Project ID 512

Competitive Research Grant (CRG)

Sub-Project Completion Report

on

Development of a sustainable agricultural risk management technology in areas affected by flash flood using numerical climate modeling data analysis

Project Duration

May 2017 to September 2018

Department of Agricultural Construction and Environmental Engineering
Faculty of Agricultural Engineering and Technology
Sylhet Agricultural University
Sylhet-3100

Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Bangladesh

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Acronyms

ANNs	=	Artificial Neural Networks
BARC	=	Bangladesh Agricultural Research Council
BBS	=	Bangladesh Bureau of Statistics
BMD	=	Bangladesh Meteorological Department
BRRI	=	Bangladesh Rice Research Institute
BWDB	=	Bangladesh Water Development Board
DAE	=	Department of Agricultural Extension
EdGCM	=	Educational Global Climate Model
EVA	=	EdGCM Visualization Application
F	=	Fahrenheit
FFEWS	=	Flash Flood Early Warning System
GCM	=	Global Climate Model
GPS	=	Global Positioning System
HILIP	=	Haor Infrastructure and Livelihood Improvement project
IPCC	=	Intergovernmental Panel on Climate Change
K	=	Kelvin
mm	=	Millimeter
MS	=	Microsoft
NASA	=	National Aeronautics and Space Administration
OLS	=	Ordinary Least square
PRECIS	=	Providing Regional Climates for Impact Studies
ppm	=	Parts per million
SDSM	=	Statistical Downscaling Model
SPARSO	=	Space Research and Remote Sensing Organization
SPSS	=	Statistical Package for the Social Sciences
sq. km	=	Square Kilometer
^{o}C	=	Degree Celsius
et al.	=	et alii (and others)
i.e.	=	id est (that is)

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Executive Summary

Development of a sustainable agricultural risk management technology in areas affected by flash flood using numerical climate modeling data analysis, a sponsored public goods research project, received funding from the NATP of Bangladesh Agricultural Research Council. This project has officially launched on 14 May 2017 through the signing of a letter of agreement. The project received an approval of budget Tk. 25,00,000/- for a period of 17 months. Aiming to develop a suitable precaution strategy in minimizing the negative impacts of flash flood on Boro crop through the characterization of climate as well as the identification of its anomalies in the short and medium range weather forecasts along with long-term climate predictions by global climate models. The objectives are achieved through the development of a flash flood trend and a flash flood precaution tool which may result in a precaution strategy for mitigating the agricultural risk of such natural disasters. Project personnel is recruited on time. Hence, procurement plan also completed according to the committed time framework. Due to the geographical location and scarcity of relevant local data of the study area the precise prediction of the trend of flash flood could not be possible. Thus, this study approaches for meteorological parameter assessment with global climate data. Three climatic parameters (precipitation, temperature and cloud fraction) are considered to evaluate their individual and combined effect on flash flood events. Downscaling is a state-of- the-art technique to generate high-resolution climate change prediction from coarse resolution of global climate model results and an obvious tool for forecasting future climate scenario at the local scale. Therefore, an attempt has been made to explore a new statistical approach with the help of user-friendly transform software to downscale the global climate model EdGCM. Arc GIS 10.5 spatial analyst tool and transform software interpolation produced the same results. The trend in temperature, rainfall and cloud at seasonal scales have been analyzed using BMD data, CCSM data and downscaled data. EdGCM Downscaled and observed data for Sylhet region indicates a better correlation between the predictor and predictand variables. Among them temperature and cloud value are more matchings in Pre-monsoon season (March-May). The CCSM and EdGCM downscaled temperature value are more similar for Sunamganj region.As there are only limited numbers of observation stations, so prediction on observation stations may mislead the information but increase in number of observation stations may generate valid data. To identify the flash flood occurring period a trend evaluation was performed. Mann-Kendall trend analysis test result transpired increasing trend for rainfall and decreasing trend for temperature and cloud fraction in the study area. The flashflood has been categorized to normal flash flood and devastating flash flood. In the month of March and April the flash flood was observed to be devastating. If there is peak temperature then small amount of rainfall can lead to flash flood with little cloud fraction present. So, the study revealed a relationship in EdGCM downscaled data among these three parameters. When the temperature is greater than 76°F, rainfall is minimum 3 mm and cloud fraction is maximum 46% then flash flood occurs e.g. more recently year 1998, 2002, 2012, 2016, 2017. According to this setup condition, no devastating flash flood is predicted for the year 2019 and 2020. In addition, impact of flash flood on *Boro* yield also analyzes in SPSS. Furthermore, an algorithm was developed in C++ programme as a flash flood precaution tool which helped to prepare strategy as well as to adapt with the flash flood in the study area.

G63CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:**"**Development of a sustainable agricultural risk management technology in areas affected by flash flood using numerical climate modeling data analysis."**
2. **Implementing organization:**

   Department of Agricultural Construction and Environmental Engineering
   Faculty of Agricultural Engineering and Technology
   Sylhet Agricultural University
   Sylhet-3100

3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s):**

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4. **Sub-project budget (Tk):**

   4.1 Total: 25,00,000/-

5. **Duration of the sub-project:**

   5.1 Start date (based on LoA signed): 14 May 2017
   5.2 End date: 30 September 2018

6. **Justification of undertaking the sub-project:**

   Flash floods arise from intense storms dropping large amounts of rain within a short duration with little or no warning. The occurrence of flash flooding is of concern in hydrologic and natural hazards science due to the top ranking of such events among natural disasters in terms of both the number of people affected globally and the proportion of individual fatalities (Borga, 2011). Due to the socio-economic development, flash flood casualties and damages potentiality is also increasing in many regions, which imply pressure on land use. Global warming has a great impact on intensifying the global hydrological cycle. Consequently, the increasing impacts of global change on climate followed by severe weather in the form of heavy rains and river discharge conditions results in frequent and severe flash flood hazard. The high-risk potential of flash floods is related to its sudden nature of the response and to the spatial dispersion of the areas which may be impacted by these floods. These characteristics of flood limit our ability toissue a timely flood warning. However, this type of flood is a common phenomenon in the

early rainy season at the substantial part of Bangladesh belongs to a low-lying delta formed by three international rivers, the Ganges, the Brahmaputra and the Meghna. In particular, these types of frequent flooding, caused by sudden on rush of waters from upstream India, remain a source of perennial concern for the haor belt's farmers. The main source of income of the farmers of this area solely depends on the rice production in the dry season. If the harvesting season of this rice crop followed by flash flood, dramatically unstable the livelihood of the inhabitant of this area. Sometimes, farmers in that belts have had difficulty in growing crops. In this regard, the characterization of climate as well as the identification of its anomalies and their influence on crops, the short and medium range weather forecasts along with long-term climate predictions may be the most powerful tools to mitigate the problems immediately. Therefore, research is needed to develop a suitable adaptation technology in managing cultivation in flash flood affected areas.

7. **Sub-project goal:**

Development of a sustainable integrated adaptation framework to avoid negative effect in the crop production under different climate change scenarios in the flash flood prone areas

8. **Sub-project objective (s):**
   - ❖ Develop precise forecasting trend to increase awareness about flash flood/climate using numerical model projection data.
   - ❖ To suggest a precaution strategy in order to minimize negative effect of crop production based on prediction.
9. **Implementing location (s):**Sylhet, Sunamganj, Maulovibazar
10. **Methodology in brief:**

10.1 Study area: This research has been conducted at the haor areas of Sunamganj, Sylhet and Moulvibazardistricts in the Sylhet division (Figure 10.1).

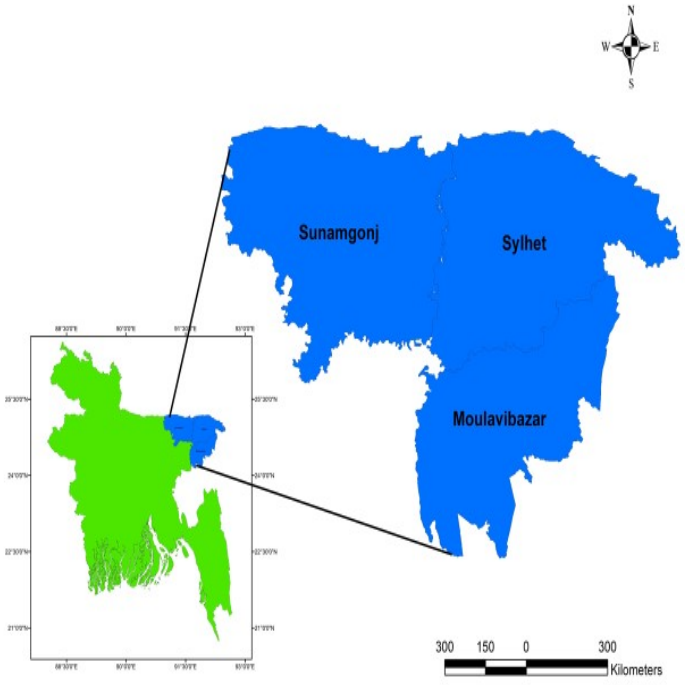


Figure 10. 1 Study Area

Sylhet's climate is classified as tropical. Rainfall is significant most of the months of the year and the short dry season has little effect. The annual average rainfall is varied from 7.79 to 10.76 mm. The Köppen-Geiger climate classification is Am. The average annual temperature of this area from 24.7 °C to 25 °C. The study area is bordered by Khasia and Jaintia hilly area of Meghalaya (Indian State) to the north of Sunamganj and Sylhet district, Assam on the east of Sylhet and Moulvibazar district and Tripura in the south of Moulvibazar district.So, the meteorology of the study area is influenced by the Indian climate. The location and climate data of the study area is given at the Table 10.1.

Table10. 1 Location and Climate data of the study area

Location	Longitude	Latitude	Total area (km^2)	Annual average rainfall (mm)	Annual average temperature (°C)
Sylhet	91.8687°E	24.8949°N	3490.40	10.76	24.8
Sunamganj	91.3992 °E	25.0715°N	3747.2	9.35	25
Moulvibazar	91.7315°E	24.3095°N	2799.38	7.79	24.7

Source: (Wikipedia)

10.2 Basic feature of the study area: About 50% of the study area is low land which is comprised of numerous haor areas. This area is frequently inundated by the flash flood and river flood. Figure 10.2. shows the inundation map of the study area.

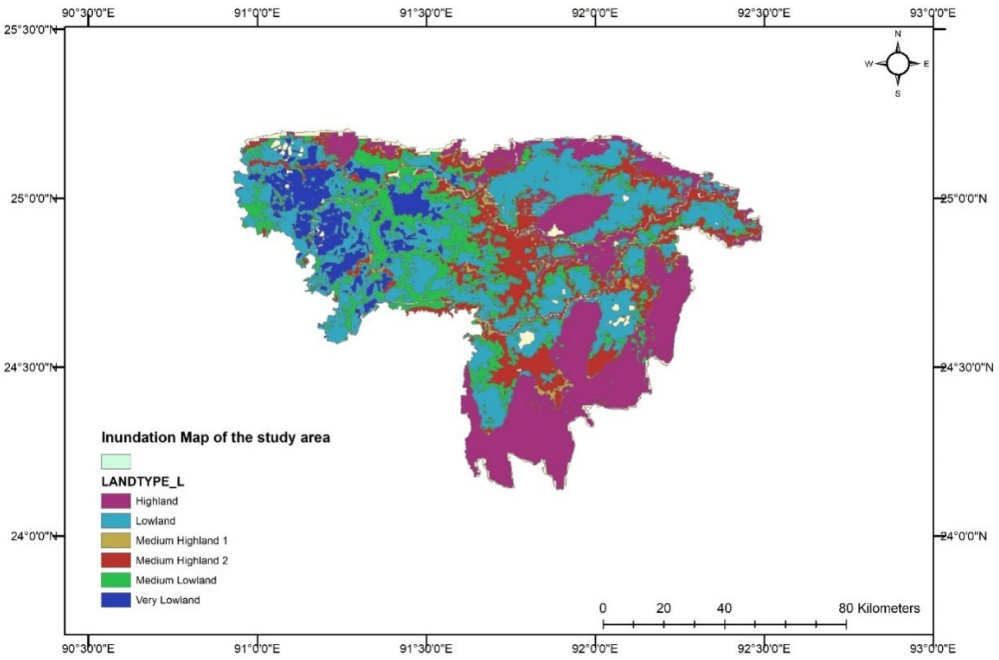


Figure 10. 2. Inundation map of the study area (Source: BARC)

Therefore, these haor areas need unique supervision of weather to forecast the yield and cropping pattern. Distribution of haors and areas under study area is depicted in the Table 10.2.

Table10. 2 Distribution of Haors and areas under study Area

District	Upazila	Total area (ha)	Haor area (ha)	No. of Haors
Sunamganj	Sunamganj Sadar, Jagannathpur, Dharmapasha, Jamalganj, Chhatak, Derai, Salla, Tahirpur, Bishambarpur	367000	268531	133
Sylhet	Jaintiapur, Beanibazar, Fenchuganj, Balagonj, Biswanath	349,000	189909	43
Moulvibazar	Moulvibazar Sadar, Kulaura, Rajnagar, Sreemangal	279900	47602	4
Total		995900	506042	180

Source (Banglapedia)

As floods are a common phenomenon in the study area, so the cropping intensity is below 200 %. Distribution of cultivated land, land use pattern and cropping intensity of study area are illustrated in Table 10.3

Table10. 3Distribution of cultivated land, land use pattern and cropping intensity of study area

District	Total cultivated land (million ha)	Land area under Haor (million ha)	Cultivated land under Haor		% of cropped area under			Cropping intensity (%)
			(million ha)	% of Haor area	Single cropping	Double cropping	Triple cropping	
Sunamganj	0.20	0.18	0.14	78	44	23	3	143
Sylhet	0.21	0.05	0.03	60	28	30	4	160
Moulvibazar	0.13	0.09	0.02	22	22	32	5	171
Total	0.54	0.32	0.19	160	94	85	12	474

Source: (Banglapedia)

The major cropping pattern of the study area is given below:

Table10. 4 Major cropping patterns in the haor areas of the study area

District	Major existing cropping patterns	% Area under the pattern	Possible cropping patterns	Exploitable area under pattern (%)
Sylhet	Boro-Fallow-Fallow	60	--	--
	Fallow-Fallow-T.Aman	10	Rabi crop-Fallow T.Aman	90
	Boro-Fallow-T.Aman	21	--	--
	Fallow-Fallow-B.Aman	05	Rabi crops-B.Aman	50
Sunamganj	Boro-Fallow-Fallow	80	--	-
	Fallow-Fallow-T.Aman	3	Rabi crop-Fallow T.Aman	70-80

	Boro-Fallow-T.Aman	8	--	-
	Fallow-Fallow-T.Aman	6	Vege. -Aus-T.Aman	100
Moulvibazar	Boro-Fallow-Fallow	64	Boro-Fallow-T..Aman	20
	Fallow- B.Aman-Fallow	18	Rabi crops-B.Aman-Fallow	45
	Fallow-Aus-T.Aman	7	Rabi crops-Aus-T..Aman	80

Source: DAE (Department of Agricultural Extension)

The study area is adjacent to the Cherrapunji which is renowned for its perennial rainfall. Due to the geographical location, most of the area of Sunamganj district is under hazard class of more than 50%. About 40% area of the Sylhet district is also under severe hazard. Figure 10.3. illustrate the hazard frequency of the study area.

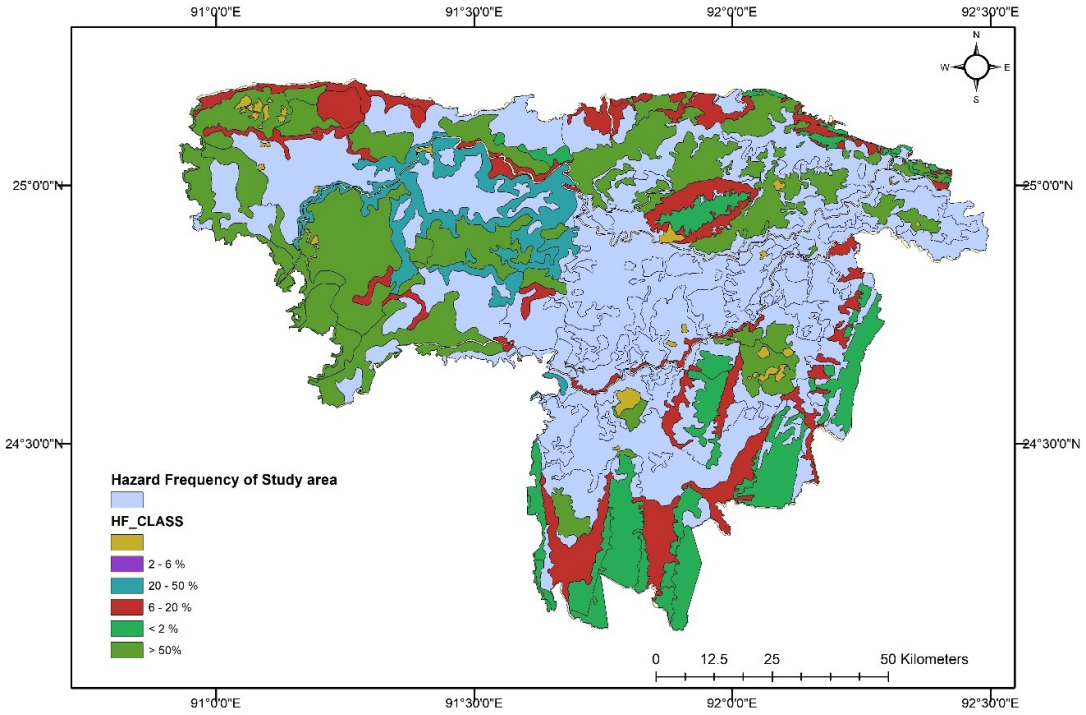


Figure 10. 3. Hazard frequency of the study area (Source: BARC)

10.3 Achievement of objective: In order to achieve the objectives of the study, the methodology (Figure 10.4) of the research consists of three parts

10.3.1 Information/Data collection

10.3.2 Analysis of collected data

10.3.3 Formulation of a precaution strategy against the effect of flashflood.

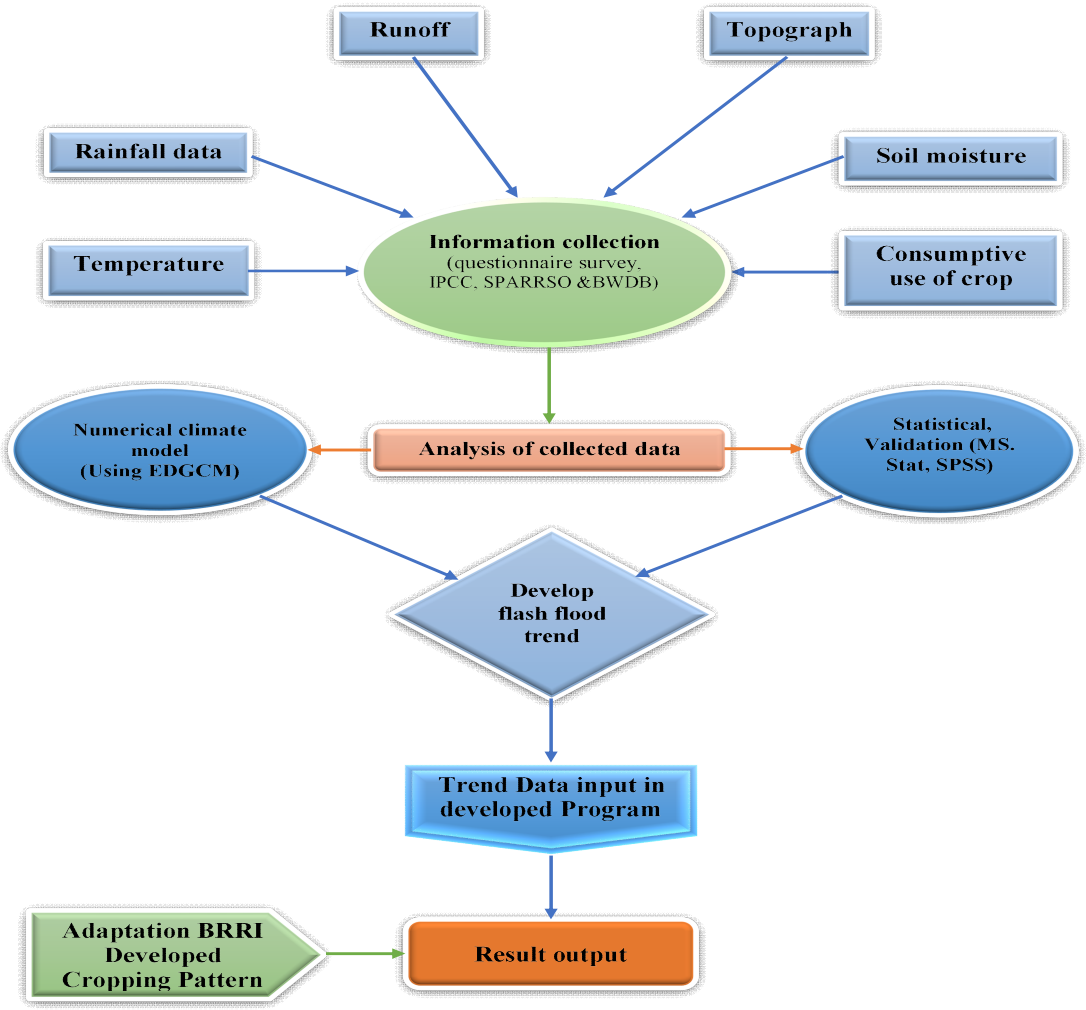


Figure 10. 4 Methodology Flow chart

10.3.1 Collection ofInformation

Collection of all the data regarding the research are listed below:

- ✓ Rainfall, temperature and cloud fraction data was considered for this study. 100 years global climate data of temperature, rainfall and cloud fraction was obtained from Educational Global Climate Model (EdGCM) software.
- ✓ The rainfall data was collected from Bangladesh Water Development Board (BWDB) for the study period of 1967 to 2017. Landsat image also purchased from Bangladesh Space Research and Remote Sensing Organization (SPARRSO)
- ✓ Rainfall, temperature and cloud fraction data was obtained from Community Climate System Model (CCSM) for the study period of 2006 to 2020. These data were produced by The Intergovernmental Panel on Climate Change (IPCC) at global scale.

- ✓ By using GPS meter location was collected from the study area during the field reconnaissance survey.
- ✓ Crop yield data, various rice diseases, fertilizer application etc. was collected from field and questionnaire survey, Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI) and Bangladesh Bureau of Statistics (BBS).

10.3.2 Analysis of collected data

Run a suitable numerical climate model such as Educational Global Climate Model (*Ed*GCM) and Community Climate System Model (CCSM) to obtain downscale data. Statistical software packages like Microsoft excel, XLSTAT and SPSS were used to obtain information about the negative effects of flash flood /climate change on crop productivity. The model selection will be performed following benchmark model selection criteria's considering the rules of "good modeling practice" (Van Waveren et al. 1999). A chain of different models and input data is being processed that act in sequence and provide decision makers with information for the preparedness as the events approach.

EdGCM (output and details): The climate model used by the *Ed*GCM software was developed at NASA's Goddard Institute for Space Studies (NASA/GISS). This 3-dimensional computer model is known as a grid-point GCM. A grid point GCM divides the atmosphere into a series of discrete grid cells. *Ed*GCM model has 7776 grid cells in the atmosphere, with each horizontal column corresponding to 8° latitude by 10° longitude and containing 9 vertical layers. The computer model numerically solves fundamental physical equations, which describe the conservation of mass, energy, momentum, and moisture in each cell, while taking into account the transport of quantities between cells. Downscaling is the state of the earth techniques which is the only device to produce local scale data for data scare region. So, this research approaches for simplified downscaling technique which can easily handle to produce local scale data from global scale data. Transform's Fill Missing Datacommand was used to replace unwanted data values with estimates of what those data values should be based on neighboring data. Spatial interpolation is a method that used here which utilize the known values at given locations to estimate a continuous surface. There are several types of spatial interpolation, including inverse distance weighting (IDW), spline, and Kriging. But kriging method only have the capability of producing a prediction surface but also provide some measure of the certainty or accuracy of the predictions because it includes autocorrelation. Due to validation of this process, this is also run at Arc GIS 10.5 using spatial annalist tool. Due to observed data scarcity in the study area both in Arc GIS and Transform software provide less value. If more stations will be installed in the study area then more precise data can be produced fromthese analyses. As kriging is the best method of interpolation and Transform software can easily done it, this software was selected for downscaling.

*Ed*GCM downscaling was done according to this flow chart in Figure 10.5.

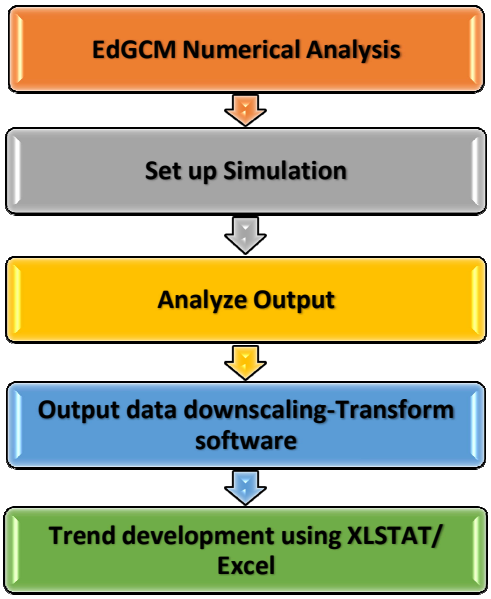


Figure 10. 5 EDGCM downscaling Flow chart

CCSM (output and details): The Community Climate System Model (CCSM) is a coupled global climate model (GCM) developed by the University Corporation for Atmospheric Research (UCAR) with funding from the National Science Foundation (NSF), the Department of Energy (DoE), and the National Aeronautics and Space Administration (NASA). The coupled components include an atmospheric model (Community Atmosphere Model), a land-surface model (Community Land Model), an ocean model (Parallel Ocean Program), and a sea ice model (Community Sea Ice Model). CCSM is maintained by the National Center for Atmospheric Research (NCAR).Its software design assumes a physical/dynamical component of the climate system and, as a freely available community model, is designed to work on a variety of machine architectures powerful enough to run the model. The CESM codebase is mostly public domain with some segregable components issued under open source and other licenses. The offline chemical transport model has been described as "very efficient". The model includes four sub models (land, sea-ice, ocean and atmosphere) connected by a coupler that exchanges information with the sub models. NCAR suggested that because of this, CCSM cannot be considered a single climate model, but rather a framework for building and testing various climate model (Wikipedia).CCSM downscaling was done according to this flow chart in Figure 10.6.

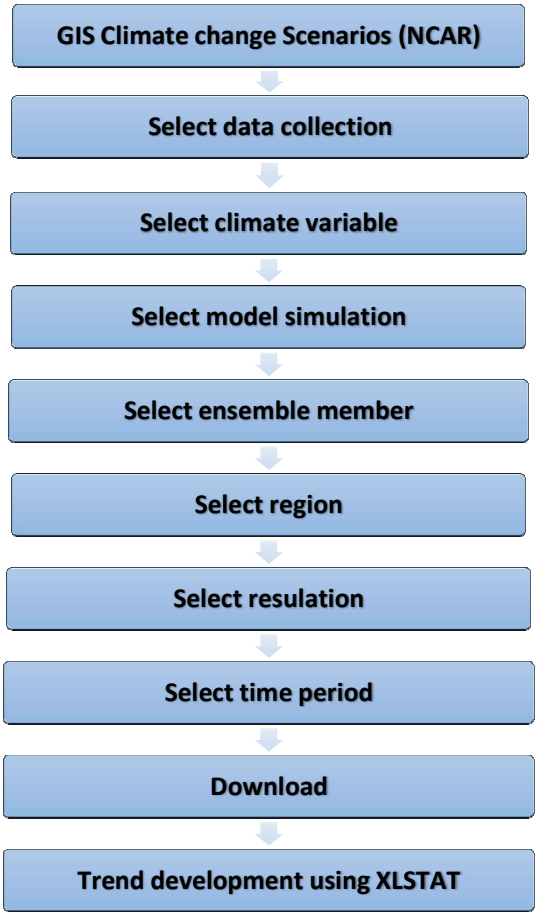


Figure 10. 6 CCSM downscaling Flow chart

Trend analysis

A steady and regular movement in a time series, through which the values are on the average increasing or decreasing, is termed as a trend (Goel, 2009). Trend analysis is used to observe trends in the time series of temperature. There are several tests to observe the trend in a time series on every climatic parameter. The test can be parametric or non-parametric. In the current study, Mann Kendall Test and Sen's slope estimator have been used in XLSTAT. Non-parametric Mann Kendall test is used to search out the presence of a monotonic increasing or decreasing trend and also the slope of the linear trend is calculated with the nonparametric Sen's methodology (Sen, 1968).

Mann- Kendall trend test

Both climatologic and in hydrologic time series Mann-Kendall trend test (Statistical test) is widely used. It is a non-parametric test and does not need the information to be normally distributed. According to this test, the null hypothesis H_0 assumes that there is no trend (the data is independent and randomly ordered) and this is often tested against the alternative hypothesis H_a, that indicates that there is a trend.

The computational method for the Mann Kendall test considers the time series of n data points and T_i and T_j two subsets of data wherever i = 1, 2, 3, n-1 and j = i+1, i+2, i+3, …, n. If a data value from a later period is higher than a data value from an earlier time period, the statistic S is incremented by 1. On the opposite hand, if the data value from a later period is less than a data value sampled earlier, S is decremented by 1. The result of all increments and decrements yields the ultimate value of S.

The Mann-Kendall S Statistic is computed as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \text{sign} T_j - T_i$$

$$\text{Sign} T_j - T_i = 1 \text{ if } T_j - T_i > 0 \text{ , } 0 \text{ if } T_j - T_i = 0 \text{ and } -1 \text{ if } T_j - T_i < 0$$

where Tj and Ti are the annual values in years j and i, j > i, respectively.

If n < 10, the value of |S| is as compared on to the theoretical distribution of S derived through Mann-Kendall. The two-tailed test is employed. At certain probability level H_0 is rejected in favor of H_1 when the absolute value of S equals or exceeds a certain value Sα/2, wherever Sα/2 is the smallest S that has the possibility less than α/2 to seem in case of no trend. A positive (negative) value of S shows an upward (downward) trend. For n ≥ 10, the statistic S is approximately normally distributed with the mean and variance as follows:

E (S) = 0

The variance (σ^2) for the S-statistic is defined by:

$$\sigma^2 = \frac{n(n-1)(2n+5) - \sum t_j(i)(i-1)(2i+5)}{18}$$

Where t_i explains the number of ties to extent i. The summation term within the numerator is employed when the data series contains tied values. The standard test statistic Zs is given by:

$$Z_s = \frac{S-1}{\sigma} \text{ for } S > 0, \ 0 \text{ for } S = 0, \text{ and } \frac{S+1}{\sigma} \text{ for } S < 0$$

The test statistic Z_s has employed a measure of the significance of the trend. This test statistic is used to check the null hypothesis, H_0. If | Z_s | is bigger than Zα/2, wherever α indicates the chosen significance level (eg: 5% with $Z_{0.025}$ = 1.96) then the null hypothesis is invalid implying that the trend is significant.

Another data point obtained on running the Mann-Kendall test is Kendall's tau. It is a measure of correlation and measures the strength of the relationship among two variables. Kendall's tau, like Spearman's rank

correlation, is carried out on the ranks of the data. For every variable on an individual basis, the values are placed in order and numbered, 1 for the lowest value, 2 for the following lowest and so on. In common with other measures of correlation, Kendall's tau can take values between ±1 and +1, with a positive correlation showing that the ranks of both variables increase together while a negative correlation shows that because of the rank of one variable increases, the opposite decreases (Karmeshu, 2012).

Hamed and Rao (1998) recommend a modified Mann-Kendall test, that computes the autocorrelation among the ranks of the data after removing the apparent trend. The adjusted variance is derived as follows:

$$\text{Var (S)} = \frac{1}{18}[N(N-1)(2N+5)]\frac{N}{NS^*}$$

$$\text{Where } \frac{N}{NS^*} = 1 + \frac{2}{N(N-1)(N-2)}$$

$$\sum_{i=1}^{p}(N-i)\,(N-i-1)(N-i-2)p_s(i)$$

N is the number of observations in the sample, NS* is the effective number of observations to the calculation for autocorrelation within the data, p_s (i) is the autocorrelation between ranks of the observations for lag i, and p is the maximum time lag under judgment. Software used for performing the statistical Mann-Kendall test is XLSTAT 2018. The null hypothesis is tested at 5% confidence level for temperature data. A comparison was done between downscaled and observed meteorological values.

Sen slope estimator

The Sen's nonparametric technique is employed to estimate the true scope of an existing trend. In the following equation, the slope N of all information pairs is calculated as (Sen, 1968)

$$N = \frac{X_{j-x_i}}{j-i}$$

where, X_j and X_i are indicated as data values at time j and i (j > i) correspondingly. The median of those n values of Q is described as Sen's estimator of slope that is derived as follows:

$$Q = T_{n+1/2} \text{ if N is odd}$$

$$Q = \frac{1}{2}(T_{n/2} + T_{n+1/2}) \text{ if N is even}$$

The Sen's estimator is computed as $Q = T_{n+1/2}$ if N seems odd, and it is considered as $Q = [T_{N/2}+T_{N+2/2}]/2$ if N seems even. In the end, Q is calculated by a two-sided test at 100 (1-α) % confidence interval and then a

true slope can be obtained by the non-parametric test. A positive value of Q indicates an upward or increasing trend and a negative value of Q provides a downward or decreasing trend in the time series.

Flash Flood trend preparation

Flash flood trend was developed using MS Excel. Final data sheet was prepared by converting the downscaled temperature unit in kelvin (K), Cloud is in percentage (%) and Precipitation is in mm/day. For better trend development the following conditions were followed for all the parameters.

- Converting the temperature to Fahrenheit using the formula

  F=K*9/5-459.67

- Precipitation is multiplying by 15 such that

  Precipitation (New)= Precipitation (original)*15

The reasons for doing this was to overlay on the same Y-axis. It still keeps to the same trend of original data.

Meteorological impact

Flash flood 2017, the severity of damages exceeds all the limit of the previous years. So, a questionnaire survey was conducted in the study area to find out impacts of the flash flood on the Boro crop production

Therefore, sample size for questionnaire survey was calculated following the equation below,

$$\text{Sample Size} = \frac{z^2 \times p(1-p/e^2}{1+(z^2 \times p(1-P)/e^2 N)}$$

Here, Population Size = N | Margin of error = e | z-score = z con, e is percentage, put into decimal form (for example, 3% = 0.03).

- ✓ Run the SPSS software to show the correlation coefficient between climatic variables and rice yield according to the season. The Ordinary least Squares (OLS) method is employed to identify the impacts of climate variation (i.e. rainfall, temperature, cloud fraction) on the yield of rice growing season for regression results. The OLS is a type of linear least squares method for estimating the unknown parameters in a linear regression model.
- ✓ For Correlation and Regression results have been used log-transformation for transforming absolute differences into relative differences. For regression analysis select two variable that is dependent and independent variable. Rice growing seasons are selected as a dependent variable (i.e. LnBoro) and three climatic parameters are selected as an independent variable (i.e. LnRainfall, LnAvg. Temp and Lncloud).

10.3.3 Formulation of Precaution Strategy: According to flash flood trend developed in the study with the impact study on *Boro* crop a more precise precaution can be made before the *Boro* season. Therefore, an algorithm was developed using C++ programme which may be used as a flash flood precaution tool. On the basis of the study a precaution strategy for minimizing the negative impacts of flash flood has been developed.

11 Results and discussion:

The research goal was to explore the factors causing flash floods in the haor areas, by studying the past flash flood data. This analysis was then applied to the downscale data of the 100 years period from January 1920 to December 2020 for our geographical areas of interest in Sunamganj district, in order to understand the likelihood of flash floods occurrence in these areas. In addition, the same procedure is followed for Sylhet district and last 50 years data (January 1970 to December 2020) was considered for this research. To develop a trend and time series graph this study adsorb a hypothesis that, increased temperature leads to an increase of flash floods. In order to test the hypothesis, the list of parameters narrowed down based on findings from studying the methods adopted by the meteorologists. In order to test the hypothesis, this research endeavored to understand the factors that cause flash floods. The nine parameters initially considered for this flash floods research: Rainfall rate, Snowfall rate, Accumulated rainfall, Ground station precipitation, Land temperature (day time), Water temperature, Vegetation, Atmosphere CO2 and Cloud cover (cloud fraction). Due to time constraint, only three parameters like rainfall rate, temperature and cloud fractions are identified to test the hypothesis of the study. Due to the scarcity of the observed data, the study expediated a step on downscaling of EdGCM and CCSM models**.**

11.1Downscaling of EdGCM output: To generate output, first EdGCM model simulations were done by pressing "control run" which established a base for assessment of all different simulations. EdGCM has in-constructed "control run" this is representative of 1920-2020. The period of 1920 has been taken as an initial year when a regular and continuous record of measure of Greenhouse Gases began. The concept of equilibrium-climate is relevant in simulations due to the fact that evaluation is most preferably possible for the no-climate-change section. EdGCM run for Global warming simulation also started from December 01, 1920 and ended on December 31, 2020. Global warming simulation of the EdGCM is also used to predict average monthly surface air temperature, average monthly rainfall and average monthly cloud fraction. In the EVA data browser of EdGCM model, "post-processing" and entails numerous steps were done. EdGCM permits introduction of global maps, zonal averages, time series plots, and diagnostic tables for 80 climate variables. There is an option to examine facts for a number of climate variables. In the evaluation step, average monthly surface air temperature, average monthly rainfall, and average monthly cloud fraction data were extracted according to latitude and longitude. Figure 11.1. shows the EDGCM output of average monthly surface air temperature, average monthly rainfall, and average monthly cloud fraction data.

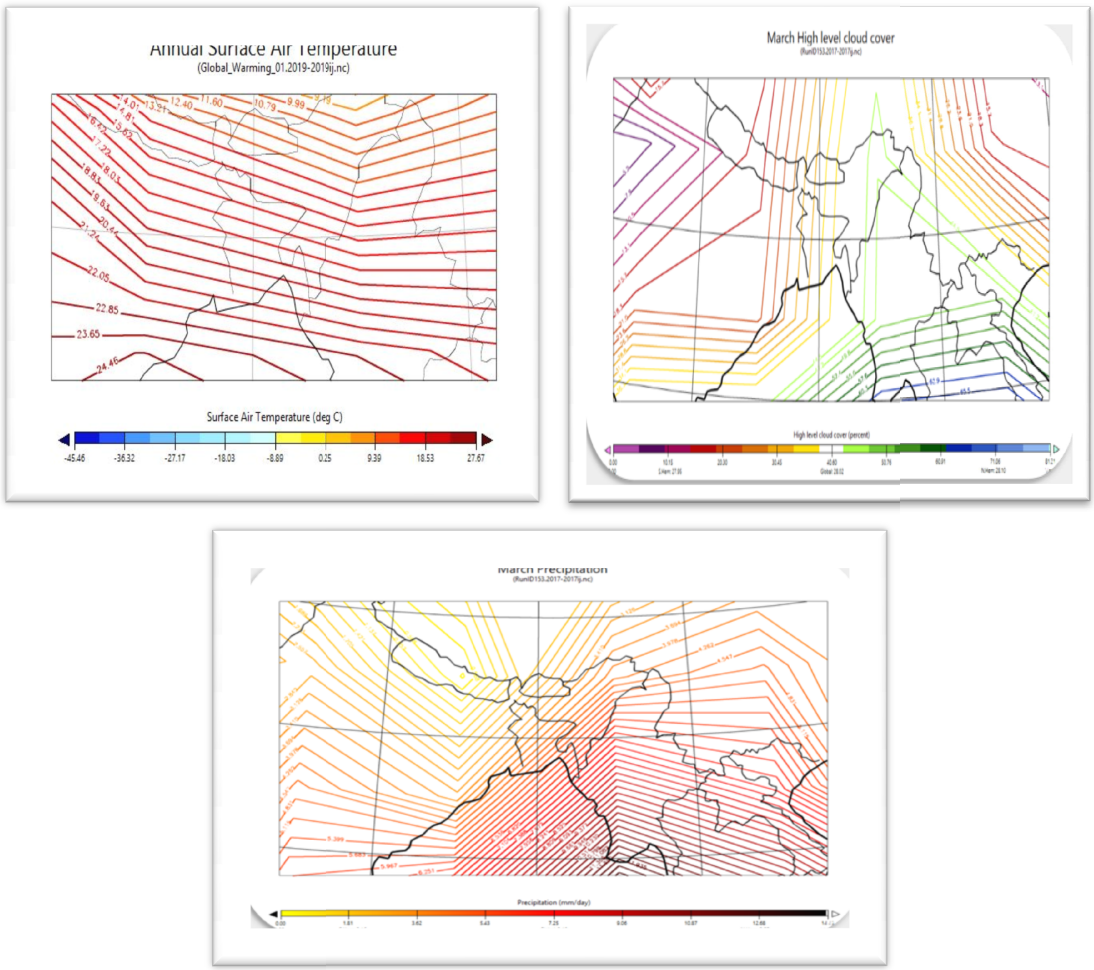


Figure 11. 1 EDGCM output of average monthly surface air temperature, average monthly rainfall and average monthly cloud fraction data

Downscaling of climate change data was conducted using transform software. The downscale output feature of Transform is shown in Figure 11.2.

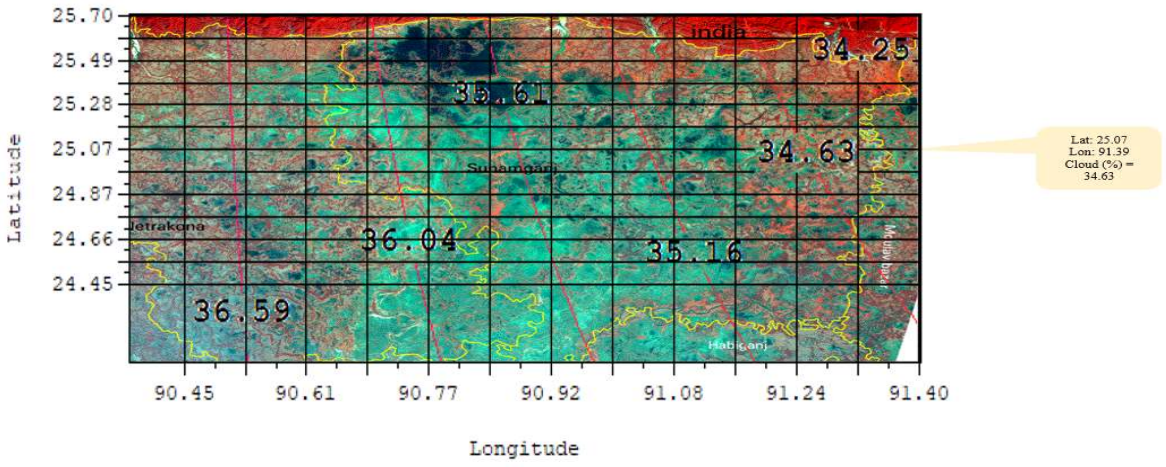


Figure 11. 2Downscale output feature of Transform

Downscale climate data from EdGCM for Sunamganj and Sylhet district is given in **Appendix 1.**

11.2 Downscaling of CCSM: CCSM can produce average monthly surface air temperature, average monthly rainfall and average monthly cloud fraction data according to latitude and longitude, the data was collected using the work place Figure 11.3.

Figure 11. 3 CCSM work place

Downscale climate data from CCSM for Sunamganj and Sylhet district is given in **Appendix 2.**

As there is only one weather station of Bangladesh Meteorological Department for collecting temperature and rainfall data whereas the station could not provide any cloud fraction data. In addition, Bangladesh Water Development Board generate continuous rainfall data for Sunamganj District from only one station. So, the study considers downscale data of EdGCM and CCSM model for flash flood trend development. Here, CCSM only provides data for the year 2006 to 2020. So, the variations in data were observed for 2006 to 2020 for EdGCM downscale data, CCSM downscale data, and local scale data. As the probability of flash flood is higher in the pre-monsoon season. Here, Figure 11.4 and 11.5 depicted the trend of the climatic parameter for pre-monsoon season derived from EdGCM downscale output. Here, Figure 11.5 and 11.6 depicted the trend of the climatic parameter for pre-monsoon season derived from CCSM downscale output.

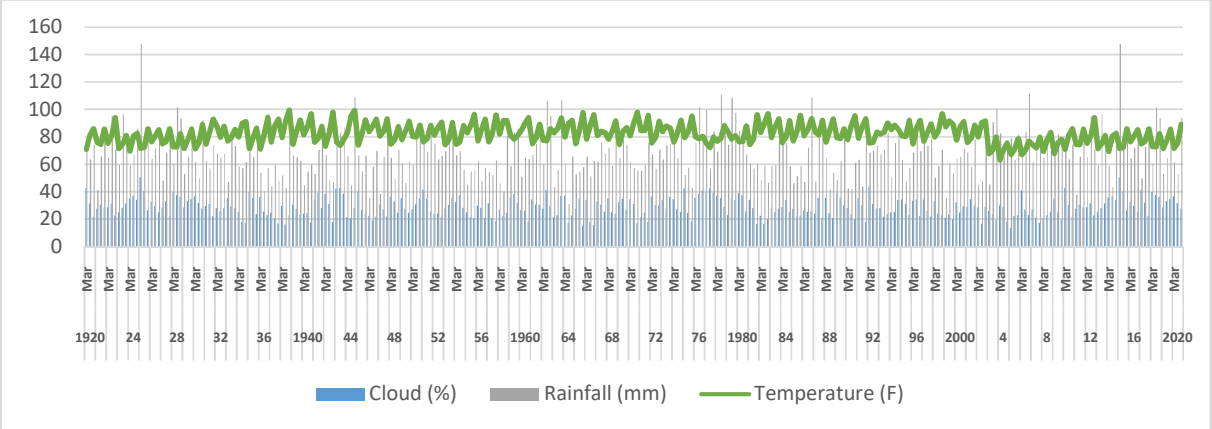


Figure 11. 4 EdGCM trendline for Sunamganj District

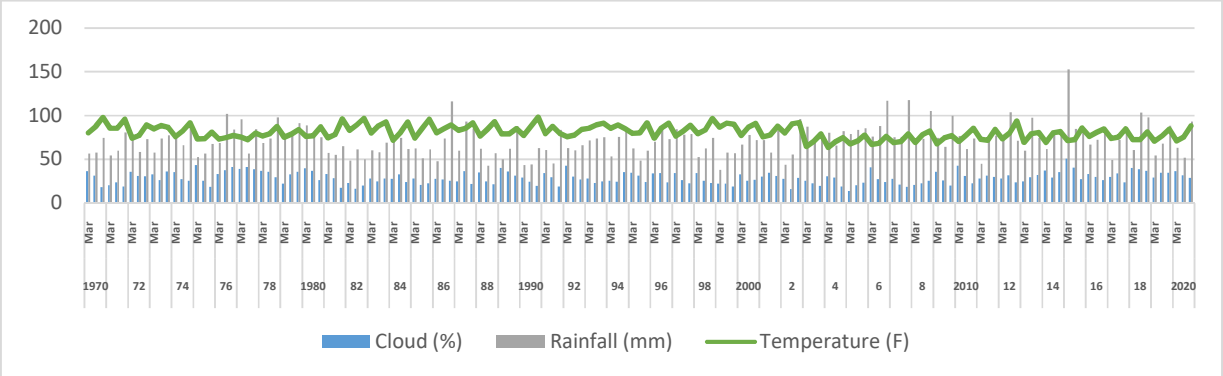


Figure 11. 5 EdGCM trend line for Sylhet District

The above graphs (Figure 11.4 and Figure 11.5) show the combination of the three parameters for the Sunamganj (1920 to 2020) and Sylhet District (1970 to 2020).

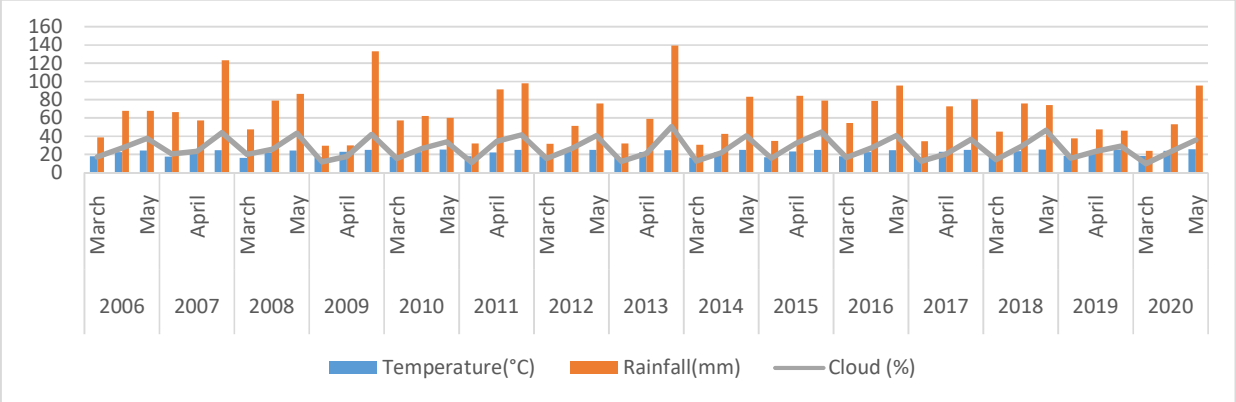


Figure 11. 6 CCSM trend line for Sylhet district

The above graph shows the combination of the three parameters for the Sylhet District from 2006 to 2026.

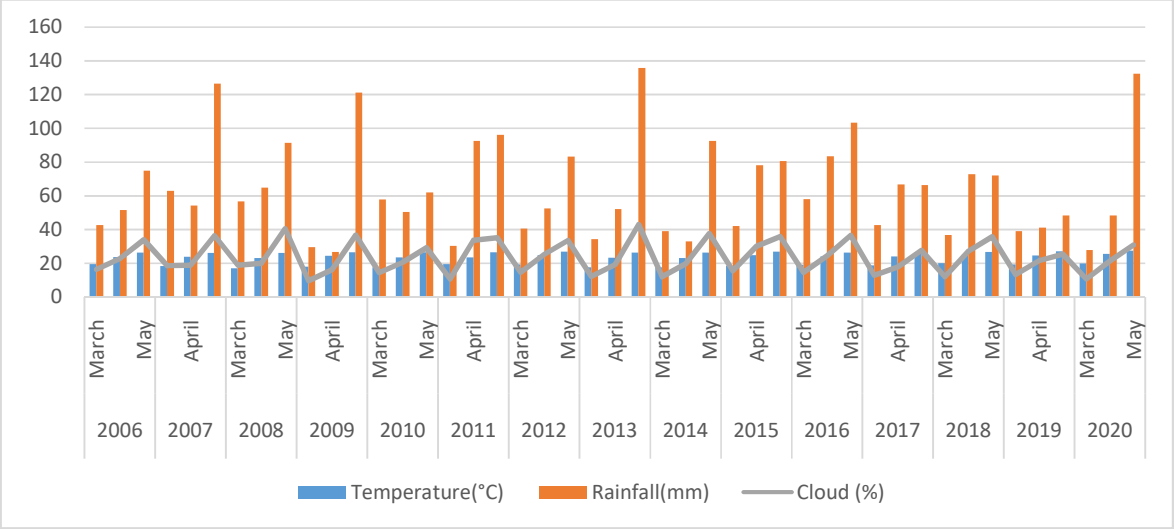


Figure 11. 7 CCSM trend line for Sunamganj district

From the combination of the three parameters data, it was found that in the year 2013 and 2020 there was extreme rainfall.

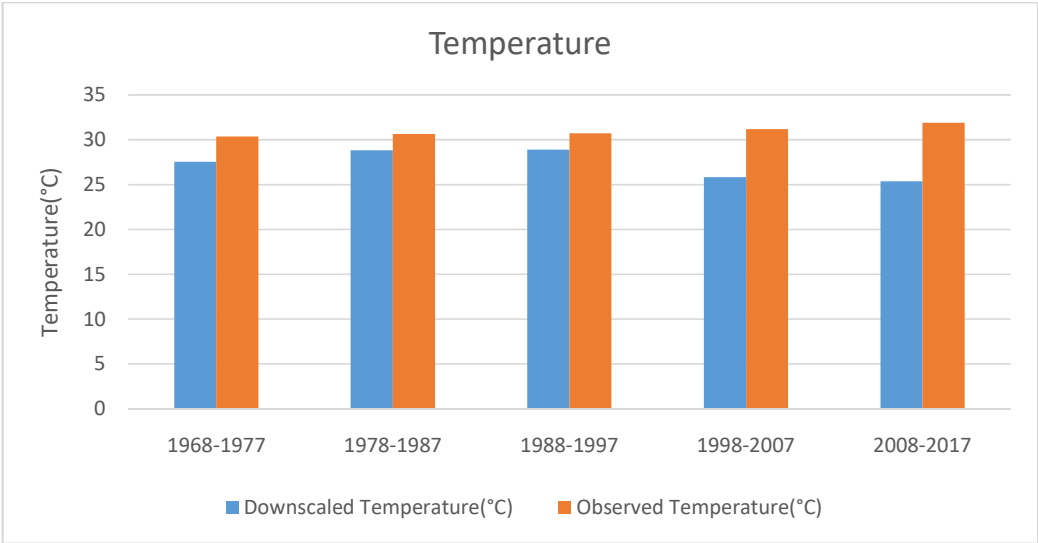


Figure 11. 8 EdGCM Downscaled and observed predicted average Pre-monsoon temperature (°C)

For Sylhet district, the trend of downscaled and observed data shows a similar type of variability which indicates a better correlation between the predictor and predictand variables. The downscaled and observed data shows similar performance for a duration (1978-1987) and (1988-1997). The downscaled and observed value are more matchings in this case. The performance of the downscaled is also satisfying in (1968-1977). In Sylhet, the downscaled fails to capture the same variability as observed value for a period (1998-2007)

and (2008-2017). As the EdGCM grids are at a distance of 8^0x10^0, so the distance is very high to capture the exact scenario. But lack of observation station also weighed on observed value. Therefore, the variations are high in downscaled and observed value.This type of anomaly was found in the downscaling data obtained by PRECIS(Providing Regional Climates for Impact Studies)(URL-1)

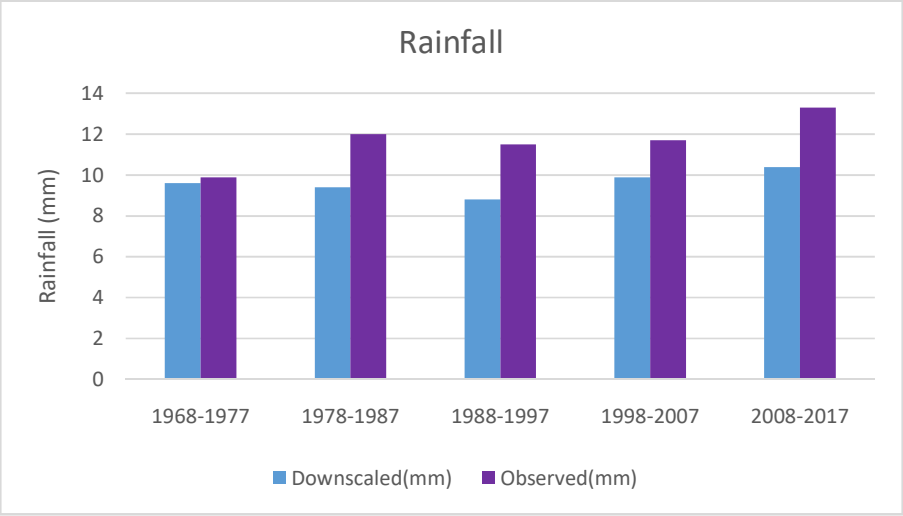


Figure 11. 9 EdGCM Downscaled and observed predicted average Pre-monsoon rainfall (mm)

The data presented here for the downscaled and observed period (1968-2017). The downscaled and observed value are more matchings for period (1968-1977). Downscaled value does not show well performance from the period of 1978 to 2017. So, the model performance is quite satisfactory.This type of anomaly was found in SDSM (Statistical Downscaling model) downscaled data (Azad,2015).

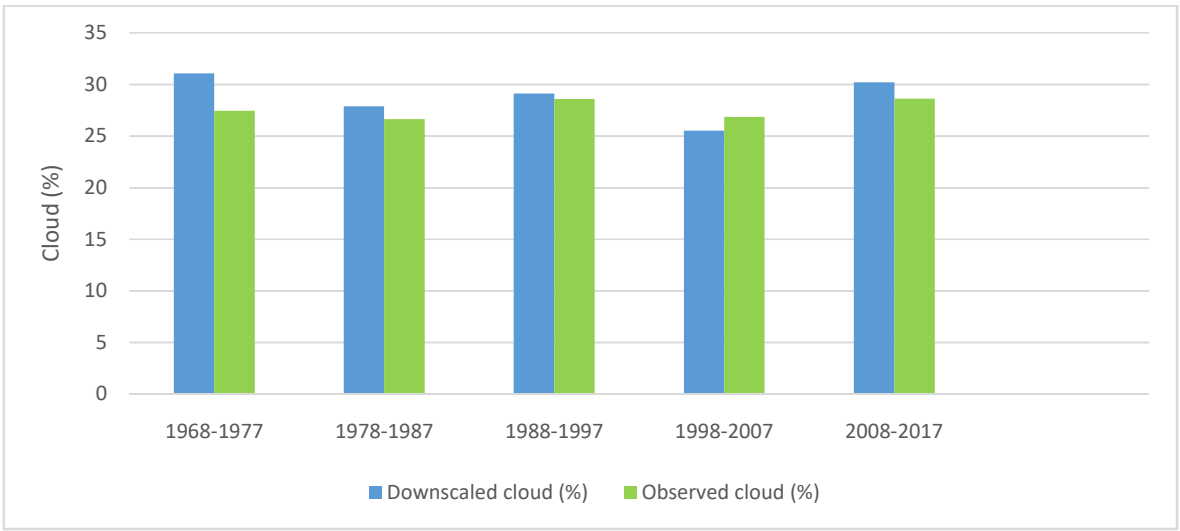


Figure 11. 10 Downscaled and observed predicted average Pre-monsoon cloud (%)

The average seasonal (Pre-monsoon season) spatial variation of cloud cover are shown in Figure 11.10. From analysis it was identified that maximum cloud cover occurs by downscaled for period (1968-1977). From observed data maximum cloud cover occurs for period 2008 to 2017. Downscaled and observed data shows a similar type of variability from 1978 to 2007.

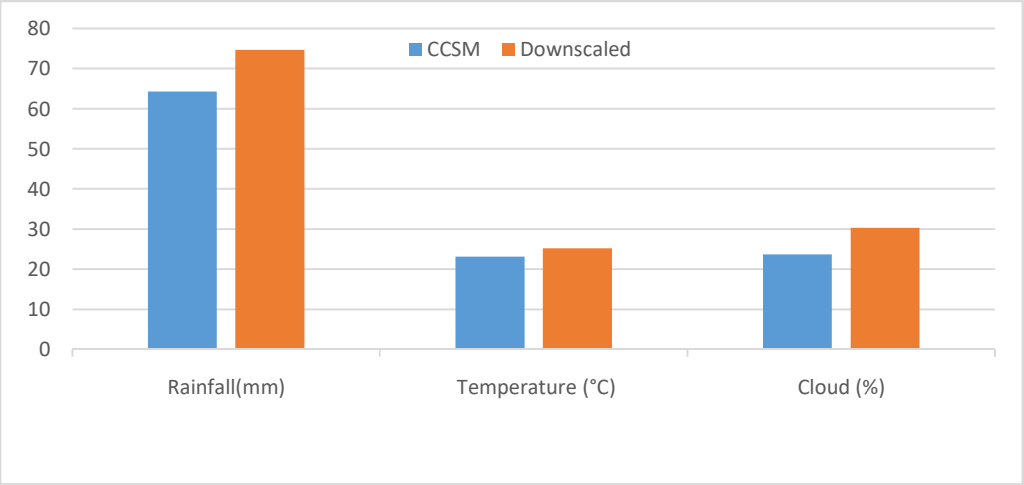


Figure 11. 11 Variability between CCSM and downscaled value for average Pre-monsoon season

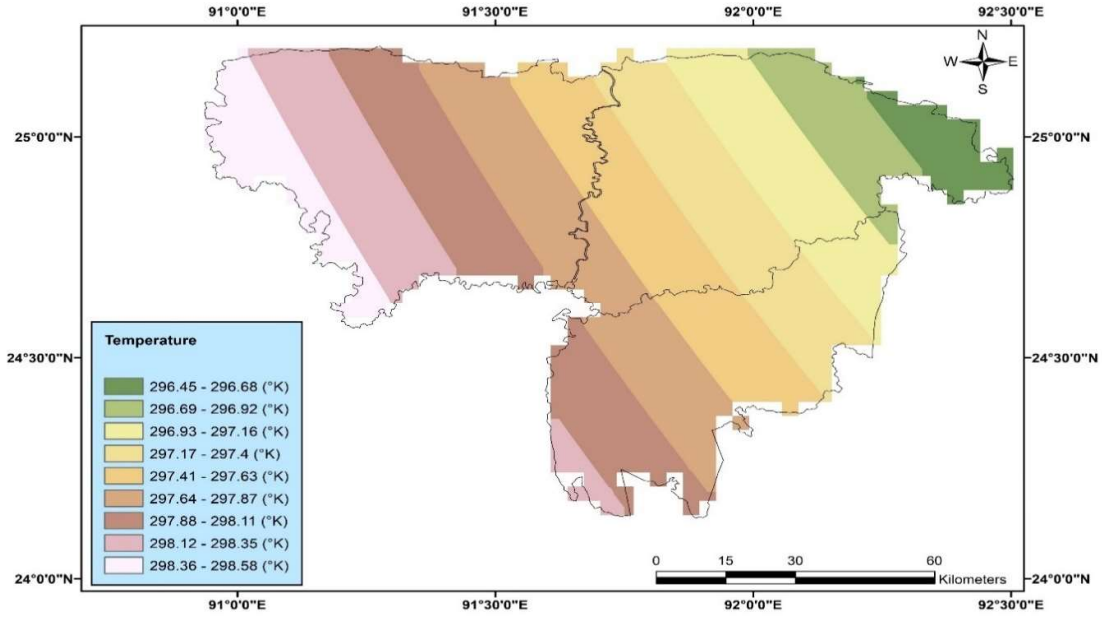
For the Sunamganj district, the trend of CCSM and downscaled data (Rainfall, temperature, cloud) shows a similar type of variability. For temperature, the CCSM and downscaled value are more matchings.

11.3 Downscaling validation

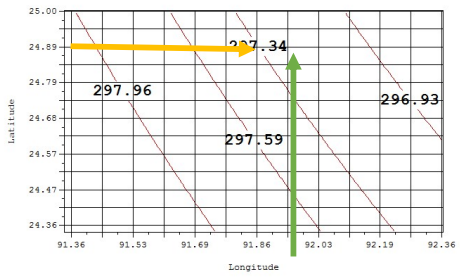
As both software Arc GIS and Transform use Kriging interpolation method, which is also the most convenient method of interpolation. The cell of EdGCM is 8^0x10^0, so it considers the out-layer data for Kriging interpolation as Figure 11.12.

Figure 11. 12. Out layer data for Kriging interpolation

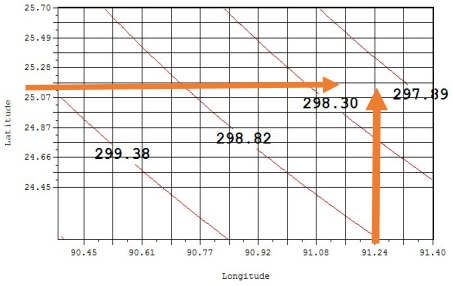
This study observed the variation in climate data of April 2017 after running both software. Figure 11.12. Shows the variations of temperature data at both software.



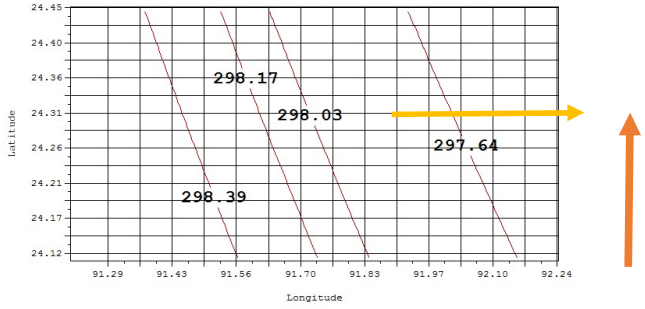
(a)



Sylhet



Sunamganj

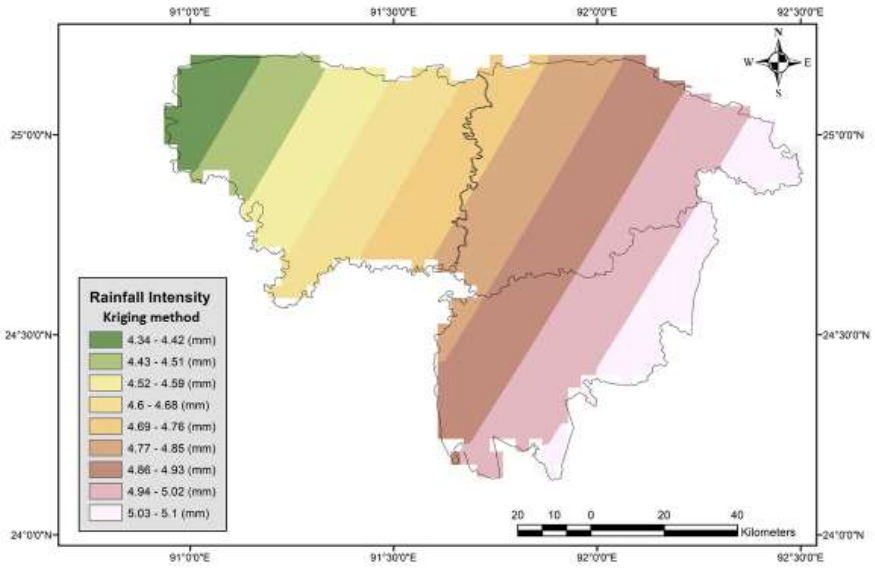


Moulvibazar

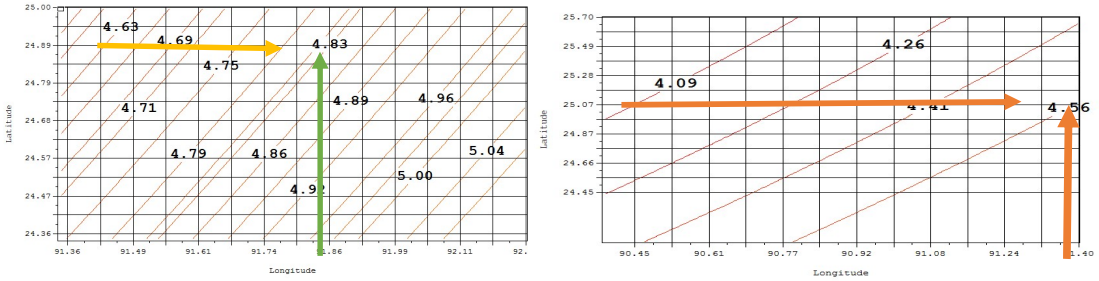
(b)

Figure 11. 13. Variations of downscaled temperature data for (a)ArcGIS and (b)Transform software

The above Figure11.13(a) and (b) shows that both the software generates same temperature data for the study area.

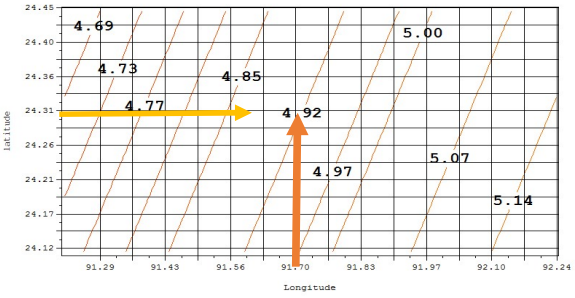


(a)



Sylhet

Sunamganj

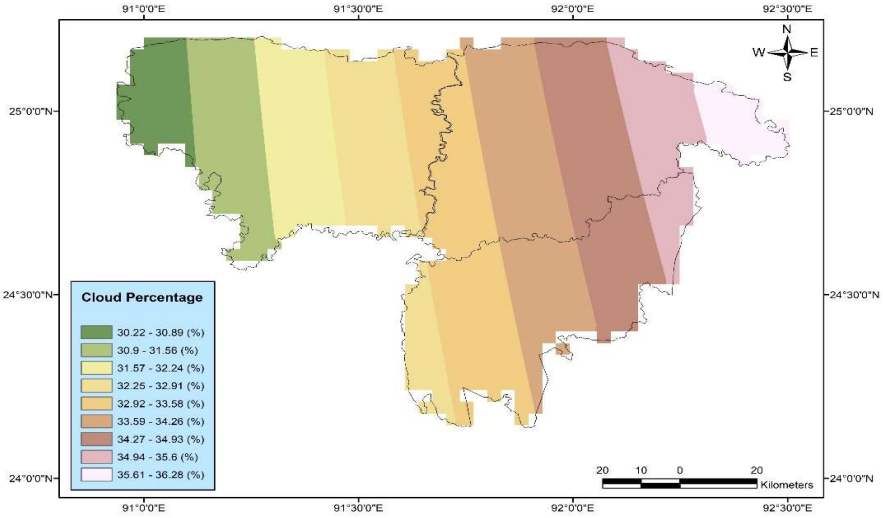


Moulavibazar

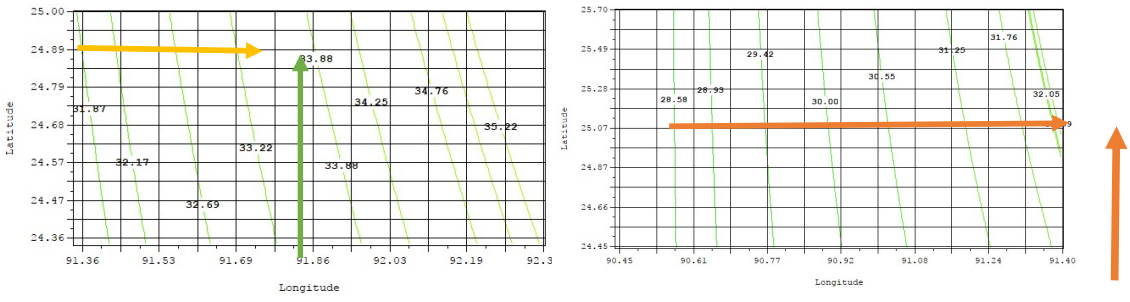
(b)

Figure 11. 14. Variations of downscaled rainfall data for (a)ArcGIS and (b)Transform software

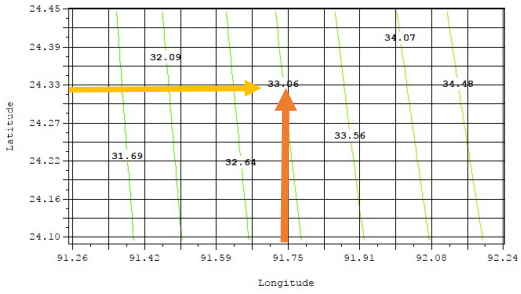
The above Figure11.14(a) and (b) shows that both the software generates same rainfall data for the study area.



(a)



Sylhet Sunamganj



Moulavibazar

(b)

Figure 11. 15. variations of downscaled cloud fraction data for (a)ArcGIS and (b)Transform software

The above Figure11.15(a) and (b) shows that both the software generates same cloud fraction data for the study area.

In this section the trend analysis of temperature, rainfall and cloud fraction of Sunamganj and Sylhet District is described. To identify where the trend is positive or negative this analysis was completed. In this analysis the resulting positive trend implies an increase in trend and negative trend implies decline in trend.

11.4Results of Mann-Kendall test for trends in annual temperature for Sunamganj:

The following tables (Table 11.1-11.2) and Figure11.16 represents the resulting trend value obtained from the Mann-Kendalltest

Table 11. 1 Results of Mann-Kendall Z test for 100 years (1921-2020) annual trend

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	*1921*	*2020*	*100*	-0.71	*Decreasing*	+

*Here, α, += 0.1 level of significance.

Here, the annual test resulted a negative trend with test statistics Z= -0.71 which implies a declining trend in temperature.

11.5Trend of annual temperature by Sen's slope estimator:

Like the Z test, the annual temperature tests resulted negative trends of magnitude -0.012-degree Fahrenheit over 100 years in the study area.

Table 11. 2 Trends of annual Temperature (Fahrenheit) over the study period (1921-2020)

Time series	First year	Last Year	No. of obs. (n)	Q
Annual	*1921*	*2020*	*100*	-0.012

Annual temperature trend is presented graphically in the Figure11.16

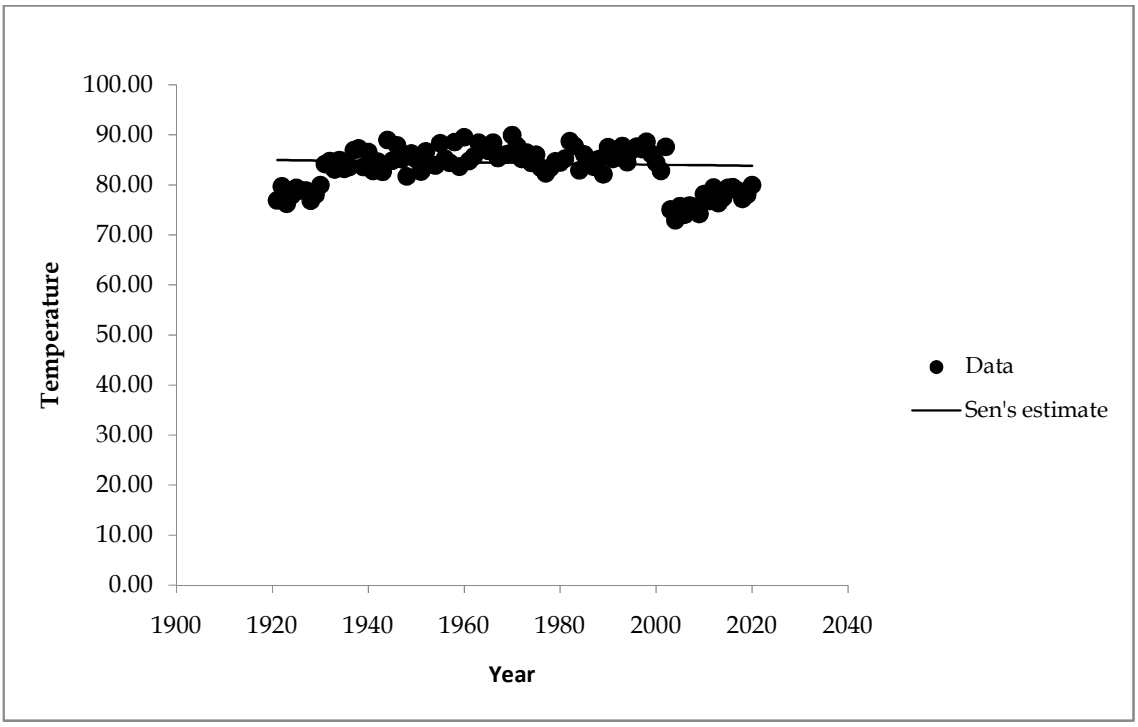


Figure 11. 16: Trend of Annual total temperature for 100 years (1921-2020)

The temperature trend is increasing from the year 1921 to 1997 but there is a sift of temperature trend to downward after year 1997. Same type of abnormality was found in downscaling of temperature data by PRECIS (Providing Regional for Impact Studies) software.Hence the trend increases afterward.The model is valid until 1997. But in modified Mann-Kendall trend test has the scope to manipulate the trend value. Therefore, the z value is negative here.

11.6Results of Mann-Kendall test for trends in annual temperature for Sylhet:

The following tables (Table 11.3-11.4) and Figure 4.3represents the resulting trend value obtained from the test-

Table 11. 3 Results of Mann-Kendall Z test for 50 years (1970-2020) annual trend

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	1970	2020	50	-2.97	*Decreasing*	**

*Here, α, **= 0.01 level of significance.

Here, the annual test resulted a negative trend with test statistics Z= -2.97 which implies a declining trend in temperature.

11.7Trend of annual temperature by Sen's slope estimator:

Like the Z test, the annual temperature tests resulted negative trends of magnitude -0.162-degree Fahrenheit over 50 years in the study area.

Table 11. 4 Trends of annual Temperature (Fahrenheit) over the study period (1970-2020)

Time series	First year	Last Year	No. of obs. (n)	Q
Annual	1970	2020	50	-0.162

Annual temperature trend is presented graphically in the Figure 11.17

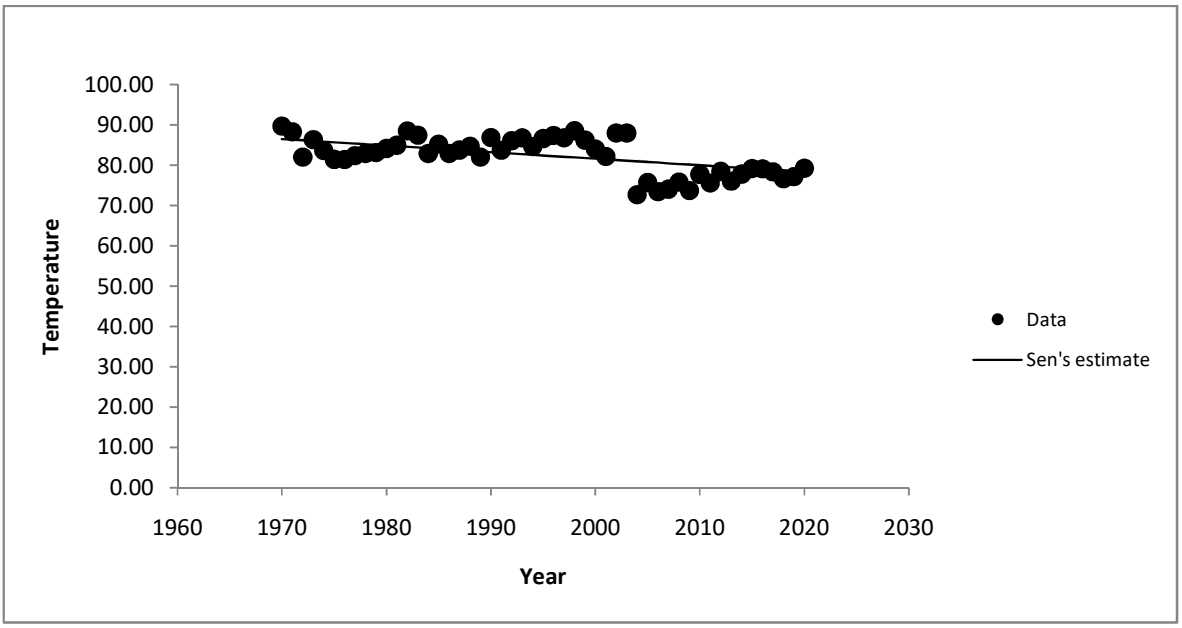


Figure 11. 17 Trend of Annual total temperature for 50 years (1970-2020).

11.8Results of Mann-Kendall test for trends in annual precipitation Sunamganj:

The following tables (Table 11.5-11.6) and Figure 11.8 represents the resulting trend value obtained from the test-

Table 11. 5 Results of Mann-Kendall Z test for 100 years (1921-2020) annual trend

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	*1921*	*2020*	*100*	2.60	*Increasing*	**

*Here, α, **= 0.01 level of significance.

Here, the annual test resulted a positive trend with test statistics Z= 2.60 which means the trend is increasing significantly.

11.9Trend of annual precipitation by Sen's slope estimator:

Like the Z test, the annual rainfall tests resulted positive trends of magnitude 0.006 mm/year over 100 years in the study area.

Table 11. 6 Trends of annual rainfall (mm/year) over the study period (1921–2020)

Time series	First year	Last Year	No. of obs. (n)	Q (mm/year)
Annual	*1921*	*2020*	*100*	0.006

Annual rainfall trend is presented graphically in the Figure 11.18

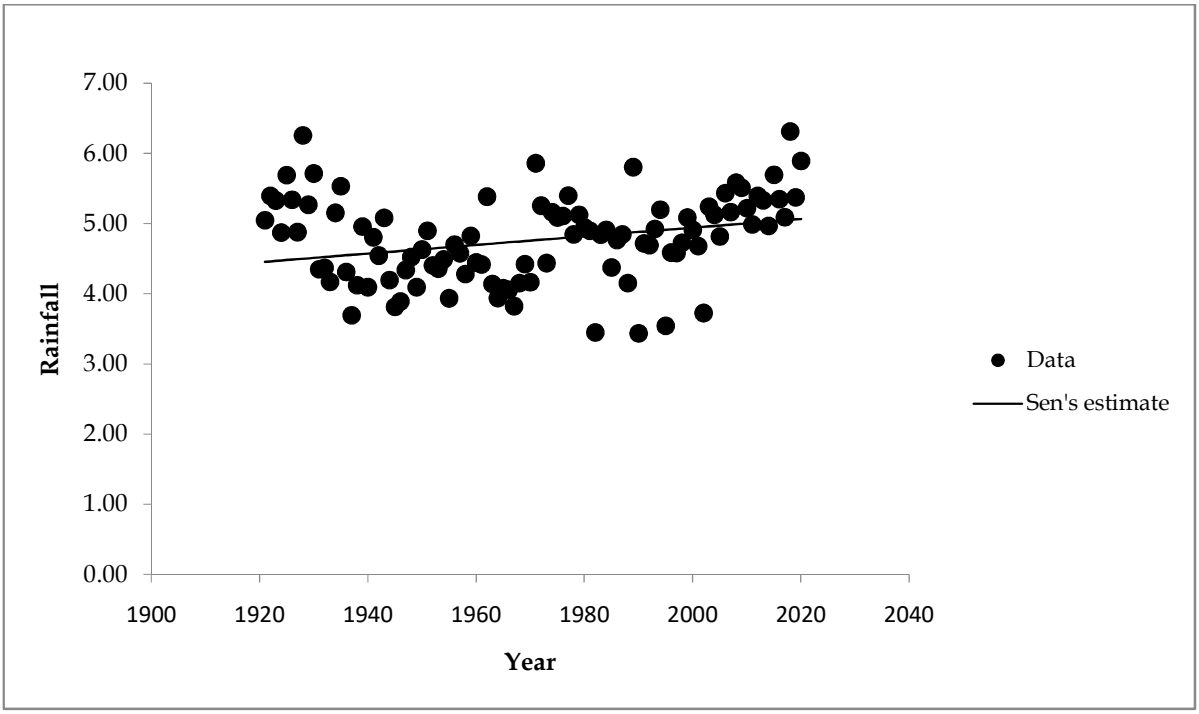


Figure 11. 18 Trend of Annual total rainfall for 100 years (1921-2020)

11.10Results of Mann-Kendall test for trends in annual precipitation Sylhet:

The following tables (Table 11.7-11.8) and Figure 11.19represents the resulting trend value obtained from the test-

Table 11. 7 Results of Mann-Kendall Z test for 50 years (1970-2020) annual trend.

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	1970	2020	50	1.99	Increasing	*

*Here, α, *= 0.1 level of significance.

Here, the annual test resulted a positive trend with test statistics Z= 1.99 which means the trend is increasing significantly.

11.11Trend of annual precipitation by Sen's slope estimator:

Like the Z test, the annual rainfall tests resulted positive trends of magnitude 0.186 mm/year over 100 years in the study area.

Table 11. 8 Trends of annual rainfall (mm/year) over the study period (1970–2020)

Time series	First year	Last Year	No. of obs. (n)	Q (mm/year)
Annual	1970	2020	50	0.186

Annual rainfall trend is presented graphically in the Figure 11.19

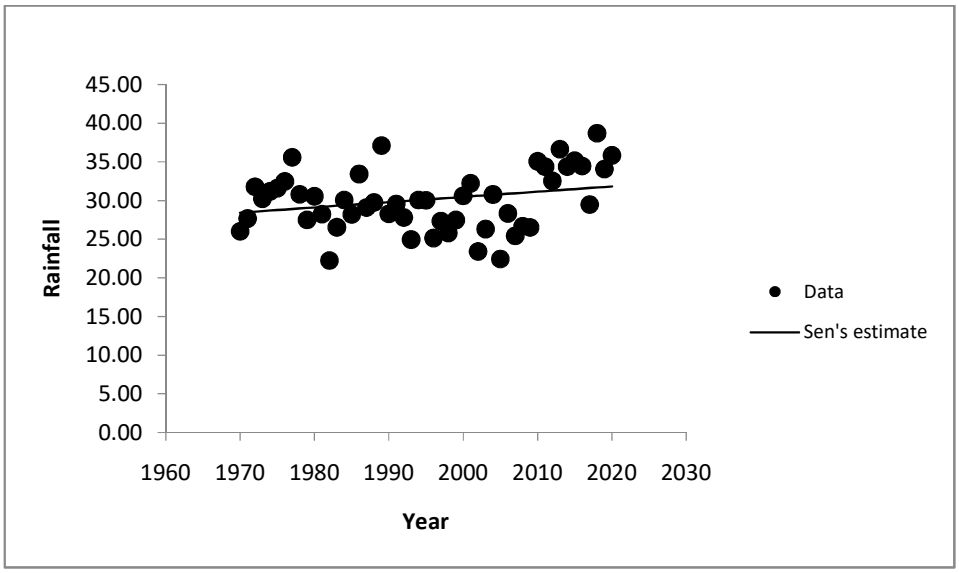


Figure 11. 19 Trend of Annual total rainfall for 50 years (1970-2020)

11.12Results of Mann-Kendall test for trends in annual cloud fraction Sunamganj:

The following tables (Table 11.9-11.10) and Figure 11.20 represents the resulting trend value obtained from the test-

Table 11. 9 Results of Mann-Kendall Z test for 100 years (1921-2020) annual trend

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	*1921*	*2020*	*100*	-0.68	*Decreasing*	+

*Here, α, += 0.1 level of significance.

Here, the annual test resulted a negative trend with test statistics Z= -0.68 which means it is in a declining trend.

11.13Trend of annual cloud fraction by Sen's slope estimator:

Like the Z test, the annual cloud fraction tests resulted negative trends of magnitude -0.010 percent over 100 years in the study area.

Table 11. 10Trends of annual cloud fraction (%) over the study period (1921-2020)

Time series	*First year*	*Last Year*	*No. of obs. (n)*	*Q*
Annual	*1921*	*2020*	*100*	*-0.010*

Annual cloud fraction trend is presented graphically in the Figure11.20.

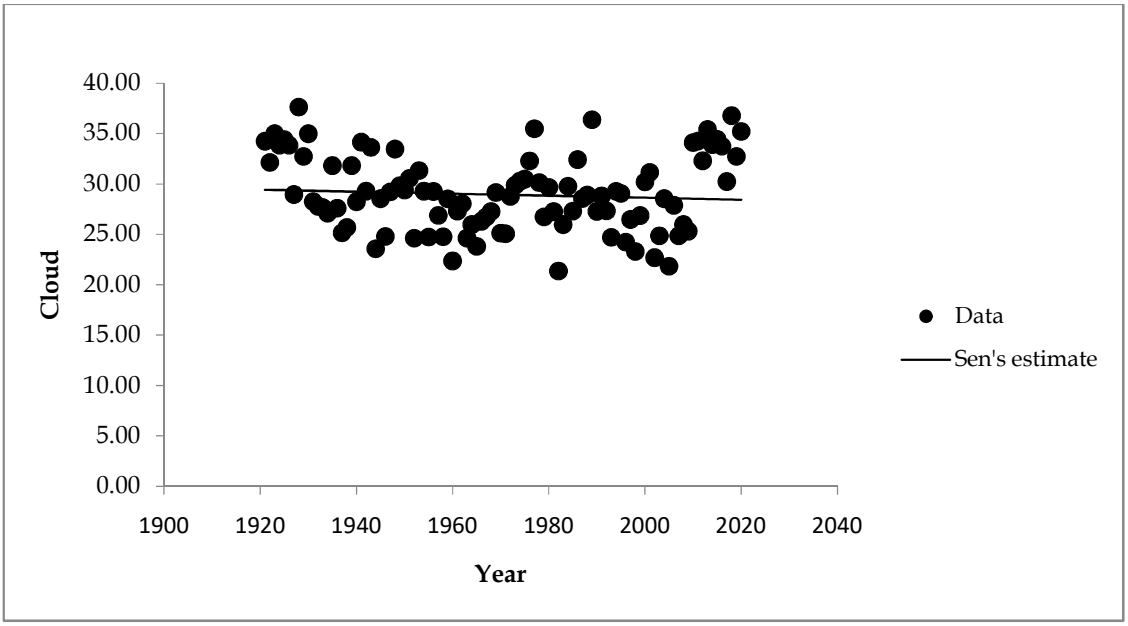


Figure 11. 20 Trend of Annual cloud fraction for 100 years (1921-2020)

11.14Results of Mann-Kendall test for trends in annual cloud fraction Sylhet:

The following tables (Table 11.11-11.12) and Figure 11.21 represents the resulting trend value obtained from the test-

Table 11. 11 Results of Mann-Kendall Z test for 50 years (1970-2020) annual trend

Time series	First year	Last Year	No. of obs. (n)	Test Z	Trend	Significance (α)
Annual	1970	2020	50	1.35	Increasing	+

*Here, α, += 0.1 level of significance.

Here, the annual test resulted a negative trend with test statistics Z= 1.35 which means it is in an increasing trend.

11.15 Trend of annual cloud fraction by Sen's slope estimator:

Like the Z test, the annual cloud fraction tests resulted positive trends of magnitude 0.068 percent over 100 years in the study area.

Table 11. 12 Trends of annual cloud fraction (%) over the study period (1921-2020)

Time series	First year	Last Year	No. of obs. (n)	Q
Annual	1970	2020	50	0.068

Annual cloud fraction trend is presented graphically in the Figure 11.21.

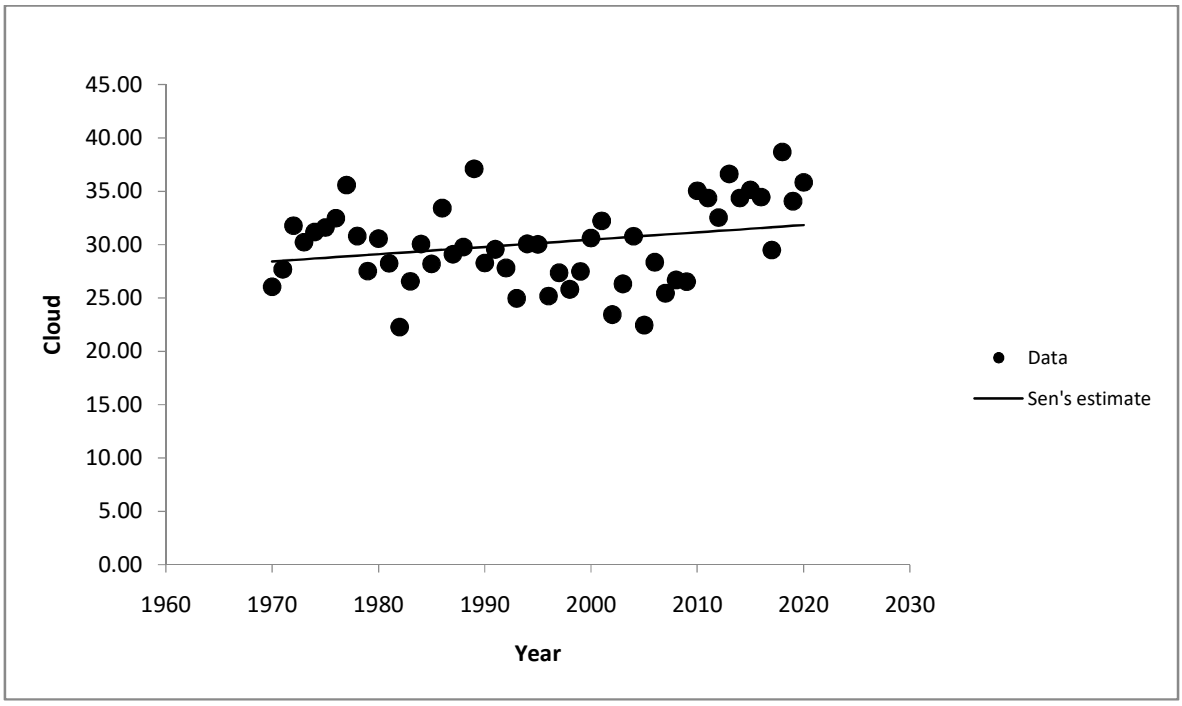


Figure 11. 21 Trend of Annual cloud fraction for 50 years (1970-2020)

11.16 Flash flood trend development:

The trend was developed by using temperature, rainfall and cloud data. The data was generated by using the EdGCM and Transform software for Sunamganj and Sylhet District. When the temperature is higher, the ground becomes drier, as a result, the run-off rate will increase. Higher the run-off rate, the higher the chances of flash flood. Analyzing the year 1920 to 2020 for Sunamganj and 1970 to 2020 for Sylhet district it was found that flash flood occurs all the year round but a higher percentage of flash flood occurs in the month between July to October. In that period mainly, normal flash flood happened. When the floods arise in March and April then it will become devastating in nature. As Sunamganj is the most flash flood prone area, the flash flood trend was developed for 1920t o 2020 and for Sylhet district 1970 to 2020.

After analysis of all the climate data, the condition of flash flood was developed here at the table (11.13)

Table 11. 13 Condition for flash flood

Temperature	Min, 76°F (≥76°F)
Rainfall	Min, 3 mm (≥ 3 mm)
Cloud Fraction	Max, 46 % (≤ 46 %)

11.17 Trend analysis of Sunamganj District:

The flash flood has been occurred when temperature is greater than 76°F, rainfall is minimum 3 mm and cloud fraction is maximum 46 %.

Here, figure 11.22, 11.23, 11.24 and 11.25 shown the flash flood trend for Sunamganj District

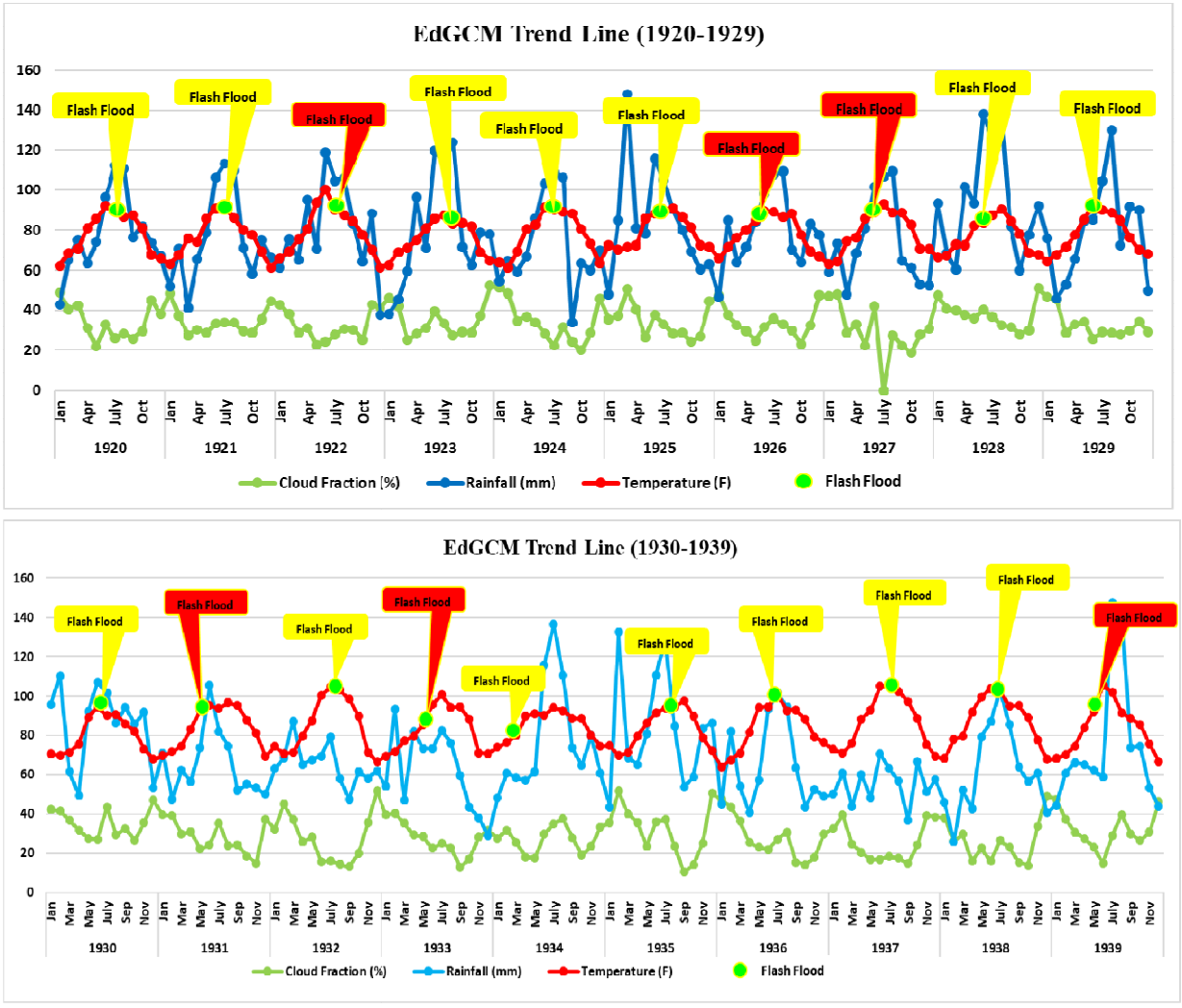


Figure 11. 22 Flash flood trend of Sunamganj District from 1920-1939

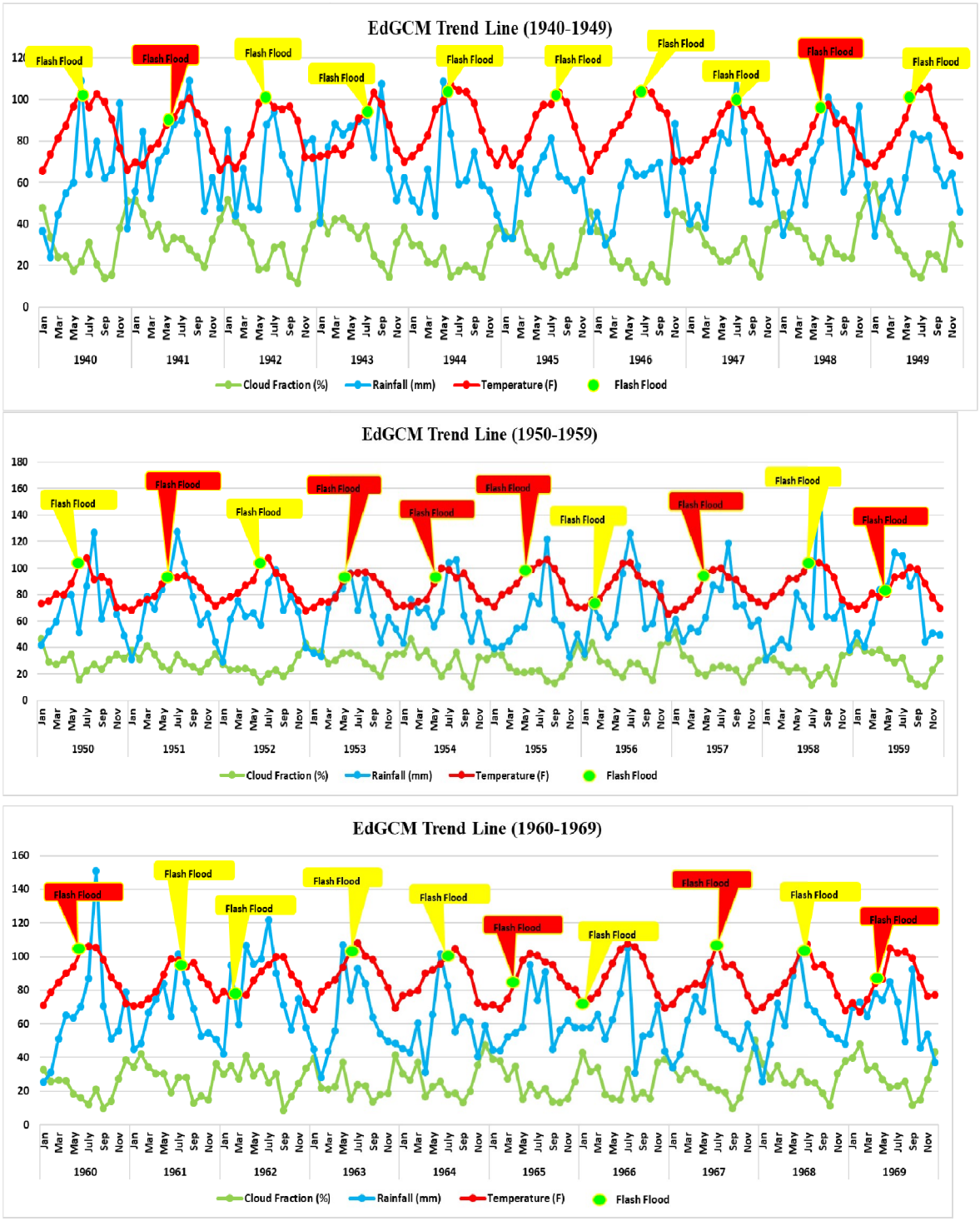


Figure 11. 23 Flash flood trend of Sunamganj District from 1940-1969

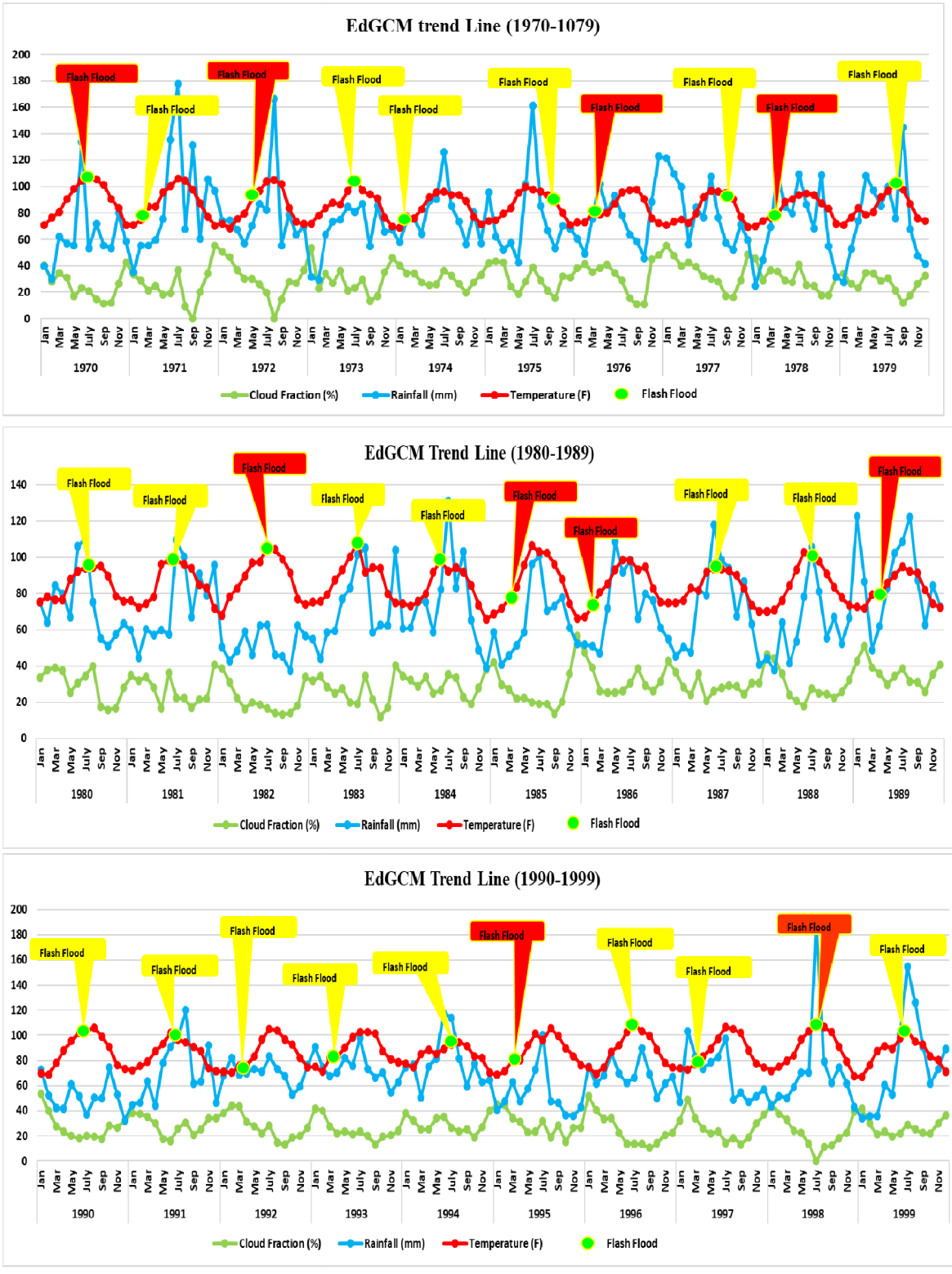


Figure 11. 24 Flash flood trend of Sunamganj District from 1970-1999

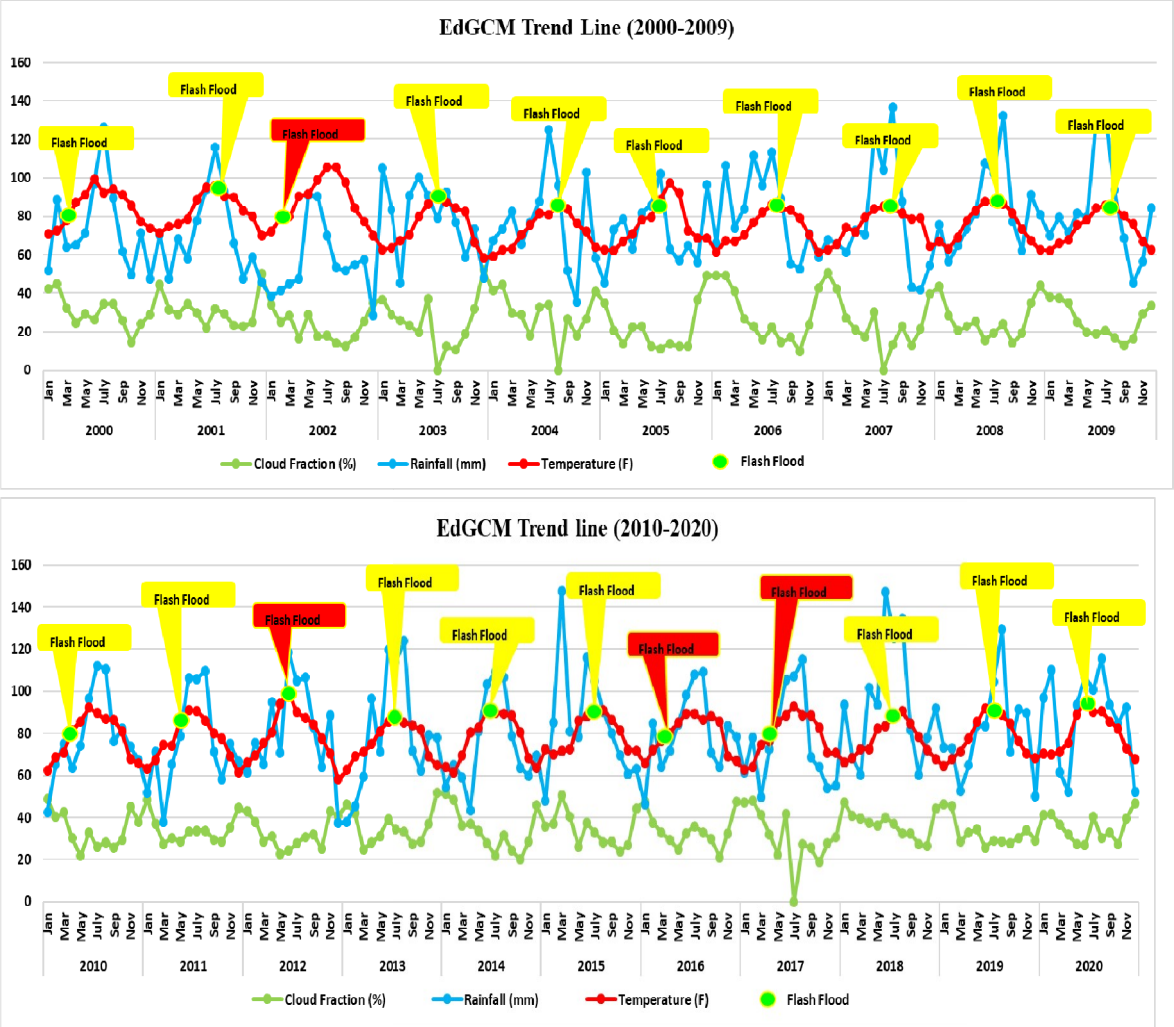


Figure 11. 25 Flash flood trend of Sunamganj District from 2010-2020

Analyzing the data for the year 1920 to 2020 it was observed that flash flood occurs in the Sunamganj District all the year around but devastating flash flood occurs in March and April and normal flash flood happens during July to October.

The following table clearly shows the devastating and non-devastating flash flooding year for Sunamganj District. Which clearly satisfied our result.

Table 11. 14 Devastating flash flood of Sunamganj

Nature of flash flood	Year
Devastating	1922,1926,1927,1931,1933,1939,1941,1948,1951,1953,1954, 1955,1957,1959,1960,1965,1969,1970,1972,1976,1978,1982, 1985,1986,1989,1995,1998,2002,2012,2016,2017.

Table 11. 15 Non-devastating flash flood of Sunamganj

Nature of flash flood	Year
Non-devastating	1920,1921,1923-1925,1928,1929,1930,1932,1934-1938,1940, 1942-1947,1949,1950,1952,1956,1958,1961-1964, 1966-1968, 1971,1973-1975,1977,1979-1981,1983,1984,1987,1988,1990-1994,1996,1997,1999-2001,2003-2011,2013-2015,2018-2020.

11.18 Trend analysis of Sylhet District:

The flash flood has been occurred when temperature is greater than 76°F, rainfall is minimum 3 mm and cloud fraction is maximum 46 %.

Here, figure 11.26 and 11.27 shown the flash flood trend for Sylhet District

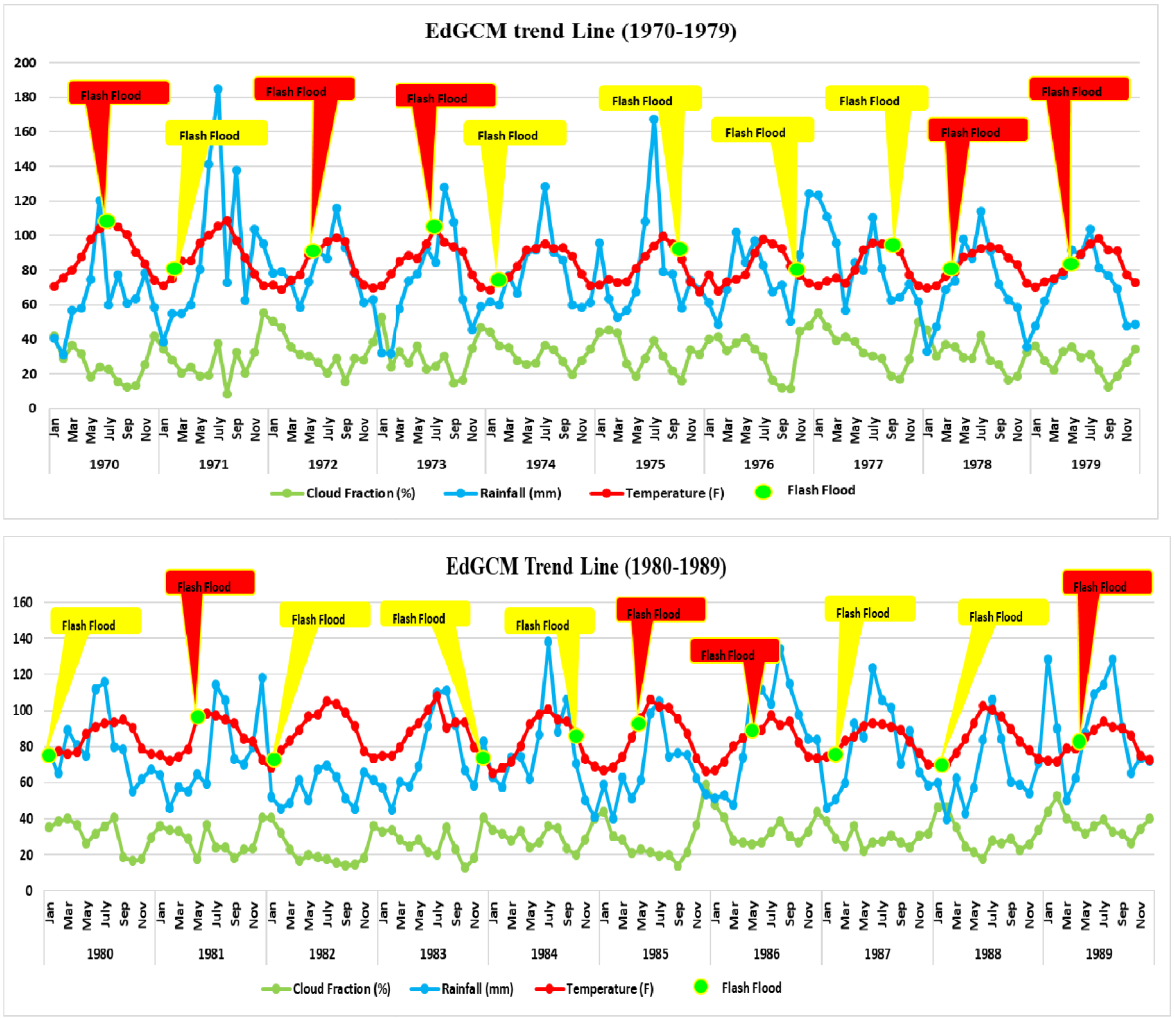


Figure 11. 26 Flash flood trend of Sylhet District from 1970-1989

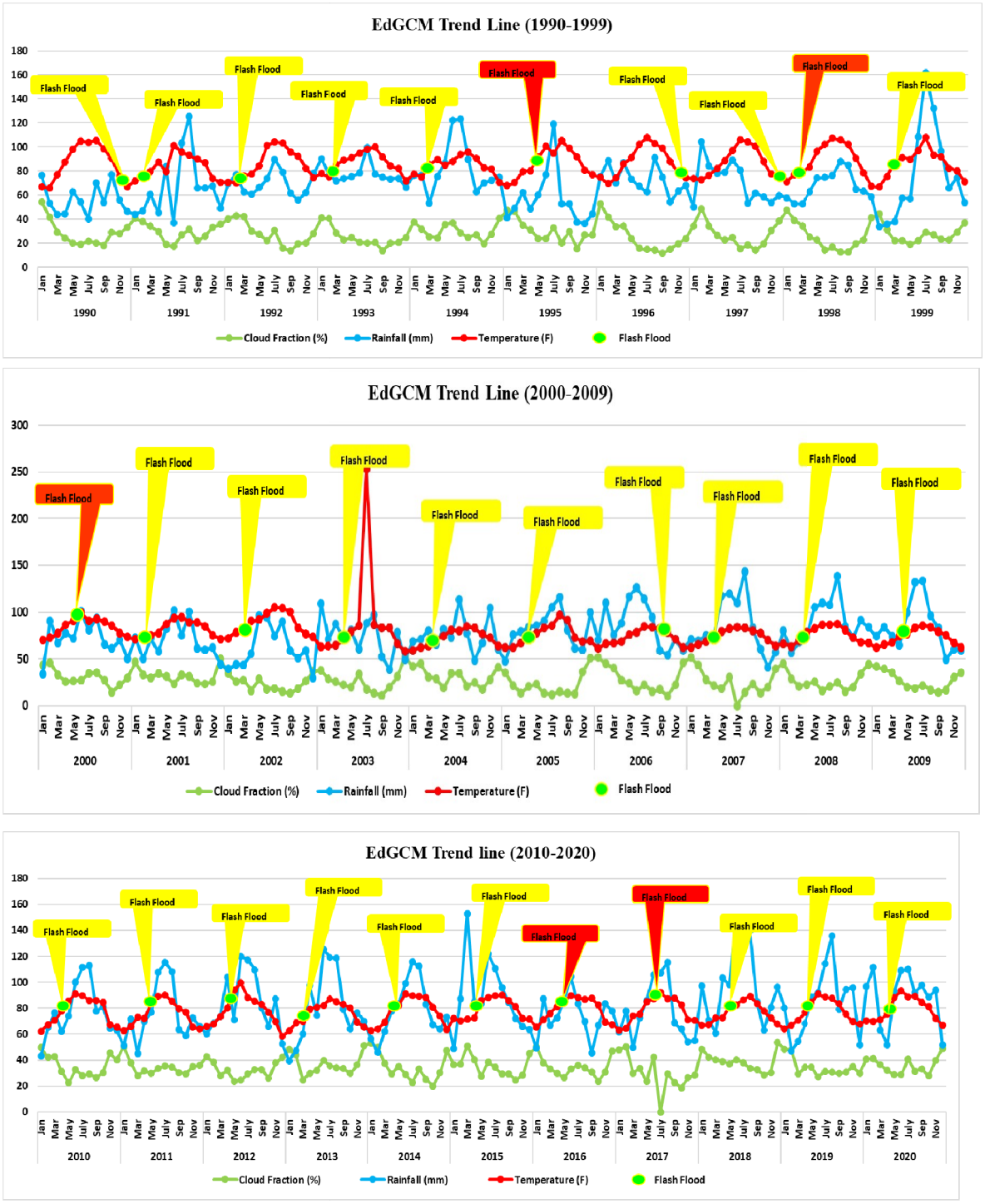


Figure 11. 27 Flash flood trend of Sylhet District from 1990-2020

The following table clearly shows the devastating and non-devastating flash flooding year for Sylhet District.

Table 11. 16 Devastating flash flood of Sylhet

Nature of flash flood	Year
Devastating	1970,1972,1973,1978,1979,1981,1985,1989,1995,1998,2000,2016,2017

Table 11. 17 Non-devastating flash flood of Sylhet

Nature of flash flood	Year
Non-devastating	1971,1974-1977,1980,1982-1984,1986-1988,1990-1994,1996-1997,1999,2001-2015,2018-2020.

11.19 Secondary data on flash flood damage in the study area:

As this research, shed light on the vulnerability of flash flood and its remedy.Therefore, it is inevitable to enlist the damages and economic losses of the study areas. Here, Damage caused by flash flood on crop production in Sunamganj haor areas illustrated at Table 11.18.

Table 11. 18 Damage caused by flash flood on crop production in Sunamganj Haor areas

Year	Flood water entered the Haor	Inundating the Boro crops	Extent of damage	Damaged Boro crop (ha)	Cost of damaged crops (Lac taka
1996	16 March	18March	75%	29,822	4102.07
1997	22 May	24 May	15%	9,830	1,278.84
1998	20 May	23 May	40%	11,579	2,365.02
1999	03 May	06 May	45%	10,950	976.65
2000	28 April	30 April	70%	1,355	420.14
2001	27 April	30 April	75%	4,963	1,899.95
2002	14 April	18 April	70 %	21,677	7,058.16
2003	27 May	30 May	20%	20,997	8,666.87
2004	13 April	15 April	90 %	95,402	34,860.40
2005	22 May	25 May	15%		
2010	3 April	5 April	90%	1,17,475	1,127 crore
2017	27 March	28 March	92%	91,690	10645.2million

(Source:Banglapedia)

On the basis of agricultural land damage, most of the damage observed at Sunamganj district of about 102,436 (ha) and less in Moulvibazar district in the year 2017. Agricultural land damaged in the study area at 2017 is demonstrated in Figure 11.29.

11.20 Spatial Changing aspects of Cultivated and Damaged Boro:

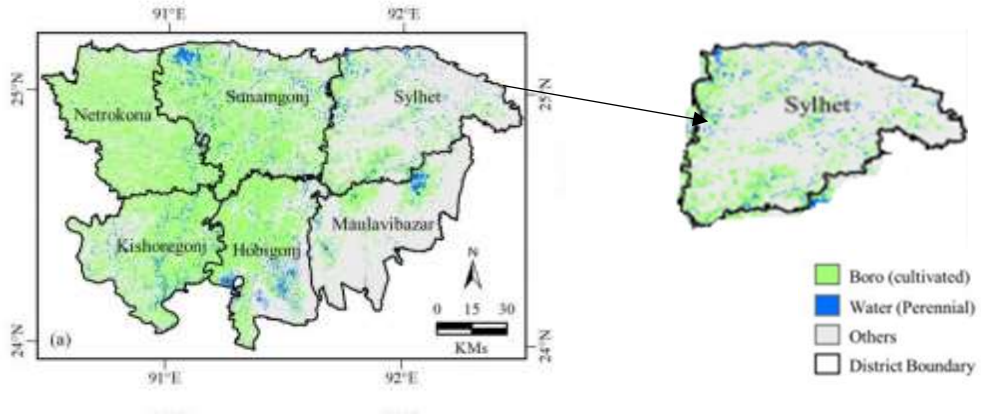


Figure 11. 28 Cultivated boro derived from Landsat-8 OLI images during the pre-flash flooding time period (Dec. 2016)

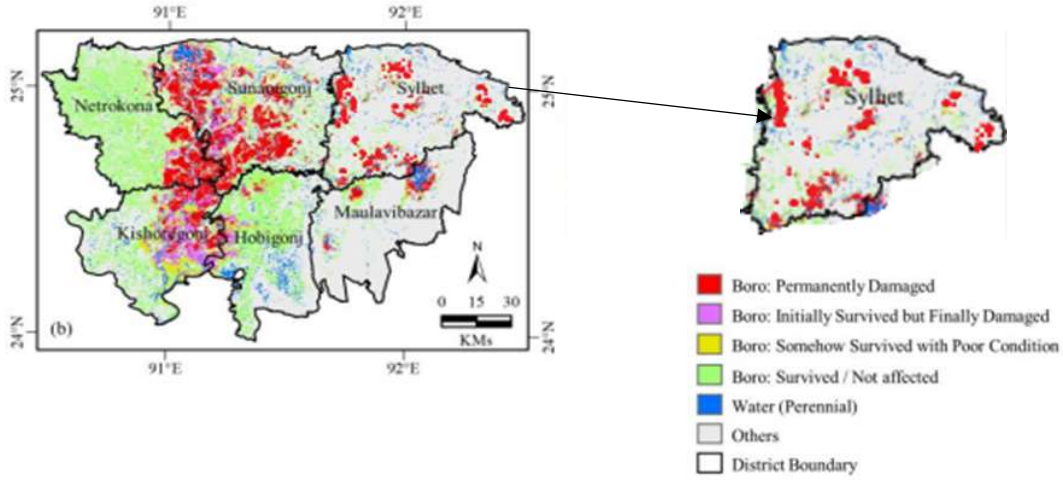


Figure 11. 29 Damaged boro derived from MODIS images due to flash flooding event (May 2017)

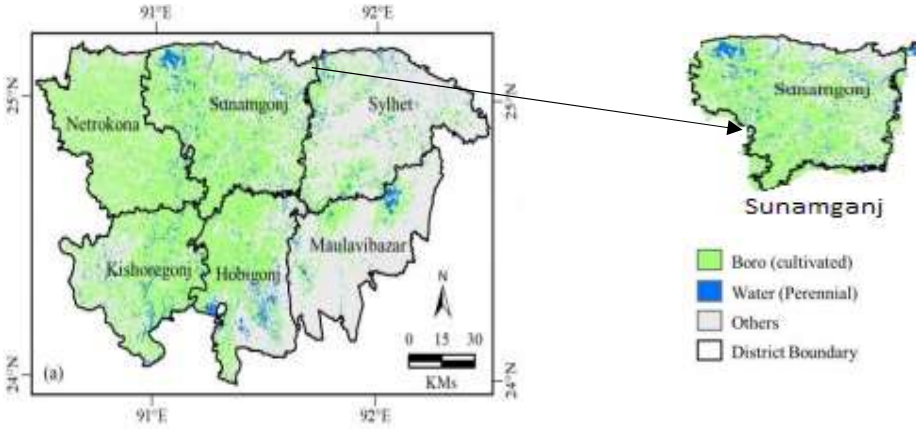


Figure 11. 30 Cultivated boro derived from Landsat-8 OLI images during the pre-flash flooding time period (Dec. 2016)

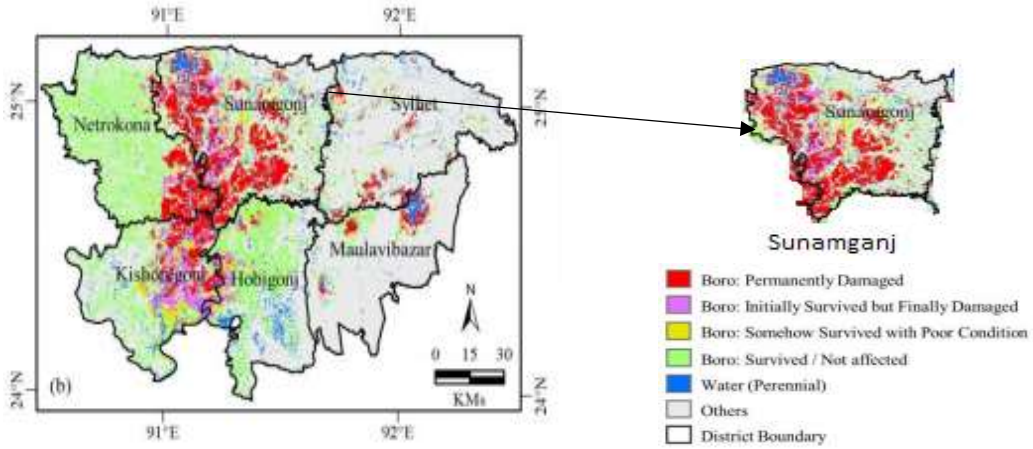
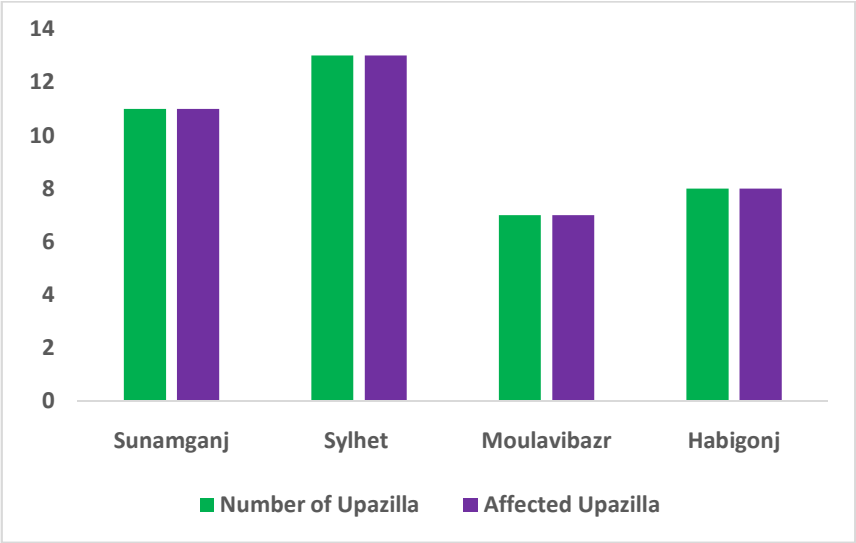


Figure 11. 31 Damaged boro derived from MODIS images due to flash flooding event (May 2017)

11.21 Some affected areas due to flash flood in Sylhet division:

From Figure (11.28-11.31) found that smaller areas in the district of Sylhet (i.e., about 19% of the total area) were suffered through *boro* cultivation. Here considered the two conditions of *boro*, i.e., permanently damaged and initially survived but finally damaged, into the damaged category. The most affected district was Sunamgonj, where about 65% of its cultivated *boro* was damaged. Sylhet district showed about relatively low damage of its cultivated boro compared to Sunamgonj district (Ahmed M R, et al 2017).



(Source: DDM, 2017)

Figure 11. 32 Number of affected upazillaas in different districts

From Figure it can be seen that all of the upazillas were affected due to flash flood.

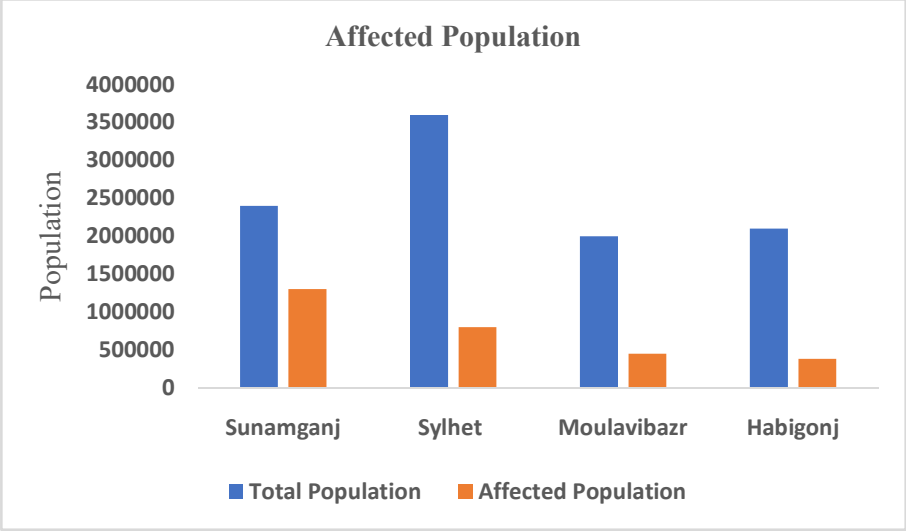


Figure 11. 33 Number of affected populations in different districts

The above Figure said that most affected populations were in Sunamganj district and the percentage was 52%. The affected population percentages due to flash flood of Sylhet and Moulavibazar districts were 24% and 21%.

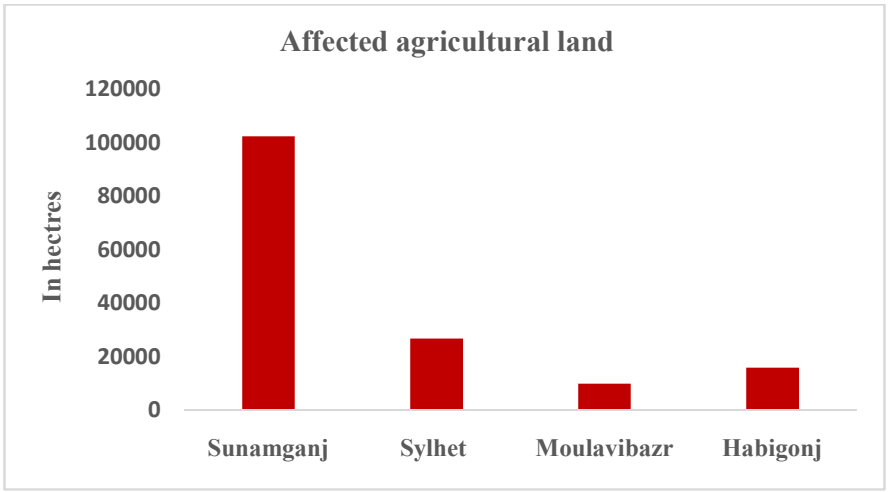


Figure 11. 34 Number of affected agricultural land (hectres) in different districts

From above Figure it is observed that, agricultural land was totally damaged for flash flood. Around 85% agricultural land was damaged in Sunamganj district. The less agricultural land damaged was observed 5% in Moulavibazar district and 22% in Sylhet.

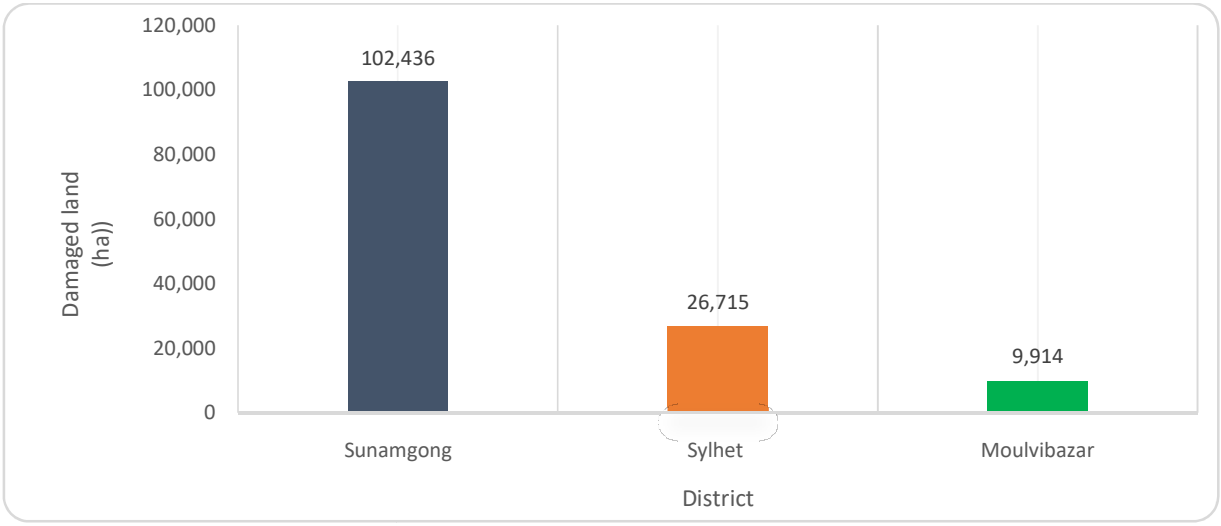


Figure 11. 35 Damaged scenario of agricultural land(ha) at the study area

11.22 Field reconnaissance and Questionnaire survey report:

A field reconnaissance and questionnaire survey were conducted at 2017. Total number of populations on Tahirpur Upazilla is 15,300 so number of respondents was measured 43 from the equations. Similarly, Total number of populations on Bishwamvarpur, Dakhin Sunamganj Upazilla is 52,628 and 183,881 so number of respondents was calculated 96 and 97.

Boro crop damage percentage was collected from questionnaire survey.

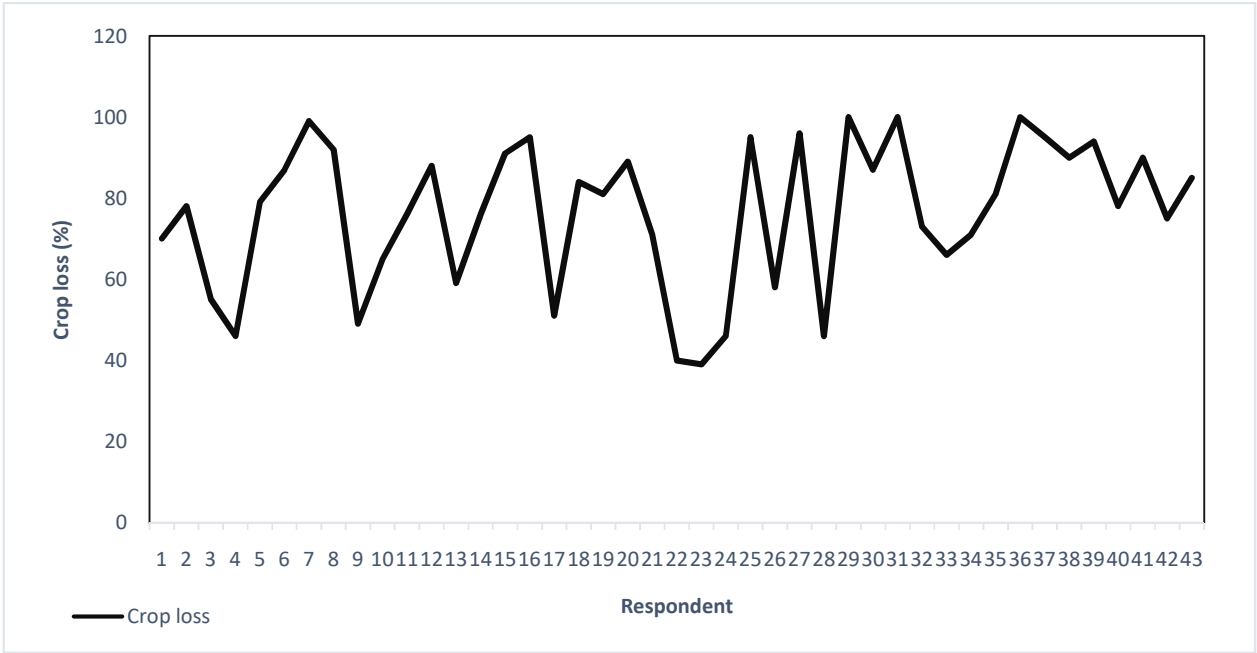


Figure 11. 36 Boro Crop losses per respondent at Tahirpur Upazilla in the year 2017 flash flood

According to the farmers at Tahirpur Upazilla, due to the unavailability of labour, mechanical equipment's and uncertain breaching of submersible embankment most of them lost their crop totally due to the early flash flood in 2017.

Existing crop variety of *Boro* rice cultivated by the three Upazilla of Sunamganj district is given in Table 11.19.

Table 11. 19 Respondent used Rice variety with their life cycle and yield data from questionnaire survey

Rice Variety	Life cycle(days)	Average yield(ton/ha)
BRRI dhan 81	140-145	6.0-6.5
BRRI dhan-28	140-142	6.0-6.2
BRRI dhan29	160-162	7.5-7.6
BRRI dhan-51	155-160	4.5-5.0
BRRI dhan52	155-160	5.5-5.7
Binadhan-12	125-130	4.2-4.5
Binadhan-14	120-130	7.6-7.8
Binadhan-11	130-135	4.5-4.8

According to survey, most popular variety was BRRI dhan- 28 in Sunamganj district whereas BRRI dhan -29 also popular due to high yield and popular Lokkhai is also common for its plant height. The common infestation and diseases of Boro rice was also collected from the farmers and DAE of Sunamganj district (Table 11.20.)

Table 11. 20 Different types of rice disease was found through questionnaire survey

Diseases name	**Losses**
Blast (leaf and collar	✓ A leaf blast infection can kill seedlings or plants up to the tillering stage. ✓ Reducing grain yield upto 55%. ✓ Leaf blast can kill rice plants at seedling stage and cause yield losses in cases of severe infection
Bakanae	✓ Crop losses caused by the disease may reach up to 20% in outbreak cases.
Bacterial blight	✓ Yield loss due to bacterial blight can be as much as 70% when susceptible varieties are grown

Common fertilizer application proportion and amount also collected through questionnaire survey. Different types of fertilizer application process for different variety is demonstrated in Table 11.21.

Table 11. 21 Different types of fertilizer application in different rice variety through questionnaire survey

Rice Variety	Fertilizer application
BRRI dhan-81	applied as per requirements
BRRI dhan-28	Urea 30-40 (2 times) TSP 7-10 MP 8-16 Gypsum 8-11 Zinc 0.7-1.0
BRRI dhan-29	Urea 30-40 (3 times) TSP 7-10 MP 8-16 Gypsum 8-11 Zinc 0.7-1.0
BRRI dhan-51	Urea, TSP, MP, Gypsum, Zinc as per requirements. After flood 3kg MP fertilizer applied per bigha.
BRRI dhan-52	Urea, TSP, MP, Gypsum, Zinc applied after 20-25 days of planting time.
Binadhan-12	i)150-180 kg urea per hectare, 110-120 kg TSP and 50-70 kg MOP after sudden flooding. (ii)In the case of making the land, the following quantity of fertilizers should be applied: 55-60 kg TSP, 10-15 kg of MOP, 8-12 kg of gypsum.

11.23 Impacts of Flash Flood on Boro rice yield:

The OLS (ordinary least square) method is performed to determine the climate change effect on Boro rice yield and the findings are presented in the table.

Table 11. 22 Estimated Results of the Boro rice Sunamganj (Regression analysis)

Dependent Variable:	Independent Variable	Coefficient	Std. Error	t-Statistic	P-value	Significance
Boro	Rainfall	-0.62	1.36	-0.45	0.061	***
	Temperature	1.90	2.96	0.64	0.054	**
	Cloud	-0.33	1.36	-0.24	0.81	

Note: *, ** and *** represents the 1%, 5% and 10% level of significance respectively

Regression Statistics	
Multiple R	0.25
R^2	0.066
Adjusted R^2	0.333
F-Statistic	0.166

Seasonal average rainfall negatively related with Boro rice yield and highly significant at the 10% significance level. This also implies that rise in rainfall could have an adverse effect on Boro yield. However, average temperature directly influences the yield of Boro rice and statistically significant at 5% level. In contrast, cloud is statistically insignificant and have no effect on the Boro rice yield.

Findings of the study also imply that 1% increase in average rainfall could reduce the yield of Boro rice by 0.62 metric ton/acre. On the other hand, 1% increase in average temperature could increase Boro rice yields by 1.90 metric tons/acre.

Table 11. 23 Estimated Results of the Boro rice Sylhet (Regression analysis)

Dependent Variable:	Independent Variable	Coefficient	Std. Error	t-Statistic	P-value	Significance
Boro	Rainfall	-0.202	0.68	-0.29	0.07	***
	Temperature	1.450	1.02	1.40	0.01	**
	Cloud	-1.510	0.83	-1.82	0.07	***

Note: *, ** and *** represents the 1%, 5% and 10% level of significance respectively

Regression Statistics	
Multiple R	0.414
R^2	0.171
Adjusted R^2	0.115
F-Statistic	3.039

The contribution of the climate variables on the yield of Boro rice is obtained from OLS method. The results of the table indicated that seasonal excessive rainfall and cloud negatively contributed and statistically significant at 10% significance levels and temperature is statistically significant at 5% significance level and positively contributed to the yield.

Findings of the study also said that 1% increase in average rainfall and cloud could reduce the yield of Boro rice by 0.202 and 1.51 metric ton/acrerespectively. On the other hand, 1% increase in average temperature could increase Boro rice yields by 1.450 metric tons/acre.

11.24 Correlation Coefficients between climatic parameters and Boro rice yield (Sunamganj):

The bivariate Pearson Correlation produces a simple correlation coefficient, r, which measures the strength and direction of linear relationships between pairs of continuous variables. The below Figure 11.37 to 11.39shows the correlation between the climatic parameters and Boro crop yield.

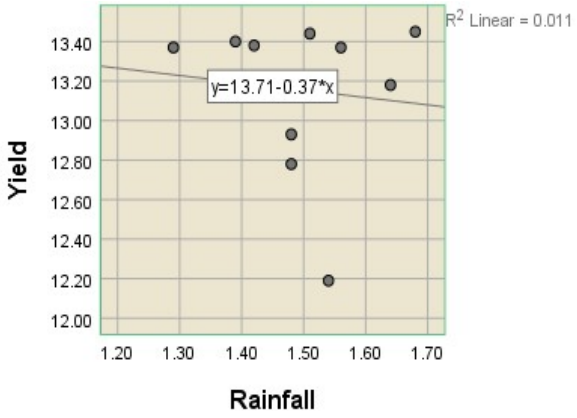


Figure 11. 37 Yield vs rainfall

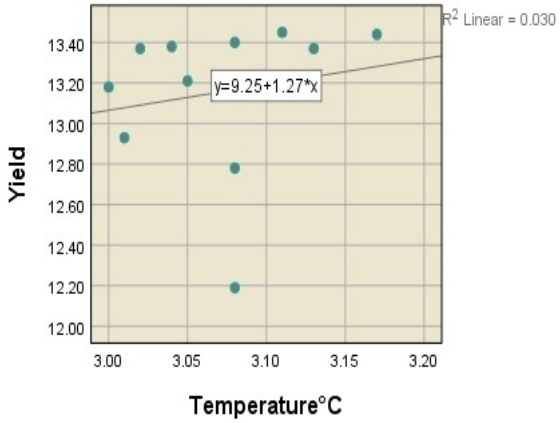


Figure 11. 38 Yield vs temperature

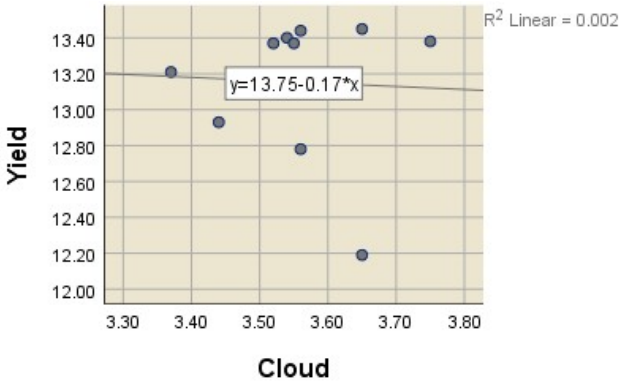


Figure 11. 39 Yield vs cloud

From above Figure (11.37-11.39) it is predicted that for Boro rice, rainfall and cloud show a negative correlation between yield. However, temperature shows a positive linear relationship means that there is a strong linear relationship between yield and temperature.

Correlation Coefficients between climatic parameters and Boro rice yield (Sylhet):

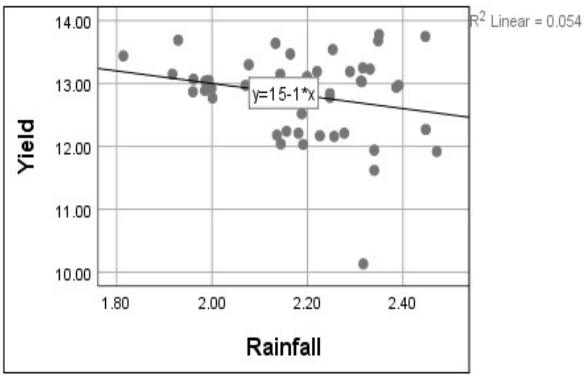


Figure 11. 40 Yield vs rainfall

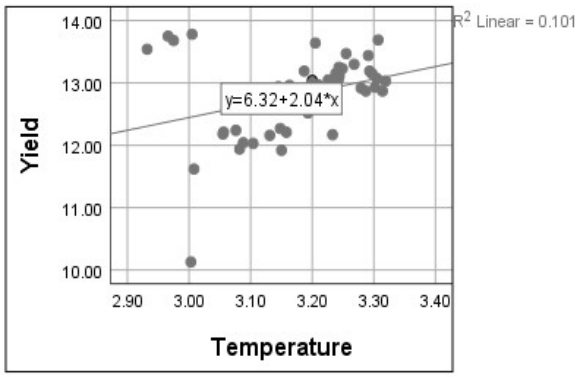


Figure 11. 41 Yield vs temperature

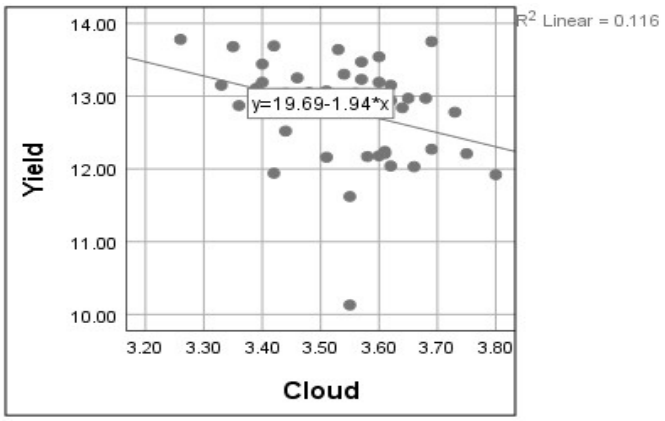


Figure 11. 42 Yield vs cloud

From Figure (11.40-11.42) it is predicted that rainfall and cloud show a negative correlation between yield. The strong linear relationship between the temperature and yield is also found from co-relation coefficients. The value of R^2 for temperature indicated that the slope of the line is moderate so yield has a good dependency on temperature.

11.25 Adaptation Framework:

Flash Flood precaution tool was developed using C++ programme. The algorithm was developed to detect early or late flash flood. is given below for

Detection of flash flood and selection of crop variety

```
#include<bits/stdc++.h>
using namespace std;
int main()
{
   string month [12] = {"JAN", "FEB", "MAR", "APR", "MAY", "JUN", "JUL", "AUG", "SEP",
"OCT", "NOV", "DEC"};
   double temperature [12] =
{64.904,68.414,71.6,77.63,85.55,91.904,90.212,89.042,85.01,75.92,69.89,69.206};
   double rainfall [12] = {4.9,4.86,3.52,4.32,5.58,5.56,6.96,8.62,4.74,6.1,6,3.34};
   double cloud [12] = {40.7,40.2,36.93,49.02,43.75,40,44.97,44.02,38.51,52.37,41.1,39.56};
   int i = 0;
   bool devastating = false;
   bool early = false;
   bool late = false;
   bool flashFlood = false;
   for (i = 0; i<12; ++i)
   {
      if (temperature[i] >= 74.0 && rainfall[i] >= 3.0 && cloud[i] <= 46.0)
      {
         flashFlood = true;
         if (i == 2 || i ==3)
         {
            devastating = true;
         }
         if (i == 2)
         {
            early = true;
         }
         if (i >= 3 && i <= 8)
         {
```

```
            late = true;
        }
    }
}
if (flashFlood == true && early == true)
{
    printf("Early Flash flood\n");
    printf("You can plant BR28, BR29 variety\n");
}
if (flashFlood == true && late == true)
{
    printf("Late Flash flood\n");
    printf("You can plant _______\n");
}
printf("-----------End--------------------------------\n\n");
return 0;
}
#include<bits/stdc++.h>
using namespace std;
int main ()
{
   string month[12] = {"JAN", "FEB", "MAR", "APR", "MAY", "JUN", "JUL", "AUG", "SEP",
"OCT", "NOV", "DEC"};
   double temperature;
   double rainfall;
   double cloud;
   int i = 0;
   int j = 0;
   printf("Enter month name\n");
   for (j = 0; j < 12; ++j)
```

```
{
    cout << "If month = " << month[j] << " then press " << j << "\n";
  }
  while(scanf("%d", &i))
  {
    printf("Enter temperature\n");
    scanf("%lf", &temperature);
    printf("Enter rainfall\n");
    scanf("%lf", &rainfall);
    printf("Enter cloud\n");
    scanf("%lf", &cloud);

    bool devastating = false;
    bool early = false;
    bool late = false;
    bool flashFlood = false;

    if (temperature >= 74.0 && rainfall >= 3.0 && cloud <= 46.0)
    {
      flashFlood = true;
      if (i == 2 || i ==3)
      {
        devastating = true;
      }
      if (i == 2)
      {
        early = true;
      }
      if (i >= 3 && i <= 8)
      {
        late = true;
      }
    }
```

```
if (flashFlood == true && early == true)
        {
           printf("Early Flash flood\n");
           printf("You can plant BR28, BR29 variety\n");
        }
        if (flashFlood == true && late == true)
        {
           printf("Late Flash flood\n");
           printf("You can plant _______\n");
        }
        printf("-----------End----------------------------------\n\n");
        printf("Enter month name\n");
        for (j = 0; j < 12; ++j)
        {
           cout << "If month = " << month[j] << " then press " << j << "\n";
        }
    }

    return 0;
}

/*
75 >
5 >
45 <
2 early or
3 to 8 late
*/
```

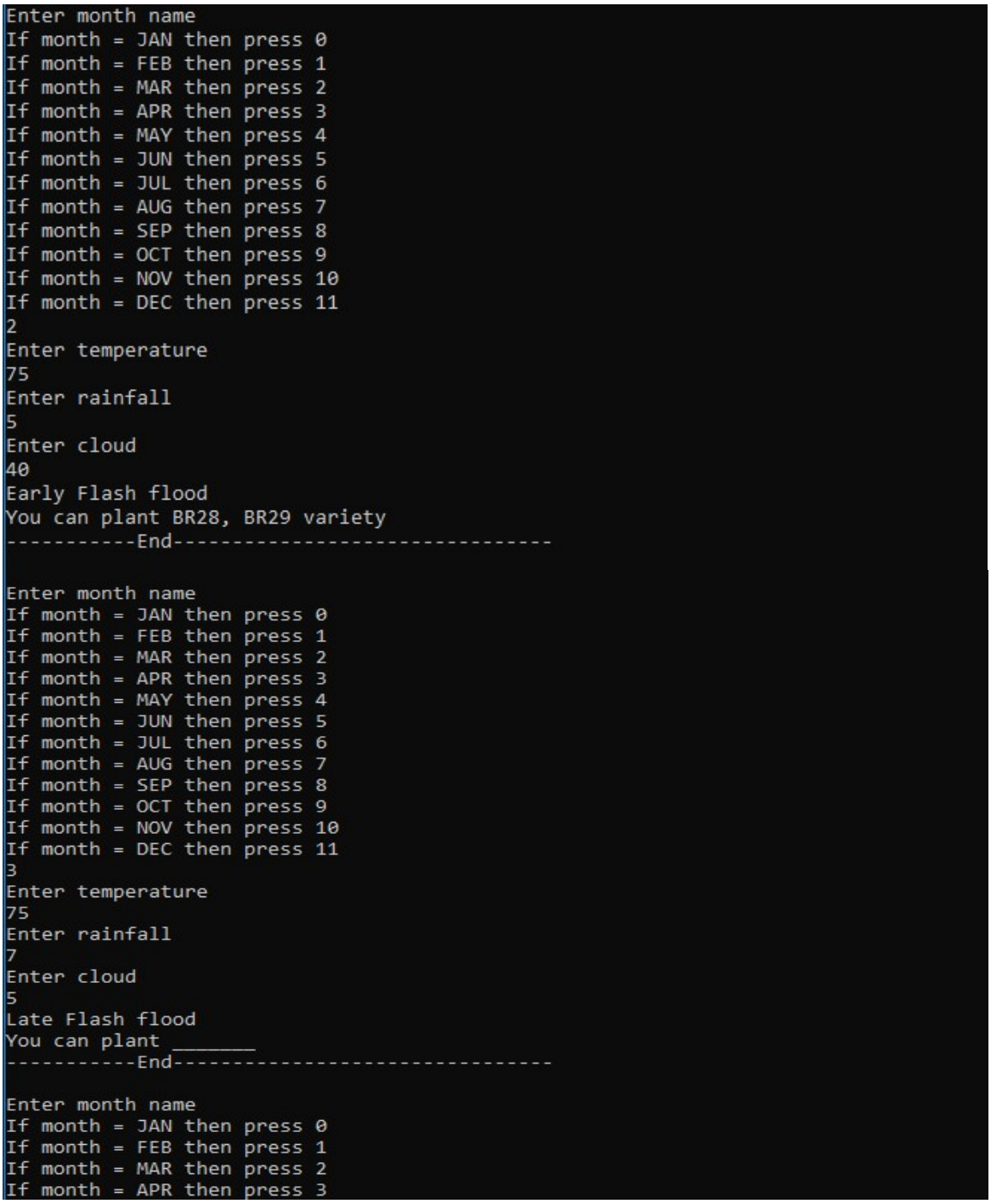


Figure 11.43Output of C++ program

11.26 Formulation of Precautions Strategy:

Figure 11. 44 Precautions Strategy Cycle

Flash Flood Forecast:

- Flash flood trend should be developed before Boro season.
- Trend value should be input in develop flash flood precaution tool (in developed algorithm) for variety selection and decision making.

Need to Awareness:

- Develop Community based organization.
- DAE and NGO Personnel
- SMS through Smart Phone.

Selection of Rice Variety:

- Bangladesh Rice Research Institute (BRRI) developed rice variety for flash flood
- Department of Agricultural Extension (DAE) suggested variety for flash flood.

Flash Flood

- If flash flood occurs then -

Response:

- Rescue efforts
- First aid treatment
- Monitoring of secondary disaster
- Construction of temporary housing
- Establishment of tent villages

Rehabilitation:

- Disaster resistant reconstruction
- Appropriate land use planning
- Livelihood support

2. Research highlight/findings

- Flash Flood trend for Sylhet and Sunamganj district have been developed. This trend line already fit for past scenario in both model synthesis (EdGCM and CCSM).
- No devastating flash flood has been predicted in the upcoming days of 2019 and 2020.
- In the numerical analysis through EdGCM, the ability of predicting non-devastating flashflood also observed.
- Although, there are variations in data of different models of flash flood, all models have their numerous potentialities on predicting flash flood and in all the cases, the test hypothesis of this research serves as a key indicator of flash flood in this area.
- As there are shortage of observation stations, this type of research output would be more reliable if more stations are installed in the study area by the Government and non-Governmental organizations.
- But it is inevitable to validate the trend line for future forecasting and impact analysis on crop scenario.
- An algorithm has been developed as a flash flood precaution tool to formulate precaution strategy for the future flash flood scenarios.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	10	99,000	10	99,000	100%
(b) Lab &field equipment	11	4,26,000	11	4,26,000	100%
(c) Other capital items	8	3,05,000	8	3,05,000	100%

2. Establishment/renovation facilities:
Not Applicable

3. Training/study tour/ seminar/workshop/conference organized:

Not Applicable

C. Financial and physical progress

Fig in Tk

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	631166	631166	631166	0	100	Lack of timely fund disbursement
B. Field research/lab expenses and supplies	864943	737145	543663	321280	74	
C. Operating expenses	245323	241811	242886	2437	100	
D. Vehicle hire and fuel, oil & maintenance	77529	112864	74329	3200	66	
E. Training/workshop/seminar etc.	122008	56865	0	122008	0	
F. Publications and printing	96850	98600	36850	60000	37	
G. Miscellaneous	58181	47093	27093	31088	58	
H. Capital expenses	404000	404000	404000	0	100	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output (i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
Flash flood trend development	• Downscaling of EdGCM data • Flash flood trend developed • Forecasting of devastating and non-devastating flash flood	Flash flood trend	Prediction of flash flood in the upcoming years
Flash flood precaution strategy	• Algorithm developed in C++ programmethat can select the crop variety for the upcoming flash flood.	Flash flood precaution tool	Flash flood strategy to adapt with this calamity.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publications		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Leaflet		✓	
Journal publication	✓		
Information development		✓	
Other publications**(Poster)**		✓	 

F. Technology/Knowledge generation/Policy Support:

i. **Generation of new knowledge that help in developing more technology in future**

- ✓ Downscaling of Educational Global Climate Model (EdGCM) data
- ✓ Flash flood trend developed for predicting future devastating or non-devastating flash flood
- ✓ Algorithm was developed as a flash flood precaution tool to select crop variety for preparedness of upcoming flash flood

ii. Technology transferred that help increased agricultural productivity and farmers' income

iii

- ✓ Flash flood precaution alert and selected variety can be disseminated to the farmers through extension workers to adapt with a flash flood scenario.

the negative impacts of flash flood in this area.

G. Information regarding Desk and Field Monitoring

Not applicable

I. Lesson Learned/Challenges (if any)

i. Forecasting flash flood and proper dissemination of information are challenging tasks considering the

- Observed data availability
- Computation resources availability
- Lead time requirements
- Institutional ability to disseminate information

ii. Lack of fund disbursement in the committed time frame work

Signature of the Principal Investigator
Date ……
Seal

Counter signature of the Head of the organization/authorized representative
Date ……..
Seal

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URL-1 https://reliefweb.int/sites/reliefweb.int/files/resources/291.%20Development%20of%20Four%20Decatde.pdf

Appendix 1: Downscaled temperature, rainfall and cloud fraction data of Sunamganj district (1920-2020).

	Months	Cloud	Rainfall	Rainfall	Temperature (c)	Temperature (K)	Temperature (F)
1920	Jan	48.71	2.85	42.75	16.84	289.99	62.312
	Feb	40.37	4.35	65.25	20.41	293.56	68.738
	Mar	42.56	5.01	75.15	21.61	294.76	70.898
	Apr	31.15	4.23	63.45	27.36	300.51	81.248
	May	21.75	4.94	74.1	29.84	302.99	85.712
	June	32.88	6.42	96.3	33.43	306.58	92.174
	July	25.99	7.49	112.35	32.03	305.18	89.654
	Aug	28.35	7.38	110.7	30.38	303.53	86.684
	Sep	25.85	5.09	76.35	30.92	304.07	87.656
	Oct	29.57	5.47	82.05	27.14	300.29	80.852
	Nov	45.1	4.91	73.65	19.76	292.91	67.568
	Dec	38.09	4.48	67.2	18.81	291.96	65.858
1921	Jan	48.59	3.45	51.75	17.25	290.4	63.05
	Feb	37.22	4.73	70.95	19.74	292.89	67.532
	Mar	27.38	2.75	41.25	24.43	297.58	75.974
	Apr	30.43	4.37	65.55	23.48	296.63	74.264
	May	28.6	5.27	79.05	29.8	302.95	85.64
	June	33.22	7.09	106.35	32.8	305.95	91.04
	July	33.9	7.56	113.4	32.65	305.8	90.77
	Aug	33.79	7.32	109.8	30.05	303.2	86.09
	Sep	29.51	4.74	71.1	26.72	299.87	80.096
	Oct	28.53	3.88	58.2	25.41	298.56	77.738
	Nov	35.43	5	75	20.71	293.86	69.278
	Dec	44.55	4.42	66.3	16.33	289.48	61.394
1922	Jan	42.94	4.1	61.5	18.9	292.05	66.02
	Feb	38.07	5.04	75.6	20.8	293.95	69.44
	Mar	28.79	4.35	65.25	24.06	297.21	75.308
	Apr	31.27	6.34	95.1	26.92	300.07	80.456
	May	22.59	4.71	70.65	34.44	307.59	93.992
	June	24.34	7.91	118.65	37.92	311.07	100.256
	July	27.59	6.99	104.85	32.33	305.48	90.194
	Aug	30.84	7.09	106.35	30.73	303.88	87.314

	Sep	30.38	5.54	83.1	29.13	302.28	84.434
	Oct	25.25	4.28	64.2	25.37	298.52	77.666
	Nov	42.85	5.9	88.5	21.4	294.55	70.52
	Dec	40.95	2.5	37.5	16.22	289.37	61.196
1923	Jan	46.25	2.54	38.1	17.1	290.25	62.78
	Feb	42.17	3.02	45.3	20.59	293.74	69.062
	Mar	25.04	3.96	59.4	21.79	294.94	71.222
	Apr	28.14	6.43	96.45	23.81	296.96	74.858
	May	31.23	4.75	71.25	27.21	300.36	80.978
	June	39.21	7.99	119.85	29.79	302.94	85.622
	July	33.37	7.6	114	30.91	304.06	87.638
	Aug	27.37	8.28	124.2	28.54	301.69	83.372
	Sep	29.15	4.78	71.7	28.79	301.94	83.822
	Oct	28.76	4.16	62.4	27.68	300.83	81.824
	Nov	37.22	5.26	78.9	20.58	293.73	69.044
	Dec	52.11	5.2	78	18.24	291.39	64.832
1924	Jan	51.37	3.62	54.3	17.78	290.93	64.004
	Feb	48.49	4.32	64.8	16.32	289.47	61.376
	Mar	34.81	3.94	59.1	20.79	293.94	69.422
	Apr	36.87	4.47	67.05	27.02	300.17	80.636
	May	33.92	5.72	85.8	28.09	301.24	82.562
	June	28.29	6.89	103.35	32.89	306.04	91.202
	July	22.05	7.27	109.05	32.22	305.37	89.996
	Aug	31.76	7.1	106.5	31.87	305.02	89.366
	Sep	24.25	2.25	33.75	31.33	304.48	88.394
	Oct	20.07	4.24	63.6	26.9	300.05	80.42
	Nov	28.63	4	60	23.07	296.22	73.526
	Dec	45.92	4.65	69.75	17.57	290.72	63.626
1925	Jan	35.72	3.21	48.15	22.48	295.63	72.464
	Feb	37.14	5.67	85.05	21.17	294.32	70.106
	Mar	50.46	9.86	147.9	21.95	295.1	71.51
	Apr	40.39	5.4	81	22.41	295.56	72.338
	May	26.3	5.22	78.3	29.96	303.11	85.928
	June	37.47	7.73	115.95	31.25	304.4	88.25
	July	33.08	7	105	32.22	305.37	89.996
	Aug	28.32	6.02	90.3	32.84	305.99	91.112

	Sep	28.53	5.35	80.25	30.25	303.4	86.45
	Oct	24.16	4.64	69.6	27.43	300.58	81.374
	Nov	26.98	4.02	60.3	22.36	295.51	72.248
	Dec	44.42	4.2	63	22.11	295.26	71.798
1926	Jan	47.56	3.1	46.5	18.8	291.95	65.84
	Feb	37.62	5.65	84.75	21.89	295.04	71.402
	Mar	32.7	4.26	63.9	24.65	297.8	76.37
	Apr	29.57	4.77	71.55	26.81	299.96	80.258
	May	24.97	5.61	84.15	29.51	302.66	85.118
	June	31.77	6.55	98.25	31.94	305.09	89.492
	July	35.86	7.19	107.85	31.81	304.96	89.258
	Aug	33.08	7.29	109.35	30.34	303.49	86.612
	Sep	29.78	4.7	70.5	31.26	304.41	88.268
	Oct	23.18	4.27	64.05	25.46	298.61	77.828
	Nov	32.66	5.54	83.1	20.76	293.91	69.368
	Dec	47.42	5.18	77.7	19.4	292.55	66.92
1927	Jan	47	3.94	59.1	17.12	290.27	62.816
	Feb	48.14	4.89	73.35	17.94	291.09	64.292
	Mar	28.62	3.21	48.15	23.78	296.93	74.804
	Apr	32.84	4.56	68.4	24.7	297.85	76.46
	May	22.33	5.39	80.85	29.86	303.01	85.748
	June	41.84	6.78	101.7	31.49	304.64	88.682
	July	0	7.12	106.8	33.86	307.01	92.948
	Aug	27.42	7.28	109.2	31.44	304.59	88.592
	Sep	22.22	4.32	64.8	31.49	304.64	88.682
	Oct	18.85	4.08	61.2	28.15	301.3	82.67
	Nov	27.73	3.5	52.5	21.48	294.63	70.664
	Dec	30.83	3.49	52.35	21.53	294.68	70.754
1928	Jan	47.39	6.23	93.45	19.05	292.2	66.29
	Feb	40.78	4.56	68.4	19.72	292.87	67.496
	Mar	39.73	4.03	60.45	22.61	295.76	72.698
	Apr	37.47	6.78	101.7	22.51	295.66	72.518
	May	36.17	6.22	93.3	27.88	301.03	82.184
	June	40.08	9.22	138.3	28.67	301.82	83.606
	July	36.95	8.34	125.1	30.93	304.08	87.674
	Aug	32.32	8.95	134.25	32.59	305.74	90.662

	Sep	31.86	5.45	81.75	29.23	302.38	84.614
	Oct	27.98	4	60	25.68	298.83	78.224
	Nov	30.01	5.18	77.7	20.3	293.45	68.54
	Dec	50.91	6.14	92.1	19.97	293.12	67.946
1929	Jan	46.49	5.05	75.75	17.99	291.14	64.382
	Feb	45.46	3.05	45.75	19.91	293.06	67.838
	Mar	28.64	3.52	52.8	21.93	295.08	71.474
	Apr	33.06	4.36	65.4	25.28	298.43	77.504
	May	34.4	5.63	84.45	29.72	302.87	85.496
	June	25.86	5.7	85.5	33.34	306.49	92.012
	July	29.17	6.99	104.85	32.3	305.45	90.14
	Aug	28.54	8.68	130.2	31.62	304.77	88.916
	Sep	27.84	4.82	72.3	29.31	302.46	84.758
	Oct	30.16	6.13	91.95	24.51	297.66	76.118
	Nov	34.21	6	90	21.21	294.36	70.178
	Dec	29.23	3.32	49.8	20.13	293.28	68.234
1930	Jan	42.11	6.38	95.7	21.31	294.46	70.358
	Feb	41.52	7.35	110.25	21	294.15	69.8
	Mar	36.56	4.09	61.35	21.87	295.02	71.366
	Apr	31.84	3.3	49.5	24.21	297.36	75.578
	May	27.41	6.14	92.1	31.76	304.91	89.168
	June	26.91	7.15	107.25	34.67	307.82	94.406
	July	43.47	6.77	101.55	32.29	305.44	90.122
	Aug	29.13	5.75	86.25	32.64	305.79	90.752
	Sep	32.47	6.28	94.2	29.86	303.01	85.748
	Oct	26.46	5.72	85.8	27.83	300.98	82.094
	Nov	35.45	6.12	91.8	22.78	295.93	73.004
	Dec	46.78	3.56	53.4	19.83	292.98	67.694
1931	Jan	39.46	4.73	70.95	20.88	294.03	69.584
	Feb	39.18	3.16	47.4	21.99	295.14	71.582
	Mar	29.63	4.15	62.25	23.66	296.81	74.588
	Apr	30.99	3.77	56.55	28.43	301.58	83.174
	May	22.17	4.9	73.5	33.77	306.92	92.786
	June	24.06	7.03	105.45	35.1	308.25	95.18
	July	35.19	5.47	82.05	34.25	307.4	93.65
	Aug	23.79	4.97	74.55	36.02	309.17	96.836

	Sep	24.13	3.47	52.05	35.06	308.21	95.108
	Oct	18.42	3.68	55.2	30.91	304.06	87.638
	Nov	14.94	3.55	53.25	27.2	300.35	80.96
	Dec	37.33	3.33	49.95	20.68	293.83	69.224
1932	Jan	32.16	4.2	63	23.52	296.67	74.336
	Feb	44.82	4.57	68.55	21.45	294.6	70.61
	Mar	37.04	5.81	87.15	21.8	294.95	71.24
	Apr	25.63	4.34	65.1	26.48	299.63	79.664
	May	28.07	4.5	67.5	30.86	304.01	87.548
	June	15.65	4.63	69.45	37.97	311.12	100.346
	July	15.95	5.27	79.05	40.37	313.52	104.666
	Aug	14.33	3.87	58.05	39.47	312.62	103.046
	Sep	13.09	3.17	47.55	36.91	310.06	98.438
	Oct	19.75	4.09	61.35	32.15	305.3	89.87
	Nov	35.42	3.87	58.05	21.86	295.01	71.348
	Dec	51.86	4.13	61.95	19.16	292.31	66.488
1933	Jan	39.48	3.59	53.85	20.85	294	69.53
	Feb	40.34	6.21	93.15	21.98	295.13	71.564
	Mar	35.07	3.13	46.95	25.05	298.2	77.09
	Apr	29.25	5.47	82.05	26.37	299.52	79.466
	May	28.35	4.89	73.35	29.65	302.8	85.37
	June	22.44	4.88	73.2	35.35	308.5	95.63
	July	24.95	5.49	82.35	38.2	311.35	100.76
	Aug	22.79	5.08	76.2	34.54	307.69	94.172
	Sep	12.72	3.97	59.55	34.63	307.78	94.334
	Oct	17.12	2.89	43.35	31.12	304.27	88.016
	Nov	28.09	2.53	37.95	21.73	294.88	71.114
	Dec	31.6	1.92	28.8	21.47	294.62	70.646
1934	Jan	27.5	3.21	48.15	23.28	296.43	73.904
	Feb	31.74	4.06	60.9	24.78	297.93	76.604
	Mar	25.29	3.89	58.35	26.55	299.7	79.79
	Apr	18.03	3.81	57.15	32.06	305.21	89.708
	May	17.39	4.11	61.65	32.81	305.96	91.058
	June	29.68	7.71	115.65	32.36	305.51	90.248
	July	34.94	9.11	136.65	34.45	307.6	94.01
	Aug	37.43	7.36	110.4	33.67	306.82	92.606

	Sep	27.84	4.91	73.65	31.48	304.63	88.664
	Oct	18.94	4.3	64.5	31.43	304.58	88.574
	Nov	23.32	5.32	79.8	26.71	299.86	80.078
	Dec	33.26	4.06	60.9	23.65	296.8	74.57
1935	Jan	35.42	2.9	43.5	23.78	296.93	74.804
	Feb	51.54	8.83	132.45	20.95	294.1	69.71
	Mar	39.92	4.58	68.7	21.81	294.96	71.258
	Apr	35.6	4.34	65.1	26.32	299.47	79.376
	May	23.42	5.38	80.7	30.1	303.25	86.18
	June	35.91	7.38	110.7	33	306.15	91.4
	July	37.14	8.56	128.4	34.28	307.43	93.704
	Aug	23.44	5.64	84.6	34.82	307.97	94.676
	Sep	10.33	3.58	53.7	36.36	309.51	97.448
	Oct	13.95	3.91	58.65	32.11	305.26	89.798
	Nov	25	5.57	83.55	26.02	299.17	78.836
	Dec	50.48	5.75	86.25	22.24	295.39	72.032
1936	Jan	47.19	3.01	45.15	17.79	290.94	64.022
	Feb	43.47	5.45	81.75	19.68	292.83	67.424
	Mar	36.3	3.6	54	21.64	294.79	70.952
	Apr	25.36	2.7	40.5	27.51	300.66	81.518
	May	22.84	3.8	57	34.55	307.7	94.19
	June	21.82	6.22	93.3	34.78	307.93	94.604
	July	27.06	6.76	101.4	38.36	311.51	101.048
	Aug	30.57	6.31	94.65	33.69	306.84	92.642
	Sep	15.22	4.24	63.6	33.81	306.96	92.858
	Oct	14.08	2.9	43.5	31.2	304.35	88.16
	Nov	17.85	3.51	52.65	26.23	299.38	79.214
	Dec	29.75	3.25	48.75	24.67	297.82	76.406
1937	Jan	32.24	3.33	49.95	22.61	295.76	72.698
	Feb	39.4	4.06	60.9	21.53	294.68	70.754
	Mar	24.57	2.92	43.8	24.5	297.65	76.1
	Apr	20.43	4	60	31.29	304.44	88.322
	May	16.64	3.2	48	33.78	306.93	92.804
	June	16.81	4.71	70.65	40.53	313.68	104.954
	July	18.12	4.2	63	40.57	313.72	105.026
	Aug	17.48	3.78	56.7	39.16	312.31	102.488

	Sep	14.6	2.45	36.75	36.19	309.34	97.142
	Oct	24.34	4.44	66.6	31.4	304.55	88.52
	Nov	39.11	3.41	51.15	23.97	297.12	75.146
	Dec	38.38	3.83	57.45	20.73	293.88	69.314
1938	Jan	37.74	3.04	45.6	20.05	293.2	68.09
	Feb	26.12	1.71	25.65	25.55	298.7	77.99
	Mar	29.55	3.46	51.9	26.38	299.53	79.484
	Apr	15.93	2.85	42.75	33.23	306.38	91.814
	May	22.57	5.28	79.2	37.49	310.64	99.482
	June	15.89	5.79	86.85	39.99	313.14	103.982
	July	26.45	6.87	103.05	39.3	312.45	102.74
	Aug	22.92	5.71	85.65	34.88	308.03	94.784
	Sep	15.22	4.25	63.75	35.14	308.29	95.252
	Oct	13.74	3.77	56.55	31.63	304.78	88.934
	Nov	33.43	4.04	60.6	25.42	298.57	77.756
	Dec	48.97	2.7	40.5	19.86	293.01	67.748
1939	Jan	47.55	2.95	44.25	19.99	293.14	67.982
	Feb	37.2	4.04	60.6	21.12	294.27	70.016
	Mar	30.48	4.42	66.3	23.68	296.83	74.624
	Apr	27.47	4.34	65.1	28.74	301.89	83.732
	May	23.11	4.15	62.25	33.45	306.6	92.21
	June	14.77	3.91	58.65	40.78	313.93	105.404
	July	28.74	9.83	147.45	38.94	312.09	102.092
	Aug	39.68	9.56	143.4	32.98	306.13	91.364
	Sep	29.74	4.9	73.5	31.36	304.51	88.448
	Oct	26.44	4.97	74.55	29.7	302.85	85.46
	Nov	30.83	3.55	53.25	24.18	297.33	75.524
	Dec	46.08	2.91	43.65	19.26	292.41	66.668
1940	Jan	47.81	2.44	36.6	18.69	291.84	65.642
	Feb	33.71	1.61	24.15	23.03	296.18	73.454
	Mar	24.02	2.97	44.55	27.41	300.56	81.338
	Apr	24.48	3.64	54.6	30.76	303.91	87.368
	May	17.44	4	60	36.02	309.17	96.836
	June	21.86	7.26	108.9	39.92	313.07	103.856
	July	30.84	4.27	64.05	35.76	308.91	96.368
	Aug	20.62	5.31	79.65	39.31	312.46	102.758

	Sep	13.71	4.15	62.25	37.08	310.23	98.744
	Oct	15.55	4.41	66.15	32.42	305.57	90.356
	Nov	38.13	6.54	98.1	24.66	297.81	76.388
	Dec	50.99	2.54	38.1	19.08	292.23	66.344
1941	Jan	51.38	3.72	55.8	21.08	294.23	69.944
	Feb	44.94	5.64	84.6	20.16	293.31	68.288
	Mar	34.33	3.52	52.8	24.56	297.71	76.208
	Apr	39.33	4.69	70.35	26.04	299.19	78.872
	May	28.12	5.02	75.3	30.92	304.07	87.656
	June	33.35	5.87	88.05	32.94	306.09	91.292
	July	32.76	6	90	36.4	309.55	97.52
	Aug	27.73	7.27	109.05	38.08	311.23	100.544
	Sep	24.02	5.57	83.55	33.92	307.07	93.056
	Oct	19.41	3.08	46.2	31.5	304.65	88.7
	Nov	32.43	4.13	61.95	24.19	297.34	75.542
	Dec	42.28	3.18	47.7	19.03	292.18	66.254
1942	Jan	51.44	5.67	85.05	21.7	294.85	71.06
	Feb	41.44	2.96	44.4	19.51	292.66	67.118
	Mar	38.26	4.44	66.6	22.74	295.89	72.932
	Apr	30.99	3.23	48.45	28.35	301.5	83.03
	May	17.88	3.13	46.95	36.66	309.81	97.988
	June	19	5.86	87.9	38.37	311.52	101.066
	July	28.57	6.25	93.75	35.77	308.92	96.386
	Aug	30	4.89	73.35	35.25	308.4	95.45
	Sep	15.1	4.29	64.35	35.96	309.11	96.728
	Oct	11.75	3.17	47.55	32.05	305.2	89.69
	Nov	27.72	5.26	78.9	22.43	295.58	72.374
	Dec	39.53	5.4	81	22.25	295.4	72.05
1943	Jan	44.12	2.72	40.8	22.55	295.7	72.59
	Feb	35.55	5.13	76.95	23.12	296.27	73.616
	Mar	42.21	5.88	88.2	24.48	297.63	76.064
	Apr	42.6	5.54	83.1	23.16	296.31	73.688
	May	38.35	5.79	86.85	25.62	298.77	78.116
	June	33.56	5.97	89.55	32.59	305.74	90.662
	July	38.55	5.96	89.4	33.88	307.03	92.984
	Aug	24.67	4.82	72.3	39.57	312.72	103.226

	Sep	20.54	7.18	107.7	36.62	309.77	97.916
	Oct	14.42	4.44	66.6	30.81	303.96	87.458
	Nov	30.95	3.43	51.45	24.21	297.36	75.578
	Dec	38.21	4.15	62.25	21.24	294.39	70.232
1944	Jan	30.06	3.44	51.6	22.57	295.72	72.626
	Feb	30.07	3.07	46.05	24.79	297.94	76.622
	Mar	21.57	4.41	66.15	28.25	301.4	82.85
	Apr	20.91	2.95	44.25	35.1	308.25	95.18
	May	28.17	7.24	108.6	37.41	310.56	99.338
	June	14.95	5.57	83.55	41.73	314.88	107.114
	July	17.28	3.95	59.25	40.3	313.45	104.54
	Aug	19.94	4.06	60.9	39.77	312.92	103.586
	Sep	17.93	4.99	74.85	36.71	309.86	98.078
	Oct	14.61	3.93	58.95	29.56	302.71	85.208
	Nov	29.91	3.75	56.25	23.74	296.89	74.732
	Dec	37.85	2.98	44.7	20.12	293.27	68.216
1945	Jan	35.91	2.23	33.45	24.4	297.55	75.92
	Feb	33.21	2.22	33.3	20.31	293.46	68.558
	Mar	40.06	4.44	66.6	23.28	296.43	73.904
	Apr	26.79	3.66	54.9	27.68	300.83	81.824
	May	23.56	4.42	66.3	33.54	306.69	92.372
	June	19.73	4.84	72.6	36.29	309.44	97.322
	July	28.91	5.41	81.15	36.52	309.67	97.736
	Aug	15.44	4.21	63.15	39.56	312.71	103.208
	Sep	16.84	4.07	61.05	36.89	310.04	98.402
	Oct	19.77	3.76	56.4	30.6	303.75	87.08
	Nov	36.75	4.06	60.9	24.63	297.78	76.334
	Dec	45.78	2.43	36.45	18.65	291.8	65.57
1946	Jan	36.53	3.02	45.3	22.91	296.06	73.238
	Feb	33.48	2.01	30.15	24.74	297.89	76.532
	Mar	22.4	2.36	35.4	28.79	301.94	83.822
	Apr	18.95	3.88	58.2	30.96	304.11	87.728
	May	21.81	4.65	69.75	33.78	306.93	92.804
	June	14.54	4.23	63.45	39.39	312.54	102.902
	July	11.98	4.25	63.75	40.43	313.58	104.774
	Aug	20.08	4.46	66.9	39.63	312.78	103.334

	Sep	15.06	4.62	69.3	35.67	308.82	96.206
	Oct	12.48	2.99	44.85	33.94	307.09	93.092
	Nov	46	5.88	88.2	21.29	294.44	70.322
	Dec	44.55	4.35	65.25	21.46	294.61	70.628
1947	Jan	37.77	2.68	40.2	21.61	294.76	70.898
	Feb	39.12	3.25	48.75	23.04	296.19	73.472
	Mar	30.4	2.55	38.25	26.94	300.09	80.492
	Apr	27.04	4.38	65.7	28.75	301.9	83.75
	May	21.81	5.55	83.25	33.91	307.06	93.038
	June	22.5	5.28	79.2	36.32	309.47	97.376
	July	26.73	7.41	111.15	37.47	310.62	99.446
	Aug	32.75	5.65	84.75	33.7	306.85	92.66
	Sep	21.03	3.39	50.85	34.91	308.06	94.838
	Oct	14.79	3.33	49.95	30.76	303.91	87.368
	Nov	37.23	4.91	73.65	26.68	299.83	80.024
	Dec	39.58	3.69	55.35	20.51	293.66	68.918
1948	Jan	44.79	2.32	34.8	22.13	295.28	71.834
	Feb	38.71	3.01	45.15	21.2	294.35	70.16
	Mar	36.5	4.31	64.65	23.65	296.8	74.57
	Apr	32.92	3.3	49.5	25.52	298.67	77.936
	May	24.44	4.7	70.5	30.72	303.87	87.296
	June	21.57	5.31	79.65	35.84	308.99	96.512
	July	33.18	6.73	100.95	36.36	309.51	97.448
	Aug	25.75	6.22	93.3	31.42	304.57	88.556
	Sep	23.89	3.72	55.8	32.26	305.41	90.068
	Oct	23.58	4.27	64.05	29.5	302.65	85.1
	Nov	43.83	6.45	96.75	22.55	295.7	72.59
	Dec	52.67	3.94	59.1	20.55	293.7	68.99
1949	Jan	59.09	2.3	34.5	20.01	293.16	68.018
	Feb	42.98	3.5	52.5	23.4	296.55	74.12
	Mar	35.04	4.02	60.3	25.5	298.65	77.9
	Apr	27.35	3.07	46.05	29.04	302.19	84.272
	May	24.46	4.13	61.95	32.92	306.07	91.256
	June	16.46	5.53	82.95	39.62	312.77	103.316
	July	14.34	5.39	80.85	40.62	313.77	105.116
	Aug	25.34	5.49	82.35	40.99	314.14	105.782

	Sep	24.83	4.45	66.75	32.75	305.9	90.95
	Oct	18.46	3.91	58.65	30.45	303.6	86.81
	Nov	39.32	4.29	64.35	24.27	297.42	75.686
	Dec	30.6	3.06	45.9	22.65	295.8	72.77
1950	Jan	46.18	2.8	42	22.8	295.95	73.04
	Feb	29	3.45	51.75	24	297.15	75.2
	Mar	26.96	3.97	59.55	26.85	300	80.33
	Apr	30.63	5.27	79.05	26.61	299.76	79.898
	May	34.8	5.31	79.65	31.42	304.57	88.556
	June	15.29	3.42	51.3	39.15	312.3	102.47
	July	22.74	5.74	86.1	42.11	315.26	107.798
	Aug	27.27	8.47	127.05	32.96	306.11	91.328
	Sep	23.54	4.09	61.35	34.22	307.37	93.596
	Oct	30.43	5.46	81.9	31.97	305.12	89.546
	Nov	34.62	4.33	64.95	21.07	294.22	69.926
	Dec	31.52	3.27	49.05	21.23	294.38	70.214
1951	Jan	37.8	2.07	31.05	19.97	293.12	67.946
	Feb	31.26	3.17	47.55	23.07	296.22	73.526
	Mar	41.46	5.2	78	24.68	297.83	76.424
	Apr	34.76	4.61	69.15	25.95	299.1	78.71
	May	25.71	5.6	84	31.26	304.41	88.268
	June	23.02	6.33	94.95	35.02	308.17	95.036
	July	34.29	8.5	127.5	33.79	306.94	92.822
	Aug	28.27	6.94	104.1	34.68	307.83	94.424
	Sep	25.44	5.21	78.15	32.96	306.11	91.328
	Oct	21.75	3.84	57.6	29.72	302.87	85.496
	Nov	28.11	4.35	65.25	25.2	298.35	77.36
	Dec	35.07	2.96	44.4	21.76	294.91	71.168
1952	Jan	26.93	1.95	29.25	24.4	297.55	75.92
	Feb	23.21	4.08	61.2	25.63	298.78	78.134
	Mar	23.66	5	75	27.36	300.51	81.248
	Apr	24.16	4.23	63.45	30.33	303.48	86.594
	May	21.23	4.41	66.15	32.59	305.74	90.662
	June	14.11	3.79	56.85	40.1	313.25	104.18
	July	20.16	5.94	89.1	41.85	315	107.33
	Aug	23.1	6.58	98.7	35.79	308.94	96.422

	Sep	17.82	4.53	67.95	33.93	307.08	93.074
	Oct	24.21	5.25	78.75	28.74	301.89	83.732
	Nov	34.44	4.46	66.9	24.35	297.5	75.83
	Dec	42.76	2.64	39.6	19.9	293.05	67.82
1953	Jan	37.25	2.39	35.85	21.24	294.39	70.232
	Feb	36.79	2.22	33.3	23.76	296.91	74.768
	Mar	27.59	4.64	69.6	23.46	296.61	74.228
	Apr	30.3	5.33	79.95	25.39	298.54	77.702
	May	35.67	5.66	84.9	32.49	305.64	90.482
	June	35.9	6.4	96	35.29	308.44	95.522
	July	33.75	4.55	68.25	35.86	309.01	96.548
	Aug	27.86	6.14	92.1	36.19	309.34	97.142
	Sep	24.2	4.27	64.05	34.14	307.29	93.452
	Oct	17.81	2.93	43.95	31	304.15	87.8
	Nov	33.51	4.18	62.7	27.1	300.25	80.78
	Dec	35.48	3.61	54.15	21.41	294.56	70.538
1954	Jan	35.44	2.88	43.2	21.95	295.1	71.51
	Feb	46.59	5.08	76.2	21.79	294.94	71.222
	Mar	32.53	4.44	66.6	23.65	296.8	74.57
	Apr	37.31	4.64	69.6	24.52	297.67	76.136
	May	28.26	3.73	55.95	31.21	304.36	88.178
	June	18.25	4.47	67.05	37.88	311.03	100.184
	July	25.75	6.92	103.8	36.96	310.11	98.528
	Aug	36.04	7.08	106.2	33.69	306.84	92.642
	Sep	17.88	4.28	64.2	35.64	308.79	96.152
	Oct	10.26	2.99	44.85	30.23	303.38	86.414
	Nov	32.45	4.41	66.15	24.96	298.11	76.928
	Dec	31	2.97	44.55	23.76	296.91	74.768
1955	Jan	35.44	2.61	39.15	21.43	294.58	70.574
	Feb	34.44	2.7	40.5	26.46	299.61	79.628
	Mar	25.1	3	45	28.31	301.46	82.958
	Apr	21.36	3.64	54.6	31.32	304.47	88.376
	May	20.85	3.71	55.65	35.78	308.93	96.404
	June	22.29	5.26	78.9	37.26	310.41	99.068
	July	22.72	4.87	73.05	39.95	313.1	103.91
	Aug	14.64	8.13	121.95	41.29	314.44	106.322

	Sep	13.13	4.07	61.05	37.42	310.57	99.356
	Oct	17.78	3.75	56.25	32.03	305.18	89.654
	Nov	27.05	2.17	32.55	23.18	296.33	73.724
	Dec	42.23	3.32	49.8	21.29	294.44	70.322
1956	Jan	32.5	2.35	35.25	21.1	294.25	69.98
	Feb	43.57	4.79	71.85	24.34	297.49	75.812
	Mar	29.85	4.14	62.1	24.97	298.12	76.946
	Apr	28.39	3.19	47.85	29.82	302.97	85.676
	May	20.92	3.84	57.6	33.82	306.97	92.876
	June	17.55	6.41	96.15	39.69	312.84	103.442
	July	28.13	8.42	126.3	40.14	313.29	104.252
	Aug	27.47	6.76	101.4	34.6	307.75	94.28
	Sep	21.91	3.63	54.45	31.36	304.51	88.448
	Oct	14.76	3.87	58.05	30.97	304.12	87.746
	Nov	41.8	5.88	88.2	25.81	298.96	78.458
	Dec	44.44	3.15	47.25	18.41	291.56	65.138
1957	Jan	51.25	4.06	60.9	20.34	293.49	68.612
	Feb	33.73	3	45	21.57	294.72	70.826
	Mar	31.31	3.62	54.3	24.59	297.74	76.262
	Apr	20.77	3.47	52.05	28.2	301.35	82.76
	May	18.95	4.18	62.7	35.58	308.73	96.044
	June	24.51	5.8	87	37.03	310.18	98.654
	July	25.9	5.6	84	37.79	310.94	100.022
	Aug	24.67	7.9	118.5	33.86	307.01	92.948
	Sep	23.22	4.74	71.1	32.9	306.05	91.22
	Oct	13.77	4.81	72.15	29.04	302.19	84.272
	Nov	24.57	3.75	56.25	25.11	298.26	77.198
	Dec	30.33	4.02	60.3	23.53	296.68	74.354
1958	Jan	32.59	2.05	30.75	22.1	295.25	71.78
	Feb	31.17	2.6	39	25.89	299.04	78.602
	Mar	26.7	3.07	46.05	27.77	300.92	81.986
	Apr	22.19	2.66	39.9	33.25	306.4	91.85
	May	24.44	5.37	80.55	33.37	306.52	92.066
	June	22.82	4.73	70.95	36.23	309.38	97.214
	July	11.59	3.72	55.8	40.51	313.66	104.918
	Aug	19	11.42	171.3	40.15	313.3	104.27

	Sep	24.46	4.24	63.6	37.99	311.14	100.382
	Oct	12.59	4.13	61.95	33.75	306.9	92.75
	Nov	33.72	4.83	72.45	24.43	297.58	75.974
	Dec	36.21	2.56	38.4	21.85	295	71.33
1959	Jan	43.13	3.38	50.7	20.71	293.86	69.278
	Feb	37.59	2.71	40.65	22.33	295.48	72.194
	Mar	36.14	3.91	58.65	27.16	300.31	80.888
	Apr	38.11	5.55	83.25	25.69	298.84	78.242
	May	32.11	5.71	85.65	27.17	300.32	80.906
	June	28.77	7.43	111.45	33.85	307	92.93
	July	32.38	7.26	108.9	34.63	307.78	94.334
	Aug	16.53	5.75	86.25	38.19	311.34	100.742
	Sep	12.2	6.56	98.4	37.15	310.3	98.87
	Oct	11.08	2.97	44.55	31.23	304.38	88.214
	Nov	22.95	3.38	50.7	25.47	298.62	77.846
	Dec	31.63	3.3	49.5	21.04	294.19	69.872
1960	Jan	32.9	1.68	25.2	21.72	294.87	71.096
	Feb	25.9	2.08	31.2	26.04	299.19	78.872
	Mar	26.56	3.4	51	29.33	302.48	84.794
	Apr	26.2	4.33	64.95	32.22	305.37	89.996
	May	18.45	4.24	63.6	34.47	307.62	94.046
	June	15.83	4.68	70.2	39.81	312.96	103.658
	July	12.12	5.79	86.85	41.07	314.22	105.926
	Aug	20.91	10.07	151.05	40.77	313.92	105.386
	Sep	9.88	4.71	70.65	36.91	310.06	98.438
	Oct	14.21	3.4	51	30.97	304.12	87.746
	Nov	27.18	3.72	55.8	28.17	301.32	82.706
	Dec	38.51	5.26	78.9	22.39	295.54	72.302
1961	Jan	34.42	2.99	44.85	21.46	294.61	70.628
	Feb	41.95	3.22	48.3	21.81	294.96	71.258
	Mar	34.28	4.45	66.75	23.91	297.06	75.038
	Apr	30.46	4.97	74.55	26.14	299.29	79.052
	May	30.36	5.58	83.7	31.78	304.93	89.204
	June	19.14	4.28	64.2	37.13	310.28	98.834
	July	28.09	6.75	101.25	36.51	309.66	97.718
	Aug	28.13	5.64	84.6	34.47	307.62	94.046

	Sep	13.03	4.61	69.15	35.8	308.95	96.44
	Oct	17.12	3.52	52.8	31.01	304.16	87.818
	Nov	15	3.65	54.75	28.57	301.72	83.426
	Dec	36.13	3.37	50.55	23.48	296.63	74.264
1962	Jan	29.9	2.81	42.15	26.17	299.32	79.106
	Feb	35.24	6.31	94.65	24.84	297.99	76.712
	Mar	27.48	3.99	59.85	25.3	298.45	77.54
	Apr	40.95	7.09	106.35	25.04	298.19	77.072
	May	29.44	6.36	95.4	29.93	303.08	85.874
	June	34.81	6.58	98.7	32.92	306.07	91.256
	July	25.15	8.11	121.65	35.18	308.33	95.324
	Aug	30.33	6	90	37.59	310.74	99.662
	Sep	8.79	4.75	71.25	37.68	310.83	99.824
	Oct	16.69	3.78	56.7	31.91	305.06	89.438
	Nov	24.56	5	75	28.86	302.01	83.948
	Dec	33.42	3.86	57.9	22.57	295.72	72.626
1963	Jan	39.44	2.98	44.7	20.34	293.49	68.612
	Feb	22.04	1.87	28.05	26.1	299.25	78.98
	Mar	21.22	2.9	43.5	28.33	301.48	82.994
	Apr	22.83	3.71	55.65	30.17	303.32	86.306
	May	36.97	7.11	106.65	34.3	307.45	93.74
	June	15.15	4.94	74.1	39.43	312.58	102.974
	July	23.81	6.19	92.85	42.3	315.45	108.14
	Aug	22.97	5.59	83.85	37.91	311.06	100.238
	Sep	13.66	4.27	64.05	36.85	310	98.33
	Oct	17.95	3.61	54.15	32.26	305.41	90.068
	Nov	18.58	3.29	49.35	27.59	300.74	81.662
	Dec	41.27	3.22	48.3	20.7	293.85	69.26
1964	Jan	30.3	3.01	45.15	24.97	298.12	76.946
	Feb	26.39	2.87	43.05	25.67	298.82	78.206
	Mar	37.08	4.03	60.45	26.57	299.72	79.826
	Apr	16.88	2.07	31.05	32.18	305.33	89.924
	May	22.5	4.37	65.55	33.29	306.44	91.922
	June	25.74	6.76	101.4	35.37	308.52	95.666
	July	18.03	5.52	82.8	37.5	310.65	99.5
	Aug	18.61	3.7	55.5	40.35	313.5	104.63

	Sep	13.24	4.27	64.05	36.85	310	98.33
	Oct	20.07	4.07	61.05	32.53	305.68	90.554
	Nov	35.51	2.7	40.5	22.54	295.69	72.572
	Dec	47.61	3.92	58.8	21.32	294.47	70.376
1965	Jan	39.19	2.96	44.4	21.83	294.98	71.294
	Feb	37.86	2.93	43.95	20.65	293.8	69.17
	Mar	27.49	3.49	52.35	23.92	297.07	75.056
	Apr	34.84	3.65	54.75	29.41	302.56	84.938
	May	15.17	3.87	58.05	36.5	309.65	97.7
	June	23.89	6.34	95.1	38.76	311.91	101.768
	July	17.6	4.94	74.1	38.04	311.19	100.472
	Aug	21.63	6.06	90.9	35.99	309.14	96.782
	Sep	13.49	2.98	44.7	35.02	308.17	95.036
	Oct	13.38	3.74	56.1	30.94	304.09	87.692
	Nov	15.64	4.13	61.95	27.85	301	82.13
	Dec	25.91	3.85	57.75	26.94	300.09	80.492
1966	Jan	42.99	3.86	57.9	22.07	295.22	71.726
	Feb	31.55	3.85	57.75	23.78	296.93	74.804
	Mar	34.08	4.38	65.7	25.72	298.87	78.296
	Apr	18	3.41	51.15	31.1	304.25	87.98
	May	15.58	4.16	62.4	35.6	308.75	96.08
	June	14.74	5.2	78	40.16	313.31	104.288
	July	32.66	7	105	42.09	315.24	107.762
	Aug	15.47	2.06	30.9	41.03	314.18	105.854
	Sep	19.14	3.52	52.8	37.69	310.84	99.842
	Oct	15.66	3.58	53.7	31.38	304.53	88.484
	Nov	37.22	4.74	71.1	25.06	298.21	77.108
	Dec	38.84	2.92	43.8	20.88	294.03	69.584
1967	Jan	34.18	2.27	34.05	22.08	295.23	71.744
	Feb	27.12	2.78	41.7	26.17	299.32	79.106
	Mar	32.87	4.13	61.95	27.17	300.32	80.906
	Apr	30.6	5.06	75.9	28.88	302.03	83.984
	May	25.35	4.5	67.5	28.41	301.56	83.138
	June	22.07	6.36	95.4	35.65	308.8	96.17
	July	20.8	3.86	57.9	41.79	314.94	107.222
	Aug	19.18	3.58	53.7	34.39	307.54	93.902

	Sep	9.64	3.32	49.8	35.01	308.16	95.018
	Oct	16.12	3.01	45.15	31.71	304.86	89.078
	Nov	33.14	3.99	59.85	24.81	297.96	76.658
	Dec	50.12	3.04	45.6	19.96	293.11	67.928
1968	Jan	36.2	1.71	25.65	20.9	294.05	69.62
	Feb	27.46	3.2	48	24.43	297.58	75.974
	Mar	34.95	4.8	72	25.71	298.86	78.278
	Apr	24.97	3.92	58.8	28.94	302.09	84.092
	May	23.63	5.9	88.5	33.1	306.25	91.58
	June	31.79	6.8	102	39.13	312.28	102.434
	July	25.35	4.76	71.4	41.79	314.94	107.222
	Aug	24.86	4.5	67.5	34.39	307.54	93.902
	Sep	18.87	4.05	60.75	35.01	308.16	95.018
	Oct	11.45	3.58	53.7	31.71	304.86	89.078
	Nov	30.24	3.43	51.45	24.81	297.96	76.658
	Dec	37.82	3.2	48	19.96	293.11	67.928
1969	Jan	39.77	4.66	69.9	22.48	295.63	72.464
	Feb	47.89	4.87	73.05	19.45	292.6	67.01
	Mar	32.59	4.3	64.5	23.55	296.7	74.39
	Apr	34.63	5.2	78	28.98	302.13	84.164
	May	27.05	4.95	74.25	30.35	303.5	86.63
	June	22.22	5.67	85.05	40.56	313.71	105.008
	July	23.04	4.85	72.75	39.07	312.22	102.326
	Aug	25.91	3.31	49.65	39.33	312.48	102.794
	Sep	11.74	6.17	92.55	37.16	310.31	98.888
	Oct	15	3.04	45.6	30.65	303.8	87.17
	Nov	27.03	3.59	53.85	24.65	297.8	76.37
	Dec	43.16	2.47	37.05	25.18	298.33	77.324
1970	Jan	40.12	2.64	39.6	21.7	294.85	71.06
	Feb	27.71	1.99	29.85	24.62	297.77	76.316
	Mar	34.42	4.12	61.8	27.1	300.25	80.78
	Apr	30.99	3.8	57	32.35	305.5	90.23
	May	17.09	3.7	55.5	36.69	309.84	98.042
	June	23.41	8.91	133.65	40.35	313.5	104.63
	July	20.91	3.55	53.25	41.7	314.85	107.06
	Aug	14.51	4.79	71.85	40.7	313.85	105.26

	Sep	11.42	3.7	55.5	38.44	311.59	101.192
	Oct	11.94	3.56	53.4	32.61	305.76	90.698
	Nov	26.65	5.33	79.95	28.7	301.85	83.66
	Dec	42.51	3.89	58.35	21.53	294.68	70.754
1971	Jan	33.57	2.36	35.4	21.47	294.62	70.646
	Feb	28.86	3.7	55.5	23.68	296.83	74.624
	Mar	21.38	3.69	55.35	29.22	302.37	84.596
	Apr	24.71	3.95	59.25	29.21	302.36	84.578
	May	18.06	5.03	75.45	35.45	308.6	95.81
	June	19.18	9.02	135.3	37.87	311.02	100.166
	July	36.51	11.87	178.05	41.1	314.25	105.98
	Aug	9.25	4.52	67.8	40.33	313.48	104.594
	Sep	0	8.74	131.1	36.4	309.55	97.52
	Oct	20.04	4.02	60.3	30.86	304.01	87.548
	Nov	34.14	7.02	105.3	25.02	298.17	77.036
	Dec	55.39	6.43	96.45	21.33	294.48	70.394
1972	Jan	50.54	4.92	73.8	22.25	295.4	72.05
	Feb	46.3	4.97	74.55	20.14	293.29	68.252
	Mar	36.53	4.48	67.2	24.13	297.28	75.434
	Apr	30.15	3.78	56.7	26.35	299.5	79.43
	May	30.16	4.7	70.5	32.96	306.11	91.328
	June	25.99	5.8	87	35.94	309.09	96.692
	July	19.44	5.49	82.35	39.91	313.06	103.838
	Aug	0	11.1	166.5	40.58	313.73	105.044
	Sep	14.72	3.7	55.5	38.74	311.89	101.732
	Oct	28.17	5.25	78.75	28.72	301.87	83.696
	Nov	26.9	4.23	63.45	23	296.15	73.4
	Dec	36.64	4.67	70.05	22.1	295.25	71.78
1973	Jan	53.32	2.1	31.5	22.19	295.34	71.942
	Feb	22.66	1.98	29.7	25.62	298.77	78.116
	Mar	34.02	4.23	63.45	28.8	301.95	83.84
	Apr	27.06	4.91	73.65	30.97	304.12	87.746
	May	36.13	4.99	74.85	30.24	303.39	86.432
	June	21.23	5.64	84.6	35.79	308.94	96.422
	July	23.22	5.39	80.85	40.62	313.77	105.116
	Aug	29.58	5.79	86.85	36.14	309.29	97.052

	Sep	13.64	3.66	54.9	34.35	307.5	93.83
	Oct	16.94	5.7	85.5	32.86	306.01	91.148
	Nov	34.93	4.39	65.85	24.8	297.95	76.64
	Dec	45.89	4.47	67.05	20.95	294.1	69.71
1974	Jan	40.44	3.85	57.75	20.31	293.46	68.558
	Feb	34.27	4.95	74.25	25.07	298.22	77.126
	Mar	34.39	5.03	75.45	24.57	297.72	76.226
	Apr	27.23	4.28	64.2	28.28	301.43	82.904
	May	25.26	5.93	88.95	33.33	306.48	91.994
	June	26.1	6.02	90.3	35.26	308.41	95.468
	July	36.26	8.41	126.15	35.64	308.79	96.152
	Aug	32.57	5.69	85.35	34.24	307.39	93.632
	Sep	26.29	4.9	73.5	34.33	307.48	93.794
	Oct	19.82	3.77	56.55	31.48	304.63	88.664
	Nov	27.65	5.37	80.55	25.13	298.28	77.234
	Dec	33.29	3.79	56.85	21.99	295.14	71.582
1975	Jan	41.99	6.38	95.7	23.21	296.36	73.778
	Feb	43.59	4.14	62.1	23.46	296.61	74.228
	Mar	42.3	3.47	52.05	26.39	299.54	79.502
	Apr	24.3	3.83	57.45	28.71	301.86	83.678
	May	18.39	2.84	42.6	35.01	308.16	95.018
	June	27.71	6.78	101.7	37.56	310.71	99.608
	July	38.88	10.76	161.4	36.53	309.68	97.754
	Aug	29	5.7	85.5	35.62	308.77	96.116
	Sep	21.17	4.44	66.6	34.18	307.33	93.524
	Oct	15.33	3.55	53.25	31.36	304.51	88.448
	Nov	32.24	4.68	70.2	26.69	299.84	80.042
	Dec	31.13	4.52	67.8	21.68	294.83	71.024
1976	Jan	38.22	4.04	60.6	22.68	295.83	72.824
	Feb	41.29	3.27	49.05	22.59	295.74	72.662
	Mar	35.3	5.04	75.6	26.68	299.83	80.024
	Apr	38.39	6.79	101.85	25.85	299	78.53
	May	41.11	5.44	81.6	26.86	300.01	80.348
	June	34.43	6.2	93	30.55	303.7	86.99
	July	28.91	5.22	78.3	35.38	308.53	95.684
	Aug	15.49	4.24	63.6	36.33	309.48	97.394

	Sep	10.65	3.9	58.5	36.64	309.79	97.952
	Oct	10.89	3.05	45.75	32.45	305.6	90.41
	Nov	44.91	5.91	88.65	24.58	297.73	76.244
	Dec	48.08	8.2	123	22.4	295.55	72.32
1977	Jan	55.45	8.11	121.65	21.53	294.68	70.754
	Feb	47.79	7.31	109.65	22.98	296.13	73.364
	Mar	39.92	6.65	99.75	23.97	297.12	75.146
	Apr	42.24	3.77	56.55	22.34	295.49	72.212
	May	39.22	5.61	84.15	26.58	299.73	79.844
	June	31.89	5.1	76.5	33.44	306.59	92.192
	July	30.16	7.18	107.7	35.97	309.12	96.746
	Aug	27.95	5.1	76.5	35.65	308.8	96.17
	Sep	17.31	3.82	57.3	34.95	308.1	94.91
	Oct	16.2	3.47	52.05	32.57	305.72	90.626
	Nov	29.15	4.74	71.1	24.93	298.08	76.874
	Dec	48.65	3.96	59.4	20.85	294	69.53
1978	Jan	45.68	1.66	24.9	20.92	294.07	69.656
	Feb	29.09	2.97	44.55	23.35	296.5	74.03
	Mar	36.98	4.63	69.45	24.82	297.97	76.676
	Apr	35.58	7.37	110.55	25.93	299.08	78.674
	May	28.97	5.65	84.75	31.22	304.37	88.196
	June	27.47	5.31	79.65	32.49	305.64	90.482
	July	40.82	7.28	109.2	34.24	307.39	93.632
	Aug	25.57	5.74	86.1	34.78	307.93	94.604
	Sep	24.59	4.56	68.4	34.27	307.42	93.686
	Oct	17.65	7.23	108.45	30.64	303.79	87.152
	Nov	17.76	3.67	55.05	28.57	301.72	83.426
	Dec	31.7	2.11	31.65	22.13	295.28	71.834
1979	Jan	34.2	1.84	27.6	21.71	294.86	71.078
	Feb	26.29	3.53	52.95	24.85	298	76.73
	Mar	23.06	4.94	74.1	28.72	301.87	83.696
	Apr	34.71	7.21	108.15	25.75	298.9	78.35
	May	34.04	6.49	97.35	27.05	300.2	80.69
	June	28.59	5.7	85.5	33.28	306.43	91.904
	July	30.71	6.64	99.6	35.88	309.03	96.584
	Aug	21.06	5.07	76.05	39.45	312.6	103.01

	Sep	11.76	9.65	144.75	36.58	309.73	97.844
	Oct	17.55	4.52	67.8	30.59	303.74	87.062
	Nov	26.54	3.17	47.55	24.35	297.5	75.83
	Dec	32.63	2.77	41.55	23.24	296.39	73.832
1980	Jan	33.35	5.01	75.15	24.01	297.16	75.218
	Feb	37.97	4.27	64.05	25.6	298.75	78.08
	Mar	38.93	5.64	84.6	24.65	297.8	76.37
	Apr	37.27	5.32	79.8	24.72	297.87	76.496
	May	25.61	4.48	67.2	31.02	304.17	87.836
	June	30.71	7.07	106.05	33.46	306.61	92.228
	July	34.5	7.38	110.7	34.52	307.67	94.136
	Aug	40.02	5.01	75.15	34.57	307.72	94.226
	Sep	17.39	3.68	55.2	35.23	308.38	95.414
	Oct	15.74	3.41	51.15	32.1	305.25	89.78
	Nov	16.69	3.82	57.3	25.99	299.14	78.782
	Dec	27.89	4.24	63.6	24.27	297.42	75.686
1981	Jan	34.76	3.99	59.85	24.38	297.53	75.884
	Feb	31.84	2.98	44.7	22.42	295.57	72.356
	Mar	34.02	4.03	60.45	23.49	296.64	74.282
	Apr	28.09	3.79	56.85	25.71	298.86	78.278
	May	16.33	4	60	35.66	308.81	96.188
	June	36.28	3.82	57.3	36.7	309.85	98.06
	July	22.44	7.3	109.5	37	310.15	98.6
	Aug	22.37	6.69	100.35	35.48	308.63	95.864
	Sep	16.82	4.48	67.2	34.38	307.53	93.884
	Oct	21.59	6.07	91.05	29.38	302.53	84.884
	Nov	22.25	5.28	79.2	28.56	301.71	83.408
	Dec	40.63	6.37	95.55	22.04	295.19	71.672
1982	Jan	38.77	3.36	50.4	20.03	293.18	68.054
	Feb	31.12	2.87	43.05	25.7	298.85	78.26
	Mar	22.49	3.24	48.6	28.37	301.52	83.066
	Apr	16.22	3.93	58.95	32.11	305.26	89.798
	May	19.94	3.1	46.5	36	309.15	96.8
	June	18.46	4.17	62.55	36.39	309.54	97.502
	July	16.49	4.18	62.7	41.02	314.17	105.836
	Aug	13.79	3.08	46.2	40.21	313.36	104.378

	Sep	13.23	3.04	45.6	37.3	310.45	99.14
	Oct	13.91	2.49	37.35	33.08	306.23	91.544
	Nov	18.39	4.17	62.55	25.07	298.22	77.126
	Dec	33.96	3.77	56.55	23.26	296.41	73.868
1983	Jan	31.79	3.64	54.6	23.98	297.13	75.164
	Feb	34.32	2.94	44.1	24.14	297.29	75.452
	Mar	28.47	3.92	58.8	26.35	299.5	79.43
	Apr	25.23	3.96	59.4	30.85	304	87.53
	May	27.47	5.14	77.1	33.88	307.03	92.984
	June	20.06	5.55	83.25	38.01	311.16	100.418
	July	19.29	6.77	101.55	42.47	315.62	108.446
	Aug	34.48	7.02	105.3	33.16	306.31	91.688
	Sep	21.74	3.9	58.5	34.61	307.76	94.298
	Oct	11.96	4.18	62.7	34.47	307.62	94.046
	Nov	16.97	4.16	62.4	26.54	299.69	79.772
	Dec	40.17	6.93	103.95	23.76	296.91	74.768
1984	Jan	34.26	4.04	60.6	23.59	296.74	74.462
	Feb	32.21	4.07	61.05	22.77	295.92	72.986
	Mar	28.79	5.03	75.45	24.23	297.38	75.614
	Apr	33.88	5.02	75.3	26.6	299.75	79.88
	May	25.06	3.9	58.5	33.2	306.35	91.76
	June	26.68	5.49	82.35	36.91	310.06	98.438
	July	35.19	8.74	131.1	33.35	306.5	92.03
	Aug	33.36	5.56	83.4	34.6	307.75	94.28
	Sep	22.85	6.89	103.35	33.24	306.39	91.832
	Oct	19.22	4.35	65.25	29.21	302.36	84.578
	Nov	27.91	3.26	48.9	23.07	296.22	73.526
	Dec	38.1	2.61	39.15	18.83	291.98	65.894
1985	Jan	41.88	3.91	58.65	20.39	293.54	68.702
	Feb	29.81	2.73	40.95	22.03	295.18	71.654
	Mar	27.35	3.07	46.05	25.05	298.2	77.09
	Apr	22.01	3.42	51.3	28.73	301.88	83.714
	May	22.56	3.92	58.8	35.39	308.54	95.702
	June	19.99	6.41	96.15	41.41	314.56	106.538
	July	19.2	6.71	100.65	39.53	312.68	103.154
	Aug	19.18	4.7	70.5	39.21	312.36	102.578

	Sep	13.54	4.88	73.2	35.48	308.63	95.864
	Oct	20.22	5.19	77.85	31.1	304.25	87.98
	Nov	35.71	4.09	61.35	23.42	296.57	74.156
	Dec	56.44	3.48	52.2	19.06	292.21	66.308
1986	Jan	47.47	3.45	51.75	19.41	292.56	66.938
	Feb	38.96	3.4	51	22.6	295.75	72.68
	Mar	26.43	3.14	47.1	27.14	300.29	80.852
	Apr	25.32	4.8	72	29.64	302.79	85.352
	May	25.41	7.26	108.9	34.04	307.19	93.272
	June	26.52	6.11	91.65	37.07	310.22	98.726
	July	30.49	6.56	98.4	36.8	309.95	98.24
	Aug	38.63	4.41	66.15	33.95	307.1	93.11
	Sep	29.46	5.32	79.8	34.83	307.98	94.694
	Oct	26.26	5.06	75.9	28.29	301.44	82.922
	Nov	31.49	4.07	61.05	23.9	297.05	75.02
	Dec	42.9	3.65	54.75	23.67	296.82	74.606
1987	Jan	36.48	3.02	45.3	23.85	297	74.93
	Feb	28.42	3.38	50.7	24.57	297.72	76.226
	Mar	24.03	3.16	47.4	28.58	301.73	83.444
	Apr	35.49	5.47	82.05	27.49	300.64	81.482
	May	20.72	5.28	79.2	33.33	306.48	91.994
	June	26.36	7.85	117.75	34.26	307.41	93.668
	July	27.82	6.58	98.7	34.16	307.31	93.488
	Aug	29.22	6.25	93.75	33.66	306.81	92.588
	Sep	28.71	4.5	67.5	32.27	305.42	90.086
	Oct	24.41	5.77	86.55	28.17	301.32	82.706
	Nov	30.62	4.22	63.3	23.01	296.16	73.418
	Dec	30.58	2.71	40.65	21.26	294.41	70.268
1988	Jan	46.18	2.95	44.25	21.08	294.23	69.944
	Feb	44.32	2.51	37.65	21.55	294.7	70.79
	Mar	35.63	4.28	64.2	24.53	297.68	76.154
	Apr	24.06	2.78	41.7	29.21	302.36	84.578
	May	20.69	3.58	53.7	33.88	307.03	92.984
	June	17.88	5.2	78	39.44	312.59	102.992
	July	27.78	7.05	105.75	38.41	311.56	101.138
	Aug	25.2	5.42	81.3	36.43	309.58	97.574

	Sep	24.69	3.68	55.2	32.77	305.92	90.986
	Oct	22.62	4.48	67.2	28.72	301.87	83.696
	Nov	25.82	3.48	52.2	25.36	298.51	77.648
	Dec	32.24	4.44	66.6	22.98	296.13	73.364
1989	Jan	42.98	8.19	122.85	22.5	295.65	72.5
	Feb	51	5.78	86.7	22.18	295.33	71.924
	Mar	39.25	3.25	48.75	26.29	299.44	79.322
	Apr	35.85	4.14	62.1	26	299.15	78.8
	May	29.93	5.54	83.1	29.9	303.05	85.82
	June	34.34	6.84	102.6	32.35	305.5	90.23
	July	38.53	7.25	108.75	34.99	308.14	94.982
	Aug	31.58	8.15	122.25	33.44	306.59	92.192
	Sep	31.14	5.85	87.75	32.95	306.1	91.31
	Oct	26.03	4.19	62.85	27.9	301.05	82.22
	Nov	35.36	5.65	84.75	23.56	296.71	74.408
	Dec	40.61	4.85	72.75	22.3	295.45	72.14
1990	Jan	53.59	4.85	72.75	20.92	294.07	69.656
	Feb	39.9	3.49	52.35	20.47	293.62	68.846
	Mar	27.92	2.81	42.15	25.46	298.61	77.828
	Apr	23.4	2.8	42	31.21	304.36	88.178
	May	19.8	4.07	61.05	35.2	308.35	95.36
	June	18.28	3.44	51.6	38.95	312.1	102.11
	July	20.04	2.45	36.75	39.97	313.12	103.946
	Aug	19.76	3.35	50.25	41.03	314.18	105.854
	Sep	17.88	3.31	49.65	37.12	310.27	98.816
	Oct	28.42	4.96	74.4	32.56	305.71	90.608
	Nov	26.66	3.54	53.1	24.54	297.69	76.172
	Dec	32.11	2.17	32.55	23.02	296.17	73.436
1991	Jan	38.21	2.98	44.7	22.19	295.34	71.942
	Feb	37.41	3.11	46.65	24.14	297.29	75.452
	Mar	35.12	4.22	63.3	26.05	299.2	78.89
	Apr	30.12	2.92	43.8	30.61	303.76	87.098
	May	17.88	5.2	78	33.99	307.14	93.182
	June	16.04	6.06	90.9	38.75	311.9	101.75
	July	26.11	6.59	98.85	36.04	309.19	96.872
	Aug	30.62	7.99	119.85	34.55	307.7	94.19

	Sep	20.91	4.1	61.5	32.73	305.88	90.914
	Oct	25.25	4.21	63.15	30.61	303.76	87.098
	Nov	33.92	6.13	91.95	23.13	296.28	73.634
	Dec	34.38	3.11	46.65	21.95	295.1	71.51
1992	Jan	38.33	4.54	68.1	21.65	294.8	70.97
	Feb	43.89	5.49	82.35	21.2	294.35	70.16
	Mar	43.74	4.56	68.4	24.11	297.26	75.398
	Apr	31.04	4.66	69.9	24.4	297.55	75.92
	May	27.74	4.9	73.5	28.58	301.73	83.444
	June	22	4.72	70.8	35.88	309.03	96.584
	July	28.49	5.54	83.1	40.52	313.67	104.936
	Aug	14.85	4.89	73.35	40.01	313.16	104.018
	Sep	12.92	4.51	67.65	35.96	309.11	96.728
	Oct	18.63	3.51	52.65	33.62	306.77	92.516
	Nov	19.93	3.94	59.1	27.85	301	82.13
	Dec	26.72	5.07	76.05	23.76	296.91	74.768
1993	Jan	41.84	6.04	90.6	23.85	297	74.93
	Feb	39.97	4.99	74.85	21.56	294.71	70.808
	Mar	27.77	4.48	67.2	27.76	300.91	81.968
	Apr	21.82	4.71	70.65	28.48	301.63	83.264
	May	23.8	5.49	82.35	32.25	305.4	90.05
	June	21.11	5.04	75.6	36.99	310.14	98.582
	July	23.31	6.51	97.65	39.15	312.3	102.47
	Aug	19.96	4.9	73.5	39.35	312.5	102.83
	Sep	13.1	4.42	66.3	38.55	311.7	101.39
	Oct	19.41	4.71	70.65	30.9	304.05	87.62
	Nov	20.63	3.62	54.3	27.03	300.18	80.654
	Dec	24.11	4.19	62.85	26.02	299.17	78.836
1994	Jan	37.91	4.98	74.7	25.34	298.49	77.612
	Feb	32.25	5.11	76.65	23.55	296.7	74.39
	Mar	25.05	3.38	50.7	29.61	302.76	85.298
	Apr	25.17	5.02	75.3	31.41	304.56	88.538
	May	34.05	5.45	81.75	29.58	302.73	85.244
	June	35.33	7.83	117.45	31.84	304.99	89.312
	July	26.62	7.58	113.7	33.83	306.98	92.894
	Aug	23.36	5.45	81.75	34.67	307.82	94.406

	Sep	25.57	3.97	59.55	33.08	306.23	91.544
	Oct	19.11	5.16	77.4	28.51	301.66	83.318
	Nov	27.05	4.18	62.7	27.73	300.88	81.914
	Dec	39.96	4.29	64.35	21.32	294.47	70.376
1995	Jan	45.43	2.69	40.35	20.27	293.42	68.486
	Feb	44.61	3.17	47.55	21.83	294.98	71.294
	Mar	34.34	4.2	63	26.92	300.07	80.456
	Apr	31	3.18	47.7	26.78	299.93	80.204
	May	22.96	3.83	57.45	33.27	306.42	91.886
	June	23.46	4.84	72.6	38.41	311.56	101.138
	July	31.66	6.68	100.2	35.48	308.63	95.864
	Aug	18.79	3.17	47.55	40.94	314.09	105.692
	Sep	28.41	3.1	46.5	37.47	310.62	99.446
	Oct	15.11	2.41	36.15	32.21	305.36	89.978
	Nov	26.63	2.4	36	28.61	301.76	83.498
	Dec	26.64	2.84	42.6	24.66	297.81	76.388
1996	Jan	51.76	5.02	75.3	23.51	296.66	74.318
	Feb	40.48	4.1	61.5	20.7	293.85	69.26
	Mar	33.3	4.55	68.25	23.73	296.88	74.714
	Apr	34.34	5.69	85.35	30.45	303.6	86.81
	May	22.48	4.64	69.6	33.31	306.46	91.958
	June	13.73	4.13	61.95	39.07	312.22	102.326
	July	13.68	4.42	66.3	42.52	315.67	108.536
	Aug	13.4	5.99	89.85	39.57	312.72	103.226
	Sep	10.66	4.62	69.3	37.62	310.77	99.716
	Oct	14.01	3.33	49.95	31.47	304.62	88.646
	Nov	20.89	4.1	61.5	25.53	298.68	77.954
	Dec	22.27	4.47	67.05	23.57	296.72	74.426
1997	Jan	32.54	3.15	47.25	23.27	296.42	73.886
	Feb	48.87	6.89	103.35	22.66	295.81	72.788
	Mar	34.32	5.56	83.4	24.94	298.09	76.892
	Apr	26	4.9	73.5	28.45	301.6	83.21
	May	21.62	5.23	78.45	31.87	305.02	89.366
	June	23.77	5.52	82.8	36.36	309.51	97.448
	July	14.36	6.49	97.35	41.55	314.7	106.79
	Aug	18.35	3.26	48.9	40.35	313.5	104.63

	Sep	13.05	3.62	54.3	38.84	311.99	101.912
	Oct	18.67	3.13	46.95	31.24	304.39	88.232
	Nov	29.73	3.43	51.45	25.1	298.25	77.18
	Dec	36.85	3.81	57.15	23.61	296.76	74.498
1998	Jan	45.09	2.88	43.2	22.09	295.24	71.762
	Feb	37.64	3.45	51.75	23.85	297	74.93
	Mar	32.91	3.33	49.95	26.59	299.74	79.862
	Apr	24.02	3.9	58.5	28.8	301.95	83.84
	May	22.65	4.7	70.5	36.06	309.21	96.908
	June	13.59	4.7	70.5	39.49	312.64	103.082
	July	0	12.42	186.3	42.02	315.17	107.636
	Aug	11.25	5.27	79.05	41.41	314.56	106.538
	Sep	12.34	4.16	62.4	39.26	312.41	102.668
	Oct	18.49	4.98	74.7	32.61	305.76	90.698
	Nov	22.49	4.1	61.5	26.09	299.24	78.962
	Dec	39.41	2.86	42.9	19.58	292.73	67.244
1999	Jan	41.95	2.26	33.9	19.51	292.66	67.118
	Feb	29.75	2.39	35.85	24.48	297.63	76.064
	Mar	21.14	2.38	35.7	30.76	303.91	87.368
	Apr	23.36	4.04	60.6	33.06	306.21	91.508
	May	19.67	3.54	53.1	31.77	304.92	89.186
	June	21.85	6.72	100.8	36.52	309.67	97.736
	July	29.04	10.32	154.8	39.86	313.01	103.748
	Aug	25.16	8.4	126	34.85	308	94.73
	Sep	22.38	6.06	90.9	33.77	306.92	92.786
	Oct	21.85	4.09	61.35	28.43	301.58	83.174
	Nov	30.23	4.9	73.5	26.75	299.9	80.15
	Dec	36.35	5.95	89.25	21.68	294.83	71.024
2000	Jan	42.16	3.47	52.05	21.56	294.71	70.808
	Feb	44.95	5.91	88.65	22.52	295.67	72.536
	Mar	32.32	4.26	63.9	25.38	298.53	77.684
	Apr	24.75	4.36	65.4	30.83	303.98	87.494
	May	29.31	4.74	71.1	32.86	306.01	91.148
	June	26.44	6.46	96.9	37.52	310.67	99.536
	July	34.48	8.42	126.3	33.45	306.6	92.21
	Aug	34.57	5.97	89.55	34.47	307.62	94.046

	Sep	25.96	4.12	61.8	32.83	305.98	91.094
	Oct	14.55	3.3	49.5	29.84	302.99	85.712
	Nov	24.29	4.76	71.4	25.15	298.3	77.27
	Dec	28.94	3.17	47.55	23.38	296.53	74.084
2001	Jan	44.63	4.69	70.35	21.93	295.08	71.474
	Feb	31.63	3.16	47.4	23.74	296.89	74.732
	Mar	29.08	4.56	68.4	24.39	297.54	75.902
	Apr	34.49	3.87	58.05	25.98	299.13	78.764
	May	29.84	5.19	77.85	31.42	304.57	88.556
	June	22.2	6.24	93.6	35.07	308.22	95.126
	July	32.09	7.72	115.8	35.64	308.79	96.152
	Aug	29.23	6.19	92.85	32.45	305.6	90.41
	Sep	23.14	4.42	66.3	32.18	305.33	89.924
	Oct	22.75	3.17	47.55	28.38	301.53	83.084
	Nov	24.87	3.92	58.8	26.74	299.89	80.132
	Dec	50.05	3.05	45.75	21.08	294.23	69.944
2002	Jan	33.92	2.57	38.55	22.2	295.35	71.96
	Feb	25.13	2.75	41.25	26.01	299.16	78.818
	Mar	28.45	3	45	26.59	299.74	79.862
	Apr	16.37	3.18	47.7	32.48	305.63	90.464
	May	29.03	6.08	91.2	33.11	306.26	91.598
	June	17.5	6.02	90.3	37.25	310.4	99.05
	July	17.94	4.68	70.2	40.89	314.04	105.602
	Aug	14.21	3.57	53.55	40.71	313.86	105.278
	Sep	12.39	3.45	51.75	36.46	309.61	97.628
	Oct	17.02	3.66	54.9	28.99	302.14	84.182
	Nov	25.51	3.84	57.6	25.2	298.35	77.36
	Dec	35.18	1.91	28.65	21.12	294.27	70.016
2003	Jan	36.81	7.01	105.15	17.1	290.25	62.78
	Feb	28.86	5.55	83.25	17.55	290.7	63.59
	Mar	25.97	3.01	45.15	19.68	292.83	67.424
	Apr	23.44	6.04	90.6	21.29	294.44	70.322
	May	19.7	6.69	100.35	26.63	299.78	79.934
	June	37.25	6.06	90.9	30.35	303.5	86.63
	July	0	5.26	78.9	33.02	306.17	91.436
	Aug	12.44	6.17	92.55	30.76	303.91	87.368

	Sep	10.61	5.12	76.8	28.95	302.1	84.11
	Oct	19.07	3.93	58.95	28.06	301.21	82.508
	Nov	32.11	4.89	73.35	19.18	292.33	66.524
	Dec	52.35	3.2	48	14.74	287.89	58.532
2004	Jan	41.45	4.5	67.5	15.07	288.22	59.126
	Feb	44.56	4.89	73.35	17	290.15	62.6
	Mar	29.75	5.49	82.35	17.29	290.44	63.122
	Apr	28.85	4.37	65.55	21.35	294.5	70.43
	May	18.08	5.13	76.95	24.19	297.34	75.542
	June	32.99	5.85	87.75	27.67	300.82	81.806
	July	34.12	8.33	124.95	27.17	300.32	80.906
	Aug	0	6.4	96	29.95	303.1	85.91
	Sep	26.79	3.45	51.75	28.77	301.92	83.786
	Oct	18.13	2.36	35.4	24.69	297.84	76.442
	Nov	26.84	6.87	103.05	22.3	295.45	72.14
	Dec	41.23	3.88	58.2	17.64	290.79	63.752
2005	Jan	34.81	3.02	45.3	16.91	290.06	62.438
	Feb	20.72	4.87	73.05	16.9	290.05	62.42
	Mar	13.56	5.25	78.75	19.54	292.69	67.172
	Apr	22.27	4.21	63.15	21.66	294.81	70.988
	May	22.87	5.45	81.75	25.8	298.95	78.44
	June	12.35	5.71	85.65	26.47	299.62	79.646
	July	11.27	6.8	102	31.49	304.64	88.682
	Aug	13.85	4.21	63.15	36.34	309.49	97.412
	Sep	12.4	3.79	56.85	33.36	306.51	92.048
	Oct	12.37	4.32	64.8	22.67	295.82	72.806
	Nov	36.72	3.75	56.25	20.42	293.57	68.756
	Dec	49.2	6.42	96.3	20.4	293.55	68.72
2006	Jan	49.39	4.41	66.15	16.38	289.53	61.484
	Feb	49.3	7.09	106.35	19.58	292.73	67.244
	Mar	40.92	4.93	73.95	19.36	292.51	66.848
	Apr	26.69	5.59	83.85	21.3	294.45	70.34
	May	22.8	7.44	111.6	24.94	298.09	76.892
	June	15.83	6.4	96	27.92	301.07	82.256
	July	22.29	7.56	113.4	29.94	303.09	85.892
	Aug	14.45	5.95	89.25	28.93	302.08	84.074

	Sep	17.18	3.7	55.5	28.46	301.61	83.228
	Oct	9.92	3.52	52.8	26.17	299.32	79.106
	Nov	23.51	4.72	70.8	21.44	294.59	70.592
	Dec	42.6	3.93	58.95	16.35	289.5	61.43
2007	Jan	50.55	4.53	67.95	16.99	290.14	62.582
	Feb	42.11	4.39	65.85	18.69	291.84	65.642
	Mar	26.98	4.1	61.5	23.41	296.56	74.138
	Apr	21.09	4.85	72.75	22.19	295.34	71.942
	May	17.33	4.71	70.65	26.47	299.62	79.646
	June	30.12	8.23	123.45	28.79	301.94	83.822
	July	0	6.94	104.1	29.52	302.67	85.136
	Aug	13.21	9.11	136.65	29.02	302.17	84.236
	Sep	22.8	5.85	87.75	27.55	300.7	81.59
	Oct	13.08	2.87	43.05	25.94	299.09	78.692
	Nov	21.44	2.78	41.7	26.11	299.26	78.998
	Dec	39.83	3.63	54.45	17.88	291.03	64.184
2008	Jan	43.44	5.03	75.45	19.43	292.58	66.974
	Feb	28.6	3.76	56.4	17.37	290.52	63.266
	Mar	20.58	4.31	64.65	20.67	293.82	69.206
	Apr	22.72	4.89	73.35	25.48	298.63	77.864
	May	25.37	5.41	81.15	28.37	301.52	83.066
	June	15.5	7.17	107.55	30.87	304.02	87.566
	July	19.46	6.84	102.6	30.75	303.9	87.35
	Aug	23.99	8.83	132.45	30.36	303.51	86.648
	Sep	14.08	5.17	77.55	27.62	300.77	81.716
	Oct	19.18	4.15	62.25	22.94	296.09	73.292
	Nov	35.08	6.08	91.2	19.69	292.84	67.442
	Dec	43.97	5.38	80.7	16.92	290.07	62.456
2009	Jan	37.82	4.68	70.2	16.81	289.96	62.258
	Feb	37.67	5.29	79.35	18.91	292.06	66.038
	Mar	34.76	4.77	71.55	19.91	293.06	67.838
	Apr	25.13	5.45	81.75	24.17	297.32	75.506
	May	19.67	5.3	79.5	25.62	298.77	78.116
	June	18.77	8.7	130.5	29.03	302.18	84.254
	July	20.77	8.76	131.4	29.8	302.95	85.64
	Aug	16.86	6.24	93.6	29.41	302.56	84.938

	Sep	13.04	4.57	68.55	26.86	300.01	80.348
	Oct	16.53	3.02	45.3	24.44	297.59	75.992
	Nov	29.44	3.77	56.55	19.47	292.62	67.046
	Dec	33.61	5.61	84.15	16.97	290.12	62.546
2010	Jan	48.7	2.85	42.75	16.85	290	62.33
	Feb	40.34	4.35	65.25	20.41	293.56	68.738
	Mar	42.56	5.01	75.15	21.61	294.76	70.898
	Apr	30.14	4.23	63.45	27.37	300.52	81.266
	May	21.75	4.95	74.25	29.84	302.99	85.712
	June	32.9	6.43	96.45	33.43	306.58	92.174
	July	26.03	7.49	112.35	32.02	305.17	89.636
	Aug	28.35	7.38	110.7	30.37	303.52	86.666
	Sep	25.85	5.09	76.35	30.22	303.37	86.396
	Oct	29.58	5.47	82.05	27.14	300.29	80.852
	Nov	45.12	4.91	73.65	19.92	293.07	67.856
	Dec	38.09	4.49	67.35	18.85	292	65.93
2011	Jan	48.59	3.46	51.9	17.26	290.41	63.068
	Feb	37.21	4.74	71.1	19.74	292.89	67.532
	Mar	27.38	2.52	37.8	23.71	296.86	74.678
	Apr	30.46	4.37	65.55	23.48	296.63	74.264
	May	28.58	5.26	78.9	29.8	302.95	85.64
	June	33.22	7.09	106.35	32.8	305.95	91.04
	July	33.91	7.06	105.9	32.68	305.83	90.824
	Aug	33.79	7.32	109.8	30.05	303.2	86.09
	Sep	29.5	4.74	71.1	26.72	299.87	80.096
	Oct	28.65	3.89	58.35	25.41	298.56	77.738
	Nov	35.46	5	75	20.69	293.84	69.242
	Dec	44.57	4.43	66.45	16.33	289.48	61.394
2012	Jan	42.92	4.1	61.5	18.89	292.04	66.002
	Feb	38.09	5.04	75.6	20.8	293.95	69.44
	Mar	28.82	4.35	65.25	24.06	297.21	75.308
	Apr	31.28	6.33	94.95	26.92	300.07	80.456
	May	22.62	4.72	70.8	34.44	307.59	93.992
	June	24.34	7.91	118.65	37.92	311.07	100.256
	July	27.6	6.99	104.85	32.33	305.48	90.194
	Aug	30.85	7.1	106.5	30.73	303.88	87.314

	Sep	32.2	5.55	83.25	29.13	302.28	84.434
	Oct	25.25	4.28	64.2	25.37	298.52	77.666
	Nov	42.87	5.91	88.65	21.4	294.55	70.52
	Dec	40.96	2.5	37.5	14.52	287.67	58.136
2013	Jan	46.27	2.54	38.1	17.09	290.24	62.762
	Feb	42.2	3.03	45.45	20.59	293.74	69.062
	Mar	25.03	3.96	59.4	21.79	294.94	71.222
	Apr	28.14	6.43	96.45	23.81	296.96	74.858
	May	31.24	4.75	71.25	27.21	300.36	80.978
	June	39.22	7.99	119.85	29.78	302.93	85.604
	July	34.52	7.59	113.85	30.91	304.06	87.638
	Aug	33.37	8.27	124.05	29.65	302.8	85.37
	Sep	27.38	4.79	71.85	28.79	301.94	83.822
	Oct	28.77	4.16	62.4	27.69	300.84	81.842
	Nov	37.15	5.28	79.2	20.59	293.74	69.062
	Dec	51.71	5.21	78.15	18.24	291.39	64.832
2014	Jan	51.39	3.63	54.45	17.78	290.93	64.004
	Feb	48.51	4.32	64.8	16.33	289.48	61.394
	Mar	36.07	3.94	59.1	20.77	293.92	69.386
	Apr	36.88	2.89	43.35	27.02	300.17	80.636
	May	33.91	5.39	80.85	28.09	301.24	82.562
	June	27.68	6.9	103.5	32.88	306.03	91.184
	July	22.05	7.27	109.05	32.23	305.38	90.014
	Aug	31.76	7.1	106.5	31.86	305.01	89.348
	Sep	24.25	5.26	78.9	31.33	304.48	88.394
	Oct	20.1	4.25	63.75	26.9	300.05	80.42
	Nov	28.64	4	60	20.24	293.39	68.432
	Dec	45.94	4.65	69.75	17.58	290.73	63.644
2015	Jan	36	3.21	48.15	22.47	295.62	72.446
	Feb	37.22	5.68	85.2	21.19	294.34	70.142
	Mar	50.48	9.85	147.75	21.94	295.09	71.492
	Apr	40.41	5.4	81	22.41	295.56	72.338
	May	26.31	5.23	78.45	29.96	303.11	85.928
	June	37.46	7.73	115.95	31.26	304.41	88.268
	July	33.07	7	105	32.23	305.38	90.014
	Aug	28.33	6.02	90.3	32.84	305.99	91.112

	Sep	28.53	5.35	80.25	30.25	303.4	86.45
	Oct	23.99	4.63	69.45	27.44	300.59	81.392
	Nov	26.97	4.05	60.75	22.36	295.51	72.248
	Dec	44.43	4.21	63.15	22.11	295.26	71.798
2016	Jan	47.56	3.1	46.5	18.72	291.87	65.696
	Feb	37.64	5.65	84.75	22.17	295.32	71.906
	Mar	32.71	4.27	64.05	24.65	297.8	76.37
	Apr	29.57	4.79	71.85	26.81	299.96	80.258
	May	24.96	5.61	84.15	29.51	302.66	85.118
	June	32.61	6.54	98.1	31.94	305.09	89.492
	July	36	7.19	107.85	31.81	304.96	89.258
	Aug	33.06	7.28	109.2	30.35	303.5	86.63
	Sep	29.79	4.71	70.65	31.26	304.41	88.268
	Oct	21.23	4.26	63.9	29.79	302.94	85.622
	Nov	32.61	5.56	83.4	20.75	293.9	69.35
	Dec	47.44	5.23	78.45	19.39	292.54	66.902
2017	Jan	47.08	4.11	61.65	17.12	290.27	62.816
	Feb	48.12	5.2	78	17.91	291.06	64.238
	Mar	41.19	3.31	49.65	23.78	296.93	74.804
	Apr	32.11	4.83	72.45	24.71	297.86	76.478
	May	22.36	5.71	85.65	29.86	303.01	85.748
	June	41.85	7.04	105.6	31.49	304.64	88.682
	July	0	7.15	107.25	33.86	307.01	92.948
	Aug	27.43	7.67	115.05	31.44	304.59	88.592
	Sep	25.63	4.57	68.55	31.48	304.63	88.664
	Oct	18.84	4.26	63.9	28.15	301.3	82.67
	Nov	27.73	3.6	54	21.49	294.64	70.682
	Dec	30.83	3.67	55.05	21.54	294.69	70.772
2018	Jan	47.38	6.24	93.6	19.05	292.2	66.29
	Feb	40.8	4.56	68.4	20.07	293.22	68.126
	Mar	39.74	4.03	60.45	22.62	295.77	72.716
	Apr	37.58	6.78	101.7	22.52	295.67	72.536
	May	36.17	6.23	93.45	27.88	301.03	82.184
	June	40.08	9.82	147.3	28.67	301.82	83.606
	July	36.97	8.35	125.25	30.94	304.09	87.692
	Aug	32.33	8.96	134.4	32.58	305.73	90.644

	Sep	32.29	5.46	81.9	29.23	302.38	84.614
	Oct	27.39	4.02	60.3	25.68	298.83	78.224
	Nov	26.4	5.19	77.85	22.31	295.46	72.158
	Dec	44.39	6.14	92.1	19.99	293.14	67.982
2019	Jan	46.47	4.9	73.5	18.02	291.17	64.436
	Feb	45.47	4.86	72.9	19.91	293.06	67.838
	Mar	28.64	3.52	52.8	21.92	295.07	71.456
	Apr	33.07	4.32	64.8	25.29	298.44	77.522
	May	34.41	5.58	83.7	29.72	302.87	85.496
	June	25.87	5.56	83.4	33.34	306.49	92.012
	July	29.17	6.96	104.4	32.3	305.45	90.14
	Aug	28.55	8.62	129.3	31.63	304.78	88.934
	Sep	27.85	4.74	71.1	29.3	302.45	84.74
	Oct	30.14	6.1	91.5	24.51	297.66	76.118
	Nov	34.22	6	90	21.24	294.39	70.232
	Dec	29.26	3.34	50.1	20.15	293.3	68.27
2020	Jan	41.31	6.48	97.2	21.32	294.47	70.376
	Feb	41.56	7.33	109.95	21	294.15	69.8
	Mar	36.56	4.09	61.35	21.89	295.04	71.402
	Apr	31.84	3.49	52.35	24.19	297.34	75.542
	May	27.41	6.25	93.75	31.76	304.91	89.168
	June	26.82	7.13	106.95	34.67	307.82	94.406
	July	40.29	6.72	100.8	32.29	305.44	90.122
	Aug	30.41	7.7	115.5	32.64	305.79	90.752
	Sep	32.76	6.23	93.45	29.86	303.01	85.748
	Oct	27.45	5.66	84.9	27.82	300.97	82.076
	Nov	39.61	6.16	92.4	22.78	295.93	73.004
	Dec	46.8	3.49	52.35	19.85	293	67.73

Appendix 2: Downscaled temperature, rainfall and cloud fraction data of Sylhet district (1968-2020).

Years	Months	Cloud (%)	Rainfall(mm)	Temperature(°k)	Temperature (°C)
1968	January	37.65	1.75	294.32	21.17
	February	28.82	3.38	295.19	22.04
	March	35.58	5.16	296.6	23.45
	April	26.11	4.11	298.12	24.97
	May	24.42	6.17	303.39	30.24
	June	33.21	7.17	308.92	35.77
	July	26.34	4.86	309.45	36.3
	August	26.48	4.92	311.39	38.24

	September	20.45	4.29	310.95	37.8
	October	12.12	3.7	302.32	29.17
	November	31.06	3.52	298.05	24.9
	December	39.63	3.39	292.01	18.86
1969	January	40.1	4.6	295.57	22.42
	February	48.11	4.8	294.36	21.21
	March	32.6	4.36	296.8	23.65
	April	35.7	5.52	302.81	29.66
	May	28.18	5.63	303.19	30.04
	June	22.48	5.73	313.44	40.29
	July	23.12	4.98	311.85	38.7
	August	27.55	3.67	312.11	38.96
	September	13.02	6.71	310.2	37.05
	October	15.27	3.17	303.75	30.6
	November	27.89	3.74	297.95	24.8
	December	43.89	2.51	294.58	21.43
1970	January	42.06	2.72	294.67	21.52
	February	28.75	2.07	297.45	24.3
	March	36.55	3.78	299.93	26.78
	April	31.5	3.86	304.11	30.96
	May	18.19	4.98	309.73	36.58
	June	24.14	8.01	313.36	40.21
	July	22.75	4	314.64	41.49
	August	15.5	5.16	313.65	40.5
	September	12.38	4.04	311.3	38.15
	October	13.19	4.24	305.58	32.43
	November	25.45	5.23	301.83	28.68
	December	42.08	3.9	296.54	23.39
1971	January	34.51	2.56	294.87	21.72
	February	28.14	3.65	297.11	23.96
	March	20.49	3.65	302.87	29.72
	April	23.88	4	302.78	29.63
	May	18.86	5.38	308.62	35.47
	June	19.13	9.43	310.91	37.76
	July	37.68	12.31	313.99	40.84
	August	8.5	4.87	315.86	42.71
	September	32.64	9.18	309.35	36.2
	October	20.5	4.18	303.78	30.63
	November	32.64	6.91	298.5	25.35
	December	55.31	6.34	294.82	21.67
1972	January	50.26	5.23	295.2	22.05
	February	46.76	5.29	293.49	20.34
	March	35.66	4.89	296.54	23.39
	April	31.12	3.89	298.33	25.18
	May	30.51	4.88	304.88	31.73

	June	26.63	6.05	306.31	33.16
	July	20.51	5.79	308.98	35.83
	August	28.86	7.72	310.41	37.26
	September	15.52	6.19	309.04	35.89
	October	28.77	5.21	299.05	25.9
	November	28.26	4.09	295.13	21.98
	December	38.46	4.19	294.15	21
1973	January	52.55	2.15	294.79	21.64
	February	24.09	2.12	298.51	25.36
	March	33.08	3.84	302.49	29.34
	April	26.38	4.93	304.57	31.42
	May	35.96	5.18	303.48	30.33
	June	22.7	6.16	308.42	35.27
	July	24.29	5.62	313.47	40.32
	August	30.42	8.52	308.82	35.67
	September	14.68	7.19	307.28	34.13
	October	16.61	4.19	305.91	32.76
	November	34.79	3.05	298.29	25.14
	December	47.08	3.92	294.36	21.21
1974	January	44.14	4.11	293.28	20.13
	February	36.18	4	297.92	24.77
	March	35.32	5.14	297.54	24.39
	April	27.64	4.43	301.1	27.95
	May	25.41	6.01	306.22	33.07
	June	26.41	6.1	306.85	33.7
	July	36.65	8.57	308.34	35.19
	August	33.77	6.01	306.72	33.57
	September	27.16	5.73	306.98	33.83
	October	19.56	4	304.32	31.17
	November	27.7	3.91	298.48	25.33
	December	34.31	4.09	294.93	21.78
1975	January	44.33	6.38	295.03	21.88
	February	45.48	4.22	296.92	23.77
	March	43.65	3.5	295.94	22.79
	April	25.72	3.77	296.19	23.04
	May	18.59	4.51	300.43	27.28
	June	28.96	7.22	304.35	31.2
	July	39.25	11.16	307.63	34.48
	August	30.22	5.27	310.77	37.62
	September	21.8	5.18	308.25	35.1
	October	16.14	3.88	303.39	30.24
	November	33.85	4.94	296.09	22.94
	December	31.39	4.6	292.92	19.77
1976	January	40.01	4.07	298.39	25.24
	February	41.48	3.24	293.13	19.98

	March	33.3	4.59	296.03	22.88
	April	37.71	6.81	296.92	23.77
	May	41.11	5.62	298.22	25.07
	June	34.52	6.46	305.25	32.1
	July	29.82	5.5	309.82	36.67
	August	16.25	4.49	308.35	35.2
	September	11.75	4.78	306.86	33.71
	October	11.55	3.37	301.18	28.03
	November	44.65	5.94	298.1	24.95
	December	47.68	8.29	295.5	22.35
1977	January	55.19	8.22	294.94	21.79
	February	47.27	7.4	296.44	23.29
	March	39.04	6.39	297.34	24.19
	April	41.33	3.78	295.64	22.49
	May	38.77	5.63	299.78	26.63
	June	32.07	5.33	306.21	33.06
	July	30.44	7.36	308.65	35.5
	August	29.14	5.39	308.21	35.06
	September	18.44	4.17	307.97	34.82
	October	16.77	4.28	305.81	32.66
	November	28.51	4.8	298.45	25.3
	December	50.06	4.1	294.74	21.59
1978	January	45.71	2.19	294.09	20.94
	February	30.11	3.16	294.98	21.83
	March	36.84	4.59	297.84	24.69
	April	35.83	4.92	299.36	26.21
	May	29.49	6.53	304.05	30.9
	June	29.05	5.77	305.28	32.13
	July	42.24	7.6	306.77	33.62
	August	27.42	6.09	307.41	34.26
	September	25.58	4.79	306.91	33.76
	October	16.4	4.2	303.72	30.57
	November	18.44	3.91	301.59	28.44
	December	32.58	2.38	295.51	22.36
1979	January	36.06	3.19	294.31	21.16
	February	27.6	4.13	296.19	23.04
	March	22.29	4.95	297.17	24.02
	April	32.86	5.13	299.3	26.15
	May	35.67	6.1	302.15	29
	June	29.51	5.93	305.15	32
	July	31.39	6.91	308.18	35.03
	August	22.14	5.42	310.03	36.88
	September	12.51	5.13	306.29	33.14
	October	18.77	4.63	306.03	32.88
	November	26.93	3.18	298.27	25.12

	December	34.52	3.25	295.92	22.77
1980	January	34.98	5.12	296.91	23.76
	February	38.51	4.35	298.37	25.22
	March	39.85	5.93	297.71	24.56
	April	36.84	5.39	298.1	24.95
	May	26.38	5.01	303.84	30.69
	June	31.95	7.47	306.03	32.88
	July	35.74	7.72	307.11	33.96
	August	40.4	5.33	307.2	34.05
	September	18.71	5.24	308.08	34.93
	October	16.54	3.67	305.81	32.66
	November	17.55	4.12	299.16	26.01
	December	29.36	4.49	297.5	24.35
1981	January	36.27	4.29	297.29	24.14
	February	33.64	3.07	295.31	22.16
	March	33.2	3.82	296.83	23.68
	April	28.67	3.68	298.96	25.81
	May	17.45	4.32	308.76	35.61
	June	36.54	3.95	310.07	36.92
	July	24.17	7.61	309.58	36.43
	August	24.16	7.03	308.09	34.94
	September	17.94	4.86	307.17	34.02
	October	22.83	4.69	302.11	28.96
	November	23.46	5.34	301.47	28.32
	December	40.64	7.88	295.58	22.43
1982	January	40.34	3.49	293.24	20.09
	February	32.3	3.03	298.67	25.52
	March	22.93	3.25	301.52	28.37
	April	16.6	4.1	304.95	31.8
	May	20.11	3.34	309.12	35.97
	June	18.56	4.49	309.67	36.52
	July	17.61	4.65	313.77	40.62
	August	15.6	4.23	313.09	39.94
	September	14.24	3.42	310.24	37.09
	October	14.74	3.03	306.12	32.97
	November	18.24	4.4	298.3	25.15
	December	35.98	4.08	296.32	23.17
1983	January	32.86	3.79	297.12	23.97
	February	33.93	2.98	296.97	23.82
	March	28.27	4.03	299.74	26.59
	April	24.6	3.87	304.4	31.25
	May	28.14	4.61	306.91	33.76
	June	21.58	6.11	311.02	37.87
	July	20.14	7.32	315.31	42.16
	August	34.99	7.4	305.62	32.47

	September	22.91	6.13	307.27	34.12
	October	12.78	4.45	307.32	34.17
	November	17.96	3.89	299.64	26.49
	December	40.58	5.53	296.71	23.56
1984	January	33.82	4.21	291.61	18.46
	February	31.84	3.85	293.23	20.08
	March	27.86	4.93	295.19	22.04
	April	33.08	4.96	300.03	26.88
	May	23.98	4.12	306.83	33.68
	June	26.97	5.77	309.79	36.64
	July	36.02	9.2	311.34	38.19
	August	34.89	5.88	308.13	34.98
	September	23.44	7.09	307.51	34.36
	October	20.27	4.7	304.12	30.97
	November	28.45	3.36	295.89	22.74
	December	40.17	2.75	293.9	20.75
1985	January	44.08	3.93	292.39	19.24
	February	30.25	2.68	293.66	20.51
	March	28.21	4.18	296.66	23.51
	April	20.91	3.41	302.66	29.51
	May	22.81	4.09	308.6	35.45
	June	21.39	6.57	314.29	41.14
	July	19.54	7.02	312.18	39.03
	August	20.13	4.98	311.87	38.72
	September	13.93	5.11	308.31	35.16
	October	21.67	5.02	303.89	30.74
	November	36.44	4.16	296.35	23.2
	December	59.01	3.57	292.11	18.96
1986	January	47.85	3.43	292.41	19.26
	February	40.39	3.54	295.26	22.11
	March	27.78	3.18	300	26.85
	April	27.07	4.93	302.41	29.26
	May	25.87	7.74	305	31.85
	June	26.83	7.44	304.93	31.78
	July	32.7	6.92	309.43	36.28
	August	38.59	8.97	306.48	33.33
	September	30.47	7.65	307.47	34.32
	October	26.79	6.54	301.04	27.89
	November	32.99	5.63	296.81	23.66
	December	43.89	5.57	296.23	23.08
1987	January	38.45	3.06	296.7	23.55
	February	29.01	3.37	297.69	24.54
	March	24.74	4.01	301.6	28.45
	April	36.36	6.21	302.91	29.76
	May	22.03	5.68	306.29	33.14

	June	27.07	8.25	307.09	33.94
	July	27.31	7.03	306.64	33.49
	August	31.02	6.78	305.98	32.83
	September	26.69	4.7	305	31.85
	October	24.15	5.91	301.28	28.13
	November	30.59	4.39	297.82	24.67
	December	31.83	3.91	294.24	21.09
1988	January	46.47	4	294.23	21.08
	February	46.29	2.63	294.34	21.19
	March	34.96	4.15	297.92	24.77
	April	24.72	2.87	302.08	28.93
	May	21.64	3.81	306.99	33.84
	June	17.58	5.58	312.4	39.25
	July	28	7.08	311.08	37.93
	August	26.32	5.63	309.1	35.95
	September	28.98	4.04	305.25	32.1
	October	22.55	3.94	301.44	28.29
	November	26.11	3.61	298.54	25.39
	December	33.64	4.74	296	22.85
1989	January	44.15	8.56	295.55	22.4
	February	52.45	6.02	295.2	22.05
	March	40.13	3.35	299.16	26.01
	April	36.22	4.15	299.23	26.08
	May	31.63	5.86	302.6	29.45
	June	36	7.27	305	31.85
	July	39.44	7.62	307.5	34.35
	August	32.57	8.57	305.91	32.76
	September	31.98	6.08	305.46	32.31
	October	26.55	4.37	303.29	30.14
	November	34.28	4.91	296.96	23.81
	December	39.9	4.82	295.79	22.64
1990	January	54.64	5.09	292.59	19.44
	February	41.86	3.57	292.16	19.01
	March	29.25	2.92	298.21	25.06
	April	24.55	2.96	304.17	31.02
	May	19.91	4.2	309.93	36.78
	June	19.08	3.61	313.69	40.54
	July	21.86	2.68	312.95	39.8
	August	20.2	4.69	313.98	40.83
	September	18.25	3.59	310.16	37.01
	October	28.88	5.14	305.64	32.49
	November	27.83	3.72	297.67	24.52
	December	33.14	3.09	292.69	19.54
1991	January	40.56	2.94	295.15	22
	February	37.96	3.12	296.96	23.81

	March	34.3	4.05	299.53	26.38
	April	29.68	3.02	304.07	30.92
	May	18.94	5.59	299.55	26.4
	June	17.37	2.45	311.68	38.53
	July	27.15	6.88	308.68	35.53
	August	31.71	8.37	307.18	34.03
	September	22.22	4.41	305.38	32.23
	October	25.73	4.41	303.6	30.45
	November	33.24	4.52	296.47	23.32
	December	35.91	3.29	294.66	21.51
1992	January	40.23	4.65	294.73	21.58
	February	42.93	5.13	294.49	21.34
	March	42.54	4.19	297.55	24.4
	April	30.26	4.03	298.54	25.39
	May	27.28	4.42	302.18	29.03
	June	22.2	4.92	311.66	38.51
	July	30.55	5.98	313.38	40.23
	August	16.09	5.29	312.87	39.72
	September	13.75	4.13	308.74	35.59
	October	19.6	3.73	306.68	33.53
	November	20.23	4.17	301.17	28.02
	December	28.08	5.19	296.73	23.58
1993	January	41.2	6.02	298.73	25.58
	February	40.62	5.14	296.92	23.77
	March	28.33	4.78	302.96	29.81
	April	22.96	4.93	304.88	31.73
	May	24.74	5.02	306.03	32.88
	June	20.73	5.23	308.13	34.98
	July	20.41	6.65	310.02	36.87
	August	20.44	5.18	311	37.85
	September	14.03	4.99	306.32	33.17
	October	20.05	4.9	302.19	29.04
	November	20.88	4.93	300.99	27.84
	December	25.13	4.45	295.13	21.98
1994	January	37.71	5.11	298.48	25.33
	February	31.85	5.11	297	23.85
	March	25.47	3.55	302.92	29.77
	April	24.43	5.04	305.06	31.91
	May	35.52	5.78	302.42	29.27
	June	37	8.15	304.37	31.22
	July	28.51	8.23	307.6	34.45
	August	25.15	5.99	308.69	35.54
	September	27.22	4.18	305.75	32.6
	October	19.86	4.69	301.43	28.28
	November	27.59	4.81	300.71	27.56

	December	40.54	5.01	294.53	21.38
1995	January	47.44	2.75	293.14	19.99
	February	46.57	3.26	294.65	21.5
	March	34.73	4.17	299.66	26.51
	April	31.46	3.25	299.98	26.83
	May	24.1	4.01	306.32	33.17
	June	23.97	5.14	311.28	38.13
	July	32.93	7.95	307.99	34.84
	August	20.33	3.51	313.97	40.82
	September	29.56	3.51	310.46	37.31
	October	15.66	2.51	306.47	33.32
	November	26.91	2.44	300.23	27.08
	December	26.79	2.96	298.05	24.9
1996	January	52.84	5.03	296.91	23.76
	February	41.89	5.91	293.93	20.78
	March	33.9	4.68	296.67	23.52
	April	34.5	5.8	303.05	29.9
	May	23.74	4.89	306.13	32.98
	June	15.88	4.49	312.21	39.06
	July	14.71	4.18	315.32	42.17
	August	14.39	6.08	312.52	39.37
	September	11.61	5	310.46	37.31
	October	15	3.61	304.43	31.28
	November	19.73	4.21	298.91	25.76
	December	23.79	4.55	296.82	23.67
1997	January	34.56	3.35	296.29	23.14
	February	48.64	6.97	295.78	22.63
	March	34.47	5.63	297.93	24.78
	April	26.42	5.22	301.04	27.89
	May	22.73	5.27	304.7	31.55
	June	24.78	5.96	309.16	36.01
	July	15.24	5.39	314.32	41.17
	August	18.75	3.54	313.26	40.11
	September	14.21	4.12	311.34	38.19
	October	19.54	3.9	304.3	31.15
	November	30.45	3.6	298.4	25.25
	December	38.55	3.98	296.82	23.67
1998	January	47.32	3.84	295.06	21.91
	February	39.14	3.53	298.23	25.08
	March	34.42	3.51	299.43	26.28
	April	25.29	4.18	301.78	28.63
	May	22.86	4.96	309	35.85
	June	14.33	4.99	312.29	39.14
	July	16.98	5.1	315.07	41.92
	August	12.68	5.89	314.25	41.1

	September	13.03	5.67	312.26	39.11
	October	19.58	4.34	305.71	32.56
	November	22.98	4.23	299.19	26.04
	December	41.14	3.91	292.9	19.75
1999	January	44.28	2.24	292.5	19.35
	February	31.2	2.39	297.43	24.28
	March	22.21	2.55	303.67	30.52
	April	22.36	3.84	306.14	32.99
	May	18.89	3.81	305.3	32.15
	June	22.25	7.25	309.34	36.19
	July	29.28	10.78	315.41	42.26
	August	26.96	8.81	307.31	34.16
	September	23.18	6.42	306.38	33.23
	October	23.02	4.39	301.18	28.03
	November	29.22	4.97	300	26.85
	December	37	3.58	295.05	21.9
2000	January	43.75	2.24	294.58	21.43
	February	46.42	6.05	295.72	22.57
	March	32.87	4.47	298.33	25.18
	April	25.86	5.2	303.67	30.52
	May	26.65	4.8	305.84	32.69
	June	27.29	6.77	310.56	37.41
	July	34.64	5.39	305.91	32.76
	August	35.63	6.26	307	33.85
	September	27.04	4.35	305.48	32.33
	October	14.85	4.09	302.91	29.76
	November	22.56	4.69	298.68	25.53
	December	30	3.37	296.28	23.13
2001	January	46.52	4.85	294.93	21.78
	February	32.81	3.32	296.63	23.48
	March	30.08	4.8	297.38	24.23
	April	34.55	3.86	298.75	25.6
	May	31.31	5.5	304.18	31.03
	June	23.49	6.78	307.63	34.48
	July	33.44	5.01	308.12	34.97
	August	31.2	6.72	304.91	31.76
	September	23.84	4.09	304.93	31.78
	October	23.58	4	302.83	29.68
	November	25.55	4.13	297.21	24.06
	December	50.43	2.98	295.03	21.88
2002	January	34.69	2.64	295.49	22.34
	February	25.88	2.96	299.03	25.88
	March	27.77	2.93	299.86	26.71
	April	16.15	3.7	305.64	32.49
	May	28.99	6.41	306.54	33.39

	June	17.98	6.33	310.17	37.02
	July	18.6	4.96	313.71	40.56
	August	15.52	6.01	313.44	40.29
	September	13.59	3.94	311.32	38.17
	October	18.51	3.39	301.78	28.63
	November	26.52	3.96	298.2	25.05
	December	37.06	2	296.1	22.95
2003	January	37.58	7.27	290.35	17.2
	February	28.77	4.74	290.89	17.74
	March	25.78	5.81	291.32	18.17
	April	22.52	4.89	294.42	21.27
	May	19.9	5.4	299.27	26.12
	June	33.91	4.03	302.9	29.75
	July	17.97	5.86	395.67	122.52
	August	13.4	6.49	303.43	30.28
	September	11.38	3.53	301.6	28.45
	October	20.25	2.57	301.53	28.38
	November	31.47	5.22	292.15	19
	December	52.91	3.29	287.84	14.69
2004	January	41.87	4.56	288.21	15.06
	February	45.56	4.74	290.14	16.99
	March	30.69	5.37	290.67	17.52
	April	29.34	4.39	294.55	21.4
	May	18.98	5.47	296.91	23.76
	June	34.69	4.86	300.39	27.24
	July	34.78	7.57	299.71	26.56
	August	21.31	5.19	302.58	29.43
	September	25.09	3.21	301.49	28.34
	October	17.34	4.49	297.97	24.82
	November	28.34	6.94	295.82	22.67
	December	41.6	4.03	291.01	17.86
2005	January	35.54	3.19	290.19	17.04
	February	21.39	5.07	289.95	16.8
	March	14.03	5.27	292.88	19.73
	April	20.77	5.59	294.65	21.5
	May	23.22	5.71	298.4	25.25
	June	13.55	6.03	301.58	28.43
	July	12.15	7.04	302.98	29.83
	August	15.22	7.71	309.36	36.21
	September	13.34	5.39	306.26	33.11
	October	13.2	4.12	295.92	22.77
	November	36.4	3.97	293.47	20.32
	December	50.64	6.63	293.92	20.77
2006	January	51.6	4.67	289.51	16.36
	February	45.06	7.34	292.43	19.28

	March	40.73	5.06	292.54	19.39
	April	27.65	5.86	293.38	20.23
	May	23.92	7.8	297.75	24.6
	June	16.06	8.41	299.1	25.95
	July	22.83	7.59	302.4	29.25
	August	15.13	6.3	302.13	28.98
	September	17.55	3.93	301.18	28.03
	October	10.64	3.63	299.13	25.98
	November	22.54	4.74	295.05	21.9
	December	46.48	3.92	289.78	16.63
2007	January	51.55	4.76	290.1	16.95
	February	43.48	4.65	291.82	18.67
	March	27.99	5.01	293.68	20.53
	April	21.44	5.03	294.48	21.33
	May	18.48	7.85	299.31	26.16
	June	30.72	8.01	301.38	28.23
	July	0	7.33	302.12	28.97
	August	14.24	9.56	301.58	28.43
	September	23.65	5.54	300.13	26.98
	October	13.85	4.03	298.75	25.6
	November	20.33	2.76	294.29	21.14
	December	39.61	3.83	291.01	17.86
2008	January	45.31	5.33	292.32	19.17
	February	29.34	3.78	290.66	17.51
	March	21.05	4.52	293.86	20.71
	April	22.6	4.91	298.95	25.8
	May	25.48	7	301.15	28
	June	16.1	7.33	303.6	30.45
	July	20.78	7.19	303.71	30.56
	August	24.96	9.24	304.09	30.94
	September	15.37	5.68	300.29	27.14
	October	20.36	4.88	295.82	22.67
	November	34.04	6.09	293.05	19.9
	December	44.8	5.59	292.73	19.58
2009	January	41.75	4.96	289.83	16.68
	February	39.22	5.64	291.74	18.59
	March	35.69	4.97	292.98	19.83
	April	26.23	4.29	296.74	23.59
	May	20.39	6.65	298.29	25.14
	June	18.91	8.8	301.61	28.46
	July	21.91	8.89	303.21	30.06
	August	17.19	6.44	302.1	28.95
	September	14.08	5.58	299.53	26.38
	October	16.91	3.27	297.42	24.27
	November	30.52	4.06	292.81	19.66

	December	35.6	3.92	290.15	17
2010	January	49.63	2.87	289.94	16.79
	February	41.98	4.36	292.91	19.76
	March	42.87	5.1	294.52	21.37
	April	31.25	4.13	298.5	25.35
	May	22.57	4.92	302.93	29.78
	June	32.49	6.67	306.02	32.87
	July	28.08	7.42	305.09	31.94
	August	29.26	7.52	303.19	30.04
	September	26.66	5.18	302.98	29.83
	October	30.28	5.41	302.29	29.14
	November	45.5	4.31	292.86	19.71
	December	40.22	4.22	291.71	18.56
2011	January	50.44	3.41	290.13	16.98
	February	38.09	4.79	291.91	18.76
	March	28.12	3.01	295.86	22.71
	April	31.64	4.64	295.34	22.19
	May	30.02	5.13	302.13	28.98
	June	33.64	7.19	304.82	31.67
	July	35.6	7.68	305.4	32.25
	August	34.39	7.22	302.73	29.58
	September	30.53	4.23	299.56	26.41
	October	29.45	3.93	298.17	25.02
	November	34.94	4.85	291.86	18.71
	December	35.8	4.41	290.92	17.77
2012	January	42.48	4.01	292	18.85
	February	38.5	4.54	293.05	19.9
	March	28.02	4.9	296.29	23.14
	April	32.1	6.93	299.81	26.66
	May	23.79	4.75	307.47	34.32
	June	24.58	7.99	310.71	37.56
	July	29.32	7.82	304.42	31.27
	August	32.71	7.31	302.77	29.62
	September	32.88	5.33	301.48	28.33
	October	26.05	4.38	298.13	24.98
	November	37.86	5.82	294.17	21.02
	December	42.14	3.51	287.7	14.55
2013	January	48.17	2.63	290.02	16.87
	February	44.14	3.16	293.52	20.37
	March	24.7	4.01	294	20.85
	April	29.72	6.51	299.49	26.34
	May	32.41	4.96	300.17	27.02
	June	39.71	8.34	300.99	27.84
	July	35.75	7.95	303.92	30.77
	August	34.16	7.9	302.6	29.45

	September	33.44	5.28	301.44	28.29
	October	29.74	4.26	300	26.85
	November	36.29	5.1	293.85	20.7
	December	51.4	4.65	291.69	18.54
2014	January	52.87	3.77	290.19	17.04
	February	50.01	3.06	290.89	17.74
	March	37.59	4.13	293.83	20.68
	April	29.15	5.19	300.01	26.86
	May	35.28	5.55	300.86	27.71
	June	29.09	6.6	306.05	32.9
	July	22.91	7.71	305.16	32.01
	August	32.98	7.49	304.91	31.76
	September	25.18	5.54	304.5	31.35
	October	20.04	4.48	300.08	26.93
	November	30.13	4.28	296.42	23.27
	December	47.33	4.86	290.59	17.44
2015	January	36.32	3.24	295.55	22.4
	February	37.15	5.82	294.34	21.19
	March	50.77	10.19	295.03	21.88
	April	40.44	5.66	295.64	22.49
	May	27.42	5.56	302.98	29.83
	June	38.46	8.14	304.49	31.34
	July	34.44	7.38	305.11	31.96
	August	29.32	6.38	305.38	32.23
	September	29.34	5.63	303.19	30.04
	October	24.74	4.81	300.39	27.24
	November	28.22	4.38	295.39	22.24
	December	45.07	4.24	295.11	21.96
2016	January	50.09	3.28	291.69	18.54
	February	38.05	5.82	294.88	21.73
	March	33.32	4.47	297.66	24.51
	April	29.99	4.84	300.48	27.33
	May	26.34	5.64	302.46	29.31
	June	33.13	6.95	305.19	32.04
	July	36.23	5.57	304.37	31.22
	August	33.9	4.64	303.7	30.55
	September	30.6	3.05	304.12	30.97
	October	23.82	4.45	301.11	27.96
	November	31	5.56	293.82	20.67
	December	47.11	5.18	292.85	19.7
2017	January	48.01	4.11	290.48	17.33
	February	50.33	5.2	291.09	17.94
	March	29.88	3.31	296.43	23.28
	April	33.87	4.83	297.34	24.19
	May	23.56	5.71	302.51	29.36

	June	42.33	7.04	303.97	30.82
	July	nill	7.15	306.47	33.32
	August	29.43	7.67	303.95	30.8
	September	22.92	4.57	304.13	30.98
	October	18.62	4.26	301.35	28.2
	November	26.39	3.6	294.79	21.64
	December	28.62	3.67	294.72	21.57
2018	January	48.59	6.47	292.52	19.37
	February	42.32	4.71	292.73	19.58
	March	40.11	4.06	295.66	22.51
	April	38.89	6.89	295.66	22.51
	May	37.08	6.54	300.61	27.46
	June	40.41	9.55	301.23	28.08
	July	38.08	8.76	303.35	30.2
	August	33.47	9.33	305.01	31.86
	September	32.81	5.66	301.78	28.63
	October	28.61	4.19	298.55	25.4
	November	30.56	5.38	295.64	22.49
	December	53.4	6.41	293	19.85
2019	January	48.46	5.35	291.02	18.02
	February	47.76	3.13	292.6	19.6
	March	29.16	3.65	294.72	21.72
	April	34.73	4.54	298.06	25.06
	May	34.82	5.92	302.22	29.22
	June	26.94	6.15	305.9	32.9
	July	31.36	7.61	304.63	31.63
	August	30.64	9.06	304.02	31.02
	September	29.63	5.28	301.71	28.71
	October	30.58	6.3	297.19	24.19
	November	34.89	6.38	294.08	21.08
	December	30.05	3.44	293.04	20.04
2020	January	40.93	6.44	294.41	21.41
	February	41.21	7.42	294.19	21.19
	March	36.38	4.21	294.84	21.84
	April	32.11	3.45	297.29	24.29
	May	28.72	6.2	304.37	31.37
	June	28.67	7.28	307.42	34.42
	July	40.89	7.33	304.67	31.67
	August	31.48	6.12	305.02	32.02
	September	33.25	6.5	302.37	29.37
	October	27.74	5.9	300.35	27.35
	November	39.81	6.25	295.53	22.53
	December	49.01	3.46	292.64	19.64

Appendix 3: IPCC data of Temperature, Rainfall and Cloud for Sylhet districts

Date	Temperature (k)	Temperature (°C)	Rainfall (mm)	Cloud (%)
1/16/2006	282.5	48.8	7.0	13.1
2/15/2006	285.0	53.3	15.1	9.3
3/16/2006	291.0	64.1	38.4	17.2
4/16/2006	295.6	72.4	67.6	27.1
5/16/2006	297.6	76.0	67.7	37.6
6/16/2006	298.8	78.1	371.3	62.9
7/16/2006	299.0	78.5	279.3	62.2
8/16/2006	298.9	78.4	254.2	59.6
9/16/2006	298.1	76.9	223.6	53.5
10/16/2006	294.8	71.0	97.8	32.3
11/16/2006	289.5	61.4	60.5	27.8
12/16/2006	284.9	53.2	53.2	20.5
1/16/2007	283.1	50.0	7.2	12.5
2/15/2007	285.7	54.7	23.3	12.4
3/16/2007	290.7	63.6	66.3	20.7
4/16/2007	295.6	72.4	57.4	23.6
5/16/2007	297.8	76.3	123.4	43.8
6/16/2007	298.9	78.3	261.7	53.4
7/16/2007	298.8	78.1	240.4	58.5
8/16/2007	298.5	77.6	188.0	55.4
9/16/2007	298.2	77.0	181.2	49.1
10/16/2007	294.8	71.0	74.9	36.8
11/16/2007	289.2	61.0	31.9	27.4
12/16/2007	284.7	52.8	45.7	20.2
1/16/2008	281.9	47.7	33.4	11.0
2/15/2008	284.5	52.5	38.7	16.6
3/16/2008	289.3	61.0	47.6	20.3
4/16/2008	295.1	71.6	79.3	25.6
5/16/2008	297.7	76.2	86.3	43.4
6/16/2008	298.9	78.4	263.7	59.5
7/16/2008	299.1	78.8	254.5	60.5
8/16/2008	299.2	78.8	267.0	59.3
9/16/2008	297.9	76.6	213.2	53.7
10/16/2008	294.8	71.0	70.8	31.7
11/16/2008	289.5	61.5	47.3	26.6
12/16/2008	284.6	52.6	17.4	14.9
1/16/2009	282.5	48.8	15.9	12.3
2/15/2009	284.9	53.1	23.3	12.0
3/16/2009	289.9	62.1	29.3	11.9
4/16/2009	295.8	72.8	30.1	17.8
5/16/2009	298.3	77.3	133.0	42.1
6/16/2009	299.2	78.9	182.2	55.5
7/16/2009	299.0	78.5	301.1	61.1

8/16/2009	298.8	78.2	244.4	62.1
9/16/2009	298.0	76.8	174.6	48.5
10/16/2009	293.7	69.0	70.6	28.2
11/16/2009	288.4	59.5	39.3	20.2
12/16/2009	285.2	53.7	15.4	18.5
1/16/2010	283.0	49.7	49.8	14.3
2/15/2010	285.4	54.0	40.9	12.2
3/16/2010	290.5	63.3	57.5	15.6
4/16/2010	295.6	72.4	62.0	26.4
5/16/2010	298.5	77.6	60.1	33.9
6/16/2010	299.1	78.7	247.1	56.0
7/16/2010	298.9	78.3	223.1	60.5
8/16/2010	298.8	78.1	222.1	58.9
9/16/2010	298.2	77.1	271.9	56.9
10/16/2010	294.8	71.0	96.2	32.4
11/16/2010	289.9	62.2	38.9	24.1
12/16/2010	284.2	51.9	22.7	16.9
1/16/2011	283.1	49.9	22.2	14.5
2/15/2011	285.3	53.9	14.9	10.4
3/16/2011	290.8	63.8	32.0	11.5
4/16/2011	295.2	71.6	91.4	34.6
5/16/2011	298.2	77.1	98.0	41.8
6/16/2011	299.4	79.3	211.9	61.5
7/16/2011	299.1	78.6	267.0	60.8
8/16/2011	299.1	78.8	188.0	54.8
9/16/2011	298.2	77.1	227.3	56.7
10/16/2011	294.8	71.0	80.2	30.2
11/16/2011	289.1	60.7	37.5	26.3
12/16/2011	284.7	52.8	31.7	16.1
1/16/2012	283.8	51.2	30.1	12.3
2/15/2012	285.0	53.3	29.5	14.9
3/16/2012	291.0	64.2	31.7	15.8
4/16/2012	296.2	73.5	51.3	26.6
5/16/2012	298.3	77.2	76.0	40.7
6/16/2012	299.3	79.0	248.6	62.4
7/16/2012	299.1	78.7	278.0	60.9
8/16/2012	299.0	78.5	240.1	61.9
9/16/2012	297.9	76.5	265.5	52.9
10/16/2012	294.7	70.9	178.4	36.6
11/16/2012	289.4	61.3	32.0	24.7
12/16/2012	284.8	52.9	21.8	17.6
1/16/2013	283.5	50.6	15.9	15.4
2/15/2013	285.9	55.0	46.3	15.7
3/16/2013	289.8	62.0	32.0	12.4
4/16/2013	295.7	72.5	59.0	21.2

5/16/2013	297.9	76.6	139.2	50.5
6/16/2013	298.8	78.2	288.5	57.5
7/16/2013	299.1	78.7	236.7	58.0
8/16/2013	298.8	78.3	261.7	60.8
9/16/2013	298.1	77.0	205.3	51.7
10/16/2013	294.5	70.4	73.1	34.6
11/16/2013	289.0	60.6	51.2	20.9
12/16/2013	283.3	50.4	10.3	14.4
1/16/2014	283.2	50.1	34.7	22.3
2/15/2014	284.9	53.1	41.2	13.5
3/16/2014	289.6	61.6	30.6	12.7
4/16/2014	295.3	71.8	42.4	22.1
5/16/2014	298.1	76.8	83.3	40.4
6/16/2014	299.3	79.0	184.2	59.9
7/16/2014	298.7	78.0	198.5	54.6
8/16/2014	299.2	78.8	215.8	55.7
9/16/2014	297.9	76.5	166.4	48.1
10/16/2014	294.7	70.8	94.7	31.4
11/16/2014	289.0	60.5	56.8	24.9
12/16/2014	285.2	53.6	4.7	15.9
1/16/2015	283.5	50.5	38.3	12.8
2/15/2015	284.8	52.9	47.0	15.1
3/16/2015	289.8	62.0	34.8	16.2
4/16/2015	296.1	73.4	84.4	32.4
5/16/2015	298.3	77.2	79.2	44.5
6/16/2015	299.5	79.4	208.4	52.3
7/16/2015	299.3	79.1	294.2	62.2
8/16/2015	298.8	78.2	288.2	56.1
9/16/2015	298.4	77.5	189.9	55.1
10/16/2015	295.1	71.4	129.9	37.3
11/16/2015	289.4	61.3	10.2	17.9
12/16/2015	284.8	53.1	54.7	16.8
1/16/2016	283.4	50.5	41.8	11.4
2/15/2016	285.3	53.9	21.6	13.2
3/16/2016	290.9	63.9	54.5	16.8
4/16/2016	295.4	72.1	78.4	27.0
5/16/2016	298.0	76.8	95.6	40.8
6/16/2016	298.8	78.1	325.0	63.8
7/16/2016	298.9	78.4	252.3	60.0
8/16/2016	299.0	78.6	274.7	59.8
9/16/2016	298.0	76.8	235.2	50.1
10/16/2016	295.1	71.6	117.7	35.3
11/16/2016	289.3	61.0	53.8	25.8
12/16/2016	284.9	53.2	12.3	20.8
1/16/2017	282.5	48.7	27.3	9.3

2/15/2017	284.5	52.4	16.3	14.0
3/16/2017	290.1	62.5	34.3	12.7
4/16/2017	295.9	72.9	72.7	20.5
5/16/2017	298.1	76.9	80.5	36.2
6/16/2017	299.2	79.0	185.6	60.7
7/16/2017	299.2	78.8	240.4	63.1
8/16/2017	299.1	78.7	290.3	63.1
9/16/2017	298.0	76.8	170.9	51.8
10/16/2017	294.7	70.7	86.6	29.5
11/16/2017	289.6	61.6	37.4	22.6
12/16/2017	285.5	54.3	12.9	16.7
1/16/2018	283.6	50.8	25.9	12.3
2/15/2018	284.7	52.7	20.3	10.5
3/16/2018	291.2	64.6	44.8	14.3
4/16/2018	296.6	74.3	75.9	28.7
5/16/2018	298.4	77.5	74.2	46.5
6/16/2018	299.5	79.5	203.2	57.7
7/16/2018	299.5	79.4	285.3	61.1
8/16/2018	299.5	79.4	256.7	62.1
9/16/2018	298.2	77.1	168.3	51.5
10/16/2018	294.6	70.5	73.5	30.1
11/16/2018	289.1	60.7	40.7	24.4
12/16/2018	284.4	52.3	2.3	8.5
1/16/2019	284.6	52.7	40.1	14.1
2/15/2019	286.9	56.8	18.1	12.2
3/16/2019	291.4	64.9	37.5	16.2
4/16/2019	296.5	74.1	47.7	23.7
5/16/2019	298.6	77.8	46.2	29.1
6/16/2019	299.9	80.1	204.7	58.2
7/16/2019	299.2	78.8	287.6	65.7
8/16/2019	299.4	79.2	260.5	61.3
9/16/2019	298.7	78.0	192.6	52.1
10/16/2019	295.0	71.4	72.7	29.3
11/16/2019	289.3	61.0	16.3	18.6
12/16/2019	284.7	52.8	15.2	13.0
1/16/2020	285.1	53.4	33.6	15.2
2/15/2020	285.9	55.0	62.8	18.3
3/16/2020	291.6	65.2	24.2	10.1
4/16/2020	296.9	74.8	53.1	23.1
5/16/2020	298.9	78.3	95.6	35.8
6/16/2020	299.4	79.2	221.2	58.3
7/16/2020	299.3	79.1	249.2	59.4
8/16/2020	299.4	79.2	194.6	53.7
9/16/2020	298.3	77.2	223.5	59.3
10/16/2020	295.3	71.8	103.5	40.1

11/16/2020	289.4	61.3	47.8	20.1
12/16/2020	285.2	53.7	13.7	12.6
1/16/2021	284.3	52.1	27.2	11.3
2/15/2021	285.9	55.0	45.9	15.1
3/16/2021	291.0	64.1	46.3	15.2
4/16/2021	295.9	73.0	58.2	26.5
5/16/2021	298.2	77.1	125.5	46.3
6/16/2021	299.3	79.1	259.3	61.8
7/16/2021	299.1	78.7	249.7	58.6
8/16/2021	299.2	78.9	279.6	62.7
9/16/2021	298.3	77.2	131.0	46.9
10/16/2021	294.2	69.9	123.6	30.6
11/16/2021	288.8	60.2	28.8	19.3
12/16/2021	284.3	52.1	24.9	16.1
1/16/2022	284.2	51.9	32.5	14.3
2/15/2022	285.6	54.4	14.6	9.8
3/16/2022	291.2	64.5	45.4	13.9
4/16/2022	295.9	72.9	62.7	21.2
5/16/2022	298.9	78.4	61.0	38.1
6/16/2022	299.4	79.3	287.0	59.6
7/16/2022	299.5	79.5	348.3	61.8
8/16/2022	299.3	79.1	255.3	63.4
9/16/2022	298.1	76.8	212.3	54.8
10/16/2022	295.1	71.5	42.9	27.0
11/16/2022	290.3	62.8	20.0	23.4
12/16/2022	285.5	54.2	47.2	21.0
1/16/2023	283.8	51.2	28.5	16.8
2/15/2023	286.3	55.6	22.9	14.7
3/16/2023	291.9	65.7	40.5	15.1
4/16/2023	296.8	74.5	80.6	33.0
5/16/2023	298.9	78.3	67.3	38.3
6/16/2023	299.8	80.1	231.7	62.1
7/16/2023	299.4	79.2	306.0	62.7
8/16/2023	299.0	78.6	300.9	63.0
9/16/2023	298.1	76.8	268.9	53.1
10/16/2023	295.1	71.5	109.2	36.0
11/16/2023	289.2	61.0	21.0	26.9
12/16/2023	284.4	52.3	38.9	17.4
1/16/2024	283.0	49.7	13.1	10.0
2/15/2024	284.8	52.9	28.1	13.9
3/16/2024	290.2	62.7	65.0	15.6
4/16/2024	296.0	73.2	53.7	25.7
5/16/2024	298.7	78.0	81.2	36.1
6/16/2024	299.1	78.6	323.3	66.7
7/16/2024	299.0	78.5	242.4	57.3

8/16/2024	298.9	78.4	238.6	58.0
9/16/2024	298.1	77.0	158.5	52.6
10/16/2024	295.2	71.7	82.9	38.4
11/16/2024	289.8	62.0	39.0	25.7
12/16/2024	285.6	54.5	34.9	18.8
1/16/2025	282.4	48.6	36.4	8.1
2/15/2025	285.1	53.5	17.6	11.3
3/16/2025	290.3	62.9	33.5	14.7
4/16/2025	296.2	73.6	70.4	22.9
5/16/2025	298.1	77.0	91.6	50.4
6/16/2025	299.1	78.7	243.7	69.2
7/16/2025	299.6	79.6	283.5	61.6
8/16/2025	299.5	79.3	283.5	64.4
9/16/2025	298.6	77.8	233.9	53.9
10/16/2025	294.9	71.2	115.3	36.5
11/16/2025	289.6	61.6	23.3	22.7
12/16/2025	284.8	52.9	31.3	15.0
1/16/2026	283.7	51.0	39.1	13.6
2/15/2026	286.1	55.4	62.0	16.7
3/16/2026	291.2	64.5	77.7	23.3
4/16/2026	295.4	72.1	66.2	28.6
5/16/2026	298.0	76.8	125.4	47.5
6/16/2026	299.2	78.9	276.9	58.5
7/16/2026	299.4	79.3	279.3	63.6
8/16/2026	299.1	78.7	271.7	63.4
9/16/2026	298.3	77.3	183.7	51.9
10/16/2026	294.8	70.9	95.8	34.4
11/16/2026	289.5	61.4	12.8	18.2
12/16/2026	284.7	52.9	13.4	

Appendix 4: IPCC data of Temperature, Rainfall and Cloud for Sunamganj districts

Date	Temperature (k)	Temperature ˚C	Rainfall (mm)	Cloud (%)
1/16/2006	283.5	50.7	6.7	13.2
2/15/2006	286.1	55.3	15.0	8.7
3/16/2006	292.7	67.1	42.7	16.6
4/16/2006	296.8	74.6	51.6	22.9
5/16/2006	299.5	79.4	74.9	34.0
6/16/2006	300.5	81.2	309.8	66.4
7/16/2006	300.4	81.0	262.1	62.8
8/16/2006	300.3	80.9	243.8	59.8
9/16/2006	299.4	79.3	195.6	53.0
10/16/2006	296.2	73.5	76.4	30.2
11/16/2006	290.8	63.8	62.8	27.3
12/16/2006	286.1	55.4	54.9	22.0

1/16/2007	284.0	51.6	11.2	12.1
2/15/2007	286.8	56.6	23.2	11.8
3/16/2007	291.5	65.1	62.9	18.6
4/16/2007	297.0	74.9	54.2	19.1
5/16/2007	299.4	79.2	126.5	36.5
6/16/2007	300.5	81.3	247.9	54.4
7/16/2007	300.2	80.7	221.9	57.2
8/16/2007	299.9	80.1	205.4	58.0
9/16/2007	299.5	79.5	190.1	51.7
10/16/2007	296.3	73.7	88.0	36.6
11/16/2007	290.5	63.3	42.2	27.8
12/16/2007	286.2	55.5	49.0	20.1
1/16/2008	282.7	49.2	31.9	12.0
2/15/2008	285.2	53.7	34.9	17.4
3/16/2008	290.2	62.7	56.6	19.0
4/16/2008	296.4	73.9	65.0	20.1
5/16/2008	299.4	79.2	91.6	40.5
6/16/2008	300.5	81.3	247.8	58.6
7/16/2008	300.5	81.2	241.9	60.0
8/16/2008	300.5	81.2	242.7	59.2
9/16/2008	299.3	79.0	212.1	56.5
10/16/2008	296.1	73.3	76.5	30.2
11/16/2008	291.0	64.0	68.0	28.0
12/16/2008	285.4	54.1	23.8	15.6
1/16/2009	283.2	50.1	18.4	13.0
2/15/2009	285.8	54.9	20.0	11.3
3/16/2009	291.1	64.4	29.5	9.7
4/16/2009	297.5	75.9	26.7	16.3
5/16/2009	299.7	79.9	121.3	36.9
6/16/2009	300.7	81.5	175.8	56.9
7/16/2009	300.4	81.0	314.0	59.5
8/16/2009	300.0	80.4	236.9	60.8
9/16/2009	299.3	79.0	170.7	49.4
10/16/2009	295.2	71.6	77.3	28.6
11/16/2009	289.5	61.4	32.4	19.8
12/16/2009	285.9	55.0	25.0	19.2
1/16/2010	284.3	52.1	55.0	15.5
2/15/2010	286.4	55.8	37.4	12.4
3/16/2010	290.9	63.9	57.8	14.6
4/16/2010	296.7	74.4	50.5	20.7
5/16/2010	299.8	79.9	62.0	29.3
6/16/2010	300.6	81.4	229.3	57.8
7/16/2010	300.4	81.0	189.6	58.8
8/16/2010	300.1	80.6	212.8	58.2
9/16/2010	299.6	79.7	271.4	57.5

10/16/2010	296.2	73.4	85.5	30.1
11/16/2010	291.5	64.9	42.6	23.4
12/16/2010	285.4	54.0	29.0	17.6
1/16/2011	284.7	52.8	25.5	14.5
2/15/2011	287.1	57.2	16.5	10.7
3/16/2011	292.6	67.0	30.4	10.8
4/16/2011	296.7	74.4	92.6	33.8
5/16/2011	299.7	79.8	96.2	35.2
6/16/2011	300.9	82.0	192.9	58.1
7/16/2011	300.5	81.3	268.7	59.7
8/16/2011	300.7	81.5	186.3	55.8
9/16/2011	299.7	79.7	249.2	56.3
10/16/2011	296.5	74.0	83.6	31.0
11/16/2011	290.7	63.6	37.9	25.4
12/16/2011	286.1	55.2	30.4	15.7
1/16/2012	285.5	54.2	36.1	12.5
2/15/2012	286.6	56.3	29.6	14.1
3/16/2012	292.3	66.6	40.5	14.6
4/16/2012	297.9	76.6	52.4	25.4
5/16/2012	300.0	80.3	83.3	33.6
6/16/2012	301.1	82.2	221.2	64.1
7/16/2012	300.6	81.3	236.4	58.2
8/16/2012	300.3	80.9	211.2	60.7
9/16/2012	299.3	79.1	218.4	52.9
10/16/2012	296.2	73.5	195.1	37.7
11/16/2012	290.4	63.1	23.6	24.5
12/16/2012	285.6	54.4	28.8	18.0
1/16/2013	284.3	52.1	25.6	16.0
2/15/2013	287.2	57.3	52.9	16.2
3/16/2013	290.8	63.7	34.3	12.3
4/16/2013	296.6	74.2	52.1	19.3
5/16/2013	299.6	79.6	135.7	43.1
6/16/2013	300.3	80.8	307.2	57.9
7/16/2013	300.5	81.2	218.9	55.1
8/16/2013	300.2	80.7	218.6	58.0
9/16/2013	299.5	79.4	200.6	50.8
10/16/2013	296.0	73.2	91.3	36.3
11/16/2013	290.0	62.4	44.3	19.4
12/16/2013	284.5	52.4	14.1	16.1
1/16/2014	284.6	52.5	39.9	24.3
2/15/2014	285.9	55.0	40.0	12.9
3/16/2014	290.7	63.6	39.0	12.0
4/16/2014	296.2	73.5	33.0	19.9
5/16/2014	299.6	79.7	92.5	37.7
6/16/2014	301.0	82.2	172.9	60.1

7/16/2014	300.4	81.0	177.1	54.4
8/16/2014	300.6	81.5	189.8	54.9
9/16/2014	299.5	79.5	168.5	46.7
10/16/2014	296.3	73.7	115.4	28.6
11/16/2014	290.6	63.4	50.2	24.8
12/16/2014	286.9	56.8	7.4	16.5
1/16/2015	285.0	53.3	36.2	12.3
2/15/2015	286.6	56.3	51.5	15.9
3/16/2015	291.7	65.4	42.1	15.5
4/16/2015	298.0	76.7	78.1	30.2
5/16/2015	300.1	80.5	80.6	35.9
6/16/2015	301.5	83.0	177.9	51.5
7/16/2015	301.0	82.0	254.8	61.3
8/16/2015	300.2	80.8	278.4	55.8
9/16/2015	299.9	80.2	191.2	55.3
10/16/2015	296.7	74.4	129.5	35.9
11/16/2015	291.1	64.3	7.0	18.1
12/16/2015	285.9	54.9	53.7	16.1
1/16/2016	284.8	53.0	38.2	11.0
2/15/2016	287.1	57.0	20.0	11.6
3/16/2016	292.3	66.4	58.0	14.7
4/16/2016	297.3	75.5	83.6	24.4
5/16/2016	299.6	79.6	103.5	36.6
6/16/2016	300.6	81.4	288.4	62.5
7/16/2016	300.6	81.4	268.5	59.6
8/16/2016	300.6	81.4	233.4	57.1
9/16/2016	299.7	79.7	244.1	50.0
10/16/2016	296.9	74.8	133.1	34.2
11/16/2016	291.1	64.2	43.9	25.0
12/16/2016	286.5	56.1	13.7	21.5
1/16/2017	284.0	51.5	12.4	9.6
2/15/2017	286.2	55.6	16.4	14.1
3/16/2017	291.9	65.7	42.6	13.0
4/16/2017	297.3	75.4	66.8	17.9
5/16/2017	299.7	79.7	66.4	27.8
6/16/2017	301.1	82.3	161.5	55.6
7/16/2017	300.8	81.9	226.6	60.2
8/16/2017	300.6	81.5	246.8	61.2
9/16/2017	299.6	79.6	165.2	52.1
10/16/2017	296.4	73.8	67.4	27.5
11/16/2017	291.0	64.1	37.1	21.7
12/16/2017	287.1	57.1	16.8	17.4
1/16/2018	285.0	53.3	33.3	13.1
2/15/2018	286.3	55.6	19.0	10.4
3/16/2018	293.2	68.1	36.8	12.1

4/16/2018	298.3	77.3	72.8	27.3
5/16/2018	300.0	80.3	72.0	35.8
6/16/2018	301.4	82.9	209.4	56.8
7/16/2018	301.0	82.1	249.3	61.9
8/16/2018	301.0	82.2	210.9	59.9
9/16/2018	299.8	80.0	171.6	49.8
10/16/2018	296.4	73.8	80.7	30.3
11/16/2018	291.0	64.1	36.1	23.1
12/16/2018	286.2	55.5	3.5	8.7
1/16/2019	286.5	56.0	29.1	13.7
2/15/2019	288.8	60.2	17.6	12.7
3/16/2019	292.4	66.7	39.0	13.5
4/16/2019	297.8	76.5	41.2	21.6
5/16/2019	300.2	80.6	48.3	25.5
6/16/2019	301.5	83.0	173.9	59.2
7/16/2019	300.8	81.8	317.2	64.0
8/16/2019	300.8	81.8	223.5	58.1
9/16/2019	300.2	80.6	204.7	48.4
10/16/2019	296.8	74.6	77.9	30.0
11/16/2019	291.0	64.0	15.1	17.2
12/16/2019	286.2	55.4	12.6	12.6
1/16/2020	286.7	56.4	38.6	16.7
2/15/2020	287.2	57.3	51.8	18.9
3/16/2020	293.0	67.7	27.8	10.8
4/16/2020	298.6	77.8	48.4	21.6
5/16/2020	300.7	81.5	132.4	31.0
6/16/2020	300.9	82.0	205.9	58.9
7/16/2020	300.7	81.6	240.7	57.9
8/16/2020	300.7	81.6	161.7	50.7
9/16/2020	299.6	79.6	196.4	56.0
10/16/2020	296.8	74.5	137.7	40.2
11/16/2020	291.0	64.1	24.5	20.1
12/16/2020	286.6	56.2	16.9	13.2
1/16/2021	285.4	54.1	19.6	12.4
2/15/2021	286.6	56.3	29.9	14.5
3/16/2021	293.2	68.1	53.4	15.2
4/16/2021	297.3	75.4	51.3	22.1
5/16/2021	299.7	79.8	148.9	44.5
6/16/2021	300.9	82.0	268.7	63.1
7/16/2021	300.6	81.4	272.8	58.0
8/16/2021	300.6	81.4	248.9	61.2
9/16/2021	299.8	79.9	142.7	47.9
10/16/2021	295.7	72.6	103.4	31.7
11/16/2021	290.5	63.2	26.3	21.2
12/16/2021	285.6	54.5	19.8	14.9

1/16/2022	285.4	54.1	31.3	14.3
2/15/2022	286.4	55.9	13.8	9.1
3/16/2022	292.6	67.1	41.0	12.9
4/16/2022	297.7	76.2	50.6	18.0
5/16/2022	300.4	81.0	54.7	32.2
6/16/2022	301.1	82.3	265.0	59.2
7/16/2022	301.0	82.2	296.7	60.7
8/16/2022	300.7	81.6	224.4	60.6
9/16/2022	299.5	79.4	212.8	51.6
10/16/2022	296.7	74.4	55.3	27.8
11/16/2022	291.8	65.7	27.7	24.2
12/16/2022	286.5	56.1	38.2	19.5
1/16/2023	284.9	53.1	28.9	16.3
2/15/2023	287.5	57.9	21.2	15.5
3/16/2023	293.3	68.2	42.7	15.0
4/16/2023	298.2	77.0	73.7	28.5
5/16/2023	300.1	80.6	75.8	32.6
6/16/2023	301.4	82.9	190.5	58.7
7/16/2023	301.0	82.2	296.3	63.4
8/16/2023	300.7	81.5	265.8	58.8
9/16/2023	299.9	80.1	278.0	52.1
10/16/2023	296.9	74.7	129.3	35.9
11/16/2023	291.1	64.4	24.5	25.6
12/16/2023	286.1	55.4	36.7	18.0
1/16/2024	284.1	51.7	11.3	10.1
2/15/2024	286.4	55.9	34.8	14.5
3/16/2024	291.8	65.5	60.6	15.3
4/16/2024	297.7	76.1	56.8	22.5
5/16/2024	300.5	81.3	90.8	34.1
6/16/2024	300.8	81.8	278.8	64.5
7/16/2024	300.6	81.4	218.1	56.4
8/16/2024	300.5	81.2	228.9	57.1
9/16/2024	299.7	79.9	158.3	51.8
10/16/2024	297.0	74.9	90.4	38.0
11/16/2024	291.6	65.2	39.6	25.7
12/16/2024	287.0	56.9	30.0	19.2
1/16/2025	283.9	51.4	31.7	8.0
2/15/2025	286.2	55.5	18.0	10.9
3/16/2025	291.9	65.7	34.2	14.8
4/16/2025	297.4	75.7	62.9	17.8
5/16/2025	299.7	79.8	102.8	44.6
6/16/2025	300.7	81.5	264.4	69.3
7/16/2025	301.1	82.4	249.4	61.7
8/16/2025	301.0	82.1	250.1	61.8
9/16/2025	300.1	80.6	211.5	52.7

10/16/2025	296.6	74.2	158.5	35.1
11/16/2025	291.1	64.4	26.2	22.5
12/16/2025	286.1	55.3	17.1	14.2
1/16/2026	285.2	53.6	31.7	14.4
2/15/2026	287.3	57.5	59.4	16.4
3/16/2026	292.6	66.9	85.7	23.9
4/16/2026	296.5	74.1	61.2	24.1
5/16/2026	299.5	79.4	123.3	43.3
6/16/2026	300.7	81.6	266.5	60.8
7/16/2026	301.0	82.1	239.2	61.6
8/16/2026	300.4	81.1	294.8	62.0
9/16/2026	299.7	79.8	186.0	51.7
10/16/2026	296.2	73.6	114.9	33.4
11/16/2026	291.1	64.3	18.1	18.1
12/16/2026	286.0	55.2	19.2	19.9

Appendix 5: Yield data of *Boro* rice in Sylhet districts

Years	Area(acres)	Production (M.tons)
1970	656240	474290
1971	669400	515705
1972	578675	353560
1973	628865	408220
1974	491435	192660
1975	650845	406080
1976	650250	417850
1977	300000	149875
1978	634000	430125
1979	558550	273905
1980	645000	460655
1981	655130	492330
1982	628755	389705
1983	626800	411585
1984	601690	423215
1985	623875	459055
1986	624245	378182
1987	605860	386915
1988	555183	350994
1989	697730	430065
1990	694050	394700
1991	708420	467160
1992	748640	535320
1993	684270	456760

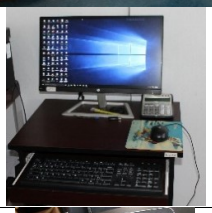
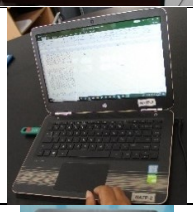
1994	751980	532570
1995	746420	514610
1996	776160	555980
1997	731670	568630
1998	732300	598200
1999	831270	686350
2000	783590	709800
2001	784310	837900
2002	840870	883100
2003	812730	870680
2004	767150	759550
2005	878905	961232
2006	862160	934297
2007	137470	111088
2008	158200	153247
2009	17017	25032
2010	144976	168841
2011	160776	195290
2012	167393	190093
2013	167275	206323
2014	170795	199833
2015	179747	212738
2016	172802	201490
2017	143099	167560

Appendix 6: Yield data of Boro rice in Sunamganj districts

Years	Area(acres)	Production (M.tons)
2007	411590	411471
2008	454845	544804
2009	463146	529063
2010	276677	353393
2011	471144	657326
2012	466510	643271
2013	470806	641455
2014	460322	649667
2015	476190	695856
2016	467945	685226
2017	134397	196500

Appendix 7: Procurement completed

Package No.	Description of Procurement Package Goods	Estimated Cost (in Tk.)	Achievements	Photos
1	2	3	4	5
GD_1	(i) Executive Table (No. 1)	20,000/-	Completed	
	(ii) Executive Chair (No. 1)	10,000/-		
	(iii) Front Chair (No. 2)	8,000/-		
	(iv) Computer Chair (No. 2)	7,000/-		
	(v) Almirah (No. 1)	24,000/-		
	(vi) File Cabinet (No. 1)	20,000/-		
	(vii) Computer table (No. 2)	10,000/- 99,000/-		

GD_2	(i) Digital soil moisture meter (No. 1)	5,000/-	Completed	
	(ii) Digital Thermo-hygrometer (No. 1)	5,000/- 10,000/-		
GD_3	(i) Desktop (High resolution computer for GIS data analysis) (No. 2)	1,20,000/-	Completed	
	(ii) Laptop (Field data analysis purpose) (No. 2)	1,20,000/-		
	(iii) Scanner (No. 1)	10,000/-		
	(iv) Color Printer(laser) (No. 1)	20,000/-		
	(v)UPS(offline) (No. 1)	10,000/- 2,80,000/-		

GD_4	Digital Camera (No. 1)	25,000/-	Completed	
GD_5	(i) GPS meter with cable (No. 4)	1,00,000/-	Completed	
	(ii) GPS meter (Trimble DS_Juno 3) (No. 2)	2,20,000/-		
	(iii) Stereoscopic 3D (No. 1)	6,000/-		
	(iv) XLSTAT	50,000/-		
	(v) EdGCM	40,000/- 4,16,000/-		

Appendix 8: List of Data Purchased from BWDB, BMD and SPARRSO

Data Types	District	Name of station	Station ID	Duration
Rainfall(BWDB)	Sylhet	Sylhet	CL128	01-apr-1957 to 30-jun-2017
	Maulvi Bazar	Moulvi Bazar	CL122	01-apr-1961 to 30-apr-2017
	Sunamganj	Sunamganj	CL127	01-apr-1961 to 30-jun-2017
		Chhatak	CL107	01-apr-1967 to 28-feb-2018
	Habiganj	Chandpur Bagan	CL105	01-jan-1967 to 31-jan-2018
		Itakhola (Baikuntha)	CL111	01-jan-1967 to 31-jan-2018
		Markuli	CL120	01-jan-1967 to 31-dec-2017
Rainfall Daily maximum in(mm)(BMD)	Sylhet	Sylhet		2007 to 2016
	Maulvi Bazar	Sreemangal		2008 to 2016
	Sylhet	Sylhet		2007 to 2016
	Maulvi Bazar	Sreemangal		2008 to 2016
Rainfall Daily total data in (mm)(BMD)	Sylhet	Sylhet		2007 to 2016
	Maulvi Bazar	Sreemangal		2007 to 2016
Rainfall Daily total data in (mm)(BMD)	Sylhet	Sylhet		1967 to 2017
	Maulvi Bazar	Sreemangal		1967 to 2017
Water Level(BWDB)	Sylhet (Surma-Meghna)	Kanairghat	SW266	01-01-1997 to 30-06-2017
	Sylhet (Surma-Meghna)	Sylhet	SW267	20-02-1997 to 30-06-2017
	Sylhet (Surma-Meghna)	Chhatak	SW268	01-01-1996 to 31-12-2017
	Sylhet (Surma-Meghna)	Dirai_on Kalni	SW269.5	01-04-1996 to 31-01-2018
	Sylhet (Kushiyara)	Amalshid	SW172.5	01-04-1996 to 31-12-2017
	Sylhet (Kushiyara)	Sheola	SW173	01-01-1996 to 31-12-2017
	Sylhet (Kushiyara)	Fenchuganj	SW174	01-01-1996 to 31-12-2017
	Sylhet (Kushiyara)	Sherpur	SW175.5	01-01-1996 to 31-12-2017

	Sylhet (Piyan)	Ratnar bhanga (Piyan gang)	SW233	01-01-1996 to 30-11-2017
	Sylhet (Piyan)	Jaflong_Spill	SW233A	01-04-1996 to 31-12-2017
	Sylhet (Piyan)	Companiganj	SW234	01-05-1996 to 30-09-2015
	Sylhet (Sari-Gowain)	Sarighat	SW251	01-01-1996 to 31-12-2017
Water Level(BWDB)	Sylhet (Sari-Gowain)	Salutikar	SW252.1	01-01-1996 to 30-09-2015
	Sylhet (Sari-Gowain)	Gowainghat	SW252	01-01-1996 to 30-09-2015
	Sylhet (Sonai-Bardal)	Jaldhup	SW265	01-01-1996 to 31-12-2017
	Sylhet (Dhalai)	Islampur	SW332	01-01-1996 to 31-12-2017
	Sylhet (Jhalukhali)	Muslimpur	SW333	01-01-1996 to 31-12-2017
	Sylhet (Lubachara)	Lubachara	SW326	01-04-1996 to 31-12-2017
	Maulvi Bazar (Dhalai)	Kamalganj	SW67	01-01-1997 to 30-06-2017
	Maulvi Bazar (Lungla)	Motiganj	SW192	01-01-1996 to 31-10-2017
	Maulvi Bazar (Monu)	Monu Rly.Bridge	SW201	01-01-1996 to 31-10-2017
	Maulvi Bazar (Monu)	Moulvi Bazar	SW202	01-01-1996 to 31-10-2017
	(River: Juri)	JuriCont_Silghat	SW135A	01-01-1996 to 30-04-2016
	Sunamganj (Jadukata)	Laurergarh Saktiarkhola	SW131.5	01-01-1997 to 30-06-2017
	Sunamganj (Surma-Meghna)	Sunamganj	SW269	01-01-1997 to 30-06-2017
	Sunamganj (Noyagang)	Urargaon	SW337	4/1/1996 to 12/31/2017
	Sunamganj (Omayan Chella)	Chella Sonapur	SW341	01-01-1996 to 31-10-2017
Soil Moisture (BMD)	Maulvi Bazar	Sreemangal		2006 to 2016
	Comilla	Comilla		2006 to 2016
	Gazipur	Joydevpur		2006 to 2016
	Dinajpur	Dinajpur		2006 to 2016

	Rajshahi	Rajshahi		2006 to 2016
	Rangpur	Rangpur		2006 to 2016
	Mymensingh	Mymensingh		2006 to 2016
Soil Moisture (BMD)	Pabna	Ishurdi		2006 to 2016
Temperature, °C (Daily average Dry-bulb) **(BMD)**	Sylhet	Sylhet		2007 to 2016
	Moulvi Bazar	Sreemangal		2007 to 2016
Temperature, °C (Daily Maximum) **(BMD)**	Sylhet	Sylhet		2007 to 2016
	Moulvi Bazar	Sreemangal		2007 to 2016
Temperature, °C (Daily Minimum) **(BMD)**	Sylhet	Sylhet		2007 to 2016
	Moulvi Bazar	Sreemangal		2007 to 2016
Temperature, °C Monthly Max.& Mean Maximum **(BMD)**	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Temperature, °C Monthly Min.& Mean Minimum **(BMD)**	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Cloud Daily average cloud amount (octa)(BMD)	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Daily Mean Sea Level Pressure in millibar(BMD)	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Daily Mean Station Level Pressure in millibar(BMD)	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Daily Prevailing Wind Speed in Knots and Direction(BMD)	Sylhet	Sylhet		1967 to 2017
	Moulvi Bazar	Sreemangal		1967 to 2017
Vegetation and Water Body (GIS LANDSAT TM/MSS data) (BMD)	Sylhet Division	Total Sylhet Divisional Area		2010 to 2017

Appendix 8: Project photos

Fig: On the way for visiting Sunamgonj

Fig: Project Area in Sunamgonj.

Fig: Areas affected by flash flood

Fig: Discuss with farmers about flash flood

Fig: Discuss with villagers about flash flood

Fig: Visiting Flash Flood Area

Fig: Visiting Haor by Boat.

Fig: Damage crop damping after Flash Flood.

Fig:Areas affected by flash flood

Fig:Discuss with villagers about flash flood

Fig: Visiting Rubber Dam at Sunamgonj

Fig:TEC meeting

Fig: Visiting DAE

Fig: Visiting BADC

Fig: Visiting BWDB

Fig: Visiting BRRI

Fig: Discuss with SSO about flash flood area at BRRI, Habiganj

Fig: Discuss with Technical officer about flash flood area at DAE, Moulvibazar

Fig: Project office monitoring by NATP team, PIU-BARC, NATP Phase-2


Fig:Project office monitoring by Director and his team, PIU-BARC, NATP Phase-2


Fig: Discuss with Executive Engineer about flash flood at Moulavibazar, BWDB.

Fig. Location identification through GPS meter

Fig. Discussion with executive engineer and fisheries officer at BWDB and DFO

Fig. Co-PI and research students doing their project work