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Full Length Research Paper

Climate changes and progression of Agricultural practices in North Benin

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Climate changes constitute nowadays potential threat to the environment and to the sustainable development. Their impacts especially affect agriculture which depends on rainfall in poor countries like Benin. In effect, the development of adequate adaptation strategies constitutes a problematic for population. This work aims at studying adaptation strategies developed by population to face climate changes. It analyzes climate changes impacts on seedling periods of cotton, maize and rice. This study was conducted in Alibori department (Banikoara and Malanville). Consequently, this study demonstrates the statement of seedling periods over a year which took into account a diversity of crops varieties (early and late) Eighty households are randomly selected. Data are collected through Unstructured and Semi Structured Interviews, Focus Groups Discussion and Participant Observations. The modifications of seedling periods are determined on the basis of discourse analysis and descriptive statistics. Results reveal that, farmers use many strategies to cope with rainfall interruption. Thus, Crops seedling periods modifications are parts of those strategies where farmers have to modify the seedling periods to these crops as a response to climate changes. Whereas at the extension services level the seedling periods remained unchanged except the case of rice.

Key Words: Climate changes, farmers, adaptation, modification of seedling periods, Benin.

INTRODUCTION

Climate changes constitute nowadays a major threat to the environment and to the sustainable development. Their impacts are related to the influence on natural resources and even on the whole activities carry on by human beings. Among them, we could mention: food security, human and animal health, economic activities and hydric resources (GIEC, 2001).

Agriculture is the main source of subsistence for most rural populations. It is also the fact of human beings activities which activities, lead to the issue of climate changes. Thus, FIDA (2008) demonstrates that in the developing country, climate changes are fundamental causes to bad harvest, the loss of cattles and then, it gives rise to major financial losses or food product prices inflation. Climate changes will affect considerably the ecosystem. Climate changes affect mostly African continent and it has become one of the major challenges to be tackled. It is more typical in arid zones (Adger et al., 2007; Haile, 2005; Huq et al., 2004; Kurukulasuriya et al., 2006). Those where the populations could draw out an important part of their subsistence. Some fearful perspectives demonstrated by FIDA (2008) reveal a decreasing of 50% of yields to rainy cultivations by 2020. Republic of Benin as West African country is under threat related to climate changes. According to (MEPN, 2008), climate changes have and will have enormous impacts mainly on water, energy, health, agriculture and forestry. Then, agriculture, is one the core field for its economy with a support of 36% to GDP (World Atlas, 2006) and to 88% of Exports incomes (Gologo, 2007) and also it requires more than 70% of the population (MEPN, 2008) where, negative impacts of climate changes are already registered. This phenomenon mortages the development of agriculture which remains largely rainfall based activity and finally influenced food security.

In such context, it is important to question about the effects of climate changes in the most affected areas in Benin and also to study their effects on the main crops undertaken by a large number of farmers.

The present study is conducted in the North Benin and more specifically in the communes of Banikoara and Malanville. Its aim is to determine the evolution of agricultural practices linked to the seedling periods of cotton,

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maize and rice towards farmers and to the agricultural extension services.

STUDY AREA

The department of Alibori is limited in the North by Republic of Niger, in the Northwest by Republic of Burkina Faso; in the south by the department of Borgou, it is localized in the East by Federal Republic of Nigeria; in the West by the department of Atacora. It is composed of six communes (Ref. picture 1) comprising two agro ecological zones. Such are: Karimama and Malanville (zone 1); far North Benin which is one of the most exposed to climate risks. Banikoara, Kandi, Sègbana, and Gogonou all are included in zone 2 (cotton zone in the North) less exposed (MEPN, 2008). So as to have a representation of those two zones, the communes of Malanville and Banikoara have been chosen as study areas.

The commune of Banikoara is 4383km². It is localized in the North-West of Alibori department. It is comprised between 10° 50’ and 11° 30’ North latitude and 2° and 2° 40 East longitude. Its climate is soudanian which moves to Sahelian type with one rainy season from May to October.

According to ASECNA (2008), the annual average of rains registered is between 723.8mm to 1280.7mm. According to the temperature the annual average of minima varies between 19.77 and 22.6°C and the ones of maxima is between 33.35 and 35.85° C (Synoptic station of Kandi).

The commune of Banikoara gains some tributaries from River Niger such are: Mekrou (410km) in the North West and Alibori (338km) in the South-East. The vegetation is composed of woodland shrubbery and herbaceous where the vegetation is composed of savannah, some tricky towards highly influenced anthropogenic but all around the waterways as a result of a wooded vegetation. The soils are ferruginous, clayish influenced and silt - laden in appropriate shallows to rice production and to the gardening.

Natural resources (soils, vegetation, water ways) are influenced by a high anthropogenic pressure which leads to a rapid evolution of environment destruction. The progressive low statement of rainfall is a motive to a highly continuous sahelization to a global monoculture (cotton).

The main crops produced are cotton, maize, rice, sorghum and groundnut. However, the commune of Malanville is 3,016km² and localized to the far North-East of Benin in Alibori department between 11, 50° and 12° from North latitude and between 2° 45’ and 3° 40 of East longitude. Its climate is Soudano-Sahelian affected by one dry season from November to April with a glimpse of the harmattan from November to April and rainy season from May to October.

According to ASECNA (2008) the annual average of precipitation varies between 472.2mm and 1449, 6mm. But, dealing with the temperature, the annual averages of minima vary from 19.77 to 22.6° C and the ones of maxima is between 33.35°C and 35.85 (Synoptic station of Kandi). The commune of Malanville is localized in North and to the East-West by Niger River with its tributaries (Alibori, Mékrou, and Sota).

The valley of Niger expands from Guéné to the minor bank of the river. Which river is composed of substantial shallows**.** The vegetation in the commune of Malanville is characterized by the wooded savannah with the development of numerous herbaceous. The soils of Malanville are mostly gneissic apart from the valley of Niger with its tributaries where we encounter sandy-clayish and ferruginous soils.

Based upon the statistics shown by the agricultural extension services in Borgou and Alibori departments during agricultural campaign 2008-2009, the main crops in the commune of Malanville are rice, millet, sorghum and cotton.

RESEARCH METHODOLOGY

Data collection

The data are stated as follow

- The rainfall data from 1961 to 2008 (synoptic station): monthly and annual averages of rainfall, the number of days per month and per year.
- The rainfall risks and their expression as perceived by the farmers.
- The seedling dates of cotton, the ones of rice and maize according to the agricultural extension services in the region.

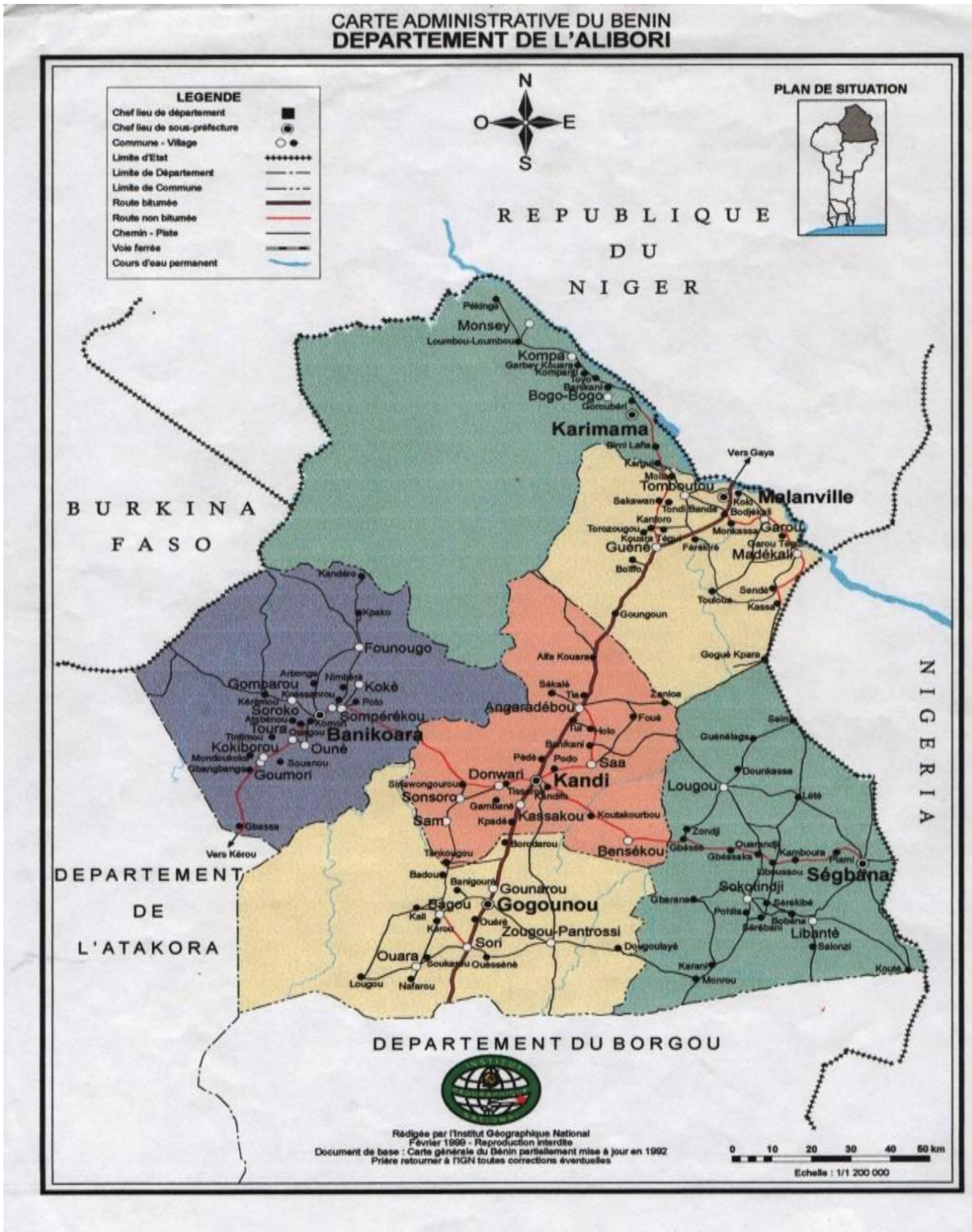
The data were collected from eighty households which were randomly selected through individual interviews (II) focus groups discussion (FGD), and participatory observation (PO).

Methods and Research Materials

We have proceeded on discourse analysis related to the issue of climate changes. Moreover, a descriptive statistics has shown the percentages of agricultural head of the household being aware of the type of risk they are exposed to. About the farmers’ perception, we choose to consider from 1941-2000 but the rainfall data are not available in Malanville synoptic station.

However, the information is just available from 1942 (launching year) and also from 1954 (launching year) for Banikoara region.

Also, we are motivated by the declaration of MEPN (2008) and Ogouwalé (2004 and 2006) who stipulated that since the end of 1960, the climate disturbances appear in Benin and they are expressed by annual reduction of amplitude to the total rainfall heights of 180mm.



Administrative situation of Alibori department.
Source. IGN (1992).

Thus, the rainfall trends have been determined by drawing the column graph and the straight line of tendency to the combination of rainfall added to the number of rainfall days per year during1961-2008.

This analysis has been completed by the ones dealing with the ongoing regimes in order to stress on the evolution of rainy season.

From that perspective, we divided out the period 1961-2008 into two, by 30 years each to focus on climate changes.

The average of rainfall regime on each period of time calculated and compared through the use of column graphs of frequency based on the Excel of Microsoft office.

This analysis is characterized by rainy season in order to show to the farmers perception on climate changes related to the included modification during the characterized rainy seasons.

Then, a given discourse analysis from the heads of the house hold is linked to the period of time registered during the seedlings of cotton, maize and rice. According to the whole community, a comparative analysis of register-

Table 1. Recap on farmers perception of rainfall trends.

Climatic risks	Commune of Malanville		Commune of Banikoara		The whole area of study	
	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
Delay in rainfall	40	100%	12	30%	52	65%
Resisting zone of dryness during rainy season	40	100%	40	100%	80	100%
Early end of rainfall	40	100%	29	72.50%	69	85.25%
Disorientation of rains	31	77.50%	29	72.50%	60	75%
Receding rainfall	29	72.50%	36	90%	65	81.25

Source. Survey data: July-August 2009.

ed periods to the side of the heads of the household are examined. Also, by focusing on these issues, the availability of technical assistance linked to agricultural extension services is set up.

RESULTS AND DISCUSSIONS

Farmers' perception on rainfall trends

The different risks related to rainfall which disturbs the original implementation of agricultural works is stated in Table 1. But risks are shown per commune.

As we compare the two communes in Table 1, we notice that all the farmers affirm that the trends of rainfall are shown through the delay in the start of rainfall in Malanville where 30% of respondents sustain that trend in Banikoara.

Thus, according to farmers in the commune of Malanville, they were mostly confronted to the delay in the rain start which is expressed by the rainfall period in the second decade of May even by the end of May during the last fifteen years or more.

The breakings of rainfall constitute a specific risk revealed by all the farmers in the study commune. In fact, the interruptions of rainfalls during the season are more frequent for the past years according to the farmers. The periods during which the interruptions are remarkable appear in May, June and also the end of September and October**.** Those interruptions are expressed through rainfall breaking for about two weeks even more than that according to the farmers declarations.

To the geographical disorientation of rainfall, we notice that 77.5% of the interviewees in Malanville and 72.5% in Banikoara confirm the trend.

Dealing with the rainfall receding in the commune of Malanville, 72.5% of farmers notice that the trend stands as rainfall receding whereas in Banikoara, 90% of farmers confirm that trend. About the early interruption of rain**,** the interviewees reveal it in Malanville whereas in Banikoara**,** 72**.5%** confirm the trend seven if the rain stops by the end of September and the beginning of October instead of mid-October.

From that point of view, we could confirm that all risks indicated above still exist and are expressed at a higher level in both communes. But in general, Malanville is permanently threatened by those risks than in Banikoara. Those different trends perceived by the farmers confirm the results of (Aho et al., 2006) who concluded that the climate changes are expressed in the North Benin throughout the delay in rainfalls. (The rains appear in May instead of April); the repetitive interruption of rainfall during agricultural works campaign; the persistence of dryness.

The farmers perception encounters Ogouwalé (2004 and 2006) and MEPN (2008) which results show a decreasing of annual amplitude at the level of total heights of rains 1960s and especially in 1970 and 1980. Are those trends different from the ones revealed by ASECNA?

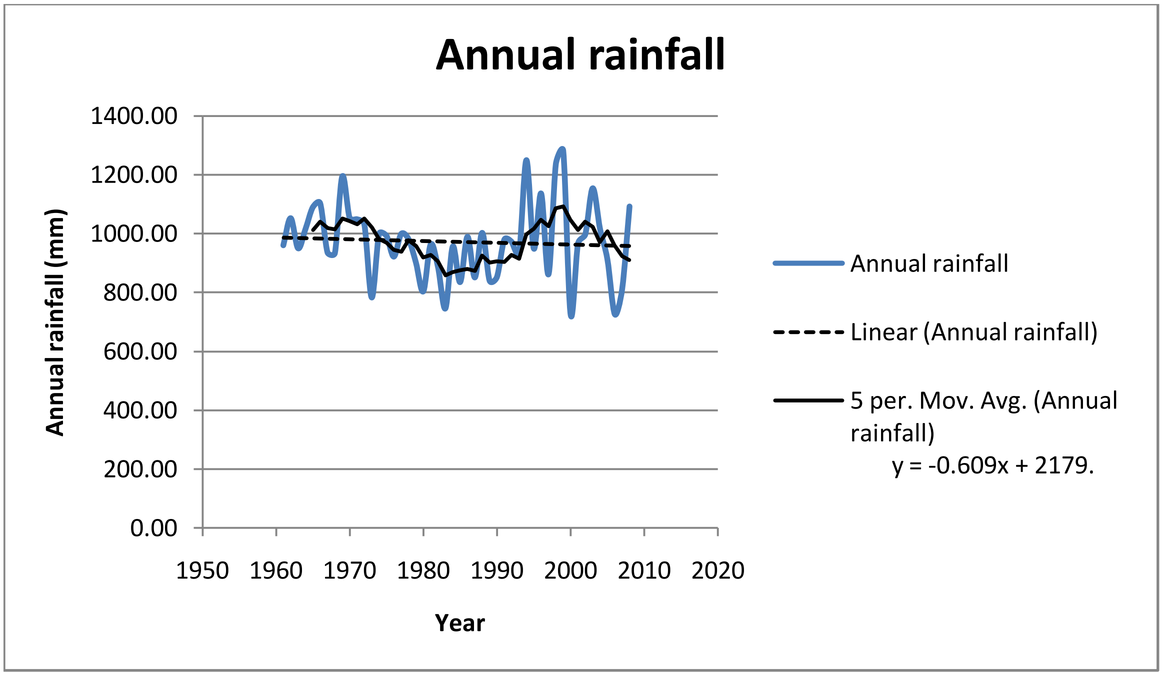
Precipitation: Determination of annual rainfall trends from 1961 - 2008

Annual rainfall combination

Case study of Banikoara

The rainfall station of Banikoara was created in 1954. Consequently, there is no availability of rainfall data before this period.

The straight line trends with its negative inclination (-0,600) demonstrates that annual rainfall heights are lower.



Graph 1. Progression of annual rainfall heights in the commune of Banikoara from 1961 to 2008.
Source. Elaborated from ASECNA rainfall data.

lower. Thus, that trend has been observed through 90% of farmers in Banikoara. It also confirms primary the argument of Ogouwalé (2004 and 2006) and MEPN (2008) which shows a reduction of annual amplitude to the heights of rains since the end of 1960, and more specifically in the year 1970 and 1980. However the coefficient of determination is lower (R^2 = 0,004), that straight line does not show the progression of the annual rainfall. So, we may not conclude a fall down of precipitations during the period 1961 – 2008. (Ref: graph 1)

Yet, the progressions of the average curves are calculated based on the duration of five years by showing the annual rainfall on four years time of progression during the period 1961 – 2008.

In effect, during 1961 – 1972, the rainfall showed an upward trend. As a result, this period was humid, whereas on the period 1973 – 1983, it had shown downward trend, expressed dry period.

During this repetitive dry period of renewal and an abundance of rainfall have moved forward from 1984 to 1999. Since that period the average of mobility falls down rapidly. But, in 2000 we notice an interruption which signaled the end of humid period and the rise of dry period.

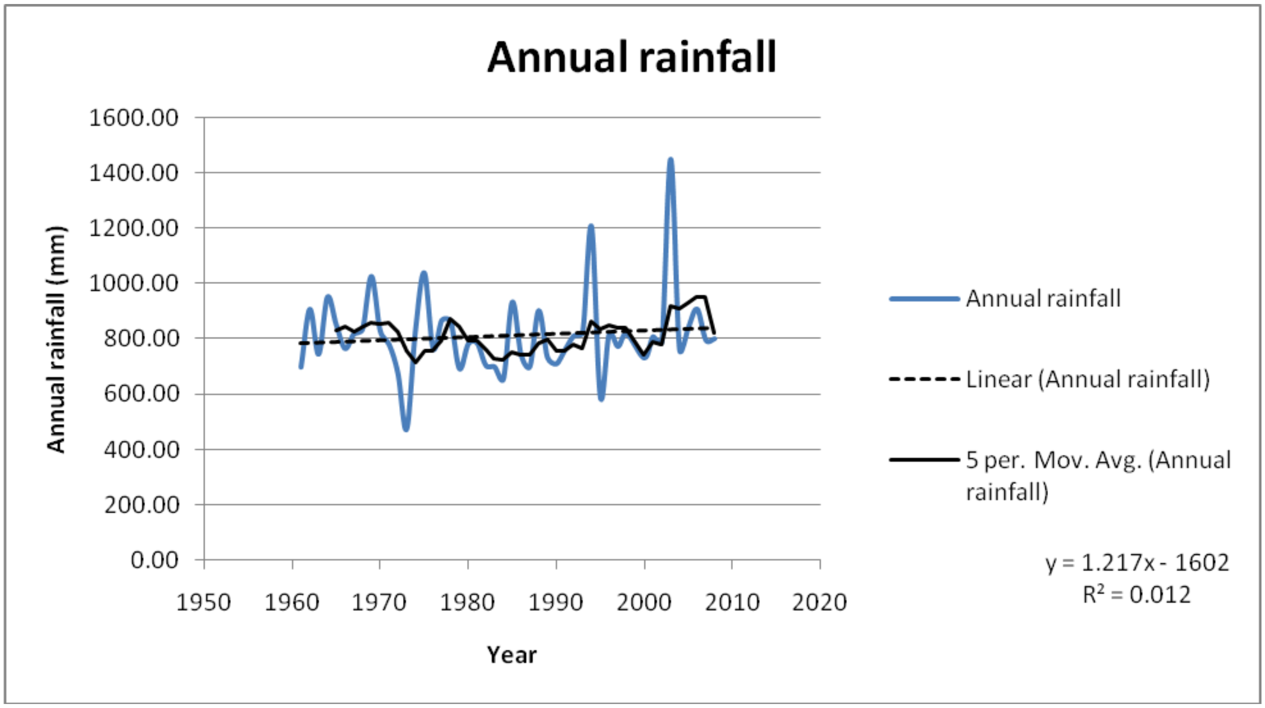
Case study of Malanville

The straight line shows a positive inclination (1.217), this demonstrates that the annual rainfall shows an upward trend. At first, that trend is opposed to the perception revealed by 72.5% of farmers and the arguments sustained by the authors quoted above. However, the determinant coefficient is low (R^2=0,012), this straight line cannot explain the progression of the annual rainfall. As a result, we may conclude the upward of rainfall on the period 1961 – 2008. (Ref: graph 2)

Moreover, the progressions of the average curves calculated based on a period of five years show that the annual rainfall has followed many stages during the period (1961 – 2008). In effect, during the period 1961 – 1969, the annual rainfall has progressed. Then, this period was humid. However, during 1970 –1973 it decreases and gives rise to a dry period.

From that dry period, a start of rainy season may follow from 1974 to 1978 so, on that period the average curve has mostly progressed. But from 1979 – 1984 the average curve decreases and a dry period took place. During this period of 1985 – 1994 the average curve has been engaged in a progressive trend and consequently it shows the setting up of a humidity period from 1985 to 1994.

From 1995 to 2000 the average curve shows a down fall trend. Then, it reveals a decreasing of rainfall on that period. This reduction is mostly remarkable through 589.6 mm of the rain during 1995. However, in 1994, the rainfall registered is around 1205.6mm. From 2001 to 2006 the average rainfall shows a high level, and it was globally humid and the year 2003 stands as an exceptional rainy period with 1449.6mm. Since 2007, we notice the beginning of a dry season.



Graph 2. Progression of annual rainfall heights in the commune of Malanville 1961 – 2008.
Source. Elaborated from ASECNA rainfall data.

To that end, we could observe in both communes a succession of rainy and dry periods. But this succession was remarkable in an acyclic way during the period 1961 – 2008. Then farmer sat the same time are facing to some increased heights rainfall period and lower rainfall period. All those aspects could explain the perception of the majority of farmers who stipulated that there is a reduction of rainfall heights.

Variability of rainfall regimes in Alibori: A comparative study from 1961 – 1984 and 1984-2008

The annual rainfall variability within a year should be considered since, an equal annual rain fall quantity, and intra-annual equivalent variability a higher instability of rainfall regimes from one year to another have affected negatively agriculture.

The comparative study of average rainfall regimes is developed and evaluated on the periods 1961 – 1984 and 1985 – 2008 since, agricultural works are rain based. All the modifications from rainfall need an additional adaptation of production systems.

The analysis of those histograms shows

The commune is characterized by one rainy season from April to October where June, July, August and September are the mostly rainy months. August is the most humid month within two periods since we have registered the highest heights rainfall and the maximum of rainy days.

During a given year, months such are: March, May, June and July are slightly more humid on the period (1985–2008) than on the period 1961-1984. However, we registered the falling down of rain heights in April, September and October. November, December and January are dry and February is more humid.

At the same time, the above graph 3 shows an increase in number of the rainy days during the whole rainy season except in June where the number of days decreases lightly, the rain height during this month stayed higher. Then, this leads to the increase of rainfall interruption revealed by the farmers. Then, the decrease of rainfall height in April and October could be explained by a delay in the rain start. The increase in the number of the rainy days (April and October) could be a motive of the early rain end.

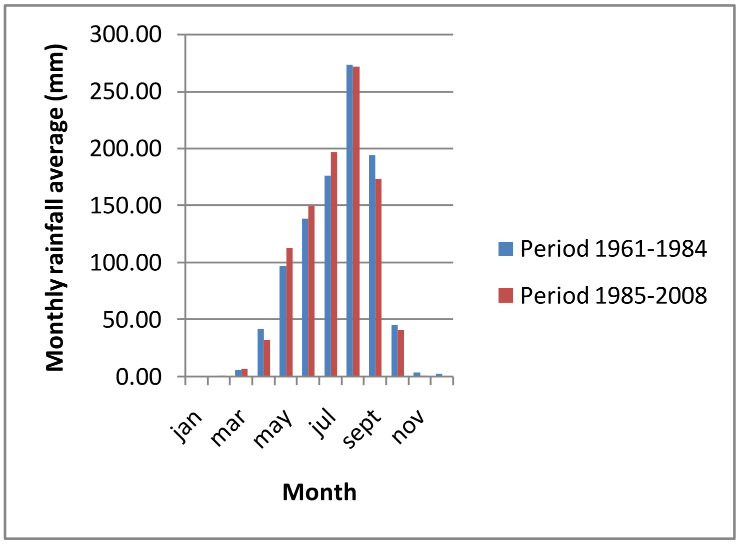
The Analysis of the histograms shows

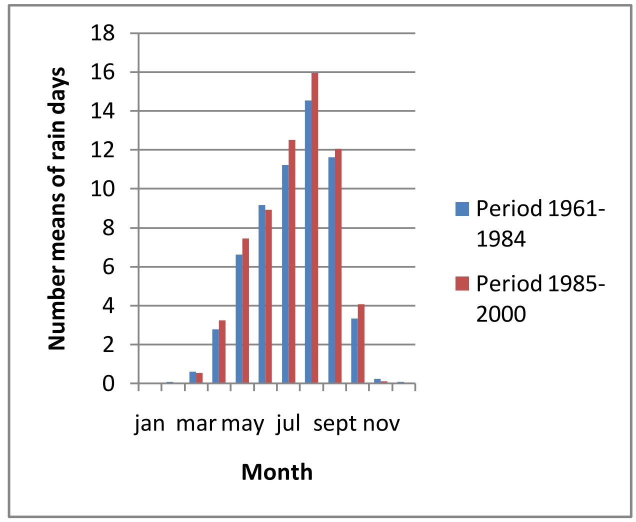
The commune of Banikoara is characterized by a one rainy season from April to October with June, July, August and September as the most humid months.

The higher rainfall heights, the number of rainy days per month are registered in August in the course of the two periods.

During a given year, April, May, July, August and October are more humid from 1985 – 2008 than on the

Case study of Banikoara.





Graph n°3. Medium rainfall regime 1961 – 1984 and 1985 – 2008.
Source: Elaborated from ASECNA rainfall data.

period 1961 – 1984. However, we notice the lower level of rain heights in June and September. At the same time, the above graph 4 shows we notice an increase in number of rainy days in May, July, August and October and then a lower level in April, June and September. The rainfall height in April is slightly higher added to less two (02) rainy days. This may be viewed as a delay in the farmers logic. Even the height, and the number of rainy days are progressing during May while this number is inferior to six rainy days and then, the expression of rainfall interruption revealed by the interviewees are justified during a given month.

The fact is that the rainfall height and the rainfall days are simultaneously lower in June, consequently, the increase of rainfall interruptions is revealed by the farmers. But the decrease of rain height in October and the increase of the rainy days in this month is a signal of the early rain end since little quantity of rain (<30mm) attempts to progress over many days.

With the rainfall modifications observed during the past years, the farmers attempt to reduce their vulnerability through a number of strategies. Among those strategies the modification of seedling period plays an important role.

Progression during cotton seedlings period according to the farmers

Most of respondents' farmers during the survey declare that: before the rainfall modifications are perceived, the whole April is devoted to a period during which natural fodders are developed. Those fodders were used to feed draught animals. Which animals, are affected by precarious life conditions resulted in the increasing scarcity of pasture during dry season. Thus, they will be capable to proceed on agricultural works.

The farmers affirm that only the clearing activities on the farms were executed during this month. The second decade of May which is the start of rainfall stands as a period of ploughed fields and the sowings. From this observation, the end of sowing activities arises by the end of June. Only the retarding farmers are still sowing until the first decade of July where the cotton cycle has lengthened six months.

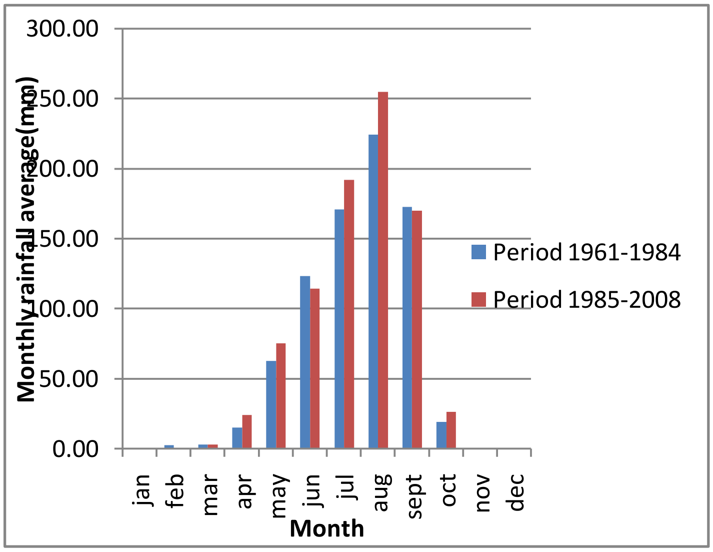
However, for those fifteen past years, according to the farmers, there is no more rain in April and May, the rains are scarce. They often notice an abnormal dryness in June. The early end of rains intervenes by the end of September or by the beginning of October. Consequently, most farmers proceed on the modification of seedlings period.

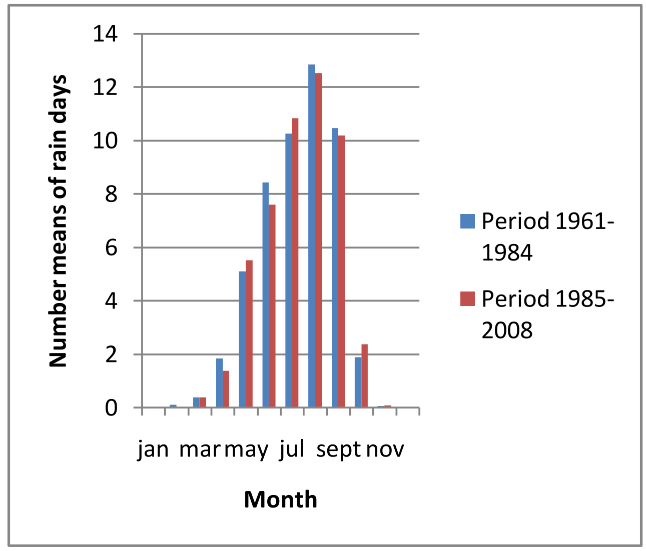
Thus, from the rainfall of the second decade of May, few numbers of farmers (30%, 10%, 17% and 22% respectively from Boiffo, Tomboutou, Komon and Kokey) begin a seedling of cotton.

However, those farmers asserted that rainfall interruptions are expressed in May and gives rise to the dryness of sowing grains part and to the seedlings ones. They finally proceeded on the new seedlings of grains and destroyed plants. But at the same time they continue by sowing new fields up to the beginning of July.

For those farmers, they have to begin the seedlings of cotton in May because there is some rainfall interruption

Case study of Malanville





Graph 4. Average rainfall regime 1961 – 1984and 1985 – 2008.
Source: Elaborated from ASECNA rainfall data.

even at the early end of rains or at the end of September and October which are detrimental to the yield.

Other farmers (35%, 40%, 52.9% and 33.33% respectively from Boiffo, Tomboutou, Komon and Kokey) affirm however that they have to wait June to tackle the seedlings of cotton. They have to focus on to some extend that they also have to wait June in order to permit cotton to cross over the interruption and the disorientation of rainfall which is frequent in May. Yet, those farmers mention that there is also some rainfall interruptions in June which influences a little bit the germination and the growing of grains but the plants have more chance to cross over normal rainy periods of July, August and September.

The third category of farmers (35%, 50%, 29.4% and 44.44% respectively from the same villages declare that they have to sow cotton in June, July so as to avoid the permanent climate risks (delay in the start of rains, rain interruption and disorientation) during May. Then, the early end of rains sometimes at the end of September and at the beginning of October affects the growth of plants sown in July.

To that end, we could affirm that the rainfall modifications lead the farmers to modify the seedling period of cotton. So, most of them sow cotton during June and July.

The different declarations from farmers related to hydric deficit confirm the results of CIRAD – GRET (2006) according to which “the supply of water is an important factor for cotton growth. The need of water supply to cotton is a minimum of 500mm during the growing season. The hydric deficit influences the spread of foliars, the retention of productive organs and the vegetative growth. It may appear a negative influence on the quality of wood fiber.”

Progression during maize seedling period according to the farmers

The same remarks are noticeable on maize production. In effect, according to maize producers (100%, 80%, 85% and 90% of them respectively from Boiffo, Tomboutou, Komon and Kokey), where maize was sown monthly in May to June with the maximum of seedlings in June since the rains start early in April and in May soils are wet in order to facilitate the ploughed fields and seedlings activities.

During that period draught animals are capable for agricultural works. According to the farmers view point, some varieties of long cycle (95 to 120 days) of maize which, exclusively were sown and nobody think about its sowing in July so as to avoid a lost production. But, for the past years, with the modification of rainfall and the promotion of short cycle varieties (65 to 90 days) by agricultural research, the farmers adopt the same behavior vis- à –vis to maize production.

During the rains in May, the farmers set up informal gardens (piece of land located behind or around the houses) on which the animals were parked for circumstance. They sow some early varieties of maize where the crops are available for the period of suture mostly with the appearance of climate risks. According to those farmers the rainfall interruption, the disorientation of rains added to the intensive warm drive them to proceed on the new seedlings.

In June, farmers declare that they sow late maize varieties. And then, in July, the remaining plots or farms are sown with early varieties. Farmers justify such attitude as a strategy to face some rainfall interruption and the early end of rains which is expressed from the end of September to the beginning of October.

That is to confirm the argument of CIRAD-GRET (2006) which stipulated that "the dryness is particularly dangerous at the period of the sowing. But its great and negative influence on the yield is noticeable during the flourishing."

A few number of farmers (20% at Tomboutou, 15% at Komon and 10% at Kokey) sow maize in August. For these categories of farmers, a lack of plough or draught animals explains their behavior. In fact, those farmers affirm that they have to borrow these means of production from their neighbours who have to cover their agricultural works in advance. However, it happens that those farmers are in a regressive position by the rainfall risks. As a result, they are still more regressive than the other since they have to wait the owners of those materials. Finally, they have to sow in August with many risks of rainfall interruptions combined with the early end of rains by the end of September to the beginning of October.

The conclusion drawn out from all those aspects stated above is that, up to now, the majority of farmers sow maize seedlings between May, June and July with the maximum of sowing in June for the long cycle varieties and in July for the short cycle. And then before the climate modification, they used to sow in May-June with the maximum of sowing in June for the varieties of long cycle and in July for the short ones. And then, before the climate modification phenomenon, they used to sow in May and June with the maximum of seedlings in June.

Progression in rice seedlings period according to the farmers

According to the rice producers, rain based rice on shallow is mostly produced. However, those farmers indicated that the free lands of those shallows have dried during dry season that it was difficult to farm if they are still less watered by the rains. Thus, any activities related to the fields (land preparation, seedlings …) were not possible before May.

Moreover, in July those lands were over flooded, and this issue is a limit to the agricultural works. Also, those farmers argue on the fact that they set up some rice production fields before July which gave rise to the beginning of heavy rains. For rain based rice, the farmers noticed that they sow till July because they used to sow on unwetted lands which are relevant to crops such are: Cotton, maize, sorghum.

For irrigated rice production only observed in Tomboutou the seedlings could be effective in a whole period of the year due to the permanent availability of water.

For those past years, the disturbances of rainfall (delay in the start of rain, the rainfall interruptions and the disorientation of rains) farmers executed lately the adequate ploughed fields to rice production. Consequently, they sow in June. Which month is a more convenient month for land preparation and they added up to July where these lands are not watered yet. And then, they could sow till July.

Those farmers declare that they often sow rain based rice during the rainfall interruption since they have ploughed land in advance. So, rice grains have to stay underground till the new rain start.

From all those aspects, the sowing of rain based rice is possible in May, June even if some farmers sow strictly rain based rice in July. But, during those past years the seedlings are ready in May, June due to climate disturbances.

Progression during cotton maize and rice seedlings period according to the agricultural extension services

The limited factor to vegetal growth in tropical region is water supply. The growing period begins since humidity is available for a long period with dry period in adverse (Ogouwalé 2004 and 2006). This period is theoretically determined by rainy season. Which rainy season, has begun and ended over.

According to Cochémé and Franquin (1968) the beginning of rainy season is defined as the period (decade) where the precipitation (P) combination is inferior to plurality of evapo transpiration potential (ETP), but superior to (ETP) / 2 and the end of the season appears to (ETP) / 2. This approach stands as fundamental to the adjustment of agricultural calendars (Boko, 1989). About those agricultural calendars, only the seedlings periods or dates are the main focus of this research.

In effect, the influence of seedlings date for the annual cultivation is often essential. Even in 1980, 54 agricultural research had proved a number of favorable dates of sowing certain main crops in Benin (IDID, 2008) and since then, those seedlings dates are promoted by agricultural extension services.

The seedlings periods recommended by the Institutions in charge of cotton production in Benin remains unchanged relatively to what was done in the past since the extension are still being trained based on the specification sheet where the reality is progressing. For instance, during cotton campaign 2009-2010, the period recommended by agricultural extension services for cotton sowing period is from 1st to 20th June in Alibori.

Table 2. Summary on the progression of cotton, maize and rice seedlings periods according to the farmers and to the agricultural extension services.

	Seedlings periods/duration			
	Before climate disturbances		**Presently**	
products	Farmers	Agricultural extension services	Farmers	Agricultural extension services
Cotton	Second decade of May, first decade of July	1st to 20th June	May, June, July	1st to 20th June
Maize	May, June with the maximum of seedlings in June	Before 15th June for the late varieties and till the end of June for the early varieties	May, June, July with the maximum of seedlings in June for late varieties and in June for early varieties	Before the 15th June for the late varieties and until the end of June for the early varieties
Rain based rice	May, June	15th May 15th June	June, July	15th June, 15th July

Source. Survey data: July – August 2009.

The sowing period of maize recommended by agricultural extension services is before 15th June for the long cycle variety and until the end of June for the short ones.

The specification sheet on staple crops: cereals, leguminous and tubers published by National Institute of agricultural research (INRAB, 1995) indicates that the seedlings period of rain based rice is comprised between 15th May and 15th June.

But that seedling period has changed due to climate disturbances. In effect, the specification sheet on the varieties of rice production and the promoted strategies of production by the MAEP during the agricultural extension in-house training in 2009 and 2010 shows that: "the seedlings period of rice in the North Benin due to the late start of rains and their breaking out, rice seedlings period intervenes between 15th June and 15th July for the short cycle varieties. Nowadays, the effective seedlings between the end of June and mid-July are more successful."

We have to mention that the seedlings period of those crops does not register any modification at the level of agricultural extension services. However, the seedlings period to rice production has been adapted to the new climate variability.

Summary on evolution during the seedlings period of cotton maize and rice: A comparative analysis

The Table 2 shows the summary on the progression of the seedlings periods at the farmers and the agricultural extension services level

Table 2 shows that before any disturbances of rainfall the seedlings period adopted by the farmers are more extended and include the seedlings period promoted by the agricultural extension center. We notice that the seedlings period of cotton, maize and rice registered some modifications from farmers as a feedback to climate disturbances**.** Whereas**,** at the agricultural extension service they remain unchanged except for rice production.

However, Issa (1995) by forecasting the crops seedlings period by decade on the basis of Cochémé and Franquin (1968) approaches argued that the seedlings period must fluctuate upon the prospect climate variability.

The modifications of seedlings periods adopted by the farmers facing to climate variabilities corroborate the results of Aho et al., (2006), who demonstrated that with the effects of climate disturbances, farmers modify crops seedlings periods.

Also, these findings on neglecting or abandoning the agricultural calendar (towards the modification of seedlings periods) confirms the survey of Ogouwalé (2006) who had reported the statement of a quadragenarian farmer: "For more than twenty years time, agricultural calendar fluctuates like Nigerian currency (Naira)". In other words, the agricultural calendar nowadays is not stable anymore.

Finally, MEPN (2008) has found out that farmers changed agricultural calendar as an endogenous strategy adapted to climate changes.

CONCLUSION

The farmers in the communes of Banikoara and Malanville, in their current agricultural works are confronted to many problems linked to rainfall modifications. So as to reduce their drawbacks, the farmers from these areas adopt some strategies of adaptation.

Among those strategies, we have to mention the seedlings periods modifications in combination with its consequences such as: modifications of agricultural calendar. From this issue, the seedlings period remains unchanged except in the case study of rice production according to the agricultural extension services.

In terms of perspective, we suggest the promotion of new Institutes to research development so as to invest in the survey for new seedlings dates which could be more recommended to new climate changes. As a result, it might satisfy the whole community of farmers. Thus, the experimented productions of the different existing varieties have to be conducted freely and easily by farmers in focusing on different dates of rainy season and the dates which give rise to good production for the benefit of farmers. This testing naturally has to be implemented with the active contribution of farmers.

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