

Counter-season agriculture to challenges of climatic risks of tropical Africa countries: case of the varieties of béré-béré in the sahelo-soudanian in chad

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Abstract: Saharo-sahelian country, Chad constitutes a door of entry of the desert which threatens central Africa. With a speed of 2.9 km/year of extent, the latter affects, in all connections, the environment. It follows a weakness of output of the pastoral and especially agricultural activities which are dependent on the quantity of the rainfall and the quality of the grounds. Objective: This article, with the assistance of the cartography, wants to be a tool of decision-making aid through the spatialization of the ground with potentiality of counter-season agriculture below the 12° of latitude N Method: The step which enabled us to accomplish this work consists in crossing the satellite images with the old topographic charts in order to put forward the zones favorable to off-season agriculture by grounds, products and their cycle. Chad has many zones of retention of water favorable to counter-season agriculture. Some are related to the rivers and others are natural basins of recovery.

Keywords: Agriculture, counter-season, spaces, cartography, culture

INTRODUCTION

Chad is located between 7th and 24th degrees of Northern latitude and 13th and 24th degrees of eastern longitude. It is the link between the Sahara and the Sahel. This geographical situation confers to it a climate with two alternatives. One single season of rains centered over August and July. Around the 15th of the northern degree, precipitations hardly exceed 2 months while the extreme south boxes beyond 5 months.

The rhythm of the austere climate determines, in time and space, the activities of the rural Chadian producers. The pastors are, all the years round, subjected to transhumance with tendency to concentration in the South leading often to fatal farmer-stockbreeders conflicts. The farmers, in general, are constrained with only one seasonal and annual production because of the unicity and the short duration of the rainy season. On the 39 million hectares of cultivable grounds (that is to say 30% of the territory) including 19 million hectares of arable lands, 13.3 million grounds are exploited[1].

The agricultural yields follow the emblaved surface and with the rainfall which strongly depend on the duration of the rain season in the year. It is often weak. This weakness of agricultural yields leads, in a recurring way, to a restarting in the rural areas and a speculation in the urban ones. Under gravity of the vital needs, the peasants put on the market the products and sometimes liquidate them before the next season. The

tradesmen, who traverse the villages at the period of harvest of cereals, buy them to store and resell at the time of lack.

To solve the problems which the consumers are confronted, the State, since 2009 proceeds to the purchases of cereals for the reconstitution of the national stock of safety by the National Office of Food Safety (NOFS) with an aim respectively of reinforcing the availability and food accessibility in the country. But the long circuit of withdrawal of funds of the Treasury gives time necessary and the opportunity to the tradesmen to disguise itself as a supplier of this last. Also they use all forms of easy ways, at the moment of the resale, to repurchase with the State to resell expensive with the consumers.

The agriculture of counter-season appears in these conditions as an alternative to mitigate the cereal deficit if the 5.5 million potentially irrigable hectares are developed[1]. It can, not only contribute to food safety but also to the improvement of the socio-economic conditions of the rural and perish-urban populations by the increase in the assets in agricultural produce by two annual harvests[2]. By the additional offer of cereal harvest, counter-season, the prices on the markets can appreciably know a light fall. But in spite of the need for the practice of the culture counter-season, neither the farming community, nor the authorities are interested in it appreciably.

The culture of counter-season has been practiced for several decades in the valleys of Logone, Chari and mainly in the plains of Salamat[3]. But why isn't this culture extended to other zones of the territory where there are flooded plains through the country? It isn't known by other people? What are the barriers to its extension? And what are the zones possible to accommodate this culture below the 12° N? Such are the questions which guided this work.

Our work which wants to be a decision-making aid has double objective. First is to put forward the importance of the culture of counter-season in food safety and agronomic knowledge of the culture and its problems in order to develop the know-how of the peasants and to organize the die. Second is, in knowledge of its agronomic characteristics, to spatialize the corresponding favorable zones on the site.

The site of research is the sahelo-soudanian part of Chad below 12° N starting from Ndjamena the capital. Include between the isohyets 600-1200 mm, it shelters two lakes (Léré and IRO), two rivers (Chari and Logone) with the large basins and of the easily flooded plains by rainwater and with the considerable agricultural potentialities.

METHOD AND MATERIALS

The methodology which enabled us to carry out this article has as a base the investigations, the talks and the direct observations which allowed the data-gathering with which we coupled those of the people who preceded us in the set of themes. The sites of data acquisitions were chosen by reasoned sampling: the existence of a river and practice of agriculture in the basins. They cover the river basins, the plains of flood and the arranged perimeters. Using a card of investigation into various aspects of agriculture, managed with 150 exploitations in these zones, the investigation enabled us to characterize agricultures and to appreciate the barriers to the development of the cultures of counter-season. The whole of these data of ground were stripped manually and treated using the spreadsheet Microsoft Excel 2010

The satellite contribution of image SPOT acquired in March 2013 was considerable to us in the spatialization of the zones potentially favorable to the cultures of counter-season. They were crossed with the old topographic charts which, only, could not give an interpretation reasoned because of their age. The followed method rests on the principle of the constant supervision by colored visualization. It implies a step in four times:

- geographical Pre-assistance;
- Interactive statistical treatment;
- Final general classification;
- Post assistance geography and automatic cartography.

RESULTS AND COMMENTS

Our approach enabled us to appreciate the impact of the climatic phenomena on the one hand, and on the other hand to establish the typology of the rural producers of counter-season and finally to spatialize the zones of occupation as well as the zones potentially favorable to the cultures of counter-season.

TO THE CLIMATIC ZONES CORRESPOND SOCIO-ECONOMIC ACTIVITIES

According to the temperatures, precipitations and grounds, Chad set out again in three great climatic zones where the socio-economic activities differ in time and space (cf 1). Located in the North, the Saharan zone is located between isohyets 0 and 200 mm of rain per year. The temperatures vary there between 46-47° C the poverty of the grounds and the absence of the vegetation support neither agriculture nor breeding. The rare possible cultures are made in the palm plantations. One meets there the dromedaries because of their resistance to the dryness.

In the South the zone sahelo-soudanian is in which one distinguishes the types sahelo-Saharan between (200 and 600 mm), sahelian (600-900 mm), soudano-saheliann (900-1100 mm) and soudanian (1100-1200 and more mm).The temperature pattern is marked by one relatively cold period going from December to February (11 to 22° C) and one hot period. The average maximum of the temperatures is reached in March (35- 38C) in the south, in April (40-41° C) in the center and May-June (42-43° C).The vegetation goes there from the steppe to the clear forest passing by raised savanna. They all record however, a unicity of the rain season.

The consequences of these climatic risks are numerous at the same time for agriculture generally and the cultures in particular. The agricultural activities its confine in the zone sahelo-soudanian with an output reducing of the South towards the Center. With defect of the rains, by places, because of the stop of the farming operations, certain fields are given up, the cultures sown of others test difficulties of rising or the young seedlings fade. For the marketing year 2013-2014, out of 403520 ha emblaved for pure cereals in the 3 areas namely both Logones and Tandjilé, 8834 ha are destroyed due to the deficit of the rains. On 763466 ha for all the confused cultures, 17908 ha are it (ONDR, 2013)[12].

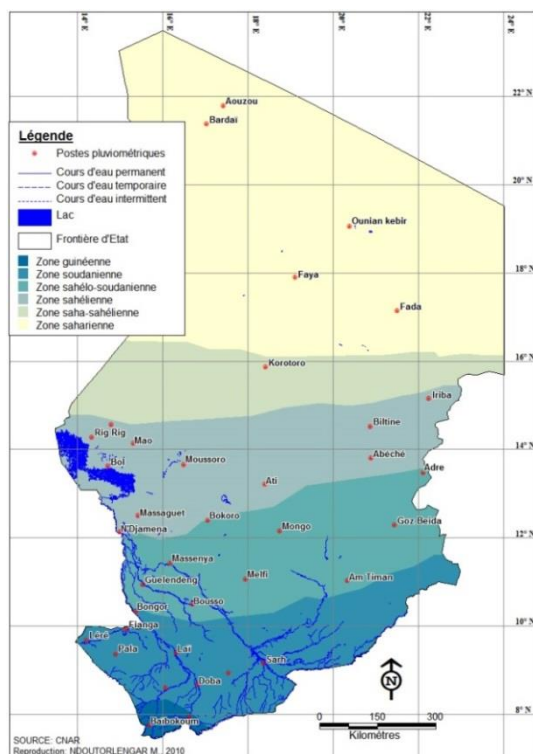


Figure 1: Climatic distribution by zone

In response to the pluviometric deficits correspond the overdrawn agricultural assessments even in the well-known zones of high productivity a few decades ago. For example with the title of the crop year 2010/2011, no Sector of Rural Development (SDR) of the Area of Rural Development of Center-South (RDRCS) has a positive cereal assessment. The cereal production in 2011 was 248425 tons against a need for the cereal population of 460181 tons. The deficit was then -211757 tons (Cf. fig 2) (ONDR/RDRCS, 2012)[11]. It is -201922 tons for the crop year 2012/2013 (ONDR/RDRCS, 2012)[11]. Only marketing year 2013/2014 recorded a surplus of 33230 tons. But the situations were not the same ones inside the RDRCS, If the cereal assessment of Tandjilé were positive (104827 tons), those of Western Logone and of Eastern Logone had remained overdrawn. They were against -41026 tons for Western Logone -30565 for the Eastern one (ONDR/RDRCS, 2013)[12].

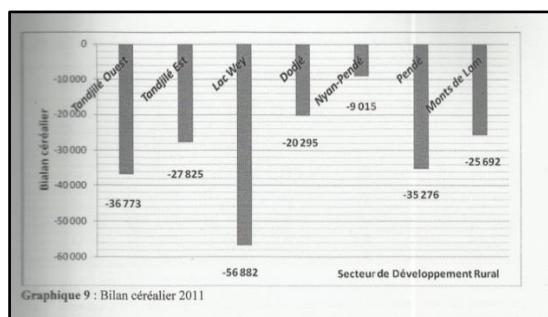


Figure 2: Cereal assessment 2011

Source: ONDR/RDRCS, 2012[11]

The agriculture of counter-season seems to be an ignored activity of the majority of Chadian peasants in comparison with the results of the surveys. 86,2% of the surveyed people stated to practice only cultures of the rain season and to make only one harvest in the year. The practice of the culture of counter-season varies according to modes' of production and geographical space. The market gardening's cultures triumph over cereals occupying 72,5% and are placed on the banks of the rivers to profit from the irrigation (Cf. photographs n°1). One also meets them in the irrigated troughs of low pressure but opencast mines (cf Photographs N°2). One finds them in majority in the areas of Chari, Mayo Kebbi and Tandjilé and in both Logones.



Photo no-1

A salad field of counter-season irrigated by water of Kabbia using a pump engine. (Stereotypes: KELGUE Solomon, 2013).



Photo no-2

An onion field of the easily flooded zones of Mayo Kebbi sprinkled of water of open wells of which the depth does not exceed 2 m with the shrinking of water of flood. (Stereotypes: KELGUE Solomon, 2013).

The cereals of counter-season seem to be the prerogative of some areas accounting for that 27,5% with fields installed in the zones of floods. The areas

considered producing of cereals of counter-season are Salamat, Chari Baguirmi and Tandjilé of the 6 areas of the site of research. They are in general the sorghums called "béré-béré" practiced in the ponds.

The culture of béré-béré resembles a practice of a group of individuals, except the few rare arranged irrigated perimeters. The people who practice it are, in general, of Moslem obedience (82% of the practise of the agricultural system).The justifications given by all and sundry differ from a camp to another. For the partisans of the culture, the production is a heritage of the ancestors since generations. For others, the culture of béré-béré is a practice of "weak" because of the flexibility related to its production.

The culture of béré-béré of the ponds does not require ploughing because of the surface of the grounds of water culture submerged during several months. They contain only few adventitious with the withdrawal water. Thus, the peasant carries out simply sowing without being concerned with grubblings. The plantation can be done in sowing or a road repair after preparation of sowing.

The sowing of béré-béré of pond is carried out when the ground is still wet, using a stick with the pointed end which one inserts in the ground up to 25 to 30 cm, the seeds are thus deposited at the bottom of the hole at a rate of 4 to 8 seeds per seed hole. They are then covered with a fine ballasting. This depth of sowing makes it possible on the one hand to ensure the lifting and on the other hand to protect the young growths against certain predators. The spacing's between the seed holes and on the line vary from 1, 2 to 1, 5 meters [5].

Road repair, in what relates to it, is also applied to the moment of the shrinking of water as in the first case after a preparation of the seedbed of which the duration of stay varies from 1 to 2 months. The maintenance of béré-béré, from sowing to harvest is less require. Only one sarclo-hoeing is carried out when the lines of sowing are quite visible before the ground is not desiccated completely[5]. It does not require any fertilization. But what is the importance of this culture of counter-season for a country like Chad with the austere climate and where the food insecurity is recurring?

"BÉRE BÉRE": FOOD IMPORTANCE AND AGRONOMIC APTITUDES

"Béré-béré" or sorghum of fall is counted among cereals the most cultivated because of the importance of its volume of production and of extended from occupied surface. In the world, it comes in 5th position while it occupies the 3rd after corn and rice in Africa. In the Sahel, it is at the head with the millet occupying between 50 and 70% of the cultivable surfaces [3]. In Chad, it comes in second position after

the millet followed by corn and rice in the food practices.

There are three varieties of béré-béré in Chad all known of Sudanese origin, introduced at the beginning of the years 1970.They in common have the period of installation of the seedbed (August 10 to September 15), the mode of tillage (cleaning and light ploughing), the quality of the grounds of reception (muddy, argillaceous and argilo-muddy) and good resistance to pour and break. Also, they ask neither the chemical manure nor organic to develop but, on the other hand, require two weeding before maturity.

In comparison with the characteristics above, béré-béré are resistant cultures to dryness, but to obtain raised productions, it requires water passably. Also work of Bennett *et al.* [8] show a strong productivity of the culture of the sorghums for availability out of water. For an availability of 500 mm water, the production can be more than 6000 kg/ha.

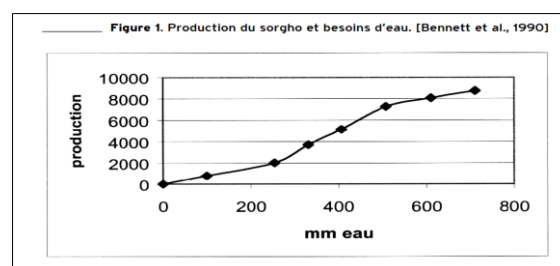


Figure 3: Production of the sorghum and requirements out of water

Source: Bennett and Al, 1990[8].

For this reason, the stable production of sorghum in a hostile environmental context (austere climate, poverty of the grounds) and demographic (growth and its corollaries) for a country like Chad is a colossal challenge which challenges everyone

VARIETAL SPECIES OF BÉRE IN CHAD: AGRONOMIC APTITUDES

The three varieties of béré-béré produced are consumed in Chad are distinguished from each other by physical characteristics (height, color of grains, length of the panicle...) and agronomic and agronomic almost similar.

THE BÉRE WHITE ONE OR DJIRESSE BEIDA

The variety Djiresse Beida takes this name from the color of its grains. Its cycle is the longest of the three (cycle sowing-50% of flowering estimated at 75 days and cycle sowing-maturity at 130-145). On average high of 205 cm, it approximately produces some 20 cm length panicles known as sowing-compact. The average output with the hectare is 4 tons. Its agronomic characteristics are as follows.

Table 1 : Technical data sheet of white béré-béré

Name	-White Djiresse or Djiresse Beida
Agronomic characteristics	
Type of ground	Muddy, argillaceous and argilo-muddy
Tillage	cleaning and light ploughing
Seed bed	August 10 at September 15
Spacing	1,20 m x 1,20 m
Plant health treatment	Insecticide with broad
Collect	80 % reach physiological maturity
Characteristics organoleptic and techniques	
Content of nutritive elements	Proteins
Aptitude for the transformation	Advised for the ball and pulp
Culinary quality	Good gustatory qualities

Source : ITRAD, 2014.

THE BÉRÉ BÉRÉ YELLOW ONE OR DJIRESSE BEIDA

The variety of béré-béré yellow differs from the first by its short cycle, its size and its output. Its cycle of sowing to flowering is 60 days for 110 to 125 of sowing to maturity. With a size of 185 cm, it pushes a compact panicle of 17 cm. its output with the hectare is a ton less than the first variety.

THE BÉRÉ BÉRÉ RED ONE OR DJIRESSE HAMA

The béré-béré red one clearly which is used mainly for the preparation of the "ball" and one of local beers of millet called "Bilabial" results from a variety whose cycle varies between 110 to 125 days. Its panicle of 18 cm is supported by a stem of good strength of 195 cm. By its characteristics (content of nutritive elements and culinary quality), it is appreciated.

DIFFERENT ADAPTABLE VARIETIES

In the countries close and different of the continent varieties of sorghum of fall on grounds are produced to which the characteristics are close to those of Chad which can be adapted at the local level. In Cameroon, made studies, several decades ago, showed the existence of the culture of the sorghums of fall in the valley of Logone. They are divided into two groups according to the grounds of reception and the farming cycle [7].

The first group that of Muskwari, is mended at the end of the end of the rain season on vertisols, on the basis of form of the stalk, the shape of panicle and of the characteristics of the grains includes 7 traditional types according to Barrault and Al, [6] quoted by J Chantereau[7]

Table 2: Classification of the Muskwari sorghums in Cameroun

Traditionnal Type	Race	Stalk	Brown layer	Color grain	Vitreousness grain
Safrari	Durra	“Crossé ‘or with	Absence	Yellow	Enoughvitreous
Madjeri	Durra	“Crossé ‘or with	Absence	White	Enoughvitreous
Bourgouri	Durracaudatum	Right	Absence	Others	Farinaceousfood
Adjagamari	Durra	“Crossé”	Absence	Ivoiry	Enoughvitreous
Soukatari	Durra	“Crossé”	Absence	Red	Enoughvitreous
Mandouweiri	Durra	Right	Absence	Clearmaron	Enoughvitreous
Soulkeiri	Durra	Right	Absence	White ou red	Enoughvitreous

Source: J.Chantereau, 2001 [7]

The second group is that of Babouri which is more homogeneous, 2 great types [6].

Table 3: Classification of the Babouri sorghums in Cameroun

traditionnal Type	Race	Stalk	Brown layer	Color grain	Vitreousnes
Wale-Mansan	Durracaudatum	Right	Presence	White	Farinaceousfood
Madesse	Durracaudatum	Right	Presence	Red	Farinaceousfood

Source: J.Chantereau, 2001[7].

These varieties of the sorghums of fall produced in Cameroun in the basin of Logone can also be developed in Chad. At least on other side of the border even if they cannot be extended to other sites especially that this one is consisted of the same Logon River.

ZONES FAVOURABLE TO THE CULTURE OF BÉRE BÉRE IN CHAD

The step of the establishment of the culture of the sorghums of fall, for a better output, must take account of the availability of the hydrous reserves of the ground, temperature and nutritive elements.

THE AGROECOLOGIC CONDITIONS FOR A GOOD GROWTH OF THE SORGHUM

The establishment of a culture which starts with germination takes account not only of the capacity of the biological capacity of the cultures but also of the

conditions of temperature and the moisture of the grounds. For the case of the sorghums of fall, optimum conditions for germination located between 21 and 26°C. Below 12, 5 and beyond 45°C germination not possible. The optimal temperature of growth ranges between 24 and 27 °C. It can however tolerate temperatures higher than 40 °C [9]. Under the conditions of temperature above, a need between 380 and 630 mm for water gives a maximum output.

Camara Fodié Gagny [10] characterized and classified in two groups the grounds favorable to the culture of the sorghums of fall. The first group, adapted best, is consisted of the hydro orphic grounds with gley and vertisols of the temporarily flooded depressions composed by the clays deposited by sedimentation and decantation during the floods with the principal following characteristics:

Table 4: Characteristics of the grounds best adapted to the sorghums of fall

Nature	Level
Organic matter	Weak
Capacity of water retention	15 to 20%
PH	Neutral
Permeability	0.5 to 2 cm/h

Source: Camara Fodié Gagny, (2001)[10]

The second group, the adaptable ones, is consisted of the grounds with pseudogley of depth.

Grounds with spots and conceptions on river materials of decantation. Fundamental characteristics.

Table 5: Characteristics of the grounds the best adaptable ones to the sorghums of fall

Nature	Level
Clay	40 to 60%
Capacity of water retention	15 to 18%
PH	Neutral
Permeability	1 to 2 cm/h
Structure	Unstable

Source: Camara Fodié Gagny, (2001) [10]

THE FAVOURABLE ZONES TO THE CULTURE OF FALL IN CHAD

Many zones of Chad present characteristics of the grounds favorable to the culture of the sorghums defined in work of Camara Fodié Gagny, [10] and J Comas, H. *et al.* [9]. The first are those identified, arranged since decades. But some of them are

developed but others not. On the extent of the territory, on the whole 7 perimeters are officially arranged. They are perimeters arranged of Boumou, Béré and Déréssia in Tandjilé, the perimeters of Kim and the racks (A and B) in Mayo Kebbi, the rack of Doba in Eastern Logone and the perimeter of bédaya in Eastern Mandoul.

Table 6: principal perimeters irrigated in Chad

N°	Nom	Surf. (ha)
1	Boumou	3000
2	Kim	1200
3	Casier (A et B Bongor)	500
4	Béré	400
5	Bédaya	100
6	Casier de Doba	1300
7	Déréssia	1200

Source: ONDR, 2014 [13]

Among the 7 irrigated perimeters, only 3 are currently functional and accommodate the culture of rice within the framework of the presidential project called National Project of Food Safety (NPF). They are the perimeters of Boumou, Kim and Béré which are exploited only to the 1/3, to the maximum, of their real surface. The others remained without development even in a traditional way.

Several possibilities of development of the perimeters are possible for in order to reinforce food safety. A consecutive culture of the rice and sorghum of fall on the perimeters of the zones high and early rainfall (Bédaya, Doba, Boumou, Béré and Déréssia) for the functional perimeters. Another possibility is to produce the sorghums on the perimeters not emphasized. A traditional practice of this culture is also possible around these two types of arranged surfaces.

Beyond the arranged perimeters, Chad has many natural zones suitable for the culture of the sorghums of fall except the basin of the lake famous Chad indicated. They can be divided into two groups. First is consisted of the basins of the small internal lakes and the perennial rivers. They are the basins of the lake Fitri in Batha and Iro in the Chari Means. The lake Léré and the Ounianga lakes are indicated little because of the stranding of their basins. Basins of Logone and Chari, two principal rivers, which irrigate the site mainly

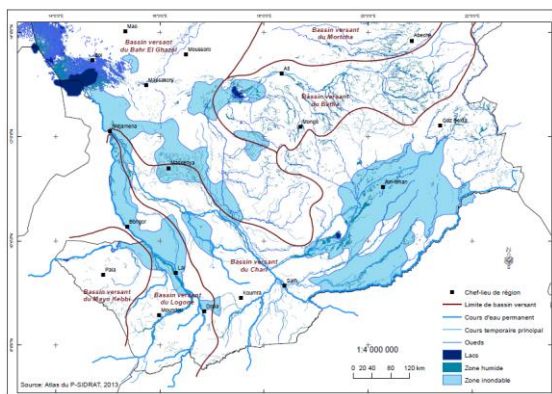


Fig-4: Zones favorable to the culture of béré-béré

The second group is composed by the natural easily flooded zones being able to allow the growth of the sorghums of fall without irrigation. It acts, inter alia, of the easily flooded plains which cover all the area of Mayo Kebbi and the major part of East Tandjilé, two Logones and the Moyen Chari.

CONCLUSION

During decades, before the advent of oil, agriculture played a significant role in the economy of Chad. With the report of the impacts of the oil incomes, no one can doubt the importance of this sector. Then, in the current context of the austerity of the climatic conditions and the keen demand due to the increase in

population, a particular interest is to be granted to the culture of counter-season to mitigate the deficit of the productions of the rain season. Thus, the authorities, the agents and partners in the development, the researchers and the farmers, all, are called out to this cause. The first actions to be undertaken by the authorities, with the support of the partners, are to make operational all the existing arranged perimeters, to implement others and to finance research for experimentation of the possible varieties to the local context and to develop country know-how. The country contribution to food safety must start with the appropriation of the cause. The improvement of the living conditions country starts with the increase in incomes which depends on annual harvest. Also a value added to any rural economy induced the macroeconomics.

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