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Resilience of agricultural systems against crises

Making effective use of climate information by small scale farmer in managing rain-fed maize production. A case study in Bole, Ghana

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1. Introduction

Climate largely controls the vegetation cover and sets limits for crop production and pastoral activities. Under rain-fed agriculture, the rainfall is the primary supplier of water buts its amount is unevenly distributed both geographically and seasonally.

Maize (*Zea mays* L.) is a major staple cereal crop of great importance in sub-Saharan Africa and requires a good distribution of rainfall. In the early stage, sufficient water in the soil allows the plant to develop a healthy root system. This protects the plant against temporary periods of water stress. Rainfall during the growing season should not fall below 200 mm .

The start of the rain is often marked by considerable day to day variability, making the actual planting time uncertain. Soil water management is very important and a key factor in achieving agricultural production. Information on availability of water is of necessity in agriculture for effective management of farm activities, which helps prevent pre-harvest losses. Maize production in the Bole district of Ghana is mainly rain-fed and is sensitive to climatic conditions.

2. Objectives

- ❑ To determine the period during which there is favourable moisture environment for maize production.
- ❑ To establish the expected rainfall distribution and patterns.
- ❑ To develop a cropping calendar for maize production.

3. Methods/Procedures

- 40 years climatic data on rainfall and evapo-transpiration were obtained from Ghana meteorological service. Data on maize were obtained from GLDB, Kumasi.
- Statistical analysis used include the following;

a. $\text{Frequency of exceedance (P)} = \frac{\text{Highest rank number}}{(\text{Lowest rank number} + 1)} \times 100\%$ based on Weibull method

b. $\text{Aridity index (for a period)} = \frac{\text{Rainfall in that period}}{\text{Evapotranspiration in that period}}$

c. $\text{Risk factor} = \frac{(\text{Evapotranspiration} - \text{Prob. of rainfall at 80\%})}{\text{Evapotranspiration}}$

d. Standard deviations and coeffecients of variaions for both the rainfall and the evapo-transpirtion were also calculated.

4. Results and discussion

Table 1: Standard deviation and coefficient of variation for Bole for the period (1961-2002).

Month	Rainfall			Evapo-transpiration		
	Mean rainfall(mm)	SD	CV	Mean ETo(mm)	SD	CV
Jan	2.1	8.11	386.2	242.9	20.4	8.4
Feb	9.3	16.08	172.9	240.2	18.97	7.9
March	51.9	35.69	68.8	197.4	34.84	17.6
April	99.4	41.83	42.1	167.7	39.23	23.4
May	130.8	57.5	44	127	14.38	11.3
June	146.6	60.75	41.4	97.7	8.48	8.9
July	160.6	74.09	46.1	77.7	7.34	9.4
Aug	150.6	52.49	34.9	76.2	5.56	7.3
Sept	206.8	67.07	32.4	86.3	6.12	7.1
Oct	104.6	60.51	57.8	110.8	9.44	8.5
Nov	21.1	28.3	134.1	161.1	20.97	13
Dec	7.3	16.7	228.9	204	29.6	14.5

- For a rainfall to be more reliable, its coefficient of variation must be less than 50%.

Figure 1: Graph of mean monthly rainfall and mean monthly ETo against time for Bole (1961-2002)

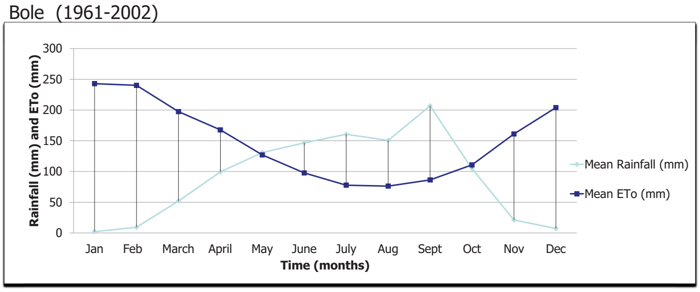

Table 2: Mean monthly rainfall, 80% probability rainfall, ETo and 80% probability ETo, and aridity index and risk factor for Bole (1961-2002)

Month	Rainfall (mm)	Rainfall at 80% probability	ETo (mm)	ETo at 80% probability	Aridity index	ETo-P80 (mm)	Risk factor
Jan	2.1	0	242.9	229.5	0.01	242.9	1.00
Feb	9.3	0	240.2	226	0.04	240.2	1.00
March	51.9	22	197.4	170	0.26	175.4	0.89
April	99.4	65	167.7	135	0.59	102.7	0.61
May	130.8	86	127.0	117	1.03	41.0	0.32
June	146.6	97	97.7	92	1.50	0.7	0.01
July	160.6	105	77.7	95.9	2.07	-27.3	-0.35
Aug	150.6	109	76.2	71.8	1.98	-32.8	-0.43
Sept	206.8	153	86.3	81.2	2.40	-66.5	-0.77
Oct	104.6	55	110.8	104	0.94	55.8	0.50
Nov	21.1	0	161.1	146	0.13	161.1	1.00
Dec	7.3	0	204.2	184	0.04	204.2	1.00
Year	1091.1	691.8	1789.2	1652.4	0.61	1097.4	0.613

- The risk of crop failure can be minimized if rainfall is greater than or equal to the potential evapo-transpiration or if the aridity index is greater than or equal to 1 for the months. This is an indication of wetness period during which there is some amount of water in the soil to support crop growth.
- When the aridity index gives a fraction, then it is an indication of the dry period during which the rain-fed crop is most probably under stress.
- Water deficit occurs during the dryness period and this is best time to dry any harvested maize.

Table 3: Length of growing period and humid period at Bole

Parameter	Growing period	Humid period
No. of days at mean rainfall	214 days	150 days
80% rainfall probability	183 days	114 days
Rainfall amount	894.8mm	795.4mm

Table 4: Cropping calendar

Maize varieties	Time of input supply	Time of land Preparation	Time of planting	Time of harvesting (days)
La Posta	By February	Early April	1st to Mid Week May	120
Dobidi	By February	Early April	1st to Mid Week May	120
Aburotia	By February	Mid April	Mid to end of May	110
Safita 2	By February	Early April	1st to 3rd Week of May	95
TEZSRW	By February	Early April	1st to 3rd Week of May	95
Okomasa	By February	Early April	1st to Mid Week of May	120
Obatampa	By February	Mid April	Mid to end of May	110
Abeleehi	By February	Mid April	Mid to end of May	110
Dorke SR	By February	Early April	1st to Mid Week of May	95
Golden Crystal	By February	Mid April	Mid to end of May	110
Kawanzie	By February	Early April	1st to Mid Week of May	95
Mamaba	By February	Mid April	Mid to end of May	110

5. Conclusion

- ❑ The cropping calendar, as well as the data on the length of growing period, length of humid period can serve as a guide for planning of most farming activities.
- ❑ The information on the aridity index, risk factors, coefficient of variation can be used to minimise the risk of crop failure.
- ❑ The analysis is an essential tool for planning and management of rain-fed maize production in Bole.
- ❑ This work should be extended to other parts of the country and the world, as well for use by stakeholders in the agriculture industry in order to mitigate some of the impact of climate change.

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