

When nature talks to us

Comparative analysis of representations of climatic and environmental changes

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Introduction

Farming societies everywhere are always concerned by meteorological developments in both the short term (special meteorological events) and on a more long-term scale (climate trends). There is talk in all societies aimed both at describing the meteorological changes perceived as the seasons go by and at what might be the reasons for the perceived, observed changes. Rural societies do not perceive or interpret the present climate changes in the same terms as those of technical/scientific approaches (BASSET and CRUMMEY, 2003; KORBÉOGO, 2013). Collecting popular perceptions of meteorological changes makes it possible to both compare ‘popular’ and ‘academic’ knowledge and obtain information about the specific practices that may result from these representations. Indeed, farming practices are often determined directly by the perceptions that farmers may have of the supposed meteorological pattern as the season in question proceeds. It is thus essential to collect stakeholders’ accounts in order to understand their farming practices, their choices with regard to sowing date or technique, the moments chosen for harvesting and the conservation techniques used for heads or grain. Like any attempt to improve agricultural production, enhancing the safeguarding of harvests in spite of the meteorological changes effecting the wet seasons requires close discussion with farmers and intrinsic understanding of their reasons for using a certain technical option rather than another.

Perceiving means deciding. Perceiving means choosing from the mass of information available that which is relevant for the action planned. It is not just combining and

weighting but also and above all choosing—choosing between rival forms, taking decisions in sensorial conflicts. Perception means decision and so does memory, with equal importance. Many sometimes contradictory perceptions coexist in the same society and may compete with each other. The data collected are from qualitative type anthropological and geographic surveys conducted in five different regions of West Africa: the Niakhar zone in Senegal located in the heart of Serer country in the groundnut area in central Senegal, the Djougou region in north-west Benin and finally the Bonkoukou zone in Niger, 100 km east of Niamey. Secondly, interviews were also held near Podor in the Senegal River region and in the Wankama region (Dantiandou) in Niger. The data collected indicate both the diversity and richness of perceptions of climatic and environmental changes, the plurality of the representations that explain these changes and the multiplicity of the practices used to address them. Beyond this diversity, bodies of perceptions and representations are common to the various zones considered with regard to both rainfall and the natural environment and its changes. The stakeholders encountered at the three main locations perceived three phenomena clearly: changes in features that characterise climate such as rainfall, temperature and winds. New features are emerging such as dust and grass species and known features such as ponds, fauna and shrub and herbaceous species are disappearing. Natural cycles and rhythms have always been upset periodically by events considered by witnesses as being exceptional. It is clear that this ‘exceptional’ feature must be examined. The discussion proposed here is hinged in what can be perceived by stakeholders themselves—such as continuity, change or true breaks.

The issue of translation, a challenge for anthropology?

Any anthropological survey requires considerable translation work. The questions that preoccupy a researcher are formulated as questions that can be submitted to the stakeholders encountered. Anthropology requires considerable semantic translation (OLIVIER DE SARDAN, 2008). Likewise, qualitative interviews conducted by a geographer and centred on questions of the perception and representations of environmental changes require the same effort as for semantic translation. The question of popular meaning and academic meaning is raised (OLIVIER DE SARDAN, 2001)

The notion of ‘environment’ is a recent elaboration in and by western societies (ACOT, 1988; MOSCOVICI, 1977; ABÉLÈS *et al.*, 2000; DESCOLA, 2000). The notion of climate is too often related to meteorological variations in common parlance whereas researchers examine very long periods (centuries and at least decades). Thus how can the notions of ‘climate’ and ‘environment’ be translated? How is it possible not to give bias to the statements and reports of the people with whom we

have discussions and make the most accurate possible description of the changes that they perceive and the associated representations? Attention has always been paid to meteorological phenomena and climatic variations by all social groups and especially those who draw their resources from the land, from animal husbandry and from gathering (FAIRHEAD and LEACH, 1994, 1996; KORBÉOGO, 2013). Thus rainfall, wind and temperature are factors around which the questions asked acquire meaning. There are vernacular terms to indicate these features that are more neutral and concrete than climatic and environmental changes'. For rural people, these terms better give a true expression of the meteorological events that are signs of climate change in the long term. There are thus no terms to express climate in West African languages. Reference is made on the subject to the nature of the winds, to that of space, with the latter understood as the immediate surroundings including soil and vegetation. Reference is also made to hot and cold, i.e. perceived temperature, and also to the characteristics of rainfall—for example its intensity or variability.

Identical methodology was used at Djougou, Niakhar and Bonkoukou. Most of the data were gathered during three collective surveys of the 'Ecris'¹ type (BIERSCHENK and OLIVIER DE SARDAN, 1994), part of which concerned representations of meteorological, environmental and climatic changes. The surveys were conducted in November 2011 in Bonkoukou (Niger), in April 2012 in Niakhar (Senegal) and in November 2012 in Djougou (Benin). Complementary qualitative surveys were performed systematically at each of the locations. They made it possible to focus the data and obtain studies of cases serving as examples. Semi-directive surveys were conducted with Niakhar farmers during the 2013 winter period. Surveys were selected when millet was grown on the largest area of the farm. Semi-directive interviews were also conducted with other resource persons: extension agents (Ancar², CADL³ manager) and heads of villages.

Several ESCAPE programme researchers who are not specialists in social science participated in the Ecris surveys—in particular in Senegal and Benin. The two or three-person teams that conducted the interviews were thus made up of agriculturalists, climatologists, demographers, anthropologists and geographers. The data reporting meetings held every evening were rich in the combined expertise of researchers in social science, agriculturalists and climatologists. The results of the Ecris surveys carried out at the three main locations made it possible to compile the questionnaires for the quantitative surveys drafted by the socio-demographers of the ESCAPE who had themselves participated in the Ecris surveys, and these questionnaires were delivered to Djougou and Niakhar (see. Chapter 4). Here, the results of the qualitative studies are not aimed as much showing the extent of the gap between the population's perceptions of environmental and meteorological changes and the rainfall and temperature records accumulated by researchers in climatology but are aimed more at gauging the knowledge of the population and the representations shared in different ways. Our aim is to report what the populations

1. Ecris : *Enquête collective rapide d'identification de groupes stratégiques* (Rapid collective survey to identify strategic groups).

2. Ancar : Agence nationale de conseil agricole et rural.

3. CADL : Centre d'appui au développement local.

perceive as continuities and changes or, in contrast, breaks with the experience that they may have of the meteorological and environmental conditions of their living environment.

Continuities: the transmission of knowledge about meteorological forecasting

The rural areas in question feature a body of knowledge and practices that are shared in variable manner according to sociocultural or socioprofessional groups and also according to the age and sex of the persons questioned. This knowledge makes it possible to interpret the nature of the area or the quality of the season and to predict future climatic features in order to adapt to the effects that these may have. It is constructed around signs and symbols, identified in space (with the appearance or disappearance of certain shrub or herbaceous species or their flowering, the cries of certain animals and birds, changes in the direction of winds, the appearance or disappearance of certain stars, etc.) and passed down from generation to generation, enabling farmers to master space and orient themselves in time. This mastery of space means that they can make choices that benefit their everyday work.

The expression of local knowledge is centred on the interpretation of signs observed in the stars, trees and grasses, animals, winds, etc. These signs announce the seasons and their quality. The movement of the stars is the most commonly recurrent feature interpreted by crop farmers while herders tend more to interpret the drying or flowering of trees and herbaceous plants. Amadou OUMAROU (2004: 285) thus notes that 'time [for the Peuls of the Dallol Bosso (Niger)] displays a repetition of circular environmental phenomena that marks the end of one season and the beginning of another'. The data collected in the areas studied show that:

- the appearance and position of stars determine sowing dates and the quality of future harvests in Niger and the intensity of the rainy season at Djougou in Benin;
- for sedentary farmers, the appearance of different stars marks the beginning or end of sowing and even the end of the rainy season. For example, in Niger the appearance of the *aliije* in Fula (three stars aligned in the east) causes concern if the heads of early millet are not mature. Farmers then know that there will be a maximum of two further rainfall events;
- the desiccation of the foliage of the gao (*Acacia albida* or *Faidherbia albida*, a forage tree: its fruits and leaves are eaten mainly by small ruminants) is a sign that the rainy season is about to begin;
- winds are also indicators of changes of season: the monsoon announces the rainy season, the dropping of monsoon winds announces its end, the Harmattan announces the start of the cold, dry season and whirlwinds at the end of the Harmattan announce heat.

Likewise, certain behaviour of animals and birds announces the winter season: the appearance of a bird called the ‘*walia*’ (in the Djerma and Hausa languages) and ‘*waliaje*’ (in Fula) and the croaking of toads herald the arrival of the monsoon within the following two weeks. At Djougou, the sound of a bird considered to be very intelligent announces the start of the rains. Farmers say that it speaks several languages (in Yom it is *kpas -noo a* ‘the one that announces the rainy season’). The Peuls use the Yom name. The bird sings once in February, twice in March and then many times towards the end of March, showing that the rainy season should start 20 days later.

The behaviour of birds and animals sometimes enables stakeholders to measure changes. An old man in Djougou thus said that before the period between the increase in the song of this bird and the arrival of the rains lasted no longer than 10 days but that today the bird may sing a number of times and the rain is still slow in coming. He now mentions a gap of at least 20 days. The bird thus indicates that the rains start later.

Stakeholders also mention *disturbances in the direction of winds* and the *temperature of these winds* (wind is felt to be warm when it should be cold and vice versa) as a major change, showing more serious changes whose causes they do not know and that they have not experienced in the past.

Changes observed in climate features: rain, temperature and wind

Farmers’ perceptions of climatic and environmental changes are centred on as many representations that they make of meteorological features consisting of precipitation, temperature and wind and of the changes affecting their natural environment: ponds, vegetation, watercourses, etc. This perception must therefore be analysed starting with the characteristic features of each of these components. In emic perception (OLIVIER DE SARDAN, 1998), the climate of the study area refers to rain, wind and temperature. The popular perceptions described here that are related to these features show the homogeneity of the changes observed in Niger, Benin and Senegal.

Disturbances of rainy seasons

The disturbances of rainy seasons take the form of the lateness of the first rain or of the effective settling in of the rainy season, irregular rainfall poorly distributed in both time and space and an early end of the rains. Several of our surveys show the interdependence of these various factors of disturbance of the normal progress of rainy seasons. While in Niger the first rains were recorded in the 7th month of the farming year and lasted for four to five months, in recent years the first rains have generally been between the 8th and 9th months, resulting in shortening of the duration of the

rainy season to a maximum of three or four months in this case. Irregularity and poor spatio-temporal distribution of rains have thus become recurrent and are the main signs of the disturbance to rainy seasons observed for several decades.

Farmers see the lateness of the first rains as the main cause of poor crops. We were told at the three locations that ‘The later we sow, the more risk there is of the rains stopping early’. Descriptions include changes at the beginning and end of the rainy season and patches of drought. The latter are more numerous and more marked today than before the two major droughts in the Sahel in 1973 and 1984. This increased intensity and duration of drought patches causes problems for plant growth. The villagers stress that the rains no longer come ‘at the right moment’ for crops: precipitations start before sowing and return after what should have been the date of the sowing. Rainfall has thus become irregular: ‘We don’t understand any more!’. For example, the increase in rainfall and the rise in temperature in the Senegal River valley result in increased pest risk, thus making market garden crops vulnerable.

In Serer country, farmers in the Niakhar region observe the shortening of the rainy season. Today, the rainy season lasts for hardly three months instead of five months as in the past.

The rainy reasons have featured a late start and early end of precipitation during the last three decades. Heavy rainfall for very short periods generally alternate with drought periods lasting for 5 to 20 days according to the persons surveyed. The patches of drought observed between rainfall days hinder crop growth. They are observed within the same village terroir. Indeed, the areas covered by rainfall have decreased in all the zones studied. It can happen that in the same village area part receives rainfall while the rest does not have a single drop! Farmers have responded to this uncertainty in rainfall. The period 1961-1990 was marked by major changes in farming practices, a drier climate and the gradual abandoning of 110-120 day long cycle millet (Sanio), the spread of dry sowing of millet in the groundnut region and the cultivation of bottom land. These features show the links between rainfall and the changing of farming systems.

Today, farmers combine long cycle and short cycle varieties to face these forms of rainfall risk. The example of the combining of Souna millet and Sanio millet in alternate seed holes in the same field on farms in the Niakhar region illustrates this.

Table 1.
Changes in periods of rain and sowing periods, expressions of climate change.

May	June	July	August	September	October
←	← Normal rainy season →				
	← Dry sowing (millet) →		← Present rainy season →		
		← Sowing after rainfall (millet, groundnut, cowpea, watermelon) →			

Thanks to the increase in rainfall (2007-2014), the remarkable reappearance of Sanio in land in the Niakhar region since 2009 shows the reversibility of farming practices that are continuously adjusted to the pattern of rainfall. The water requirements of Sanio are estimated to be around 544-598 mm (DANCETTE, 1983). It is reminded that this crop, grown in large bush fields from 1965 to 1969, covered an average of 33% of the cultivated area of the village of Sob in the Niakhar region (LERICOLLAIS, 1972). During the 1986 farming season, a little Sanio was noted at Sob, Ngayokhème and Kalome (FAYE *et al.*, 1987).

Changes of temperature

Changes of temperature during the dry and cold seasons are also perceived by farmers as one of the major factors that indicate climatic changes. In the past, dry seasons were sunnier and displayed much higher temperatures, giving a good rainy season as precipitation was regular and abundant for the four months of the winter season.

‘At the height of the day during dry seasons, rays of sunlight were so hot we often had the impression of burning. When the sun was high in the sky, it was not possible to walk on the ground without shoes and the birds took refuges in the granaries and houses. And this intense heat was the sign of heavy rainfall and good harvests’ (interview of a farmer in the village of Wankama, September 2012).

The cold seasons also feature particularly cold peaks. In certain periods, especially in the cold season, old people had to keep warm with a fire from the morning to midday. These intensely cold moments are called ‘*dottidjo bon dan barnu*’, an expression in the Djerma language meaning that the old people go so close to the fire that they give the impression of putting their heads in it.

During an interview, the head of Podor meteorological station mentioned the very marked increase in temperatures in the river basin. The rise accentuates evaporation and causes water stress in crops, especially during the warm counter-season (from March to June). Farmers must perform regular watering and thus cover the extra cost of the irrigation facilities used. This statement by the person we had a discussion with at Podor clearly illustrates the rise in temperatures in the zone:

‘It has been so hot that the insolation measurement apparatus was burned and damaged. This is shown by gaps in the record sheets. However, the data must be given by telephone at every hour of the day to the meteorological agency in Dakar’ (talk with the head of Podor station, July 2013).

Mentions of high temperatures—especially at the beginning of the rainy season—were collected at all the survey locations. Indeed, the persons we talked to have acute perception of temperature variability in the same season.

Changes in wind characteristics

Wind characteristics concern wind direction, force and whether wind is reddish or not. According to the persons we talked to, wind direction in the past depended on the season. The wind blew from a precise direction in each season. However, this

principle has been considerably disturbed today. For several years the wind generally blows from any direction. The precision in wind direction that indicated each season no longer exists. A new type of wind is observed, which is generally reddish, dry and hot, violent, sudden and fairly frequent. The high frequency of these winds in an environment subjected to strong deforestation caused by abusive felling causes erosion, the unusual formation of *koris*, runoff and flooding. All these factors participate in the impoverishment of cultivated areas. The winds also transport reddish dusts that cause illnesses of all kinds among the population, especially in the cold season.

Breaks: between the disappearance of 'known phenomena' ...

Several features of the immediate environment (shrub species, ponds, etc.) and known, usual meteorological signs are now little visible or not at all in farmers' areas. Various shrub and herbaceous species have been reported as disappeared or disappearing in all the study locations. At the locations in Niger this mainly concerns trees such as *Ziziphus mauritania* (*darey*), *Balanites aegyptiaca* (*garbey*), *Acacia polyacantha* spp. (*dan*), *Grewia bicolor* (*kélli*), *Acacia macrostachya* (*tchidi*), *Adansonia digitata* L. (Bombacaceae) (*koo nya*), *Combretum nigricans* (*déli-nya*), and edible herbs or species with medicinal uses (treatment of fever, stomach ache and diarrhoea): the hanza, *Gynandropsis gynandra* (*fubey*), *Leptadenia hastata* (*hanamm*), *Cassia occidentalis*, *Chrozophora brocchiana*, etc.

At Niakhar, many persons questioned explained that the landscape used to be 'darker' as the trees had much more foliage.

'At that time, there weren't the big surveys that people do now. To go to Niakhar, you had to walk for 5 kilometres and it was forest between Sob and Niakhar. There were robbers; if they killed you they took your baggage and went off and you lost the herds too, they killed the herders and took the oxen. We carried the harvests through the forest, we had nowhere to put them, we carried them on our heads. We carried groundnuts on our heads, and millet and kindling too. If you couldn't put it on your head you rolled it along the ground. I experienced all that ... ' (interview with a 90-year-old man in the village of Sob in the Niakhar region, July 2014).

The reference made by this person concerning the demographic monitoring surveys performed at the Niakhar location since 1962 makes it possible to date the decrease in numbers of trees and the thinning of forest to more than 70 years ago (before 1945). People in the Niakhar region also mention the disappearance of market gardens since the 1970s in Serer country. Soil erosion and intense degradation by salinisation of groundwater are visible.

With regard to water resources, the disappearance, shrinking and/or early drying out of ponds at the three locations were noted by the populations. Thus accounts in

Djougou recount the drying of small watercourses (Doubiera, Biyigui, Adjeta-Behma), and then of medium-sized ones (such as Mara) and finally the shrinking of the largest watercourses (Bakou, Massy, Wewe and Sew). Another feature displaying disappearances is the fauna in village areas. The interviews thus report the disappearance of big cats and scarcer large and small game in the Djougou region. Likewise, the persons questioned at Bonkougou said that deer, guinea fowl, hares, bustards and jackals had disappeared from the area.

... and the appearance of 'new phenomena'

In Niger, the appearance of reddish dust previously little known by the population led to questions and concern. The appearance of unknown plants or the proliferation of recent plants such as purple witchweed is mentioned at the three locations. This plant is only grazed by livestock in extreme cases and farmers know it makes land unsuitable for cultivation. The long dry periods identified by farmers enhance the rapid growth of witchweed (*Striga hermonthica* or *ndoxum* in Serer) and the appearance of insect pests on plants. The spread of witchweed is a sign of the impoverishment of cultivated land. Serer farmers consider it to be very harmful for millet as it prevents plant growth. As a result, its spread heralds a decrease in millet yields in the zone. The return of wetter conditions perceived by the population is leading to the reappearance of plant species that had disappeared. This is the case of the '*pattuki*' and the '*selew-lew*' in the alluvial valley of the Senegal River. '*Pattuki*' (in Pulaar) is *Acacia polyacantha*, a medicinal plant used as an antiseptic and for general tiredness, aches and pains in the side. '*Selew-lew*' (in Pulaar) is *Leptadenia pyrotechnica*, a multi-purpose medicinal plant (treatment of eyes, dermatitis, use as a diuretic and for constipation and colic). Its branches are woven to make ceilings in dwellings and sheds and also to make fencing for housing and enclosures for livestock in the alluvial valley of the Senegal River.

The repeated floods during the last 10 years throughout West Africa (Ouagadougou, 1 September 2008, etc.) have been mentioned in one of the zones covered—the River Senegal valley—as a new and intense phenomenon. Thus in an interview in January 2013, the head of the village of Sinthiou Diambo told us that during the 2012 rainy season 80% of the land equipped for irrigated farming was flooded because of the heavy rains. However, the farmers—fervent believers—facing the climate risk simply said 'God gives us rain when he wants and where he wants'. The 2012 floods that affected a large number of the irrigation systems of the Podor SAED⁴ delegation was the result of the heavy rains that year, after that of 1999 that had caused an exodus of a whole village, Donaye, located in the alluvial valley.

4. SAED : Société d'aménagement et d'exploitation des terres du delta et de la vallée du Sénégal.

Table 2.
The damage caused to irrigation systems by the heavy rains during the 2012 rainy season.

	Affected area	Area flooded	Sown area flooded
Figures (ha)	1 329	984	942
Figures (%)	100	74	70

Source: SAED, *Direction des aménagements et de la gestion de l'eau (DAGE) Podor, 2013.*

Here, rainwater flooded 1329 hectares of land, making it unavailable for crops. The damage consists of a loss of investment in 942 hectares under rice, affecting 3,588 farmers. In the Guédé rural community (after 22 years of operation of the irrigation system), the smallest area under rice was recorded in 2004, with 537.99 ha. This goes a long way towards explaining the damage caused by the flooding of perimeters equipped for irrigated farming.

The causality of changes in the climate and the environment

Interpretations of the causes of climatic and environmental changes are centred on two major trends: anthropic causes and those related to sociocultural representations.

Anthropic causes

Acts by humans form one of the main causes given for the changes perceived. First and foremost comes the perception by all persons that the population has increased during the last 20 years and the acceleration of the use of natural resources results directly from this. Stakeholders also explain this increase in the use of resources by an increase in commercial operations—generalised in the Djougou region (LANGEWIESCHE, 2004, 2006). Thus charcoal-making in the Djougou and Bonkougou regions meets the financial requirements of women and results in faster tree felling. The doum palm, *Hyphaene thebaica* (whose leaves are used for making mats, ropes, winnowing baskets, hats, etc.) is also sold increasingly. At the three locations, tree felling, the reduction of fallows and the disappearance of animal species are perceived as a direct consequence of human activity—through both deforestation and agricultural colonisation. Pressure on cultivable land goes back a long time in the Niakhar region (LERICOLLAIS, 1999) and is mentioned systematically by our respondents. At Wankama for example, deforestation following the abusive felling of timber for sale is the main indicator of environmental changes.

This decrease in shrub species results in the unusual formation of ponds which, in the opinion of local farmers, is the cause of strong winds that result in the decrease or poor distribution of quantities of rain; the erosion of crop fields and the burying of young seedlings mean that farmers have to sow several times in the same year. Indeed, although winds could be strong at times in the past they were never as violent as they are today.

The increase in the numbers of transhumant cattle is reported to have hardened the ground by trampling. The land is first of all more difficult to till and, second, rainfall blocks the ground and can no longer infiltrate. Thus the herds in the Djougou region that belong to Peul cattle farmers are accused of damaging areas around ponds and contributing to silting. In Niger, serious and sometimes violent disputes between herders and rice growers are caused by the drying of water points—blamed on trampling by cattle. The practices of transhumant herders are stigmatised in the Djougou region.

Causes associated with sociocultural representations

From the sociocultural viewpoint, the main cause of climatic and environmental changes mentioned by respondents is endogenous and related to the abandoning of certain sociocultural values constructed in particular around rites and sacrifices.

Indeed, the gradual abandoning of certain practices involved in autochthonous religions and also those of Muslim marabouts is mentioned in conversations about the causes of changes. In both cases beliefs associate certain rites (sacrifices or prayers) and the depth and quality of annual precipitations recorded at a location.

INTERPRETATION BY MARABOUTS, ISLAMIC SCHOLARS

In the Bonkoukou and Wankama regions of Niger, Muslim marabouts make a link between natural events and the succession of prophets. This form of interpretation enabled them to predict the characteristics of each rainy season and choose the corresponding rituals and sacrifices. Thus at each rainy season the marabouts asked the people to sacrifice a chicken, a goat, a sheep or a cow. The animal to be sacrificed was either given by the head of the village or purchased using sums given by the population. It is stressed that these sacrifices were performed outside the village and the meat had to be eaten on the spot, without which the sacrifice would have no effect. These forms of sacrifice are becoming more rare in villages, although some survivals can still be seen.

rites practiced by zimmas, the holders of local animist beliefs

In these regions of Niger, *zimmas* (a term in Djerma indicating holders of magico-religious knowledge) performed their '*foleys fooris*' or '*Doboussosso*', ceremonies of possession dances. To organise the ceremonies, people make contributions and bring cereals to the *zimmas*. The practice of the *zimmas* is organised in the seventh month of the year and is aimed at predicting the amount of rainfall in the year and the spatial distribution of rain in the village area. The predictions enable the population to be warned of risks of drought or flooding.

For example, in Bonkougou, the *zimmas* used a fairly simple but strongly symbolic procedure that runs as follows in this description by a respondent:

‘Two lines at right angles to each other were scraped in the ground and a calabash of special water was poured out at their point of intersection. And, naturally, this water ran along the lines marked in four directions representing the four cardinal points. Spatial distribution of rains is defined by the amount of water that may run on each side of the pattern traced. If for example the eastern segment receives more water than the others, this would mean that annual rainfall will be much greater to the east of the village and its surrounding area’ (interview performed in 17 July 2012 with one of the persons involved in the organisation and holding of the *Doboussosso*).

This practice also consisted of preventing attacks by insects that could destroy the crops. And apart from the money and cereals used for the organisation and holding of the ‘*foleys foris*’ or ‘*Doboussosso*’, the *zimmas* had the right to further payment in kind. Thus at the end of each harvest, each household had to give a bundle of millet to the chief *zimma*. The latter used this as he wished, generally distributing it to the ‘needy’ (usually old or indigent people).

But all these practices have now been abandoned for several years, in particular because of the advent of new Islamic practices. This new religious trend interprets these practices as a form of association of beliefs that it terms a ‘great sin’ as they are related to animist practices. And many respondents consider that all the difficulties encountered today can be blamed on the abandoning of these practices considered to be traditional. Indeed, all the threats prevented by these practices are those involved today in the situation of climatic and environmental changes that make seasons and crops unpredictable and precarious.

Various rites that are now abandoned were mentioned during the surveys conducted in Niger. Each year, propitiatory rites were performed to ensure that the harvest would be good. Thus, before sowing a grain crop, a white chicken was sacrificed to ask for a good farming season. A rite that can be qualified as circumstantial, that is to say that is only performed in certain circumstances—in this case when there was a long period with no rain during the rainy season—was performed. During this rite, women and children carrying cereal grains of all kinds went around the village, pouring seeds at the feet of the big *gao* (*Acacia albida* or *Faidherbia albida*) and in the cemeteries, thus calling on the souls of the dead and on ancestors. According to the persons interviewed, once the ritual had been performed the rains always came. Collective prayers in the cemeteries or at the pace reserved for the prayers of annual festivals might also take place to make the rains come. All these sacrifices and rituals have now been abandoned.

Avoidance practices were also aimed at not upsetting the cycle of the seasons and their quality. Thus a kind of pact between humans and insects—recounted in the foundation myths—led to not eating *foy youtto* (*Ceratothera sesamoides*, whose leaves form the base of a glutinous green sauce much appreciated in Mali). The male elders of the village, considered as wise men, made incantations concerning this very specific type of herb called ‘*zoulombou*’ or ‘*foy youtto*’. The pact forbade humans to eat the herb until the harvests. In return, the insects ate the herb and,

according to the pact, could not attack crops. However, the pact was broken as soon as someone dared eat the forbidden herb and the insects retaliated by attacking crops.

In the Niakhar region, in Serer country, farmers have used a set of strategies to face the increased scarcity of cultivable land, the impoverishment of soils, the collapse of the groundnut economy and the very marked decrease in rainfall (LERICOLLAIS, 1999). They rely on their experience and on the carefully conserved memory of past farming seasons, which explains to a considerable degree their great flexibility with regard to climatic events (LERICOLLAIS and MILLEVILLE, 1997). In parallel, the use of mystical forces is very important. This is the meaning that should be ascribed to the traditional Khoy ceremony in Serer country. Sacrifices and incantations are performed before the sowing of millet in order to obtain good wintering. In the village of Sob, the ceremony is held before the first rain, on a Wednesday, under a large baobab given the name of the protective genie, *diyamsen*. The date of the first sowing is also set on the completion of the ceremony.

Beyond the question of these abandoned rites, respondents mentioned the breakdown of certain well-known social equilibriums. These failures are expressed around various types of behaviour considered as being potentially destructive for society because of the divine fury that this behaviour generates. Today, four main sets of social behaviour can be noted that are perceived as disturbances.

Failure to respect customary hierarchy in farming activities— and in particular obligations and practices concerning the relation of primogeniture and precedence—is a very important cause of ‘ecological disturbances’. It is thus forbidden to hoe before the land chief starts; for good field productivity, fieldwork (hoeing, sowing, ploughing and harvesting) must be launched by a man belonging to a given family in the village, generally the family of the land chiefs that is to say whose whose eldest male handles annual propitiatory rituals and that is considered to be native to the place, that is to say the first to arrive. This elder male must take the first step, alone. Nobody in the village should start to hoe, sow, plough or harvest before this man.

The accentuation of individualism in households is denounced as being a major cause of the upsetting of the cycle of the rains in Niger and in Benin in particular. The decrease or even the disappearance of mutual aid within the same family, between families and in society in general causes disturbances in the progress of the rainy season. According to one of our respondents:

‘Although in the past you couldn’t eat alone, knowing that your own brother, a relation or the neighbour had no food, things are different today. And people are even happy about the difficulties faced by others.’ (Bonkoukou, 2012).

Practicing Muslims also consider that what they call ‘*moral depravation*’ and the calling into question of a society built on the power of male elders leads to disturbances of the natural order of things. These disturbances are so great that they affect meteorological changes and are probably one of the causes. The changes in the status of women and children are sometimes seen as the calling into question of Muslim precepts that prefer to encourage the authority of men, heads of households.

Women are accused of ‘not staying at home as God recommends’. Today, women are also accused of ‘being everywhere and having activities of all kinds, going from market to market and exhibiting their bodies’. This is also the subject of sermons by Muslim religious chiefs in Senegal. Young people—both boys and girls—are accused of no longer obeying the orders and advice given by their parents. This very deep-seated calling into question of relations of authority structured by distinctions of age, by sex and by generation is perceived as a major cause of social malfunctioning which, by a ricochet effect, causes malfunctioning of the intensity and regularity of the rains.

Injustice in the management of state affairs is also perceived as a problem that can cause malfunctioning. According to our respondents, the holders of power no longer guarantee justice and equity between citizens. Because of this, the weakest persons endure the injustice of leaders considered to be corrupt. These representations are shared throughout West Africa. Thus on 18 January 2014, heavy rains started in Ouagadougou at 4 am. Old people had never seen such a thing—rain in January in a Sahel country. Interpretations acquired a political tinge and on the same Saturday the political opposition in Burkina Faso held a protest march in opposition of the Blaise Compaore’s government to revise Article 37 of the Constitution that limits the number of times elected persons can renew their seats. While the first interpretations tended to say that Blaise Compaore was so powerful that he could cause very heavy rainfall to prevent the opposition demonstration from taking place, at the end of that day after several thousand people had braved the rain to demonstrate in the street, the popular verdict was clear: this rainfall announced the arrival of a major revolution that would oblige Blaise Compaore to leave power. The event happened 11 months later after the popular insurrection of 30 and 31 October 2014.

All these ‘deviant’ individual and collective behaviours are considered to be such as to provoke divine wrath (in Niger) or that of the ancestors (HÉRITIER-IZARD, 1973) (in Burkina Faso, Serer country in Senegal or at Djougou). Because of the mystical sanctions that they generate, this behaviour causes varied meteorological phenomena: heavy rainfall, floods, red dust wind, the drying of watercourses, etc. Today, animist sacrifices and rituals and those practiced in the name of Islam are considered to be contrary to the new practices of Islam and are gradually being abandoned. But a large number of the persons questioned consider that this abandonment is the cause of climatic changes, the decrease in rainfall, the decrease in crop yields and the degradation of pastoral resources.

In conclusion

Farmers are aware of *long-term trends* (decreased rainfall, drought) and *inter-annual variations of the climate*. The perception of long-term changes is generally expressed by strong landscape markers: the disappearance of plants (tree or herbaceous species), of animals and temporary ponds and the appearance of invasive

species. As impoverishment of the soil means that the land is less productive than before in all the zones considered, the population is more aware of the problems associated with the change of the rainy season. The vulnerability of the population is thus two-fold, being both agricultural and climatic and both amplify each other mutually. The question of changes and the ability to face them is raised first of all in terms of soil fertility. The decrease in land productivity combined with the question of rainfall presages the setting up of new strategies to handle this: the recovery of land, increased use of fertiliser (including fertilisers from urban wastes with high toxicity), the development and/or the increase in the growing of companion crops, the introduction of new cultivated varieties or species, the adoption of new agricultural and non-agricultural activities, the evolution of the position of women's activities, an increase in temporary or definitive migration, etc. In parallel, the rise of islamisation and re-islamisation, the degradation of the environment, climatic variations and their corollaries, the expansion of technological resources for meteorological orientation and forecasting are all factors that reduce the dynamism of local knowledge, know-how and practices, even if their presence remains effective in all the areas examined in this research.

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