# Effects of Temperature, Rainfall and Relative Humidity on Visceral Leishmaniasis Prevalence at two highly affected Upazilas in Bangladesh

Md. Ruhul Amin[1], Shafi Mohammad Tareq[1], Syed Hafizur Rahman[1] and Md Romij Uddin[2]

[1]Department of Environmental Sciences, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh.
[2]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
ruhul_happy01@yahoo.com (Md.Ruhul Amin)

**Abstract:** An attempt was taken at Fulbaria Upazila, Mymensingh & Santhia Upazila, Pabna in Bangladesh with 25 (1987-2009) years of climatic data (temperature, rainfall, relative humidity) and Visceral Leishmaniasis incidence to observe correlation between climate variables and Visceral Leishmaniasis prevalence. The prevalence of the disease was increased with the rise of yearly average maximum temperature and yearly average relative humidity at Fulbaria. Negative association was found between Visceral Leishmaniasis incidence and yearly average minimum temperature, yearly average temperature & yearly total rainfall in both the study areas. At Santhia, the disease prevalence was found to have negative correlation with yearly average maximum temperature and with the rise of yearly average humidity the prevalence was increased.

## 1. Introduction

The functioning of many ecosystems may be influenced by climate change which is one of the most significant environmental issues of the present world (Chowdhury and Debsharma, 1992). Visceral Leishmaniasis (VL) commonly known as Kala-azar is a public health problem in Bangladesh with the highest disease burden in the Mymensingh District (WHO, 2003). The disease is caused by the leishmania parasite and transmitted by sand fly bites (Napier, 1996). Kala-azar almost disappeared during 1961-1970, presently the disease reported from 139 upazillas in 45 districts of Bangladesh (Martens, et al., 1995). Thomson et al (1999) reported that historically Kala-azar is endemic in Bangladesh. In the sixties and very early seventies DDT spraying under the malaria eradication programme successfully controlled Kala-azar transmission in Bangladesh (Burton, 1997). In the late 1970s, Kala-azar reappeared in Bangladesh sporadically (Ericksen et al., 1996).Lower socio-economic group from rural areas are suffering from the disease, approximately 54% of total cases are from Mymensingh district; Pabna, Tangail and Jamalpur will add 25% cases (Ahluwalia et al., 2003). Sand fly, vector of the disease, prefers breeding in alluvial soil with high sub-soil water table, temperatures ranging from 7 to 37°C, and Relative Humidity (RH) above 70% (Addy and Nandy, 1994). Relative Humidity and temperature influence the life cycle of sand flies (Dhanda et al., 1982).The distribution and abundance of pathogens may be determined by various climatic factors, e.g. temperature, humidity, rainfall, sunshine, wind, atmospheric pressure, etc(IPCC,2007).As transmission of disease may be influenced by climate-related changes in life-cycle dynamics of pathogens (Githeko et al., 2000). So, it is important to explore the correlation between various data on climate and Kala-azar prevalence.

## 2. Material and Methods

Data (monthly) on temperature, rainfall and relative humidity for Mymensingh and Ishwardi in Bangladesh over the period 1987-2009 were collected from Bangladesh Meteorological Department and converted into yearly average maximum & yearly average minimum temperature, yearly average temperature, yearly total rainfall and yearly average relative humidity. Climatic parameters i e, temperature, rainfall and relative humidity of Mymensingh and Ishwardi meteorological station were used for Fulbaria and Santhia respectively. Data of Kala-azar incidence for both these areas during the period were collected from MIS, DGHS, Mohakhali, Dhaka. Yearly average maximum & minimum temperature, yearly average temperature, yearly total rainfall, yearly average relative humidity and Kala-azar prevalence were compared and analyzed. To find the association between Kala-azar prevalence and climatic parameters, the Pearson's correlation was applied.

## 3. Results and Discussion

### 3.1. Climate variables in Fulbaria: Effects on Kala-azar incidence

### 3.2. Climatic parameters

Yearly average temperature and yearly average maximum temperature increase by 0.012°C and 0.01°C per annum respectively and per annum estimated regression of yearly average minimum temperature over the period from 1987-2009 is marked by increasing trend of 0.034°C (Figure 1).Yearly total rainfall decreases by 2.40 cm. The highest (283cm) and the lowest (132cm) yearly total rainfall were observed in 1988 and 1992. The yearly average relative humidity is marked by an increasing trend of 0.05% during the study period. The highest yearly average relative humidity (83%) was in 2000 & 2009.

### 3.3. Correlation between Climate characteristics and Kala-azar incidence

Correlation coefficients between climate factors and Kala-azar have been calculated. In the study area, Table 1 shows Kala-azar were found to have negative correlation with yearly average minimum temperature (-0.18), yearly average temperature (-0.35) and yearly total rainfall (-0.03), and to have positive correlation with yearly average maximum temperature (+0.11) and yearly average humidity (+0.69).The trends of Kala-azar and climatic parameters for the period of 1987-2009 are also shown in graphical presentation. Figure 2 represents positive correlation between Kala-azar and yearly average maximum temperature, yearly average humidity.

### 3.4. Climate variables in Santhia, Pabna: Effects on Kala-azar incidence

From 1987-2009, regression of yearly average temperature shows an average rise of 0.009ºC (Figure 3) and the highest temperature(31.49ºC) was in 1987 and 1999 and the lowest yearly avg. min. temperature(19.46 ºC) was observed in 1989.The yearly avg. min. temperature is also found by an increasing trend of 0.04ºC.

### 3.5. Climate variables

Figure 3 shows total rainfall is in increasing trend over the study period from 1987-2009.The estimated simple regression of yearly average max.temperature shows an average decrease of 0.31ºC per annum over the mentioned period. The highest yearly total rainfall (175cm) and the lowest (87cm) were observed in 1990 and 2002 respectively. Regression of humidity shows an average rise of 0.08% per annum. Over the study period, the highest difference, 7% was observed between the highest and the lowest yearly average humidity.

### 3.6. Correlation between Climatic Parameters and Kala-azar incidence

Kala-azar is negatively correlated with 3 climate parameters out of used 4 (Table 1 and 2). Table 2 represents Kala-azar incidences were found to be negatively correlated with yearly average maximum temperature (-0.016), yearly average minimum temperature (-0.080), yearly average temperature (-0.322) and yearly total rainfall (-0.108) over the period. The positive correlation of Kala-azar was observed with yearly average humidity (+0.573).

**Table 1.** Correlation between Kala-azar and climatic parameters of Fulbaria, Mymensingh district are shown below.

| Climate characteristics | | Value of Correlation Coefficient |
|---|---|---|
| n=25 | Yearly average maximum temperature | + 0.105 |
| | Yearly average minimum temperature | - 0.179 |
| | Yearly average temperature | - 0.352 |
| | Yearly total rainfall | - 0.033 |
| | Yearly average humidity | + 0.692 |

**Table 2**. Results of correlation analysis between climate related variables and Kala-azar cases of study area Santhia, Pabna

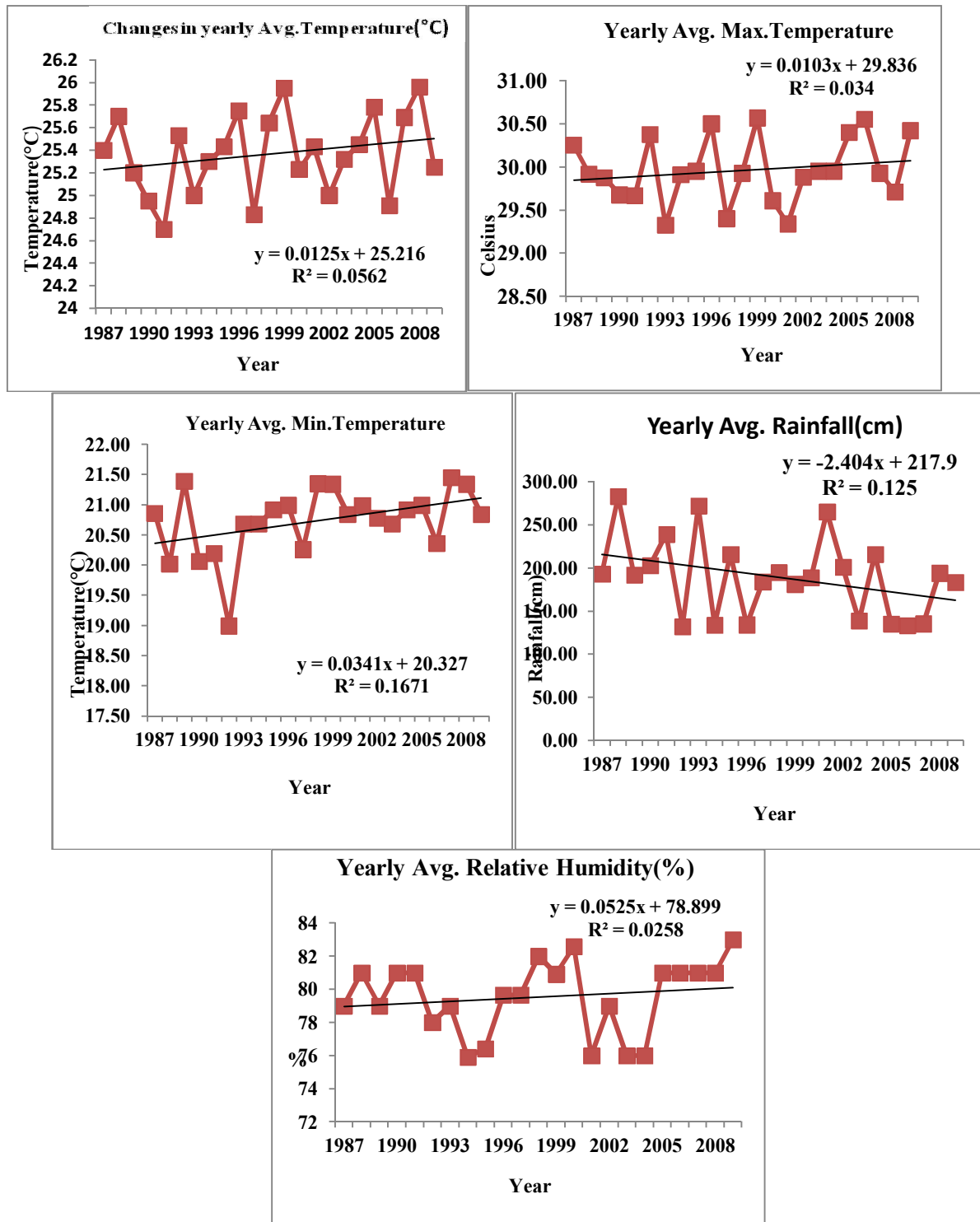| Climatic parameters | | Value of Correlation Coefficient |
|---|---|---|
| n=25 | Yearly average maximum temperature | - 0.016 |
| | Yearly average minimum temperature | - 0.080 |
| | Yearly average temperature | - 0.322 |
| | Yearly total rainfall | - 0.108 |
| | Yearly average humidity | + 0.573 |

**Figure 1.** Regression of yearly Avg. max. temperature, yearly Avg. min. temperature, yearly  average temperature, yearly total rainfall and yearly average humidity in Fulbaria
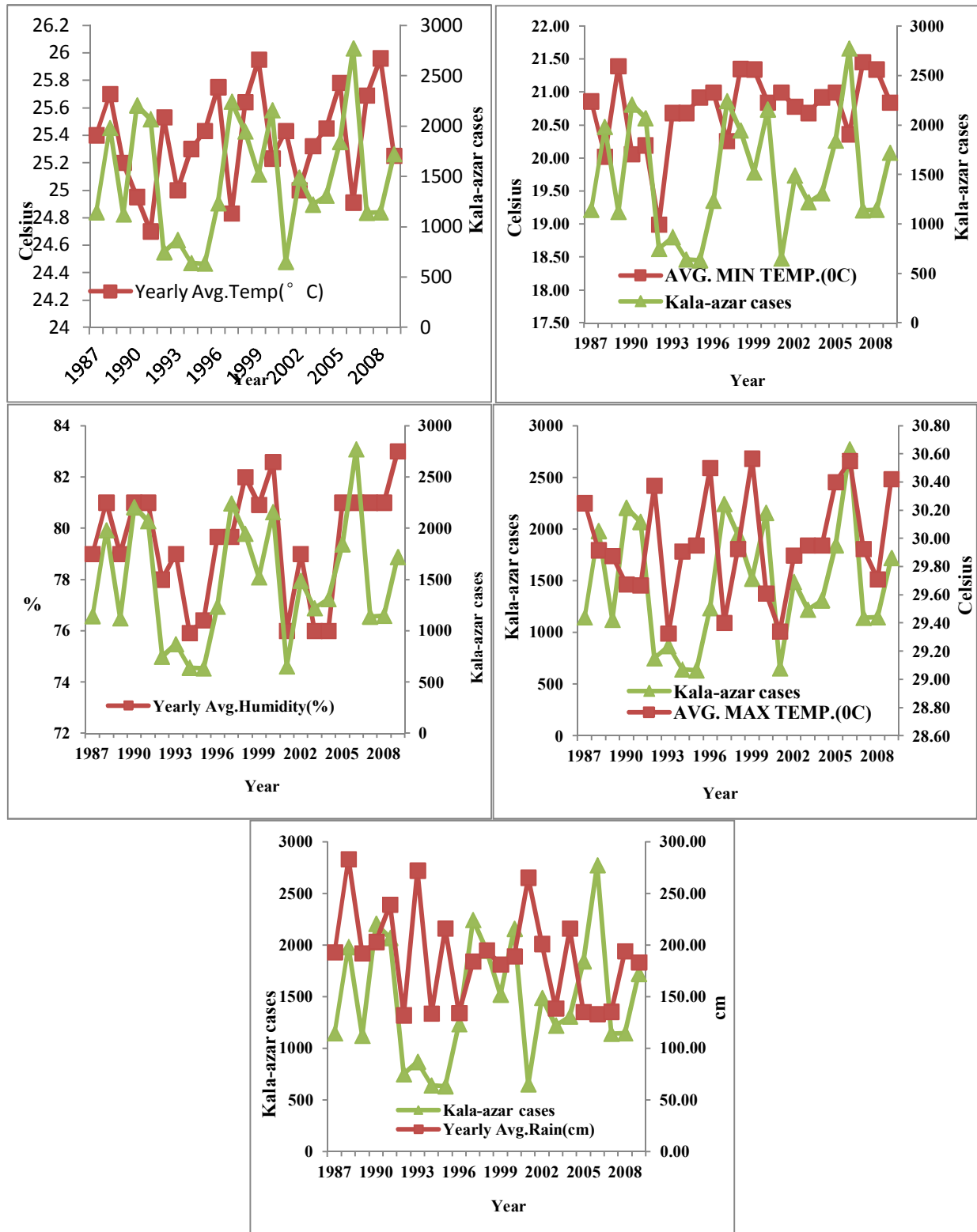
**Figure 2.** Trend of Climate variables and Kala-azar cases in Fulbaria from 1987-2009
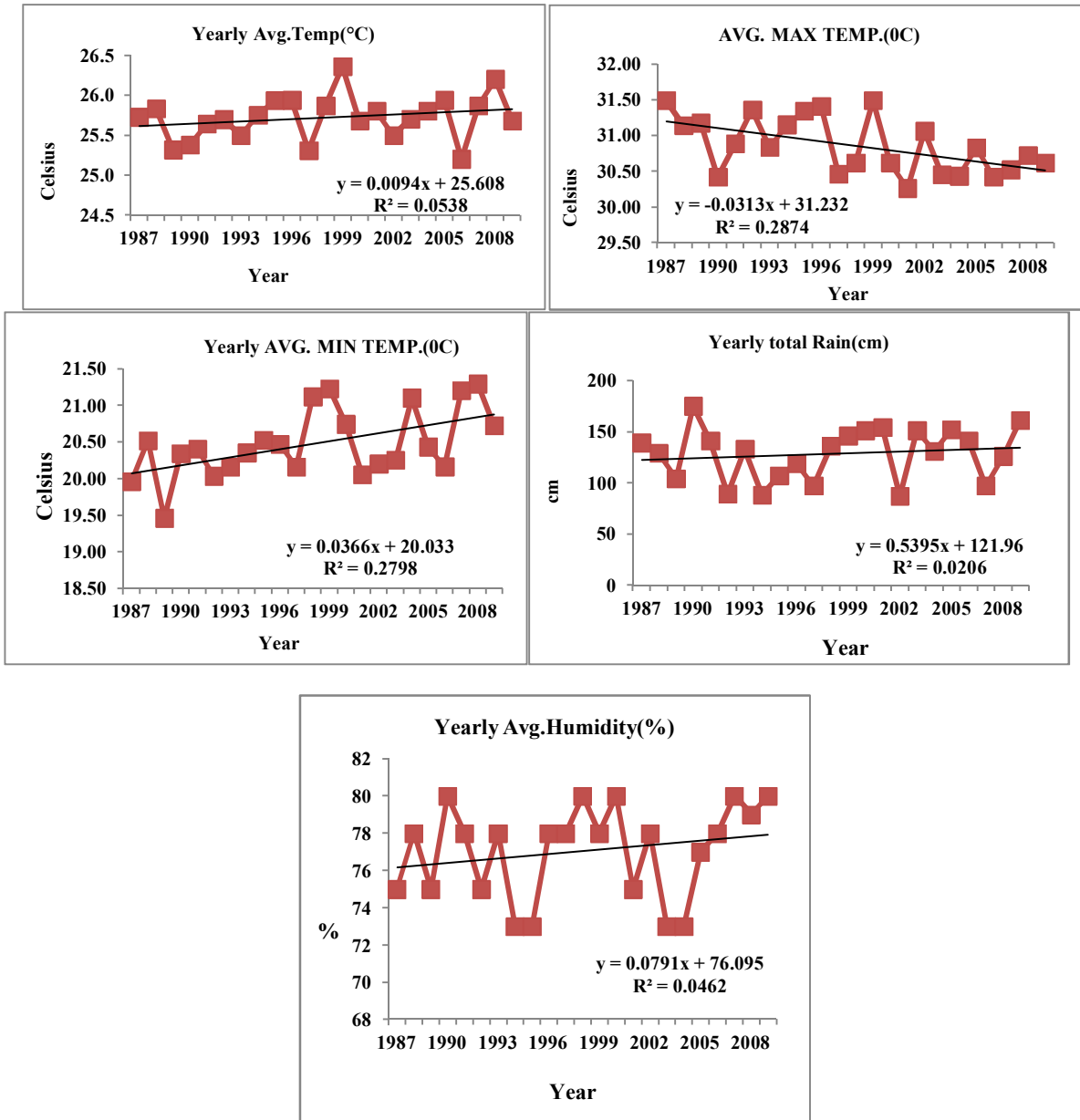
**Figure 3.** Trend of Climate variables in Santhia, Pabna from 1987 – 2009
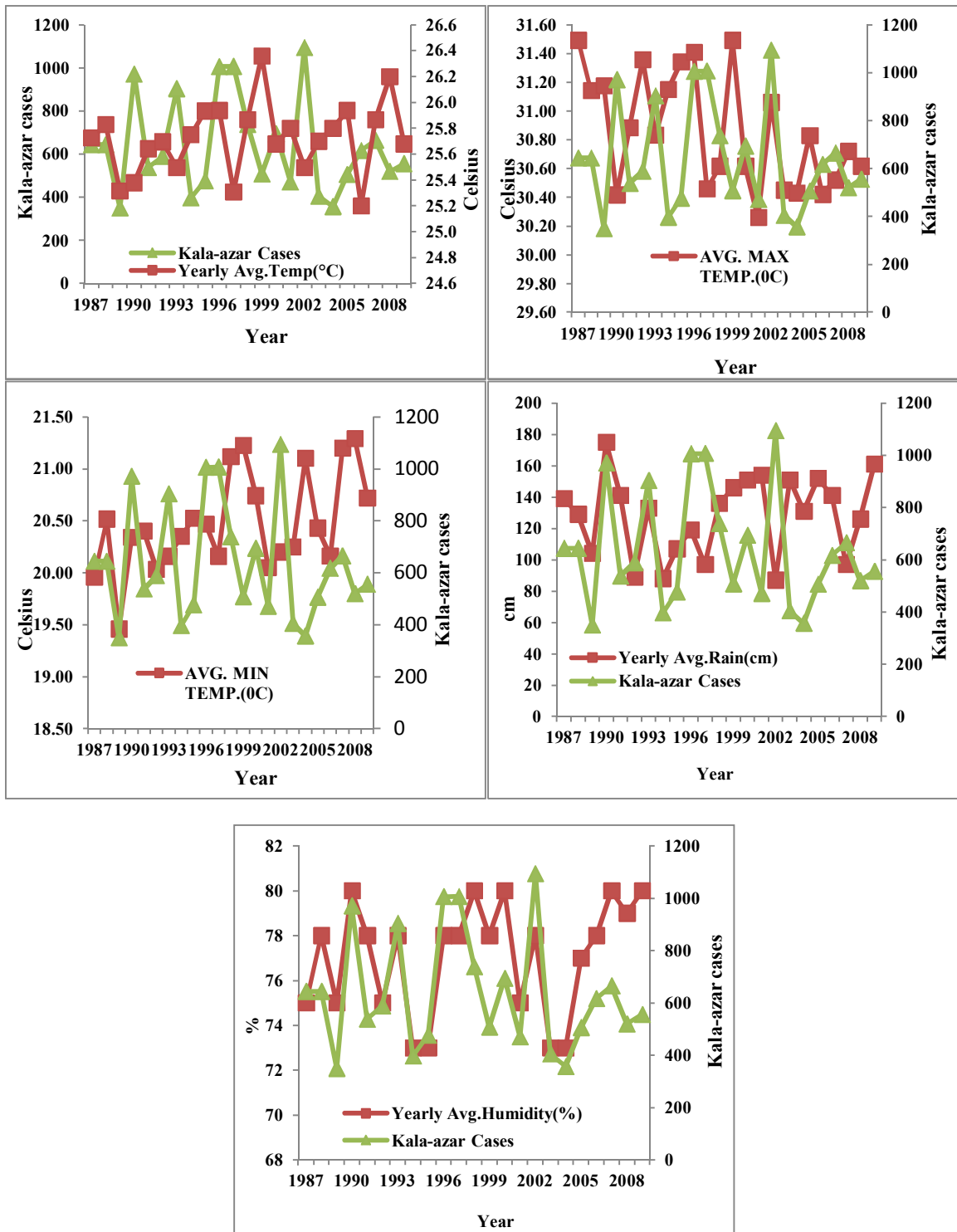
**Figure 4:** Trend of climate variables and Kala-azar incidences in Santhia, Pabna for the period of 1987-2009

**Corresponding Authors:**
Md. Ruhul Amin
Department of Environmental Sciences
Jahangirnagar University, Savar, Dhaka-1342
E-mail: ruhul_happy01@yahoo.com

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