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RESEARCH ARTICLE

DETERMINING THE BEST SEEDING AND DURATION OF THE CULTIVATION PERIOD IN N'DJAMÉNA AND SURROUNDINGS-CHAD

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ABSTRACT

Curves of time variations of evapotranspiration and precipitations have been plotted, their points intercept determined. This enable us to find out the seeding period and the duration of the useful rainy season which corresponds to the cultivation period in N'djaména and surroundings for the years from 1980 to 2007. This study has shown that the confortable time to begin planting is mid-July, the average duration cultivation period, from the moment of planting to the harvest, is fifty days. Outside this laps of time irrigation should be unavoidable.

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INTRODUCTION

In order to obtain better harvests and also to avoid extra expenditures generated by the irrigation, some agricultural activities should be held during the rainy season. Usually with the approach of the first rainfalls many farmers have already cultivated their fields and are just waiting for them to start planting. Nowadays, because of the climate change, farmers are facing many problems caused by the mismanagement of the rainy season in general, and its beginning and end in particular. Many of them ignore when to start planting after the first rainfalls. When the first rainfalls are registered, they run to their fields for planting activities. Very often, when young plants start growing, a sudden dry period occurs for even more than a month. Recall that at this stage of development plants need a lot of water. Because of dryness, most of them die. When the precipitations are back, the only remedy is to plant again, what many farmers cannot do because they do not have enough seeds. Thus, the populations are exposed to hunger because they do not know how to manage the beginning of the rainy season. The situation becomes worst when they ignore the duration of the useful rainy season and the corresponding agricultural species to be planted. It is understandable why thousands of persons in such areas are under constant international community food supplies despite the fact that their soil is rich and abundant for agriculture. Sometimes, up to 70% of inhabitants are farmers, but hunger always persists. In order to reduce this constant food dependence from the international community, some researchers have investigated ways and means to get out from this situation. Some paid attention to rainfall regime, (Gautier *et al.,* 1998; Kiote *et al.,* 2009; Label *et al.,* 2009; L'Hote *et al.,* 2002), and the quality of the rainy season, (Sane *et al.,* 2008). Others studied the rainy season potential (Swakumar, 1987) and the farmers' perceptions of the climate change and the ways to adopt their agricultural strategies to that situation, (Mertz *et al.,* 2009).

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Also trends of the rainy season and their impacts to the beginning of agricultural activities were briefly analyzed, (Ozer *et al.,* 2009), the extreme values of pluviometry studied, (Ozer *et al.,* 2015). It is has shown that the soil water reserve in N'djaména and surroundings are permanently negative except the months from July to September for some years; (Njipouakouyou *et al.,* 2017).This paper is our contribution to the problem of hunger in N'djaména and around. For the authors, the determination of the best seeding and cultivation periods is one of the prior solutions. Their main idea is as follows.The highest values of evapotranspiration (ET) are registered during the dry season and the lowest – during the rainy season. Inversely vary the precipitations (RR). Thus, when the rainy season approaches the ET decreases from its maximal to its minimal value which occurs around the middle of the season. Then it starts increasing to its maximal value around the middle of the dry season. At the same time, the precipitations increase at the end of the dry season from zero to its maximal value around the middle of the rainy season. Then they decrease to zero at the beginning of the dry season. It is clear that when plotting the curves of time variation of ET and RR they should have two points intercept in normal conditions, one at the beginning and another at the end of the rainy season. The further from one another are these points, the best are the conditions for agriculture. Also the further is the maximal value of RR from the minimal value of ET, these best conditions are reinforced. Our goal is to determine these points intercept (if any) using the data registered in N'djaména and surroundings, to study their position relatively to one another, to analyze their extreme values and at last to conclude. This work is divided into four paragraphs and the references at the end presented in alphabetic order. The first paragraph introduces the subject and exposes its problematic. The second one presents the climate of the locality, the data and the methodology. The results and analysis are in the third paragraph. The fourth one is reserved to the conclusion and recommendations.

DATA AND METHODOLOGY

Data

Data is from N'djaména and surroundings. This area has two seasons, the rainy one from April – May to October. The dry season occupies the remaining time. The data covers a period of 27 years, from 1980 to 2007, and concerns the evapotranspiration of reference (ETP) and the pluviometry (RR). Both are measured in mm/month. It is not primary data as it has already been treated and presented in tabular forms of monthly mean values. This treatment has been carried out in the National Services of Hydrology where the ETP was calculated using the Penman – Monteith formula, (Njipouakouyou *et al.,* 2017).

Methodology

We have adopted the graphical method. Hence, the curves of ETP and RR were plotted in the same coordinate axes with the time (months) on the x axis and ETP and RR – on the y axis. Their points intercept were determined (when possible) and analyzed to find out the best seeding and cultivation periods in the concerned localities.

RESULTS AND ANALYSIS

For a best management of the graphs, only the ones for some representative cases will be included in the text. In general, the ETP increases from January to its maximal value around March – April, then decreases to its minimal value around August – September from where it starts increasing again. At the same time the first rainfalls are observed around March – April. From this period the precipitations rapidly increase to their maximal value around July – August from where they start decreasing to zero around October – November. The whole period of study can be divided into three sub periods. The first one concerns the years when there were no points intercept between the two curves, meaning that the required conditions were not favorable at all. These years were 1984, 1987, 1990, 1995 and 1997. For this case, some representative curves are presented in Figure 1. It is obvious that during that time, the populations had suffered a lot from hunger. Unpublished documents from national agricultural services indicate that they had received intensive food supplies from international community to avoid human tragedy. The second sub period concerns the years when some conditions were observed, but not enough sufficient for agricultural activities. These years were 1980, 1983, 1985, 1986, and 1989. The duration of their useful rainy period was at most 36 days. Also, the maximal values of the RR were closer to the minimal values of the ET. For this case, some representative curves are presented in Figure 2. The last sub period covered the remaining years. During this time the required conditions were more favorable. For some years the closeness of the points intercept and the smallness of the domain of interception of the two curves indicate that only few conditions were fulfilled for agricultural activities. In general, species with about 50 days vegetative cycle were preferable; otherwise, farmers should run to irrigation. Some representative curves for this case are presented in Figure3. All the graphs for the years from 1980 to 2007 enabled us to estimate the seeding and cultivation periods in the localities. The results are presented in Table 1. Here the periods are indicated in days and months. For example 10.07 means the 10^{th} of the seventh month. The durations are in days.

Table 1. Periods for agricultural activities in N'djaména and surroundings: their times of beginning and end (in day and month), their durations (in days)

Years	Periods Beginnings and ends	Durations
1980	10.07 -30.08	51
1982	20.07 - 10.09	51
1983	01.08 - 20.08	20
1984	0	0
1985	05.08 - 25.08	20
1986	10.07 - 10.08	31
1987	0	0
1988	20.07 - 20.09	61
1989	20.07 - 25.08	36
1990	0	0
1991	15.07 - 30.08	46
1992	10.08 - 30.09	51
1993	20.07 - 30.08	41
1994	10.07 - 15.09	67
1995	0	0
1996	20.07 - 10.09	52
1997	0	0
1998	20.07 - 10.09	52
1999	20.06 - 20.08	61
2000	20.06 - 30.08	71
2001	20.07 - 30.09	72
2002	01.08 - 20.09	50
2003	15.07 - 10.09	56
2004	01.07 - 15.08	45
2005	10.07 - 10.09	62
2006	15.07 - 10.09	56
2007	20.06 - 30.08	71

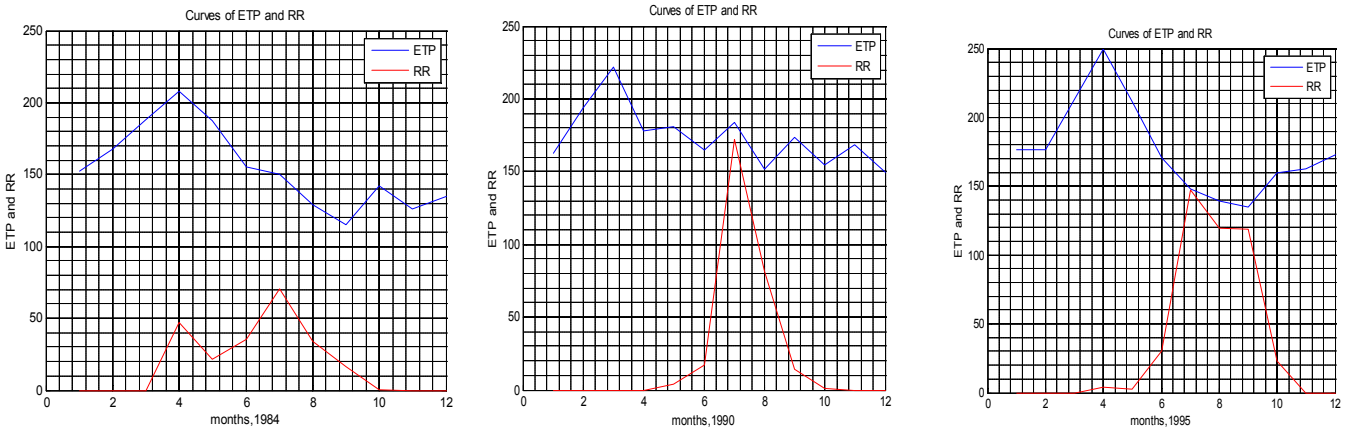

Figure 1. Graphs of ETP(t) and RR(t) for unfavorable years, t-time in months

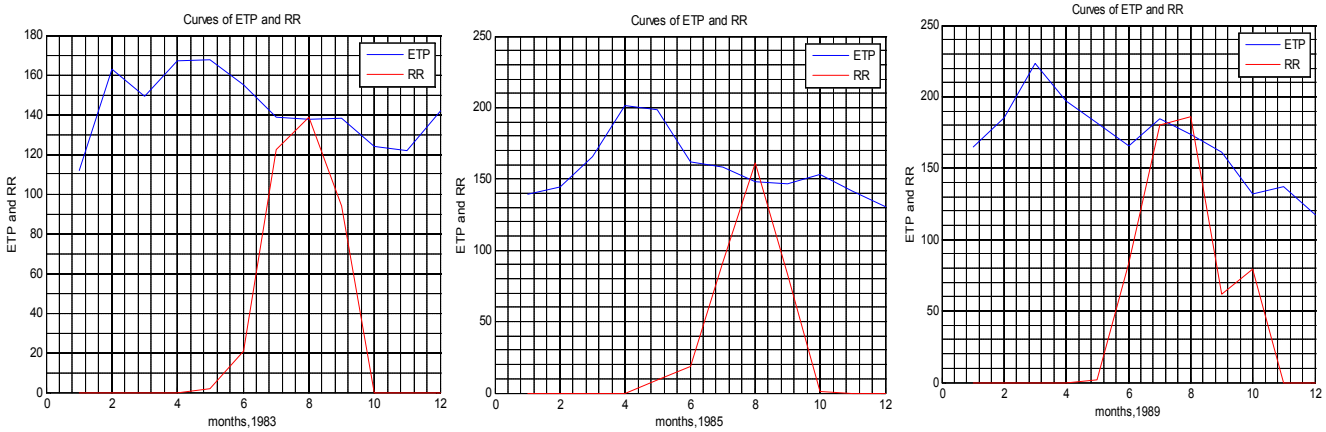

Figure 2. Graphs of ETP(t) and RR(t) for not enough favorable years, t-time in months

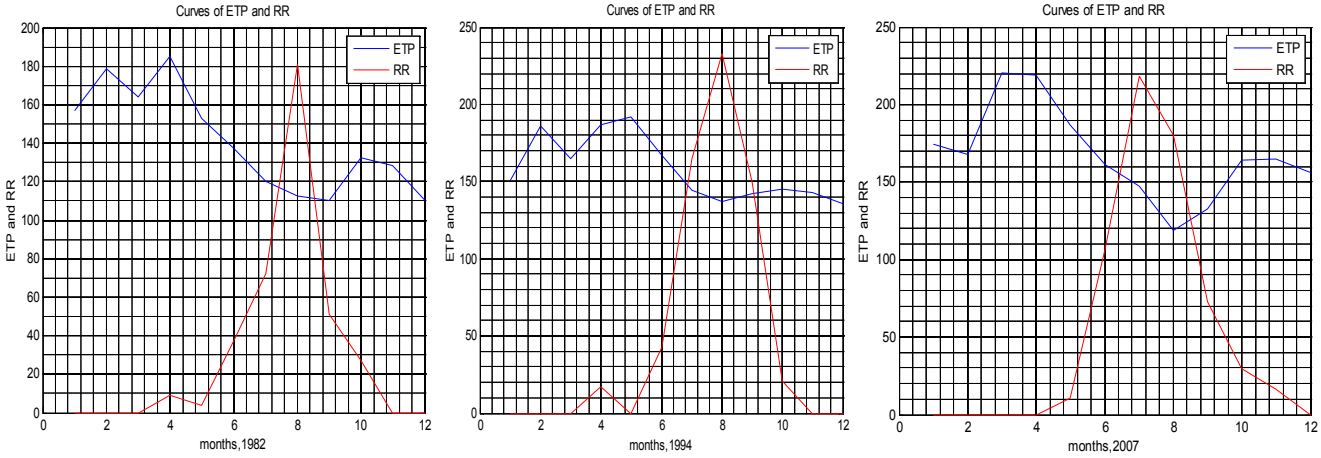

Figure 3. Graphs of ETP(t) and RR(t) for favorable years, t-time in months

Table 1 tells that the best seeding period in N'djaména and surroundings is mid-July and the harvest should be programmed around 50 days after. Consequently, cultural species should have such a vegetative cycle. Surely that if farmers respect this calendar, there will be enough food for the populations and the permanent dependence on the food supplies from international community will be reduced. These results should also be implemented and extended to other localities to reduce seeds lost caused by planting at inappropriate time.According to other sources, (for example Memento de l'agronome, 1993), the average pluviometry in N'djaména was 646 mm/year for an average yearly total rainy days of 71 days. It is then clear that the climate is getting worse in the considered localities.

Conclusion and recommendations

This study clearly shows that the best time to start planting in N'djaména and surroundings is mid-July. The species to be priory selected should have around 50 days vegetative cycle. Except the calculation of the ETP which needs special data and sufficient knowledge and appropriate tools, the feasibility of such a study is not difficult. Thus, this approach is recommended to be implemented and extended in other areas.

Recall that a climatic cycle corresponds to a period of 30 years according to the World Meteorological Organization, WMO, and that our investigation period almost corresponds to that laps of time. Thus, we can conclude that at the climatic point of view, 18.52% of time have the conditions not favorable for agricultural activities, 18.52% - the conditions more or less favorable and 62.06% – better conditions for agricultural activities.

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