ANALYSES OF RADIATION AND RAINFALL PATTERN IN KANO STATE-NORTHERN NIGERIA (1978-2007)

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ABSTRACT - Analyses of radiation and rainfall pattern was designed to study the relationship between rainfall and radiation in Kano {latitude 12^0N and longitude 8^0E}. Generally, man's comfortability depends mostly on the weather condition which largely depends on radiation from the sun and rainfall .Over the years, different kinds of radiation are considered. Global radiation also known as gunn-bellani radiation (short-wave<3 up) describes solar radiation hitting a horizontal area on earth. Gunn-bellani radiations and rainfa ll measurement data January 1978-December 2007) Spanning a period of 30 years were supplied by the Nigerian methodological service NIMET Lagos, Nigeria. The data obtained were in daily values from which the future assumptions were made. Base on these data, Descriptive and trend analysis was employed. The result shows that; April, may, june, July, August ,September and October recorded a significant value of rainfall. Which shows that August reveals too much rainfall (table 1, fig.1). Fig.5 and fig.6 represent the line graph of radiation (ml) Gunn-bellani of (January to June and July to December) respectively which the trend line indicates y=0.075x+20.28 and y=0.004x+16.13 and the coefficient of determination is R^2=0.33 and R^2 =0.007 respectively. From the results, the inhabitants of kano state in Nigerian will experience an extremely harsh weather which is caused by a continues gunn-bellani radiation, cloud, dust, altitude and less rainfall.

Key Words: Gunn-Bellani Radiation, Rainfall, Temperature, Weather and Climate.

INTRODUCTION

Generally, man's comfortability depends mostly on the weather condition which largely depends on radiation from the sun. This is mainly because virtually all physical, chemical and biological processes occurring near the ground or in the atmosphere involves energy transformations. weather is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy. Most weather phenomena occurs in the troposphere just below the stratosphere. Weather generally refers to day-to-day temperature and precipitation activity, while climate is the term for the average atmospheric condition over periods of time [30], [31], [32], [33], [34], [35].

When used without qualification, "weather" is understood to be the weather of earth. Weather is driven by air pressure (temperature and moisture) differences between one place and another. These pressure and temperature differences can occur due to the sun angle at any particular spot, which varies by latitude from the tropics. On earth surface, temperature usually ranges $+40^0$c (-40^0F to 100^0F) annually. Over thousands of years, changes in earth orbit affect the amount and distribution of solar energy receives by the earth and influence long-term climate and global climate change [36], [37], [38], [42], [43].

The Genesis

Solar radiation is an electromagnetic radiation coming from the sun. This radiation is the direct source of energy and life on earth. It drives the atmospheric and oceanic current, evaporates the water that later falls as rain and snow, and induces the plant photosynthesis that provides foods, fibre and fuel [27], [28], [29].

The sun's radiation reaches the surface of the earth in the form of waves, such as radio waves, infrared radiation, visible light, ultraviolet (uv) rays, x-rays and gamma rays. These waves form the electronmagnetic spectrum and differ only in the wave length and frequency of radiation other than that, all the waves are essentially the same radiations from the sun [32], [44], [45], [46].

EFFECTS OF RADIATION

Over the years, man is subjected to permanent impacts of radiation. Its influences include:

- The growth of plants
- Building materials
- Documents
- Works of art
- Energy extraction from natural resources
- Etc.

HUMAN EFFECTS

Solar through the visible light, make us to see clearly especially in day time. The infrared solar radiation or infrared light provides us heat. And the ultraviolet radiation, also known as black light, is a source for medical equipment sterilization and natural skin tanning. These are the common healthful effects [8], [47], [48], [49].

Some of this heat (long wave) escapes back out of the atmosphere and some of it is reflected back into the earth by greenhouse gases like ozone and co2. This is what allows us to live on the planet atmosphere trapping heat and keeping us warm with a climate [20], [21], [48], [49].

But when stuff like co2 (carbon dioxide) get higher in concentration, more of the heat is reflected. This warms the earth even more. This is a problem because an increase in heat changes the weather and effects the climate of the whole world. Animals and plant's habitants are charged and this is bad. This includes crops and humans. Heat stress whilst working outdoors in hot environments is a potential hazard, especially in developing countries where a large population of workers are involved in agriculture. In order to conduct an ergonomics analysis of such working environments, methods that allow the radiation to be incorporated should be considered [1], [2], [3], [4], [5], [51].

However, excessive exposure to solar radiation can cause severe problems to human health. Too much UV radiation may cause skin cancers photoage skin, and alter your immune system, making you Vulnerable to infectious diseases. It can also cause cataracts and other eye diseases. Moreover,

excessive infrared radiation may lead to heat stroke. Sun's radiation facilitates photosynthesis, which allows the plant to survive and light energy to chemical energy. Plant produce oxygen and carbohydrates which in turn enable us to breathe and produce energy [6], [7].

The solar radiation received at the Earth's surface in the visible part of the electromagnetic spectrum (from approximately 0.4-0.7 μm), which plays an important role in the development of daily human activities as pointed out by [24], [25], and the atmospheric radiation under study are global solar radiation (Gunn-bellani) Availability of solar radiation data is essential for the study design of economic viability of systems that use solar energy [23]. The knowledge of global radiation is very important in the design of solar systems, the prediction of their performances and the estimation of efficiencies of existing systems. Such knowledge, gain over a period, should be useful not only to the locality where the radiation data are collected, but for the wider world community [16], [17], [50].

[23], pointed out that the directly or indirectly measurement of radiation can be estimated indirectly using fundamental models or simpler models. The direct method, downward atmospheric radiation is measured with a pyrgeometer [39], [40], [41].

Rainfall is a climate parameter that affects the way and manner man lives. It affects every facet of the ecological system, flora and fauna inclusive. Hence, the study of rainfall is important and cannot be over emphasized [10], [13], [19]. The study of rainfall distribution is also important in rain harvesting, agricultural production especially plant production. The seasonality of rainfall invariably affects crop and animal production. Storage of agricultural products, architectural designs, building and constructional, field work and tourism also depend on the seasonality of rainfall. The frequency and intensity of rainfall in a particular season results in seasonal floods [10], [13], [14], [15], [18].

According to [13] in line with [8], [9], researchers seem to be more comfortable with working on such parameters as total rainfall, extreme intensity extreme frequency, extreme event and total raindays when dealing with rainfall data. Though the proportional contribution from extreme events to the total rain fall depends on the method used to calculate the index. An increase in the number of rain days often increases with total rainfall and extreme frequency [11], [12], [26].

[19], rainfall is a climate parameter that affects the way and manner man lives. Aside from the beneficial aspect of rainfall, it can also be destructive in nature [22].

MATERIALS AND METHODS

GEOGRAPHY OF THE AREA

For the Analyses of radiation and rainfall pattern to be properly understood, the geographical background of the landmass is necessary.

The location of the study site is Kano, it is located in North-western Nigeria. Created in May 27, 1967 from part of the Northern region, Kano State borders Katsina State to the Northwest, Jigawa State to the North-East, Bauchi State to the South-East and Kaduna State to the South-West. The capital of Kan State is Kano. And lies at latitude 12^0N and longitude 8^0E. Kano State has been a commercial and agricultural State which is known for the production of groundnuts as well as for its solid mineral deposits. It has more than 18,684 square kilometers (7,214 sq mi). of cultivable land and is the most extensively irrigated state in the country (Nigeria).

Data source

The data on radiation (mi) [Gun-bellani] and rain fall (mm) were extracted from the Nigeria meteorological services (NIMET) Lagos, Nigeria from 1978 to 2007 a period of 30 years.

Method of analyses

DESCRIPTIVE AND TREND ANALYSIS WAS EMPLOYED TO SHOW:-

- COMPARISM BAR CHART OF RAINFALL (MARCH.-OCT, 1978 – 2007)
- THE MULTPLE MONTHLY ANALYSES OF MONLY-MEAN DAILY TOTAL RAINFALL BETWEEN MARCH TO OCT. (1978-2007)
- THE MULTPLE COMPARISM BAR CHART OF GUNN-BELLANI RADIATION (JAN.-JUNE, 1978 – 2007)
- THE LINE GRAPH OF GUNN-BELLANI RADIATION (JUNE TO DEC. 1978-2007)

RESULTS:

TABLE 1: MEASURED VALUES OF RAINFULL IN KANO STATE.

RAINFALL (mm)													
STN	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Kano	1978	0	0	0	34.5	73.7	197.9	308.6	257.6	29.6	29	0	0
Kano	1979	0	0	0	0	32	110.5	191.9	257.2	111	20.1	0	0
Kano	1980	0	0	0	0	93.5	122.8	282.6	310.5	67.6	35.4	0	0
Kano	1981	0	0	0	19.5	36.2	62.1	142.8	202.5	111.8	0	0	0
Kano	1982	0	0	0	18.6	66.2	62.3	157.9	261.3	70.5	1.3	0	0
Kano	1983	0	0	0	0	27.2	47.4	91.4	266.1	67	0	0	0
Kano	1984	0	0	0	0.3	52.7	81.7	157.5	50.5	118.7	17.3	0	0
Kano	1985	0	0	21.5	0	27.4	164.6	169.8	162.2	110.1	0	0	0
Kano	1986	0	0	0	2.1	9.8	136.6	259.2	175.2	105.8	4.2	0	0
Kano	1987	0	0	0	82.2	68.9	164.5	110.1	65.5	14.8	0	0	0
Kano	1988	0	8.1	0	32.8	16	149.2	213.6	488.5	154.1	0	0	0
Kano	1989	0	0	0	0	10.4	36	142.4	382.1	84	45.3	0	0
Kano	1990	0	0	0	0	40.1	54.8	233.1	142.4	89.2	0	0	0
Kano	1991	0	0	1.7	63	120	148.6	70	455.1	20	0	0	0
Kano	1992	0	0	0	37.4	122.1	45.1	191.4	324.8	205.5	0	0.7	0
Kano	1993	0	0	0	0	48.2	288.1	157.9	406.9	94.4	0.6	0	0
Kano	1994	0	0	0	17.2	6.5	101.6	149.1	325.2	156.5	35.8	0	0
Kano	1995	0	0	0	7.4	25.9	155	189.4	145	173.5	3.5	0	0
Kano	1996	0	0	0	0	37.2	143.1	253.8	417.6	235.5	47	0	0
Kano	1997	0	0	0	30.9	100.6	161.9	253.9	451.9	251.2	40	0	0
Kano	1998	0	0	0	14.1	69.6	173	573	571.8	444.1	26.4	0	0
Kano	1999	0	0	0	0	44.5	88.8	533.5	466.9	240.3	17.7	0	0
Kano	2000	0	0	0	0	98.3	135.7	364.2	332.4	174.4	34	0	0

Kano	2001	0	0	0	41.1	185.8	231.1	604.7	521.1	205.6	0	0	0
Kano	2002	0	0	2.8	1	124.4	274.9	376.6	199.9	54.1	0	0	0
Kano	2003	0	0	0	10	66.8	247.2	394.5	464.8	232.6	13	0	0
Kano	2004	0	0	0	175.7	189.9	406.7	277.7	229.4	0	0	0	0
Kano	2005	0	0	0	1.9	119.7	188.1	383.6	442.9	200.4	39.7	0	0
Kano	2006	0	0	0	0	149.7	114.9	374	334.4	336	0	0	0
Kano	2007	0	0	0	421.1	107.3	329.3	188.5	410	37.5	0	0	0

Fig. 1
THE MULTPLE COMPARISM BAR CHART OF
RAINFALL (MARCH.-OCT, 1978 – 2007)

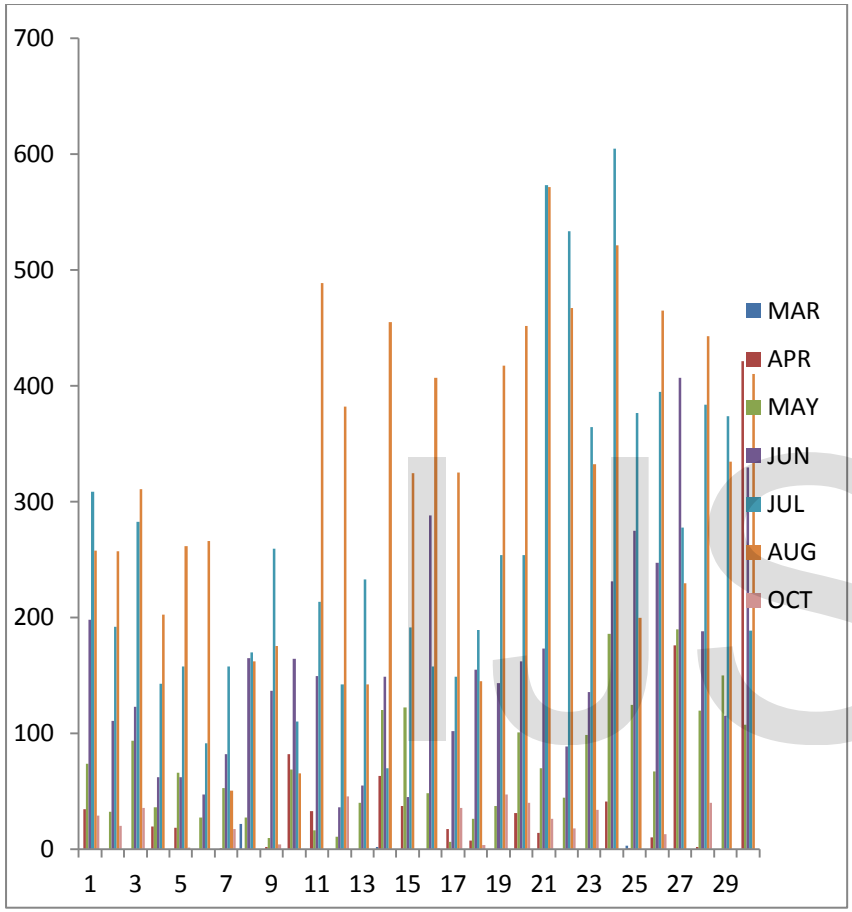


Fig. 2 MONTHLY ANALYSES OF MONLY-MEAN DAILY TOTAL RAINFALL BETWEEN MARCH TO OCT. (1978-2007)

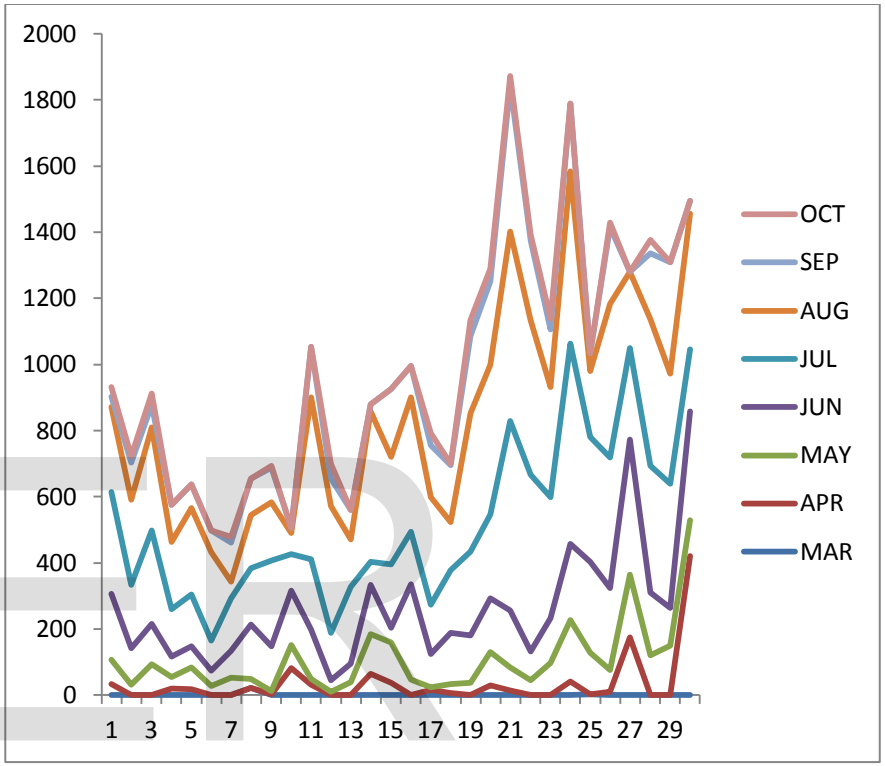


TABLE 2: MEASURED VALUES OF RADIATION IN KANO STATE.

				RADIATION (ml) (GUNN BELLANI)									
STATE	**YEAR**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	
Kano	**1978**	**18.8**	**21.4**	**23.1**	**19.8**	**21.9**	**21.3**	**16.9**	**20**	**22.4**	**20.2**	**16**	1
Kano	**1979**	**16.2**	**19**	**19.2**	**20.8**	**19.4**	**17**	**13.7**	**19.7**	**23.9**	**21.3**	**17.8**	1
Kano	**1980**	**17.8**	**19.3**	**21.4**	**20.9**	**19.9**	**21.3**	**22.8**	**19.6**	**19.3**	**17.2**	**17.2**	1

Kano	1981	16.8	18.6	21.8	23.1	18.8	20.1	15.6	16.9	17.1	17.7	17.7	19
Kano	1982	18.4	19.1	21.7	22.4	21.3	17.6	17.4	17.6	16.7	18.4	16.8	17.3
Kano	1983	13.6	19.1	19.2	19.4	20.4	18.1	17.1	17.7	19.3	18.1	18	16
Kano	1984	16.4	18.3	19.6	18.7	18.3	19	16.8	18.5	16.8	17.4	17.5	14
Kano	1985	17.2	17.4	17.5	18.5	19.1	17.5	16.3	18.7	18.2	18.2	18.8	15
Kano	1986	18	20.7	20.4	21.1	19.6	19.6	17.7	18.8	19.3	19.5	17.9	15
Kano	1987	17.7	19.4	19.9	20.2	20.7	19.1	19.3	17.5	19.4	19.1	19.1	16
Kano	1988	16	18.3	19.4	19.7	20.4	18.1	16.2	17.2	19	20.1	19	15
Kano	1989	15.7	18.1	20.9	21.5	19.3	18.6	18.2	17.6	17.7	19.3	18.1	15
Kano	1990	17.9	19.5	19.3	21.3	18.9	17.9	18	17.6	18.9	18.9	18.8	17
Kano	1991	16.3	19.3	19	19.5	17.3	18	15.3	14.8	19.6	17.6	16.8	15
Kano	1992	14.5	17.8	18.1	14.7	18.9	17.7	16.3	14.3	17.6	18.1	16.7	16
Kano	1993	15.9	19.8	20.5	20.8	19.3	19.2	16.2	16.5	18.2	18.4	16.8	16
Kano	1994	15.7	17.6	20.6	19.6	18.8	18.9	17.3	15.4	16.7	18.1	17.6	15
Kano	1995	15.6	18.8	19.4	19.2	18.4	18.9	17.3	17.5	17.4	18.2	16.9	17
Kano	1996	18.6	19.3	19.9	19.7	19.3	19.6	18.7	15.8	18.3	17.8	18.1	18
Kano	1997	18.2	17.3	19.3	20.3	19.2	18.4	18	18.5	18.1	19	18.8	18.1
Kano	1998	16.7	18.4	19.2	20	18.6	19	15.6	15.5	18	18.3	18.2	17.1
Kano	1999	17.3	18.9	20.8	19	18.9	19.1	16.4	15.7	18	18.2	17.9	16.8
Kano	2000	17.6	16.9	18.4	20.9	20.4	18.5	16.8	17.5	20.1	19.3	25.4	16.6
Kano	2001	16.7	17.3	16.7	18.3	9	8	5	5	8	8	15.7	16.2
Kano	2002	13.3	17.1	20.1	18.6	4	5		5	15.3	18.2	15.5	15
Kano	2003	16.4	19.1	19.2	19	5	5	1	9	17.3	18.4	18.3	16.3
Kano	2004	17.2	18.7	19.6	18.1		5	7	7	16.1	18.2	18.1	15.2
Kano	2005	14	16.7	18.2	18.5	1	7	7	4	15.4	18	16.6	15.6
Kano	2006	15.6	18.4	18.8	18.7	4	9	9	9	10.1	17.2	16.2	16
Kano	2007	16.6	20.2	21.2	18.1	1		5		19.6	16.8	16.4	15.2

Fig. 3
THE MULTPLE COMPARISM BAR CHART OF GUNN-BELLANI RADIATION (JAN.-JUNE, 1978 – 2007)

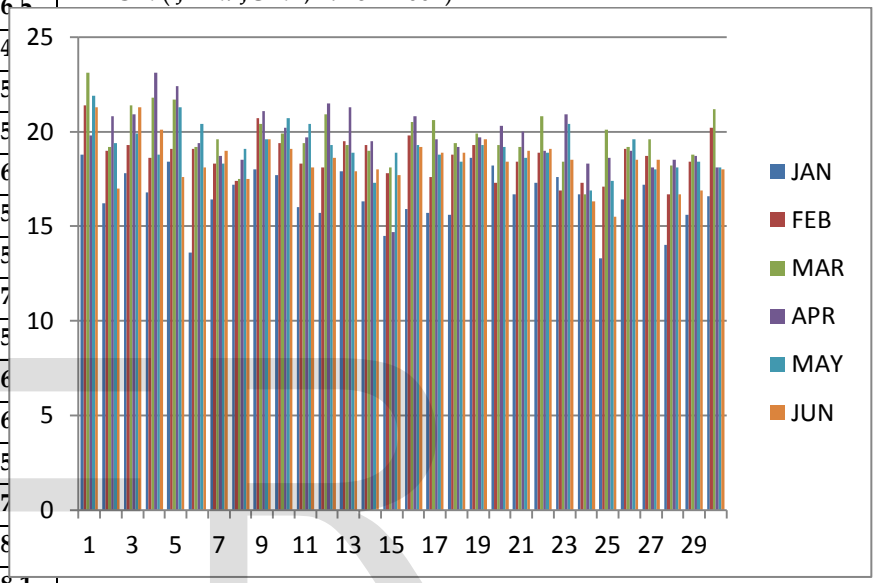


Fig. 4
THE MULTPLE COMPARISM BAR CHART OF GUNN-BELLANI RADIATION (JULY.-DEC., 1978 – 2007)

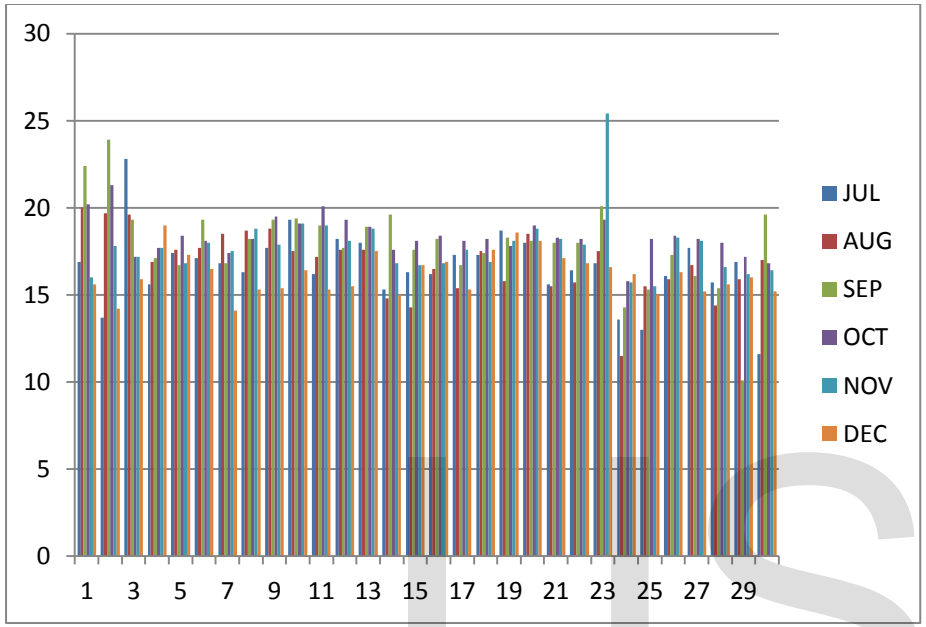


Fig. 5

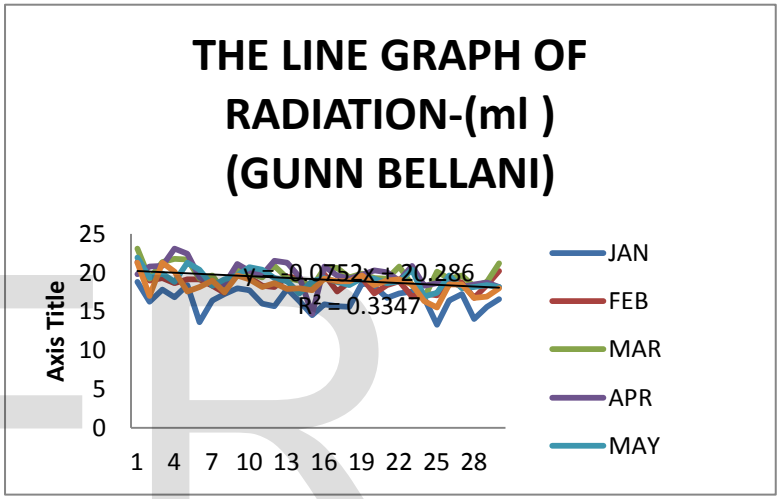
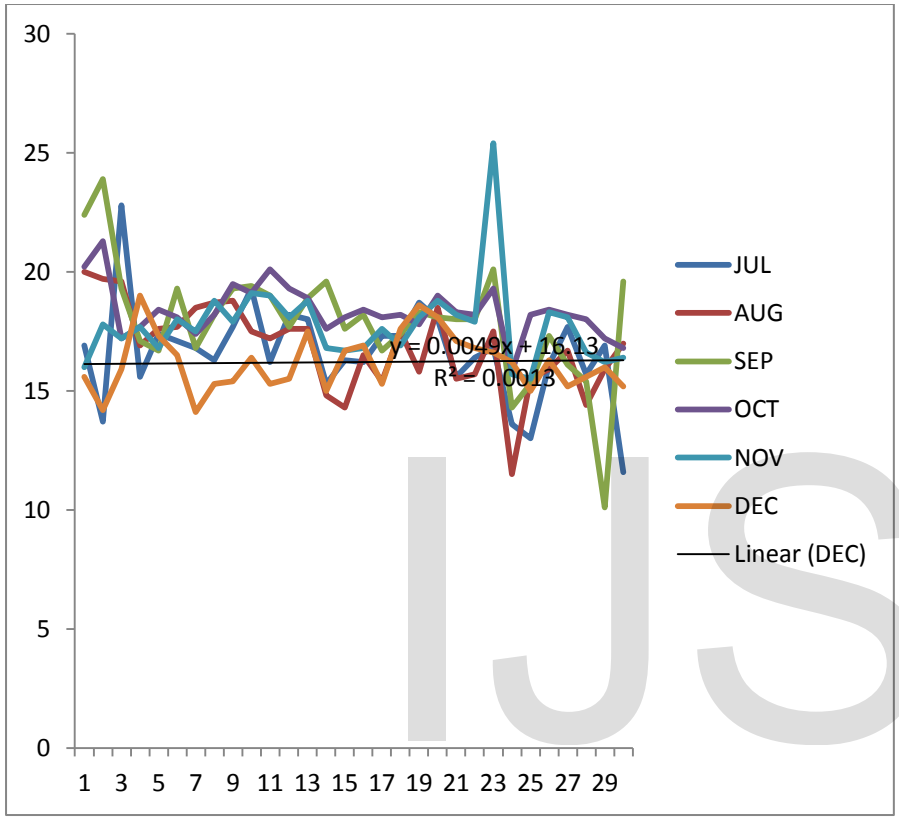


Fig. 6
THE LINE GRAPH OF GUNN-BELLANI RADIATION (JUNE TO DEC. 1978-2007)



Discussion of Results

From the results, Descriptive and trend analysis was employed. Table 1 indicated values of rainfall from 1978 to 2007 (mm), of which January, February march, November and December recorded non-significant value of rainfall. While April, may, July, August September and October recorded a significant value of rainfall. Fig I show a multiple bar chant of rainfall measurements from march to October (1978-2007). Which shows that August reveals too much rainfall. Fig 2 shows the Cyclical movement of rainfall measurements from march to October (1978 to 2007).

Table 2 indicated radiation (ml) measurement (Gunn-bellani) from 1978 to 2007, of which the least radiation experienced during the period of study was in September 2006 (10.1) and the highest experience was on November 2000 (25.4). fig 3 and fig 4 represent multiple comparison bar chart of January to June and July to December (1978 to 2007) respectively.

Fig 5 and fig 6 represent the line graph of radiation (ml) Gunn-bellani of (January to June and July to December) respectively which the trend line indicates y=0.075x+20.28 and y=0.004x+16.13 and the coefficient of determination is R^2=0.33 and R^2=0.007 respectively.

Summary and conclusion

Hence, from the results, the inhabitants of kano state in Nigerian will experience an extremely harsh weather which is caused by a continues gunn-bellani radiation, cloud, dust, altitude and less rainfall. Table 1 indicated values of rainfall from 1978 to 2007 (mm), of which January, February march, November and December recorded non-significant value of rainfall. While April, may, June, July, August September and October recorded a significant value of rainfall. Measurement of radiation (Gunn-bellani) from 1978 to 2007, of which the least radiation experienced during the period of study was in September 2006 (10.1 ml) and the highest experience was on November 2000 (25.4 ml).The peoplein this area will not be able to grow some species of plant like cocoa, palm fruit etc. Timber business will be very poor.

However, excessive exposure to Gunn-bellani radiation can cause severe problems to human health. Too much UV radiation may cause skin cancers photo age skin, and alter your immune system, making you Vulnerable to infectious diseases. It can also cause cataracts and other eye diseases. Moreover, excessive infrared radiation may lead to heat stroke. Sun's radiation facilitates photosynthesis, which allows the plant to survive and light energy to chemical energy. The inhabitants will experience poor quality air due to lack of plant. Plants produces oxygen and carbohydrates which in turn enable us to breathe and produce energy.

Conclusively, design of economic viability of systems that uses solar energy should be encourage more in the area ; If Rain making is not practicalize in the area of study, they will be population reduction.

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