deficits. The water requirements for maximum yields of staple crops (cowpea, sorghum and millet varieties) have not been satisfied in most years. This resulted in recurring deficits of production sometimes generating food insecurity which exacerbate the poverty. This issue puts Niger in a very precarious situation and more vulnerable to climatic variability**.** Indeed, a recent study on mapping of vulnerability and poverty in Africa listed Niger as one of the countries that are both most vulnerable to climate change and with the least capacity to respond (Orindi et al., 2006; Stige et al., 2006). Vulnerability to droughts and climate variability is exacerbated by a series of additional factors and risks. For instance, floods occurred in 2008 and 2010, affected nearly 200,000 residents and caused a sharp increase in the incidence of water borne disease. In addition, 6 872 ha of crops were destroyed and more than 232833 residents were affected (OCHA Niger, 2013). Consequently the increased frequency of these extreme events resulted in increased risk of crop failure most of the years. In response, the Niger government has elaborated strategic plans based on sustainable agriculture including “3N initiative” (les Nigeriens Nourissent les Nigeriens) which is aimed at improving food and nutritional security. Despite the growing strategies measures in adaptation and increasing resources dedicated to promote sustainable land management and increase agricultural productivity yet, smallholder famers still face numerous challenges including structural food insecurity and unsustainable agro-pastoral practices. Therefore there is a need to understand in depth the full range of smallholder farmer’s needs which in turn could help them to effectively adapt and improve their livelihoods while ensuring food security. Assessing the perceptions of farmers on meteorological events and their strategies of adaptations could be the first step towards solutions.

Thus, there is a growing demand from policy makers for a better understanding of the most vulnerable livelihoods (Tschakert, 2007) in order to design appropriate adaptation tools. A better understanding of farmers’ perceptions of climate change, ongoing adaptation measures, and the decision-making process is important to inform policies aimed at promoting successful adaptation strategies for the agricultural sector. Therefore farmers need to recognize the climatic changes already taking place in their areas and undertake appropriate investments towards adaptation (Komba & Muchapondwa, 2012). The perceptions of the indigenous people about climate change and their responses to climate change have significant roles to play in addressing climate change (Obayelu et al., 2013). Moreover several studies (Simelton et al., 2013; Moyo et al., 2012; Gbetibouo, 2009; Maddison, 2006; Okonya et al., 2013) noted that the success of any adaptation strategies would depend on a better understanding of farmers’ perception about climate change and variability. Hence, various studies have been done in recent years to understand famers’ perceptions on climate change and climate variability. For instance a study conducted by Sanfo et al. (2012) in Burkina Faso revealed that famers understand climate change and climate variability primarily based on weather-crop interactions and on events that are associated with climatic fluctuations similar results were found throughout literature. Concerning Temperature and rainfall amount changes, Kemausuor et al. (2011) indicated that more than 80% of farmers believe that temperature in Ejura-Sekyedumase district had become warmer and over 90% were of the opinion that rainfall timing had changed, resulting in increased frequency of drought. In fact Gbetibouo, (2009) reported that more than 70% of farmers perceived that rainfall decrease. Moreover various studies have shown the awareness of farmers on climate change (Shashidahra & Reddy, 2012; Maddison, 2007; Ndambiri et al., 2012; Fisher et al., 2010). However those studies on perceptions of climate deal with temperature and rainfall patterns (Deressa et al., 2009; Fisher et al., 2010). Historical climatic data are often used to confirm farmers ‘perceptions (Orlove et al., 2000, Vedwan & Rhoades, 2001; Deressa et al., 2009; Fisher et al., 2010) or to reject them (Maddison 2007). Furthermore these studies provided bulked information at country or at region level. So far, not much is known about on how local farmers perceive climate change within the same country and what the disparities of skills among farmers are, and assess whether these perceptions are in line with meteorological observations measurements. A comparative approach to understand their perception at local level is useful in revealing the differential effects of climate. It helps also in underscoring the gaps of adaptive strategies and skills among them and their needs and barriers that prohibit from effectively adapting. Therefore in Niger where the population rely on natural resources, the extent of progress towards development in this country will depend not only on effective adaptation to climate change and variability but, most importantly, on empowerment of farmers with skills, taking advantage of the long-standing experience of drought and integrating the indigenous knowledge in policies. Empowering farmers with skills and knowledge is a catalyst for them to respond to the effects of climate change and is a key to sustainability. Most importantly, understanding indigenous knowledge is critical to developing effective climate change adaptation strategies also for decision makers and policy makers to learn how and where to enhance adaptive capacity location by location. In this context, the present study aims in assessing farmers' perceptions on meteorological events at local scale for understanding their effects on vulnerable farmers, the disparities of skills between them as well as their ability to cope with climate variability.

2. Material and Methods

2.1 Study Areas

The study was carried out in two districts of Niger Republic, Diffa and Aguie, because they belong to different agro ecological zones (Fig. 1).

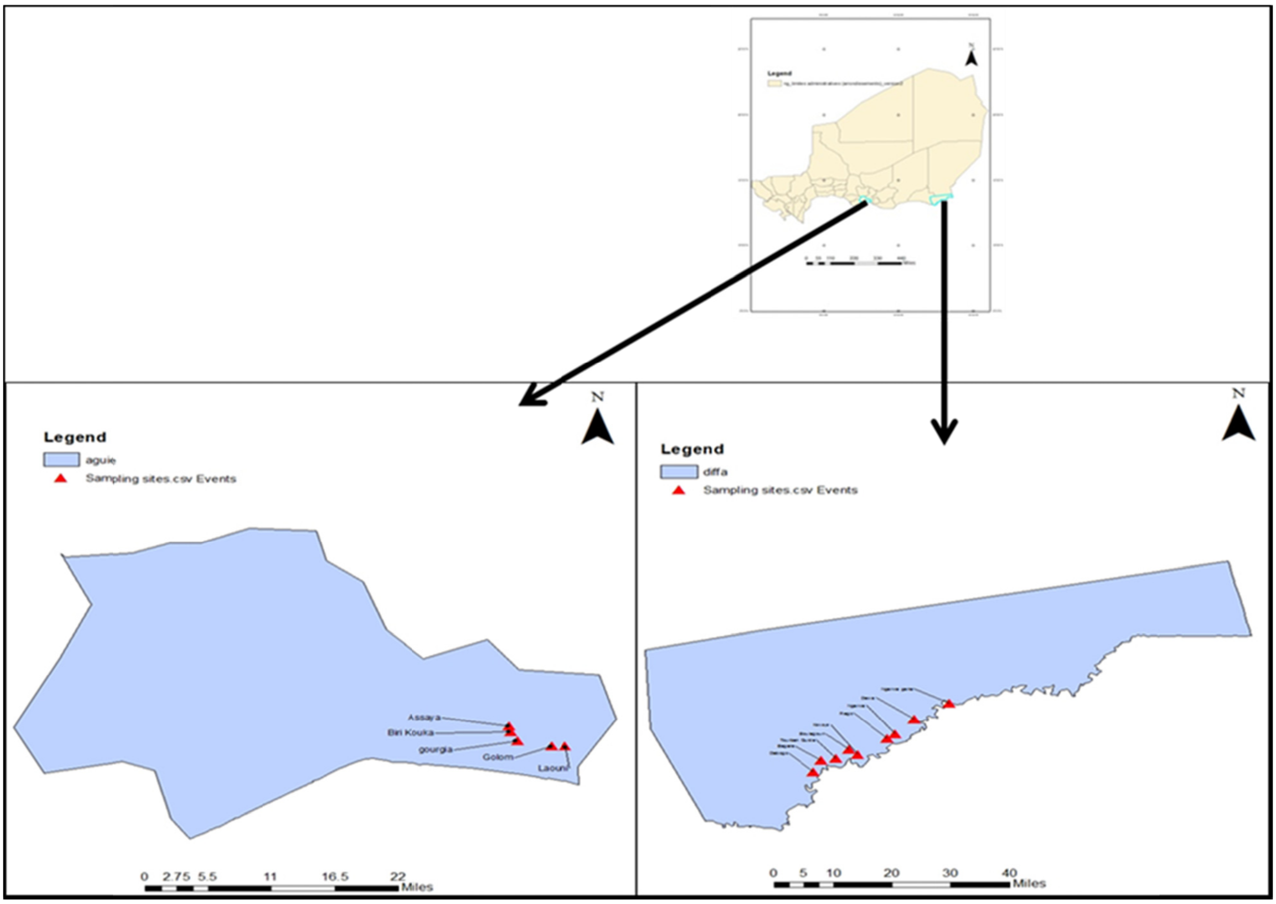


Figure 1. Location of area examined

The mean annual rainfall in Diffa is ranging from 200 to 400 mm. The dry season is characterized by the lowest temperatures (21ºC averages) between November and February and highest between March and June. The maximum temperatures are ranging between 33°C during the rainy season and 46°C during the dry season with a short rainy season mostly less than 3 months. Aguie district lies between 400 à 60 mm isohyets with the rainy season lasting 3 to 4 months (Djariri M. L, unpublished, 2009).Temperatures can reach 45 degrees in the warm dry season and down to 10 ° in the cold dry season. Average temperatures are between 27 and 29°C. Rainfed farming is the main form of crop production in both districts. However it is practiced at risk due to the large interannual rainfall variability of climate. This activity is a subsistence based on cereal growing (millet, sorghum and maize) and some drought resistant pulse crops (cowpea, groundnut). Despite that local early varieties of pearl millet (*Pennisetum glaucum*) (80-90 days cycle) or (60 days cycle) are cultivated, pearl millet farming has progressively receded, while irrigated crops persist surrounding the Lake Chad and in the Komadougou Yobe valley in Diffa and Goulbi valley in Aguie. Given the scarcity of rainfall recently, today the irrigated farming system has always been of crucial importance in generating much of income in both Diffa and Aguie Districts. Generally, irrigation systems are recession flood systems where the pumps are placed on the border of the river and water is distributed to the different plots by a system of narrow earthen canals. The main irrigated crops are onions, local eggplants, barley, tomato, chili pepper and sweet pepper. Today, irrigated sweet pepper is the high value crop in the region, ensuring self-sufficiency and generation of income in these areas.

2.2 Data Collection

The study used both quantitative and qualitative information. Twenty years daily meteorological data of temperature and rainfall of Diffa and Aguie districts obtained from the AGRHYMET Regional Centre were analyzed. The multiple-stage and simple random sampling procedure were used to select a sample of 284 and 98 respondents respectively from the Diffa and Aguie districts. The target populations for this study were farmers in Diffa and Aguie districts involved in rainfed and irrigated agriculture. A structured questionnaire with closed and open-ended questions was administered to collect information. Data were collected from 2013 and 2014 through a field survey by face-to-face interviews with farmers. Data and information collected were focused on perceptions of changes in rainfall amount, temperature, onset and end of rainy season, length of the growing season, access to extensions services and adaptations over the last 20 years. In this paper, extension services include transferring knowledge to farmers, advising and educating farmers in their decision making, enabling farmers to clarify their own goals and possibilities, and stimulating desirable agricultural developments (Xiaolan & Shaheen, 2012).

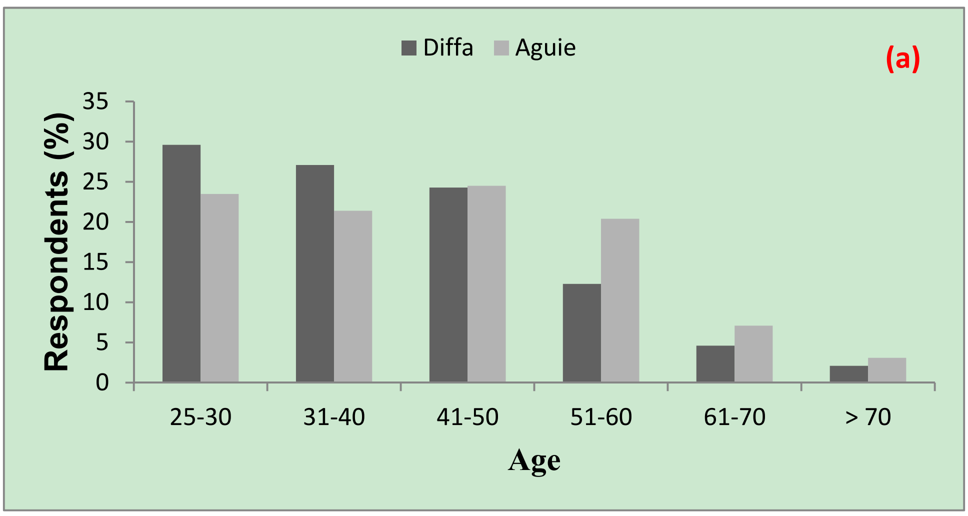
2.3 Data Analysis

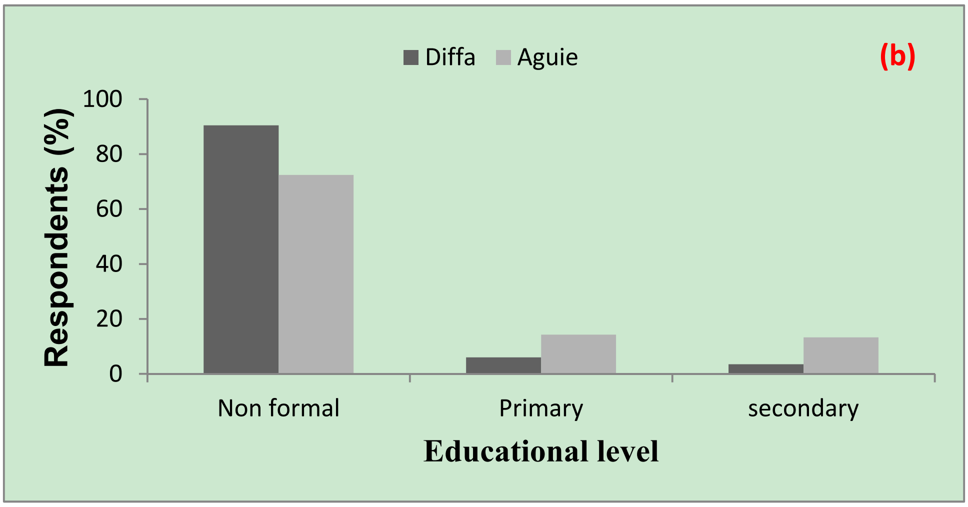
Instat^{+} software, version 3.36 was used for statistical analysis of daily rainfall and temperature data to estimate the onset and end of the rainy season and the length of growing period. The onset and cessation were given as defined by Alhassane et al. (2013). The onset was defined as the day after the 1st of May with 20 mm of rain totaled over 1 or 2 consecutive days without a dry spell of more than 20 days within the subsequent 30 days. The cessation was defined as the first day after 1st September when the climatic water balance is less or equal to 0.5 mm, so when the water consumption of the plant and climatic demand deplete the soil water reserve. The length of rainy season for a particular year is obtained from the difference between cessation and onset of that year. Statistical Package for Social Sciences (SPSS) 20th edition was used for basic descriptive statistical analyses. Means, percentages and frequencies were used to summarize and categorize the information gathered. Farmers' perceptions on weather patterns were compared to meteorological observations. For linear trend, t-test was run on annual means of climatic parameters to check significance.

3. Results

3.1 Social Characteristics of Farmers of Diffa and Aguie Districts

The results (Fig. 2.a) indicated that the respondents were in the average age of 25 to 70 above years. In both districts respondents have much in common with respect to education. Most of farmers (90%) had no formal education in Diffa. However 6% had primary level and 3% secondary level. Similarly in Aguie 72% had no formal education and only 14% and 13% had respectively primary and secondary level (Fig. 2b). Majority of the householders (43% and 41% respectively in Diffa and Aguie) had 11-20 years of farming experience (Fig.2.c).





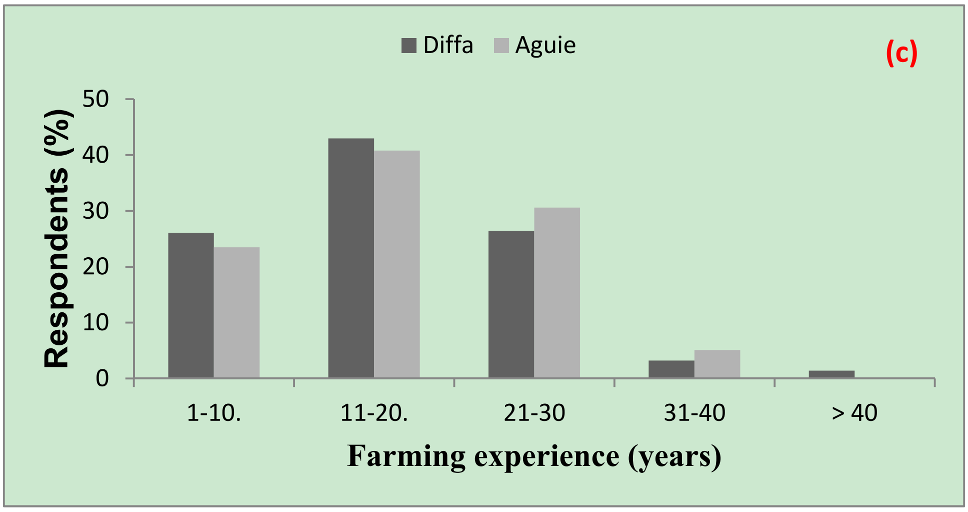


Figure 2. Farmers 'social characteristics, (a) age, (b) educational level and (c) farming experience

3.2 Smallholder Farmers' Perception of Changes in Rainfall Patterns

Farmers were asked how the rainfall patterns had changed over the 20 past years. All respondents have observed a number of changes in the overall climate pattern (Fig. 3). Most of farmers claimed that the rainy season started later and stopped earlier. Majority of respondents (86% in Diffa and 57% in Aguie) noted a slight delay in onset. In the other hand 66% in Diffa and 55% in Aguie believe that the cessation was earlier. Some differences emerge in respect with length of rainy season and rainfall amount. Majority of farmers (82%) noted a decrease in rainy season length over time in Diffa, in contrast 52% believed an increase in Aguie. Also over 77% of farmers believed that rainfall amount has decreased in Diffa, on the contrary 56% perceived its increase in Aguie. Further analysis on sub-group basis (Fig. 4) indicated almost similar results across the both districts with some little difference in rainy season length in Diffa. Most of respondents with more than 20 years of farming experience believed that there was an increase of rainy season length in Diffa district.

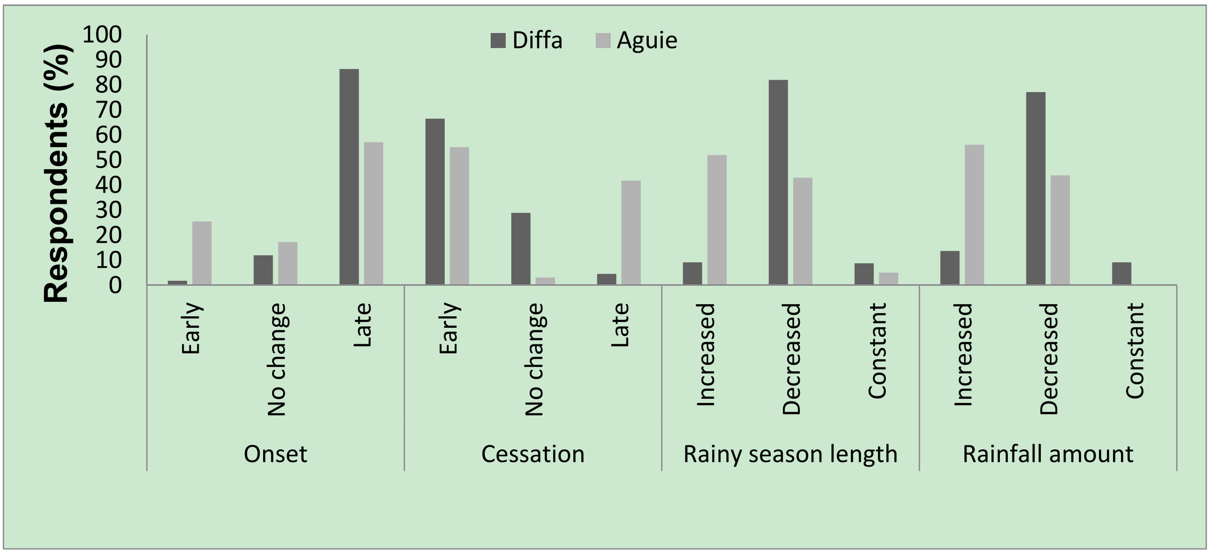


Figure 3. Overall farmers' perception of changes in rainfall patterns in Diffa and Aguie

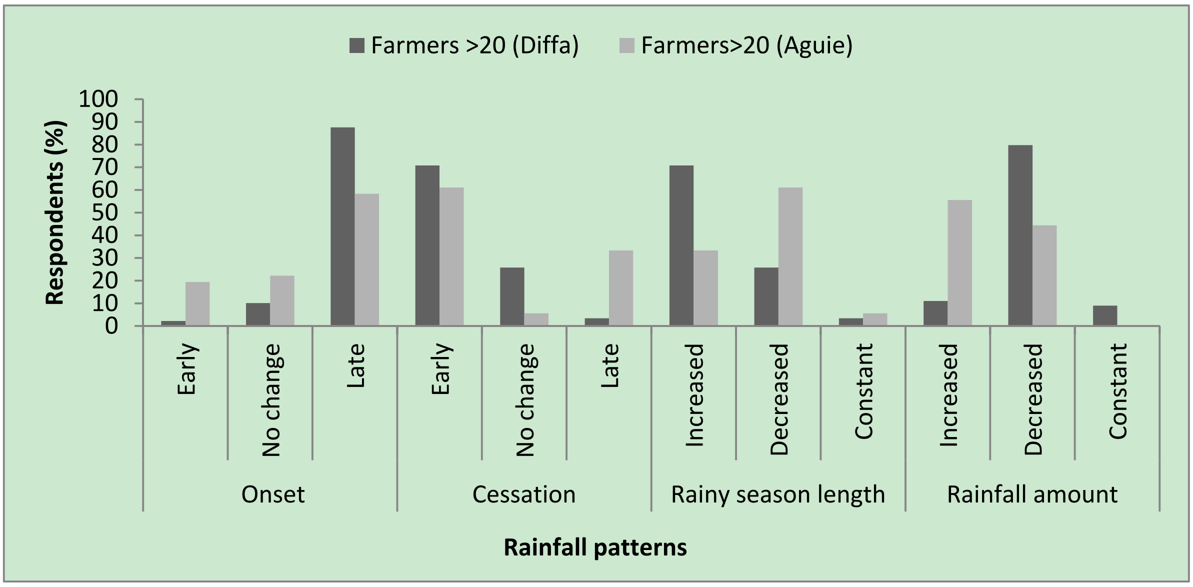


Figure 4. Smallholder farmers (with more than 20 years farming experience) perception of changes in rainfall patterns in Diffa and Aguie

3.3 Smallholder Farmers' Perception of Changes in Temperature

A large number of smallholder farmers' perceived changes in temperature and droughts (Fig. 5). Almost 84% noticed an increase of temperature over the last 20 years in Diffa compared to 81% in Aguie. Over 46% of respondents observed an increase of droughts in Diffa compared to 58% in Aguie.

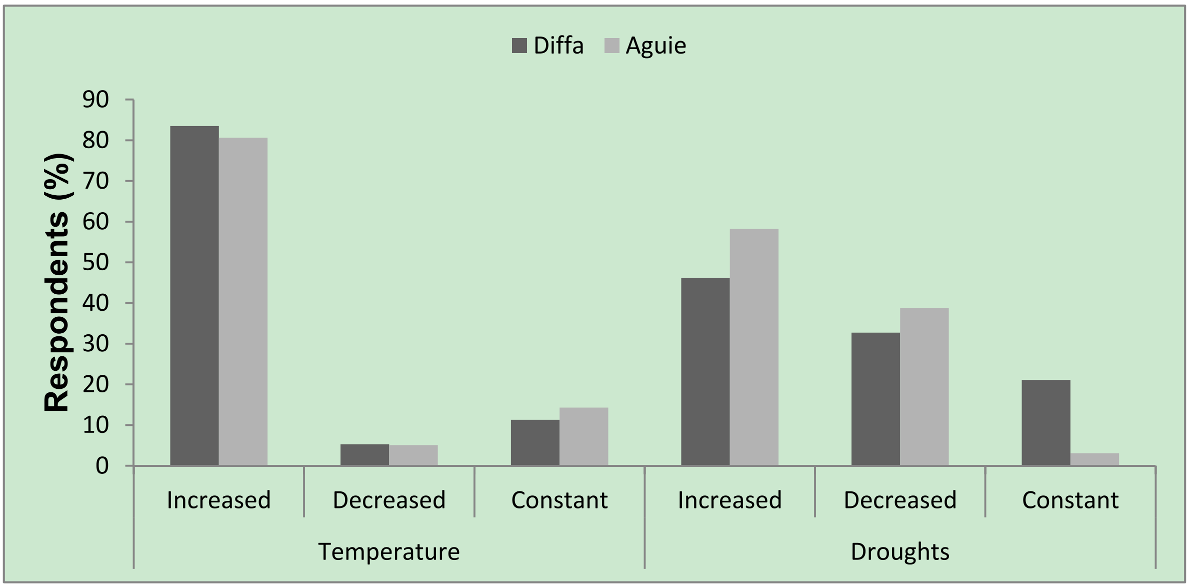
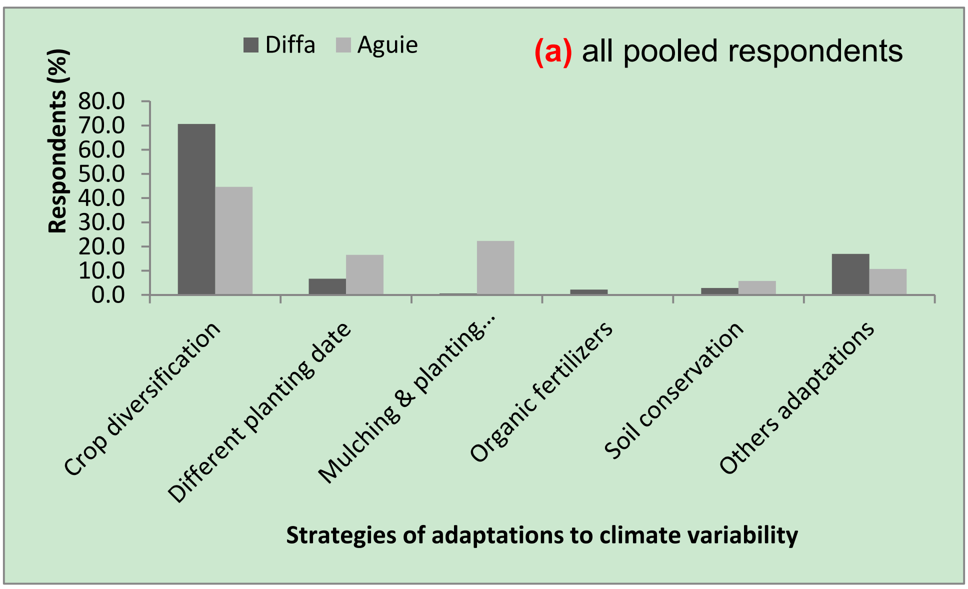
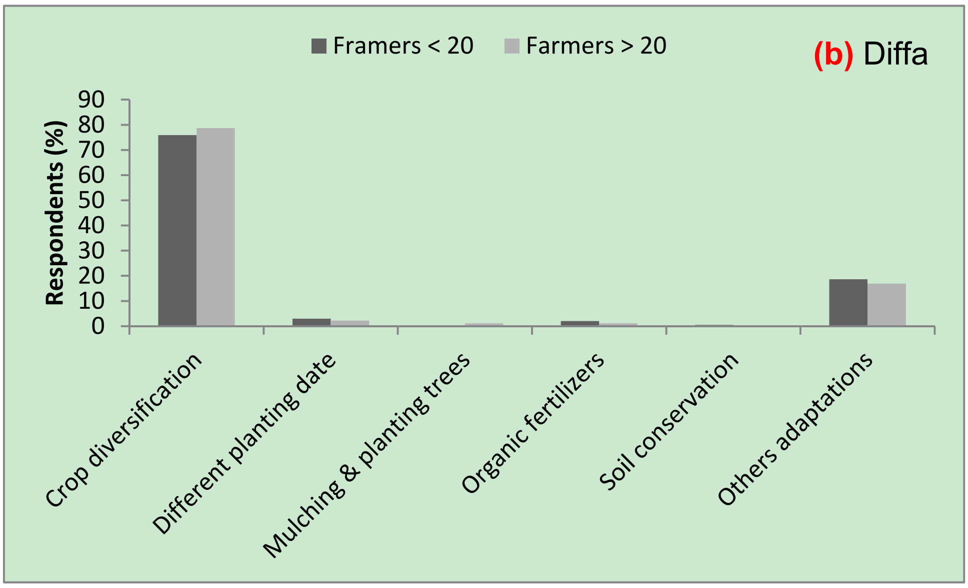


Figure 5. Farmers' perception of changes in temperature and drought in Diffa and Aguie

3.4 Farmers' Strategies for Adaptations to Climate Variability and Climate Change

The results (Fig.6) indicated both farmers in Diffa and Aguie adopted various adaptation strategies to climate variability. This included crop diversification (76%), different planting dates (3%), planting trees (0.4%), organic fertilizers (2%) and other strategies including resistant varieties to heat, increasing frequency of irrigation, changing fields (0.4%) in Diffa compared respectively to 54%, 14%, 11%, 0%, 7% and 13% in Aguie. Crop diversification refers to mixed cropping and aimed to increase crop portfolio so that farmers are not dependent on a single crop to generate their income. In this paper, planting trees refers to a strategy that farmers implemented to prevent violent winds or others disasters to protect their crops. To investigate the adaptations strategies in depth, further analysis on sub-group basis were done: farmers with less than 20 years of farming experience and those with more than 20 years. The results (Fig. 6b) and (Fig. 6c), respectively in Diffa and Aguie, indicated that crop diversification was the most predominant adaptation strategy, but increase of percentage of other solutions as different planting dates, planting trees, use organic fertilizers etc. was observed for young farmers compared to old farmers. Farmers with less than 20 years of experience are also more likely to adopt more adaptation strategies.





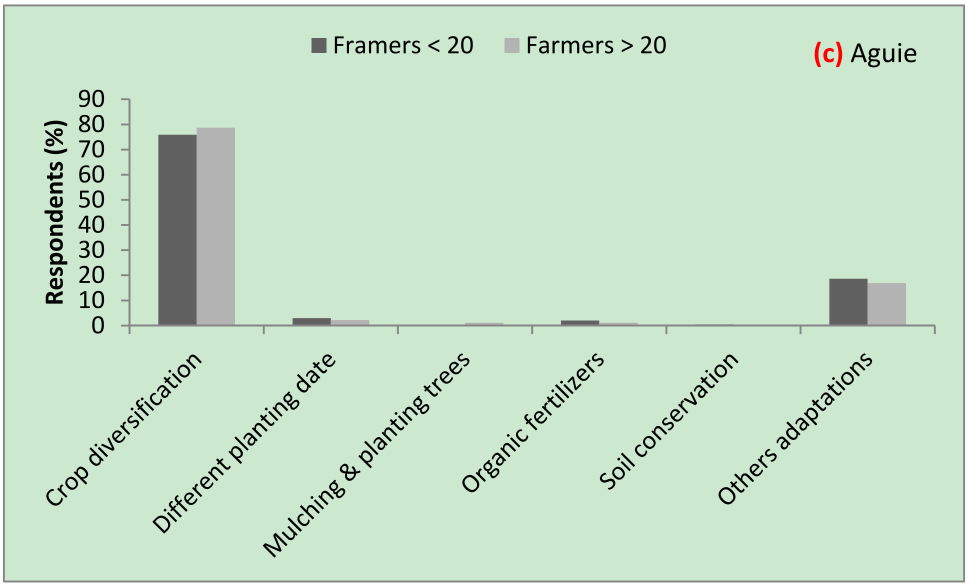


Figure 6. (a) adaptations to climate change for all respondents in Diffa and Aguie; (b) and (c): adaptations to climate change in Diffa (farmer > 20 years faming experience vs farmers < 20 years) respectively in Diffa and Aguie

3.5 Farmers' Barriers to Climate Change Adaptations

The lack of information, irregularity of extension services, no subsidies, lack of access to improved crop varieties, poor government attention to climate problems and low awareness level were the various barriers that prohibit farmers from adapting effectively (Fig. 7).

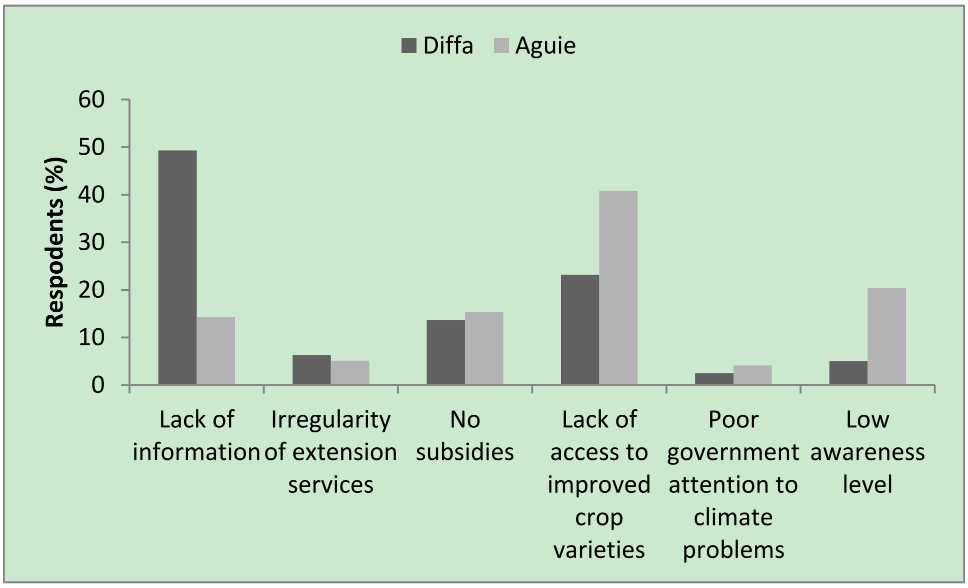


Figure 7. Barriers to adaptation measures in Diffa and Aguie districts

3.6 Farmers Access to Agricultural Extension Services

The analysis of the frequency of extension agents to visit farmers on their fields indicated that 32% of the farmers had never been visited by extension agents and 55% rarely been visited in Diffa. In contrast in Aguie 70% had frequently contact with extension services and 3% only had never been visited (Fig.8).

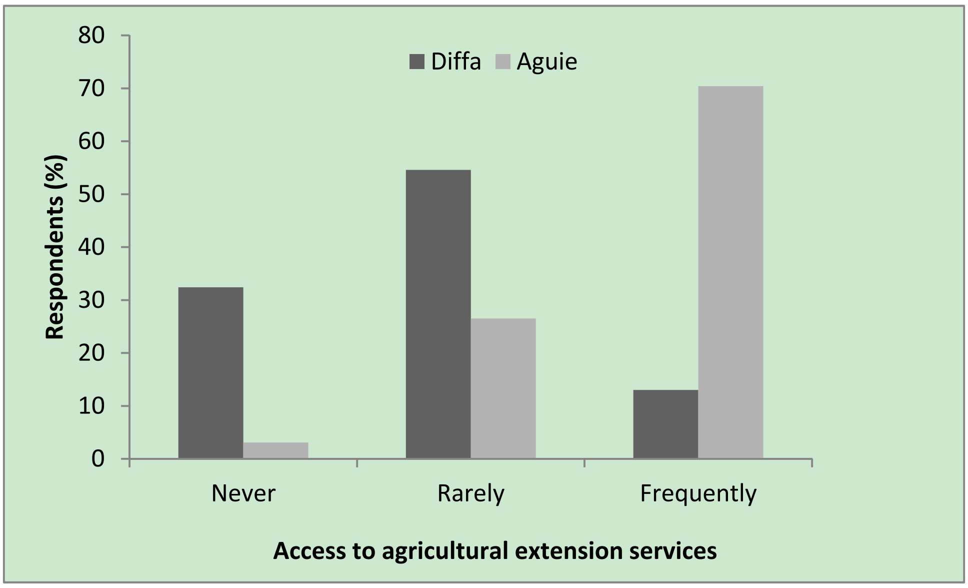
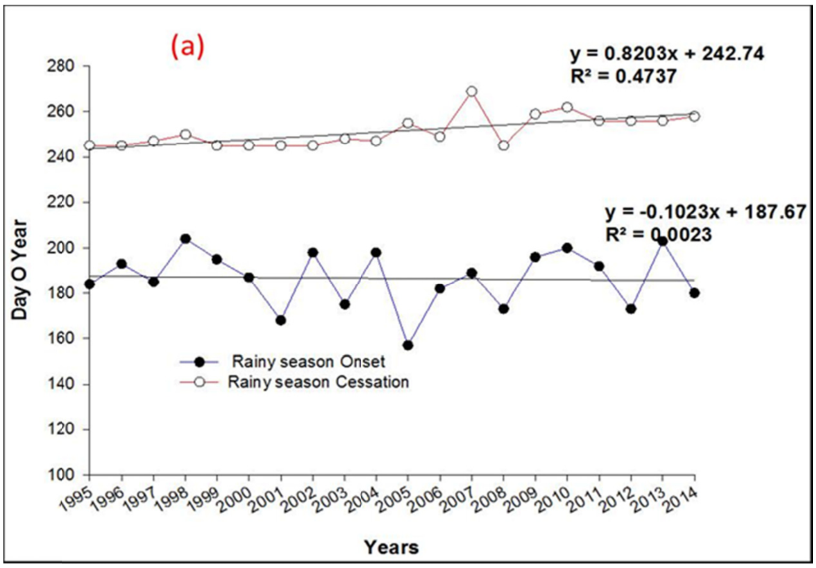
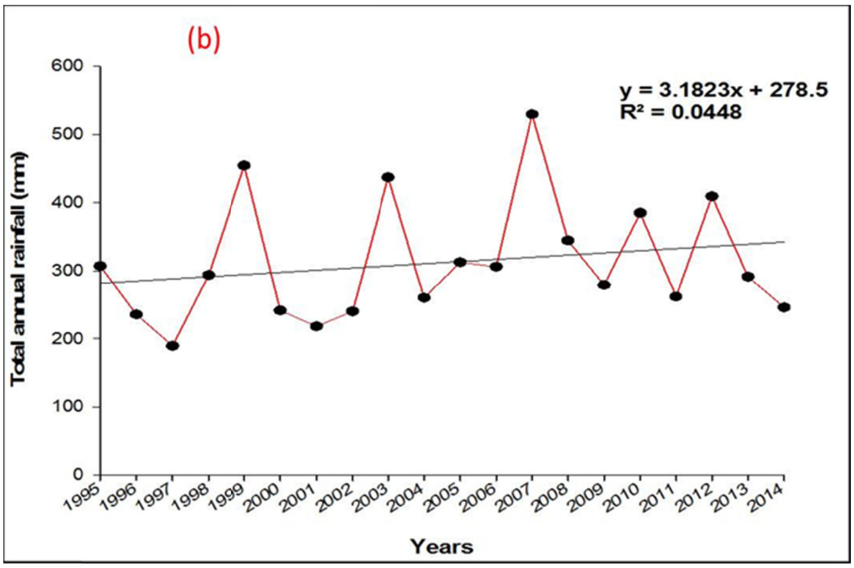


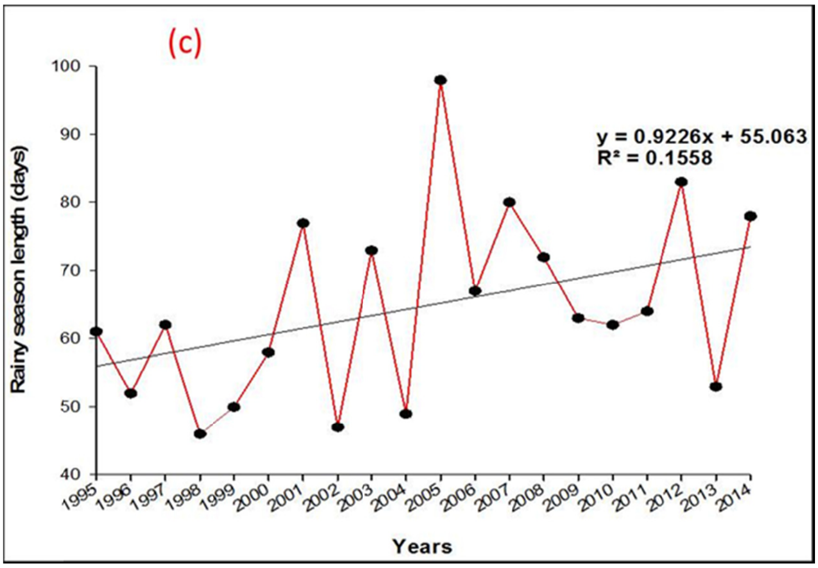
Figure 8. Farmers' access to agricultural extension services in Diffa and Aguie

3.7 Meteorological Data Analysis

The onset and cessation of rainy season were determined in term of number of Day of the Year (DOY). This means an increase of number of DOY lead to a delay of onset and a decrease lead to an early onset. With regards to cessation, an increase of DOY lead to late rainy season and a decrease lead to early end of rainy season. A simple linear regression was used to depict the linear trends of climatic parameters data over the last 20 years (Fig. 9 and 10) and statistical significance via t-test (table 1 and 2). All trends for onset, cessation, temperature, rainfall amount and rainy season length were negative or positive trends for any of period of record (1995-2014) in both Diffa and Aguie. In Diffa, statistically significant tendencies were found for temperature and cessation of the rainy season, whereas onset, rainfall amount and rainy season length trends were not statistically significant, even though there were negative and positive trends for the period (1995-2014) considered. In Aguie, onset and cessation of the rainy season and rainfall trends were negative but these results were not statistically significant at 95% confidence limit during the period of 1995-2014. The rainy season length and rainfall amount trends were respectively positive and negative but not statistically significant. On the other hand, the temperature trend at Aguie showed a slight increase and the result was statistically significant during the period of 1995-2014.







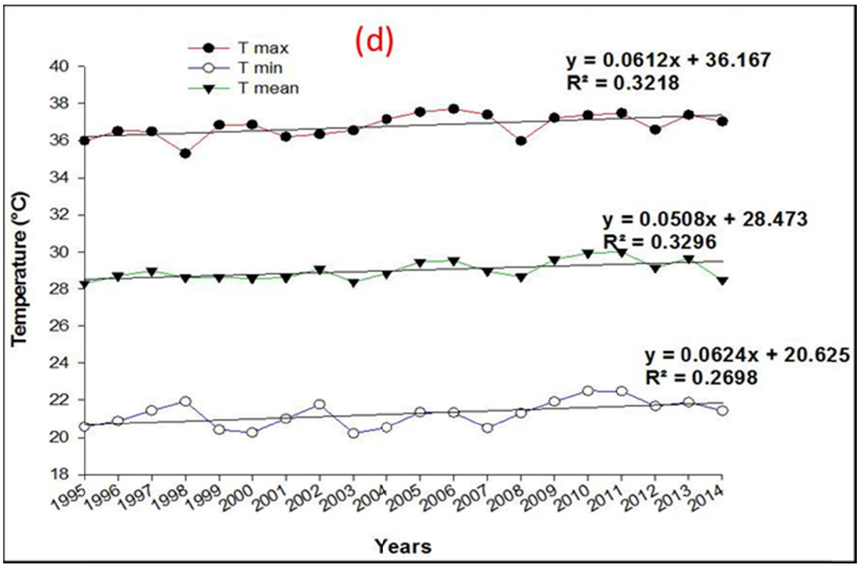
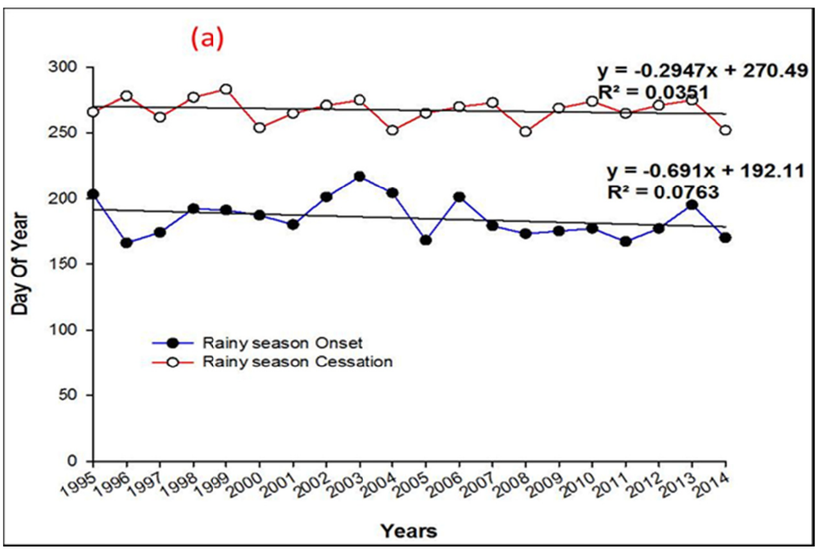


Figure 9. Trend analysis for climatic parameters as well as onset and cessation of the rainy season in Diffa, (a) - onset and cessation of the rainy season, (b) annual amount of rainfall, (c) rainy season length, (d) annual average (minimum, maximum and mean) temperature



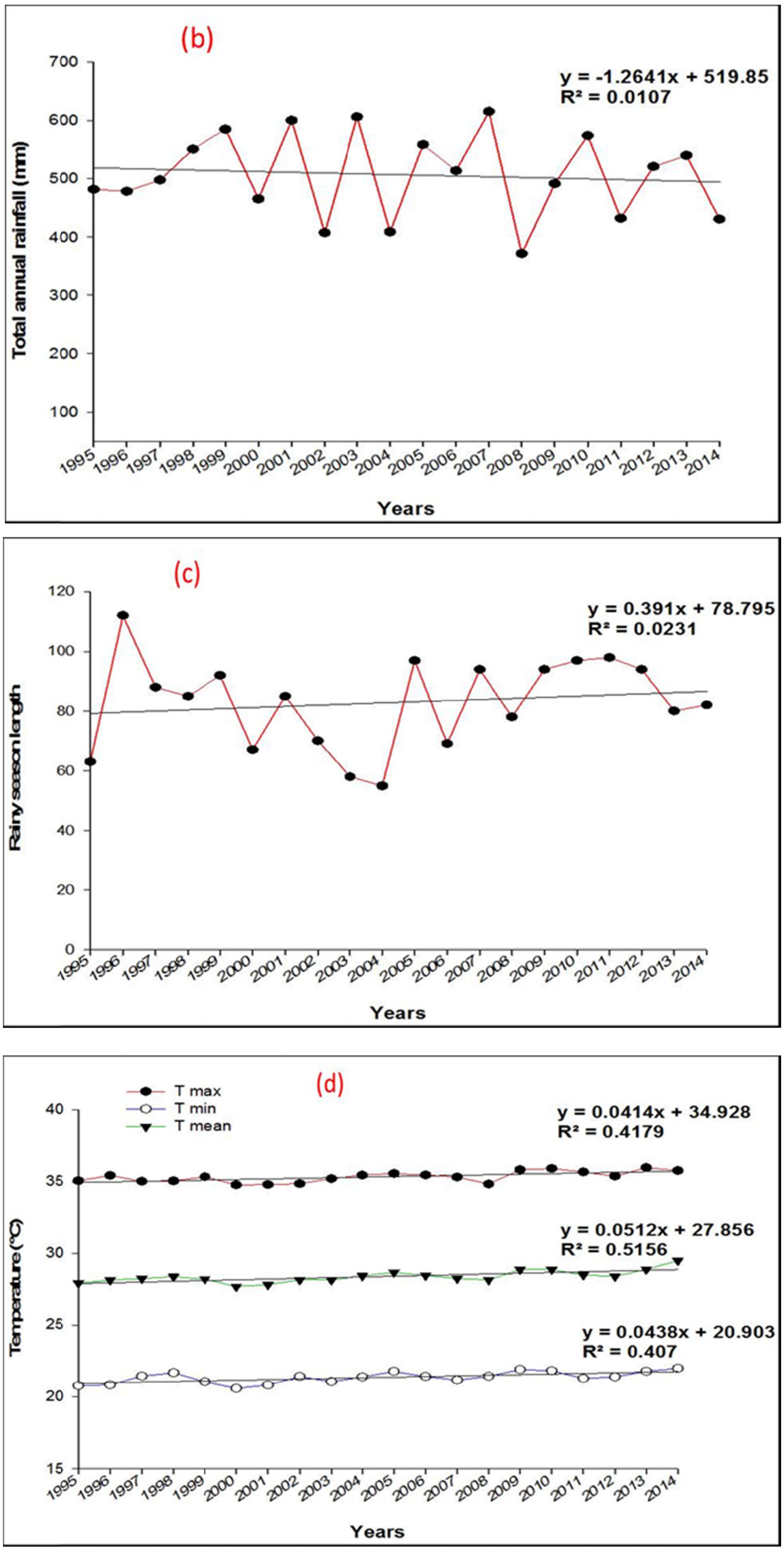


Figure 10. Trend of climatic parameters in Aguie (a): onset and cessation of the rainy season, (b): annual amount of rainfall, (c): rainy season length, (d): annual average temperature (minimum, maximum, mean)

Table 1. T-test analysis of regression slopes of climatic parameters in Diffa district

Parameters	Unit	Mean (1995-2014)	Trend Unit (slope)	significance (P-value)
T max	[°C]	36.8	0.06	**0.009**
Tmin	[°C]	21.3	0.06	**0.019**
T mean	[°C]	29.0	0.05	**0.008**
Onset	DOY	187	-0.10	0.841
Cessation	DOY	251	0.82	**0.001**
rainfall	mm	311.9	3.18	0.370
Rainy season length	days	65	0.92	0.08

Table 2. T-test analysis of regression slopes of climatic parameters in Aguie district

Parameters	Unit	Mean (1995-2014)	Trend Unit (slope)	significance (P-value)
T max	[°C]	35.4	0.04	**0.009**
Tmin	[°C]	21.4	0.04	**0.019**
T mean	[°C]	28.4	0.05	**0.008**
Onset	DOY	185	-0.69	0.23
Cessation	DOY	267	-0.29	0.42
rainfall	mm	506.6	-1.26	0.66
Rainy season length	days	83	0.39	0.53

4. Discussions

4.1 Social Characteristics in the Study Areas: Diffa and Aguie District

The investigation shows that the majority of the farmers were in the age classes above 25 years in both Diffa and Aguie. Furthermore, most of them had between 11 and 40 years farming experiences. Hence, they should be able to give credible information on climatic variability and on its impacts in the region. However, regarding to their education level, it is very low in both districts, amid slight differences noted among farmers. Schooling level could influence appreciation ability of weather patterns and adaptations. Thus, Maddison (2007) reported a positive relationship between the education level of the household head and adaptation to climate. Farmers with higher levels of education are more likely to adapt better to climate change. Benor et al. *(*1997) reported that education is important in creating positive mental attitude towards adoption of modern farming innovations. Promoting improved access to (better-quality) formal education is thus a way to increase adaptive capacity (Wamsler et al., 2012). Therefore there is a need to empower farmers with educational skill knowledge.

4.2 Smallholder Farmers' Perception of Changes in Rainfall Patterns and Comparison with Meteorological Measurements

To compare farmers' perceptions of rainfall patterns with past 20 years meteorological measurements from Diffa and Aguie, climatic data were analyzed. Regardless of agroecological zones, farmers claimed the rainy season started later and stopped earlier, whereas statistically the onset trend was negative, i.e. rainy season tends to start earlier, but the trend is not significant. This was in strong contrast with farmers' perceptions (86%) who indicated a slight delay in onset. Controversially, the positive and statistically significant cessation trend was in line with the perception of 66% of farmers who claimed that cessation was earlier over the last 20 years. Regarding to the rainy season length as well as rainfall amount, over 77% of respondents perceived a decrease in length of growing season and rainfall amount. However, statistically these parameters were constant within the observation period. Similarly the rainy season tends to start earlier in Aguie, but this was not in agreement with the majority of farmers' perceptions (57%) who indicated a later onset. The sub-group analysis of farmers with over 20 years of farming experience, indicated an increase of rainy season length and a decrease of rainfall amount in Diffa, meanwhile in Aguie a decreased of length of growing season and an increase of rainfall amount were noted. In both districts, these farmers' perceptions were not supported by the meteorological data. There was a large discrepancy between the meteorological data measurements of rainfall and the perceived weather patterns in both districts. The perceived variations in rainfall patterns could be explained by the difference in the appreciation of the onset/end of the rainy season between farmers and technicians due to the occurrence of false starts/early cessation of the cropping period these last two decades (Alhassane et al., 2013). In addition, the large number of illiterate farmers and the high spatio-temporal variability of the rainfall patterns could limit their memory capacity to remember the events over the years. Many studies on the perceptions of farmers with respect to climate change repeatedly didn't show evident agreement between climatic data observations and the farmers' perceptions on the onset and the cessation of rainy season (Mulenga & Ayala, 2014; Moyo et al., 2012; Simelton et al., 2013; Amadou et al., 2015, Thomson, 2011).

4.3 Smallholder Farmers' Perception of Changes in Temperature and Comparison with Meteorological Measurements

The average annual temperature trends (minimum, maximum and mean) exhibited a positive trend in both districts suggesting a significant increase over the 20 years period. This was in agreement with respondents perceptions (84% and 81% respectively in Diffa and Aguie). These findings were in concordance with the studies carried out by Mulenga and Ayala (2014). The authors found more consistency among observations related to temperature, with statistical evidence corroborating accounts of rising temperatures in all study sites in Zambia. Furthermore other studies (Shashidahra & Reddy, 2012; Ishaya & Abaja, 2008; Deressa et al., 2009; Gbetibouo, 2009; Fosu-Mensah et al., 2010) indicated also an increase in temperature over the years, resulting in increased frequency of drought. In this study, temperature remains the only parameter which the meteorological trend was clearly in agreement with the perceptions of farmers in both districts.

4.4 Farmers' Strategies for Adaptation to Perceived Climate Change

From the above analysis of meteorological data, there is no evidence of any statistical significance in rainfall patterns in both districts over the last 20 years. Nevertheless, based on their subjective observations, farmers expressed some coping strategies to adapt to climate variability/change in their areas. A large percentage of the householders in Diffa (76 %) and in Aguie (54%) adopted crop diversification in the sense of mixed copping. Crop diversification was also the most predominant adaptation strategy in farmers with less or more than 20 years farming experience. Hence, it is not evident whether this strategy is a response to the climatic change or is a traditional measure to reduce risk of crop failure due to climatic or other factors (e.g. pests). In fact according to farmers, mixing cropping millet or sorghum with cowpea and vegetables for example allows to harvest cowpea grains and vegetables when the growing season is too short for millet to grow successfully or millet spikes damaged by birds or insects. Therefore, this strategy seems to be rather a traditional strategy to reduce crop risk failure in these agro-ecological zones than a specific response to climate change. It is well known amongst farmers that greater crop diversity and mixed cropping offer considerable protection against farming failure, including climate-related risk (FAO, 2011). Nevertheless, other strategies (different planting dates, planting trees, organic fertilizers) were increasingly observed especially with young farmers (<20 years farming experience). These strategies are reported as reliable solution to climate change (Phiri & Saka, 2008, Sarr et al., 2014). Thus, young farmers have seemingly more potential to diversify adaptation strategies to climate change. This could be due to their open mind towards the adoption of new technologies. The lack of appropriate adaptation measures among the majority of farmers might be due to lack of suitable information on climate strategies adaptations and of means to invest in systems of improved agricultural technology. In Niger, since many years farmers face harsh agro-pastoral environment leading to an impoverishment. It will be difficult for them to sustain in addition the effect of climate changes. Therefore, the government should pay more attention on relevant and effective adaptations measures in order to help farmers mitigate and adapt to climate impacts. Better production techniques and market-oriented strategies will help to generate a sustainable source of income.

4.5 Farmers' Barriers to Climate Change Adaptation, Access to Extension Services and Improving Adaptations to Rainfall Variabilities

Famers are attempting to adapt on-going rainfall variabilities, but there were some constraints hindered them to adopt appropriate measures. This include lack of information, irregularity of extension agents, no subsidies, lack of access to improved crop varieties, poor government attention to climate problems and low awareness level. However, barriers to adaptation strategies vary within districts. For example the lack of information is the most important barrier to adaptation in Diffa, while in Aguie, lack of access to improved crop varieties is the main barriers. These results indicated in both locations a low access by farmers to extension services. In fact, since 1998, the extension services gradually decline and today there is no longer working public agricultural extensions in Niger. Only the private sector and some NGOs played some role in providing extension and advisory services to the farmers. It is known that agricultural extension service, is mainly responsible to create awareness among farmers and has a strong reliance to exchange information among farmers (Hedjazi et al., 2006). Another important number of studies (Mmbengwa, 2009; Anaeto et al., 2012; Mmbengwa et al., 2012; Ayanwuyi, 2013) have also underlined the important role of extension services in supporting farmers to adapt climate. According to IPCC (2011), climate change and its associated uncertainties implies that extension services need to regularly access to new knowledge and extend it in an adequate and timely manner to the farmers. Therefore, in Niger, where agricultural production remains the main source of income for most rural householders (86%), the government should prioritize the re-implementation of the agricultural extension service because it will significantly increase farmer awareness of changing climatic conditions as well as effective adaptation measures.

5. Conclusion and Recommendations

This paper provides insight into the perceptions and adaptations to climate variabilities in two agro-ecological zones Diffa and Aguie in Niger Republic. The findings shown that most respondents perceived changes in rainfall patterns, temperature and droughts, but farmers' perceptions do not match with the past meteorological records. These perceptions might be strongly influenced by factors such as limited capacity to record climatic trends over a longer period of time, media and public opinion. Thus, farmers' perceptions should not be the only criteria when identifying gaps and needs of farmers, but rather criteria to be exposed to the objective facts which will enable them to take adequate adaptation measures. The discrepancy between perceived and observed historic climate trends may be the reason why crop diversification was found as a major adaptation strategy. The study revealed also that farmers have poor capacity to adapt to climate variability due to lack of extension services support.

Regarding the importance of agriculture in Niger and the ongoing climate variability, it is recommended:

- Re-implementation of agricultural extensions services and capacity building in training agricultural extension agents in Niger Republic. The extent of rural sector development will depend on empowering rural farmers with objective climate information and technological skills that enable them to use modern technologies and cope with climate impacts;
- Improve policies that encourage access to credit, drought resistant crop varieties and detailed local climate information;
- The government should invest more in agriculture in order to make it more attractive.

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