CHAPTER - III

CLIMATIC AND AGRICULTURAL INSTABILITY IN THE DISTRICT OF BURDWAN

Introduction: The improvement of the low yields from a cultivated land depends on suitable climate, fertility of the soil and other factors. Climate is the principal aspect of the physical environment affecting agriculture. The characteristics of the soil are the essential media for growth of the plant. The soil is the product of present and past climates and the vegetation has flourished on the soil. In a small degree, relief also varies with changes in climate. The relationship between climate and the characteristics and condition of the soil is of maximum importance for plant growth. One of the causes "of India's agricultural distress must be attributed to the climate of that country". Variation in weather is a constant source of fluctuation in crop yields, and climate sets limits to what may be attempted, particularly, in arid lands.

The uncertainties of weather have significant impacts on agricultural strategy. It is very difficult to establish the relationship and influence of weather on production of crops.

The climatic elements can be modified by man to a very small degree. The major climatic elements are rainfall, temperature, sunlight and wind. Among them rainfall is the most important
and variable phenomenon. The production and quality of crops fluctuate with the climatic variability from year to year.

The assumption, as suggested by Rao, is that "the characteristic appropriate for 'Bad weather' is called here 'Vulnerability Index'; and the characteristic appropriate for 'Good weather' as 'Response Index'. In 'Bad weather' the loss in output and that in 'Good weather' the gain in output due to weather factors is proportional to an index of quality of soils in a farm". ²

Rainfall : From agricultural point of view, rainfall is the most important climatic factor. The systems of crop production must be correlated more or less with the existing moisture conditions. Rainfall is largely concentrated from July to September. June and October are comparatively drier months and the rest of the year is relatively dry. The variability of rainfall is exceedingly high in amount, time and space in the district of Burdwan. The distribution of rainfall in the agricultural season is far more important than the quantum of annual rainfall. Agriculture makes use of water derived from the soil collected from rainfall. The climatic conditions differ in the district of Burdwan from West to East. The south east of the district is lowlying and more humid. Towards west, the land is gently undulating with a well drained laterite soil.
The uncertainty, variability and ill-distribution of rainfall sometimes obstruct the best efforts of the farmer. The production of crop depends primarily on rainfall during monsoonal period (June-September) and in winter and summer the production of crop depends on the water of canal and deep tubewell. The rainfall has "the biggest effect in determining the potential of any area, the crops which it is practicable to grow, the farming systems which can be followed and the nature timing and sequence of farming operations". The Kharif crop mainly depends on the monsoon rainfall. It is quite natural that late arrival and early retreat of the monsoon seriously hampers the growth of paddy. Late arrival of monsoon delays the sowing of Kharif crops and continuation of precipitation even after the usual monsoon period damages the ripe crop. It is necessary to improve traditional rainfed farming which consists in the retention of rainfall in the soil by special tillage practices and by the construction of small embankments or ponds to intercept surface runoff. Another measure is the complete use of water flows either by retention and water level control in areas—protected with embankments or by conducting the water through channels or pipes to prepared production areas. The maximum utilization of variable rainfall should be followed through the above mentioned methods. The maximum utilization of
stored water is to provide facilities to maintain water supplies throughout the non-rainfall season.

**Temperature**: The climate of the western part of the district is of extreme nature both in temperature as well as humidity. There is high temperature all over the district but in the eastern side it falls rapidly at night due to availability of more water surface. During summer, hot winds known as 'Loo' blow from central India to the western part of the district. The average minimum temperature ranges from 16° to 20°C in December-January and maximum temperature varies from 33° to 38°C in April-May. High temperature remains steady till the monsoon burst.

Seasonal crops (e.g. pulses, vegetables, oilseeds etc.) are developed with relation to various seasons. Enterprise of the farmers is highly susceptible to adverse weather conditions and therefore, there is uncertainty in agricultural production. Though the total rainfall in Burdwan is sufficient in normal years, its distribution during the crop period is erratic. Therefore, in normal years artificial irrigation is a necessity to ensure a normal harvest. Owing to low rainfall and high evaporation, the area suffers from drought. Sudden rains of high intensity or prolonged duration of the
CO-EFFICIENT OF VARIABILITY OF RAINFALL
1901-1950

DISTRIBUTION OF MEAN ANNUAL RAINFALL
1966-67-1976-77

Fig. No. 16
same cause severe flooding as water cannot drain quickly off the land by percolation and runoff.

In figure the variability of rainfall for 50 years is shown. The highest variability occurs over Mongalkote P.S. High variabilities of rainfall occur at the western and northeastern parts of the district. It will be seen from the map that there is a great variability of rainfall in the district according to space and time.

Table 1

| Co-efficient of variability of rainfall during 1901-1950 (in percentage) |
|-----------------------------|-----------------------------|-----------------------------|
| Burdwan                     | 17.56                       | Shyamsundar                 | 28.27                       |
| Kalna                       | 20.67                       | Asansol                     | 32.61                       |
| Katwa                       | 21.30                       | Monteswar                   | 39.61                       |
| Mankar                      | 23.27                       | Mongalkote                  | 48.36                       |

Source: Regional Meteorological Office, Calcutta.

Over southeastern part (Burdwan-Memari area) of the district (Fig. 16) the average annual rainfall is high. In the north eastern and south western parts, the mean annual rainfall is more or less medium. The rest of the district shows almost equal ranges of average annual rainfall, which varies from 120 cm to 135 cm.
BURDWAN MEAN MONTHLY RAINFALL 1976-77

Fig. No. 17
The Figure (Fig. 17) represents a comparative analysis of monthly rainfall for 10 stations for the year 1977. The map shows that there are large variations of distribution of monthly rainfall between the stations. Though the stations are situated a little apart from each other, the variation of rainfall is remarkable. Spatial variation of monthly rainfall is one of the principal factors for agricultural variability of the district.

Table 2

Monthly rainfall for 10 stations for the year 1976-77
(Rainfall in centimetre)

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[Source: Regional Meteorological Office, Calcutta]

* Burnpur Town Engineering Department, IISSCO.
The variation of total annual rainfall of different parts of the district are not very remarkable. "Intensity of rainfall" fluctuates from year to year. The Figure (Fig. 18) shows the intensity of rainfall for three stations, of which Hirapur has maximum variability of intensity of rainfall. Deforestation of several areas in the district is the main factor for this variability, as there is a direct relationship between rainfall and vegetation. Another factor is the topographical variation as "the intensity of rainfall generally varies with the altitude".

### Table 3

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CIRCULAR GRAPHS SHOWING RAINFALL & TEMPERATURE 1970

ASANSOL

JAN

BURNPUR

FEB 40°C

MAR

APR

MAY

JUN

JUL

AUG

SEP

OCT

NOV

DEC

20 CM 20°C

30 CM 30°C

10 CM 10°C

OMBROTHERMIC DIAGRAMS

PANAGARH

BURDWAN

BURNPUR

MOUNTS →

DRY PERIOD

WET PERIOD

Fig. No. 20
There is high temperature from March to October and low temperature from November to February throughout the district. Three circular graphs (Fig. 19) of Hirapur, Asansol and Burdwan are shown here for comparative analysis of rainfall and temperature. There are little variations of monthly rainfall and temperature in Hirapur, Asansol and Burdwan. The fact that there are such differences in variabilities of the three stations within a short distance intervening between these leads to the conclusion that this variability is largely a function of relief.

The Ombrothermic Diagram (Fig. 20) illustrates that Burdwan is an area of more wet period than Hirapur and Asansol. Due to this longer wet period in Burdwan paddy occupies the principal position among the crops.

It is true that though paddy grows during the months of maximum rainfall, it still needs irrigation as the rainfall is variable both in quantity and distribution during the period of cultivation. The water requirements of growing paddy follow more or less a set pattern. Excessive rainfall at any time serves no useful purpose and may sometimes be actually harmful. Such uncertainties in rainfall, specially in the western part of the district, coupled with the lack of irrigation facilities have an adverse effect on agriculture.
CLIMOGRAHS FOR TWO TOWNS OF BURDWAN

ASANSOL

BURODAN

MONTHLY VARIABILITY OF RELATIVE HUMIDITY & TEMPERATURE 1969 BURDWAN

1972

1975

Fig. No. 21

Fig. No. 22
**Sunshine**: Along with temperature and rainfall, sunshine is also one of the contributing factors in agriculture. The amount of sunshine, degree of sunshine and cloudiness of the sky are the regulating factors for growth of a plant. For the cultivation of crops and good yield rate, a long duration of sunshine is more important than its intensity. The district of Burdwan represents the typical climate for the cultivation of paddy and wheat. "The intensity of solar radiation increases rapidly with altitude as the amount of dust in the atmosphere decreases. Sunlight falling on bare soils can lead to water evaporation and organic matter breakdown".  

The climographs (Fig. 21) show more close pattern in Burdwan than Asansol because the highest-lowest ranges of humidity and temperature are low in Burdwan. Moreover, climograph shows the condition of cloud, pressure and wind direction of Asansol and Burdwan.

The monthwise relationship between relative humidity and temperature of Burdwan, as shown in Figure (Fig. 22) illustrates that relative humidity bears a direct relation with temperature. In the month of July, August and September, the relative humidity is high because of the temperature which is also high in the month of May and June.
Physical conditions of crops: Every plant requires a certain amount of water for its growth. Abundant supply of water is considered as the most important factor for production of paddy. Water is lost by evaporation, percolation and runoff from surface of the field and transpiration from plants and also due to maldistribution. An annual rainfall of 125-155 cm well distributed over the year is suitable for the growth of paddy. Paddy requires a mean monthly temperature of about 23° - 26° C during the growing season. As rainfall is heavy in the monsoonal lands the water-supply conditions suit the crop well. There are three types of paddy, Aus, Aman and Boro, which are cultivated in different seasons.

Aus: This crop is sown in May-June (Bengali Month Jaistha) after 'Kalbaishakhi rain', when the temperature remains high. The growing of crop takes place in high temperature and sufficient stagnant water. At its ripening period, bright sunny weather is necessary in the month of September-October (Ashwin-Kartick). The crop is harvested in October. The crop is usually grown mostly in areas which are submerged.

Aman: Aman crop is sown in July-August (Ashar-Sravan) when the temperature is pretty high and the cultivated lands are filled with stagnant water. The growing and ripening periods
are the same as that for Aus crop. It is harvested in November-December after ripening in bright sunny weather during October-November. The crop is generally grown both in irrigated and non-irrigated areas as it is grown during monsoon.

*Boro*: It is a winter crop and it requires irrigated water, medium temperature and bright sunny weather. It is sown in December-January (Pausha-Magha) and harvested in April (Chaitra-Baishaka). This crop is grown in the same land after harvesting of Aman or Aus. Due to non-availability of rains, irrigated water is necessary from canals, tanks and tubewells. The crop is mostly grown on low lying marshy areas where water accumulates.

*Wheat*: This crop grows well under a cool dry climate with a minimum temperature of 15° - 18°C. A cool, moist climate is preferable during the growing period. An average rainfall of 65-70 cm is considered favourable. Its growing period is the same as that of Boro paddy. It is sown in December-January and harvested in March-April. Prolonged low temperature is very necessary for the growing of wheat. Wheat requires irrigated water during sowing and growing periods. For good production of this crop, bright sunny weather, constant low temperature and irrigated water are needed,
RELATIONSHIP BETWEEN ANNUAL RAINFALL & YIELD OF PADDY IN BURDWAN

![Graph showing the relationship between annual rainfall and paddy yield in Burdwan over the years 1947-48 to 1977-78.](image)

**Fig. No. 23**
and as such, winter season is the ideal period for wheat cultivation.

The requirement of water varies in different periods of the growth of the plant i.e. 30-35 per cent is required for the preparation of land, sowing and transplanting of plants; 50-55 per cent from planting upto the time of flowering, and 10-15 per cent upto the time of ripening. The water requirement varies with the duration of the crop, mechanical composition of soil, amount of soil humus and variety of crop.

An analysis of the relationship between annual rainfall and yield of paddy shows that rainfall fluctuates every year from 80 to 260 cm during 1947-48 and 1977-78. Aus and Aman paddy completely depend upon rainfall. For that reason fluctuation in the yield of the crop, takes place with the fluctuation of the amount of total rainfall. During 20 years from 1947-48 to 1967-68, yield of crop mostly depended upon amount of rainfall. After 1967-68, yield/crop increased abruptly though fluctuations were present. The yield of Aus and Aman depends upon total amount of annual rainfall (Fig. 2.3). To compensate for the irregularity of rainfall irrigation is very necessary. A number of canals for irrigation were constructed after 1950-51. At present, a
RELATION BETWEEN
CLIMATIC SEASON & CROPPING SEASON

Fig. No. 24
large area is being cultivated from irrigational canals. But this is not adequate for the Boro and wheat crops which are solely dependent on the irrigational water in winter and cannot therefore, be cultivated in many areas. These canals are also fully dependent upon the amount of total annual rainfall. Therefore, wheat and Boro paddy are indirectly dependent upon rainfall.

The district of Burdwan presents various types of crops with its variable climate. Figure (24) shows that temperature is very high in the months of April, May and June, but rainfall is low or medium during this period. During July, August and September both rainfall and temperature are high. From October the temperature as well as rainfall gradually decreases. The months of December and January are very cold and then rainfall is minimum or nil. From March the temperature rises and amount of rainfall increases. About 200 days are required for the growing of Aman crop. More than one month of rain-free period is necessary for harvesting of Aman paddy. Boro crop requires a long period about 120 days of low temperature and sufficient irrigated water. For good yield of wheat a long spell of cold weather of about 150 days is very essential. In the harvesting time of all crops rainfall is very harmful
and bright sunny weather is necessary for less wastage of crop. Besides rice and wheat, various other crops which include pulses, sugarcane, potato and jute etc. are grown in the district. Sugarcane and jute were cultivated widely in the past, but at present these are grown only in a few areas of the eastern part of the district (e.g. Ketugram, Katwa, Kalna, Purbasthali and Rayna P.S.). The cultivation of jute is gradually decreasing because it is a "soil exhausting crop". High temperature and high rainfall are suitable for jute ecology. Sugarcane is essentially a tropical crop. It requires a long humid season during the period of growth and a fairly dry cold season. The coverage of the crop is gradually decreasing due to its long growing period and for the need of a fairly dry cold season. Pulses are grown at the western part of the district because medium and comparatively high lands are suitable for the crops. Pulses are of two types - Kharif and Rabi. From their ecological consideration it is evident that these can be grown in varied conditions. Moderate temperature and rainfall suit potato. Accordingly, in central and eastern parts of the district potato cultivation takes place.

Large amounts of organic matter in the soil are produced in areas where temperature is high. Organic matter is dependent upon climatic conditions of that area. Due to
VARIABILITY OF CLIMATIC FACTORS WITH ALTITUDE AND ITS RELATION WITH CROPPING AREA

![Graph showing variability of climatic factors with altitude and its relation with cropping area.](image)

**Fig. No. 25**
presence of high temperature and surplus moisture in some parts of the district, the organic materials rapidly decompose when aerated. "As a consequence, such soils lose a major portion of their original organic matter shortly after they being brought under cultivation". 8

Variability of climatic factors with altitude and its relation with cropping area (Fig. 25)

Hirapur is situated at a high elevation, (100-120 m) where annual rainfall is medium and average temperature is higher than in Burdwan and Kanksa P.S. The position of Kanksa is on a gently sloping land at an elevation of 60-70 m. The annual rainfall is lower than that of other two areas and temperature is medium. Burdwan lies on flat land (20-30 m), where temperature is the lowest and rainfall is the highest among the three stations. The figure shows the gross area under cultivation and percentage of total area in divided rectangles. The cropped area is at 97 per cent in Burdwan, 41 per cent in Kanksa and 25 per cent in Hirapur. Cultivated area in each police station depends primarily upon rainfall, temperature and topography.

It can be said that throughout the district of Burdwan climate and topography has a great deal to do with cultivation. In pre-Independence era, agriculture of Burdwan
depended upon rainfall and the water supplied from tanks, wells, rivers etc. During that period lack of irrigation water adversely affected production of crops. The wide range in production of crops in recent years has become possible because of the availability of irrigation, fertiliser and other technological inputs. "For crop production, even distribution of rainfall over the agricultural season is far more important than the quantum of rainfall in the year".  

Figure indicates that there is a distant relationship between the climate and the agricultural development of the district. The rainfall variability is high, co-efficient of variability ranges from 17 to 48 per cent during 1901-50. Therefore, successful agricultural production depends on irrigation to a considerable extent. The winter season remains dry with very little rainfall, which is beneficial to Rabi crops. Summer season with heavy showers is very beneficial to Kharif crop. The method of cultivation is still very much dependent on the vagaries of nature, that is why, there are high fluctuations in productivity even in the case of modernised agriculture. Figure (26) shows the correlation between average annual rainfall and yield of Aman and Aus. In case of Aus, coefficient of correlation is 0.48 and in case of Aman, it is 0.4. The figure illustrates fairly positive degree of correlation in both the crops Aman and Aus, though
a little higher correlation exists in case of Aus than Aman. Due to the lack of rainfall in winter Boro crop and wheat are cultivated by irrigation.

"Penman of the Rothamstead Experimental Station in the U.K. even concludes that the daily water requirement of all crops would be much the same if they were grown on the same soil and for the same growing season". 10 This idea has been entertained by many irrigation specialists till now.

Conclusion: In the district, high yielding variety seeds were introduced in 1967-68, which require timely irrigation and sunshine together with inputs of various kinds. Aus and Aman variety cultivated in monsoonal period is not of high yielding type. There is lack of sunshine during monsoon period. Moreover, the district gets untimely and irregular rainfall. As a result, the yield rate fluctuates with climatic instability. That is why HYV seeds are not cultivated during monsoon period. During winter HYV is cultivated by optimum irrigation and sunshine. But all cultivated lands do not get irrigation facilities during winter. During winter the district produces high yielding Boro paddy from a limited area at the eastern and central parts of the district. Therefore, it is necessary to cultivate high yielding variety of crops of Aman, Aus and Boro in monsoon climate. The
performance of agriculture in a year depends mainly on the rainfall behaviour and the terrain condition of the locality. The agricultural production has become independent of climatic behaviour since the inception of canal irrigation. But due to inadequate and untimely irrigation facilities the crop yield is still greatly dependent on climate. It is true, that the HYV requires better and timely irrigation than the local varieties, but still it promises a better yield.

The production of crop should be stable because of the new variety seeds, though climate may be unstable. In the light of the present and foreseeable technology, the district will never have sufficient water to completely satisfy the plant needs. It will continue to be a limiting factor of crop production. Therefore, it is essential that future supplies of water be used in a more efficient manner. The new variety of crops should be planted in the district, which should have better adaptability for our climatic and terrain conditions.

The ground water reserves should be improved and supplied timely for utilization in periods of drought and also in the western part of the district. There should be provision of water cisterns for collecting rainfall and supplying as supplementary irrigation to cushion rainfall
deficiencies. "For conjunctive use of surface and ground water and for a judicious exploitation of the ground water resources, geological, hydrological and geohydrological studies of the tract should be made". The measures should be taken against flood damage to agricultural production in the eastern part of the district through channelization for rapid water removal or diversion of flood water into uncultivable zones or into artificial storage from which water later may be released during subsequent dry seasons.

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