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AN INVESTIGATION INTO THE EFFECTS OF IRRIGATION DEVELOPMENT ON SOME CLIMATIC FACTORS IN TWO IRRIGATION SCHEMES IN NIGERIA

Ojediran J. O.

Department of Mechanical Engineering,
Ladoke Akintola University of Technology,
Ogbomoso, Nigeria

ABSTRACT

An analysis of climatic data for two irrigation projects in Nigeria was carried out. The schemes investigated are Itoikin Rice Project (IRP) and Zauro Polder Project (ZPP located in the Rain Forest and Sudan Savanna zones of Nigeria respectively.

At IRP, an annual mean rainfall of 1332mm with low variability between the years at coefficient of variation (Cv) of 17% level was recorded. Post0irrigation development relative humidity (RH) records for Itoikin indicate an annual mean of 77.9% with a Cv of 1.6%. These results show that irrigation development in this area is associated with unusual scanty rainfalls in the dry months of the year due to large volume of water. There was consistent high relative humidity during the usual irrigation periods. Post-irrigation development maximum and minimum temperature records at Itoikin indicate annual means of 31.6°C and 22.6°C respectively. All these micro-climatic data affirm the effect of irrigation during the supposedly dry months of the year.

At ZPP, climatic data were largely unavailable, only the data for a few pre-irrigation development years (1974 – 79) were obtained. These data indicate an annual mean rainfall of 568.4mm and annual mean of 35.1°C and 21.3°C, respectively at ZPP. These micro-climatic data for ZPP area may be used as baseline for monitoring of the impact of the full blown project when it commences.

Keywords: Irrigations, Temperature, Rainfall, Relative Humidity

INTRODUCTION

In the arid and semi-arid regions of the world, crops depend primarily on irrigation to curtail the adverse effects of long droughts, between rainfall, on their growth and yield. In the humid regions, irrigation is supplemental to rainfall, and it is applied to allow all year round foming and improve yields. Other benefits include the production of industrial export crops for import substitution, production of perishable crops at locations close to the centre of population, development of depressed areas, and creation of employment opportunities (Nwa, 1987). However, there exists also some unsalutary effects. These need to be addressed to prevent a stifling of the immense benefits of irrigation practice.

Studies of impacts of irrigation development on the micro-climate of the immediate environment have been reported in literature. Earlier reported studies by Mistry and Purohit (1989) and Afoz and Singh (1991) were on the impacts of irrigation developments on the micro-climate of irrigation schemes' environments in India. Similarly, Biswas (1988) observed that the presence of reservoirs or large surface area of water, which often characterize irrigation developments evidently have impact on the micro-climate. This observation, perhaps, led to the recommendation of regular meteorological observation of scheme environments to identify changes especially of temperature and relative humidity. Other reports in literature include those of Bolton et al., (1990) Brabben (1989), Conway et al., 1987), Harver et al., (1987), Jensen (1983) and kennedy (1988). A major obstacle to proper environmental monitoring as observed by Ojediran (1997) is the lack of baseline data on most schemes for adequate comparative analysis and assessment of impact(s). This is especially so with climatic data that are often taken for granted due to the low and often unobservable immediate effects of its variation.

The objective of this study is to investigate the effects of irrigation development activities on temperature, rainfall and relative humidity of the environments of two irrigation schemes in Nigeria.

MATERIALS AND METHODS

Study Area

The schemes selected fall into two sub-ecological zones viz: Itoikin Rice Scheme Ogun – Osun River Basin Development Authority, (OORBDA), in the rain forest and Zauro Polder Pilot Scheme in the Sudan Savannah Zone of Nigeria.

The OORBA was established along with other River Bain Development Authorities in 1976 via decrees No. 25 and 31 of 1976 and 1977 to cover the entire land mass of the country. The OORBDA covers the entire Oyo, Ogun, Osun and Lagos states of Nigeria which lie between longitudes 3°E and 5°E, and latitudes 6°N and 9°N with an estimated land area of 66,624km2 (Arzika, 1983). Itoikin Rice Project is one of the 14 farmer-based projects of the OORBDA situated in the lower Osun operation area and in a small village Itoikin, Lagos state (6.5°C., 3.5°E) on the Ijebu-Ode-Ikorodu highway.

Zauro Polder Pilot Project (ZPPP), a pilot irrigation scheme under the Zauro Polder Project (ZPP) of Sokoto Rima River Basin Development Authority (SRRBDA) began operation in 1974. The project lies in the South Western part of the SRRBDA and in the middle Rima valley between Argungu and Birnin Kebbi towns in Kebbi state, Nigeria. The ZPPP is located in a lowland area (Fadama) about 2km away from Birnin-Kebbi town which lies on latitude 12.5°N and longitude 4.3°E, in the Sudan Savannah region and the semi-arid zone of Nigeria.

Data Collection

At Itoikin Rice Scheme, only the post-irrigation development data were available since the meteorological station appears to have been established along with the scheme. Conversely, no meteorological station has been established in or around the Zauro Polder Project, hence only the scanty pre-irrigation development data available at the Department of Meteorological Services, Lagos were obtained. The use of data from distant Ijebu-Ode and Sokoto for the assessment of impacts on micro-climatic factors on these schemes was deemed unjustifiable, as it may lead to a misrepresentation of the impacts being studied. Baseline studies were, therefore, carried out for both scheme to be used (Itoikin Rice Project and Zauro Polder Pilot Scheme) as basis for future monitoring of these factors.

RESULTS AND DISCUSSIONS

Effects of Irrigation of Rainfall

Itoikin Rice Scheme

At Itoikin Rice Scheme, the available post-irrigation development rainfall data (1983 – 93) indicate an annual mean of 1332mm, with low variability between the years at coefficient of variation (Cv) of 17% level. Annual variation of rainfall for this period, presented in Fig. 1, indicate a sudden increase in 1984, perhaps an effect of the inception of irrigation activities around the area. A general increase in annual rainfall was observed between 1987 and 1991, a period when the scheme was consistently in operation. The drop in annual rainfall of 1992 and 1993 is expected since rice production was reported to have effectively stopped, and implication, intensive irrigation, in 1990 (Shittu, 1995). This perhaps led to reduced area of exposed surface water for evaporation and consequently rainfall.

A study of the monthly variation of rainfall for these years (1983 – 93) as detailed in Table 1 indicates rainfall peaks in July and September and three dry months (December – February) of scanty and highly variable rainfall is depicted by Cv values in the range of 135 – 258%. Table 2 also shows the percentage contributions of each months to the annual rainfall.

Table 1: Detailed Post-irrigation Development Rainfall Records for Itoikin Rice Scheme, Nigeria

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1983	0	0	108.1	46.7	209.4	313.7	88.6	25.2	75.8	1.3	0.7	13.2	882.7
1984	0.5	2.0	111.2	203.3	158.0	187.6	122.3	153.6	204.7	183.3	21.7	0	1346.4
1985	0.6	0	2.6	64.8	164.8	207.0	204.4	179.7	244.8	88.1	39.1	0	1195.5
1986	9.9	25.3	56.6	129.4	128.6	152.5	85.3	29.3	218.6	210.1	7.2	0	1052.8
1987	0	28.3	97.7	36.9	224.2	434.5	190.6	224.3	284.2	166.5	54.4	0	1741.5
1988	4.8	13.5	37.3	92.3	135.1	272.1	291.7	161.5	165.8	167.0	107.7	0.9	1449.7
1989	0	0	54.8	83.2	120.1	286.5	207.3	230.3	230.3	182.4	0	0	1394.9
1990	14.7	0	0.5	190.4	190.0	253.0	395.6	59.5	184.8	157.3	20.2	62.2	1528.2
1991	3.4	1.0	42.0	236.8	183.4	157.6	340.1	157.0	212.6	179.6	0	0	1513.5
1992	1.8	0	2.9	61.5	12.2	248.9	289.1	79.3	323.0	109.1	0	0	1243.8
1993	0	0	100.2	84.9	249.0	312.3	155.3	N/A	N/A	233.3	167.4	0	1302.6

N/A = Not available Man = 1332mm

Table 2: Variation of Mean Monthly Rainfall and Relative Humidity of Itoikin Rice Project, Nigeria (1983 – 93)

Month	Rainfall			Relative humidity	
	Mean value	% Contribution	*Cv(%)	Mean value	*Cv(%)
January	3.3	0.2	139	69.2	11.0
February	6.4	0.5	163	73.1	4.3
March	55.8	4.1	74	76.5	2.9
April	111.8	8.2	58	77.9	2.5
May	171.9	12.6	24	80.2	2.9
June	256.8	18.8	30	81.8	3.6
July	215.5	15.8	45	81.7	2.1
August	130.0	9.5	56	81.4	3.1
September	214.5	15.7	30	81.9	3.2
October	152.6	11.2	40	81.0	1.7
November	38.0	2.8	135	79.3	2.6
December	6.9	0.5	258	72.6	7.0

*Cv – Coefficient of Variation

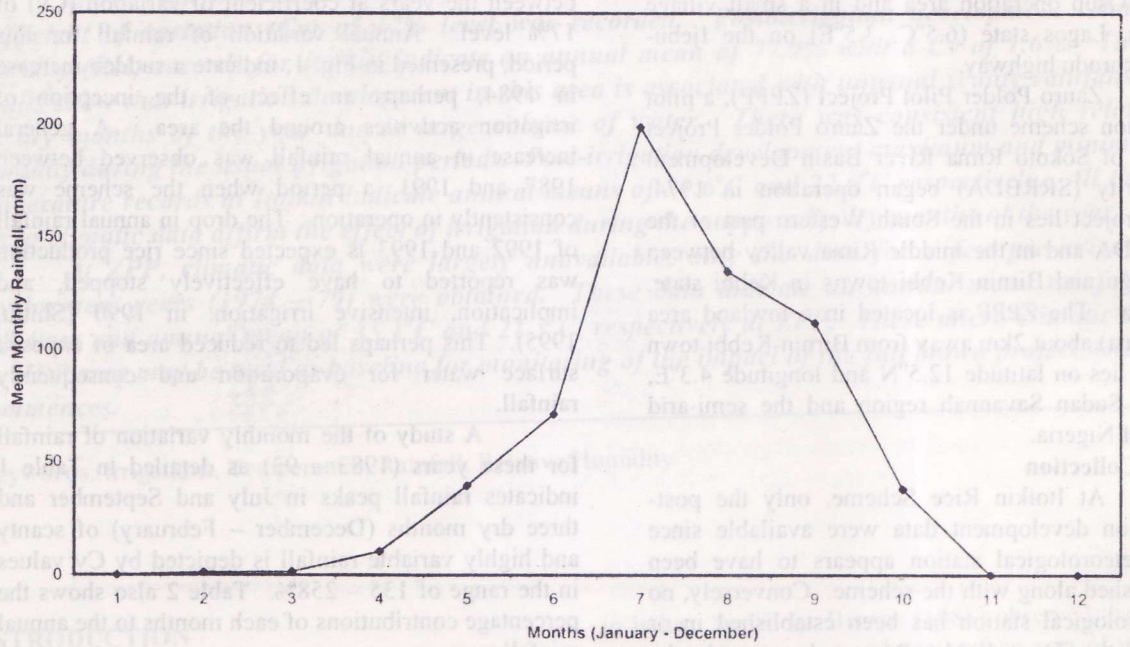

Fig. 1: Mean Monthly Rainfall Distribution in Zauro Polder Project, Birnin Kebbi Between 1974 and 1979

Zauro Polder Scheme

Rainfall data for the Zauro Polder Pilot Scheme were largely unavailable, thus only a few pre-irrigation development years data (1974 – 79), which were fairly incomplete were obtained. The complete portion of these data (1974 – 77) indicate and annual mean rainfall of 568.5mm for Birnin-Kebbi. Fig.1 drawn from the collected data shows that the months of November to March are virtually rainless, with April experiencing slight and highly variable rainfall. These records may be used as baseline for proper monitoring of the impact of the full blown project when it commences.

Effect of Irrigation on Relative Humidity

Itoikin Rice Scheme

Post-irrigation development relative humidity (RH) records for Itoikin indicate an annual mean RH of 77.9% with a CV of 1.6% for ten years record. Fig. 2 shows the annual variation of RH at Itoikin. Table 2 shows the mean monthly relative humidity for the scheme. Data in Table 3 indicate, expectedly, that June and September which have the highest rainfall also have very high RH values. However, the earlier reported dry months of November – February show relatively high RH values in the range of 69 to 79%. This, perhaps, corroborates the earlier assertion in this study that irrigation of Itoikin may have led to the scanty rainfalls recorded in those dry months. A high RH of the nature recorded in these months (Table 3) indicate high evaporation and most possibly from the open water surfaces created by the surface irrigation practiced on this scheme.

The values of the computed coefficients of variation (CV) for these months (2.6 to 11%) as contained in Table 3 further attest to consistent high relative humidity during the usual irrigation periods.

This tends to suggest that irrigation activities at Itoikin has had perceptible impact on the RH and hence micro-climate of the area. A statistical analysis of the RH values of January (month with the lowest RH) and September (month with highest RH) indicate that the difference in mean RH values are not significant ($t = 1.6$) at 5% level. This further suggest that a source of vapour exists in the environment to raise the RH of a dry month to that of the raining season level.

Zauro Polder Pilot Scheme

Pre-irrigation development RH data available for the Zauro Polder Pilot Scheme, which is documented here as baseline study; indicate an annual mean RH of 50.5% for Birnin-Kebbi. Fig. 3 showing the variation in mean monthly RH of Birnin-Kebbi indicate that for 5 months in the year (raining season) the area experienced relatively high humidity with a peak of 80% in August, while for the rest of the year (October – April), low RH value in the range of 23 – 39% were observed.

Effect of Irrigation on Temperatures

Itoikun Rice Project

At Itoikin, Post-irrigation development maximum and minimum temperature records indicate annual means of 31.6°C and 22.6°C respectively. Annual variations of these parameters for the eleven years records are shown in Fig. 4. Fig. 4 shows the mean monthly maximum and minimum temperature of the scheme after its development. This figure also appears to support earlier trends in rainfall and RH for the months of December to February.

The abnormally low minimum temperature and high maximum temperatures for these months seem to affirm the effect of irrigation during the supposedly dry months of the year. Further verification or validation of these assertions may be necessary when project becomes fully operational again.

Zauro Polider Pilot Scheme

At Zauro Polder Pilot Scheme, pre-irrigation development records of maximum and minimum temperatures indicate annual means of 35.1°C and 21.3°C, respectively. Fig. 3 indicates the variations of both parameters from year to year for 1974 – 1980. A computation

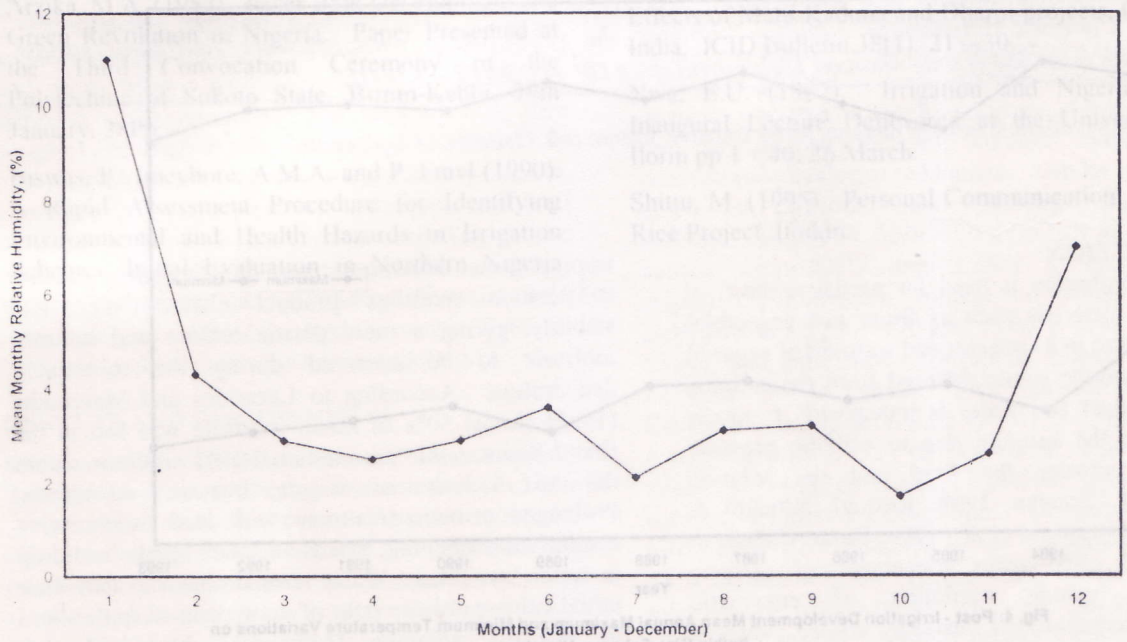

Fig. 2: Mean Monthly Relative Humidity Distribution at Itoikin Rice Project Between 1983 and 1993

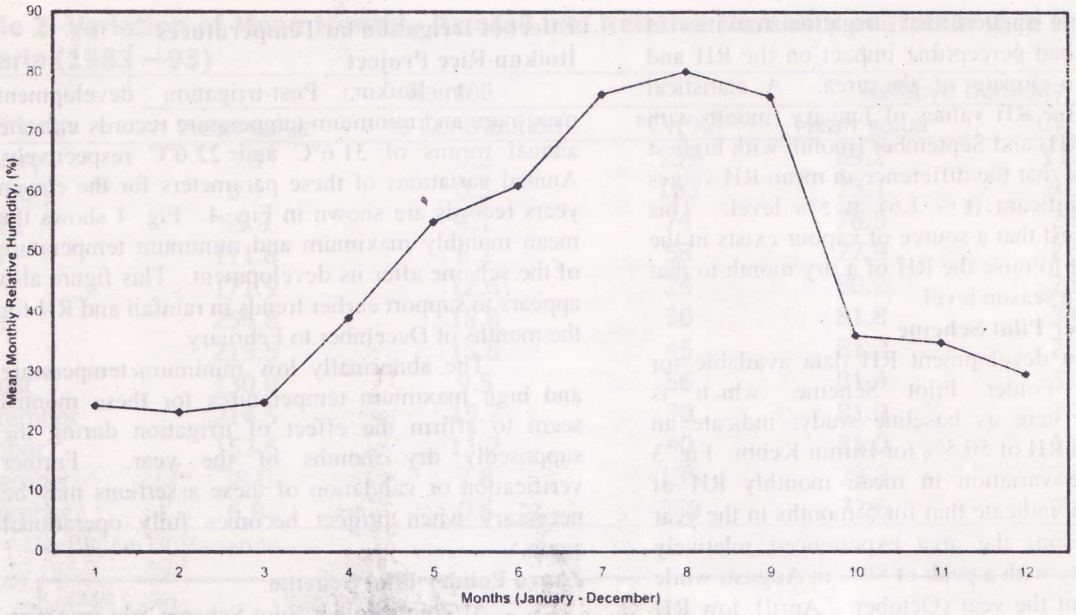

Fig. 3: Mean Monthly Relative Humidity Distribution in Zauro Polder Project Birnin Kebbi Between 1974 and 1979

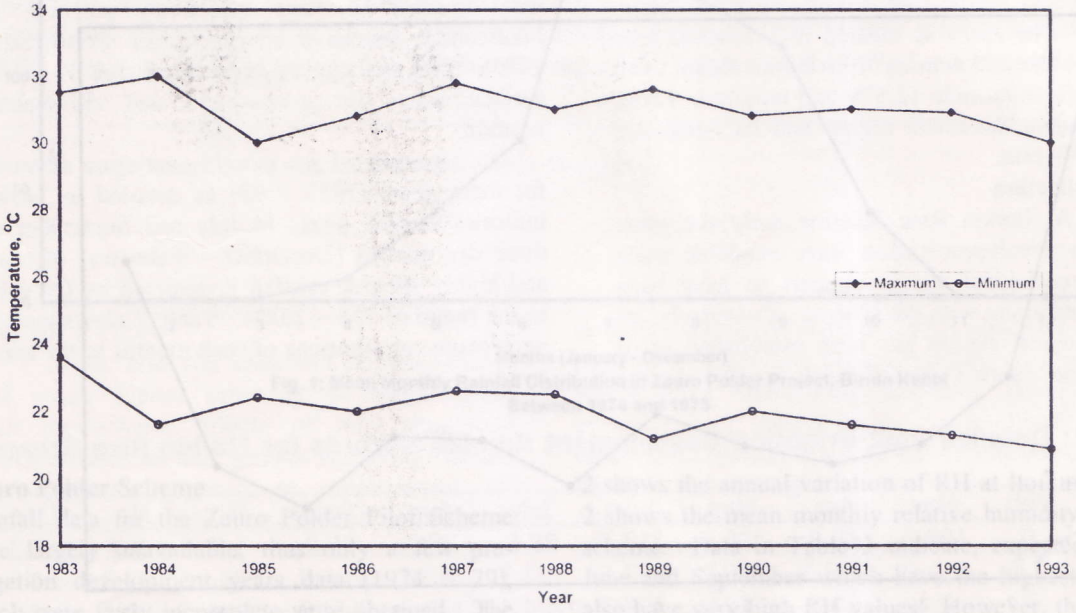

Fig. 4: Post - Irrigation Development Mean Annual Maximum and Minimum Temperature Variations on Itoikin Rice Scheme, Nigeria.

of the monthly means for this period indicates very low variability (low coefficient of variation) in both maximum and minimum temperatures from year to year.

CONCLUSIONS

The effects of irrigation development schemes in two sub-ecological zones in Nigeria were investigated. The study involved tow irrigation schemes located in the Rain Forest and Sudan Savannah zones of Nigeria. From the results of the investigation, the following conclusions can be drawn.

1. The annual mear. rainfall of 1332mm with coefficient of variation (CV) of 17% level was recorded for Itoikin rice Project. Post-irrigation development relative humidity for this scheme was 77.9% with a CV of 1.6%. These results have led to some scanty rainfalls in the dry months of the year. Post-

irrigation development maximum and minimum temperature records at Itoikin indicate annual menas of 31.6°C and 22.6°C respectively.

2. At Zauro Polder Irrigation Scheme, climatic data obtained indicate an annual mean rainfall of 568.4mm and annual mean relative humidity of 50.5%. The records of maximum and minimum temperatures of the scheme indicate annual means of 35.1°C and 21.3°C. These data may be used as baseline for monitoring of the full blown project when it commences.

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