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Hydrological Growth Season (HGS) for Umudike Agro-Belt of Southeastern Nigeria

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Abstract: Daily rainfall data collected for thirty-two years (1972-2004) were used to develop a Hydrological Growth Season (HGS) for agricultural purposes in Umudike agro-belt. Umudike is an internationally accredited agricultural community in the southeastern part of Nigeria. To maintain or boost the tempo of food production and security within this agrarian zone, an HGS has been constructed using agro-meteorological data. The raw data of daily rainfall were processed into pentades which was thereafter used to obtain an ogive graph. Deductions from the graph show that certain crops like maize *Zeamays*, okra *Abelmoschus esculentus* (L.) Moench, egg-plant *Solanum gilo* etc can be planted up to three times in a year and not the ordinary traditional once per year practice. Also, some other crops such as cassava *Manihot esculenta* Crantz can be cultivated twice within the year. All these measures are geared towards achieving food security in our time which is one of the nation's empowerment strategies.

Key words: Hydrological growth season, pentade, onset-cessation, ogive, food security

INTRODUCTION

Food production is very important to any community or country that wants to develop. This assertion is quite correct with regard to our country Nigeria. For us to conceptualize our nation's empowerment drive many inevitable steps have to be taken. On top of the priority list of these steps is the assurance of stable food for our teeming population. There is no way a hungry man can be productive in the nation-building process. Many developmental strategies abound but so many mouths are yawning to be fed. The situation calls for everybody to contribute his quota towards food production in our communities and country at large. It is for this purpose that this study is set to achieve.

An onset-cessation Hydrological Growth Season (HGS) has been developed for Umudike agricultural zone using rainfall data acquired for more than thirty years. The HGS is to be used for planning and cultivating crops more than once a year. Within specific periods of the year some certain crops could be cultivated twice or thrice in a year. For example, maize *Zeamays* can be grown thrice in Umudike and cassava *Manihot esculenta* Crantz can be cultivated twice. This measure is geared towards achieving food security which is an aspect of our nation's empowerment strategies for development.

Location and brief facts about the study area: The study area is located within Latitudes 05°00'-05°29'N and Longitudes 07°00'-07°33'E in the southeastern part of Nigeria within the rain forest zone. Geologically, Umudike is a syn-sedimentary environment of the lignite series/coastal plain sand formations Geological Survey of Nigeria (1985) in the northern flank of the Cenozoic Niger Delta region whose drainage pattern is a simple dentritic system. The rivers here support agricultural practice immensely. With undulating topography, the area has a 73-year mean temperature of 27°C and annual mean rainfall of 2161.8 mm NRCRI (2005) the soil types are rich arable land. The altitude is 122 m amsl. Umudike is traditionally and predominantly a farming community whose major agricultural products include cassava, maize, vegetables, plantains/banana, palm produce and livestock. The inhabitants engage themselves in one form of food production or the other although using the traditionally and non-scientifically researched techniques. The sitting of some agro-based institutions within the area testifies to this fact. Two institutions among them: Michael Okpara University of Agriculture, Umudike (MOUAU) and National Root Crops Research Institute (NRCRI) intensify the drive towards agricultural activities thereby promoting food production through teaching, research and extension services.

Hydrological concepts: It is difficult to talk about plant (crop) cultivation with utter disregard to geohydrology or hydrology of a place and some important natural processes in the area.

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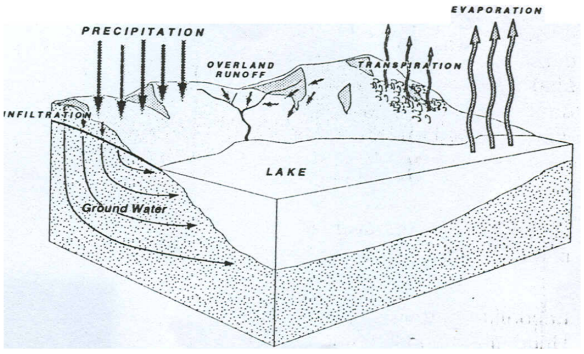

Fig. 1: Hydrological cycle

One of these processes is the hydrological cycle. This is an ever-changing migration of atmospheric, surface and ground water as a complex inter-dependent system or process referred to as hydrologic or hydrological cycle (Fig. 1, Shaw, 1998 and U.S. Environmental Protection Agency, 1993).

It is the natural circulation of water near the surface of the Earth whose driving force is derived from the radiant energy of the sun (Shaw, 1998; Davis and DeWiest, 1966). Evaporation takes place as the sun heats up the water molecules and by some combined circumstances, the water vapour changes back to liquid state again resulting into condensation to form clouds and thereafter, with favourable atmospheric conditions, precipitates in form of rain or snow. Rainfall touching the ground constitutes surface runoff or infiltrates into the ground. However, there may be interception of the rain reaching the ground which might give rise to evaporation again. As the water infiltrates through the soil layers of the ground it percolates on reaching the water-table where the rock becomes saturated or it is taken up by vegetation from which it may go back into the atmosphere through transpiration. The surface runoff and ground water flow join together in surface streams, springs and rivers to empty into the ocean. At the ocean, the process begins again. According to Davis and DeWiest (1966) it is pertinent to note that Geologic evidence strongly suggests that the volume of water in the oceans has remained reasonably constant during the past 500 Ma, so the total amount within the hydrologic cycle must have also remained nearly constant (Davis and DeWiest, 1966).

The importance of water to cultivation of food crops cannot be over-emphasized and that is why the hydrological cycle is mentioned here. Production of food crops is essential, this lays the relevance of this treatise.

Data source, processing and analysis: The large assemblage of data used in this study are secondary data sourced from the Agrometeorological station of the National Root Crops Research Institute (NRCRI), Umudike. This consists of weather and climatic data from 1st January 1972-31st December, 2004 with standard instruments (Fig. 2 and 3).

The data processing was done by converting the entire period into pentades. On the whole there are seventy-three pentades from which, using software, a graph of cumulative frequency of total rainfall in millimetres versus pentade numbers gives a frequency cumulative curve (ogive) shown in Fig. 4.

From the ogive it is possible to determine the approximate ONSET and CESSATION dates of rains within Umudike and its environs during this long period of time. The data processing and analyses show the following results/deductions:

Onset	=14 pentades
Cessation= 61 pentades	
∴ Hydrological Growth Season (HGS)	=61 – 14 pentades
⇒ Cessation minus onset	= 47 pentades

Developing an HGS and application: From the results obtained the hydrological growth season (HGS) for Umudike is 47 pentades which is equivalent to 235 days of rain in a year. With this vital information and other physical factors, the cultivation of crops like maize *Zeamays* can be done up to three times within the year instead of the usual once per year method of cultivation. This also applies to okra *Abelmoschus esculentus* (L.) Moench and egg-plant (locally called anara) *Solanum gilo*. This is done within specified periods of the year after considering the life span of the crop (germination time to harvest time). The planting periods are 11-15th March, 9-13th June and 7-11th September each year. Cassava *Manihot esculenta* can be cultivated twice yearly depending on the species. Trial experimental farming on a small-scale level has been successful and it is anticipated that it will work in large-scale level within this area.

RESULTS AND DISCUSSION

This study was in response towards a clarion call for concerted efforts towards food production. Applying scientific research to adjust our environment to enhance agricultural production is necessary, more especially, for sufficient local consumption and export. Typical examples of these crops are cassava and maize which constitute basic staple foods in various ways as well as foreign exchange earner mainly from cassava (Nigeria is at present the world's largest producer and exporter of cassava).

Meanwhile, we have a challenge: in my institution there are four giant silos constructed some years back waiting to be stored with grains (maize), how do we fill them? And what do we do in this regard? With HGS we can do it provided our water supply system is assured. Indian corn thrives well in Umudike, therefore

Metheorological office data sheet **Metform 1091**
[Revised 19821]

Register of rainfall, 198……

Station name …… Met.O.Stn No.

Country ……..…… Complete site details should be recorded overleaf. WA Stn No. ……

Regular observation time in winter ……..…….... [clock time] and during British Summer Time at ……..…… [clock time]

The morning measurement must be entered to the previous day – See instructions overleaf

Rainfall Date	Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	RAINFALL DATA BANK	
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm		
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31		X		X		X			X		X			31
TOTALS														Totals
													Annual total	

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To the Meterological Office unless specifically requested.

Dd 8229223 2/82 WS883

Fig. 2: A typical daily rainfall data form

PENTADE	1972	1973	1974	1975	1976	1977	1978	1979
A1	0	C	0	0	C1	0	0	0
A2	0	66.3	1.78	0	0	0	0	0
A3	0.76	66.3	1.73	0	0	0	0	6.3
A4	0	66.3	1.78	0	0.4	0	0	6.3
A5	0.76	66.3	1.78	0	0..4	0	0	6.3
A6	0.76	75.44	1.78	0	0.4	1.5	0	6.3
A7	1.01	75.44	2.54	0	45.6	25.2	0	32.8
A8	1.01	75.44	2.54	0	86.3	25.2	2.1	32.8
A9	1.01	75.44	2.54	0	94.8	25.2	2.1	35.6
A10	1.01	83.57	2.54	0	98.3	26.6	4.8	57.9
A11	49.03	148.36	4.06	4.83	114.5	26.6	4.8	58.9
A12	65.54	148.36	12.44	55.63	132.4	26.6	16.8	59.1
A13	65.54	148.36	12.44	60.2	135	30.8	54.9	118.5
A14	74.85	148.36	37.08	67.98	140.3	30.?	54.9	118.5
A15	182.46	171.47	143	69.76	172	30.8	78.1	122.8
A16	187.03	171.47	143	74.59	238	30.8	78.1	128.4
A17	187.03	207.53	147.32	77.89	313.8	52.3	143.7	145.1
A18	192.11	220.99	168.15	118.27	375.6	101.5	163.7	161.6
A19	361 .77	267.21	189.23	118.27	378.1	124.7	179	178.4
A20	362.02	267.21	225.81	189.64	417.2	165.1	194.4	178.4
A21	424.77	363.23	229.53	205.3	419	206.1	222.1	193.3
A22	449.41	409.71	248.58	305.01	495	265.1	278.7	211.3
A23	471.93	459.5	371.77	391.88	523.4	282.3	338.5	241.2
A24	527.26	546.02	371.77	449.54	56.4	282.3	361.9	294.6
A25	595.62	590.21	382.44	481.54	565.2	304.3	388.4	349
A26	632.2	616.88	386.25	498.05	598.5	396.3	412.8	360.2
A27	633.98	683.68	524.68	557.74	617.1	438.4	481.4	362.5
A28	642.01	763.44	567.1	637.5	646.8	555.8	550.1	483.6
A29	661.06	837.86	587.67	685	664.3	556.8	572	515.6
A30	725.94	861.65	593.26	701.76	707.3	598.4	615.9	568.9
A31	752.86	932.52	628.23	763.83	717.4	619.5	635.4	593.1
A32	763.28	966.3	720.43	794.33	723.3	645.8	697.2	673.8
A33	784.11	1105.75	721.95	891.03	758.6	657.8	721.6	702
A34	785.38	1253.32	783.34	958.53	873.7	683	743.2	765.8
A35	794.02	1340.18	896.66	964.1 3	913.9	692.7	857.3	811.6
A36	798.85	1376.75	943.91	999.93	985.6	721.4	867.4	866.4
A37	856.93	1395.04	979.9	1035.33	1007.4	814.6	869.9	884
A38	872.93	1404.7	980.41	1040.73	1039	897	967.9	974.5
A39	888.49	1459.06	1012.67	1066.43	1088.3	909.8	969	1 041 .1
A40	935.52	1473.53	1057.13	1127.83	1094.2	983.6	1203.7	1067.1
A41	950.76	1543.64	1068.56	1165.93	1153.6	1019.6	1205.6	1101
A42	1043.97	1596.98	1137.84	1173.03	1196.1	1053.4	1207.9	1155
A43	1112.81	1636.1	1151.81	1186.73	1206	1093.9	1218.1	1191.5
A44	1145.07	1682.33	1173.9	1221.63	1206	1094.3	1353	1195.4
A45	1160.31	1724.52	1254.92	1270.03	1216.4	1128.7	1366	1213.8
A46	1313.99	1800.21	1267.28	1284.63	1249.9	1255.9	1404.9	1242.5
A47	1330.66	1947.27	1320.79	1287.53	1268.6	1382.4	1461.8	1323.9
A48	1528.53	2043.03	1329.42	1337.03	1355.1	1401.9	1466.2	1341.3
A49	1616.93	2112.64	1377.17	1370.43	1401.5	1469.'f	1536.7	1379.6
A50	1650.2	2181.98	1467.09	1495.23	1473.9	1539.9	1562	1453.2

Fig. 3: A typical window of pentade data (source: NRCRI, Agromet)

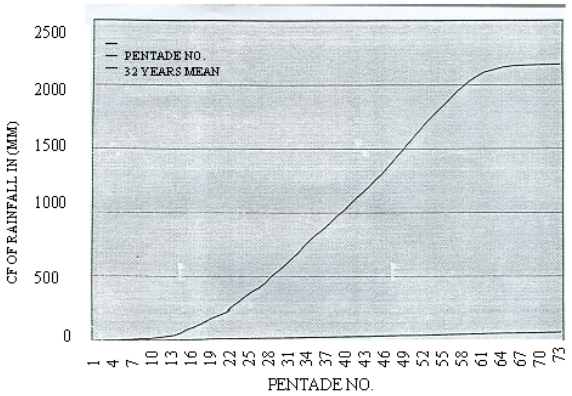

Fig. 4: Umudike rainfall cumulative frequency curve from 1972-2004 to determine onset and cessation dates of rains

we can use this environment-friendly farming practice/system to succeed.

Interestingly, in a bid to increase food production and minimize hunger, NEEDS policy Needs (2004) thrust strive towards food security and food surplus that could be exported. It also aims at investing to improve the quality of the environment in order to increase crop yields. To achieve these policy thrusts, agricultural development shall be vigorously pursued from all angles with the aim of achieving food security and reducing poverty.

Achieving food security in our time is one of the nation's strategies towards technological, economic and social empowerment. This study will serve as one of the preliminary steps for further research in developing all year-round cropping within this agro-belt zone of Nigeria.

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