Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 10, Issue, 04, pp. 35342-35345, April, 2020
https://doi.org/10.37118/ijdr.18673.04.2020

ISSN: 2230-9926

RESEARCH ARTICLE **OPEN ACCESS**

DIAGNOSTIC INVESTIGATION OF THE SEEDING PERIOD IN FOUMBOT AND SURROUNDINGS, WEST REGION OF CAMEROON. PERIOD: 2010-2018

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ARTICLE INFO

Article History:
Received 18th January, 2020
Received in revised form
11th February, 2020
Accepted 17th March, 2020
Published online 30th April, 2020

Key Words:
Daily rainfalls, Monthly and Yearly Numbers of Rainy Days, Means Values, Small Dry Season, Rainy Season.

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ABSTRACT

It is clear that at the beginning of the rainy season, the time distribution of the rainfall is very irregular. Enough long dry periods are regularly observed and when rainfalls are registered, their pluviometry is usually very low. If we accept that the wet period starts when at least two rainfalls with a minimum of 5 mm of pluviometry each are registered every week, then we conclude that the rainy season in Foumbot and surroundings begins at May. Thus, by this period, farmers should start their agricultural activities.

Citation: ***Njipouakouyou Samuel, Galmai Orozi, Chef Laboratoire LAPACE, Nchoutnji Ibrahim and Thierry Gaitan Tchuenga Seutchueng.* 2020.** "Diagnostic investigation of the seeding period in foumbot and surroundings, west region of cameroon. period: 2010-2018*", International Journal of Development Research*, 10, (04), 35342-35345.

INTRODUCTION

For already more than tenths of years, the management of the rainy season in the locality of Foumbot and surroundings, West Region of Cameroon, gives serious headaches to farmers and agricultural administrative. Determining when to begin the seeding process in the fields is not an easy job. It usually happens that after about two weeks of regular and abandon first rainfalls, almost all the farmers are already achieving their agricultural activities including seeding plants in the fields. These first rainfalls stimulate new plants to grow. Then suddenly it stops raining. Thus, young plants whose water needs are very high at this stage of development are exposed to a deep stress which should compromise their development and consequently their yields. If this situation stays long, the populations should be exposed to hunger and mendacity, between others. The solution to this problem is to reseed the fields, what is not easy as they usually do not have enough seeds. Very often, abundant and regular rains are back again when these damages are already effective.

This period of disturbances is called a small dry season. To solve similar problems, different investigations have been carried out for other zones. Attention should be paid to the next recent ones: the determination of the soil water reserve for better use in agriculture (Njipouakouyou i. al. 2017), the investigation of the seeding and cultivation periods in N'djaména and surroundings (Njipouakouyou i. al. 2017), the time distribution of the rainfall in order to diagnose the small dry season usually observed at the beginning of the rainy season (Njipouakouyou i. al., 2019, Njipouakouyou i. al., 2019). The objective of this study is to forecast this small dry season whose consequences could socially, economically and ecologically be catastrophic for the concerned populations. Whence the importance of this investigation. For this study, daily data on rainfall is needed. Then, time distributions of the monthly and yearly numbers of rainy days are determined and analyzed. The beginning of agricultural activities is determined based on the hypothesis that there should be at least two weekly rainfalls with a minimum of 5 mm of pluviometry each. This article has five sections. The first and present one exposes the problematic. The second one presents the data and methodology. The third is reserved to the results of computations and their analysis. The conclusion and recommendations are in the fourth section. At last, the bibliography in alphabetic order ends the work.

Data and methodology

Data: The data is the daily rainfall at the meteorological station of the branch of the Institute of Agricultural Researches for Development (IRAD), situated in Foumbot in the West Region of Cameroon. As these observations were carried by researchers themselves, it is very probable that this data is accurate and representative. With its volcanic soil, the agricultural activities are very developed in this area from where big quantities of various foods are regularly transported to many cities, including neighboring countries. The quantities of rainfall measured with standard station pluviometer placed at a level of 1.50 meter above the earth surface for the period from 2010 to 2018 were presented in tabular forms. Moreover, this station respects almost all the required recommendations of the World Meteorological Organization. Thus, the obtained results should be representative.

METHODOLOGY

From the daily pluviometries, monthly and yearly numbers of rainy days were determined and their daily means calculated. The daily means represent the daily quantity of rain considering that rainfall was equally distributed in the rainy days of the considered period. Standard deviations on the yearly numbers of rainy days were calculated and analyzed. All the results of computations are presented in tabular forms in the text of the next section.

RESULTS AND ANALYSIS

Some parameters of investigation are in Table 3.1 where n and RR are respectively the monthly numbers of rainy days and pluviometry, rr is the daily means of pluviometry; ∑n is the annual numbers of rainy days, ∑RR – the annual pluviometry, and rr_{an} – the daily means of pluviometry assuming that the annual amount of rainfall was equitably distributed among the annual numbers of rainy days. ∑ are the monthly sums of the corresponding parameters over the whole period of investigation, - their corresponding standard deviations, $\sum_{av}$ – their monthly means calculated over the period of investigation. In Table 3.1 January and December have no rainfall. For the 9 years period of investigation, the number of rainy days was minimum in 2011 with only 94 days and maximum in 2018 with 117 days. As both January and December have 62 days, it comes that either in 2011 or 2018, rainfall occurred almost every 3 days in the case of equally distribution in the remaining months. This also concerns the whole period as other numbers of rainy days are between the above ones. The pluviometry was minimum in 2012 with 1309.0 mm and the maximum in 2014 with 2122.9 mm. Based again on the hypothesis of equitable distribution of rainfall, it comes that at least 4.3 mm/day and at most 7.0 mm/day of rainfall were registered during the whole period. If we consider the real numbers of rainy days and correspondent pluviometries, it comes that the minimal value of the daily pluviometry, 12.6 mm, and the maximal value, 18.9 mm, were registered respectively in 2012 and 2018. For the whole period, the mean values of rainy days, pluviometry and daily pluviometry were 108, 1736.3 mm and 16.1 mm. The standard deviations calculated for the daily pluviometry and this last parameter used to be of the same order. In some cases the daily pluviometry was one order higher. The time tendency of the monthly numbers of rainy days, n, varied very roughly. An attempt of its modeling was carried out. Its clouds of points indicated a slitely quadratic relationship between the time t and the function n(t). Thus, it can be represented by the expression:

$$n(t) = at^2 + bt + c, \quad (3.1)$$

where a, b and c are coefficients to be determined using the least square method. To avoid complicated computations, let t = 0 corresponds to June. Thus, for January and December, t = -5 and t = 6, respectively. For illustration purpose, only three cases fitting with others are presented here. They concern 2010, 2013 and 2016 for which the regression equations are respectively:

$$n(t) = -0.4t^2 + 0.8t + 14; \quad (3.2)$$

$$n(t) = -0.4t^2 + 1.0t + 15; \quad (3.3)$$

$$n(t) = -0.3t^2 + 0.6t + 12. \quad (3.4)$$

Qualitatively, these equations fit with the reality as at the beginning of the rainy season the number of rainy days starts increasing, then reaches its maximum, and at last decreases. Also all their corresponding coefficients are closer to one another indicating that there is not significant differences between corresponding monthly numbers of rainy days when passing from a year to another. For the quantitative aspect, the results of simulation with these formulas are presented in Table 3.2 where n_{exp} represents the observed data, n_{th} – the theoretical one and II – the absolute value of the degree of fitness of the formulas. If we assume that for a model to be acceptable, the degree of fitness should not exceed 3 days, we conclude that all these models roughly describe the real situation as we sometimes have II ≥ 3. In particular and relatively to a year, this inequality occurred 4 times in 2010, 7 times in 2013 and 6 times in 2016 confirming the time variability of the rainfall in general. The time modeling of the variation of the annual numbers of rainy days was done by analogy. Here, t = 0 for year 2014. Therefore, for years 2010 and 2018, t = -4 and t = 4, respectively. A fictive variable, N, was introduced such that N = 0 for n = 100 days. Consequently for n = 113 and n = 117 we have respectively N = 13 and N = 17. Investigating the relationship N(t) and analyzing the plotting cloud of points permitted to conclude that it is of linear form, therefore we may write:

$$N(t) = at + b , \quad (3.5)$$

a and b are the coefficients to be determined using the least square method. This linear regression was:

$$N(t) = 0.9t + 8.1. \quad (3.6)$$

The results of simulation with (3.6) are presented in Table 3.3 where N_{exp} and N_{th} are respectively the reduced experimental and theoretical numbers of rainy days.

Modeling with linear regression seemed to give not good estimations. Consequently, an attempt with a quadratic function was done. The degree of fitness generated with this last one gave the values even more than four times greater corresponding ones obtained with the first model.

Table 3.1. Characteristics of the rainfall in Foumbot and surroundings Period: 2010 – 2018

		2010	2011	2012	2013	2014	2015	2016	2017	2018	∑		$\sum_{av}$
January	n								1				
	RR								2				
	rr								2				
February	n	7	2	5		1	2			5	22	2	4
	RR	95.2	45.7	83.3		30.2	6.5			122.9	383.8	43.8	64.0
	rr	13.6	22.9	16.7		15.1	3.3			24.6	96.2	7.6	16.0
March	n	5	6	1	9	9	8	10	4	11	63	3	7
	RR	68.7	74.3	3.5	66	198.2	90.3	106.5	50.4	193.3	851.2	64.0	94.6
	rr	13.7	12.4	3.5	7.3	22.0	11.3	10.7	12.6	17.6	111.1	5.4	12.3
April	n	11	7	10	9	15	9	9	11	5	86	3	10
	RR	114	65.8	141.7	131.1	204.8	141.1	74.8	187.5	123.0	1183.3	45.7	131.5
	rr	10.4	9.4	14.2	14.6	13.7	15.7	8.3	17.0	24.6	127.9	4.9	14.2
May	n	14	9	10	10	12	10	7	13	10	95	2	11
	RR	174.9	180.3	97.3	143.0	160.7	137.1	149.1	212.2	132.1	1386.7	33.0	154.1
	rr	12.5	20.0	9.7	14.3	13.4	12	21.3	16.3	13.2	134.4	3.7	14.9
June	n	11	8	11	11	9	144	15	14	14	105	2	12
	RR	169.8	98.9	152.0	135.9	123.9	12	322.3	192.3	266.4	1605.5	72.2	178.4
	rr	15.4	12.4	13.8	12.4	13.8	12	21.5	13.7	18.0	132.0	3.5	14.7
July	n	12	15	15	16	12	266.8	16	14	14	126	2	14
	RR	144.0	335.7	207.4	262.9	253.7	22.2	280.5	265.3	252.2	2268.5	52.4	252.1
	rr	12.0	22.4	13.8	16.4	21.1	16	17.5	19.0	18.0	162.4	3.6	18.2
August	n	8	12	14	9	15	216.1	17	15	18	124	4	14
	RR	124.2	243.0	164.3	154.8	392.1	13.5	265.6	344.4	368.5	2273.1	97.9	252.6
	rr	15.5	20.3	11.7	17.2	26.1	20	15.6	23.0	20.5	163.4	4.7	18.2
September	n	19	19	11	19	15	278.4	10	16	19	148	4	16
	RR	7	310.5	140.7	453.3	283.9	13.9	255.4	456.1	289.7	2724.7	98.7	302.7
	rr	13.5	16.3	12.8	23.9	18.9	21	25.5	28.5	15.2	168.5	5.8	18.7
October	n	20	14	17	15	19	277.5	13	12	14	145	3	16
	RR	386.6	248.6	270.0	178.5	312.6	13.2	199.0	227.0	190.7	2290.5	66.4	254.5
	rr	19.3	17.8	15.9	11.9	16.5	4	15.3	18.9	13.6	142.4	2.6	15.8
November	n	6	2	9	6	12	62.9	3	6	7	55	3	6
	RR	74.2	23.7	48.6	94.5	162.8	15.7	30.0	65.2	51.3	613.2	41.6	68.1
	rr	12.4	11.9	5.4	15.8	13.6		10	10.9	7.3	103.0	3.5	11.4
December	n			1	2								
	RR			0.2	43.5								
	rr			0.2	21.8								
∑n		113	94	104	106	119	114	100	106	117	973	8	108
∑RR		1608.3	1626.5	1309.0	1663.6	2122.9	1620.7	1683.2	2002.4	1990.1	15626.7	254.3	1736.3
rr_{an}		14.2	17.3	12.6	15.7	17.8	14.2	16.8	18.9	17.0	144.5	2.0	16.1

Table 3.2. Simulation of the monthly numbers of rainy days at Foumbot and surroundings for the years 2010, 2013, 2016

Months	2010			2013			2016		
	n_{exp}	n_{th}	II	n_{exp}	n_{th}	II	n_{exp}	n_{th}	II
1	0	0	0	0	0	0	0	2	2
2	7	4	3	0	5	5	0	5	5
3	5	8	3	9	8	1	10	9	1
4	11	11	0	9	11	2	9	10	1
5	14	13	1	10	14	4	7	11	4
6	11	14	3	11	15	4	15	12	3
7	12	14	2	16	16	0	16	12	4
8	8	14	6	9	15	6	17	12	5
9	19	13	6	19	14	5	10	11	1
10	20	11	9	15	13	2	13	10	3
11	6	8	2	6	10	4	3	8	5
12	0	4	4	2	7	5	0	5	5

Table 3.3. Simulation of the annual numbers of rainy days in Foumbot and surroundings for the period from 2010 to 2018

	-4	-3	-2	-1	0	1	2	3	4
n_{exp}	113	94	104	106	119	114	100	106	117
N_{exp}	13	-6	4	6	19	14	0	6	17
N_{th}	5	5	6	7	8	9	10	11	12
n_{th}	105	105	106	107	108	109	110	111	112
II	8	11	2	1	11	5	10	5	5

Table 3.4. Monthly numbers of rainy days with at least 5 mm of pluviometry each

	Jan.	Febr.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2010	0	5	5	9	13	9	9	7	14	17	4	0
2011	0	2	4	5	8	6	11	8	18	11	2	0
2012	0	4	0	7	9	8	11	11	9	13	4	0
2013	0	0	5	7	9	8	11	8	17	13	4	0
2014	0	2	9	12	9	8	11	14	14	16	9	0
2015	0	1	7	7	10	9	10	12	15	18	4	0
2016	0	0	6	5	5	11	14	13	11	12	1	0
2017	0	0	2	9	11	11	14	15	15	10	4	0
2018	0	5	9	6	9	11	14	18	19	11	6	0

Thus, the linear model is the one to be retained. So, the annual numbers of rainy days increase from year to year and this tendency was usually remarkable by the end of rainy season. The objective of our study is to determine the best seeding period avoiding the small dry season generally observed at the beginning of the rainy season. Our reasoning is based on the hypothesis that at least two rainfalls each of at least 5 mm pluviometry should occurred every week in the locality. Thus, at least 40 mm of pluviometry should be registered every month in the locality. The monthly numbers of rainy days with at least 5 mm of pluviometry are presented in Table 3.4. To have at least two weekly rainfalls of 5 mm of pluviometry each, the monthly number of rainy days should not be less than 8. Exceptionally, we can also include 7 monthly rainfalls. Analyzing Table 3.4, it comes that this condition starts to be filled in May. In April, it is filled only at 66.66%. Thus, with a high probability, farmers could start seeding with less risk by the last decade of April. For the whole period of study, 2016 was the year of big risks as this condition was filled only in June. The most comfortable year was 2014 where farmers could start seeding already in March. It is obvious that the chance for these situations to occur is only about 10/100 each while for end of April it is 90/100.

Conclusion and recommendation

This study shows that starting seeding from earlier March to mid April is very risky no matter the abundant rainfall usually registered at the beginning of the rainy season. Moreover, at the beginning of the rainy season, the soil is still very dry and need a lot of water to adjust the soil water reserve lost by the evapotranspiration.

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