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SOME ADAPTATION STRATEGIES OF THE POPULATION OF THE SAHEL TO THE EFFECTS OF CLIMATE CHANGE: CASE OF THE CIRCLE OF YÉLIMANÉ, MALI

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ABSTRACT

This study analyzed perceptions of the effects of climate change at the local level in the Yélimané area, Kayes region. A sample of 36 households, six (6) per village, were investigated. Community leaders facilitated data collection through the formation of focus groups. The investigations were carried out using tools such as the interview guide and questionnaires, taking into account the categories of social actors (the elderly, adults, and young people, as well as farmers, opinion leaders and technical services/NGOs). The results showed that communities are affected by climate change through high winds, irregular rainfall, drought, and increased crop pests. The social manifestations were the intensification of transhumance, the multiplication of conflicts over scarce resources. This has led to the spread of food insecurity and the high mobility of the labor force to other locations such as gold panning sites as well as urban cities.

Keywords: Climate Change, Biological Diversity, Desertification.

1. INTRODUCTION

Desertification, climate change and the loss of biological diversity are crucial issues for the dry regions of Africa. The combined effects of these changes are testing the development efforts of countries and, at the same time, the livelihoods of the poorest populations on the planet (CNU, 1994). According to the same author, there is no doubt that ecosystems have an influence on the climate. and reciprocally. Climate change has considerable impacts on the local climate, increasing, depending on the location, desertification, land degradation and the loss of biological diversity. In the study area, climate change is manifested by the lack of rainfall where the accumulations rarely exceed 600 mm, a delay in the installation of the June-July rainy season today, unlike April May in the 1970s, strong heat sometimes exceeding 45°C; strong winds blowing in all directions and at all times; severe environmental degradation resulting in the loss of arable land, the loss of certain ligneous, fodder and herbaceous species; the wells which were approximately 10 m deep in the 1960s are beyond 20 m or 30 m depending on the site and the area is no longer suitable for growing cotton today.

The United Nations Convention to Combat Desertification, adopted in 1994, suggests that experiences in combating desertification and conserving biodiversity could be a good starting

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point for the study and understanding of adaptation. to climate change (Dorsouma A. H. and Mélanie R.-D, 2008).

The population of the Sahel is affected by the recurrence of crises linked to multifaceted shocks. These crises have made populations vulnerable to food and nutritional insecurity (Dorsouma A. H. and Mélanie R.-D, 2008). Among the causes of this chronic insecurity, we can distinguish the fragility of ecosystems and the degeneration of natural resources, floods, locust invasions and epizootics, the poor performance of production systems, monetary and non-monetary poverty, unsuitable food practices SMART 2011, led by Mali's Ministry of Health and UNICEF. Added to this are the various economic, social, health and security shocks.

The recurrence of these shocks (armed conflicts, secessionist, jadism, COVID 19), combined with certain weaknesses in the existing mechanisms for the prevention and management of risks and crises has led to the deterioration of the livelihoods of populations, particularly rural and peri-urban populations. This situation has significantly increased their vulnerability to food and nutritional insecurity, both cyclical and structural.

These climate changes primarily threaten the primary sector, agriculture, livestock, fishing and forestry, key sectors for the country's economy. In Mali, health, infrastructure and industry are also exposed to climate change. Also, the lives of people in Mali are dependent on these changes.

As reported by D. Bambara et al (2011), among the unpredictable and non-regular events that are shocks and other disturbances, it would be good to distinguish on the one hand the climatic events that have marked the history of populations (drought, flood Hazards that occur frequently without being cyclical or predictable, but which can still have a significant impact on the livelihoods of the farming community, usually in a negative sense (thus making them stand out rather to the rank of "problems") such as sudden price changes.

This study aims to document the local perception on the harmful effects of climate change on the well-being of the population of the circle of Yélimané.

2. MATERIALS AND METHODS

2.1. Study sites

The study focuses on the recession zone of the circle of Yélimané. Among the 12 rural communes of this circle, those of Gory, Toya and Guidimé are retained. The criteria that led to the choice of the said municipalities relate to: (i) their accessibility in all seasons, (ii) their practice of two cropping systems (rainfed and flood recession).

In each of the communes, two villages were chosen as a sample, making a total of six (6) villages according to: (i) their ethnic diversity, (ii) their socio-economic activities in a degraded environment continue.

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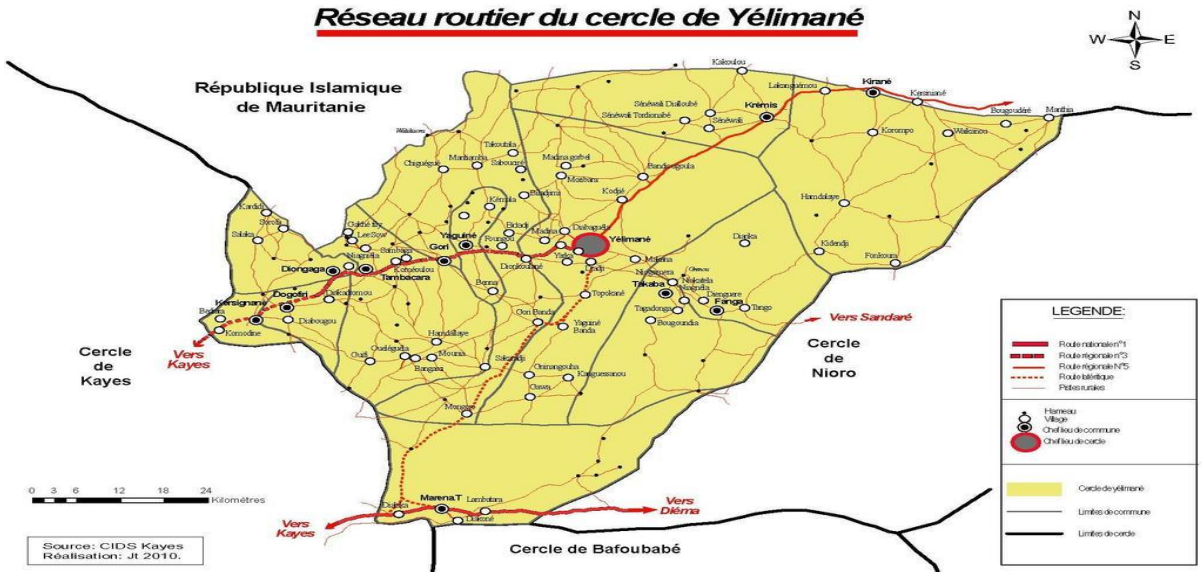

2.2. Collection tools and instruments

An interview guide, for a qualitative assessment of the data to be collected, was designed and administered to focus groups, resource persons and opinion leaders. A questionnaire was also developed and administered to 36 households at a rate of six (6) per. village. The questionnaire was used to quantify individual household data.

2.3. Typologies in villages and resilience strategies

From the focus-group results (composed of 8 to 12 people), a certain typology emerges in each village according to their means of existence. This typology was designed on the basis of the declaration of the elderly (60 years and over) during the focus groups, adults and young people.
In this context, except for people in the age groups of 30-59 years and 60 years and over met our expectation. The group of young people aged 18 to 29 does not have any benchmarks to compare the current period with that prior to the appearance of the climate change phenomenon, as its consequences are experienced today. The objective is to identify the criteria of precariousness "poverty" or wealth according to the local vision of the local communities for their social categorization in the village.

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Table 1: Typology of household categories

Villages	"Rich" (Wealthy) Sôrôtiguiw» Class 1	"Less wealthy" (less affluent) "Danganw" Class 2	(Destitute) "Bololankolonw" Class 3
Dougoubara	Have enough manpower, soil (rainfall + flood receding) and agricultural equipment. Flocks of sheep/goats and poultry. Have an emigrant. Self-sufficient	Insufficient equipment, lack of land in the flood, some sheep / goats. Not self-sufficient	Insufficient manpower, incomplete and insufficient equipment, no emigrating, some poultry. Lack of land. Not self-sufficient
Foungou	Have enough manpower, livestock, land and equipment and emigrants. Self-sufficient	Have the equipment, the land (flood / rainfall), insufficient manpower. No emigrants. Not self-sufficient	The one who has no land, no equipment, livestock, poultry or emigrants. Not self-sufficient
Yanguiné	Having land, united and supportive family, having agricultural equipment, emigrants and savings, self-sufficient	Insufficient land, lack of manpower, no emigrants and incomplete equipment. Not self-sufficient	No land. Not self-sufficient.
Gory	The household must have emigrants, the land, the entire agricultural equipment. Rolling means for travel, have savings, sheep, cattle, equines and poultry. Self-sufficient	Have your equipment complete, no sufficient land, no emigrant. Not self-sufficient	The one who has no land, no equipment and no emigrant. Not self-sufficient.
Diabaguéla	Have enough manpower, land and equipment, means of transport (rolling), emigrants, herds of cattle and sheep, equines and poultry. Self-sufficient	Have the equipment, the land (flood / rainfall), insufficient manpower. No emigrants. Not self-sufficient	The one who has no land, no equipment, livestock, poultry or emigrants. Not self-sufficient.
Kémala	Have enough manpower, livestock, land and equipment and emigrants. Self-sufficient	Having your land of cultivation, no equipment, no emigrant. Not self-sufficient	Not self-sufficient, no land, no equipment or emigrants. Not self-sufficient.

Source: classification of villagers during the collection mission in 2014 – 2015 on the Yélimané sites.

2.4. Methodological approach

The methodological approach was structured through the following phases: a preparatory phase, an exploratory phase and an in-depth investigation phase.

The first point consisted in carrying out a prospective mission in order to make contact with the physical and human environments, followed by the investigation phase which identified the physical and human traits, the economic activities, the modes of social organization in place, technical support services, NGOs and other support partners.

- Sampling of surveyed households

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The 6 households were chosen as follows: 2 equipped households, 2 average households and 2 poor households (poor land ownership, little or no equipment, labor and even less liquidity in savings). This choice has the advantage of assessing the resilience strategies of each category according to its status and rank in the local social hierarchy.

- The analytical framework

This framework first looked at livelihoods which are composed of five major capitals namely, natural capital, physical capital, human capital, social capital and financial capital and their interactions between them and also with the environment.

The Sustainable Livelihoods (SL) framework is the tool used by this study to analyze the effects of climate change on people's living conditions (Figure 1). It is generally used to improve the understanding of livelihoods, especially of rural populations. It highlights the fundamental influences and processes as well as the multiple interactions that exist between the various factors affecting livelihoods (Dieudonné, G, 2001).

The SL framework has helped to place people, especially the rural poor, at the center of a web of interrelated influences that impact how these people create livelihoods for themselves and their households. Closer to people, and at the center of the frame, are the resources and assets associated with the livelihoods to which they have access and use, namely, natural resources, technologies, skills, knowledge and their capacities, their health, access to education, sources of credit, or their social support networks.

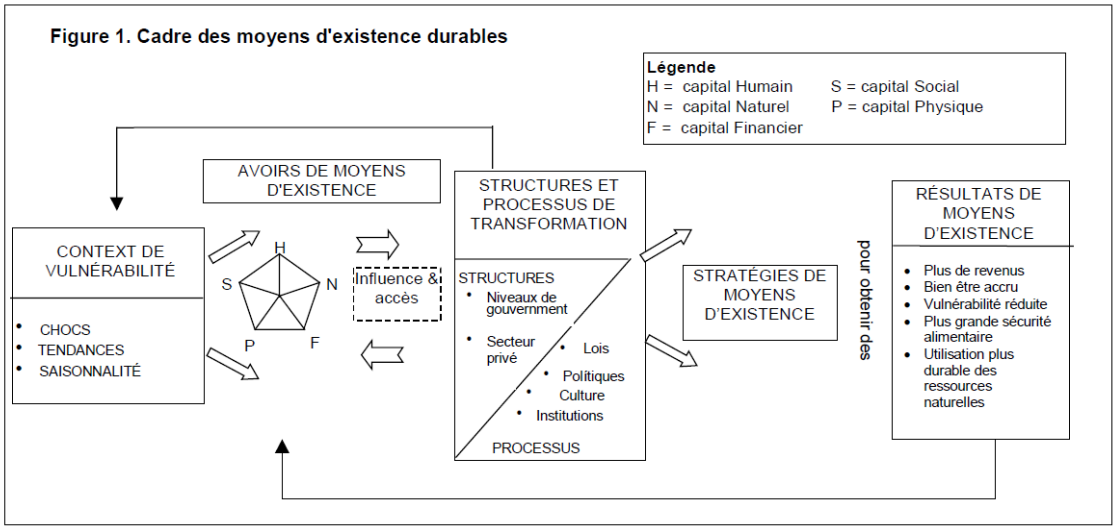

Figure 1: Sustainable Livelihoods Framework
Source (DFID, 1999)

3. RESULTS

3.1. Manifestations of climate change according to groups.

It should be noted that the memories of the populations of the area in relation to climate change go back to the 1960s for some, to the 1970s for others. Many current agricultural workers were not yet born.

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According to old or old men (60 and over).
In relation to time, we witness from year to year:
- “insufficient flooding”;
- "a delay in the installation of wintering in June-July today, unlike April and May in the 1970s";
- “a short winter season (July-September unlike May-October in the 1970s”);
- “high temperatures sometimes exceeding 45°C”;
- “strong winds blowing in all directions and at all times”;
- “poor distribution of rainfall in space and time”;
- “severe environmental degradation resulting in the loss of arable land, the loss of certain ligneous, fodder and herbaceous species”;
- “the appearance of new forage and herbaceous species whose role and function are poorly controlled”;
- “the silting up of water points resulting in the disappearance of certain ponds”;
- “and the disappearance of certain animal species of fauna”.

Other findings of signs according to the actors,
“The warning signs of wintering were readable in the presence, at a certain time of the year, of such and such an animal such as storks, cicadas; the hornbill of the savanna either by their cries, or by their song or their movement oriented in such a direction”.
“Nowadays, all these markers are disrupted in their life cycle, for example: certain species (storks) whose arrival in our fields announced the imminence of the rainy season no longer take leave of these spaces”.
“Animals whose songs or cries guided us are no longer silent, they are present and permanent”
"The only clues that always seem to guide us are the stars, the cycle of flowering, leafing or defoliation of certain woody species".

And paradoxically, arable land has decreased due to the effects of climate and demographic pressure on resources. This leads to land degradation concomitantly with poor agricultural practices. The rare resources (water points, lowlands, pastoral areas, etc.) become an issue of covetousness between various socio-professional users and also a point of concentration and refuge for all the enemies of crops (rats, birds , worms, locusts). Thus, signs of conflicts between actors are appearing, forcing elected municipal officials and technical services to develop strategies for the concerted management of resources.

According to old or old women (60 years and +)
“Excessive deforestation and forest degradation have dealt a severe blow to harvesting and processing activities”.
"The forest has degraded to such an extent that it is difficult to find firewood."
At the family level, “wells that were about 10m deep in the 1960s are less than 20m today. This state of affairs has oriented the majority of women's agricultural activities in the lowlands, especially for market gardening”.
"At independence, during the off season, women met in the vestibules to spin cotton or even at the edge of the ponds to dye clothes with indigo".

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"Nowadays, the area is no longer suitable for growing cotton and indigo is in sharp decline following the silting up of water points"

On the whole, this degradation of the environment has caused a lack of income for these women following the reduction or disappearance of certain raw materials (indigo, cotton).

“Women are oriented towards the diversification of activities (fattening, small market gardening business” etc.

According to adult men and women (30 – 59 years old)

The phenomenon is manifested by:

“A decrease in the duration of the rainy season, a late start and/or an early cessation of the rains”.

"A very low yield of the fields from year to year".

“Yesterday or in the past, the strong heat announced the heavy rains but nowadays everything has changed and the weather remains eternally hot and without rain”.

“For the causes, we attribute this to a divine will which manifests itself cyclically every 30 or 50 years according to some of our old people”.

"Today, none of the local varieties of cereals from the 1968-1970s are suitable for rainfed crops or flood recession crops".

Still according to these adults: “We promote cereal varieties whose technical itinerary we have very little knowledge of, hence the cause of the poor yield”.

"The same observation emerges in adults as in old people on the water regime, the silting up of ponds, the extinction of water points and banks".

In this context of advanced degradation of resources, “breeders faced with the problem of feeding cattle, cattle, opt for transhumance to the south and west, particularly in the circles of Kolokani, Kita, Bafoulabe” etc.

Just like the people of a certain age (the old ones) witnessing the changes, the phenomenon remains very worrying and at this rate agriculture will be more and more compromised in arable land. Nowadays, many farmers focus their production activities on the lowlands for flood recession crops.

According to young people (18 – 29 years old)

It should be remembered that this group of young people is mixed and composed mainly of women whose marriage does not exceed 15 years at most. For these young people who do not count a great experience in the matter,

According to a youth group leader from the village of Gory,

“The current Change escapes our reason because, to listen to our old people, everything was balanced, no drought, no strong wind, no scorching sun and the forest was there with lots of edible fruits/leaves and game in abundance, and even fish in the many rivers”.

“This time remains a memory for these old people, a legend and a normal cycle for us young people”.

According to these same authors "For lack of alternatives, all the projects of young people here are supported by exodus or migration because the environment is not favorable in terms of income-generating activities".

Still according to the same young people, “To hear our old people, the varieties of cultivated cereals knew a cycle of 4 to 6 months of rain and the fields knew fewer pests, predators than

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today. Nowadays, agriculture, which is the main activity of the parents, remains threatened at mid-maturity by birds, rats or the early cessation of the rains".

"For us young people, happiness comes from elsewhere, because all those that we have as community achievements at the village or commune level (housing, socio-sanitary and educational community infrastructures) the source came from elsewhere". This is why in our vulnerability and poverty criteria: "any household that does not have at least one immigrant on its account is potentially vulnerable".

Following the climatic disturbances, "We, the young people, no longer have confidence in agriculture, in the land at the level of the Yélimané circle and prefer to invest in housing in Kayes, Bamako and at the same time constitute stocks of foodstuffs with of our parents here".

And to another to add that, "if we don't want to invest too much in agriculture, it is to avoid losses because wintering here in Yélimané is a lottery, unlike Spain or Equatorial Guinea where we work in the plantations and where it rains all the time" but "As for Mali: it is either insufficient rains, poor distribution, early stoppage, birds and other crop enemies" .

Analysis of the content of speeches according to categories

The different discourses held by the focus groups in different villages show that the peasant communities of Yélimané perceive the effects of climate change According to the community of Yélimané, these changes are reflected in a decrease, poor distribution and increasing irregularity of rainfall, disruption of the regime of the winter, cold and warm seasons.

In response to these changes in Yélimané, farmers have adopted adaptation strategies, the most common of which are: varietal adaptation, use of water and soil conservation techniques, use of organic manure, modification of sowing dates. In the circle of Yélimané, these answers vary according to the type of field (declining or exposed) in the space depending on where one is located. Nowadays, most of these innovations remain limited by material, financial, technical and access to information constraints.

When analyzing these different discourses held by different strata, complementary and often contradictory information emerges. Each stratum is the psychic expression of its experiences, that is to say the fruit of its time through its perception, its disappointment and its deduction of the climate change phenomenon. Old people as well as adults are disturbed by the effects of climate change. Their material referents which are knowingly or unconsciously imprinted on their personality are deteriorating from day to day and among which we must mention: forests, groves, ponds, fauna and immaterial being thus summed up in the climate, temperatures, winds, the seasons, which change over the years. "In short, it must be admitted that these changes constitute the sum of several factors not all dependent on humans and which are part of a natural dynamic". As for the young people, they do not really measure the gravity because they do not have enough tangible testimonies or historical references. They are not at all jealous like people of a certain age, of this part of the land which was not generous in their time, which some even call "the land of the parents". For some and casually "if the climatic pressures exceed the capacities of the communities then there; you have to leave for somewhere else and the earth is vast and wide for this kind of movement". At this level of the proposal of the young, lies all the contradiction with the people of an advanced age "old people" who for them; any displacement constitutes at this age a weaning on several levels (material and immaterial) that no alternative can compensate.

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3.2. Public perceptions of climate change

This analysis is based on the local community classification table.

Class 1 "Wealthy ("Sôrôtiguiw")"

Features

This class is characterized by food self-sufficiency, the availability of labor, the availability of declining land both in the high zone, the possession of a large livestock (cattle, sheep/goats and poultry) the existence of the account of the family of immigrants and savings, membership of the various association groups, "your villager", seat in the local decision-making bodies for local development actions with local elected officials and constitute entry points for external technical structures and NGOs.

Perception of the effects of climate change

The changes that have taken place in these elements of richness are called: the disruption of availability according to rainfall patterns, the accentuation of candidates for migration, the reduction in yields in the recessions following poor rainfall, the pressure of birds and other pests, the reduction in the rate at which the savings are fed, the permanent loss of a few heads in the herds. Pronounced option of breeding: transhumance.

Class 2 "Less well-off ("Danganw")"

Features

Class 2 is characterized by total non-self-sufficiency over the year, insufficient equipment, insufficient land in both systems (recession and high zone), some sheep / goats and poultry, no savings. No labor outside family members, the household contains emigrants whose contribution remains too low to modify or switch to stability.

Perception of the effects of climate change

The lack of food self-sufficiency worsens year after year, the equipment is amortized without renewal at will for lack of liquidity or savings, the land is degrading for lack of manure transport equipment on the fields, the labor of The already insufficient work is very mobile, loss of some head of sheep/goats in the off season. The able-bodied indulge in the seasonal exodus immediately after the harvest, too much pressure on the harvest: birds, rats, insects and heat.

Class 3 "Destitute ("Bololankolonw")"

Features

Class 3 is characterized by lack of food self-sufficiency throughout the year. A precarious living situation remains dominant, insufficient equipment, insufficient land in both systems (recession and high zone), no livestock, a few poultry, no savings. No labor outside family members, no emigrants whose contribution can modify or tip the household into relative stability.

Perception of the effects of climate change

This classifies the effects of climate change on all his livelihoods. Unsanitary housing, rural activity is carried out on the basis of the loan of equipment, or the gestures of the village "tons" which are mutual aid structures at the local level in all the villages, the "tons" come to the aid of all phases of work in the fields, the chain of solidarity is very much alive in these communities and to the benefit of the poorest.

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3.3. Coping Strategies

Remember that these communities had made a classification during the focus and we will further investigate these classes in their similarities or differences.

Class 1 "Wealthy ("Sôrôtiguiw")"

The purchase of additional cereals for a year with a shortage in the flood, encouraging male labor for the seasonal exodus, the practice of market gardening, the transhumance of herds, the breeding of guinea fowl because they are less affected by avian diseases and also able to withstand the heat, the recruitment of labor, the multiplication and strengthening of public community works are the different strategies developed by this class.

Class 2 "Less well-off ("Danganw")"

The subsistence strategies developed by this class boil down to the sale of sheep/goats and poultry, seasonal exodus, market gardening and petty trade.

Another aspect linked to the various cases of seasonal exodus but which remains decisive in stock management is the movement of labour. In many off-season families, there are only old people left who have little effect on the consumption of the stock unlike the labor force which has temporarily ventured out. These movements, such as seasonal exoduses, can be internal strategies to rationalize stock management.

Class 3 "Destitute ("Bololankolonw")"

In general, this class benefits from the assistance of the community based on mutual aid, community life whose main virtue is sharing. Their precarious living status does not exclude them in any way and from nothing, on the contrary, it is a factor of integration. Originally they are descendants of the same ancestor and benefit from the advantages of community life in a large family. This class is melted into a community that feels like it is the victim of two uncompromising pressures, namely the natural pressure on the modes of existence leading to poor performance, social disorganization and bad management and administrative policies. , subsidies at the central state level.

4. DISCUSSION

Most West African countries are affected by many adverse effects of climate change. In recent years, there has been a significant increase in their frequency and intensity due to climate warming (Gemenne et al., 2017). This climatic dynamism observed at the level of the communities in Mali, precisely in Yélimané, is similar with the results of research work on climate change carried out in the various international contexts (CGIAR, 2006; Adejuwon, J, 2003). According to these various authors, climate change and its socio-environmental consequences are even more perceptible when considering the local level. Added to this is soil degradation, coastal erosion, deforestation, low crop diversification leading to the degradation of lowlands and basins which threaten food security and amplify poverty (Breumier et al., 2018)

Based on the age criterion again, the views differ on the perceptions and indicators of climate change and its socio-environmental consequences in African peasant communities, the results indicated that significant changes are related to the water, agriculture, farmland. And for Africa, the same research work has highlighted a low availability of water per inhabitant and its decrease

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of around 75% during the middle of the 20th century. Yegbemey et al. (2014) found that in northern Benin maize producers perceived climate change through the delay in the onset of rains, pockets of drought during the rainy season, poor spatial distribution of rains, strong winds and excessive heat. These perceptions corroborate those identified by this study in central and northern Benin in rice production (Amegnaglo et al., 2018). In arid areas, according to the same source, a 10 to 30% drop in water availability is expected by 2020, and due to climate change, 75 to 250 million people will be exposed to water scarcity and water stress. By affecting agricultural production, climate change compromises food security, and the western Sahel will be particularly affected (Climate change, 2001).

These changes in climate forecasts lead to a drop in yields, soil fertility, the frequency of transplanting plants and the adjustment of the agricultural calendar by modifying sowing dates as well as supplementary irrigation. This result is confirmed by the work of Baudoin et al. (2014) and Amegnaglo et al. (2018). The strategies initiated by the communities of the Yélimané circle on climate change are similar to those developed in the studies of perceptions and strategies for adapting to changes in class 1 strategies which determine factors for gender, contact with a project on climate change, the use of organic manure and access to information on climate forecasts. Gender is more determining to the strategies because it is significant at 1% while the others are significant at 10% (Lionel U., 2020). The results of the study showed that farmers clearly perceive the changes in precipitation and that these changes are reflected in a decrease and an increasing irregularity of the rains, a disruption of the winter season, a greater frequency of pockets of drought, etc.

According to Reeves et al., (2016), Breumier et al., (2018), these influences are manifested by floods, droughts, modification of the agricultural calendar, heat waves and low productivity are all the most important effects. more tangible ones that affect farming households. Added to this is soil degradation, coastal erosion, deforestation, low crop diversification leading to the degradation of lowlands and basins which threaten food security and increase poverty.

The results show that the changes result in a decrease, a bad distribution and an increasing irregularity of the rains, a disturbance of the mode of the winter, cold and hot seasons. This same result was confirmed by Ozer, Pierre, (2014) who showed that the precarious health of livestock, the reduction in cereal yields, the increase in the frequency of floods in certain cities and the deterioration of livelihoods are most often attributed to climate change.

Ultimately, the perception of the notion of adaptation varies from one society to another and depends on the means of existence of the populations and the level of development of the country. It refers to any adjustment in natural or human systems to respond to actual or expected impacts of climate change.

CONCLUSION

The results of this study led to the following conclusions. Farmers perceive climate change through its negative effects on the various agro-sylvio-pastoral and halieutic productions (insufficient rainfall, violent winds, drought, high temperatures, locusts and the abundance of seed-eating birds, caterpillars on crops).

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The effects of the climate have led rural communities in the Yélimané Circle recession zone to implement a variety of resilience strategies in various areas. Some of these strategies involve the adoption of varieties with high productive potential and resistance to climatic stress, birds and other pests. At the breeding level, the strategy is cross-breeding and the introduction of species resistant to climatic stress. As for social capital, we see a strengthening and restructuring of social organization through new socio-professional associations supported by partners such as NGOs and immigrants for work in the public interest (development of market gardens, bas-funds, rural tracks, boreholes / fountains, dykes, bridges) etc.

It would be desirable to: (i) establish a congruence study between farmers' perceptions of climate change and the scientific results available in the Sahelian band of Mali; (ii) make an assessment of the effects of endogenous adaptation practices on the livelihoods of the socio-professional strata of the Sahel.

THANKS

Our thanks go to the collaborating peasants of the villages of Fongou, Dougoubara, Gory, Kemala, Yaguiné in the circle of Yélimané and to the ACC-II project through its component 6 which agreed to finance this research. Our thanks go to the representatives of NGOs, technical services in the area (ADR, Agriculture Service, Town Hall) and traditional institutions for their support during the research work in the field. We thank the Mali-Kingdom of Norway bilateral cooperation and the other collaborating partners of this research.

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