# THE ISSUE OF CROPS ESTABLISHMENT IN BURKINA FASO WESTERN AREA

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*ABSTRACT*

This article deals with Burkina Faso crops establishment constraints, on the basis of its geographical position, its climate and farming systems. Data recorded from previous studies show rainfall decline since the sixties. The impact of this phenomenon varies from one micro-area to another and has an influence on farming activities. Most of the farms use animal traction equipment. At the beginning of farming season, soils are dry and compact, animals are in a bad shape and the farming techniques are inappropriate. Rainfall scenarios should be taken into account in crops establishment and its improvement. Constraints such as rainfall variation and unsuitable tools and techniques, give an opportunity to explore new paths and ways of handling agricultural problems and conducting research activities in south Sahelian Africa. A soil preparation system in accordance with the recommended dates must take into account the timing of the first rainfalls. Many solutions can be evaluated so such new equipment development and appropriate techniques for saving water of the first rainfalls and determination of suitable climatic areas for specific crops.

*Keywords: rainfall variations, crops establishment constraints, animal traction, farming systems.*

## INTRODUCTION

Burkina Faso is a landlocked country located at the heart of West-Africa between latitudes 9°20 and 15°05 north with Mali, Niger, Benin, Togo, Ivory Coast and Ghana as neighbors. This geographical location results in a dry tropical climate to the country. According to Sivakumar and Gnoumou (1987), there are three main climatic zones, and the South Soudanian zone constitutes the western part of Burkina Faso (located between $10^{th}$ and $14^{th}$ parallel north). It represents 20% of the national territory, that is, 57000 km$^2$.
The country's economy is based on agriculture, which represents 85% of the working population and counts at a rate of more than one third towards the gross domestic product (GDP). Cotton and corn are the main cash crops of the country. In reference to several studies, (Tersiguel, 1995 and IN.E.R.A[3], 1996), the fact of growing alternatively cotton and corn as cash crops justify the level of mechanization and the high level of technical competence of the producers. The western area essentially provides those crops. In fact, SO.FI.TEX[4] indicates that, the west zone provides 90 % of national cotton production. In the above-mentioned area, 75 to 80% of the surfaces of cereals are devoted to corn.

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Unfortunately, these last decades, this type of agriculture depending on rainfall is more and more compromised because of the delay in establishing the cultures, namely in the animal traction farming systems. This type of mechanization is used on more than 75% of the farms of the western area (FAO-AGSE, 1998) in comparison to the motorized system that is taking less than 1%.

The delay as regards seedlings has a negative impact on the following elements:

- The application of soil preparation techniques and weeding (Son, 1994): we can witness a spontaneous development of ridging, not only because of the early development of weeds but also due to the risks of reduction of farming areas (Ouédraogo, 2000);
- The use of fertilizers: the delay brings about the use of amounts, smaller than the required amount in view of lowering the risks in case the plants cannot go their vegetative cycle round;
- Manure: the efficiency of manure also decreases when there are late seedlings (Berger and al., 1987);
- The crop protection: the seedlings are exposed to devastators like the white fly (*Bemisa tabaci*) on the cotton plants;
- Productivity: the lack of water at the end of the cycle of late cotton seedlings reduces the number and size of the capsules. Dakouo and al. (1993) and, Couilloud and Daeschner (1971) think that late seedling produce about 45 to 70% of the volume of useful flowers of early seedlings. The early seedling lowers considerably the rate of rot of the capsules (Cauquil, 1963). The production of nitrogen decreases progressively starting from the beginning of the rainy season; as a result, there is a strong sterility of the plants with also a decrease in size of seeds. From mid-June, any delay brings about a decrease in productivity of about 250 kg/ha every decade (Dakouo and al, 1993). Kambiré and al. (1999) obtained similar results on corn.

This paper is concerned with exploring and pointing out the main constraints linked to the crops establishment, especially cotton and corn in the western area of Burkina Faso. It is also concerned with examining the best approach to solve the problem in the future.

## MATERIALS AND METHODS

The rainfall at the beginning of rainy season and the dates of the first rains useful of seedlings are very unpredictable. Rainfall establishment is random (Somé and Sivakumar, 1994). The following steps have been use for the analysis of rainfall influence on crops establishment:

1) Collection daily rain data over thirty years of the western area, on thirty-five stations of the Meteorology National Office;

2) Data processing with suitable statistical software packages. They are:

- INSTAT: This software is specialized for the statistical treatments in agronomy and in agro-climatic. The basic version is a statistical package for the treatment and the analysis of data (Sern, Knock and Hack, 1989). INSTAT allows summarizing data of daily rains in average rains of period of ten days, monthly and annual, as well as the rainfall frequency treatment (A year out of 2, 2 years out of 10, 8 years out of 10) and the dry periods duration. A day is considered as dry when daily quantity rain is lower than the threshold 1.8 mm, which is used for the sahelian countries. It corresponds of daily water satisfaction of cotton plant, during seedling periods.
- SURFER: This software allows spatial summaries of rainfall data obtained by INSTAT (isohyets drawing).

The identification of technical aspects on crops establishment were based on qualitative sample survey of 79 producers of four villages, which are sharing out, in the western area

(Balla, Bagassi, Boni and Sidéradougou). The levels of mechanization (manual work, animal traction, motorization) were considered in the sounding. Objective is to encircle the perception of crops establishment delay.
Soil quality is handled, especially basis on literature, with an enrichment of data collected with the sounded producers.

**RESULTS AND DISCUSSION**
Control dates of rainfall are from the first May for the beginning and its end from the first September. The period of seedling is based on four phases:

- Early seedlings: from the first May to May 30;
- Optimal seedlings: from the first June to June 15;
- Late seedlings: from June 16 to July 15.

These periods are relative to cotton and corn establishment (Dakouo and Berger, on 1987).
The crops establishment delay is more difficult for animal traction farming systems than the two other systems. Small farmers strategies developed embody the difficulties faced in the establishment of animal traction farming systems. These farms develop strategies like dry direct seedling with two or three repetitions, ridging, plowing in dry period and the renting of motorized disc harrows at light soil damping period, increase soil erosion.
As far as a mechanized animal traction system is concerned, two essential factors can be at the origin of the delay in establishing crops: natural factors and technical factors.

**NATURAL FACTORS**
**- Constraints linked to rainfalls**
Since the end of the decade 1960-1969, Burkina Faso entered a cycle of changes as regards precipitation regimes. Since the last decades, rainfall average amount has been varying between 800 and 1100 mm per year. In fact, on a yearly basis we can notice an important decrease of rainfalls (Somé, 1989). That climatic crisis caused the disappearance of isohyets 1200 mm in the western area of the country (Somé and Dembélé, 1996), at a rate of two degrees every decade. According to them, an important rain might endow a year with surplus. Eldin (1984) advises that rainfall must be measured in terms of frequencies or occurrence probability instead of average. That approach shows up (Fig 1 and 2) a strong spatial and temporal variability of the rainfalls in the area, as well as in the rest of the country.

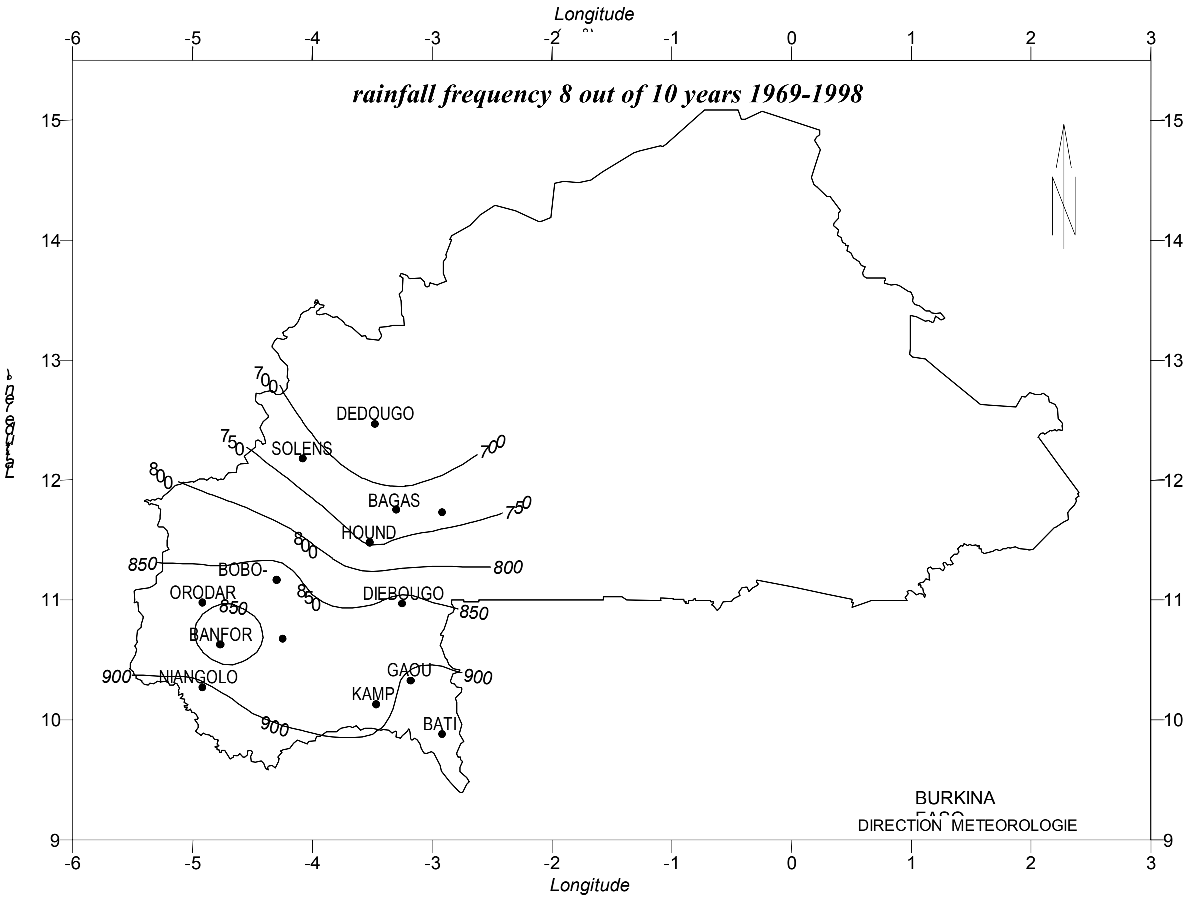


Fig 1. Rainfall frequency 8 out 10 years 1969-1998 in the western area

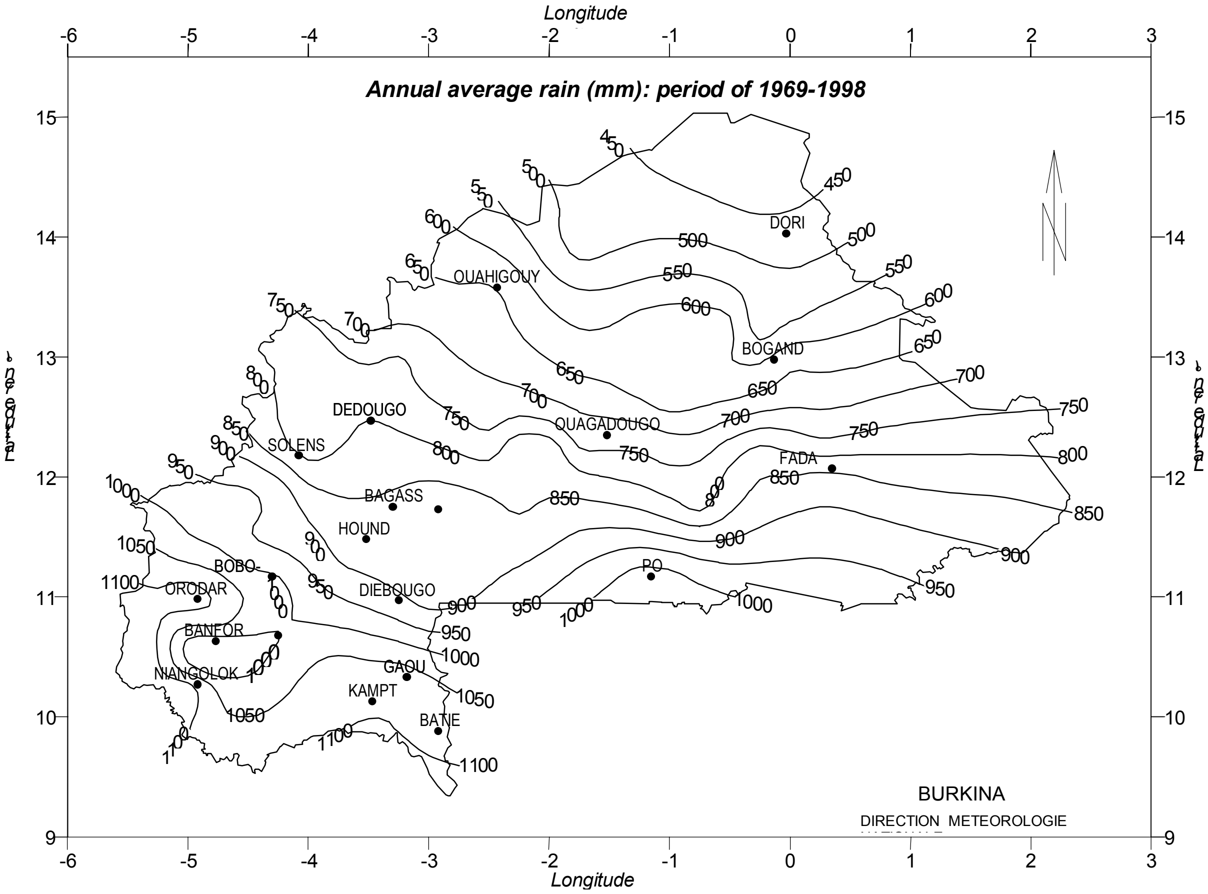


Fig 2**.** Annual average rain (mm): period of 1969-1998

In fact the records of rainfall from different frequencies of a given station (period of 1969-1998), table 1 shows, gaps that may vary from 100 to 200 mm in comparison to the average. That shows a temporal variation of rainfall.

Table 1. Rainfall frequencies and annual average of five stations

| Stations | 8 years out of 10 | A year out of 2 | 2 years out of 10 | Annual average |
|---|---|---|---|---|
| | Average (mm) | Average (mm). | Average (mm) | Average (mm) |
| Bomborokuy | 548.04 | 732.00 | 770.52 | 708.63 |
| Solenzo | 732 | 881.20 | 950.2 | 831.31 |
| Houndé | 749.24 | 905.81 | 1044.90 | 905.01 |
| Bobo-Dioulasso | 881.46 | 973.20 | 1115.10 | 1008.8 |
| Niangologo | 945.36 | 1059.10 | 1301.50 | 1105.50 |

For a given frequency, rainfall may vary from a station next to one another (table 1): It is the spatial variation of rainfalls. It appears that in a same area seen as "homogenous" there are spatial and temporal variations of rainfall. That spatial and temporal variation is stressed by the development of local rainfalls (Somé and Dembélé, 1996). It is then important to know whether those spatial and temporal variations are significant or not.

Besides, for an area where rainfalls are homogenous, the success of an agricultural operation will depend on the chosen frequency. For example, (Somé, 1989) indicates that the 8 out of 10 years rainfall frequency is more favorable to the establishment of seedlings not only to obtain a good growth but it mainly allows the plant to perform a convenient vegetative cycle.

That is why one must take into consideration the scenarios of rainfall occurrence that show the period of crops establishment operations. In the case of the western area, Berger and al. (1987) think that the seedlings must be established in the last decade of May while it starts raining around March and April. The analysis of the these early rainfalls (table 2) of a same area, seen as “homogenous” and at the same frequency, reveals volumes and differences in rainfalls for stations that are next to one another.

Table 2. Records of rainfalls from March to April from north to south

| station | 8 years out of 10 | A year out of 2 | 2 years out of 10 |
|---|---|---|---|
| Bomborokuy | 2.20 | 9.95 | 27.48 |
| Solenzo | 8.46 | 23.25 | 44.70 |
| Houndé | 16.94 | 41.55 | 66.96 |
| Bobo-Dioulasso | 25.54 | 54.05 | 110.44 |
| Niangologo | 72.96 | 110.40 | 135.44 |

At the frequency of 8 years out of 10, that is favorable to the seedling, there is an early development of weeds that render inefficient the use of plowshare. Thus, the majority of producers having an animal traction are obliged to use herbicide treatments before using the farming tools.

Therefore, in order to limit the decrease of farming area they use ridging that goes faster than flat plowing and avoids marking out lines for the seedlings. It is worth noticing in manual seedling. It is necessary to think over the choice of technique sequences in accordance with the agricultural operations, from the first soil preparation to the last one before seedling.

It stands out that the spatial and temporal variation of rainfall makes it necessary to set up a micro-zones approach in order to come closer to the preoccupations of the producers. The ability of the producer to prepare the soil early is also a preoccupation. So it is necessary to determine climatic zones that are close to the working conditions of producers before elaborating research or development programs.

**The Soils**

The soils of the cotton zone in the west mainly consist of tropical ferruginous types washed on diverse materials (sandy, sandy-clayey). We, also, can find ferralitic, hydromorphic soil. The organic elements rate goes decreasing from south to north, with the rainfalls (Boulet, 1976). This rate is from 1 to 1.5% on a great majority of soils (Berger and al., 1987). The annual mineral rate being 2 %, the actual medium organic elements rate would be at 0.85% in comparison to 1.15% in 1985, with the absence of organic restitution. The soils of the cotton zone in the west are characterized by a massive structure, not really coherent and a stability that goes from average to bad; hence a vulnerability to erosion and streaming. On the bared ferruginous (at Saria) soil, the infiltration varies from 10 to 20 mm per hour while the intensity of rainfall may reach 120 mm per hour.

According to Somé (1989), sporadic and intense rainfalls come across at the beginning of the rainy season with an intensity that varies from 60 to 120 mm per hour on a scale of a few minutes to an hour. They are very aggressive on bared soils, and particularly on tropical ferruginous soils that filter very slowly. In this case we can observe an important washing of nutriments that we hardly can balance with the use of fertilizers (Haïnzelin, 1998). As to the average of sunshine, it varies from 8 hours/day in the south-west (Somé, 1989). The global radiation on the soil is very important (15 to 22 Mega Joules/$m^2$ a day) and determines this way a hot climate (Siban, 1988). The periods of heat are around March to May (beginning of agricultural activities). Temperatures under shade are beyond 40° C, with evaporation varying from 10 to 12 mm a day in May. This characteristic is all the more important, since the remaining bare ridges give way to the evaporation of first rains and erosion. It is then important to improve the vegetal coverage of the soil as well as its filtering capacity by bringing organic materials, before the first rains.

**TECHNICAL FACTORS**

The light infiltration of the first rains limits the realization of early plowings. Many authors (Mourifié, 1993, Tersiguel, 1995) have pointed out that crops establishment varies in accordance with the type of energy used in soil preparation. In addition, because of the variations in rainfall and rapid evaporation (12 mm a day at the period), the available scope of time after each rain for plowing in good conditions is reduced. Thus, when rains start lately, the dates of soil preparation in manual farms are set earlier than in conventional motorized soil preparation, despite the heavy nature of the job (Ouédraogo, 2000). Meanwhile, the beds prepared by those machines consist of fine aggregates that are vulnerable to erosion. The latest dates are observed with animal traction equipment (Lendres, 1992).

Ki-Zerbo (1999) explains this delay by the fact that animals are not in good shape at the beginning of the rainy season and also by the fact that the plowing tools are inappropriate with regard to the low moisture of soils. In fact, the optimum level of moisture to allow flat plowing on a small scale is a little above the capacity of retention (I.R.A.T[5], 1970). Son (1984) estimates the specific resistance of the soil at 600 and 800 N/dm$^2$ when starting soil preparation. This confirms Lendres (1992) argument that late seedlings are attributable to extension in time of soil preparation because of the unavailability of appropriate tools and of local conditions. In fact the tools used are ploughshares, "manga" hoes, "triangle" hoes with engaging components like dug foot ploughshare, the reversible chisel share, the ridged machine. Those conventional tools of animal traction are efficient when the soil is wet enough. The commonly used soil preparation techniques are: the flat plowing and ridging (Son, 1994). The chisel share is not often used, because inefficient when the soil is dry. Yet, as noticeable by Ouédraogo (2000), mechanized farms are much more productive in that the level of mechanization is set high. It appears that animal traction contributes to the intensification and increase of the cultivated area, despite the limits caused by the availability of energy at the beginning of activities and inappropriate cultivating tools.

The improvement of the nutritional quality of the animals in dry season and development of cultivating tools that can work on dry soils can be solutions to the technical factors.

The analysis of the issue of crops establishment reveals the following limits:

- The spatial temporal variations of rainfall make the technological packages designed for large agricultural zones inefficient;
- The initial state of bared compact soils, in association with the preceding plowings make the intervention of conventional tools difficult;
- The continuing degradation of soils that are already poor in organic elements under the action of men and climate;
- The conventional tools and the animal work force necessary for launching the agricultural activities are inappropriate to work on the dry soils conditions.

Despite those constraints, animal traction is seen as a means of intensification and extension of farming areas. In order to survive, producers are developing among other strategies, the re-use parcels by direct seeding, repeated two or three times, the renting of motorized equipment

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and by dry farming despite its inefficiency (Mugishawimana, 2000). Yet those techniques, like anti-erosive sites, crop rotation, short term fallow, even though necessary are not sufficient. The necessity of early soil preparation in view of avoiding weeds and the decrease of cultivated area remains a major preoccupation of producers. Soil preparation system definition in accordance with the advised dates must take into account the scenarios of the first rainfalls.

**CONCLUSION**

In order to effectively utilize animal traction systems, it might be worth considering:

- The definition of the homogenous micro-climatic area in order to select the optimum cropping systems;
- Taking into account the rainfall occurrence patterns in the selection of soil preparation techniques;
- The development of tools and appropriate techniques for collecting water from the first rainfalls;
- Involving producers in the development of the innovations.

The success of the innovations to be developed will be based on the ability of researchers and stakeholders of development to organize in the same time multi-disciplinary teams and totally involving the producers as stakeholders.

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