

CHAPTER - III

MATERIALS AND METHODS

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M A T E R I A L S A N D M E T H O D S

3.1. SHORT PROFILE OF COOCH BEHAR DISTRICT

Cooch Behar is a district which is situated at the north eastern fringe of Jalpaiguri division in the state of West Bengal. In shape it forms an irregular triangle having an area of 3404 sq.K.M. and is bounded by Jalpaiguri district in the north and west, in the east partially by Goalpara district of Assam and partly by Rangpore district of Bangladesh and the south is entirely bounded by Bangladesh. One of the striking features of Indo-Bangladesh border is the presence of innumerable "CHHITMAHAL"s spread throughout the border line.

The district lies between the parallels $26^{\circ} 50' 40''$ and $25^{\circ} 32' 20''$ North latitudes and is bounded on the east and west by $89^{\circ} 47' 40''$ and $89^{\circ} 54' 35''$ East longitudes.

The district of Cooch Behar geographically forms a part of Himalayan Terai of West Bengal. The district belongs to the Terai agro-climatic zone of West Bengal. This district also belongs to the Meteorological sub-division of Sub-Himalyan West Bengal. It is also situated in the high atmospheric pressure zone. The atmospheric pressure is 1000 millibar.

The climate of this district is basically per-humid in nature with distinctive characteristics of high rainfall, high relative humidity and low temperature. About three-fourth of the

total annual rain fall is received during the south western monsoon (June to September). The first intermonsoon period (March to May) and the second intermonsoon period (October to November) have a relatively low intensity of rainfall.

The number of rainy days are recorded highest in the months of June & July. The number of rainy days often crossed twenty days in the months of June and July followed by 15 to 20 days in August and September. But in the months of April, May and October it varied in maintaining a central tendency towards 10 days in a month. During the season, minimum and maximum temperatures recorded are in the range 5°C to 33°C. The temperature reached the maximum in August and the lowest temperature is recorded in the month of January. During the rainy season, the relative humidity appears around 90% in this district. In winter season it ranges from 60 to 75 percent. The overall climate of Cooch Behar is damp and not so hot. The normal annual rainfall of this district is 3292 millimeters.

The district is a net-work of rivers and small streams, beds of which have formed the soil of Cooch Behar. The principal rivers are the Teesta, Torsha, Jaldhaka, Kaljani, Raidak, and Mansai etc. . The majority of these rivers take rise in the Himalayas. After passing through Duars these rivers enter this district from the northern part and flow into Bangladesh on their way to join the Brahmaputra.

The net cropped area is about 75 percent of the total area of this district. The main crop of this district during

Kharif season is Winter Rice(i.e. Aman paddy). A little over 47 percent of gross cropped area is shared by Winter Rice (Aman) in this district. The aman paddy is basically rain fed crop here because only 10% of cultivated land are under irrigation scheme. But the most of facility of irrigation concerned is in the Rabi crop and to some extent in the pre-Kharif crop.

The majority of the people of Cooch Behar depend on agriculture and it is their principal source of livelihood.

3.2. The nature of Data used :

It is pointed out earlier that the Cooch Behar district has been selected for the study. The crucial variables used in this study are rainfall and yield of winter rice. On the whole the categories of data required are as follow :

3.2.1. Rainfall (Monthly) :

There are more than seven rain gauge stations in Cooch Behar district where rainfall is recorded. However there are immense irregularities in the maintenance of proper records.

The total precipitation is not uniform throughout this district. It is the highest in the northern part and as one proceeds south wards it decreases.

The northern part of this district has an annual precipitation rate more than the normal rainfall (3292 mm), while the southern part of this district has less than normal rainfall. Therefore, on the assumption that the rainfall at the center of the northern part is highly correlated with that at other centers

of this part and as the same assumption holds for the southern part of the district, we have chosen two rain gauge stations for which proper information is available. The chosen two rain gauge stations are Cooch Behar and Dinhata. The monthly rainfall data are collected from published observations from sources and some of them are collected from the rain gauge stations.

The monthly rainfall data of the two stations have been collected for the period from 1901 to 1988. The data consist of monthly sum. During compilation of monthly data some difficulties have been faced due to missing records from the stations. However, the difficulties in filling up the missing data for some months, have been overcome by considering monthly normals of the stations or by using the respective long term monthly mean values for the station. Meteorologically more significant annual totals are derived from the monthly sums of rainfall of the respective stations.

3.2.2. DAILY RAINFALL

Daily rainfall data for the Cooch Behar station have been collected from the Meteorological, Center Cooch Behar. The daily rainfall data of Cooch Behar are available for the period from 1971 to 1988.

In this context, it is noted that the daily rainfall data for Dinhata cannot be available for long period. This discrepancy imposed some limitations to the study.

3.2.3. Estimated Rice yield :

Aman paddy singularly accounts for about 70% of total rice area of this district. It is grown extensively as a rain fed crop. The winter paddy, too, is predominated by local varieties. A little over 80 percent of total area under winter paddy is occupied by local varieties.

The climatic factor, particularly rainfall, is used to estimate the yield of winter rice. Winter rice yield data in Kg/hectare have been collected for the period, 1972 to 1988 from the record published by the Govt. of West Bengal.

The rice yield data consist for the district of Cooch Behar. The yield of winter rice has been included as dependent variable in the study for crop-weather relationship.

3.3. SOURCES OF DATA

The monthly sums of rainfall data for the raingauge stations at Cooch Behar and Dinhata are collected from India Meteorological Department by some published records and from its local Meteorological center. Some relevant rainfall data have been collected from the raingauge station at Central Tobacco Research Institute, Dinhata, Cooch Behar.

The yield estimates of winter rice for the Cooch Behar district have been collected from "Statistical Abstract" published by the Department of Applied Economics and Statistics, Govt. of West Bengal and estimates of area and production of principal crops in West Bengal published by Socio-Economic and Evaluation

Branch, Govt. of West Bengal.

Some relevant observations have been collected from the "Key Statistics" published by the District Statistical officer, Bureau of Applied Economics and statistics, Government of West Bengal, Cooch Behar.

Some statistics regarding the physical features of this district have been collected from "Agriculture in Northern Districts of West Bengal—Profile and Prospects" published by North Bengal campus, Bidhan Chandra krishi Viswavidyalaya, Cooch Behar, West Bengal.

3.4.

METHODOLOGY USED

The statistical method is based on the analysis of real data. A particular technique is more clearly understood when it is presented in numerical as well as mathematical term.

The basic statistical theory and methods are freely followed from time to time throughout the study. These are mean, standard deviation and variance, mean deviation etc.. The graphical analysis is also employed to familiarize with the mathematical concepts.

The two basic discrete distributions i.e., negative binomial and Markov-dependent Geometric model, the most common kind of discrete variables, are considered for probability model. The geometric probability model arising from the Markovian probabilities are considered to fit the distribution for time varying variable. The variables are frequency variables and the

use of this model have some a "prior" justification in terms of modeling of rare events occurring over periods of time.

The stochastic process has been employed by utilizing the Markovian property. The transition probabilities constitute the Markovian model. Here we confine to the homogeneous chain system. We have also considered the unit-step transition with two-state and five-state Markov chains. The entropy defined by Shannon has been used to measure the uncertainty of the transition probabilities and to test the Markovian dependence of daily rainfall.

To measure the oscillatory character in the historic time series of rainfall, that is, to search for hidden periodicities within the instrumental time frame, spectral analysis is used to recognize this rhythm. The autocovariance, autocorrelation are also utilized to set up the spectral analysis with its initial parameters with the help of Box-Jenkin's method.

The multiple regression analysis is also applied in this study whenever this is found to be meaningful, particularly, to establish the empirical crop-weather relationship in the district of Cooch Behar.

The maximum likelihood method, least squares method and the method of moments are adopted to aim at the evaluation of the unknown basic parameters of the populations from the information of sample or realization under study.

To establish the relationship between the distribution of population and the distribution of sample realization statistics, the sampling theory are employed to measure the

reliability of statistics. The basic sampling theory is concerned here mainly with the four sampling distributions.

These distributions are :

- i) Standard Normal distribution.
- ii) Student's t-distribution.
- iii) Snedecor's F-distribution, and
- iv) Chi-Square distribution

with it's limiting forms also.

These are the distributions of corresponding statistics, e.i. the z , t , F and χ^2 statistics. These statistics are applied whenever these are required and meaningful.

Besides these tests, we have employed some other tests like Geary test and Durbin-Watson test etc.

The statistical tables of the sample distribution and the statistical tables for Geary test have been used comprehensively to get the theoretical values of the relevant test criteria.

For the analysis of Chapter VII, we have used the statistical software program of BMDP and the statistical procedure have been explained duly, CSSC, Indian Statistical Institute provides the Statistical Computer program for appropriate analysis.

In Chapter VIII, we have used the statistical program of the Micro-Data processor, Personal Computer (PC-FA-11) of N.B. Campus, Bidhan Chandra Krishi Viswavidyalaya, Cooch Behar.