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PART IV
CLIMATE AND AGRICULTURE


GOVERNMENT OF INUIA
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## PREFACE

The Report of the National Commission on Agriculture comprises 69 chapters in 15 parts. A complete list of chapters and parts is given in pages (iii) to (v). The Terms of Reference of the Commission and its composition are given in Part I-Chapter I-Introduction.

This volume entitled 'Climate and Agriculture', is Part IV of the Report and is divided into the following two chapters :
13. Climate and Agriculture
14. Rainfall and Cropping Patterns

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## 13

## CLIMATE AND AGRICULTURE

## 1 INTRODUCTION

13.1.1 "It is intolerable that this world of the 1970 's with all its. scientific progress and its slowly growing sense of common purpose, should go on enduring a situation in which the chances of enough decent food for millions of human beings may simply depend on the whims of one year's weather." The Director General of the Food and Agriculture Organisation (FAO) of the United Nations said this in a statement to the Press on February 1, 1973. The statement very aptly sums up the Indian scene and the recurrent years of low food production during the past decade are still fresh in our memory. In a predominantly agricultural country like India, national progress is vitalls linked with increasing production of agricultural crops. A major factor influencing growth, sustenance and yield of crops is weather, in fact, weather is significant in nearly every phase of agricultural activity from the preparatory tillage to harvesting and storage. Successful farming, therefore, calls for appropriate decisions in relation to weather for choice of crop, sowing. transplanting, scheduling of irrigation, fertiliser application, use of pesticides etc. A knowledge of risk due to adverse weather conditions such as drought, floods, hailstorm, frost and environmental conditions conducive to pests and disease incidence is essential.
13.1.2 The Royal Commission on Agriculture (RCA) (1928) recognising the close relationship of weather and agriculture recommended that :
"Much useful light would be thrown on agricultural questions if the weather data collected by the Meteorological Department were correlated with the statistics of area sown and yield of crops collected by the Revenue Departments. Agricultural Departments should make themselves responsible for meteorological studies relating to the influence of weather conditions on the growing crop."
In pursuance of the above recommendation, the India Meteorological Department (IMD) commenced work on agricultural .meteorology in 1932 and has been conducting micro-meteorological studies in cooperation with agricultural institutes and State Agriculture Departments. 2-133Deptt of Agri/76

In 1945, a coordinated Crop-Weather Scheme, patterned on the model of the British Crop Weather Scheme, was introduced. The scheme aimed at collection of basic meteorological and crop data in a farm environment with a view to studying their inter-relationships, with an attempt to study the effect of individual climatic elements like temperature and rainfall on crop yield as a necessary first step. Standard statistical techniques were employed, but the results obtained could not lead to a fuller understanding of the complex biological processes of the plant, which are conditioned by a large number of combinations of the environmental factors. A broadening of the scope of investigation is found necessary to encompass wider considerations like energy budget and water balance.
13.1.3 Several aspects of this subject need detailed study. In a paper ${ }^{1}$ presented at the symposium on crop, weather and water relationship in agricultural production, a few specific problems were raised on the role or contribution of each of the factors of weather and technology to crop production. In this connection, reference was made to the large decline in production in 1965-66 and 1966-67 as compared to 1964-65 and the much larger rise in 1967-68, a normal year, and almost stationary production in spite of unfavourable weather conditions over large parts of the country in 1968-69. These raise the important question on the relative roles of weather and technology. Similarly for the planner, it would be helpful to know in advance, the years' production well before the date of harvest, but the question is whether this could be attempted through the use of meteorological factors. A related point is whether Indian climate has trends, periodicity, points of symmetry etc. which could be used for purposes of prediction. Another point concerns weather in relation to pests and diseases. The major problem of cropweather relationship, however, persists. An attempt has been made to analyse these and other related problems in the subsequent sections.

## 2 Climate

13.2.1 A brief introductory account is given of the main climatic features of the country and this is followed by a discussion of climatic factors important to agriculture, such as precipitation, rainfall variability, rainfall correlations, breaks in rainfall, temperatures, wind, sunshine and radiation and climatic change-trends and periodicity.

1 Sarma, J. S., 1969. Crop-weather relationship-Areas of Study. Symposium on Crop, weather and water relationship in agricultural production-Annual Conference, Indian Society of Agricultural Statistics, Bombay.

## General Description

13.2.2 The climates of India are varied and diverse. Khasi-Jaintia Hills (Meghalaya) in the extreme east is one of the rainiest areas in the world with annual averages of the order of $1000-1050 \mathrm{~cm}$ while in the extreme west in Rajasthan there are areas receiving less than 10 cm . The contrasts in climate are striking. Punjab and adjoining areas have continental climates with extremes of temperature ranging from $45-50^{\circ} \mathrm{C}$ in summer to near freezing temperatures in winter, while Kerala has equable maritime climate throughout the year. The major feature of Indian climate is the alternation of the seasons when the winds reverse in direction twice in the year. The seasonal features are :
(i) In the winter months of December to February, the principal feature of weather is the passage of western disturbances over the northern areas of the country which receives significant precipitation. Kashmir gets rainfall of 10 cm per month or more during January and February. The precipitation in the adjoining plains is small, 3 cm pm or less and very uncertain too. Because, however, of its importance for crops a seasonal forecast of total rainfall and snowfall combined (in northwest India) for January to March is issued by the IMD. The extreme southeast of the peninsula gets significant rainfall during November and December. In the rear of the areas affected by western disturbances in the north strong cold winds blow and temperatures fall considerably giving rise occasionally to cold waves. The fall in temperatures may be 10 to $12^{\circ} \mathrm{C}$ below normal and near frost or frost conditions are not uncommon.
(ii) March to May is a period of continuous rise in temperatures over most of the areas of the country. In March, temperatures are highest in the Peninsula with order of $38^{\circ} \mathrm{C}$ and the seat of maximum shifts to north and northwest by May with temperatures of 45 to $50^{\circ} \mathrm{C}$. This is a period of severe thunderstorm activity all over the country and where moisture is less as in the north and northwest, duststorms are more frequent. Maximum wind speeds in thunderstorms have exceeded 100 knot but 60 to 80 knots are more common. Rainfall is substantial in Assam and neighbouring areas and in Kerala and adjoining Karnataka and Tamil Nadu. In fact May is an important rainy month in areas to the south of Bangalore. Thunderstorms are also sometimes accompanied by hail. Hailstorms are more common in the north and northeastern areas and some of them are of destructive violence, the stones varying up to 7 to 8 cm in diameter.
(iii) June to September is the rainiest period of the year for most of the country. The southwest monsoon sets in on Kerala coast towards the end of May, the average date being May, 30 and proceeds northwards. The monsoon is established all over the country by the end of June. The orography of India considerably modifies the flow patterns in this season. The principal feature of this season is the trough of low pressure on the sea-level pressure map. This extends from the Punjab in the northwest to the head of the Bay of Bengal. Depressions form in the north Bay of Bengal and move in a westerly direction across the country giving heavy to very heavy rainfall. The intensity and degree of monsoon rainfall vary from year to year. The monsoon may set in late with large delays in rainfall, have long breaks in July and August or withdraw earlier. It is essential to note these variations in distribution and plan agricultural operations accordingly. The daily frequency of the locations ${ }^{1}$ of the trough during July and August of the years 1961 to 1969 corresponding to longitudes $77^{\circ} \mathrm{E}, 81^{\circ} \mathrm{E}$ and $87^{\circ} \mathrm{E}$ is shown below. The position was considered normal, if the trough was located between latitudes $27^{\circ}$ to $29^{\circ} \mathrm{N}$ along $77^{\circ} \mathrm{E}, 25^{\circ}$ to $27^{\circ} \mathrm{N}$ along $81^{\circ} \mathrm{E}$ and $23^{\circ}$ to $25^{\circ} \mathrm{N}$ along $87^{\circ} \mathrm{E}$.


Over NW India trough is represented by longitude $77^{\circ} \mathrm{E}$. The trough is north of normal position on about 45 per cent of days during July and August. This large frequency of northerly positions may be due to the influence of mid-latitude systems moving across north of India. Southerly positions are mainly associated with the passage of monsoon lows or depressions from the Bay of Bengal or with those forming over northeast Arabian sea and Gujarat. This frequency is, however, small. The trough is in normal position on about half the days along $81^{\circ} \mathrm{E}$.

[^0]Slightly increased frequency in northerly positions in August is mainly due to more northerly tracks of Bay depressions in this month. In northeast India and north Bay of Bengal (along $87^{\circ} \mathrm{E}$ ), the frequency during July and August is nearly the same for corresponding positions. On 70 per cent of the days, the monsoon trough is either normal or to the south of it. The 12 GMT position of the trough on any day and the rainfall reported at 03 GMT next day at stations within two degrees of latitude on either side of the line along longitudes $77^{\circ}, 81^{\circ}$ and $87^{\circ} \mathrm{E}$ were examined. The frequency of occurrence of different intensities of rainfall is shown below :-

Percentage Frequency of Rainfall


About 35 to 45 per cent of the days received moderate to heavy rainfall along the longitudes considered.
(iv) In addition to the trough, note has also to be taken of the depressions/storms* forming in the head of the Bay of Bengal in the monsoon season and moving in a westnorthwesterly or northwesterly direction. The average frequency for June to September is about 7. The average latitudinal positions of depressions crossing different longitudes from $92^{\circ}$ to $75^{\circ} \mathrm{E}$ together with their respective standard deviations are given in Appendix 13.1 -Statement I. From long. $75^{\circ}$ to $90^{\circ} E$, the standard deviation varies between 1.3 to $1.5^{\circ}$ and standard deviation of the mean is about $0.1^{\circ}$ only over many longitudes. This is a clear indication of the high stability of the mean track positions. It may be seen from Statement I, Appendix 13.1 that the rise in average latitudinal position is $0.2^{\circ}$ for one degree of longitude from $91^{\circ}$ to $88^{\circ} \mathrm{E}$ and thereafter from $87^{\circ}$ to $78^{\circ} \mathrm{E}$ generally between 0.3 to $0.4^{\circ}$. As heavy to very heavy rain is associated with passage of depressions and the maximum is in the southwestern sector, the mean track is helpful for prediction of direction of movement mainly on climatological considerations.

[^1](v) October-November is a transition period. Weather is generally fine except in the south peninsula which gets significant rainfall in these months. The averages can be even 30 cm in small parts of Tamil Nadu coast. October and November together account for 40 per cent of annual rainfall in Tamil Nadu and neighoubring areas. The important feature of this season is the storms* (sometimes severe or very severe) forming in the Bay of Bengal which strike the east coast of India and recurving northeast cause heavy damage to life and property. In October, storms originate between latitudes 8 to $14^{\circ} \mathrm{N}$ and move initially in a northwesterly direction and a number of them recurve and move northeast. The average number of storms/depressions based on 80 -year records is four during October to December and of these only two cross coast. The following short table ${ }^{1}$ shows the frequency of storms/depressions crossing or coming within a degree of the east coast of India for various latitudinal positions.
Frequency of Storms/Depressions crossing Coast (1891-1970)
latitude October November December ${ }^{\circ} \mathrm{N} /$

| 22-21 | . | . | . |  | 5 | 2 | - |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 21-20: | - | - | . |  | 7 | 2 | - |
| 20-19 |  | . | . |  | 11 | 3 | - |
| 19-18 | - | - |  |  | 8 | 5 | - |
| 18-17 | - | - | - |  | 5 | 2 | - |
| 17-16 | . | - | - | - | 16 | 3 | 2 |
| 16-15 | . | - | - | - | 7 | 4 | 1 |
| 15-14 |  | . | . | . | 8 | 4 | - |
| 14-13 | . | . | . | - | 4 | 5 | 2 |
| 13-12 | . | - | . | - | 5 | 12 | 1 |
| 12-11 | . | . | - | - | 3 | 8 | 3 |
| 11-10 | . | . | . | - | 1 | 11 | 2 |
| 10-9 | . | . | - | - | - | 1 | 3 |
| 9-8 |  | . | - | . | - | 2 | - |
| total |  | - | - | - | 80 | 64 | 14 |

The most frequent positions where east coast has been struck in October is between latitudes 14 to $17^{\circ} \mathrm{N}$ and 18 to $21^{\circ} \mathrm{N}$. In November lowest latitudes $10-13^{\circ} \mathrm{N}$ predominate and account for 50 per cent of total. Very heavy rains of 20 to 40 cm in

[^2]24 hours are not infrequent though occasionally even 50 cm has been reported. If one examines the frequency of daily rainfall, it will be noticed that it is a few heavy falls which account significantly in the annual totals and the absence of the storms in any year would mean reduced rainfall. Besides the heavy rainfall it is also the very strong winds reaching speeds of 100 to 120 knots which cause extensive damage to property. The maximum estimated winds in gusts during severe storms is of the order of 150 knots and such strong winds have been experienced in different parts of the east coast right up to West Bengal and Bangladesh.

## Rainfall

13.2.3 The Rainfall Atlas of India ${ }^{1}$ contains maps of normal monthly, seasonal and annual rainfall and rainy days and of variability of rainfall (coefficient of variation CV). The Atlas includes also maps of seasonal rainfall as per cent of annual. The Introduction to the Atlas gives a short account of the main features of rainfall of the country. In view of this, no detailed account of rainfall will be given here except for a brief reference to the annual features. Almost the entire country east of longitude $79^{\circ} \mathrm{E}$ (Tiruchi-Jabalpur-Bareilley) and the west coast has normal annual rainfall of more than 100 cm ; in particular Assam and neighbouring areas and most of the west coast gets more than 250 cm . Rainfall in the Peninsula excluding coastal belts is generally 50 to 75 cm and in northwest India it decreases to less than 30 cm west of Jodhpur. More than 80 per cent of the annual rainfall is received during June to September excepting in the Peninsula south of Hyderabad to the Ieeside of the Ghats, south of Cannanore (Lat. $11^{\circ} \mathrm{N}$ ) along the west coast, in Assam and adjoining areas, West Bengal and coastal Orissa and in the northern areas of Jammu \& Kashmir. In these eastern States the percentage is 70 to 80 ; the reason for the lower percentage is the significant rainfall of May and October in these areas. Appendix 13.2Maps I to III show rainfall of July, June to September and annual. Map VI (a) shows June to September seasonal rainfall as percentage of annual. Data showing subdivisional rainfall and rainy days and coefficient of variation are given in Appendix 13.1-Statements II to IV. What is of primary concern for agriculture, however, is the distribution of rainfall during periods of crop growth. This aspect is examined in detail in Chapter 14 on Rainfall and Cropping Patterns. The reports on rainfall and corpping patterns of the various States which are published separately also includes detailed rainfall analysis pertaining to their respective areas.

[^3]Rainfall Normals
13.2.4 The rainfall normais at present in use are those published by the IMD1 which are based on available data during 1901 to 1950 with a minimum of five years. The total number of stations in this publication including closed stations is 2693 . The distribution Statewise along with the number at present is shown in Appendix 13.1-Statement V. These normals are more than two decades old and there is frequent demand for more recent normals and that these should cover all the raingauge stations, as far as practicable. Another point concerns the normals for shorter periods; if these could be reduced to normals for a uniform period, their usefulness in comparison would be more reliable. The publication also contains normals of districts. As the number of stations have not remained uniform, district normals for different periods are not easily comparable. Besides there are districts with wide range in annual rainfall. The district averages, in such cases are likely to be misinterpreted. A review of the method of working out normals for short periods, districts etc. seems necessary. A connected but important question is the preparation of subdivisional departures-monthly, seasonal and annual. The number of raingauges in each of meteorological subdivisions has not remained constant and various normals have been used in working out departures. It is necessary that IMD reviews the entire question of preparation of normals of rainfall and number of rainy days and publishes very early the latest set of normals for use and reference.

## Dates of Onset and Withdrawal of Southwest Monsoon

13.2.5 The main rainy period is the southwest monsoon which is also the kharif season for crops. It would be of help to agriculturists to have a broad idea of the normal rainy periods in the different parts of the country. For this purpose, Appendix 13.2-Map VII shows the normal dates of onset and withdrawal of the southwest monsoon. These have been prepared initially from graphs of five-day normals of rainfall for about 200 stations. The middle day of the characteristic rise in rainfall, mostly in June was plotted for each station and the isopleths drawn. Similarly from the characteristic decrease in rainfall, the dates of withdrawal were worked out and corresponding map prepared.
13.2.6 In this connection it is necessary to emphasise that the amounts of rainfal corresponding to the dates of onset of monsoon, may 1 1962. Monthly and Annual normals of rainfall and number of rainy days (based on records from 1901 to 1950).Memoirs, India Meteorological Department, XXXI (III), New Delhi.
not in many parts of the country meet the minimum rainfall requirements for the sowing of crops. A clear understanding of the distinction between the two is necessary. The maps provide the normal date of start of the rainy season and the duration of the season; as a first indication this would be of value for initial planning. Some studies on the amounts of rainfall needed for sowing and their dates of occurrence have recently been initiated in the IMD but would need to be tried out in practice before stabilising the approach. To give an idea of the range of variation in the normal dates of onset and withdrawal of the southwest monsoon, we consider here Kerala and Bombay for which data of seventy years 1901-70 are available. The frequency distribution of dates is shown in Table 13.1.
table 13.1
Frequency Distribution of Dates of Onset of Southwest Monsoon over Kerala and Bombay-1901-70


The range of variation in dates of onset in Kerala extends over six weeks while in Bombay it is less, five weeks. The important point is the high variability of the dates of onset and the position would not be different even for the dates with specified amounts of rainfail needed for sowing. A few decades ago an attempt was made to forecast the dates of onset of monsoon and in view of the importance of such studies for agriculture, it is desirable to study dates for sowing in the different part of the country with a view to their forecasting when such dates are found helpful after trial by agriculturists in actual practice.

## Frequency of Daily Rainfall

13.2.7 To give an idea of the occurrence of different intensities of daily rainfall, frequency tables are available for about 300 stations in the different parts of the country. These tables serve the purpose of indicating frequency of heavy rain in different parts of the country and also their approximate contribution to the annual total. In fact, in many areas of the country it is only a few heavy falls which account for most of the annual rainfall. As an example, in Saurashtra and Kutch only 10 per cent of the total number of rainy days account for about 50 per cent of the total annual rainfall. As such information is of value to agriculture, it is desirable that IMD should publish for all the taluk stations (and representative stations in States which do not have taluk or tehsil divisions of districts) frequency distribution of daily rainfall using a uniform period 1901 to 1960 .

## Nature of Frequency Distribution of Rainfall

13.2.8 Information on the nature of frequency distribution of rainfall is of importance for evaluation probability of occurrence of different daily rainfall amounts. It is found that frequency distributions of daily, weekly and monthly rainfall do not follow the normal or Gaussian distribution. In fitting these distributions incomplete Gamma type distribution is employed and probabilities are evaluated accordingly. The use of probability values of weekly rainfall is often limited because of the extremely high variability of such weekly values. However, these weekly data may be of use for various agricultural purposes. It is desirable that IMD publish weekly totals of rainfall for all the stations for which at least 20 years' data are available in consultation with Indian Council of Agricultural Research (ICAR) and other user interests. When we examine ${ }^{1}$ the frequency distributions of seasonal (June to September) and annual rainfall, these are found to mostly follow the normal law. This result is useful for quickly evaluating seasonal and annual probabilities and in other statistical analysis.

Depressions/Storms and Heavy Rainfall
13.2.9 Depressions and Storms forming in the Indian seas and travelling over land cause very heavy rain. 40 cm or more in 24 hours is not infrequent particularly in Andhra and Tamil Nadu coastal areas.

[^4]More than 25 cm in 24 hours has fallen all over the country excepting in certain interior parts of the Peninsula and the extreme northern areas. The JMD has brought out atlases ${ }^{1}$ showing the tracks of all the depressions and storms during 1891 to 1960 and 1961 to 1970. Auxiliary maps showing the frequency of depressions passing over different land areas and areas of formation are also included. Very heavy and heavy rain is invariably associated with the passage of storms and depressions and in many areas contributes significantly to the total annual rainfall as mentioned earlier. A knowledge of their frequency or probability of occurrence in different areas should be $i$ help in planning.

## Snowfall

13.2.10 The India Meteorological Department prepares every year an annual summary of snowfall information collected from its few observatories and the reports of Government officials and travellers in the areas to the north and northwest of India. The reports are mostly qualitative except those from the observatories. Though considerable improvement and expansion of network of observatories has taken place in recent decades, the position still needs careful review. The problem of obtaining quantitative snowfall information from mostly inaccessible regions is difficult. The importance of snowfall was recognised by Blanford (Chief Meteorological Reporter) as early as 1880 . He had observed that heavy snowfall in the region to the north and west of India caused abnormal pressure conditions and was unfavourable to the advance of the monsoon over the areas affected. Later, snow accumulation at the end of May came to be included as one of the significant factors in the regression equation used for forecasting monsoon rainfall. In recent decades, however, the earlier degree of association (correlation. coefficient) has not been maintained and has even changed sign. This may be due to the nature of the approximations involved in putting the snowfall information in quantitative figures. Another direction in which snowfall information was used was to find out its contribution to river flows. The analysis was done about two decades ago and the data available did not show encouraging results. All these only show the urgent need for recording and collecting snowfall data in a systematised form for further analysis and use. We recommend intensified efforts by IMD to organise a good snowfall network to enable a fuller understanding of its role on subsequent weather and its contribution to river flow.

[^5]Glaciation
13.2.11 A related subject is the study of glaciers. Except for a few isolated expeditions in the Himalayas, work in this field is almost absent. We are hardly aware of its potential in the context of water resources of the country. It is understood that the Geological, Meteorological and other connected departments or organisations are planning coordinated programmes of glacier studies, but it is necessary that systematic work should be organised and for the purpose suitable organisation needs to be developed in the Meteorological and Geological Departments which are closely connected with the subject.

Dew
13.2.12 Dew is water vapour in the atmosphere condensed on surfaces of objects exposed to nocturnal radiation. This could be an additional source of moisture for plants. Observations of dew were started on a regular basis from 1968 with a network which now consists of about 80 stations. A preliminary analysis ${ }^{1}$ using data of two to three years has shown the following features.
(i) Dew accumulation is 15 to 30 mm in north and northeast India during October to March. This deposition is comparable to values in other tropical and even temperate countries. The largest value is over Assam with a six month accumulation exceeding the annual amount in Israel.
(ii) The total dew in January in the submontane plains of north India from south Punjab to Assam where water stress in this month is about 40 mm , could meet about 25 to 50 per cent of water deficiency. In the dry area dew deposition is too small to contribute to soil moisture.
The picture does not yet seem promising for the relatively drier areas.
Rainfall Variability
13.2.13 Indian rainfall is highly variable. Two places may have the same or nearly the same averages but with differing degrees of variability. Therefore, the publication of averages without a measure of their standard errors is likely to lead to differing interpretations. As a rule, we recommend that rainfall averages should be always accompanied by their respective standard deviations. The measure used for describing

[^6]ariability is the coefficient of variation (CV). Because of its importance, he variability in different parts of the country is briefly stated.
(i) January-February: CV is 80 to 100 per cent or higher except in Kashmir and northeast Assam where it is 40 to 50 per cent. Rainfall in these months is very highly variable and uncertain.
(ii) March-May: CV for this season is $30-40$ per cent in Assam and neighbourhood, $40-50$ per cent in West Bengal, South Kerala and interior areas south of Bangalore excluding east coast. Elsewhere CV rises rapidly to $80-100$ per cent or higher.
(iii) June-September : June CV is $30-40$ per cent along West Coast and northeast Assam and 60 to 100 per cent elsewhere. Almost the entire area west of Bombay-Lucknow and south of latitude $16^{\circ} \mathrm{N}, \mathrm{CV}$ is 80 to 100 per cent or higher. In July which is generally the rainiest month for most of the country, CV is 40 per cent or less east of longitude $80^{\circ} \mathrm{E}$ (Madras-Jabalpur-Bareilly) and along the West coast. CV is high over northwest India increasing from 50 per cent to 80 to 100 per cent west of Jodhpur. In the peninsula on the leeside of the Ghats covering Madhya Maharashtra, Karnataka, Rayalaseema and Tamil Nadu CV is mostly 80 to 100 per cent. August CV distribution is nearly similar to July. September CV shows marked difference from earlier months CV in the peninsula including coast is generally 60 per cent with pockets of 80 to 100 per cent in the southeast. The season's CV is 20 to 30 per cent east of longitude $80^{\circ} \mathrm{E}$ and along West coast. In the Peninsula it is 40 per cent rising in the extreme southeast to 80 to 100 per cent West of Lucknow up to Jodhpur, CV is 30 to 50 per cent and higher elsewhere.
(iv) October to December : October CV is 80 to 100 per cent except for southern portions of the peninsula and Assam where it is of the order of 60 per cent. November CV is $60-80$ per cent in Tamil Nadu and Kerala and 80 to 100 per cent or higher elsewhere. December is 80 to 100 per cent in the southeast Tamil Nadu and more than 100 per cent in the rest of the country.
(v) Annual : West of Surat to Delhi line, CV exceeds 30 per cent and rises rapidly to 60 to 80 per cent in west Rajasthan and Kutch. Elsewhere CV is 20 to 30 per cent with lower values along west coast and in northeast Assam.

As may be seen from the above great caution is necessary in interpreting the behaviour of rainfall in India. Monthly rainfall variability even in the rainiest months (July and August) and areas, is as high as 40 to 50 per cent. When one comes to September, CV is higher and in October uncertainty becomes nearly complete. If these aspects are not taken note of in crop planning, risk of uncertainty with consequent failures is great. In the case of winter months the amounts are small and CV very high. We recommend that when the next set of rainfall normals are worked out, simultaneously CV also should be computed and both published together. Maps showing Coefficient of Variation for July, June to September and Annual are included in Appendix 13.2-Maps IV to VI. These have been taken from the Rainfall Atlas of India (1971), published by the India Meteorological Department.

## Rainfall Correlation

13.2.14 There are frequent queries on the relationship between the rainfall of one month with that of subsequent months, particularly during the southwest monsoon. Such a study of intercorrelations for months April to September for all the meteorological subdivisions is available in the publication on Indian Monsoon Correlations. ${ }^{1}$ The principal result is that deficient rainfall during any month of the monsoon season is just as likely to be followed in succeeding months by abundant as well as deficient rainfall and vice versa. Inter-correlation coefficients (cc) exceeds 0.30 only in a small number of cases. There is no significant inter-correlation between August and the other monsoon months. However, there are a number of significant cc's between individual monsoon months and the monsoon season as a whole. Sample tables for East Uttar Pradesh, Madhya Maharashtra and Tamil Nadu are given in Appendix 13.1- Statement VI. We now refer briefly to the degree of association or correlation among the various Meteorological subdivisions of the country for the southwest monsoon season as a whole. These are shown in Appendix 13.1-Statement VII. A significant feature is that Assam rainfall is negatively correlated with that of most of the Meteorological subdivisions or the cc is not significant. Another point is that in general, neighbouring or adjoining subdivisions are significantly correlated but this does not extend far. Such information would be helpful for grouping together areas in connection with seasonal, forecasting in the country.

1 Rao, K. N., Jayanthi, S. and Bhargava, V. K., 1972. Indian Monsoon Corre-lations-Part 1 Monthly Inter-Correlation for all the Meteorological Sub-divisions of India, Metesrological Monograph No.4, Climatology, India Meteorological Department.

Breaks in Rainfall in July-August
13.2.15 Breaks are periods during the southwest monsoon when there is considerable diminution of rainfall over large parts of the country. A major feature of the sea-level pressure map in the southwest monsoon months of June to September is the trough of low pressure which runs northwest to southeast from the Punjab to the head of the Bay of Bengal. During breaks the axis of the trough is close to the foothills of the Himalayas when westerly winds prevail over the greater part of the country. On such occasions there is considerable decrease in rainfall over most of the country. In a study1 of breaks during the 80 year period 1888 to 1967, there were a total of 113 breaks, 53 in July, 55 in August and 5 in July-August. The study is based on analysis of past daily, weekly and monthly weather and related surface and upper air data. The frequency of breaks in each decade was as follows :

TABle 13.2


There was significant decrease between 1928 and 1947 but in the last two decades the frequency has risen again. The average number of breaks is four in three years.
Duration of Breaks
13.2.16 The duration of breaks has varied from 3 to 21 days and half of them are of 3 to 4 days. Breaks of duration of 8 continuous days and higher form 20 per cent of the total in July and 24 per cent in August. The following data indicate that breaks of longer duration exceeding a week are not infrequent :

| Breaks <br> number of days |  | July <br> $\%$ to total | August <br> $\%$ |
| :---: | :---: | :---: | :---: | :---: |
| $3-4$ | to total |  |  |

1 Ramamurthy K., 1969. Some aspects of the 'Break' in the Indian Southwest Monsoon during July and August, Forecasting Manual Part IV, 18. 3. India Meteorological Department, Poona.

The total number of break days in the 80 -year period was 306 in July and 356 in August. The average duration of a break is $3 \cdot 8$ days in July and 4.5 days in August. The distribution of total number of break days in ten days period of July and August is as follows :


Break days are not uniformly distributed in the different ten days of July and the last ten of August. While there is near uniformity between 11 July to 10 August, the maximum is between 11 to 20 August with average of 2 breaks. This perhaps is the reason for the general impression of greater frequency of breaks in August in the country, though the above shows clearly that the average number of breaks is practically the same in July and August.

Rainfall in Break Periods
13.2.17 Because of the widespread decrease in rainfall it would be useful to know the order of this decrease in the different parts of the country. This is shown in Appendix 13.1- Statement VIII for 12 break periods in the years 1951 to 1967 in the different meteorological sub-divisions of the country; the breaks of 4 to 12 days' duration during these years totalled 83 days. The mean percentage departure from normal was negative in all the sub-divisions except in north and south Assam, Sub-Himalayan West Bengal, Bihar plains, Rayalaseema and Tamil Nadu. In eleven of the sub-divisions the mean departures ranged from -51 to - 85 per cent. In order to give an idea of the distribution the number of rainy days expressed as percentage of normal and percentage departure of rainfall during the breaks are shown in Appendix 13.2Maps VIII and IX:

## Spatial Distribution of Rainfall

13.2.18 While the above gives an idea of the average departures for the sub-divisions as a whole, it would be both useful and necessarv to
know the category of rainfall distribution also (widespread 76-100\% of the stations in a sub-division, fairly widespread $51-75 \%$, scattered $26-50 \%$ and isolated $1-25 \%$ of stations having 2.5 mm or more rainfall daily). These details were worked for the different meteorological sub-divisions and are shown in Appendix 13.1-Statement IX. The categories scattered to dry account for 70 to 90 per cent in many of the sub-divisions. In Assam and sub-Himalayan Bengal the per cent of occasions of widespread and fairly widespread rainfall is over 80. Even in an area of good rainfall like east Madhya Pradesh only 21 per cent occasions were widespread and fairly widespread.
13.2.19 The above analysis is general and in view of importance of such a knowledge for agriculture and planners, it is necessary to analyse taluk data from this point of view and make the same available to all users. We recommend early action in the matter by the state Agriculture Departments in cooperation with IMD.

## Temperatures

13.2.20 A major feature of distribution in space and time of normals of maximum, minimum and mean temperatures is the small extent of variations over large areas in the monsoon season. The variation in July mean temperature over most of the country is less than $5^{\circ} \mathrm{C}$. Between July and August and in some areas July to September, the monthly averages differ hardly by a degree. What, however, would be needed most is the distribution of daily maximum and minimum temperatures to evaluate the frequency of high or low temperatures and their spells (heat waves, cold waves) too. This information would be useful in planning for different distribution of temperature ranges. We recommend that IMD should publish frequencies of daily maximum and minimum temperatures including spells of high or low temperatures for all the observatories with data of five years or more. Hourly data for a number of stations are now available for more than five years. These data are useful in knowing hourly distribution and thus the diurnal variation of temperature. Frequency of hourly values exceeding certain threshold figures necessary to know the duration in hours of different ranges of temperatures for application in cropweather studies.
13.2.21 The country has a reasonably good network of temperature recording stations for getting an idea of the distribution in space and time. Two main publications which give the averages are referred to. The climatological Tables of observatories in India (1931-60) issued by the IMD contains normals of (a) maximum and minimum temperatures and(b) dry and wet bulb temperatures for 0830 and 1730 hrs IST. The publication also contains extremes of maximum and minimum 3-133D:ptt.ofAgrl./76
temperatures based on all available data up to 1960. The climatological Atlas of India (Abridged) published in 1971 by IMD includes maps of (a) mean temperature and (b) maximum and minimum temperatures for January, April, July and October. In addition, maps of maximum temperature for May and absolute maximum and minimum tempera. tures are included. As the maps of extreme temperatures are based on data of 60 years or more, they could also be regarded as the highest, lowest temperatures ever likely to be recorded. These maps and data should be adequate for getting a general picture of range and the distribution of temperatures in the country. We understood that the stock of these basic publications is low and IMD should arrange for their republication early.

## Sunshine

13.2.22 The duration of bright sunshine is an important factor affecting crop growth. It would, therefore, be useful to have a brief idea of its distribution ${ }^{1}$ which is as follows :
(i) The daily average in January is more than 7 hours per day except in Kashmir. The western half of the peninsula and adjoining Gujarat areas has the highest average of more than 9 hours per day. Only in the extreme north and over Kashmir, the values are low and Srinagar average is only 2.5 hours per day. The low values in the extreme north may be attributed to the passage of succession of western disturbances during the winter season when clouding is also high. With the advent of summer conditions the duration of bright sunshine shows a general increase and the average in April is 9 to 10 hours per day over most of the country. The highest averages are over Gujarat and the adjoining regions of Rajasthan and Maharashtra.
(ii) The pattern changes completely with the onset of the southwest monsoon in June and July. The west coast has an average of less than 3 hours per day. Bombay's average is only 2.5 hours. Assam and Bengal and the extreme southeast Madras have averages of 4 to 5 hours per day.
(iii) By October, the southwest monsoon has withdrawn from most of the sub-continent. With a maximum of more than 10 hours, over western Rajasthan, it decreases to less than 6 hours in the extreme northeast and southern parts of the sub-continent.

[^7](iv) The annual average duration of bright sunshine is 7 to 9 hours a day. The annual range of sunshine decreases from 5 to 7 hours in the Peninsula to 3 to 4 hours in northern latitudes. The average monthly duration is maximum in the Peninsula in February and during April-May in north India; it is minimum in the monsoon season. Diurnal variation is nearly similar at most stations with flat maxima between 10 to 15 hours local time and least in the monsoon seasons. Isopleths of hourly values show two ovals separated by a central zone of low values during monsoon months; this feature is not noted in Kashmir latitudes. A pronounced inverse relation exists between sunshine and cloudiness. The correlation coefficient between annual mean cloudiness and sunshine of 57 stations distributed all over the country is 0.76 . The highest duration of sunshine recorded on any day so far is 12.5 to 13.3 hours to the north of lat. $20^{\circ} \mathrm{N}$ and 11.5 to 12 hours in the peninsula. The frequency of daily duration exceeding 9 hours is generally least during the monsoon. Sunshine is not a serio's limiting factor over almost the entire country.
(v) Maps showing the duration of bright sunshine and percentage frequencies of number of days of bright sunshine exceeding 9 hours for the months January, April, July and October and for annual are given in Appendix 13.2-Maps X and XI. The present network is not large but is helpful in giving a fair idea of the average distribution in the different parts of the country.
13.2.23 Solar radiation is an important factor in crop studies but observational data in this country are very limited. The network has only resently been expanded and a summary of the available data is contained in a paper ${ }^{1}$ on Global Solar (T) and Diffuse Solar Sky Radiation. The main features are described below
(i) The annual mean of global solar radiation ranges between 400 and $500 \mathrm{cal} / \mathrm{cm}^{2}$ and mean daily values are maximum in March, South of lat. $13^{\circ} \mathrm{N}$ and in May elsewhere. It is minimum in July-August over western monsoon area and in November in the east and north latitudes. The annual mean diffuse solar radiation ranges between 175 to $200 \mathrm{cal} / \mathrm{cm} .^{2}$ This is maximum in the monsoon and

[^8]least in winter. Diurnal variation of global solar radiation is practically the same at all the stations with flat maxima between 11 to 13 hours and atleast in the monsoon months. Diurnal variation of diffuse solar radiation is similar but in magnitude is only a small fraction, one fifth to half of global solar radiation. The highest global solar radiation recorded is 625 to $700 \mathrm{cal} / \mathrm{cm}^{2}$ in latitudes south of $20^{\circ} \mathrm{N}$ and $700-800 \mathrm{cal} / \mathrm{cm}^{2}$ north of $20^{\circ} \mathrm{N}$. The highest diffuse radiation is of the order of 400 $\mathrm{cal} / \mathrm{cm}^{2}$.
(ii) Mean daily global solar radiation and diffuse solar sky radiation are shown in Appendix 13.2-Maps XI (a) and XI (b) respectively.

## Winds

13.2.24 Surface winds in the country are generally weak, mean daily wind speeds being less than 10 to 15 km per hour, excepting along Saurashtra Coast where they are stronger. Strong or high winds are mainly in association with cyclonic storms, depressions, thunder or dust storms, squally weather along coasts etc. There is clear difference between the strong or high winds in thunder-squalls and in cyclonic storms. The former are momentary gusts while in the latter the duration of high winds is much longer. The strong winds due to cyclonic storms along some part or the other of our coastal belts are almost a regular annual feature; only recently, we had the storm which struck Saurashtra coast causing severe damages estimated at several tens of crores of rupees. The maximum wind speeds estimated in the cyclonic storms is 150 to 250 km per hour. Most of the information is estimated as the number of anemographs recording wind continuously throughout the day, is not large. The northwesters of Bengal are well known and speeds in gusts in the squalls have exceeded frequently 60 km per hour. In severe thundersqualls speeds of 160 km per hour have been recorded. Thundersqualls are generally localised and the very high winds in gusts last only for a few minutes as compared to storms. Considerable damage occurs to crops when winds with high speeds blow over an area-lodging of crops, creation of conditions favourable to frost when air is cold, increase in evaporation when air is hot and dry, loss of water in reservoirs due to high evaporation etc. and by transpiration from plants and trees. To check the ravages due to high winds, wind shelters have been proposed. Considerable work has been done in USA, USSR and other countries in this field and generally these studies have been found helpful; windbreaks have helped increase yields in grain crops by 20 to 80 per cent
and 100-200 per cent in some grasses' in the USSR. The major beneficial effects due to wind breaks ${ }^{1}$ have been stated as follows :
(i) checking air movement and thus affording protection to fields and orchards;
(ii) checking of the movements of top-soil and consequent prevention of strong winds in areas where the soil is sandy or very fine;
(iii) reducing evaporation from free water surfaces and transpiration from the vegetation by reducing windspeed;
(iv) providing shade to farm stead, and
(v) providing timber and fuel as older trees are replaced by younger ones.
In recent years the network of anemograph stations has considerably increased and processed data to meet the varying agricultural needs in the form of means frequencies of wind speeds in different ranges, frequency of duration of windspeeds in various ranges etc. should be published by IMD.

## Weather Phenomena

13.2.25 Information on frequency of thunder, hail, dust storm, squall etc. is collected from observatories of the IMD and of hailstorms from at wider network. Averages and frequencies of these are available in the Climatological Tables of observatories referred to earlier. Most of this information is supplied by part-time observers with the result that their dependability is less. It has been observed that the frequencies recorded by full-time staff differ much from part-time observatories. In recent years, the network of stations with full-time departmental staff has considerably improved and the new set of normals and frequencies when published should improve the position.

## Climatic Change-Trends and Periodicity

13.2.26 The problem of trends and periodicity in Indian climate has always attracted and continues to attract attention. Questions pertaining to this aspect have been raised even at the highest level of Government. Considerable work in the field of trends has been done in the country, but most of it is in respect of individual stations only. In dealing with areas, a common difficulty has been the lack of data computed on a uniform basis i.e., using the same set of normals and the same number of stations. A first requirement is therefore the publication of complete series of data of all stations with records of 70 years or more and

[^9]preparation of uniform serics for the various meteorological sub-division of the country. This work is necessary so that a detailed analysis may be made for the country as a whole using both individual stations with long records and also for the various meteorological sub-divisions. These would also be helpful in examining correlations among the various seasons and sub-divisions in greater detail and for grouping similar areas.
13.2.27 Periodicity in weather has also been examined in a limited way, but so far there is no significant support for any definite period. A recent analysis ${ }^{1}$ of rainfall series in Madras, for 158 years (the largest in the country) shows that there is no trend or periodicity. We feel that the data recommended for being compiled in the preceding paragraph of this Section when ready, would enable detailed examination with a view to arrive at dependable conclusions.
13.2.2 The above studies have been limited to rainfall mostly and also to the use of statistical techniques. But the problem of climatic change and climate prediction is much broader and is a global problem too. The subject of global decrease in temperature in recent decades is engaging the attention of a number of distinguished scientists all over the world and international symposia and discussions have recently been held to review the present position and explore possibilities of climate prediction. Unless we get to a better understanding of the physical processes and causes involved in climatic variation, the problem of prediction will continue to be difficult and complex. In the meantime the subject would have to be attacked by all possible approaches dynamic, physical, and statistical. All these will need considerable time, effort and concentrated attention. In view of the importance of climatic prediction to agriculture we recommend that the study of climatic change and prediction be taken up as a project by the Indian Institute of Tropical Meteorology (under the Ministry of Tourism and Civil Aviation) in cooperation with the Meteorological Department, ICAR and other interested Ministries/Departments of the Government of India.

## 3 AGROMETEOROLOGY

## Meteorology and Crop Production

13.3.1 Quantitative studies on crop-weather relationship attracted attention in the beginning of the century when certain data were collected

[^10]on groundnut and cotton crops in Egypt and interpreted in terms of weather factors. This was followed by a comprehensive crop-weather study on wheat in Britain (1922). The broad object in these studies could be said to have been whether the plant itself can be used as an indicator of its own yield. It is not difficult to visualise that the play of weather factors starts right from the time the seed is put in the soil. Every weather sequence favourable or adverse, has its impact on the growth and development of the plant. The easiest way to visualise this is to examine any crossection of a log of wood which contains many concentric rings, each of which represents an annual growth of vascular bundles, which are used by the tree for translocation of food material. The distance between any two rings is an indication of the type of weather which a particular tree has experienced in a particular year. Compared to the life of a tree, the life of a crop plant is very much shorter, but even in this case, the variation in height, the intensity of branching or the quickness or the delay in the time of flowering all vary from year to year depending upon the weather. It is generally estimated that weather as a single factor could be responsible for as much as 50 per cent of variations in yield which occur from year to year, the remaining 50 per cent being due to other factors like irrigation, manuring and plant protection measures etc. Although it appears so simple to visualise, when it comes to relating the play of weather factors on a crop plant quantitatively to various plant characters and the yield, the job becomes very complicated. This is because merely correlating the weather factors with the morphological features like the plant height, the number of leaves or branches, the number of flowers and so on does not represent the full story of the plant development. The real clue to the changes that occur in a plant lies in the bio-chemical activities. It is these biochemical activities which manifest themselves ultimately in various external features. Therefore, what can possibly afford an answer to the growth pattern which is found in a particular season is how the biochemical changes within the plant have been influenced by the weather. An ideal study should include the bio-chemical aspects also together with the measurement of external features for a clear answer of the inherent relationship between the plant and weather. This is piecisely what B.A. Keen had emphasised in his presidential address to the Royal Society, London while commenting upon the British results (1940).
13.3.2 As stated earlier in section 1, crop-weather scheme was initiated in India around 1945 for collection of meteorological data in the farm environment and even inside crops simultaneously with the collection of data on certain selected crops. The crops chosen for the study on all-India basis were wheat, rice, jowar, cotton and sugarcane. The plant observations included the progress of germination as revealed
by the number of seedlings observed per day after sowing, the height of plants, the number of tillers/branches, the time of flowering, the number of flowers in the case of cotton and the yield. The observations were taken by sampling. Canada also undertook this kind of study, but with fixed sampling. One major advantage which has decidedly accrued from the crop-weather scheme is that the country today has a network of more than a hundred well equipped agro-meteorological observatories situated within the environment in which crops are grown, viz., the experimental farms. These observatories record data on sunshine, air temperature (maximum, minimum, dry, wet and terrestial minimum thermometers), soil temperature, wind, rainfall, evaporation from water surface and evaporation from soil surface. Periodical measurements of soil moisture through gravi-metric method are also made at about 20 stations. A second advantage is that series of growth and yield data measured in a systematic manner on a common all-India pattern have been collected for about a dozen stations per crop for 20 to 25 years. The growth data represent measurements of meteorological features only. The meteorological and crop data have been subjected to various studies, but if the original question is posed even at this stage whether the plant has been utilised successfully as an indicator of its own yield, the answer is not yet definite. We feel that the ICAR should include in their future programmes work of bio-chemical studies for a fuller understanding of cropweather relationship.
13.3.3 In the higher latitudes, besides soil moisture, temperature and sunshine are serious limiting factors for plant growth. Emphasis in their studies is, therefore, placed on thermo-periodism and photoperiodism and the concept of day degrees has consequently been developed which gives very clear results for those latitudes in any study involving plant and weather. In India, however, temperature and sunshine do not act as limiting factors in a given part for the crops which are commonly grown. For example, wheat a cold loving crop grows well in the northern areas but the temperature variations from year to year are not of such a magnitude as to bring about major changes in its growth pattern. Similarly, in the case of sunshine, one could expect about 7 to 9 hours of sunshine in clear seasons and even during the south-west monsoon period, there could be 3 to 5 hours of sunshine per day on an average over large parts of the country. Many crops can do well with diffused sunlight and, therefore, even in rainy season, less hours of sunshine do not adversely effect them. This would become apparent if one goes through critically all the crop-weather studies which have been made so far utilising the data collected in the country. It is either the rainfall or the moisture deficit which comes out as the most important factor influencing the crop growth. At places temperature and sunshine have
also been found to be significant contributors but there is no consistency in the results that the effect of temperature which has been found to be valid in one area is corroborated by all the areas where the same crop is grown. It seems difficult to visualise that the effect of a weather factor on a particular crop will be so particularised as to be applicable at one station and not at the other. What is intended to be emphasised here is that one has to be careful about spurious correlations and has to distinguish such correlations from the consistent ones which could be applicable to many places where the same crop is grown. If this test is applied to the data collected within the country, it would be satisfied only by rainfall.
13.3.4 The effect of sunshine, temperature or humidity etc. however cannot be ignored. In fact, whether it is the frigid latitude or the temperate or the subtropics or the tropics, plant would always need a particular set of circumstances representing the various weather elements. But, in our country, the towering influence of rainfall masks the other influences in practice when it comes to representing the results in a quantitative manner. What is, therefore, needed is to have a clear idea of the influence of individual weather factors on plant growth. In biological experiments, glass houses have been utilised in the past for conducting studies under controlled conditions. However, the glass houses are most suited to a few elements like the control of temperature and humidity. Sometimes attempts have been made to vary the light conditions also. But by and large, glass houses are not very suitable for this purpose. An improvement over the glass-house approach has taken place in recent times and is represented by the phytotrons. These are constructions of good size both in regard to length and breadth as well as height and are equipped to simulate weather with regard to a single element or a combination of various elements. Crop plants could also be grown within these phytotrons in the same manner as they would grow in a field. The IMD had once considered equipping its Agricultural Meteorological Division at Poona with such a phytotron. We feel that there is an urgent necessity to go in for such constructions not only in the IMD, but also in different agricultural universities, so that a clear idea of crop-weather relationship under controlled conditions could be obtained. It will be only after such a sted that it would be desirable to collect and studv data on field scale.
13.3.5 It does not, however, mean that the efforts should be slackened to collect the kind of data both on crops as well as on meteorology under field conditions on an all-India basis as has been done under the crop-weather schemes. The building up of such series of data over a long period of time will enable the country to have normals of crop characters as well as meteorological factors collected simultaneously
which should prove helpful to administrators, planners and research workers in many ways. Our studies (Chapter 14) on the distribution of monthly rainfall in the year have revealed that there are 174 rainfall patterns within the country. It is necessary that every zone representing a particular pattern of rainfall distribution must have one or more fully equipped agromet observatories depending upon its size etc.

## Soil Moisture Observation Network

13.3.6 A serious handicap which has been noticed in regard to agrometeorological data relates to soil moisture. There is considerable emphasis on soil moisture storage within the soil in various kinds of estimates which have a bearing on water requirements for plant growth. In the absence of soil moisture measurements, this element is estimated on the basis of other related meteorological parameters. The estimates suffer from many assumptions and the greatest of all is the depth of soil, not to speak of the type of soil. There are hardly about two dozen stations in the country at present which take direct measurement of this element. Soil moisture varies from field to field, depending upon the texture, structure and depth of soil. There is, therefore, no short cut to having actual field soil moisture observations all over the country but it may not be practicable to build up such an extensive network covering about six lakh villages. One could, however, aim at building up a network of soil moisture determining stations up to the block level. As a first step towards that objective, a minimum target of building up a network of at least 3,000 stations, each covering a taluk, must be accomplished in the next few decades. Whereas the responsibility for agrometeorological observatories proposed in the above paragraph for every rainfall zone would have to be with the agricultural universities. because of the highly technical nature of the measurements of various weather elements involved, the responsibility of soil moisture measuring. stations should be that of the State Departments of Agriculture. They should also take steps to publish the soil moisture data.

## Evapotranspiration Measurements

13.3.7 Evapotranspiration like soil moisture is a very important factor in crop growth. At present the data available on this element relate to computed values using theoretical considerations. The concept was introduced by Thornthwaite ${ }^{1}$ in the USA, who utilised an

[^11]empirical approach involving temperature and length of day. Penman ${ }^{1-}$ in 1948 developed a theoretical equation combining energy balance and: aerodynamic considerations. The equation contains terms involving temperature, pressure, wind, radiation and saturation vapour pressure deficit. The energy balance and aerodynamic combination is now in extensive use in many parts of the world. Slatyer (1967) of Australia has also made significant contributions to this approach. Meteorological parameters are measured according to established standards. On the plants side the basic idea has been that a turf when maintained saturated with soil moisture could represent the maximum loss of water through. the processes. of evaporation and transpiration; which would take place from a given area of land. The mathematical equations have usually been checked against the direct measurements of evapotranspiration from such turfed surfaces. In some places, an estimate of evapotranspiration is made also on the basis of evaporation from water surfaces of various dimensions, the most standard being the 120 cm diameter USA pan with a depth of 30 cm . A Russian tank has even dimensions of as large as 5 m diameter and about 2 m depth. The general observation is. that the evapotranspiration from any cropped area may be approximately taken to be 7 to 8 tenths of evaporation from a free water surface of a large expanse. The equations which have been developed on aerodynamic and energy considerations give a better idea of the evapotranspiration than this approach. In the absence of direct measurement on various kinds of plants and soils, computation from theoretical2 considerations is the only recourse to arrive at a gross picture of water loss due to evapotranspiration. But how far this would remain tenable under various kinds of growth of plant communities as represented by various. plants, orchards and plantation crops as also by the various field crops. is difficult to guess.
13.3.8 Hohnel in Austria had tried to estimate evapotranspiration from potted forest saplings towards the close of last century (18781880). These data were utilized by Horton ${ }^{3}$ in the USA to build up a relationship between the evapotranspiration and the height and girth of a given tree. On transpiration alone, Briggs ${ }^{4}$ and Shantz in the USA
1 Penman, H. L., 1948. Natural evaporation from open water, bare soil and grass. Proceedings of the Royal Society, London, A193: 120-146.
2 Rao, K. N., C. J. George and K. S.Ramasastry, 1971, Potential Evapotranspiration over India, Prepublished Scientific Report No. 136. India Meteorological Department.
3 Horton, E. R. 1923. Rainfall interception Monthly Weather Review, Washington 51 : 571-81.
4 Briggs, L J. and Shantz, H. L., 1914. Relative Water requirement of Plants. Plant Journal of Agricultural Research (Washington), II(1) : 65 .
studied upto 55 species and varieties (1913-16) to determine the water requirements of crops. In India, J.W. Leather! made equally extensive studies on water requirements of potted plants in the beginning of this century (1910-11). The study of single plants in small pots has now given way to lysimeters of large sizes which can permit the growth of plant communities which are comparable in growth and height with the crops found under field conditions. The depth of lysimeters is also not a limiting factor so as to make the cropped area within it pot bound. Extensive studies of evapotranspiration should be undertaken in different parts of the country under varying conditions of soil moisture in different soils and using as many plant species as possible representing field, orchard, plantations and forest plants. It is only then that a real idea of evapotranspiration under plant conditions could be had. These studies would make it possible to indicate the contribution of individual factors like transpiration from plant surfaces and evaporation from soil surfaces in a planted area as compared with the evaporation from bare soil and evaporation from free water surface. As a first step fundamental research should be conducted at all the agricultural universities and the Central institutes of the ICAR as well as at the Forest Research Institute, Dehradun on this subject. Once the studies made at these centres result in certain standard procedures, a wider network of evapotranspiration centres throughout the country will have to be planned to obtain an idea of actual evapotranspiration through direct measurement under different climatic and odaphic conditions. IMD has planned a network of about two dozen evapotranspiration stations which would take up observations with certain selected plants on a common methodology; but these evapotranspiration centres are being set up on the basis of whatever work has been possible at one single station, namely, the Central Agricultural Meteorological Observatory, Poona. The pace of setting up of these stations need not be interferred with, but this should also not be a reason to stall the study which is being suggested by us in various research centres because we are keen that the observations on evapotranspiration must be tried after involving as many plant species and as many different soil moisture conditions as possible. When this is done, the time would be opportune for establishing evapotranspiration stations at least at every district headquarter.

## Phenology

13.3.9 Phenology is a field of science which relates to the study of recurrence of an event in the life history of living being, be it plant

[^12]or animal. Britain has been systematically collecting data on the migration of birds for several decades. In India one is familiar with the appearance of cuckoo in advance of the south-west monsoon. It has always been considered by farmers as a precursor to the onset of the monsoon. Studies on tagging birds have also been taken up by a few orinthologists. Insofar as plants are concerned, the IMD arranged a study of observations on the flowering of certain selected plants, i.e., mango, neem, babul and tamarind. Phenological observations have been continued by the IMD for many years. In the case of mango, the severity of winters during December determines the intensity of flowering around February insofar as north is concerned, for the bearing naturally depends on the intensity of flowering. The severity of winters is associated with the number of western disturbances which pass through the north-western parts of the country. In the rear of the western disturbances which move across the northern parts of the country, temperatures are considerably lowered. Whether it is merely the effect of temperature or the associated precipitation which encourages subsequent flowering of mango needs further examination. Such studies could throw light on certain weather phenomena at crucial times which could give an early idea of the yield which is to be had from a crop or a tree. For this reason, it is desirable that the network of phenological observatories in the country should also be strengthened so that there is atleast one in each taluk. As the observation needed for study is the noting of the time of occurrence of a particular phenomenon like flowering or any other characteristic of plant growth, the collection of such statistics should not present much difficulty. What is to be guarded against is that the selection has to be of nature-grown plants. In the case of cultivated plants, breeding for a particular purpose (including earliness or lateness) artificially, changes the natural biological rhythms. Therefore, if cultivated plants are to be selected, it is to be ensured that the network of these phenological stations must take observations on the same variety of plants so that the data collected does not suffer from noncomparability. There should not be any difficulty for such a simple observation to be recorded at taluk headquarters. The responsibility for collecting and publishing the results of these observations should lie with the State Departments of Agriculture, who should make these available to other user interests.

## Pests and Disease

13.3.10 The sporulation in the case of fungus diseases or hatching of eggs in the case of insects is very much controlled by the temperature and humidity conditions. Similarly, the growth, specially in the early
period, of the pathogens as well as insects, is greatly controlled by these two elements. In laboratory, the measurements are usually made under petridish conditions. These, however, do not have any relevance to the field conditions and, therefore, when the results are applied to field conditions, these often fail. Although it appears obvious that many of the pests and diseases are weather controlled, the quantitative evidence under field conditions becomes very difficult. Clear examples of the influence of weather on pests and diseases are rare but one of the pests which could illustrate the role of weather is represented by the wheat rusts. It is now well known that it is the trajectory of upper level winds which determine the outbreak of rust epidemic in different parts of the country. The IMD has attempted to collect data on the incidence of pests and diseases in a qualitative manner e.g., whether a pest or disease has been noticed in a particular year at a particular agricultural research station and whether the incidence has been low, medium or high. The data are available on a number of crops for many years, but these are qualitative. The Commission on Agricultural Meteorology of the World Meteorological Organisation has addressed itself to this vital problem of study of weather in relation to diseases and pests of various crop plants including potato blight, apple scab and wheat rusts. They have prepared reviews of existing methods and indicated their practical applications and the criteria which could be adopted for warnings of disease and pests. The subject is largely in an exploratory stage. The IMD has also drawn up a scheme to intensify studies on diseases and pests of crop plants as related to weather. However, we would like the involvement of all the agricultural universities and the Central institutes of the ICAR in this task. There has to be a get together of the plant Pathologists, entomologists and the agricultural meteorologists to determine a basic line of approach towards which all the efforts of country should be directed. The responsibility for organising such a common approach should rest with the ICAR. The study should not only include the relationship between the weather and various pests and diseases under field conditions but also-a surveillance service based on meteorological observations. These studies should prove useful in forecasting the epidemics so that the farmers could take timely control measures.

Meteorology in relation to Orchards, Plantations and Forests
13.3.11 Efforts have been made in the IMD to study the microclimates obtainable in various crops including sugarcane and betelvine. These two crops represent the conditions obtainable with tall plants and fruit plantations. It will be interesting to note that under the
conditions of any afternoon in clear season, the micro-climate which is found under the conditions of a tall crop like sugarcane is very different from what obtains in the open. In the open, ground surface is the hottest near noon and temperature decreases with height in the airlayers with which plants are primarily concerned. What happens in a sugarcane field is that the hottest surface exists just over the canopy of leaves and temperature decreases with height both above and below the canopy. In other words, a dense crop like sugarcane indicates a condition in which the active surface is shifted from the ground to the canopy and within the crop the temperature increases above the ground surface until the canopy height is reached. Whereas there are unstable conditions in the open, stable temperature conditions persist within a sugarcane crop. What happens in the case of sugarcane is also applicable to thickly populated orchards. The utility of such a knowledge can very well be imagined from a simple fact that whereas dusting and spraying under unstable conditions would mean a wastage of chemicals, the stable conditions represent their efficient utilization. If a farmer is aware of the distinction, he can modify his strategy so as to make the best use of the costly plant protection chemicals. Micro-climate found within a field can also be utilised to control the pests and diseases once it becomes known what is the density of plants which is conducive or otherwise for their proliferation. A knowledge of the mircro-climate of plant communities can also help to determine the density which is necessity to optimum growth and yield. The same objective could very well apply to orchards and forests.
13.3.12 While a good number of agrometeorological observatories in the country have been located on the farms, the observatories in orchards, plantations and forests are not adequate. We recommend that this lacuna should be removed as quickly as possible. As far as orchards are concerned, a beginning could be made in the gardens and plantations located in the research institutions. In the second stage, an attempt should be made to have at least one such observatory in every district.

## Forest Meteorology

13.3.13 A knowledge of the forest-climate interaction is essential, as the WMO have pointed out, for understanding and assessing the extent of modification of climates due to the conversion of tropical and sub-tropical forest areas into agricultural lands. In arid and semi-arid regions particularly, denudation of forests may affect the water-balance of the country. Very little work has been done in India on forest-climate interaction. In Chapter 44 on Forest Ecology and Wildlife Manage-
ment, we have referred to a study on the climatic deterioration resulting from disforestation. Other studies in this field are available in the annotated bibliography on forest influences and watershed management research in India published by the FRI in 1970. However, a coordinated effort is necessary to review, assess and plan the future work in this direction. We recommend that the IMD should in consultation with the Forest Research Institute, Dehradun and the State Forest Departments review and assess the present position in the country and draw up a long term research programme in forest meteorology. The network could be determined by the Forest Research Institute, Dehradun keeping in view the ultimate objective of establishing one which would give representation to forest conditions in different agro-climatic regions. of the country.

## Hill Meteorology

13.3.14 The pattern of farming in hill and mountain areas is different from the one followed in the plains. Cultivation in hilly areas is possible in valleys and over slopes. Plots are usually small and over slopes these are arranged in terraces girdling the hill at various points of its elevation. Fruit or plantation drops and paddy are commonly grown in such areas. The choice of fruit or plantation crops as also of the field crops, other than rice, varies according to region. Temperate fruits of various kinds are the speciality of the belt comprising Kashmir, Himachal Pradesh and West Uttar Pradesh Hills. Tea is common in the Himalayan West Bengal and Assam. Pineapple is the fruit grown in Meghalaya, Manipur and Tripura. Tea, coffee, rubber, cashewnut, pepper, cardamom, clove and nutmeg are the specialities of the southern hills while coconut and arecanut are usually grown on flat lands in the valley. The common arable crops are rice, maize, small millets and potato. Despite this kind of choice being available, there is a temptation to give preferential treatment to paddy and fit it in all kinds of elevations disregarding the fact that water needed is really available for this crop only in the valleys. This brief description is meant to illustrate that there is no scientific pattern of cropping most suited to different elevations. The micro-climate over hills varies very widely depending upon various factors. The hill facing the ascending side of the monsoon winds is cooler, has more moisture and is, therefore, more lush green than the other side over which the wind descends. The duration of sunshine varies widely over small distances due to the directional orientation in general and due to the shadow effect of nearby hills in particular. Moreover, there is the valley effect where the valley acts as a pool for cold air and is covered with fog. The sequence of horticultural plantations as well as
arable crops requires to be determined after taking into account all these meteorological considerations and the knowledge in India at present on these aspects is meagre. There is, therefore, a need to pay greater attention to research work as well as agricultural developmental work specially directed to the problems of hill areas.

## Meteorology in Relation to Livestock Production

13.3.15 The application of meteorology to livestock production can be studied in three ways. These are: (a) how the micro-climate obtainable in a particular place affects the productivity of different kinds of animals (b) how micro-climate obtainable in paddocks and barns affects the health of animals kept there and (c) what is the contribution of meteorological factors in the spread of animal pests and diseases. Animal Husbandry scientists at various centres including the Indian Veterinary Research Institute, Izatnagar, have made several studies in relation to climate. Some of the prominent research institutes are also having their own meteorological observatories, but in the context of the livestock production and its future plans, the present meteorological set up exclusively for livestock is very inadequate. There is need for all the institutions dealing with animal research and dairy, piggery and poultry organisations to arrange for meteorological observations which are considered essential for their work. There is also need for conducting micro-climatic studies within the paddocks and barns, which will give an idea of the level of animal comfort that is conducive to higher production. The general purpose meteorological observatories should not, however, be confused with the observatories which are to be set up for productive animals. Just like crops, it is very necessary that the observatories are set up in the very environment in which the animals are reared and confined. The responsibility for setting up and maintaining these should rest with the respective institutions and departments.

## Weather and Animal Diseases

13.3.16 Studies in recent years have shown practical links between current weather and the epidemiology of diseases of farm animals. A review of the work in this field given in a recent technical note of WMO on 'Weather and Animal Diseases' covers subjects like the wind-borne types such as fowl pest and foot and mouth disease and parasitic and fungal diseases etc. Among the conclusions, it is stated that much can be done with existing systems of weather recording with small cost-benefit

[^13]ratios. Details are given in the annexes to this publication of the prediction systems which are now in use or under operational test in the United Kingdom. Work in this field in India seems to be limited, but the importance of the subject from the practical economic point of view is considerable. Research needs the combined efforts of animal husbandry scientists and meteorologists.

Remote Sensing Techniques
13.3.17 The World Meteorological Organisation has drawn attention to the use of remote sensing techniques in providing means of rapidly collecting a variety of agro-meteorological data. As examples, reference is made to (i) large scale colour photography supplying supplementary information on the condition of crops, pastures and forests, (ii) large differences in vegetation cover, physiography and drainage patterns provided by remote sensing images. It is desirable to examine the extent of application and usefulness of these techniques for utilisation in this country. We have dealt with this briefly in Chapter 61 on Statis-tics-Remote Sensing Techniques.

## 4 DROUGHTS

13.4.1 Departures from normal rainfall occur frequently but when eficiencies are large, widespread and/or prolonged, drought conditions set in. Definitions of drought vary widely with the area of interest. More than 60 definitions have been listed in a report on assessment of drought. Palmer (USA) defines drought as an interval of time, generally - the order of months or years in duration, during which the actual moisture supply at a given place consistently falls short of the climatically expected moisture supply. The US Weather Bureau defines drought as a period of dry weather of sufficient length and severity to cause at least partial crop failure. In a report to the Administrator, National, Oceanic and Atmospheric Administration on the influence of weather and climate on United States grain yields, prepared in December 1973, the definition of agricultural drought is given as follows: "A combination of temperature and precipitation over a period of several months leading to a substantial reduction in yield (bushels per acre) of one or more of the major foodgrains (wheat, Soyabean, corn). A "Substantial reduction" is defined as a yield (bushels per acre) less than $90 \%$ of the yield expected with temperature/precipitation equal to long term average values". But rainfall, while it may be a major criterion, does not give the complete picture and a lower rainfall that would be fatal to crops in one region might be sufficient for growth in another. Besides rainfall, factors like inten-
sity of evaporation, sunshine, soil, stage of crop growth etc. have also to be taken into account. Thornthwaite defines drought as a condition in which the amount of water needed for transpiration and direct evaporation exceeds the amount available in the soil. Some of the other definitions in use are :
(i) According to the British Rainfall Organisation a partial drought is a period of more than 28 days with a very small rainfall per day and absolute drought is a period of at least 15 consecutive days during which the rain does not exceed 0.25 mm .
(ii) The objective method for specifying drought suggested by the Australian Bureau of meteorology is to specify the minimum water need for a particular purpose. Drought occurs when rainfall during an interval is less than the minimum water need.
(iii) In USSR drought is defined as a period of ten days with a total rainfall not exceeding 5 mm .

## Drought classification

13.4.2 Droughts may be broadly classified into the following three types :
(i) Meteorological drought : It is a situation when there is significant (more than 25 per cent) decrease from normal precipitation over an area.
(ii) Hydrological drought : Meteorological drought, if prolonged, results in hydrological drought with marked depletion of surface water and consequent drying up of reservoirs, lakes, streams and rivers, cessation of spring flows and fall in ground water levels. Hydrological drought may be reflected in depleted snowmelt due to poor snow-fall in an earlier season and this may result in curtailment of power generation and affect industry as well as agriculture.
(iii) Agricultural drought : It occurs when soil moisture and rainfall are inadequate during the growing season to support healthy crop growth to maturity and cause extreme crop stress and wilt.

## Drought studies in India

13.4.3 Drought is an occasion when the rainfall for a week is half of the normal or less, when the normal weekly rainfall is 5 mm or more. Agricultural drought is a period of 4 such consecutive weeks in the period , from middle of May to middle of October or 6 such consecutive weeks
during the rest of the year. Seasonal drought occurs when the actual seasonal rainfall is deficient by more than twice the meal deviation. Subramanyam and co-workers made use of the aridity-index of Thornthwaite and drought years were classified as moderate, large severe or disastrous according as the departure of the yearly aridity index from the climatic normal value was less than $1 / 2 \sigma$ between $1 / 2 \sigma$ and $\sigma$, between $\sigma$ and $2 \sigma$, or above $2 \sigma$ respectively, $\sigma$ being the standard deviation for the set of data employed. The Drought Research Unit of the IMD at Poona, has tried to evolve a drought index on the basis of rainfall departures, monthly rainfall deciles, water periods etc. Employing Thornthwaite's water balance technique, and using potential evapotranspiration values computed ${ }^{1}$ for 300 stations from Penman formulation, areas of arid and semi-arid climatic zones were demarcated. ${ }^{2}$ Saurashtra-Kutch region of Gujarat, the western half of Rajasthan and parts of Haryana are in the arid zone where there is constant water deficit. Conditions very close to aridity prevail in the rain-shadow tract along the leeward side of the Western Ghats from Nimar in Madhya Pradesh through the districts of Khandesh, Ahmednagar, Sholapur (Maharashtra), Gulbarga, Bijapur, Raichur and Bellary (Karnataka) to Anantapur, Kurnool and Mahbubnagar districts (Andhra Pradesh). A small area within this tract around the Anantapur-Bellary chord also has conditions of aridity. Semi-arid regions comprise areas where precipitation meets only one-third to two-thirds of the evapotranspiration needs. These regions cover almost the entire Peninsula east of the Western Ghats and extend to portions of West Madhya Pradesh, West Uttar Pradesh, Haryana and Punjab. Semi-arid conditions occur in parts of Gaya, Patna and Monghyr districts of Bihar. On the lines of work done in the USA by Palmer, computations involving detailed hydrologic accounting were carried out for different meteorological sub-divisions for the period 1901-1969. The drought climatology ${ }^{3}$ of the country thus prepared shows that on an average, drought may be experienced over large areas on 20-25 per cent occasions in each of the months of the Kharif season. For identification of drought areas, IMD has defined drought as a situation occurring in any area in a year when the annual rainfall is less than 75 per cent of the normal. When the deficiency of rainfall is above 50 'per cent of the normal, it is termed as 'severe drought'.

[^14]Areas where drought has occurred in 20 per cent of the years during the period are considered 'drought areas', and where it has occurred in more than 40 per cent of years, as 'chronic drought areas'. This definition of drought does not however, take into account the distribution of rainfall so important from the point of view of agriculture. In view, however, of the differences in cropping patterns and distribution of rainfall from region to region, it is difficult to qualify the definition of drought with sufficient exactness by introducing this element and needs detailed study. Using the annual and south-west monsoon rainfall departures from normal during the period 1901 to 1960 for about 500 stations drought areas have been identified by the IMD. The Irrigation Commission accepted this approach and in their Report (1972) indicated the drought and chronic drought areas as follows :
(i) drought areas ( 20 per cent probability of rainfall deficiency of more than 25 per cent of normal)

Gujarat, Rajasthan and adjoining parts of Punjab, Haryana, West Uttar, Pradesh and West Madhya Pradesh. Madhya Maharashtra, Interior Mysore, Rayalaseema, south Telangana and parts of Tamil Nadu. a small portion of north-west Bibar and adjoining eastUttar Pradesh. a small portion of north-east Bihar and adjoining portion of West Bengal.
(ii) chronically drought affected areas West Rajasthan and Kutch. (40 per cent probability of rainfall deficiency of more than 25 per cent of normal.)
13.4.4 Thus, most of the areas identified as susceptible to drought fall within the arid and semi-arid zones mentioned above. Chronically drought affected areas are identical with the intensely arid zone. All the districts which comprise the drought zone are not equally vulnerable to crop failures as protective irrigation has been developed in some of the districts or taluks. As such those of the districts/taluks which enjoy a minimum percentage of irrigation should appropriately be excluded from the list of drought affected areas.

## Drought Prediction

13.4.5 The question whether drought can be predicted from rainfall or drought data series over an area from a knowledge of trends, periodicity etc. is of considerable importance. Rainfall series of stations in the country generally exhibit random nature and have shown no significant trend on the whole. Some of the long rainfall series have been tested for periodicity also but none of significance has been noted. In
addition, spectral analysis ${ }^{1}$ of Palmer Drought Index series, referred to earlier in this Section, available for a number of meteorological subdivisions has been tried. These show some relation to quasi-biennial oscillation and in some cases to sun-spot cycles. The amplitude of the cycle is, however, too small to be of significance. We are not alone in arriving at such results. Professor H. E. Landsberg, President, WMO Commission for Special Applications of Meteorology and Climatology in his lecture in Geneva in June 1974 on 'Drought' has expressed almost identical views in this regard as may be seen from the extract reproduced below ${ }^{2}$ :
"Data analysis of long records of precipitation in various parts of the world did not indicate any radical one-sided trends but rather fluctuations which might persist for several years. Spectral analysis revealed no well-defined cycles of rainfall anywhere but a widespread irregular rhythm of two to three years was in evidence. The analysis at the same time did not preclude entirely the presence of a weak rhythm in the 11 to 13 years spectral band which might identify with, the solar cycle. This point required further exploration".
13.4.6 The problem of quantifying drought still remains. The water balance technique is a useful approach as it takes into account precipitation, evapotranspiration and soil moisture storage and attempts to arrive at a balance between water gain and water loss. Actual observational data are lacking and water balance and other computations would have to depend for a long time to come on data calculated from theoretical considerations.
13.4.7 The Indian National Committee for the International Hydrological Decade has set up a sub-committee on Water Balance to make an assessment of water of the Indian river basins and to recommend broad outlines of future work including research studies to be undertaken. The work of this sub-committee should prove useful in the drawing up of definition of drought and future programmes of research.
13.4.8 It should be clear from the above that the approach of trends, cycles, periodicity etc. is not feasible for forecasting drought. A statistical study of rainfall or drought series could help in evaluating probability of different rainfall amounts of drought values and useful in indicating the risk of low rainfall and attendant drought in the various areas of the country. However, comprehensive and systematic study

[^15]of all past droughts by dynamic and synoptic-climatological methods both for a better understanding and for forecasting droughts is an urgent need. We recommend that this important project may be taken up jointly by the IMD and the Indian Institute of Tropical Meteorology in cooperation with ICAR. We have also dealt with some aspects of drought forecasting under Extended Range Forecasting later in this Chapter.

## 5 WEATHER BULLETINS FOR FARMERS

13.5.1 Besides rainfall, other weather phenomena such as occurrence of abnormally low or high temperatures, cloudiness, high winds, hail, etc. are of importance to agriculture for protection against frosts, regulation of spraying of pesticides and protective measures against wind or hail damage.

## Present Service

13.5.2 The IMD initiated an experimental programme of issuing farmers' weather bulletins in the 1930's. A regular weather service for farmers on a regional basis commenced operation in 1945. This consists of bulletins of actual and expected weather for each district for 2 or 3 days, issued daily by the five regional meteorological centres (RMC) at Bombay, Calcutta, Madras, New Delhi and Nagpur and meteorological centres (MC) at Jaipur, Lucknow, Gauhati, Hyderabad, Bangalore and Trivandrum. Similar Centres are proposed to be started at Srinagar, Bhubaneshwar, Patna and Ahmedabad. Warnings of adverse weather such as cyclonic storms, strong winds, heavy rains, hail, frost etc. are also included in these bulletins. These bulletins are translated into local languages and broadcast by various regional stations of All India Radio in their rural programmes. The bulletins are broadcast in the rural programme for the farmers through about $1,50,000$ community radio sets all over the country.

## Crop Weather Calendars

13.5.3 For the guidance of the Meteorologists who issue these forecasts, statewise crop-weather calendars in respect of each major crop for each climatologically homogeneous zone have been prepared by the agricultural Meteorology Division of the IDM in consultation with the crop specialists of the States. The crop-weather calendars ${ }^{1}$ were first

[^16]prepared in the 1940's and are now being revised to take into account the requirements of newly introduced varieties of crops and changes in cropping practices. The calendars depict the normal dates and duration of various phases of the crop and indicate the weather conditions of significance in each phase and a forecast of which will be of use to the farmers. While compiling the calendars, requirements given by the State authorities have been interpreted in terms of practical forecasting capabilities. In order to enhance their utility, we would suggest that separate calendars should be prepared for early, normal and late sown varieties of each crop in different zones. We are aware that compilation of calendars for varietal differences in crops would pose serious problems as inter-annual variations in weather cannot be adequately allowed for. Nevertheless, a start in this direction is desirable. For preparation of the calendar, information in respect of individual research farms all over the country may be useful. It would also be necessary to include in the crop-weather calendars information on crops like soyabean, safflower, sunflower, cow-pea, etc. which have assumed increasing importance in recent years.

## Limitations and Required Improvement

13.5.4 The bulletins for farmers issued daily give only meteorological information in a general way and, in addition, include forecast on the type of weather likely to be experienced in the different districts of a meteorological region. From the farmers' point of view such a bulletin could not be of much use because it gives no indication of the steps the farmer should take in the light of a particular type of forecast valid for the next 24 or 48 hours. He would particularly need advice on the following :
(i) whether he could sow a particular crop when the requisite rainfall may be expected;
(ii) whether he should delay his sowing operation because the rainfall is not likely to occur;
(iii) whether he should resort to irrigation to save his standing crop because of expectation of a drought spell;
(iv) whether frost is expected and if so what measures he should adopt to save his crop; and
(v) whether humid weather is expected around the flowering time so that he could take plant protection measures in order to save the crop at such a crucial time from the effects of certain diseases or pests etc.
It does not take time to realise his difficulty and therefore, before a particular weather bulletin is framed and issued for broadcast on the All

India Radio, a joint discussion among the plant scientists, agricultural meteorologists and the forecasters is considered essential. A suggestion was put forward by the IMD to the State Departments of Agriculture that at the time when the forecast is being drafted they may send their representatives for discussions. This task has become simpler after the formation of the State Meteorological Centres in recent years. There is close collaboration and coordination between the officials of the Department of Agriculture and the scientists of the agricultural universities and the respective State Meteorological Centre in the States of Karnataka and Tamil Nadu in the preparation of the daily weather bulletin. We strongly recommend that a common pattern on an all India basis for a daily/joint discussion between the plant scientists and meteorologists should be drawn up on the basis of the experience of these two States and that this should be compulsorily extended to all the States. Joint daily meetings between plant scientists and the meteorologists has recently taken another very useful direction. The latter half of 1975 saw the launching of the SITE programme (through which the television facilities have been extended to a network of about 2,500 stations spread all over the country), which includes also a feature advising farmers on agricultural operations in relation to weather. For this purpose, an Agricultural Meteorologist of the India Meteorological Department and representative of the ICAR everyday sit with the forecaster at the Northern Hemispherical Analysis Centre of the IMD at New Delhi and decide how the forecast should be oriented and telecast so as to be useful to farmers. In the light of the anticipated weather, the nature of operations the farmer should undertake with regard to sowing etc. or plant protection measures are all spelt out in the telecast programme. This is a welcome development and we hope that in course of time it will become a regular daily feature.

## Improvement in Dissemination

13.5.5 Farmers' weather bulletins are at present translated into regional languages and integrated into the rural programmes broadcast over stations of All-India Radio, usually once a day. The bulletins should preferably be broadcast by AIR twice a day in the morning and evening during periods of high listener preference. Similar broadcasts could be made on television wherever such coverage is available. District agricultural officers may be assigned the responsibility of regularly listening to farmers' weather bulletins and sending to the Directors of Agriculture and the IMD offices in each State, periodical reports of their evaluation on the effectiveness of the bulletins and give their suggestions for improvement. They should particularly highlight instances
when the operational farmers' weather bulletin helped or failed to help in protecting crops from the adverse effects of weather. This kind of feedback is necessary for effecting improvements in the agricultural weather service. The IMD should evaluate each year the performance of the farmers' weather bulletin service and present the same at conferences of agriculturists at the State level for discussions between scientists as well as the users. The ICAR should consider convening such periodical conferences for evaluation of weather service to farmers and for their improvement.
13.5.6 An important problem concerns the communication facilities available at present for the dissemination of weather forecasts and warnings for agriculture. It is recognised that the present position is very inadequate and needs significant improvement but the setting up of an exclusive communication network for the purpose does not appear feasible at present.

## Weekly Crop-Weather Bulletins

13.5.7 While the above arrangements serve the daily needs, it is necessary that each State should prepare a weekly crop-weather bulletin containing a descriptive statement on week's weather and crops, temperature and rainfall of observatories in the State and a forecast of weather a week ahead. The responsibility for the compilation and issue of the weekly bulletin should be that of the Director, Bureau of Economics and Statistics of the State and where such an organisation is not responsible for agricultural statistics, it may be of the Director who performs similar functions. In the preparation of the bulletin the Director will 'e assisted by the local Meteorologist, the representatives of the Director of Agriculture and the local agricultural university. The weekly bulletin should be issued on the same day in the week as that of the weekly weather report by the IMD. While enabling a close watch to be kept on week's weather and agricultural conditions, it will also help educate its agricultural community in getting acquainted with weather and agriculture in a more intimate manner. An effort in this direction has already been made by Karnataka, whose weekly bulletin farmat etc. is given in Appendix 13.1- Statement X as a sample.

## 6 extended range forecasting

13.6.1 Forecasts of weather for two days with outlook for subsequent two days are at present issued with reasonable degree of confidence. For longer periods say a week, a month and season, the problem
continues to be one of great complexity. A few countries issue such forecasts but the general solution has defied attempts so far. The need for such forecasts for agriculture is, however, very pressing. It may be relevant to state that the forecasting of monsoon rainfall a season in: advance, formed one of the important recommendations of the Indian Famine Commission even earlier than 1880. A brief reference to the efforts made in India is given in the subsequent paragraphs.

## Seasonal Forecasting-India

13.6.2 India has been issuing seasonal forecasts of monsoon rainfall for over 80 years and the method followed for the last 50 years is the correlation approach. Factors likely to be associated with Indian rainfall have been examined on global basis but only a few factors have shown significant correlation and fewer still have maintained their original significance. The factors thus selected have been fitted into a linear regression equation which is used for prediction. The factors and theregression equation are periodically examined for significance and new factors introduced to maintain significance, as and when necessary. Three seasonal forecasts are issued every year covering (i) the southwest monsoon months of June to September (ii) August and September and (iii) the winter months of January to March. For (i) and (ii) the areas covered are the Peninsula and northwest India and for (iii) northwest India only. Details including areas covered, factors employed, dates of issue etc. are given in Appendix 13.1-Statement XI. As the formulae have varied, only the actual performance against the forecasted value has been verified and it is found to be about 70 per cent. While the performance is not striking, it cannot be regarded as unsatisfactory either. The forecasts are, however, of limited utility as they cover vast areas and the multiple Correlation Coefficients (CC) of the regression. equations are in the range of 0.68 to 0.75 only.

## Long Range Forecasts

13.6.3 A helpful approach for prediction of rainfall a year ahead or for longer periods could be by detection of trends and/or periodicity in long term records of rainfall. Studies of a number of stations in thecountry have with minor exceptions (Konkan) not revealed any significant trends or periodicity. A quasi-biennial oscillation of nearly 2 . years has been noticed in rainfall series over many stations in the country. These and indications of eleven-year periodicity akin to sun-spot cyclein same cases have, however, small amplitudes, not large enough to have significant influence on the rainfall regimes regions. One would, therefore, have to try other methods.

## Dynamic Climatological Techniques

13.6.4 With availability of large-sized electronic computers and magnetic data storage facilities in the IMD, development of medium and long range forecasting techniques should be attempted with high priority. This could be done (i) by intensive correlation studies involving examination of a large number of factors-surface, upper air and possibly extra-terrestrial, (ii) by deriving statistical and semi-empirical formulations for smaller areas and for smaller intervals of time and (iii) by use of dynamic climatological methods. In the third method, a set of derived meteorological parameters like vorticity, vergences, wind shears, vertical, motion etc. have to be computed from average and daily data. These parameters have to be used with known and tested physical relations and prognostications attempted. Statistical analysis of derived parameters from such prognostic studies may then be tried. For medium range forecasts Numerical Weather Prediction (NWP) techniques should be evolved for forecasting precipitation, temperature anomalies, etc. upto 5 to 7 days.

## World Weather Watch

13.6.5 Under the World Weather Watch (WWW) project of the World Meteorological Organisation, the world meteorological centres at Washington, Moscow and Melbourne would be preparing forecasts for extended periods ranging from 5 days to a month or more, with the aid of large computers. The regional Meteorological Centre of WWW at New Delhi has facilities to obtain these forecasts from the world meteorological centres on fast telecommunication channels. It also receives global meteorological data as well as cloud imagery relayed from orbitting meteorological satellites round the clock. An IBM 360/44 computer has been installed at this Centre and should be used for experimental extended range forecasts for India and neighbourhood upto 5 days with the aid of the large amount of data obtained through WWW channels.

## Monsoon Experiments

13.6.6 Our knowledge of many aspects of the Indian southwest monso.on on which a large part of Indian agricultural production depends is even now far from complete. A special experiment (MONEX) has been planned as a part of the Global Atmospheric Research Programme (GARP) jointly by the World Meteorological Organisation (WMO) and the International Council of Scientific Unions (ICSU). The first phase of the programme started during the monsoon of 1973
in collaboration with USSR and four research ships of USSR and two of India participated in this phase. The study will be intensified during. the first GARP Global Experiment (FGGE) to be conducted jointly by WMO and ICSU during 1977. A Geostationary Meteorological Satellite (GMS) is planned to be launched by USSR over the equator at $70^{\circ} \mathrm{E}$ and will keep a constant watch over the weather over India and the surrounding areas with capability to relay pictures of developing cyclones or advancing monsoon clouds once every 20 minutes. A variety of new techniques are being evolved to obtain data on winds, temperatures, humidity etc. from all over the globe during GARP. With the help of these technological developments and large computers it should be possible to obtain more definite knowledge of the physical processes of the Indian SW Monsoon by the end of this decade and develop reliable techniques for medium range and long range forecasts of its advance, pulsations and withdrawal for the use of agricultural community.
13.6.7 In view of the large and complex problems involved we strongly recommend that research into the various aspects of the subject including those outlined above should be given priority. The entire range of subjects could be grouped under Extended Range Forecasting and work distributed among the IMD, Indian Institute of Tropical Meteorology, and other interested institutions. Sufficient funds should be made available by Government and an advisory group should be set up under the chairmanship of the Director General of Observatories. with membership from Meteorological Department, ICAR, IARI and Agricultural Departments of the States to periodically review and draw up concerned programmes for speedy implementation.

## 7 CROP WEATHER RELATIONSHIP

137.1 A number of research institutes and organisations are at present engaged in the study of crop-weather relationships. Certain biochemical aspects of crop-weather relationships have been referred to in Section 3. The IMD is studying various aspects of drought, forecasting of crop yields, dry farming etc. A Crop Weather Studies Unit has been set up in the Directorate of Economics and Statistics in the Ministry of Agriculture and Irrigation to concentrate on the publication of long term comparable data on crops and weather, derivation and computation of rainfall indices, analysis of crop weather relationship between weather and crop production etc. The IARS and the IARI are engaged in experimental work on crop weather relationships. Some of the agricultural universities have also been engaged on studies in this important field.

## Weather Parameters and Crops

13.7.2 Crops are greatly dependent on weather during the periods of growth and particularly in the critical phases like germination, flowering, seed setting, manuring etc. For healthy growth and good yields, certain optimum conditions of rainfall, temperature, wind, sunshine, soil moisture etc. are essential. However, the problem is complex and much work would have to be done to arrive at dependable relationships in quantitative form between these factors and yields of crops. Such studies are being actively pursued in many countries. In the USA crop yield studies are made using regression techniques, both linear and curvilinear. In addition to weather factors, technological trend is used both in its linear and quadratic forms. In the USSR crop yield forecasts, using curvilinear techniques, are issued. Besides weather parameters, soil moisture, stage of crop development, soil type and evapotranspiration are also considered. Instrumented aircraft are employed to obtain information on acreage as well as on the state of growth of the crops. Ninety per cent success has been claimed. Research work in this field is being done in Canada and Australia also. In India data collected under the All-India Coordinated Crop Weather Scheme introduced in 1945 have been statistically analysed using the techniques of regression, Fisher's response curves, fitting of probability distribution of meteorological factors and Ezekiels' curvilinear regression. The studies have brought out the relatively large dependence of crop growth and yield on rainfall and its distribution in various phases compared to other meteorological parameters. At Niphad (Maharashtra), Dharwar (Karnataka) and Powerkheda (Madhya Pradesh) rainfall above normal in the month preceding sowing and in germination phases has been found to have beneficial influence on wheat yield. At Niphad and Jalgaon (Maharashtra) an idea of the final yield of wheat could be had from the nature of germination and shoot growth when the crop is two months old. An early study on the influence of rainfall distribution on cotton yields at Akola and Jalgaon has shown that an additional inch ( 2.54 cm ) of rain in the fourth week of May has an adverse effect. Heavy and continuous rainfall in the latter half of July and the first half of August affects the yield adversely as it gives rise to weeds and water logging and delays weeding and interculture operations. Heavy rain at the end of September or the early part of October damages the cotton crop by causing the shedding of bolls. These and various other studies were carried out with data from experimental stations over limited periods. They were also severely conditioned by non-availability of uniform data over long periods. Added to these are the diversity of farming practices in the country which limited the extension of field experimental results. for assessment of overall crop yields.

## Crop Yield Formulation

13.7.3 After the droughts of 1965 and 1966, the IMD on the recommendation of the Planning Commission set up a unit in the latter half of 1967 for investigations on drought climatology and for developing techniques for issue of crop yield forecasts using meteorological parameters. The work involved detailed statistical analysis to isolate the critical periods in weather factors which have significant association with crop yield. These are combined to derive linear regression equations and used for forecasting yields of crops. In the case of rice, the distribution of rainfall during the crop growing season is found to be the most crucial weather parameter; temperature plays only a minor role. For wheat, pre-season precipitation and distribution of temperature during crop growing season are important. Minimum temperature between $5.6^{\circ} \mathrm{C}$ and $7.2^{\circ} \mathrm{C}$ and maximum temperature not exceeding $21.1^{\circ} \mathrm{C}$ are generally conducive to better wheat yield. Critical periods when weather elements significantly affect yields of rice are given in Appendix 13.1-Statement XII. Formulae have been developed for 22 sub-divisions of the country for quantitative yield forecast of rice, 6 for yield of wheat, 2 for yield of bajra and 5 for jowar in dry farming area. Tentative forecasts for kharif rice are framed in August, September and October and final forecasts in November. Work on similar lines is being carried out at the IARS on the basis of data from six experimental stations. It has been found that rainfall during the period January to April has contributed significantly to the yield of the wheat crop. A study of the response of yield to rainfall indicated that in unirrigated tract the rainfall was beneficial to the growth of the crop during the entire crop season, while in the irrigated tract the rainfall during the months of December and March had a damaging effect on the crop.
13.7.4 In the case of rice, the rainfall in July is beneficial to the crop while in August it has some adverse effects. Similar studies were also conducted in respect of jowar, cotton, groundnut and barley. It was noticed that about 90 per cent of the variation in yield was explained by the variation in rainfall in the case of cotton and groundnut while this variation was of the order of about 45 per cent for jowar and barley.

## Crop Yield and Rainfall Distribution

13.7.5 The Institute of Agricultural Research Statistics, New Delhi, has carried out linear regression analysis with yield as the dependent variable and total rainfall during the five crop growth phases as independent variables. About 47 per cent of the variation in wheat yield was due to variation in the rainfall during each period. Rainfall
during pre-sowing, flowering and grain formation period was more important and effective as compared to rainfall in other periods. In Raipur district of Madhya Pradesh, the total rainfall for the months of June and August does not have much effect on rice production, but the total rainfall during the months of July and September has greater influence on the crop yield. During the month of July a deficiency of the order of 16 per cent in rainfall showed an adverse effect on crop production, while the corresponding percentage in the month of September was of the order of 13 per cent. The above findings have been confirmed from the physiological point of view also. Computation showed that a deficiency of the order of 16 per cent or more might be observed once in three years. This could happen for two consecutive years once in sixteen years. The data were also examined to study the pattern of occurrence of rainfall with the help of Markov Chains for the crop season-June 1 to September 30. Probabilities of a day being wet or dry depending on weather conditions on the previous day were thus computed.

## Rainfall Indices

13.7.6 It has been observed that there are considerable variations in the amount of rainfall received within a State or even a district. Further, there are variations in the amount of rainfall received within a crop season in a particular area. The Directorate of Economics \& Statistics of the Union Ministry of Agriculture and Irrigation, have initiated the compilation of rainfall indices for different crops and groups of crops. The actual rainfall in a particular month or session is expressed as the percentage of the normal. Only those regions/States are considered where the crop is grown to an appreciable extent. Further, only the period of the growing season-from preparatory tillage to harvesting -is studied. In the case of rice, rainfall indices for 9 States, accounting for about 90 per cent of the total production of rice, have been worked out by weighting the individual State/Sub-Division during 1964-65, which was a normal year. Similarly, for wheat, rainfall indices have been constructed for the period September-April for 6 States, accounting for about 92 per cent of the total production of wheat in the country. For all the foodgrains considered together the rainfall indices for each of the four seasons viz. monsoon (June-September), post-Monsoon (OctoberDecember), Winter season (January-February) and summer (March-May) have been constructed by combining the indices for 12 States accounting for about 90 per cent of the total production of foodgrains in the country. These indices have been compiled from 1950-51 onwards. It is proposed to correlate yields/production with these indices to enable (i) an assessment of the effect of rainfall on the yield/production of individual
crops, and (ii) forecasting of crop yield/production at different stages during a crop season. A limitation of this method is that equal weightage has been given to the monthly rainfall during the entire life cycle of a crop. Further, a month may be too long a period to adequately cover the life cycle of a crop. It is, therefore, suggested that (i) periods smaller than a month should be considered for construction of rainfall indices; and (ii) a system of weights should be developed on the basis of experimental data to combine the rainfall indices during the different phases of crop growth. A study should be conducted to determine the variability in weekly, fortnightly and monthly indices.

## Contribution of Technology to Crop Production

13.7.7 It is generally difficult to isolate the contribution of technological development and favourable weather to increased crop production. However, taking into account the available data, which is scarce, it may be possible to arrive at an estimate of their relative magnitudes. Such a study could profitably be undertaken in rainfed areas of the country. Studies on crop-weather relationships by the IMD indicate that in the case of rice-yields the percentage variation accounted for by technology varies from 4 to 46 per cent in different regions. The percentage variation in the yield of rice accounted for by the technology alone for some of the subdivisions of the country is given in Appendix 13.1-Statement XIII. The upward trend due to advances in technology-improved seeds, fertilizers, pesticides, etc. is discernible in many areas especially after 1950. In the case of Tamil Nadu and Andhra Pradesh, an earlier technological trend is noticed from 1906 to 1920 presumably due to extension of irrigation facilities.

## Physiological Response of Crops to Weather

13.7.8 For a better understanding of the crop-weather relationship it is necessary to assess the physiological response of crop to weather. Towards this objective, firstly intensive measurements of micro-meteorological parameters would have to be made for an assessment of water balance and energy budget in crop environment. These experiments spread over a relatively short period of about five years have to be replicated in space and time at a number of places close to one another. These measurements have then to be evaluated in laboratory experiments under controlled conditions. Secondly, climatic data collected from meso-scale network have to be applied to solve practical problems of a farm area of several hundred to several thousand hectares. Data thus collected should be used to (a) explain fluctuation of yield, (b) select times of planting and harvest and (c) guide irrigation scheduling and 5-133Deptt. of Agril./76
other cultural operations. Thirdly, data collected on macro-scale could be used in development of formulae for forecasting crop yield.
13.7.9 Crop weather studies by the IMD should be intensified and forecast formulae developed on a district-wise basis taking into account such additional factors as soil moisture, irrigation, consumption of fertilisers, and area under high yielding varieties. Further, such relationships would have to be continually revised to suit the changing conditions. 13.7.10 Efforts should be made to collect detailed data on acreage, yield, etc. according to (a) varieties, (b) irrigated and unirrigated, and (c) various cultural practices like drill sown, transplanted, broadcast, etc. so that it may be possible to arrive at more precise crop-weather relationships. Efforts should also be made to attempt forecasts of acreage under crops on the basis of climatological march of weather and other factors like prices of competing crops.

## 8 WEATHER MODIFICATION

## Basic Considerations

13.8.1 Even during rainless spells in the monsoon, the atmosphere has as much precipitable water in some places as during active periods and extensive clouds may pass over a region without precipitation. Cloud seeding is the technique by which clouds could be induced to precipitate on such occasions. In 1938, the feasibility of rain stimulation and hail suppression through the introduction of artificial sublimation nuclei into super-cooled clouds was established by Findeisen, on theoretical grounds. Interest in the work remained obscure till 1948 when Schaefer used dry ice particles as artificial ice crystals to stimulate rain on a deck of super-cooled altocumulus clouds and Vonnegut found that silver iodide particles, being similar in crystal structure to ice were, more effective than dry ice at temperature below $3^{\circ} \mathrm{C}$. Since the mechanism of formation of rain in 'warm' clouds (above $0^{\circ} \mathrm{C}$ temperature) is through coalescence of water droplets, use of hygroscopic nuclei like common salt and Calcium chloride which aid the production of large size water droplets, are found to be effective. Seeding is best done from aircraft flying inside the cloud. It can also be done, but in a less effective manner, from nuclei generators located on the ground. Condensation nuclei, mostly silver iodide or dry ice (solid carbon dioxide), have been used to seed clouds in the temperate countries. Hydroscopic nuclei, mostly common salt or Calcium Chloride, have been employed in the tropics.

## Cloud Seeding Experiments

13.8.2 Beginning in 1947 cloud seeding experiments have been carried out in Australia, USA, Japan, USSR and Israel and the results are summarised below :
(i) Australia : Experiments have been conducted in five locations since 1947. Of these at only one location was a significant increase in rainfall noted. At three locations there was definite decrease while in the fifth region there was an increase of only 4 per cent in the precipitation.
(ii) USA: Cloud seeding on strict scientific lines was begun in 1952. Preliminary results of some of these indicated increase in precipitation. The experiments carried out in Florida for drought alleviation, indicated that nearly 50 per cent of the total rainfall came from seeded clouds. But instances of decrease in precipitation following seeding have also been reported. Dynamical cloud seeding of individual clouds by massive injection of seeding material by pyrotechnic devices have been conducted since 1964 in Florida, California and the Carribean. The technique is an improvement of the normal cloud seeding methods in that it aims at the release of latent heat of fusion by freezing the supercooled water droplets above the freezing level in clouds, thus inducing the cloud to grow and deposit its rain content. The growth can be vertical as well as lateral and the results could be spectacular. In a recent experiment on drought mitigation in Florida by dynamical cloud seeding, it was estimated that the benefit-to-cost ratio was as high as $31: 1$. Rainfall of about 100,000 acre was attributed to the seeding.
(iii) Japan : During the period 1947 to 1960 , cloud seeding trials have been carried out by major universities. About 20 per cent increase in precipitation in a five-year ground based experiment was reported. The trials of warm and cold seeding carried out from 1961 to 1967 have led to mixed results.
(iv) USSR : Rain making is considered as a proven success in the USSR where the total number of personnel working in the field runs into thousands. ' The experience gained in the field of rain making is now being made use of for the purpose of fighting forest fires. The experimental and operational cloud seeding projects in USSR make use of both conventional and dynamic seeding techniques.

Thunderstorm dissipation project was started in the early sixties. The powders used for seeding clouds are finely powdered cement and Cupric Oxide. Seeding operations were accomplished from aircraft by flying at heights ranging from 6 to 12 km . Ordinary aircrafts were used for flying in the lower height range and jet aircraft in the higher height range. About 200 clouds were seeded over a period of 5 to 6 years. The amount of cement used for seeding ranged from 5 to 10 kg in Cumulus Congestus and to 40 kg in a thunder cloud. Within 10 to 20 minutes of the injection of material into Cumulus Congestus, the cloud either dissipated or transformed into altocumulus. In the case of thunder clouds, the dissipation took place within 30 minutes of seeding. In both the cases, the material was introduced from the top of the cloud. Better results were noticed when the top of the cloud consisted of supercooled drops. The cloud tops ranged in temperature from $20^{\circ} \mathrm{C}$ to $35^{\circ} \mathrm{C}$. Experiments conducted in the winter stratus clouds (clouds top- $18^{\circ} \mathrm{C}$ ) whose depth varied from 2 to 3 km indicated negative result.
(v) Israel: In the trials conducted from 1961 to 1966; positive increase in precipitation has been noticed every year. An overall increase of 18 per cent was indicated. For the interior areas alone, the increase was 29 per cent.

## Artificial Rain-making Experiments

13.8.3 With the aid of ground based Silver Iodide generators experiments were conducted by some private companies on the Western Ghats during the year 1951-53. Seeding with the aid of aircraft was also attempted by a few State Governments. There was, however, no attempt on the part of any of the rain makers to conduct experiments on a scientific basis to answer the question whether the showers that occurred after the seeding cloud have occurred even without it. The first conference of scientists to consider the problems of artificial rain-making in India was held at Delhi in 1953 and on its recommendations, a Rain Research Unit was started in 1955 at the National Physical Laboratory, Delhi: It is now a part of the Indian Institute of Tropical Meteorology at Poona. Experiments using warm cloud seeding have been conducted, on randomised basis, from ground, 4 monsoon periods at Jaipur (1960-63), 6 monsoon periods at Agra (1960-65) and 9 monsoon periods at Delhi (1957-61 to 1963-66) in the plains of north India. The seedings were also carried out from aircraft during the monsoon period (1962) at Delhi.

Orographic clouds were seeded for two summer seasons (1964-65) over the Munnar hills in South India. An increase of 20 per cent in the season's rainfall could be attributed to the ground based cloud seeding. Cold cloud seeding from ground based generators has been conducted at Delhi for three successive winter seasons. The number of seedable occasions available being small in each winter, the experiments will have to be continued for some more seasons before dependable conclusions become possible. A scheme for conducting ground based seeding experiments near Madras and seeding to the leeward of the Western Ghats by using common salt in a finely powdered form has been sanctioned. In this year (1975), cloud seeding was tried in Madras area and in Karnataka also.
13.8.4 Hail suppression Another field of interest in weather modification in India is hail suppression. Extensive damage by hail is caused to horticultural crops like apple orchards and rabi wheat in the ripening stage in Punjab, Haryana, Himachal Pradesh, Jammu \& Kashmir and part of Uttar Pradesh during the winter, pre-monsoon and post-monsoon seasons. The method used for suppressing hail is overseeding, which aims at production of more ice crystals to serve as potential hail-stones which together with the naturally created ones grow only to a limited size thereby considerably reducing the damage. The seeding is done with the help of aircrafts or by firing rockets to release seeding material into clouds. In USSR where the most spectacular results of hail supression have been reported, estimates of the benefit-to-cost ratio are said to vary from $5: 1$ to as much as $17: 1$ depending on the region. While demonstrable evidence is available for an increased stimulation of rainfall in the seeded areas, the possibility of indiscriminate seeding lcading to a decrease in rainfall over the target area also exists. The position regarding hail suppression seems much less convincing. Since the synoptic meteorologist is unable to forecast the occurrence of precipitation or hailstones from any given unseeded cloud, clouds have to be selected by random sampling for seeding, thus increasing the difficulties in assessing the results of cloud seeding. Use of computer models, along with the use of radio-active nuclei, observations by radar and by a ground observation network in the target area could aid in the acquisition of reliable data to ascertain the efficiency of seeding.
13.8.5 Development of Seeding Agents : Apart from the conventional silver iodide the IITM, Poona has succeeded in developing mixture of AGI and some iodates which are capable of producing glaciation at temperatures close to $0^{\circ} \mathrm{C}$. The ashes of ' khair ' plants grown in Haryana have also been found to be effective as seeding agents.
13.8.6 Economic Aspects : The increase of 10 to 20 per cent in precipitation in situations where rain would have fallen in the natural
course is indicated by the ground based seeding experiments in India. Cloud seeding will be of some value in relieving drought and can lead to significant improvement in crop yields, if carricd out successfully at critical periods. It has been estimated that a 1 per cent increase in precipitation in hydroelectric catchments will compensate the cost of the cloud seeding operations, while in purely agricultural regions increases of as much as 5 per cent in precipitation may be required to pay off for the operations. As mentioned earlier, the technique of dynamic cloud seeding holds promise as a reliable niethod of producing artificial rain when suitable clouds exist.

## WMO's Views

13.8.7 In connection with the above it is relevant to refer here to the statement issued in June 1974 by World Meteorological Organisation (WMO) in Geneva. While survcying the present position they emphasised that weather modification was still largely at the research stage and operations should be undertaken only after the most careful study by experts of the particular situation on the understanding that the desired end-results may not always be achieved. The full statement is given in Appendix 13•1-Statement XIV.

## Future Plans

13.8.8 The 1972 drought focussed the attention of Government and scientists to initiate weather modification experiments in the country at an early date. The Union Minister of Science and Technology held a meeting with scientists in May, 1973 to discuss the feasibility of existing techniques as a result of which it was recommended that experiments should be undertaken during the next two to three years using both the inexpensive ground based seeding technique developed in India and the sophisticated dynamical cumulus modification techniques developed in USA. Keeping in view the WMO statement, we recommend that it is essential and urgent to strengthen both the research and operational aspects of the present organisation in the IMD and the Indian Institute of Tropical Meteorology to enable them to conduct further trials and experiments for the next two to three years to arrive at dependable conclusions.

## 9 RESEARCH, EDUCATION AND TRAINING AND INTERNATIONAL COOPRRATION

## Research

13.9.1 Several problems involving research, analysis and investigation
in the field of agrometeorology have been mentioned in the preceding Sections. In addition some more are indicated below.

## Mathematical Simulation Modelling

13.9.2 In recent years investigations are in progress on mathematical simulation modeling in agrometeorology for the quantitative evaluation of the effects of agrometeorological factors on the conditions and productivity of agricultural crops. This is a welcome development. The present state of work in this field needs review for application of such models to Indian data and conditions. IMD in consultation with ICAR should work out a joint programme of study using this approach.

Production Functions for Crop Yields
13.9.3 The Planning Unit of the Indian Statistical Unit, New Delhi, has been engaged in studies on production functions for crop yields with dated inputs of irrigation water. For studying economically optimal use of water it is necessary to know the shape of the crop response function to different quantities of water used by the crop throughout its growth cycle. An important factor in this is the soil moisture release curve which is used as an indicator of actual yield. Evapotranspiration data are important in all these studies but lack of actual observational data has necessitated the use of computed values based on a number of assumptions. According to a paper on wheat ( ${ }^{1}$ ) prepared by the Planning Unit, the results seem encouraging even after use of computed values of evapotranspiration. It is desirable that such studies are extended using actually observed evapotranspiration values which are becoming available at some stations and in their absence use of recent computed values.

## Irrigation Evaluation

13.9.4 A study (2) has been made on the estimation of direct returns from supplemental irrigation of a monsoon rice crop as part of a broader objective to determine whether irrigation water in Rajpur district of Madhya Pradesh might be profitably reallocated to a wheat crop during the arid months of the year. The analysis is detailed and uses probability

[^17]considerations. Pan evaporation data have been used as a first approximation of paddy evapotranspiration. The estimated water need during September-October stress period is a minimum of 17 cm and maximum usable of 33 cm . The general conclusion on the basis of conditions as prevalent at the time was not favourable for reallocation hypothesis. It would be uneconomical to allocate water applied as supplemental irrigation on monsoon paddy to irrigated dry season wheat. It has been observed in the preface to this study that the author and his family lived in the area for fifteen moniths and collected the requisite data after careful scrutiny and checking. This considerably enhances the value of the study. Studies of the above type are desirable for a proper evaluation of irrigation and yield relationship of crops.

Agroclimatalogical Maps
13.9.5 During the past few decades, considerable volume of agrometeorological data have been collected and some of it has also been published. The time seems opportune to carefully examine and review the feasibility of preparation and publication of an agroclimatic atlas giving at least essential agroclimatic maps. Requests for such maps are also reported to be on the increase as there is at present no such suitable Atlas. It is understood that the IMD has plans for publication of such an atlas. The contents of the proposed atlas should be worked out in detail in consultation with ICAR and Directorate of Economics and Statistics, Ministry of Agriculture \& Irrigation so that it would serve as a source of reference to a wide class of users. The stress in the Atlas would no doubt be on maps having a close bearing on agriculture. In this connection it may be mentioned that the Commission for Agricultural Meteorology of WMO at its Sixth Session held in October, 1974 has appointed a Rapporteur on Agroclimatic Maps ${ }^{1}$ to examine the problems of different scales and to make proposals for the specifications of agroclimatic maps. It would be very desirable that the specification drawn up by the IMD should conform as far as practicable with those of WMO.

## Education and Training

13.9.6 In our Interim Report on the Establishment of Agrometeorological Divisions in Agricultural Universities, we have recommended as follows :
(i) A Division of Agricultural Meteorology should be started in every agricultural university and certain other selected uni-

1 Abridged Final Report. 1975, Sixth Session of Commission for Agricultural Meteorology, Washington 14-25 October, 1974. WMO No. 402, Secretariat of the World Meteorological Organisation, Geneva, Switzerland.
versities and central institutions which have the requisite facilities.
(ii) The Agrometeorology Division should deal with meteorological research of biological nature and also teach agricultural meteorology at all the levels.
(iii) ICAR should establish and finance the Agrometeorological Divisions in the Universities and also draw up the qualifications for staff and syllabi for the various courses.
(iv) Every Agrometeorological Division should have a well-equipped first class field observatory.
13.9.7 We have recommended the opening of a large network of soil moisture, phenological and other types of observational stations. With such large numbers, inservice training of staff in practical observational work assumes considerable significance. The need is for training of lower level staff consisting of undergraduates and Secondary School Certificate holders who will be required to man large number of raingauges, soil moisture and other observational stations. The inservice training should be arranged by the concerned organisations in consultation and cooperation with the agrometeorology division of the IMD. Specialised training as required should be arranged in consultation with the IMD. In all these training programmes, cooperation and coordination between State agricultural organisations and IMD are essential.

## International Cooperation

13.9.8 The World Meteorological Organisation is a Specialised Agency of the United Nations Organisation and the Commission for Agricultural Meteorology is one of its eight technical commissions. The permanent representative of India on the World Meteorological Organisation is the Director General of Observatroies of the IMD. The technical commissions held their meetings once every four years. In the past a representative from the IMD used to be deputed to attend the meetings. The Commission for Agricultural Meteorology held its Sixth Session in Washington from October 14-25, 1974. The subjects discussed included methods in agricultural meteorology, meteorological factors and agricultural production, modification and control of the agricultural environment, drought and agriculture, meteorological aspects of soil degration and fertility, forest meteorology, weather forecasting for agriculture, weather and climate and food production, economic benefits of agrometeorological services and training and symposia in agricultural meteorology. One of the major items was climate and food production. The importance of the subjects discussed both from the meteorological
and agricultural points of view needs no emphasis. Rapid developments are taking place in science and technology and international meetings afford valuable opportunities for mutual exchange of views and discussions. In a field so vital as agricultural meteorology we recommend that every effort should be made to depute agrometeorologists also to the Commission's meetings.

## 10 Organisation of meteorological observatories and RAINGAUGES FOR AGRICULTURE

13.10.1 The India Meteorological Department has a wide network of about 500 synoptic observatories for recording various weather observations. Besides, there are a number of hydrometeorological observatories for collection of basic hydrometeorological data for planning river valley and flood control projects. In addition, there are about 50 agrometeorological stations maintained by different State agriculture departments that provide on a routine basis simultaneous meteorological and biological information regarding growth and yield of important crops as well as weather experienced by the crops during their life cycles. Another 70 auxiliary agrometeorological stations recording meteorological observations in farm areas are maintained by State and Central agricultural institutions. There is also a network of about 4400 raingauge stations maintained by the various State Governments whose data are received or arranged to be received by the IMD at Poona. Besides, there are about 3600 raingauges maintained by railways and other official agencies in different States, whose data are at present not being published in the State Rainfall Tables.
13.10.2 Meteorological data and forecasts cater to several categories of interests. The network density of meteorological observatories varies according to the requirements of the user interests. To meet the increasing demands for weather data for operational purposes and for research into various aspects of agriculture including also animal husbandry, horticulture, forestry, fisheries etc., there is need for a complete and early review of the existing network by the respective State and Central elepartments and organisations concerned. The programme for future meteorological network for agriculture including animal husbandry, forestry etc. should have unified development under three broad headings viz., (a) micrometeorological observatories in selected areas for the understanding of the basic physical interaction between the plant and its environment; (b) meso-scale climatic network designed to provide farmers information to improve their agricultural operations and (c) macro-seale regional networks designed for better weather forecasting capability. The
rainfall organisation in the country will have to be considered along with these. We have recommended elsewhere in our Report that there should be well-qualified agricultural personnel even at taluk level. The observatories to be opened should be manned by qualified agricultural staff to ensure the accuracy and reliability of the observations. We have already referred to the need for soil moisture observations from each taluk at least. The rainfall organisation is now reviewed with suggestions for its improvement.

Rainfall Registration in India
13.10.3 It should be clear from the preceding sections that rainfall is vital to agriculture. Rainfall statistics are obviously, therefore, extremely valuable to agricultural scientists, planners and administrators. The IMD were recently consulted about the present set-up of rainfall organisation in India. The following are the main points :
(i) Rainfall registration in India is governed by the 1890 Rainfall Resolution of the Government of India. In accordance with this Resolution, the subject of rainfall registration in the country was brought under the technical control of the IMD; the various State Governments are responsible for the following items: (a) the maintenance and inspection of all raingauge stations under their control; (b) the recording and collection of rainfall data from these stations; (c) the regular publication of such data for the use of the public; and (d) the supply of special printed statements of daily and monthly rainfall in prescribed forms to the IMD for the compilation of the two annual publications viz, the 'Daily Rainfall of India' and 'Monthly of Annual Rainfall of India'. The Director General of Observatories, IMD is responsible for (i) the technical advice to the State Governments on all matters connected with the rainfall registration, such as selection of sites and installation of raingauges, methods of rainfall observation, inspection of raingauge stations, etc. and (ii) the compilation and issue of consolidated rainfall data for the whole of India, (e) rainfall observations are recorded in the country at the observatories and at raingauge stations maintained by the States or their agencies. Raingauge stations whose data are published in the printed Rainfall Tables are classed as "Reporting stations". The number of such stations at present is over 5000. The distribution is shown in Appendix 13.1Statement $V$ of the number of stations from each State whose data are received or arranged to be received by the India Meteorological Department at Poona. This number is 4399 and does
not include the raingauges maintained by the IMD. Rainfall is recorded daily at all the raingauge stations in the country at 0830 hrs IST and represents the total for the preceding 24 hours and at many departmental observatories, twice or more.
(ii) There is a total network of over 8000 raingauge stations spread all over the country. Out of these, there are about 5000 stations whose records are generally available in published form and/or on punch cards; others are non-reporting stations as stated above.
(iii) Out of the 5561 raingauges inspected, only 2.1 per cent function without any deficiency. Most of the raingauges suffer from some instrumental defect or the other; exposure conditions of raingauges are also not in conformity with the standards laid down by the IMD.
(iv) Implementation of reports of the Inspecting Officers of the IMD has been carried out only in 10.5 per cent cases.
(v) Publication of rainfall data is in arrears anywhere up to 10 years or sometimes even more.
13.10.4 It is clear that the arrangements envisaged in the Rainfall Resolution have not worked and are not working satisfactorily. The quality of data cannot be also said to conform to standards because of instrumental and exposure defects and lack of adequate checking. Printed data are lagging behind and in the data printed, the IMD has to state the following types of lacunae:
(i) The total of daily rainfall values as computed do not tally with the monthly totals printed.
(ii) The heaviest daily rainfall in each month given in the tables is not tallying with the heaviest picked up from daily values due to either shift of line in printing or misprint.
(iii) The monthly totals of rainfall and rainy days shown in the end of Daily Tables do not tally with the corresponding totals given in the Monthly and Annual Tables.
13.10.5 The India Meteorological Department was also asked whether (in view of the unsatisfactory state of rainfall instruments, their oxposure and statistics) it was not appropriate that the Department takes up the direct responsibility of all matters pertaining to rainfall organisation. The Department has stated that, though the arrangement between it and the States concerned with regard to the Rainfall Registration in the country has not worked so satisfactorily, it is not practicable to take up the entire job of rainfall registration. However,' in order to provide uptodate and accurate printed rainfall data collected according to national standards of instruments and exposure, a scheme entitled 'Reorganisation of Rainfall Registration in India' has been drawn up. The main features of the scheme are
(i) All raingauges (about 4000) to be procured, inspected and installed departmentally.
(ii) Payment to Rainfall Observer @ Rs. 10 p.m. at par with Class V part-time departmental observatories. Payment is to be made by the Department.
(iii) Issue of Monthly Rainfall Bulletin by the Department.
(iv) Publication of monthly and annual rainfall data to be done departmentally.
While noting the action which the India Meteorological Department is proposing to take under its scheme entitled "Reorganisation of Rainfall Registration in India", it is suggested that :
(i) all the existing 8000 raingauges in the country should be brought within the purview of the scheme;
(ii) all of them should belong to the category of "Reporting Raingauges", and
(iii) all the arrears of rainfall data should be printed most expeditiously.
13.10.6 We have given considerable thought to the future of rainfall organisation in the country. Water is a major natural resources and maintenance of proper statistics is essential to meet the requirements of agricultural departments, irrigation departments, etc. The present arrangements which were introduced more than eight decades ago are in bad shape and particularly so during the past two decades or more. The exposure and maintenance of the raingauges are extremely unsatisfactory. Of the existing raingauges, hardly two per cent satisfy the standards. Checking of rainfall data for their accuracy is extremely limited. Hardly ten per cent of the recommendations of inspectors have been implemented. The Director General of Observatories is no doubt the technical adviser to States on rainfall registration but his manifold functions leave him little time for this field due to circumstances beyond his control. The problems involved in organising the rainfall registration of the country which already has eight thousand raingauges and which may increase in number rapidly in the future, are considerably complex. The future proposals of the Director General of Observatories outlined above can only meet partially the needs of the situation. We are, however, concentrating here on the requirements for agriculture.
13.10.7 As a basic policy we recommend that agrometeorological observational organisation including raingauges as required by State Departments of Agriculture should be directly under their respective control. The State Departments of Agriculture should meet the finances needed for the maintenance of the organisation and make provision in their budgets accordingly. In line with this policy, every State should review their requirements immediately and draw up programmes for speedy implementation.
13.10.8 There is increasing demand from many sources for improved and expanded network of raingagues. Daily and short period rainfalls show large differences even at short distances. While States may review the position in this regard taking all aspects into consideration, we recommend as a first step that there should be at least one raingauge in each Block. The number of Blocks is at present about 5100 while the number of reporting State raingauges is 4400 . About 700 new raingauges would have to be set up early.
13.10.9 Rainfall recording is done by a variety of officials revenue, police etc. But the current data of the reporting raingauge stations are most needed urgently by the Departments of Agriculture for crop weather seasonal reports, for use of other State and Central departments etc. We, therefore, recommend that the State raingauge network should be placed under the charge of the Director of Agriculture who will take over all the functions and responsibilities of the State Rainfall Registration Authority. We have recommended above that every block area must have at least one raingauge. Also, as Block Development offices will have qualified scientific personnel, they should be in charge of the raingauges in their respective areas regarding observational work, maintenance of equipment, supervision and related work. This would involve shift of all the existing gauges to the Block Development offices which should be done in a phased manner because of the problems involved, These mainly are :
(i) The approval for the new sites should be obtained from the Director General of Observatroies, who is the technical adviser Rainfall Registration in the country;
(ii) Constructional works at the new site for the erection of raingauges should have to be arranged;
(iii) Unsatisfactory equipment should be replaced by standardised new instruments; and
(iv) Examination of the applicability of the existing rainfall normals for the new site.
In order to speed up action on all these, coordinated and cooperative action with the Director General of Observatories is essential. It should be emphasised that rainfall record is a compilation of scientific measurements made according to national and international standards and unless taken in the prescribed manner usefulness of such rainfall data will be considerably vitiated.
13.10.10 It has been recommended elsewhere in-this Report that the State Agricultural Departments will have planning units to look after planning, progress and evaluation of agricultural programmes. This unit will also take over the work of preparing the rainfall data in the form required for publication in State Gazettes as at present. This will enable the State Departments of Agriculture to use the data in their extension and
planning work with least delay. The daily rainfall data of States should be published after preliminary scrutiny within six months after the month to which they relate to. With the large volume of data coming in, the planning unit should have facilities for getting the basic data punched on cards according to standard format as prescribed by the Agricultural Department after discussions with India Meteorological Department. This arrangement will ensure uniformity, speedier processing, checking for reliability of data and supply.
13.10.11 As the planning unit is to deal with rainfall and meteorological data which will be required by the State Agricultural Departments, we recommend that there should be a qualified Agricultural Meteorologist to handle all this scientific material in this unit. At the Centre, the collection, compilation and analysis of the data should be done in the Directorate of Economics and Statistics. The Directorate should havea person qualified and experienced in Agricultural Meteorology as well as statistics to be in charge of this work so that the meteorological data could be properly analysed and prescribed in a form uscful to all the concerned interests.
13.10.12 The Meteorological Department has all the necessary facilities and competence in the matter of checking whether the equipment and data conform to standards etc. They should continue to exercise this responsibility so that all rainfall data recorded in the country will have uniformity in standards. The above proposals would involve considerably increased work to the India Meteorological Department and they should be provided the necessary additional staff so that the existing State rainfall organisation may be placed on firm scientific basis.

## 11 SUMMARY OF RECOMMENDATIONS

### 13.11.1 The main recommendations are summarised below :

Climate

1. Present rainfall normals (1901-50) which are more than two decades old should be revised and published early. Normals of stations computed with records for shorter periods should be reduced to the same period as those with complete records.
(Paragraph 13.2.4)
2. The method of working of district normals should be reviewed. Percentage departures from normal of rainfall for the various meteorological subdivisions should be worked out for all the years from the beginning on a uniform basis and using the latest normals.
(Paragraph 13.2.4)
3. Frequency distributions of daily rainfall should be prepared for all taluk stations and published.
(Paragraph 13.2.7)
4. Weekly totals of rainfall of all stations with data of at least 20 years should be published.
(Paragraph 13.2.8)
5. A good network of snowfall recording stations should be organised. Studies on the contribution of snow to river flow should be undertaken.
(Paragraph 13.2.10)

## Claciology

6. IMD, Geological Survey and other concerned departments should draw up coordinated programmes of work in the field with a view to understanding their role in Indian weather.
(Paragraph 13.2.11)
Rainfall Variability
7. Whenever normals of rainfall of a station or area are computed, they should always be accompanied by their respective standard deviations and values of Coefficient of Variation.
(Paragraph 13.2.13)
8. 'Breaks' in rainfall should be analysed for taluk areas and published for general use.
(Paragraph 13.2.19)
Temperatures
9. Frequencies of daily maximum and minimum temperatures, heat and cold wave spells and duration in hours of temperatures in different ranges should be prepared and published.
(Paragraph 13.2.20)
10. Reference publications (i) Climatological Tables of Observatroies in India (1931-60) and (ii) Climatological Atlas of India (Abridged) should be reprinted early as copies of these are not readily available.
(Paragraph 13.2.21)
Wind
11. Averages of hourly wind data and frequencies of speeds in different intervals and durations should be published for all the stations for which data are available.
12. Complete series of rainfall of all the stations in the country with records of 70 years or more, percentage departures from normal of all the meteorological subdivisions should be published to facilitate detailed studies of trends and periodicity in Indian rainfall.
(Paragraph 13.2.26)

## Climate Change

13. The problems concerning climatic change and prediction should be taken up as a research project by the Indian Institute of Tropical Meteorology, Poona in cooperation with India Meteorological Department and ICAR etc.
(Paragraph 13.2.28)

Agrometeorology
14. ICAR should examine the feasibility of inclusion in their future programmes of research biochemical studies for a fuller understanding of crop weather relationships.
(Paragraph 13.3.2)
15. There is urgent need to go in for phytotrons at all the agricultural universities to have clearer ideas on crop weather relationships under controlled conditions.
(Paragraph 13.3.4)
16. Each one of the rainfall zones into which the country has been divided (vide Chapter 14) should have at least one fully equipped agromet observatory.
(Paragraph 13.3.5)
17. Every taluk should have at least one soil moisture measuring station. The total for the country would be about 3000 and this network should be built up by the State Agricultural Departments during the next few decades. They should also arrange for the publication of these data.
(Paragraph 13.3.6)
18. Studies of evapotranspiration under varying conditions of soil moisture in different soils and using as many plant species as possible are urgent and this work should be started at all the agricultural universities, the central institutes of ICAR and the Forest Research Institute Dehra Dun. Based on the results of these studies, a suitable network of stations, one at least in each district, for actual observational measurements should be started.
(Paragraph 13.3.8)
19. The network of stations recording phenological observations should be expanded so that there is at least one station in each taluk. The 6-133 Deptt. of $\mathrm{Agrl} / 76$
selection has to be of nature-grown plants as far as possible.
(Paragraph 13.3.9)
20. ICAR should organise a joint meeting of plant pathologists, entomologists and agricultural meteorologists for organising a unified approach to the study of problems of pests and diseases. These will not only include the relationship under field conditions between weather and pests and diseases but also steps for starting a surveillance service based on meteorological factors which should be helpful in forecasting and controlling the epidemics.
(Paragraph 13.3.10)
21. Meteorological observatories in adequate numbers should be set up in orchards, plantations and forests.
(Paragraph 13.3.12)
22. India Meteorological Department in consultation with Forest Research Institute, Dehra Dun and State Forest Departments should draw up a long-term research programme in forest meteorology.
(Paragraph 13.3.13)
23. All institutions and organisations dealing with animal research and dairy, piggery and poultry should arrange for meteorological observations needed for their work and conduct micro-climatic studies within paddocks and barns.
(Paragraph 13.3.15)
24. Research studies should be undertaken with a view to forecasting animal diseases.
(Paragraph 13.3.16)
Droughts
25. Comprehensive and systematic studies of all past droughts by dynamic and synoptic climatological methods should be undertaken as a joint project by the India Meteorological Department and the Indian Institute of Tropical Meteorology, Poona, for developing techniques for forecasting them.
(Paragraph 13.4.8)
Crop Weather Calendars
26. Existing crop weather calendars should be brought up-to-date. Separate calendars should be prepared for early, normal and late sown varieties of each crop in different areas of the country. They should also be prepared for crops like soyabean, cow-pea, safflower, sunflower etc.

## Weather Bulletins

27. Weather bulletins for farmers should include advice on agricultural operations and should be prepared daily after joint discussions between forecasting officer and agricultural officer deputed by local agricultural department to make them purposeful. In the light of Karnataka and Tamil Nadu experience this arrangement of joint daily discussions in preparation of operational weather bulletins should be compulsorily extended to all States. The trial SITE programme of weather broadcasts for farmers issued after joint discussions of representatives from ICAR, Agricultural Meteorologist and the weather forecaster should become a regular feature.
(Paragraph 13.5.4)
28. IMD should evaluate each year the performance of weather bulletins for farmers and discuss at conferences of agriculturists at State level. ICAR should consider convening of such periodical conferences for evaluating weather service to farmers and for their improvement. (Рагаgraph 13.5.5)
29. Every State should issue a weekly crop weather bulletin containing description of week's weather and crops in the State and outlook for a week ahead. The responsibility for the compilation and issue should be that of the Directorate of Economics and Statistics with cooperation from the local Meteorologist, the Director of Agriculture of the State and a representative from local agricultural university.
(Paragraph 13.5.7)

## Extended Range Forecasting

30. Research into various aspects of 'Extended Range Forecasting' should be given priority and work distributed among the IMD, Indian Institute of Tropical Meteorology, Poona and other interested institutions. An advisory working group may be set up with the Director General of Observatories as Chairman and membership from IMD, ICAR and State Agricultural Departments to periodically assess and review the speedy implementation of programmes of work.
(Paragraph 13.6.7)'
Crop Weather Relationships
31 (i) Crop weather studies in progress in the IMD should be intensified and formulae developed on a district-wise basis.
(ii) Detailed data on acreage, yield etc. according to varieties, irrigation, cultural practices etc. are essential for crop weather studies and
these should be compiled in standard format by Directorate of Economics and Statistics. Formulae for forecasts of crop acreage should be developed using climatological factors.
(Paragraphs 13.7.9 and 13.7.10)
Weather Modification
31. The research and operational aspects of the present organisation for weather modification in the India Meteorological Department and Indian Institute of Tropical Meteorology should be strenghtened to conduct further trials and experiments to arrive at dependable conclusions.
(Paragraph 13.8.8)

## Research Education and Training

33. Work in the field of Mathematical Simulation Modelling should be reviewed and attempts made with data available in India. IMD in consultation with ICAR should work out a joint programme of study using this approach.
(Paragraph 13.9.2)
34. Production functions for crop yields should be worked out using techniques of analysis developed in the Indian Statistical Institute and in the paper on irrigation evaluation under monsoon rainfall conditions.
(Paragraphs 13.9.3 and 13.9.4)
35. The present position regarding agroclimatological atlas should be reviewed and as soon as feasible, a detailed and comprehensive atlas should be prepared.
(Paragraph 13.9.5)
36. Inservice training of staff for manning various types of Agromet observatories should be arranged by the State agricultural organisations in cooperation with IMD.
(Paragraph 13.9.7)
37. Agricultural Meteorologists should be deputed to meetings of the Commission of Agricultural Meteorology of World Meteorological Organisation.
(Paragraph 13.9.8)

## Observational Organisation

38. As a policy, the observational organisation needed by State Departments of Agriculture etc. should be controlled and maintained by them. They should provide all the finances needed for the purpose.

Every State should immediately review their observational requirements and the organisation needed by them for necessary action.
(Paragraph 13.10.7)
39. Every Block should have at least one raingauge and they should be located in Block Development Office.
(Paragraph 13.10.8)
40. Rainfall Organisation in the States which is primarily needed by the State Agricultural Departments should be placed under their direct control; they will examine the present locations etc. of raingauges and take action to shift them to block offices in consultation with and cooperation of the Director General of Observatories who will continue to be technical adviser on all matters concerning meteorological observations.
(Paragraph 13.10.9)
41. Departments of Agriculture will have a planning unit for dealing with planning, progress and evaluation of agricultural programmes. Each unit must have a qualified Agricultural Meteorologist who should look after all matters pertaining to meteorology including the rainfall organisation. He will arrange for the collection, scrutiny, checking, processing and publication of the data and for supply of data to all concerned. At the Centre, these items of work should be handled by the Directorateof Economics \& Statistics. As these form basic data for analysis they should also be punched in prescribed formats in consultation with India Meteorological Department.
(Paragraphs 13.10.10 and 13.10.11)
42. The proposals regarding reorganisation of State rainfall organisation will involve considerably increased work to the India Meteorological Department and they should be provided with additional staff for the purpose.
(Paragraph 13.10.12)

## APPENDIX 13.1

(Paragraph 13.2.1)
Statement I—Average latitudinal position of Depressions Crossing Different Longitudes from 92 to $75^{\circ} \mathrm{E}$ during July and August-based on data of 80 years from 1891 to 1970.*

*From an unpublished report by R. Suryanarayana. Indian Institute of Tropical Meteorology, Poona.

## APPENDIX 13. $\mathbf{1 7}^{7}$ (Contd.)

(Paragraph 13.2.3)
Statement II-Normals of Rainfall (Cm) for Meteorological Sub-Divisions of the Country


APPENDIX II 13.1-Statement II (Contd.)

| S. Meteorological No. Sub-Divisions |  | Annual | Season Jan-Feb. |  |  |  | Season Mar-May |  |  |  |  |  | Season June-Sept |  |  |  | P | Season Oct-Dec. Oct Nov Dec ST |  |  |  | P |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Jan | Feb | ST | P | Mar | Apr | May | ST | P | Jun | Jul | Aug | Sep | ST |  |  |  |  |  |  |
| 16 | Madhya Pradesh (East) |  | 143 | 2 | 3 | 5 | 5 | 2 | 2 | 2 | 6 | 6 | 19 | 43 | 39 | 22 | 123 | 86 | 6 | 2 | 1 | 9 | 6 |
| 17 | Gujarat Region | 97 | L | L | L | - | L | L | 1 | 1 | 1 | 13 | 40 | 24 | 16 | 93 | 96 | 2 | 1 | L | 3 | 3 |
| 18 S | Saurashtra and Kutch | 48 | L | L | L | - | L | L | 1 | 1 | 2 | 7 | 21 | 10 | 7 | 45 | 94 | 2 | L | L | 2 | 4 |
| 19 K | Konkan | 287 | L | L | L | - | L | 1 | 3 | 4 | 1 | 62 | 108 | 63 | 37 | 270 | 94 | 10 | 3 | L | 13 | 5 |
| 20 M | Madhya Maharashtra | $92$ | 1 | L |  | 1 |  | 1 | 2 | 3 | 3 | 15 | 28 | 18 | 16 | 77 | 84 | 7 | 3 | 1 | 11 | 12 |
| 21 | Marathawada | 80 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 4 | 5 | 14 | 17 | 14 | 20 | 65 | 81 | 5 | 3 | 1 | 9 | 11 |
| 22 | Vidarbha | 109 | 1 | 2 | 3 | 3 | 1 | 1 | 1 | 3 | 3 | 17 | 34 | 26 | 18 | 95 | 87 | 5 | 2 | 1 | 8 | 7 |
| 23 | Coastal Andhra Pradesh | 100 | 1 | 1 | 2 | 2 | 1 | 2 | 5 | 8 | 8 | 10 | 15 | 15 | 17 | 57 | 57 | 19 | 12 | 2 | 33 | 33 |
| 24 T | Telangana | 91 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 5 | 5 | 13 | 24 | 19 | 19 | 75 | 82 | 6 | 2 | L | 8 | 9 |
| 25 | Rayalaseema | 68 | 1 | 1 | 2 | 3 | 1 | 2 | 5 | 8 | 12 | 6 | 8 | 10 | 13 | 37 | 54 | 11 | 8 | 2 | 21 | 31 |
| 26 | Tamil Nadu | 102 | 4 | 2 | 6 | 6 | 2 | 5 | 7 | 14 | 14 | 6 | 7 | 10 | 11 | 34 | 33 | 19 | 20 | 9 | 48 | 47 |
| 27 | Coastal Karnataka | a 326 | L | L | L | - | 1 | 3 | 11 | 15 | 5 | 84 | 110 | 63 | 28 | 285 | 87 | 18 | 7 | 1 | 26 | 8 |
| 28 I | Interior Karnataka (N) | 69 | L | L | L | - | 1 | 3 | 5 | 9 | 13 | 9 | 13 | 10 | 13 | 45 | 65 | 10 | 4 | 1 | 15 | 22 |
| 29 I | $\begin{array}{ll} \text { Interior } & \text { Karnata- } \\ \text { ka (S) } & . \end{array}$ | 124 | L | 1 | 1 | 1 | 1 | 5 | 10 | 16 | 13 | 18 | 31 | 21 | 14 | 84 | 68 | 15 | 7 | 1 | 23 | 19 |
| 30 K | Kerala . . | 301 | 2 | 2 | 4 | 1 | 5 | 11 | 25 | 41 | 14 | 67 | 68 | 42 | 24 | 201 | 67 | 31 | 19 | 5 | 55 | 18 |
| 31 A | Arabian $\quad$ Sea Island | 155 | 3 | 1 | 4 | 3 | 1 | 4 | 15 | 20 | 13 | 34 | 28 | 21 | 15 | 98 | 63 | 16 | 11 | 6 | 33 | 21 |

## APPENDIX 13.1 (Contd.)

Statement IU-Normals of Rainy Days for Meteorological Sub-divisions of the Country


## APPENDIX 13.1-Statement III (Contd.)

| S. | Meteorological | Annual Jan |  | Season Jan-Feb |  |  | Season Mar-May |  |  |  |  | Season June-Sept |  |  |  |  | Season Oct-Dec |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| No. | Sub-Divisions |  |  | Feb | ST | P | Mar | Apr | May | ST | P | Jun | Jul | Aug | Sep | ST | P |  | Nov | Dec | ST | P |
| 17 | Gujarat Region | 43 | $0 \cdot 2$ | $0 \cdot 2$ | 0.4 | 1 | $0 \cdot 1$ | $0 \cdot 2$ | 0.4 | $0 \cdot 7$ | 2 | 5 | 15 | 12 | 7 | 39 | 92 | 1 | $0 \cdot 5$ | $0 \cdot 1$ | 2 | 4 |
| 18 | Saurashtra and |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Kutch . | 23 | 0.2 | $0 \cdot 2$ | 0.4 | 2 | 1-1 | $0 \cdot 1$ | 0.4 | 0.6 | 3 | 3 | 9 | 6 | 3 | 21 | 92 | 0.70 | . 2 | $0 \cdot 1$ | 1 | 4 |
| 19 | Konkan . | 93 | 0-2 | $0 \cdot 1$ | $0 \cdot 3$ | 0 | $0 \cdot 1$ | $0 \cdot 4$ | 1 | 1 | 2 | 17 | 27 | 24 | 16 | 84 | 91 | 5 | 1 | $0 \cdot 3$ | 6 | 7 |
| 20 | Madhya Maharashtra | 49 | 0.4 | $0 \cdot 2$ | 0.6 | 1 | $0 \cdot 3$ | 0.9 | 2 | 3 | 6 | 8 | 13 | 10 | 9 | 40 | 79 | 4 | 2 | $0 \cdot 5$ | 7 | 13 |
| 21 | Marathwada . | 45 | 0.5 | $0 \cdot 5$ | 1 | 2 | $0 \cdot 6$ | 0.9 | 1 | 3 | 6 | 8 | 11 | 9 | 9 | 37 | 81 | 3 | 2 | 0.5 | 5 | 11 |
| 22 | Vidarbha | 55 | 0.9 | 1 | 2 | 4 | 1 | 0.9 | 1 | 3 | 6 | 9 | 15 | 12 | 9 | 45 | 83 | 3 | 1 | 0.6 | 5 | 8 |
| 23 | Coastal Andhra <br> Pradesh | 53 | $0 \cdot 6$ | 0.8 | 1 | 3 | $0 \cdot 7$ | 2 | 3 | 6 | 10 | 6 | 10 | 9 | 9 | 34 | 63 | 7 | 4 | 1 | 12 | 24 |
| 24 | Telangana | 54 | 0.4 | 1 | 1 | 3 | 0.9 | 2 | 2 | 5 | 8 | 8 | 14 | 11 | 10 | 43 | 79 | 4 | 2 | $0 \cdot 3$ | 6 | 10 |
| 25 | Rayalaseema | 41 | 0.6 | 0.4 | 1 | 2 | 0.4 | 1 | 3 | 4 | 12 | 4 | 6 | 6 | 7 | 23 | 57 | 6 | 4 | 1 | 11 | 29 |
| 26 | Tamil Nadu | 53 | 2 | 1 | 3 | 5 | 1 | 3 | 4 | 8 | 16 | 4 | 4 | 6 | 6 | 20 | 37 | 9 | 9 | 4 | 22 | 43 |
| 27 | Coastal Karnataka | 112 | $0 \cdot 2$ | $0 \cdot 1$ | $0 \cdot 3$ | 0 | 0.4 | 2 | 5 | 7 | 7 | 23 | 28 | 25 | 16 | 92 | 81 | 9 | 4 | 0.8 | 14 | 12 |
| 28 | Interior Karnataka (North) | 47 | $0 \cdot 2$ | $0 \cdot 2$ | 0.4 | 1 | $0 \cdot 6$ | 2 | 4 | 7 | 14 | 7 | 10 | 8 | 8 | 33 | 68 | 6 | 2 | $0 \cdot 6$ | 9 | 19 |
| 29 | Interior Karnataka (South) | 67 | 0.4 | 0.4 | 0.8 | 1 | $0 \cdot 7$ | 3 | 6 | 10 | 15 | 9 | 13 | 11 | 9 | 42 | 63 | 9 | 4 | 1 | 14 | 20 |
| 30 | Kerala . . | 126 | 1 | 1 | 2 | 2 | 3 | 7 | 10 | 20 | 15 | 23 | 24 | 19 | 13 | 79 | 62 | 14 | 9 | 3 | 26 | 21 |
| 31 | Arabian $\quad$ Sea Islands | 87 | 2 | 0.8 | 3 | 3 | 0.9 | 2 | 7 | 10 | 11 | 17 | 15 | 12 | 10 | 54 | 63 | 9 | 7 | 3 | 19 | 22 |

## APPENDIX $13 \cdot 1$ (Contd.)

(Paragraph 13.2.3)

Statement IV-*Coefficient of Variation (\%) of Monthly, Seasonal and Annual Rainfall for 31 Meteorological Sub-divisions of India

| Sub-Division | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Ann | JanFeb | Mar- <br> May | JuneSept | JuneOct | Oct <br> Dec |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1. North Assam | 75 | 56 | 59 | 34 | 30 | 17 | 18 | 21 | 22 | 41 | 90 | 110 | 8 | 38 | 22 | 8 | 8 | 37 |
| 2 South Assam | $\bigcirc 134$ | 73 | 64 | 37 | 35 | 19 | 21 | 20 | 22 | 46 | 107 | 151 | 9 | 57 | 23 | 10 | 9 | 38 |
| 3 Sub-Himalayan <br> West Bengal | 118 | 85 | 86 | 58 | 27 | 24 | 27 | 28 | 27 | 67 | 184 | 205 | 12 | 63 | 26 | 13 | 12 | 62 |
| 4 Gangetic West Bengal | 117 | 111 | 108 | 73 | 44 | 41 | 28 | 23 | 26 | 69 | 149 | 200 | 13 | 86 | 36 | 14 | 15 | 62 |
| 5 Orissa . | 121 | 104 | 106 | 77 | 55 | 42 | 26 | 24 | 22 | 65 | 135 | 220 | 11 | 81 | 42 | 12 | 13 | 53 |
| 6 Bihar Plateau | 112 | 92 | 108 | 83 | 60 | 46 | 25 | 18 | 29 | 83 | 168 | 203 | 11 | 70 | 45 | 12 | 12 | 72 |
| 7 Bihar Plains | 106 | 90 | 120 | 103 | 55 | 49 | 27 | 26 | 35 | 91 | 196 | 241 | 14 | 66 | 43 | 16 | 15 | 81 |
| 8 Uttar Pradesh (East) | 99 | 107 | 140 | 166 | 86 | 59 | 36 | 25 | 43 | 128 | 230 | 146 | 18 | 70 | 72 | 20 | 20 | 104 |
| 9 Uttar Pradesh (West) | 84 | 89 | 99 | 112 | 75 | 68 | 31 | 33 | 61 | 147 | 203 | 121 | 19 | 56 | 59 | 22 | 23 | 98 |
| 10 Haryana | 91 | 97 | 111 | 163 | 127 | 82 | 41 | 51 | 87 | 193 | 251 | 131 | 28 | 62 | 76 | 31 | 32 | 114 |
| 11 Punjab . | 79 | 86 | 92 | 107 | 86 | 73 | 38 | 43 | 104 | 208 | 200 | 102 | 26 | 52 | 54 | 32 | 33 | 91 |
| 12 Himachal Pradesh | 68 | 64 | 71 | 64 | 58 | 61 | 26 | 31 | 67 | 122 | 166 | 88 | 16 | 43 | 39 | 21 | 22 | 67 |
| 13 Jammu and Kashmir | 57 | 59 | 50 | 48 | 53 | 56 | 33 | 82 | 82 | 103 | 139 | 75 | 16 | 38 | 28 | 26 | 26 | 62 |
| 14 Rajasthan West | 130 | 162 | 174 | 166 | 146 | 81 | 54 | 74 | 107 | n.a. | 220 | 184 | 42 | 105 | 99 | 43 | n.a. | 650 |
| 15 Rajasthan East | 101 | 124 | 168 | 221 | 135 | 78 | 40 | 50 | 72 | n.a. | 170 | 152 | 28 | 81 | 99 | 30 | 45 | 437 |

APPENDIX 13.1-Statement IV (Contd.)

| Sub-Division | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Ann | I JanFcb | MarMay | JuneSept | JuneOct | Oct Dcc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 16. Madhya Pradesh (West) | 114 | 110 | 131 | 151 | 130 | 53 | 29 | 35 | 50 | 114 | 172 | 153 | 18 | 76 | 78 | 18 | 19 | 83 |
| 17 Madhya Pradesh (East) | 127 | 89 | 120 | 125 | 102 | 47 | 2.3 | 25 | 34 | 85 | 137 | 169 | 13 | 75 | 68 | 13 | 13 | 68 |
| 18 Gujarat . | 262 | 176 | 275 | 385 | 225 | 71 | 46 | 59 | 73 | 190 | 194 | 229 | 29 | 163 | 170 | 29 | 29 | 146 |
| 19 Saurashtra and Kutch | 195 | 193 | 336 | 469 | 258 | 93 | 53 | 70 | 96 | 226 | 223 | 286 | 35 | 134 | 196 | 36 | 36 | 171 |
| 20 Konkan - . | 236 | 295 | 187 | 246 | 209 | 36 | 29 | 36 | 47 | 100 | 147 | 240 | 16 | 188 | 174 | 16 | 17 | 86 |
| 21 Madhya Maharashtra | 184 | 188 | 175 | 114 | 102 | 37 | 28 | 36 | 39 | . 70 | 125 | 179 | 18 | 145 | 67 | 17 | 18 | 59 |
| 22 Marathwada | 199 | 165 | 176 | 140 | 147 | 46 | 41 | 48 | 46 | 87 | 151 | 183 | 25 | 119 | 88 | 25 | 26 | 70 |
| 23 Vidarbha | 143 | 120 | 124 | 155 | 129 | 46 | 29 | 33 | 43 | 103 | 152 | 181 | 20 | 86 | 78 | 19 | 20 | 73 |
| 24 Coastal Andhra Pradesh . | 135 | 166 | 180 | 90 | 71 | 42 | 29 | 28 | 32 | 50 | 69 | 131 | 16 | 106 | 54 | 18 | 18 | 36 |
| 25 Telengana | 180 | 139 | 152 | 97 | 85 | 41 | 29 | 30 | 42 | 72 | 115 | 212 | 20 | 97 | 58 | 20 | 21 | 64 |
| 26 Rayalaseema | 152 | 190 | 205 | 92 | 68 | 35 | 78 | 59 | 37 | 49 | 72 | 141 | 21 | 109 | 49 | 28 | 26 | 40 |
| 27 Tamil Nadu. | 109 | 117 | 89 | 57 | 47 | 27 | 38 | 37 | 35 | 37 | 48 | 82 | 14 | 77 | 32 | 18 | 14 | 28 |
| 28 Coastal Karnataka | 188 | 321 | 136 | 87 | 112* | 22 | 27 | 35 | 51 | 45 | 80 | 177 | 12 | 162 | 83 | 14 | 13 | 39 |
| nataka (North) | 187 | 189 | 134 | 68 | 52 | 25 | 32 | 51 | 36 | 51 | 117 | 206 | 18 | 127 | 38 | 19 | 18 | 54 |
| 30 Interior Karnataka (South) | 139 | 186 | 104 | 53 | 40 | 30 | 30 | 38 | 38 | 43 | 76 | 141 | 15 | 107 | 29 | 19 | 16 | 37 |
| 31 Kerala . | 111 | 107 | 66 | 39 | 67 | 26 | 30 | 44 | 47 | 29 | 44 | - 67 | 12 | 69 | 40 | 18 | 15 | 24 |

Based on data for 1901-1950.

## APPENDIX 13.1 (Contd.)

(Paragraph 13.2.4)
Statement V -Number of Raingauges-Statewise-having published Normals and Number of Reporting Raingauges for which Rainfall Data are received or arranged to be received by IMD at Poona.




## APPENDIX 13.1 (Contd).

(Paragraph 13.2.17)
Statement VIII-Percentage Departure (from normal) of rainfall in the Meteorological Sub-Divisions of India during twelve break periods.

| Meteorological Sub-Division | $\begin{aligned} & \quad 24-29 \\ & -\quad \text { August } \\ & 1951 \end{aligned}$ | $\begin{aligned} & 18-29 \\ & \text { July } \\ & 1954 \end{aligned}$ | $\begin{gathered} 21-25 \\ \text { August } \\ 1954 \end{gathered}$ | $\begin{aligned} & \text { 22-29 } \\ & \text { July } \\ & 1955 \end{aligned}$ | 23-26 <br> August 1956 | $\begin{gathered} 18-22 \\ \text { August } \\ 1962 \end{gathered}$ | $\begin{gathered} \text { 17-21 } \\ \text { July } \\ 1963 \end{gathered}$ | $\begin{gathered} 28 \text { July } \\ -3 \text { Aug } \\ 1964 \end{gathered}$ | 4-15 August 1964 | 2-11 <br> July 1966 | 23-27 <br> August 1966 | $\begin{aligned} & 7-10 \\ & \text { July } \\ & 1967 \end{aligned}$ | Mean Dep. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| North Assam | +81 | $+65$ | +62 | +83 | $+60$ | $+166$ | +9 | +104 | +27 | +22 | +98 | +105 | $+73$ |
| South Assam | +308 | $+150$ | $+246$ | $+118$ | $-15$ | +166 | --44 | $+127$ | +40 | -1 | $+211$ | +170 | +123 |
| Sub-Himalayan West Bengal | +97 | $+76$ | +3 | +123 | + | +12 | $+$ | +109 | +64 | $+28$ | +265 | +230 | +102 |
| Gangetic West Bengal | -45 | -44 | -47 | +19 | +28 | +19 | -2 | +9 | -40 | - 51 | -43 | $-11$ | -17 |
| Orissa | -54 | -70 | -65 | -63 | -5 | -36 | -47 | $-51$ | -37 | -74 | -73 | -31 | -51 |
| Bihar Plateau | -75 | -49 | -54 | -42 | -5 | $+15$ | -37 | -54 | -69 | -73 | -40 | -49 | -44 |
| Bihar Plains | -15 | +54 | -14 | $+28$ | $+126$ | +211 | +35 | $+21$ | -33 | -52 | +35 | +49 | +37 |
| East Uttar Pradesh | -65 | +33 | -67 | -28 | 0 | +246 | -32 | $+28$ | -85 | -89 | $=55$ | -38 | -13 |
| West Uttar Pradesh : |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Plains | -88 | +9 | -85 | -93 | +53 | -5 | -43 | -10 | -85 | -97 | -54 | -37 | -45 |
| Hills | -60 | +23 | $+87$ | -74 | -31 | $+52$ | +2 | -46 | -61 | -46 | +27 | +105 | -2 |
| Punjab | -75 | $+5$ | -98 | -91 | +35 | +169 | -81 | -1 | -63 | -63 | -98 | +29 | -28 |
| Himachal Pradesh | +1 | $-17$ | +22 | -56 | -36 | -31 | +117 | -57 | -79 | -78 | -63 | -32 | -26 |
| Jammu and Kashmir | -26 | -80 | -98 | -75 | -33 | -35 | -13 | -28 | -56 | -32 | -92 | -95 | -55 |
| West Rajasthan | -100 | --55 | -100 | -100 | -97 | 0 | -90 | -92 | -99 | -50 | $-100$ | -77 | -80 |
| East Rajasthan | -100 | -77 | $-90$ | -98 | -85 | -46 | -66 | -81 | -99 | -92 | $-100$ | -75 | -84 |
| West Madhya Pradesh | -95 | -56 | -91 | -59 | -92 | -63 | -67 | -81 | -80 | $-92$ | -92 | -88 | -80 |
| East Madhya Pradesh | -89 | -39 | -41 | -39 | -80 | -51 | -39 | -75 | -73 | -91 | -76 | -74 | -64 |
| Vidarbha | -55 | -51 | -89 | -51 | -94 | -62 | -95 | -69 | -70 | -91 | -98 | -96 | -77 |
| Gujarat Region | -95 | -57 | -84 | -81 | -44 | -34 | -77 | -65 | -97 | -92 | -100 | -91 | -76 |
| Saurashtra and Kutch | -99 | -77 | -94 | -79 | -97 | -77 | -80 | $-76$ | -96 | -82 | -100 | -69 | -85 |
| Konkan | -65 | -18 | -31 | +108 | -76 | -58 | -54 | +3 | -70 | -87 | -73 | -56 | -40 |
| Madhya Maharashtra | -65 | -41 | -67 | -53 | -56 | -53 | -79 | --44 | -55 | -56 | -70 | -68 | -59 |
| Marathwada | -100 | +4 | -99 | +55 | -86 | +11 | -89 | +1 | +13 | -43 | -100 | -100 | -44 |

APPENDIX 13.1-Statement VIII (Cond.)

| Mctcorological Sub-Division | $\begin{gathered} \text { 24-29 } \\ \text { August } \\ 1951 \end{gathered}$ | $\begin{gathered} \text { 18-29 } \\ \text { July } \\ 1954 \end{gathered}$ | $\begin{gathered} \text { 21-25 } \\ \text { August } \\ 1954 \end{gathered}$ | $\begin{aligned} & \text { 22-29 } \\ & \text { July } \\ & 1955 \end{aligned}$ | $\begin{gathered} 23-26 \\ \text { August } \\ 1956 \end{gathered}$ | $\begin{gathered} \text { 18-22 } \\ \text { August } \\ 1962 \end{gathered}$ | $\begin{aligned} & \text { 17--21 } \\ & \text { July } \\ & 1963 \end{aligned}$ | $\begin{array}{r} \text { 28July } \\ -3 \text { Aug. } \\ 1964 \end{array}$ | $\begin{gathered} \text { 4-15 } \\ \text { August } \\ 1965 \end{gathered}$ | $\begin{gathered} 2-11 \\ \text { July } \\ 1966 \end{gathered}$ | $\begin{gathered} \text { 23-27 } \\ \text { August } \\ 1966 \end{gathered}$ | $\begin{aligned} & \text { 7-10 } \\ & \text { July } \\ & 1967 \end{aligned}$ | Mean <br> Dep. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Coastal Andhra Pradesh | +3 | +31 | +26 | -3 | +11 | -14 | -5 | -46 | -. 57 | -65 | -6 | -90 | -18 |
| Telangana . | -47 | -7 | -93 | -55 | -83 | -36 | -62 | -43 | -79 | -88 | -94 | -97 | -65 |
| Rayaliseema | +13 | +357 | -69 | +13 | -77 | +13 | +126 | +243 | +.85 | +64 | -95 | -77 | $+50$ |
| Tamil Nadu | $+59$ | +123 | +40 | -44 | +138 | +94 | +71 | +303 | $+128$ | +121 | +108 | -11 | +94 |
| Coastal Karnataka | -88 | +19 | -91 | +74 | -87 | +54 | -61 | +78 | -72 | -60 | -84 | -12 | -27 |
| Interior Karnataka North . | -53 | +42 | -51 | -13 | -85 | -21 | -88 | +140 | -15 | -44 | -100 | -73 | -30 |
| Interior Karnataka South | -66 | -9 | -41 | -50 | -97 | -63 | -66 | $+100$ | -1 | -25 | -95 | -55 | -39 |
| Kerala | +18 | -29 | -95 | -17 | -88 | -81 | -76 | +44 | -24 | -31 | -71 | -44 | -41 |

## APPENDIX 13.1 (Contd.)

(Paragraph 13.2.18)

Statement IX—Spatial Distribution of Rainfall during Break (expressed as percentage)

| Meteorological Sub-Division |  | Category of Distribution |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | . | Widespread | Fairly Widespread | Scattered | Isolated | Dry |
| North Assam . | - | 55 | 28 | 13 | 4 | - |
| South Assam . | - | 62 | 24 | 12 | 2 | - |
| Sub-Himalayan West Bengal | - | 87 | 9 | 3 | 1 | - |
| Gangetic West Bengal | - ${ }^{-}$ | 13 | 17 | 22 | 42 | 6 |
| Orissa . . | - | 1 | 19 | 31 | 43 | 6 |
| Bihar Plateau . | - | 17 | 11 | 36 | 24 | 12 |
| Bihar Plains | - | 27 | 19 | 25 | 18 | 11 |
| East Uttar Pradesh . | - | 9 | 17 | 24 | 30 | 20 |
| West Uttar Pradesh : Hills * | - | 17 | 28 | 35 | - | 20 |
| Plains . | - | 10 | 10 | 19 | 38 | 23 |
| Punjab | - | 4 | 7 | 17 | 27 | 45 |
| Himachal Pradesh | - | 29 | 18 | 15 | 19 | 19 |
| Jammu \& Kashmir | - | - | 5 | 11 | 22 | 62 |
| West Rajasthan | - | - | - | 8 | 7 | 85 |
| East Rajasthan | . | 1 | 1 | 12 | 26 | 60 |
| West Madhya Pradesh | - | 1 | 5 | 21 | 50 | 23 |
| East Madhya Pradesh | - | 6 | 15 | 39 | 26 | 14 |
| Vidarbha : |  | 54 | 6 | 10 | 42 | 38 |
| Gujarat Region | - | - | 2 | 34 | 16 | 48 |
| Saurashtra and Kutch | - | - | - | 8 | 35 | 57 |
| Konkan | - | 41 | 17 | 27 | 7 | 8 |
| Madhya Maharashtra | - | 4 | 6 | 28 | 56 | 6 |
| Marathwada | $\bullet$ | 6 | - | 30 | - | 64 |
| Coastal Andhra Pradesh . | - | - | 9 | 30 | 42 | 19 |
| Telangana . | - | 2 | 10 | 25 | 21 | 42 |
| Rayalaseema . | . | 4 | 13 | 16 | 25 | 42 |
| Tamil Nadu . | . | 4 | 7 | 45 | 36 | 8 |
| Coastal Karnataka | - | 54 | 12 | 16 | - | 18 |
| North Interior Karnataka | - | 5 | 4 | 28 | 37 | 26 |
| South Interior Karnataka | . | 6 | 19 | 31 | 21 | 23 |
| Kerala | . | 25 | 16 | 21 | 15 | 23 |

7-133Deptt of Agri/76

## APPENDIX 13.1

Statement X-Format For Weekly Crop Weather Report
Government of $\qquad$
Department of $\qquad$
WEEKLY CROP WEATHER REPORT (for the week ending Wednesday Week No. From D/
to D/ to be issued on Saturday)

I Summary of weather conditions
From D/
to $\mathrm{D} /$ Issued on D/
(This information has to be furnished by the Mcteorologist of the India Meteorological Department. Working in the Headquarters of the State and it should contain briefly descriptions of
a) general condition of the weather in different parts of the State with stress on rainfall, temperature and wind and
b) any anamolies or hazards noticed in different parts of the State)
:Summary of Agricultural Operations in Progress, condition of standing crops and posts and diseases.
District Main Crops
Agricultural Condition of the
Weeds, Pests_and Diseases
Estimate of yield/hectare (to operations in standing crops be furnished after the crop is progress. in maturity)
11
2
3
4
5
21
2
3
4
5
(This information has to be furnished by the Officers of the State Department of Agriculture, working in different districts, taluks and blocks and has to be processed by the Department issuing the bulletin. A proforma of the type shown in annexure can be developed for obtaining the information in a coded form, so that it will be easy for the officials to send the report)

## APPENDIX 13.1 -Statement X (Contd.)

II Fodder and Water Supply position :


## APPENDIX 13.1-Statement $X$ (Contd.) <br> ANNEXURE

## Department of Agriculture, Government of Karnataka

Crop Report for the Week ending on
(Give the information in respect of 4 or 5 major crops grown in the area. Use the code given on the reverse side).
District :

Taluk :

2. Water Supply Position (For Livestock)

Abundant/Adequate/Inadequate/Scarcity
3. Fodder and pasture

Abundant/Adequate/Inadequate/Scarcity

## APPENDIX 13.1-Statement $X$ (Contd.)

## ANNEXURE (Contd.)

## DESCRIPTION OF THE CODE

(a) (b) and (c) Tillage operations. Sowing and planting and interculturing and weeding: S-Started P -in progress C - Complete
(d) Crop growth : V-Vigorous N-Normal Sn-Subnormal Dr-Droughty Wi-Wilting
(ii) Stage of Growth : Gr-Germination, Ggr-Grand Growth, Hd—Heading, Gd-Grain development, M-Maturity, T-Tillering.
(iii) Harvest and (iv) Threshing : S-Started, P -In progress, C -Complete.
(e) (i), (ii) and (iii) Extent of damage by pests, Extent of damage by diseases and extent of weed growth; Mi-Mild, Mo-Moderate, Sv-Severe, Ep-Epidemic.
(f) Soil Moisture Condition : A-Optimum, B-Moderate, C-Fair, D-Poor.
(g) Estimate of Crop Yield: Ava-Above average, Av-Average, Bav-Below average, P-Poor.
(h) Marketing of produce: R-Ready for marketing, S-Started, P-In progress, C-Complete.

Instructions:-Furnish the information in respect of 4 or 5 major crops grown in the region. Name of the crop should be furnished above the serial number for 'Crops' in the proforma.

While filling the proforma put a tick mark to whichever it is applicable. Fill in some items when applicable.

Take every possible care to provide very reliable information.
The officer furnishing the information should write his name and designation and sign at the space provided for this purpose.

Post the envelope directly to avoid delay. Post the envelope one day in advance if there is a postal holiday either on Wednesday or Thursday or Friday.

## APPENDIX 13.1 (Contd.)

Statement XI Seasonal Rainfall Forecasts issued by the India Meteorological Department

(Paragraph 13.7.3)
Statement XII Critical Periods when Weather Elements Significantly Affect Yicld of Rice

| sub-division | period | favourable | unfavourable | remarks |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 | 5 |
| 1. Sub-Himalayan West Bengal | 1 July to 15 Sept. |  | dry spell for 2 weeks or more | If dry spell continues for 3 weeks or more, yield will be reduced by $12 \%$. |
|  | 16 Sept. to 15 Oct. | rainy days | each rainy day increases the yield by 12 lbs per acre. |  |
| 2. Gangetic West Bengal | 16 June to 15 July 16 Sept. to 15 Oct. | restricted rainy days 17 rainy days |  | Each rainy day increases yield by 11 lbs . per acre. |
|  | July and August |  | dry spell of 10 days or more | If dry spell continues for 3 weeks or more, yield may reduce by $50 \%$. |
|  | June | rain over normal |  | Every additional 25 mm of rainfall over normal ( 23.6 mm ) increases yield by 18 lbs acre. |
| 3. Orissa | 1 Oct. to 7 Oct. | rainfall |  | Increase in yield by 24 lbs/acre for each 25 mm of rainfall. |
|  | 19 Sept. to 25 Sept. | range of temperature |  | Increase in yield by 24 lbs/acre for each degree Farenheit ( 0.6 C ) increase in range of temperature. |
|  | 10 Oct. to 18 Nov . |  | heavy rain | Decreases yield by 10 $\mathrm{lbs} /$ acre. |



APPENDIX $13 \cdot 1$-Statement XI (Contd.)

| 1 | 2 | 3 | 4 | 5 |
| :---: | :---: | :---: | :---: | :---: |
| 8. Haryana | 3 Aug. to 13 Aug. | rainy days |  | increase in yleld $38 \mathrm{lbs} /$ acre for each rainy |
|  | 19 June to 25 June | rainfall |  | for each 25 mm of rain, increase in yield is 75 lbs/acre |
| 9. Konkan . . | 1 July to 30 Sept. |  | dry spell, floods, on more than 30 occasions | Yield can reduce as much as $15 \%$. |
|  | June to Aug. July to Sept. July to Aug. | higher rainfall cloudiness normal mean temperature |  | relationship logarithmic |
| 10. Madhya Maharashtra | July | rainy days |  | Yield increases by 34 lbs/acre for each rainy day. |
|  | August |  | dry spell of 10 days or more. | dry spell of 3 weeks reduces yield by $35 \%$. |
| 11. Vidarbha . . | 18 June to 24 June | rainfal! |  | increases yield by 20 lbs/acre for each 25 mm of rainfall. |
|  | 22 Aug. to 30 Aug. | rainfall |  | increases yield by 20 lbs/acre for each 25 mm of rainfall. |
|  | 1 July to 15 Sept. |  | absence of rain for 8 days or more | if dry speil continues for 3 weeks or more, yield is reduced by $40 \%$. |
| 12. Coastal Andhra Pradesh | October Aug. to Sept. | rainfall | dry spell excceding 3 weeks | increase of $30 \mathrm{lbs} / \mathrm{acre}$ for each rainy day. dry spell for more than 4 weeks reduces yield by 15 to $20 \%$. |
| 13. Telangana - |  |  | rainfall exceeding $8^{\prime \prime}$ in <br> the first three weeks |  |
|  | 11 to 26 Aug. and 6 to 15 Oct | rainfall |  | each 25 mm of rain during these periods increases yield by $19 \mathrm{Jbs} /$ acre. |


| 14. Tamil Nadu |  | more than normal rainfa during second half of May and June in Mer and Bhagmandala area |  | rainfall exceeding normal by $20 \%$ during each period increases yield by 40 to $60 \mathrm{lbs} /$ |
| :---: | :---: | :---: | :---: | :---: |
| 15. Coastal Karnataka | June <br> Aug. and Sept. |  | more than normal rainfall dry spell of 18 days or more' |  |
|  | 1 July to 15 Sept. July and August | restricted rainy days normal maximum temperature |  |  |
| 16. Interior Karnataka North | July | rainfall |  | increase of yield for each 25 mm of rain $25 \mathrm{lbs} / \mathrm{acre}$. |
|  | Aug. \& Sept. |  | 18 days or more of dry spell | if dry spell continues for 28 days or more yield can decrease 40 to $50 \%$. |
|  | July to Sept. | mean maximum temrature about $30^{\circ} \mathrm{C}$ |  |  |
| 17. Interior Karnataka South | June | rainfall |  | increase in yield for each 25 mm of rain $60 \mathrm{lbs} / \mathrm{acre}$. |
|  | July \& August | , | dry spell of 18 days or more | if dry spell continues for 18 days or more. yield decreases by 15 to $20 \%$ |
|  | September | rainfall |  | Yield increases by 50 Flos /acre for every 25 mm . of rain. |
| 18. Kerala . . . | 16 June to 1 Aug. |  | dry spell of 18 days or more; 3 or more occasions of floods. | Yield may decrease by about $15 \%$. |

## APPENDIX $13 \cdot 1$ (Contd.)

(Paragraph 13•7•7)
Statement XIII—Percentage Variation in Yield of Rice_Accounted for by Technology


APPENDIX 13.1 (Contd.)
(Paragraph 13.8.7)

Statement XIV-WMO Statement on weather Modification
At its twenty-sixth session (Geneva, June 1974) the Executive Committee approved a revised version of the WMO statement on weather modification made by the Sixth Congress (1971. The text of this revised statement is given below.

Present state of knowledge and possible practical benefits in some fields of weather modification.

## Geheral

It has been demonstrated that ice crystals may be caused to form in supercooled clouds by seeding them with dry ice, silver iodide and other nucleants. Ice crystals are known to play an important role in the process of formation of precipitation; cloud seeding therefore provides a means of modifying the precipitation process in some types of supercooled clouds. The seeding of a supercooled cloud converts it to ice, releasing latent heat which can have important dynamical effect. The varied and controversial results of seeding experiments appear to be due to the complexities of the dynamics and microphysics of the precipitation process. An encouraging beginning in the understanding of these processes has been made through the development of numerical models which incorporate both the dynamics and microphysics and their interactions. Such models and their successors may be expected to define more clearly the most favourable' seeding situations and the observations needed for the evaluation of the results. Although some experiments have apparently yielded positive results, the possible practical beenfits of weather modification can be realized only through an increased research effort. The research should be directed primarily at cloud dynamics and mesoscale dynamics and the interactions of dynamics with microphysics, since knowledge of the latter is relatively more complete. There is a great need for simultaneous measurements of dynamical and microphysical parameters.

Some experimehts have been made to test the possibility of seeding warm clouds with hygroscopic particles or water droplets in order to increase precipitation. The results obtained from these experiments have not been conclusive or sufficiently positive.

It appears that the most spohisticated statistical procedures are an inadequate substitute for more complete knowledge of the atmospheric mechanisms. However, statistical desigh and evaluation of experiments are both necessary to increase our understanding of physical aspects in the further development of weather modification, particularly in connection with the valuation of the practical results of experiments.

It is important to emphasise that weather modification is still largely at the research stage. For this reason, operations should be undertaken only after the most careful study by experts of the particular situation, and on the understanding that the desired and results may not always be achieved.

Brief summaries of the current status of weather modification in several categories are given below.

Stimulation of precipitation
Of the many experiments conducted in this field, only a few have clearly demonstrated that seeding has increased the precipitation; in some cases, there is evidence of a decrease. However, these apparent contradictory results seem to emerge from the fact that, in different geographical locations, clouds have different cloud-droplet spectra and different ice crystal properties and concentrations. There is some evidence that winter-time orographic precipitation can be somewhat increased over mountain ranges. Similar results have also been obtained in subtropical, continental cumulus clouds in winter.

There is some evidence that certain subtropical convective clouds become taller and larger, with a tendency to merge, when they are heavily seeded to release latent heat.

In view of the high correlation between the size of convective clouds and the rainfall from them, the seeded clouds presumably give more rainfall than if they had not been seeded. Confirmation is required from further suitably designed experiments.

## Dissipation of fog

Supercooled fog and status can be dissipated by growth and sedimentation of ice crystals, induced by seeding the fog with ice nucleahts or by means of cooling agents. This has been brought into operational use at several airports at which there is a relatively high incidence of supercooled fog. The more com. mon warm fog may be dissipated by the use of heat, hygroscopic particles and the down-wash of helicopters. Successful experiments have been reported with each of these techniques, but only the use of heat seems operationally viable at present.

## Hail Suppression

Many countries have focused considerable attention on hail suppression projects in the last decado or so. In spite of the complexity of the hailforming processes and the extremely large variability in hail occurrence which make hail suppression experiments very difficult to assess, there appear to be promising prospects of success in the near future.

Impressive reports of successílil reduction hail damage to crops, with resulting economic benefit, have provided impetus to many experiments and large mainly operational projects. As yet, there are no universally recognized methods and the results to date are not unambiguous. The seeding methods produce different effects on different storms, and it is essential that detailed understanding of the structure and the processes of various types of storms be obtained so that seeding procedures specially tailored to the specific atmospheric conditions can be dotermined. The development of numerical models is of great importance for the future understanding of the processes within cumulonimbus clouds. These models should incorporate proper dynamics and thermodynamics with details of the microphysics and water phase transition processes and their interaction. This approach should be tested against detailed direct measurements of cloud properties.

More basic research is required to resolve questions on various hailstorny theories models and suppression techniques. Development of more reliable evaluation methods based on both physical and economic indicators is also needed.

## Hurricance Modification

The seeding of hurricanes has been followed by reduced maximum wind velocities. Confirmation is required from further experiments which should include an increased number of measurements in pertinent regions of the storm. This is because assessment will largely depend upon physical methods rather than statistical ones. There is also need for improved numerical hurricance models to provide guidance for future experiments.

Other aspects
Exploratory investigations are being conducted into the suppression of forest and bush fires, the inducement of down draughts in developing convective clouds and the prevention of lighting. Attempts are also being made to seed cold ice-supersaturated layers of the atmosphere in order to produce clouds, with the object of preventing the formation of rediation fog.

## APPENDIX <br> 13.2

List of Maps

Map

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v
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13. 2. 13 Coefficient of Variation of Rainfall, Annual
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13.2.5 Dates of Onset and Withdrawal of Southwest Monsoon.
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13.2.23 Daily Diffuse Solar Radiation


Basell upon Survey of India map with the permission of the Surveyor General of India.
The terfitorial Waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
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Appendix 13.2


The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line. 113








## 14

## RAINFALL AND CROPPING PATTERNS

## 1 Introduction

14.1.1 The population of the country which was 548 millions in 1971 is estimated to reach about 935 million mark in 2000 AD , which surely necessitates increased: agricultural production. Land resources being limited, emphasis has to be placed on increasing productivity per unit area. Temperature and other climatic conditions being favourable throughout the year over most parts of the country, it is possible to grow more than one crop in a year provided water is available. In some parts of the country the spread of rainy season is long enough to provide ample scope for double cropping. This potential is yet to be fully exploited, There is undoubtedly scope for increasing irrigation resources in the country, but our estimates show that the area under irrigation is not expected to be more than 42 per cent of the total cropped area in 2000 AD , although it would mean considerable improvement over the percentage of 22 in 1970-71. Therefore, judicious utilisation of direct rainfall and irrigation water, singly and in combination, will have to be thought of for increasing production.
14.1:2 Farming technology has so advanced that it is possible to increase crop yields even under rainfed conditions, but the choice of crops would have to depend upon the amount and distribution of the prevailing rainfall. Additionally, it will be necessary that the maximum possible quantity of rain water is conserved in ponds and pools situated either within the farm area or elsewhere, in soil profiles and underground storages so that the same could be readily used to save crops in times of stress. Not only in rainfed farming but even under irrigated conditions, one will have to plan for the most economic and efficient use of water to derive maximum possible benefit from rainfall reducing dependence on irrigation so that the advantage of availability of water could be extended to as large an area as possible. This necessitates a close study of the existing cropping patterns vis-a-vis rainfall patterns aimed at determining the nature of changes needed in cropping patterns to make the maximum use of rain water. The cropping patterns depend primarily on soils and
climatic factors, but as they evolve, also represent the integrated effect of the requirements, local habits and economic factors through time. In the context of increasing production, it is necessary to examine them from a scientific angle and find out possible alternative patterns having higher potential. Accordingly, the Commission undertook a comprehensive study of the rainfall and cropping patterns of the country, using taluk as unit of area. The study covered several other relevant factors also to facilitate an integrated assessment, viz., orography, land use pattern, human and livestock populations, and power availability for cultural operations, soils and climate.
14.1.3 The detailed data on rainfall and crops collected would enable one to delineate the country into suitable agro-climatic regions, as crops represent the integrated effect of several natural factors including soils. The extensive crop and related data thus collected and processed during the present study should provide a valuable source of reference particularly for planning at levels ranging from taluk to all-India, besides its utility for the main purpose of arriving at the future cropping patterns. The initial processing of data and study was done for each State separately. In view of their importance the basic data and the results of study together with all relevant tables and maps are being published separately in the form of State Volumes. The report on 'Rainfall and Cropping Patterns of Karnataka' is included as an Appendix at the end to serve as an illustration. This chapter consists of nine sections. The methods followed for defining rainfall, cropping and livestock patterns are explained in section 2 on Methodology. A brief review of the different factors being covered is also included. Section 3 deals with general information on area, population, land use, irrigation, soils and livestock. Rainfall patternszones are analysed in section 4. Areas, both geographical and gross cropped, are shown against each pattern for the seasons June to September, October to January and February to May separately. The rainfall zones of section 4 have been grouped to form regions with a few simplifications and approximations and these are considered in section 5. The regions form the basis of study for crops etc. A list of the regions together with particulars of geographical and gross cropped areas is included. In addition, a comprehensive Appendix 14.6-Statement V giving the details of taluks/subdivisions in each Region with cropping patterns of State areas in each region and indication of percent irrigated areas in the districts in the region has also been prepared. Section 6 is devoted to cropping patterns of regions but a list of patterns in each State is also included. While discussing cropping patterns in each region, the suitability of the present cropping structure and suggestions for improvement have also been included. Area, distribution and yield of some selected crops have also been analysed. This section includes also a summary of the Reports prepared by some of the States. Section 7 gives suggestions for future cropping
patterns. The last section contains a summary of conclusions and recommendations. A number of statements and maps showing rainfall, cropping and livestock patterns etc. are included as appendices at the end.

## 2 Mbthodology

14.2.1 The methodology followed in the study is described in this Section. The chief features of the study are (a) use of taluk or tehsil as unit of area; (b) introduction of the coded numerical form to express patterns of distribution of rainfall for the whole year, as also of crops and livestock; (c) inclusion of information on orography, temperature, evapotranspiration, rainfall, soils, irrigation, land use, human and livestock populations, power availability for field operations and yield performance of crops, all of which influence in different ways and degrees the cropping patterns of a place and (d) presentation of coded information on rainfall, crops etc. on maps of scale 1:1 million.

Rainfall Patterns
14.2.2 As stated in Chapter 13 on Climate and Agriculture, a major feature of Indian rainfall is that 70 to 95 per cent of the annual rainfall occurs during the Southwest monsoon months of June to September throughout the country, except in the south east peninsula and Kashmir and adjoining hill areas. The monsoon as well as annual rainfall show large fluctuations from year to year, but as stated in Chapter 13 on Climate and Agriculture, there is no evidence of any significant trend or periodicity in them when examined over a long period. July and August are in general the rainiest months. When rainfall is considered in relation to crop production the annual or seasonal totals do not have much significance compared with the totals for smaller intervals. A relevant question therefore to be considered is whether rainfall should be examined on a weekly, fortnightly or monthly basis. The coefficient of variation (CV) of monthly rainfall is as high as $40-50$ per cent even in the rainiest month of July over most of the central, northern and eastern India. In the south excluding west coast, CV is 60 to 100 per cent. The variability of weekly or fortnightly rainfall is many times greater. This is a major difficulty in using weekly and fortnightly rainfall as dependable indicators of rainfall distribution. Therefore, while studies for individual or specific problems on the basis of weekly or fortnightly rainfall data have their own utility in spite of their high variability, for a macro-study like_the.present one for the whole country, monthly data are most convenient.
14.2.3 In order to facilitate examination of the distribution of rainfall during periods of crop growth, limits of rainfall which have closer relation to broad requirements of crops, have been drawn up. The time span of most of the crops is usually of the order of 90 days or longer. Keeping this in view, the following limits have been used in the study :
(i) Rainfall of greater than 30 cm per month (pm) for at least three consecutive months would be suitable for a crop like paddy whose water need is very high;
(ii) $20-30 \mathrm{~cm} \mathrm{pm}$ for not less than three consecutive months would be suitable for crops whose water need is high but less than that of paddy, for example, maize and black gram;
(iii) $10-20 \mathrm{~cm} \mathrm{pm}$ for at least three consecutive months is considered suitable for crops requiring much less water, e.g. bajra and small millets;
(iv) $5-10 \mathrm{~cm} \mathrm{pm}$ is just sufficient for crops which are low water requiring, e.g. moth ( $p$. aconitifolius) and ephemeral grasses; and
(v) Rainfall less than 5 cm pm is not of much significance for crop production.
14.2.4 For denoting the year's rainfall distribution using monthly totals, a"code having letters of the alphabet with numerical subscripts is employed. The letters denote limits of monthly rainfall'and the subscript to a letter the number of months in which rainfall indicated by the letter is received. The limits chosen are the same as stated in paragraph 14.2.3 for different types of crops.


The southwest monsoon months June to September form the principal rainy season and outside it there are hardly a few areas"and months with rainfall of even 5 to 10 cm pm . In depicting therefore the year's distribution
@Overlapping interval points suitably adjusted.
*In distributions involving A or B types, rainfall amounts of less than 10 cm are less significant and their frequency is also small. To reduce the number of combinations, $D$ type is skipped over in distributions beginning with $\mathbf{A}$ or $\mathbf{B}$ and $E$ symbol denotes less than 10 cm pm . Thus $\mathrm{B}_{2} \mathrm{E}_{2}$ would denote two months $20-30 \mathrm{~cm} \mathrm{pm}$ and two months less than 10 cm pm .
+An examination of monthly rainfallin the country shows that except for areas in the west coast, extreme north east and some hill areas, monthly rainfall seldom exceeds $40-50 \mathrm{~cm}$.
the portion for June to September is central and it is entered in brackets. To the right is the distribution for the post-monsoon months of October to January and to the left that for the pre-monsoon months February to May. The number of possible combinations of months with different rainfall amounts and frequency for a four-month period is 45. A list of these is given in Appendix 14.1 and these cover all the types and ranges of rainfall occurring in the different parts of the country in the southwest monsoon season. The year is divided into three periods of four months each. The arrangement of months in each of the four-month periods is in the order of decreasing rainfall and not according to calendar sequence. However, no serious difficulty arises in general as the rainiest months in each season are well known e.g. July and August are usually the rainiest in June to September period. Similarly May is the rainiest month in the period February to May and October in October to January period. To facilitate identification of rainfall of the different months, decoded form according to calendar sequence of each of the distributions occurring in the country have been suitably included and this coding sequence would therefore not offer any difficulty. An example of a yearly distribution is D1 E3 (A2 B1C1) C1D3, in which for each of the three periods, the symbols are in order of decreasing rainfall which is not necessarily the calendar sequence. Its interpretation follows :
(i) D1 E3 represents the period February to May in which one month's rainfall (usually May) belongs to $5-10 \mathrm{~cm}$ type and the remainder three months get less than 5 cm pm .
(ii) A2 B1 Cl represents the period June to September, in which two months (usually July and August) get more than 30 cm pm, one month (September) belongs to $20-30 \mathrm{~cm}$ type and the remaining month i.e. June has $10-20 \mathrm{~cm}$ type.
(iii) C 1 D 3 represents the period October to January in which October belongs to $10-20 \mathrm{~cm}$ type and the rest to $5-10 \mathrm{~cm}$ pm type.
14.2.5 If an identical distribution occurs over two or more adjacent taluks, the distribution is designated as a pattern and the area covered by it is distinguished as a zone and indicated suitably by numbers. Rainfall patterns have been identified for the whole country using the methodology described above. The data used for the analysis are the monthly normals of rainfall ( 1901 to 50 ) contained in Memoirs of India Meteorological Department Vol. XXXI-Part 3, 1962 and depicted on all-India map of scale 1:1 million. The terminology followed in describing and discussing distributions of monthly rainfall is as follows :
terminology
(i) rainfall pattern

## description

When a seasons's (four months) or the year's ( 12 months) distribution is referred to, according to context.
terminology
(ii) type . . . . When rainfall of any of the five intervals (ii) A to $E$ is referred to e.g. A type, B type etc. (iii) category . . . . When a range between types is referred to e.g. A1 to B2 category.
14.2.6. Boundaries of Rainfall Zones: Taluk is the unit of area in the present study and analysis but as rainfall is recorded at individual locations, we would have to consider the adequacy of a station (or stations) as representing the respective taluks in which it is (or they are) located. Although rainfall is a highly variable element, it is seen that differences in monthly, seasonal and annual amounts are small within short distances and the data of the taluk station could be used as representing rainfall of the taluk for all practical purposes. Being point measurements, isolines for the same or nearly the same type of distribution of monthly rainfall can be drawn. These isolines will not necessarily follow the boundaries of taluks but intersect them and the following procedure has been adopted for dealing with portions of taluks :
(i) where variations are small, isolines follow the taluk boundaries;
(ii) where essential, isolines intersecting taluk boundaries have been retained; and
(iii) when listing taluks included in different rainfall zones, any area of less than a quarter of a taluk is omitted.

## Cropping Patterns

14.2.7 The basic data for the study of cropping structure of the country is the area distributions of crops in the taluks. Numerous crops are grown in a taluk but most of them occupy a very small area as per cent of gross cropped area. For purposes of our study we have limited the crops in a taluk to those which individually occupy 10 per cent or more of the gross cropped area of the taluk and these are taken to constitute the crop distribution of the taluk. In this process, several crops have often got excluded, though they may be of local importance, e.g. vegetables, potato, tobacco, sugarcane, fruits etc. A minimum upper limit of the total areas of crops in a distribution or a pattern has been fixed at 70 per cent after several trial computations. The maximum number of crops needed to reach the minimum of seventy per cent area limit, seldom exceeds four or five. Also, it is only rarely that crops with more than 10 per cent area are omitted from inclusion in a cropping pattern. Thus, a combination of crops, each occupying not less than 10 per cent of the gross cropped area of the taluk and with a total of not less than 70 per cent of the gross cropped area of the taluk is considered as constituting a cropping pattern provided it is the same over two or more adjacent taluks.
14.2.8 As in the case of rainfall, crop areas are coded in terms of crop symbols with numerical subscripts to denote per cent areas covered. The code is as follows :

| crop | code |  | crop | code |
| :---: | :---: | :---: | :---: | :---: |
| rice | Pd |  | groundnut | Gn |
| pulses other than | Pu |  | oilseeds other <br> than groundnut | 0 |
| pigeonpea and |  |  |  |  |
| gram |  |  |  |  |
| potato | Pt |  | oats | Oa |
| Wheat | W |  | cotton | C |
| maize | M |  | other fibres | Fb |
| small millets | Mt |  | fodder | F |
| jowar kharif | Jk |  | fruits | Fr |
| jowar rabi | Jr |  | plantations | L |
| jute | Ju |  | sugarcane | S |
| bajra | B |  | vegetables | V |
| barley | Ba |  | chillies | Ch |
| ragi | R |  | pigeonpea (tur) | T |
| gram | G |  | tapioca | Ta |
| area coverage* (pe | ross cro | area) | - | code |
| 70 or more | - | - - | . - | 1 |
| 50-70 | - | . . | - - | 2 |
| 30-50 | - | . . | - - | 3 |
| 10-30 | - | . . | - - | 4 |
| less than 10 | - | - - | - - | 5 |

overlapping interval points suitably adjusted.
The code number indicating the percentage area coverage by a particular crop is affixed as a subscript to the crop symbol concerned. The first crop in a pattern has always the highest area among crops in the patterns and the rest do not necessarily follow the order of decreasing areas. For example crop pattern C3 Jr3 Mt4 indicates that cotton area is $30^{\circ}-50$ per cent and jowar (rabi) and millets each occupy 10-30 per cent of the gross cropped area; the total is 70 per cent or more. The cropping patterns so derived have been indicated on maps of $1: 1$ million size and analysed.

## Relative Yield Index (RYI) of Crops

14.2.9 The performance of crops in different parts of the country has been examined using the yield data of the respective crops. These are readily available in published form for districts and States only. Instead of using absolute yield values they have been expressed as per cent of allIndia. The yield of a crop in a district expressed as percentage of all-India is called Relative Yield Index of the crop and denoted by symbol RYI. RYI values have been computed for the principal crops based on area and production statistics of districts for the three-year period, mostly 1968-69
to 1970-71. The three-year yield averages lend some stability to these figures and the years used were the latest at the time these were computed.

## Livestock Patterns

14.2.10 The livestock patterns are relevant in the present context only in so far as these are related to production of fodder and feeds. Taluk data, which are the basis in this study for major components, have not become available from the Livestock Census, 1972. Hence, data of 1966 Census as published by the States form the basis of computations. The categories of animals included in livestock census are shown below together with the symbols used in the present study :
category symbol
cattle :
males
(over 3 years) . . . . . . $\mathbf{C m}$
females (over 3 years) . . . . . . Cf
young stock (under 3 years) . . . . . . Cy
buffaloes:
males (over 3 years) . . . . . . Bm
females (over 3 years) . . . . . . Bf
young stock (under 3 years) . . . . . . By
sheep . . . . . . . . $\mathbf{S}$
goats G
horses, mules and ponies . . . . . H
donkeys . . . . . . . . D
camels
Ca
pigs . . . . . . . . . $\mathbf{P}$
Following the same percentage intervals as used for crop patterns, the livestock patterns are identified and expressed in the following coded form. percent of total livestock*
code
70 or more . . . . . . . 1
$50-70$. . . . . . . . 2
$30-50$. . . . . . . . 3
$10-30$. . . . . . . . 4
less than 10 . . . . . . . 5
overlapping interval points suitably adjusted.

Soils
14.2. I1 Soil data corresponding to the scale used for the rainfall, crops and livestock patterns are not available for all the areas of the country. Out of about 305 Mha of the country's surveyable area, only about 90 Mha have been surveyed by one method or the other, but some of these areas need resurveying. In some States like Bihar and West Bengal, which have been covered almost entirely by reconnaisance survey, the work on soil correlation has not made much progress. Because of this position, we submitted an Interim Report specially on Soil Survey and Soil Map of India (August, 1972) recommending that expeditious measures should be undertaken to prepare the soil map in 1:1 M scale. We envisaged that a useful soil map of India could be prepared within about 10 years' time, if necessary steps to organise soil survey parties in accordance with specific requirements are commenced urgently. This being the position, it has not been possible to go into greater detail regarding soils than giving a broad description based on the information in the map prepared by the All-India Soil and Land use Survey, Indian Agricultural Research Institute (1971).

## Power

14.2.12 The components of power are human, animal (mainly bullocks and he-buffaloes), mechanical and electrical. Human power reckoned here comes from cultivators, agricultural labour and those engaged in livestock, forestry, fishery and plantation etc., as reported in the official census of 1971. Since district data from 1972 Livestock Census have become available and since it is sufficient for a broad idea of power availability in the present context, the same have been used for power study. Information on agricultural machinery has also been obtained from the same source. For estimation purposes, the contribution of each of the power components has been taken to be as follows:-

```
component
```

horse power (HP)
per unit
(i) human

| (for each person in the age group | $15 — 59$ years) |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| man | . | . | . | . | . | . |
| woman . | . | . | . | . | . | . |

(ii) animals
bullocks/buffaloes . . . . . 0.40
camels . . . . . . . . .00

Component
horse power (HP)
per unit
(iii) mechanical/electrical
tractors . . . . . . . 25.00
power tillers . . . . . . 7.00
power sprayers/dusters . . . . . 2.00
diesel engines . . . . . . 7.00
electric motors . . . . . . 6.00
electrically operated sugarcane crushers . . 6.00
As tractors are also employed for hauling operations, only half of their number has been taken for calculating available power for tillage. Eighty per cent of human and animal power is taken as power available for crop production after allowing 20 per cent for extra farm activities. The reasons for these assumptions and detailed discussion of power availability have been given in Chapter 50 on Farm Power.

## 3 GENERAL INFORMATION

14.3.1 This Section contains a brief analysis and description of certain essential factors such as areas, human population, land use, irrigation, soils and livestock population which have a bearing on cropping patterns. Climatic factors including temperature, evaporation, dered in sunshine and radiation and general rainfall distribution have been consithe preceding Chapter.

## Area

14.3.2 The geographical area of India is 328 Mha. As district and taluk data are used in the analysis, a brief indication is given of the distribution of their areas in the different States and the country. There were 356 districts in 1971,1 and their areas are distributed as shown in Appendix 14-2—Statement I. The districts are not of uniform size and vary widely from a few hundred sq km in the case of city/capital districts to more than 20 thousand sq. km . About a quarter of the total number of districts have areas of less than 5 thousand sq km. Seventy per cent of the districts have areas between 5 to 20 thousand sq. km . The frequency of districts with area between 5 to 10 thousand sq km is 40 per cent. Of the 12 districts whose areas exceed 20 thousand sq km, 5 are in Rajasthan, one is Kutch in Gujarat and another is Bastar in Madhya Pradesh.

[^18]14.3.3 The taluk areas also vary widely. The total number of taluks in States where such a division of the district exists is about 1850.1 In as many as 7 States of 14 listed in table 14.1, about 60 to 75 per cent of taluks exceed 1000 sq km in area. Even in a State of small area like Kerala 12 out of 57 taluks have areas higher than 1000 sq km . Areas of 40 per cent of the taluks in Madhya Pradesh are more than 2000 sq km each. Nonuniformity in areas of districts and taluks makes intercomparison of data difficult.

Table 14.1
Taluks/Tehsils exceeding 1000 sq km in Area

| State |  |  |  | Number of taluks/tehsils | Number with area of more than 1000 sq km | percentage of col. 3 to col. 2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Andhra Pradesh |  |  |  | 195 | 139 | 71 |
| Gujarat |  | . | - | 184 | 53 | 29 |
| Haryana |  | . | . | 32 | 24 | 75 |
| Himachal Pradesh |  |  |  | 52 | 11 | 21 |
| Karnataka |  | . |  | 175 | 84 | 68 |
| Kerala |  | . | - | 57 | 12 | 21 |
| Madhya Pradesh |  | - |  | 190 | 169 | 89 |
| Maharashtra |  | . |  | 235 | 147 | 63 |
| Orissa |  | . |  | 103 | 61 | 59 |
| Punjab . |  | . |  | 41 | 25 | 61 |
| Rajasthan . |  | - |  | 196 | 113 | 58 |
| Tamil Nadu |  | - |  | 133 | 52 | 38 |
| Uttar Pradesh |  | - |  | 207 | 129 | 62 |
| Jammu \& Kashmir |  | - |  | 44 | 9 | 20 |

## Population

14.3.4 The total population of the country according to 1971 Census is 547.9 million corresponding to an average density for the country as a whole of 182 persons/sq. km. The density, however, shows large variations when State, district and taluk areas are considered. Appendix 14.2Statement II shows the State density and frequency of district density in different intervals. Among the States, Kerala (549) and West Bengal (504) have the highest density of over 500 per sq km; Bihar, Tamil Nadu and Uttar Pradesh have density of about 300 per sq km; Uttar Pradesh density would be much higher, if the hill districts are excluded. Nagaland, Manipur and Arunachal Pradesh have low density of less than 50 per sq km but among the bigger States, Rajasthan has a low density of only 75 per sq km. The density of Jammu \& Kashmir is vitiated due to lack of
1 Districts in Assam, West Bengal and Bihar are not divided into taluks.
information on occupied areas. The district density shows large variations from less than 100 to over 1000 per sq km. Kerala and West Bengal are the only States with districts (which are not State capitals) which have density exceeding 1000 per sq km. Excluding Union Territories 20 per cent districts have density less than 100 per sq $\mathrm{km}, 40$ per cent are between 100 and 200 per sq km and 30 per cent above 300 per sq km. Appendix 14.8 - Map VI shows the distribution of district density of population. The areas of low and high density are shaded. The belt of the country extending from West Uttar Pradesh to West Bengal (excluding hill areas and southern portions of Bihar) has density exceeding 300 per sq km . The only other continuous belt of high desnity is Kerala and neighbouring parts of Tamil Nadu.
14.3.5 For computing power availability for agriculture we need to know the agriculturall working population which is taken to include cultivators, agricultural labour and those engaged in livestock, fishery, forestry and allied activities. These categories total to 130 million but they cover all age groups up to 60 and above. Considering that effective work force engaged in agriculture is from 15 to 59 years, the agricultural workers for these age groups total to 109 million. This represents about 20 per cent of the population of the country. Corresponding figures for the different States are shown in Appendix 14.2-Statement III and these vary between 15 and 25 per cent except for Nagaland ( 32 per cent) and Meghalaya (31 per cent). The maximum agricultural working population of 25 per cent is in Andhra Pradesh and Madhya Pradesh. Four States viz. Punjab, Haryana, West Bengal and Kerala have only 15 per cent. The frequency distribution of agricultural working population is as follows :
agricultural working population
as per cent of total

# number of <br> States 

14.5-15.0 . . . . . . . 4
$15.1-20.0$. . . . . . . 5
$20.1-25.0$. . . . . . . 10

## Land Use

14.3.6 The different items of land use have been expressed as percentages of the total reporting area. The reporting area increased gradually from $289 \cdot 3$ Mha in 1950-51 to 305.6 Mha in 1969-70 and 305.3 Mha in 1970-71. The area for which no returns exist as percentage of total geographical area is 6.7 per cent. Table 14.2 gives the all-India land use statistics for 1969-70 to 1971-72. It will be seen that of the total reporting
area of about 306 Mha , forests occupy 21.6 per cent and land not available for cultivation about 15 per cent. Ten per cent of the area is barren and unculturable and area put to non-agricultural use is 5 per cent. Permanent pastures and other grazing lands, land under miscellaneous trees, crops and groves not included in net area sown and cultivable waste together account for 11 per cent. Current fallow lands are 4 per cent and other fallow lands account for 3 per cent of total reporting area. All these items total to about 55 per cent of reporting area. In 1969-70, net area sown was 45 per cent and in the subsequent two years 46 per cent. The cropping intensity is 118 per cent, area sown more than once being 18 per cent. Net irrigated area was $22-23$ per cent of net sown area and gross irrigated area 23-24 per cent of gross cropped area during this period.
table 14.2
All-India Land Use Classification ${ }^{1}$-1969-70 to 1971-72

| Classification | per cent of reporting area |  |  |
| :---: | :---: | :---: | :---: |
|  | 1969-70 | 1970-71 | 1971-72 |
| area under forests | $21 \cdot 6$ | 21.6 | 21.5 |
| area not available for cultivation |  |  |  |
| (i) area put to non-agricultural use | $5 \cdot 2$ | $5 \cdot 3$ | 5.4 |
| (ii) barren and uncultivable land | 9.9 | 9.5 | $9 \cdot 6$ |
| total (i \& ii) | $15 \cdot 1$ | $14 \cdot 8$ | 15.0 |
| other uncultivated land excluding fallow land |  |  |  |
| (i) permanent pastures and other grazing lands | $4 \cdot 2$ | $4 \cdot 4$ | $4 \cdot 3$ |
| (ii) misc. tree crops and groves not included in net area sown | 1.5 | 1.4 | 1.4 |
| (iii) culturable waste land | 5-2 | $5 \cdot 3$ | $5 \cdot 2$ |
| total ( $i+i i+i i i$ ) | $10 \cdot 9$ | $11 \cdot 1$ | 10.9 |
| fallow land |  |  |  |
| (i) other than current fallows | $3 \cdot 1$ | $2 \cdot 8$ | 2.9 |
| (ii) current fallows | 4.0 | $3 \cdot 7$ | 4-1 |
| total (i+ii) | $7 \cdot 1$ | $6 \cdot 5$ | 7.0 |
| net area sown . . . | $45 \cdot 3$ | 46.0 | $45 \cdot 6$ |
| total reporting area (thousand hectares) | 306,050 | 305,270 | 305,583 |
| total Geographical area (thousand hectares) | 328,048 | 328,048 | 328,048 |
| percentage of total cropped area to net area sown | $118 \cdot 1$ | $117 \cdot 6$ | $117 \cdot 7$ |
| percentage of area sown more than once to net area sown | $18 \cdot 1$ | $17 \cdot 6$ | $17 \cdot 7$ |
| percentage of net irrigated area to net area sown | 21.9 | $22 \cdot 3$ | $22 \cdot 7$ |
| percentage of gross irrigated area to gross crop- | $22 \cdot 8$ | $23 \cdot 3$ | $23 \cdot 5$ |

1 Indian Agriculture in brief 13th and 14th Editions, DES.
14.3.7 Appendix $14 \cdot 2$-Statement IV shows the land utilisation statistics for 1969-70 for different States and Union Territories in the country. Some of the main features are briefly stated.
(i) Forests : Andaman and Nicobar Islands are almost entirely under forests ( 94 per cent) closely followed by Arunachal Pradesh with 81 per cent. Around sixty per cent of the reporting area in Himachal Pradesh, Jammu \& Kashmir, Tripura and Mizoram is under forests. Among the major States, Madhya Pradesh and Orissa have a third of their area under forests. In Kerala and Andhra Pradesh, a quarter of the total area is under forests. There are practically no forests in Punjab, Haryana and Rajasthan. In the rest of the major States forests account for ten to twenty per cent of the reporting area.
(ii) Land not available for cultivation is generally 10 to 20 per cent. However 33 per cent of land in Assam, 26 per cent in Gujarat and 60 to 85 per cent in Manipur, Meghalaya and Nagaland is not available for cultivation.
(iii) Fallow lands are generally less than 10 per cent and in some States practically negligible. Only Bihar, Rajasthan and Tamil Nadu have 12 to 16 per cent area under fallow lands.
(iv) Net sown area is highest, 80 per cent of reporting area, in Haryana and Punjab. It is around 40 per cent in the belt from Rajasthan to Orissa and Andhra Pradesh and 50 to 60 per cent in the west and south from Gujarat to Kerala and Tamil Nadu. In Assam and Tripura net area sown is around 30 and 20 per cent respectively while in Himachal Pradesh and Jammu \& Kashmir it is around 10 and 15 per cent respectively. In Manipur net area sown forms only eight per cent of the reporting area and negligible in the north eastern States.
(v) Area sown more than once as per cent of net sown area is highest ( 68 per cent) in Himachal Pradesh and 30 to 40 per cent in the tract from Punjab to West Bengal and Orissa, Tripura and Kerala and 15 to 25 per cent in Jammu \& Kashmir, Meghalaya, Andhra Pradesh and Tamil Nadu; elsewhere, it is small 5 to 10 per cent. The intensity of cropping is not high, particularly in the South.

## Irrigation

14.3.8 The net and gross irrigated areas during the two decades from 1950-51 are shown in Table 14.3, Net irrigated area rose by fifty per cent, though during the last three years, the rise has been small. The increase in gross irrigated area has been larger, seventy per cent. According to estimate for 2000 AD given in Appendix $15 \cdot 2$ of Chapter 15 on Irrigation,
the gross irrigated area during the next three decades will be more than doubled.
table 14. 3
Irrigated Area

| Year |  |  |  |  |  |  | Net | Gross |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1950-51 | . . . | . | - | - | - |  | 20.9 | $22 \cdot 6$ |
| 1955-56 | . . . | . | . | - | . | - | $22 \cdot 8$ | $25 \cdot 6$ |
| 1960-61 | . . . | . | - | - | - | . | $24 \cdot 7$ | 28.0 |
| 1965-66 | . . . | . | - | . | - | - | $26 \cdot 3$ | $30 \cdot 9$ |
| 1969-70 | . . . | . | . | - | . | . | $30 \cdot 4$ | $37 \cdot 3$ |
| 1970-71 | . . . | . | . | - | - | - | 31.2 | $38 \cdot 5$ |
| 1971-72 | (provisional) | , | . | - | - | - | 31.6 | $38 \cdot 6$ |

According to estimate for 2000 AD gross irrigated and cropped areas are expected to be 84 Mha and 200 Mha respectively. This would correspond to a gross irrigated area of 42 per cent, leaving still about 60 per cent to be fed by direct rainfall. Rainfed agriculture would continue to dominate Indian agriculture, almost as a permanent feature. The distribution of gross irrigated areas-Appendix 14.2 Statement-IV shows wide variations among the States, being less than 10 per cent in Madhya Pradesh and Maharashtra (two of the biggest States in the country), to about 75 per cent in Punjab which is the State with highest percentage of irrigation in the country. Haryana and Tamil Nadu are next with around 45 per cent but 30 per cent less than Punjab. Andhra Pradesh and Uttar Pradesh are about a third irrigated. Bihar, West Bengal, Assam and Kerala have 20 to 25 per cent irrigation and elsewhere it is 10 to 20 per cent. Appendix 14-2-Statement V shows the frequency of districts in each State in different class intervals of net irrigated area. Of the 302 districts for which data could be collected, only 40 ( 13 per cent) have more than 50 per cent irrigation. A third of the districts had less than ten per cent. About 20 per cent of the districts had 30 to 50 per cent net irrigated area.
14.3.9 The distribution of irrigated area under various sources is shown in Appendix 14.2-Statement VI. For the country as a whole, 40 per cent of the net irrigated area is under canals, 38 per cent under wells and 15 per cent under tanks. The State figures shown significant variations. Canal irrigation accounts for nearly half the net irrigated area in Madhya Pradesh, Andhra Pradesh, Kerala and Punjab, around 60 per cent in Haryana and Assam and more than 95 per cent in Jammu \& Kashmir. In Karnataka, Tamil Nadu, Rajasthan, Uttar Pradesh and Bihar around 35 per cent area is irrigated by canals. A feature of significance is that in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan and Punjab well irrigation
accounts for more than 50 per cent of irrigated area. In Tamil Nadu, Bihar and Karnataka it is 20-30 per cent only. Elsewhere well irrigation is small or negligible. The highest percentage of tank irrigation is in Orissa being 51 per cent, and accounts for a third in Tamil Nadu, Karnataka and Andhra Pradesh. Tank irrigation accounts for $10-20$ per cent in Rajasthan, Maharashtra, Kerala and West Bengal; elsewhere it is negligible. Net irrigated area as per cent of net sown area of districts is shown in Appendix 14.8-Map VII which relates to the year 1970-71 for a number of areas and to 1969-70 for the rest.

Soils
14.3.10 As already mentioned in Section 2, information on soils is scanty. We give here a brief idea of the main types of soils prevailing in the different parts of the country. This account is based on the Soil Map of India, published in 1972 by IARI which is on a scale of $1 \mathrm{~cm}=60 \mathrm{~km}$. For more details, reference may be made to Soils of Indial as compilation by the Fertiliser Association of India for the different States of the country. The account which follows is given for areas in latitudinal intervals.
(i) Latitudes souih of $16^{\circ} \mathrm{N}$ :

The areas covered are Tamil Nadu, Kerala, most of Karnataka and southern parts of Andhra Pradesh. Excluding coastal areas, the main soils in the rest of the portion are red sandy with pockets of mixed red and black, red loam and laterite. A wide laterite belt runs along the west coast from northwest to southeast and immediately adjoining area in the east has red loam soils. East coast like the west has a narrow or thin strip of coastal alluvium with deltaic alluvium in Tanjore area and pockets of red loam and lateritic soils.
(ii) Latitudes 16 to $20^{\circ} \mathrm{N}$ : Along west coast southern half is laterite and northern red loam. In the east, coastal alluvium and in Krishna and Godavari areas deltaic alluvium are present. Of the remaining area half of it in the west has black soils mostly medium deep and in in the east red sandy with sizeable pockets of deep black and red loam soils.
(iii) Latitudes 20 to $24^{\circ} \mathrm{N}$ :

The areasd txercove eends from Saurashtra and Kutch in the west to Tripura and Mizoram in the east. Almost the entire area to the west of longitude $80^{\circ} \mathrm{E}$ is covered by black soils with pockets in Gujarat of calcareous soils of deltaic alluvium in Kutch. East of longitude $80^{\circ} \mathrm{E}$, the soils are red and yellow
except for pockets of laterite, red sandy and laterite soils; the areas of West Bengal are mostly alluvial.
(iv) Latitudes 24 to $32^{\circ} \mathrm{N}$ :
(a) West of longitude $76^{\circ} \mathrm{E}$, the areas covered are Rajasthan and Western portions of Haryana and Punjab. Soils in these areas are desert, calcareous, old alluvial in parts of Ganganagar and Ferozepur, alluvial with salinity in Tonk and Jaipur and in Amritsar to Jullundur. It should be mentioned that a fairly wide belt of calcereous soils runs from latitude $22^{\circ}$ in Surendranagar and Mehsana districts to Hissar and Ferozepur districts. The Southeastern part has red brown, mixed red and black and alluvial with salinity soils.
(b) East of longitude $76^{\circ} \mathrm{E}$ :

South of line from Jaipur to Gaya and then to West Dinajpur (West Bengal) soils are moderate black, mixed red and black or red sandy in the western half and red and yellow with small area of red sandy up to West Bengal (longitude $88^{\circ} \mathrm{E}$ ). Excluding hilly areas both to the north and east, the rest of the area is mainly alluvial with saline patches.
(v) Latitudes North of $32^{\circ} \mathrm{N}$ :

In the extreme north there are glaciers and permanent snow, mountain meadow sub-montain and brown silt soils.
(vi) General:

Alluvial soils occupy about 30 per cent of the geographical area of the country. Alluvial soils calcareous, coastal alluvium, deltaic alluvium and alluvial soils affected by salinity and alkalinity occupy 12 per cent. Desert soils are 4 per cent in area, black 15 per cent and red soils 9 per cent. All these types total to about 70 per cent of the geographical area.

## Livestock

14.3.11 The total livestock population of the country rose from 307 million in 1956 to 336 in 1961, 344 in 1966 and 355 million in 1972. The total rise during the last decade has been of the order of 6 per cent. Cattle constitute the largest in numbers, being half the total number of livestock. Among cattle, males of over three years are larger in number than the rest, the approximate distribution being Cm 21 per cent, Cf 16 per cent and Cy 14 per cent of total livestock population. This percentage distribution has remained practically the same from 1951. Goats are 19 per cent and sheep 11 per cent. Together, cattle, goats and sheep account for over 80 per cent of the total livestock in the country. Camels and horses are the lowest in numbers, being only 0.3 per cent of the total. Pigs constitute 12-133Deptt. of Agrl./76
nearly 2 per cent. The total number of buffaloes is not insignificant, being more than ten per cent. The males, females and youngstock individually constitute less than 10 per cent of the total livestock and, therefore, do not figure in the livestock patterns in general. Sheep form the predominant category in Andhra Pradesh, Tamil Nadu and Karnataka in the south and in Himachal Pradesh and Jammu \& Kashmir in the north. In Rajasthan sheep are next to goats but are in substantial numbers being over 20 per cent of the total. The belt from Maharashtra to Uttar Pradesh in the north and Assam in the east has generally Cm as the largest category. Goats assume this position in Kerala, Rajasthan, Gujarat and West Bengal. In West Bengal and Bihar both male cattle and goats have nearly equal numbers. It is of interest to mention that goats are the largest category in Kerala with 30 per cent of total; female cattle are also high in numbers with 26 per cent closely followed by young stock with 24 per cent of total. Gujarat too is similar with $\mathbf{G}$ and Cm having nearly equal percentages. Punjab and Haryana have Bf as the largest category. Bf account for more than 10 per cent in Uttar Pradesh, Gujarat and Andhra Pradesh. In the eastern States pigs are important. In Nagaland they are more than 50 per cent of total livestock. In Manipur they are slightly higher than Cm . In Goa, Daman and Diu they are nearly of the same order as male cattle. The other categories are mostly negligible in numbers. A few other points are:
(i) Cm is not less than 10 per cent of total livestock in any State except Kerala and Nagaland. The highest proportion is in Uttar Pradesh ( 28 per cent) followed by West Bengal, Assam, Orissa, Madhya Pradesh and Maharashtra with about 25 per cent each. Elsewhere it is between 15 and 20 per cent.
(ii) Cf varies between 10 to 25 per cent and the maximum is in Madhya Pradesh, Orissa, Kerala and Assam. Cy is lower and ranges between 10 and 20 per cent.
(iii) Bf accounts for about 20 per cent in Haryana and Punjab and 10 to 15 per cent in Gujarat and Andhra Pradesh. By category is highest in Punjab and Haryana ( 19 per cent) and less than 10 per cent elsewhere. In West Bengal it is hardly 1 per cent.
(iv) Sheep in Tamil Nadu, Andhra Pradesh, Karnataka, Jammu \& Kashmir and Himachal Pradesh are 21 to 25 per cent. In the very heavy rainfall States of Kerala and Assam they are almost absent.
(v) Goats are about 30 per cent in Kerala and Rajasthan.
(vi) Even in Rajasthan, Punjab and Haryana, camels hardly form 2 per cent.
(vii) The percentage of pigs is maximum in the eastern States and Andaman and Nicobar Islands. In Goa, it is about 20 per cent.

Appendix 14.3-Statement I shows the different livestock categories in each of the States as percentages of their respective totals in 1966 and 1972 censuses.
14.3.12 The livestock patterns in the States have been analysed using taluk data except in the case of Kerala and a few eastern States for which district/sub-divisional data have been utilised. The patterns are listed in Appendix 14.3-Statement II. As may be expected in examining smaller areas, the variations from the main patterns for the State as a whole, would often be considerable. As an example, Kerala's main pattern begins with $G$ but more detailed analysis shows that there are significant areas where Cf predominate. There are very few patterns which begin with a subscript 3 and of 2 there are extremely few. The predominance of sheep and cattle (male) in the southern States excluding coastal areas may be noted.
14.3.13 A number of patterns are common in different States. In drawing up the livestock patterns for the whole country, patterns which are common to two or more States will appear only once. Also, to show the broad features of livestock distributions in the country, patterns with two or three common categories are grouped together and the remainder categories shown as alternates by oblique lines. The total numter of patterns drawn up in this manner for the whole country is thrity five (35) and these are listed in Appendix 14.3-Statement III. They are distributed according to category and numerical subscript as follows :


Male cattle have not exceeded 50 per cent of total livestock population of any taluk/district in the country. In two patterns with $S$ and $P$, the percentage is above 50 and in one about 70 or higher. The number of patterns in the country is small and is suggestive of uniformity in distribution over large areas.
14.3.14 The livestock patterns in the different parts of the country are shown in Appendix 14.8 (Map V).

## 4 RAINFALL PATTERNS-ZONES

14.4.1 The rainfall distributions of individual stations have been analysed in the manner explained in Section 2 above. In many cases, each taluk has only one station and linear interpolation and simple permissible approximations have also been employed while analysing the distributions. All taluks with identical distributions have been grouped together and the patterns drawn up for each State separately. In writing the annual rainfall distributions, the arrangement in each four month period is according to decreasing class interval and not according to calendar sequence of months. To get over this, decoded form of rainfall patterns and their equivalents have also been given according to calendar months. Additional information on (i) frequency of months with rainfall greater than 10,20 and 30 cm per month, (ii) geographical area expressed as per cent of State area and (iii) gross cropped area as per cent of total cropped area of the State has also been included. These are given in Appendix 14.4 Statemen I. The advantage of presentation in this form is that one will know at a glance the rainfall in each month and the number of consecutive months with different amounts of rainfall which is essential for crop analysis. The area covered by each pattern is a zone and the zones are numbered in each State according to increasing rainfall intervals. Basic information of annual rainfall, month of maximum rainfall, rainfall total of month of maximum and preceding or following whichever is higher and number of months with 10 cm pm or more and total of rainfall for these months are included for each taluk station in an appendix to the State Reports.

## Zonal Areas

14.4.2 The areas under each of the patterns (zones) for the periods June to September, February to May and October to January have been worked out for each of he States separately and'for the country* as a whole. These are contained in Appendix 14.4—Statements II to IV. Salient features are discussed below :
(i) February-May : 72 per cent of country's geographical (reporting area gets rainfall of less than 5 cm pm and 15 per cent area has $5-10 \mathrm{~cm}$ mostly during May. The main feature of this period is thus that about 90 per cent of the geographical area of the country

[^19]does not have even one month of 10 cm or more of rainfall i.e., C type during February to May. The higher types are confined to Assam, West Bengal, Kerala and to some extent to Tamil Nadu, Karnataka, Himachal Pradesh and Jammu and Kashmir.
(ii) In June to September the principal rainy season areas of patterns/types vary widely. A4/A3 types cover a total area of 7 per cent. A2 B2 has the largest area of 12 per cent and A2 B1Cl per cent. A2 types are largest with 26 per cent of total geographical area and all A types together occupy 41 per cent area. B areas are less. B2 type covers 11 per cent and all B types together 22 per cent. $C$ is more than $B$, with a total area of 29 per cent. C4/C3 area is 9 per cent and C2 about 11 per cent. D area is about 7 per cent. E is almost negligible with only 0.6 per cent area. The areas of SW monsoon patterns beginning with types $A, B, C$ and $D$ and exceeding one per cent are distributed as follows:

| Per cent area |  |  | A | B | $\cdot$ | C |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $1 \cdot 01-2.00$. | . | . | 2 | 2 | 1 | D |
| $2 \cdot 01-5.00$. | $\cdot$ | . | 5 | 3 | 2 |  |
| $5.01-10.00$. | . | $\cdot$ | 1 | 2 | 4 | 1 |
| $10 \cdot 01-13.00$. | . | . | 1 |  |  |  |

(iii) During October to January 45 per cent area is under E type, i.e. no month has even 5 cm of rainfall. Thirty per cent of the area mostly from Assam to Uttar Pradesh and in the souhetrn States gets $5-10 \mathrm{~cm}$ during October. Fifteen per cent is in $10-20 \mathrm{~cm}$ pm class and this covers the east coast belt up to Bengal and areas in north eastern States.
14.4.3 Gross Cropped Area : Appendix 14.4-Statement V shows the gross cropped area in 1969-70 in each State for each of the rainfall patterns of the South-west monsoon. A4/A3 covers only 5 per cent of gross cropped area, but A2 is nearly a quarter ( 24 per cent) and $A_{1}$ nearly 9 per cent. B2 types are 13 per cent and B1 9 per cent. C4/C3 is 12 per cent and C2 areas total to another 12 per cent. All these add up to about 84 per cent.

## All India Rainfall Patterns

14.4.4 The four monsoon months constitute the dominant rainfall period in the country. During these four months, the patterns in different areas may vary from $A$ to $E$ type. When one considers the rainfall in the preceding four months and also that in the succeeding four months, the
patterns are considerably large in number. Even in type A, there can be rainfall of that magnitude in all the four months or in three, two or one month. Thus under type A itself, there would be 13 patterns if monsoon months alone are considered. But when the patterns of rainfall in the preceding four months as also in the succeeding four months are considered. the number of patterns under Type A becomes 73. Likewise, with monsoon season type B, the total number of patterns would be 31, while it would be 49 with type C, 15 with type D and 6 with type $E$. This makes a total of 174 patterns as shown below :

| type |  |  |  |  |  |  |  |  | no. of patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | 73 |
| B | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | 31 |
| C | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | 49 |
| D | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | 15 |
| E | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | 6 |

The Statewise break-up of number of patterns considering the entire year end on the basis of monsoon types $A$ to $E$ is shown in Table 14.4. It is to be noted that some of the patterns are common to more than one State. The number of common patterns and the total net patterns are shown in the last two columns of the table. The complete list* of patterns with respective all-India Zone numbers is given in Appendix 14•4-Statement VI.

[^20]
tabla 14.4 （Contd．）

|  | Southwest monsoon pattern | 厣 |  | 苋 | $\begin{aligned} & \text { 市 } \\ & \text { 翤 } \end{aligned}$ |  |  | Jammu \＆Kashmir | $\begin{aligned} & \text { 受 } \\ & \text { 鬲 } \end{aligned}$ | $\begin{aligned} & \text { 号 } \\ & \text { 宮 } \\ & \text { 棌 } \end{aligned}$ |  | $\begin{aligned} & \text { \# } \\ & \stackrel{W}{3} \\ & 0 \end{aligned}$ |  |  |  |  |  | $\begin{gathered} \text { 淢 } \\ \hline \end{gathered}$ | Total all <br> States | Number com－ mon in two or more States | Total exclu－ <br> ding <br> com－ <br> mon <br> pot－ <br> terns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| B1 C1 E2 | －－ | 1 |  |  |  |  |  |  |  |  | 1 | 1 |  |  |  |  | 1 |  | 4 | 2 | 1 |
| B1 C3 | ．． | 1 |  |  |  |  |  |  |  |  |  |  | 1 | 2 | 3 | 1 | 1 | 1 | 10 | 4 | 6 |
| B2 C2 | － |  |  |  | 3 | 1 |  |  |  |  |  | 1 | 1 | 1 | 1 |  |  | 1 | 9 | 5 | 4 |
| total | －• |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 31 |
| C1 D1 E2 | －－ |  |  |  |  |  |  |  |  |  | 1 | 1 |  |  | 1 | 1 | 3 |  | 7 | 2 | 5 |
| C1 D2 E1 | ．． |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 |  | 1 |  | 5 | 1 | 4 |
| C1 D3 | －－ |  |  |  |  |  |  |  |  |  |  | 1 |  | 1 | 5 | 4 | 2 |  | 13 | 3 | 10 |
| C2 D1 E1 | ．． |  |  |  |  |  |  |  | 1 | 1 | 1 | 1 |  |  |  |  | 4 |  | 8 | 3 | 5 |
| C2 D2 | ．． |  |  |  |  |  | 2 | 1 |  |  | 1 | 1 |  | 1 | 4 | 3 | 6 |  | 19 | 6 | 13 |
| C3 E1 | －． |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | － | 1 |
| C3 D1． | ．． |  |  |  |  | 1 |  |  | 1 | 1 | 1 |  |  | 1 | 3 | 2 |  |  | 10 | 5 | 5 |
| C4 | －． |  |  |  | 1 |  |  |  |  |  |  | 1 |  | 2 | 3 | 1 | 2 |  | 10 | 4 | 6 |
| total． | －• |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 49 |
| D1 E3 | － |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  | 1 |  | 2 | － | 2 |
| D2 E2 | －． |  |  |  |  |  |  | 1 | 1 |  | 1 |  |  |  |  | 2 | 4 |  | 9 | 1 | 8 |
| D4 | ．． |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  | 1 | － | 1 |
| D3 E1． | － |  |  |  |  |  | 1 | 1 | 1 | 1 |  |  |  |  | 1 |  |  |  | 5 | 1 | 4 |
| E4 | －． |  |  |  |  |  | 2 | 1 |  |  |  |  |  |  |  |  | 3 |  | 6 | － | 6 |
| total | －－ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 21 |

14.4.5 Rainfall maps : The rainfall patterns depict the distribution of monthly rainfall in coded form for the entire year. These are shown in Appendix 14.8, Map I. The decoded version of the patterns are given in the respective State tables in Appendix 14.4-Statement I.
14.4.6 A knowledge of the month of maximum rainfall (M) together with (a) totals of rainfall ( Rf ) and rainy days ( Rd ) of two consecutive months-month of maximum and of preceding or following whichever is higher and (b) the number of consecutive months ( $n$ ) with month of commencement ( m ) and totals of rainfall ( Rf ) and rainy days ( Rd ) of these months, is helpful for an understanding of the cropping patterns, etc. These items of information are given for the taluks in the country as far as available in the respective State reports and are also shown in Appendix 14.8 (Map II).

## 5 Rainfall Regions

14.5.1 The number of rainfall zones into which the country is divided is 174 . This number may not seem large for a country of India's size but for convenience in handling and bringing out clearly areas with different number of consecutive months of $10-20 \mathrm{~cm} \mathrm{pm}, 20-30 \mathrm{~cm} \mathrm{pm}$ and 30 cm pm or more, the various zones have been grouped into bigger units and designated as 'Regions' by introducing two simple modifications in the rainfall code used earlier for drawing up the rainfall patterns. The first is to combine Classes D and E for reasons mentioned below and replace them by only one symbol $E$ to denote rainfall of less than 10 cm . In connection with general limits of rainfall for different types of crops it has been indicated that rainfall of $5-10 \mathrm{~cm}$ per month for not less than three consecutive months would be helpful for crops which are low water requiring like moth, ephemeral grasses etc. It should, however, be remarked that for satisfactory growth of crops, rainfall should be closer to 10 cm per month for at least three consecutive months. From this point of view, keeping a class of $5-10 \mathrm{~cm}$ per month may not be satisfactory. While information on this is available in the detailed rainfall patterns of the different States, in the case of Regions the limit of $5-10 \mathrm{~cm}$ pm is not shown separately but is combined in class less than 10 cm pm , denoting this by symbol E. Thus, there will be only four classes in describing the patterns of distribution of the rainfall of Regions : A, B, C, and E, A, B, and C have the same meanings as before. If in a distribution of four months, two or three months are of one class (say B) and one a stage higher (A), the distribution is sown as belonging to the same class $B$ for not less than three consecutive months and written as (B4/C3). For example, A4, A3 B1, A3 C1 and A3 E1 are combined and shown as Jn (A4/A3) to indicate that there are not less
than three consecutive months of A type during June to September. Similarly, distributions A1 B4, A1 B2 C1, A1 B2 E1, B4, B3 C1 and B3 E1 are combined and written as Jn (B4/B3) and B1 C3, B1 C2 E1, C3 E1 and C4 as Jn (C4/C3).
14.5.2 Using the above simplifications, the number of rainfall patterns is only 62. The area covered by each of these Rainfall Patterns (which includes one or more of the corresponding zones) is termed a Region. The country is thus divided into 62 Rainfall Regions and numbered 1 to 62. A few hill areas in the extreme east, Nagaland, Manipur, Arunachal Pradesh, Nilgiris and West Uttar Pradesh hills are not shown as data for these areas are extremely sparse or absent. Rainfall Patterns for these areas on the basis of available data have been shown separately earlier and could be referred to as needed. It is similar for Andamans and Nicobars and Laksha Dweep group of islands. The 62 Rainfall Regions are shown in Appendix 14.10 (Map III).
14.5.3 Region I covers areas which do not get in any month even 10 cm rainfall. Regions 2 to 17 include areas with one or more months during June to September of C type rainfall or higher and these are listed in increasing order of rainfall distribution. Regions 18 to 22 have rainfall of 10 cm or more pm for one or more months beginning with October. The other regions 23 to 62 are arranged in increasing order of rainfall. Two statements showing list of regions together with relevant particulars on rainfall patterns, actual geographical and gross cropped areas with percentages to all-India, number of taluks in each Region and their location in States; are detailed in Appendix 14.5-Statements I and II Some of the main features of the Regions are discussed below:-
(i) Regions 1 to 17 cover about three-fourths of the geographical $(74.5 \%)$ as well as gross cropped areas ( $77.7 \%$ ) of the country. Region 1 has a gross cropped area of 2.7 per cent of the total. The areas of these Regions extend from parts of West Bengal to Jammu \& Kashmir, Punjab, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Karnataka and Andhra Pradesh.
(ii) Region 18 is small and covers a few taluks only, two in Karnataka and four in Himachal Pradesh. This is the only Region where rainfall of $10-20 \mathrm{~cm}$ is confined only to October. Region 2 whose cropped area is 5 per cent of total has also only one month of $10-20 \mathrm{~cm}$ but this is July in northern areas and September in the Peninsula. Regions 19 to 31 cover areas in the South Peninsula reaching southern portions of Orissa. C or higher type of rainfall is for 2 to 3 months from October in Regions 19 to 22, from September for 2 to 4 months in Regions 23 to 26 and for three to five months from August in Regions 27 to 29. In Regions 30 to 36 , rainfall of C or higher type is mostly from June
(in a few cases from July) for four or five months. In Regions 55 to 62 which cover mainly Assam and Kerala, rainfall of C or higher type is for 7 to 8 months from May, April or March. In Regions 38 to $40,43,46$ and $50-53$ there are two different periods during which rainfall is of C or higher class.
(iii) For study of crop structure, it is necessary to have for ready reference the distribution of rainfall according to calendar months. The coded form in Appendix $14 \cdot 5$-Statement I would not immediately meet this need. Besides, it is also necessary to know the month of commencement and number of consecutive months with rainfall in different class intervals. Such information is contained in the rainfall pattern lists given in Appendix 14.5-Statement II, but is not easy for frequent handling. For this reason, the rainfall distributions of the various Regions arranged according to calendar months are given below in (iv).
(iv) Rainfall Regions are arranged in eleven groups (I to XI) according to month of commencement of rainfall of 10 cm pm or higher and distributions of rainfall are shown in sequence of calendar months with following symbols:

| Ja | January | Jl | July |
| :--- | :--- | :--- | :--- |
| F | February | Au | August |
| Ma | March | S | September |
| Ap | April | O | October |
| My | May | N | November |
| Jn | June | D | December |


| Group no. | Rainfall Region | Rainfall pattern | Gross cropped area (per cent of all-India |
| :---: | :---: | :---: | :---: |
| I | 1 | no month with 10 cm or more | 2.73 |
| II | rainfall of 10 cm pm or more for one or two months during June to September only. |  |  |
|  | no. of consecutive months |  |  |
|  | $2 \mathrm{Jl} / \mathrm{S}$ | Cl 1 | 5.04 |
|  | $3 \mathrm{~J} / \mathrm{Au}$ | C2/JnCl SCl 1 -2 | 8.94 |
|  | 5 Jl B1 | Cl 2 | 1.87 |
|  | 6 J1 B2 | 2 | 0.92 |
| III | rainfall of 10 cm pm or more for three or four months during June to September only. |  |  |
|  | no. of consecutive months. |  |  |
|  | $4 \quad \mathrm{Jn}$ (C4) | C3) $4 / 3$ | 16.90 |
|  | 7 Jl B2 | 13 | 8.72 |


| Group $n$ no. | Region no. | Rainfall pattern | Number of consecutive months | Gross cropped area (per cent of all-India) |
| :---: | :---: | :---: | :---: | :---: |
| dV | 8 | $\mathrm{Jn} \mathrm{Cl} \mathrm{B2} \mathrm{C1}^{\text {c }}$ | 4 | $3 \cdot 33$ |
|  | 9 | Jn (B4/B3) | 4/3 | $2 \cdot 53$ |
|  | 10 | In (C1 A1 C2) | 4 | 0.39 |
|  | 11 | Il (A1 B1 C1) | 3 | $1 \cdot 39$ |
|  | 12 | Jn (Cl A1 B1 Cl) | 4 | $4 \cdot 07$ |
|  | 13 | $\mathrm{J}(\mathrm{A} 2 \mathrm{C})$ | 3 | $2 \cdot 44$ |
|  | 14 | Jn C1 A2 Cl | 4 | $3 \cdot 50$ |
|  | 15 | Jn Ci A2 B2 | 4 | $7 \cdot 57$ |
|  | 16 | Jn B1 A2 B1 | 4 | $7 \cdot 15$ |
|  | 17 | Jn (A4/A3) | 4 | $0 \cdot 18$ |
|  | October |  |  |  |
|  | 18 | OCl | 1 | 0.09 |
|  | 19 | OC2 ${ }^{\text {- }}$ | 2 | 1.34 |
|  | 20 | $\bigcirc \mathrm{Cl} \mathrm{Bl} \mathrm{Cl}$ | 3 | $0 \cdot 12$ |
|  | 21 | O Bl Cl | 3 | 0.08 |
|  | 22 | O Bl Al Bl | 3 | 0.08 |
| V | September | SC2 | 2 | 0.98 |
|  | 24 | S C3 | 3 | 0.93 |
|  | 25 | S C1 B2 | 3 | 0.10 |
|  | 26 | S Cl B1 A1 Cl | 4 | $0 \cdot 17$ |
| VI | August |  |  |  |
|  | 27 | Au C4/C3 | 4/3 | 1.86 |
|  | 28 | Au C3 B1 Cl | 5 | 0.67 |
|  | 29 | Au C2 B1 Al Cl | 5 | 0.20 |
| VII | June |  |  |  |
|  | Five months from June or four from July (October 10-20 cm.) |  |  |  |
|  | 30 | In (C3/C4) OC1 | $4 / 5$ | $2 \cdot 60$ |
|  | 31 | $\mathrm{Jn}(\mathrm{~B} 4 / \mathrm{B} 3) \mathrm{OCl}$ | 4/5 | 0.88 |
|  | 32 | $\mathrm{JnCl}_{\mathrm{C}} \mathrm{AlC}$ | 5 | $0 \cdot 17$ |
|  | 33 | Jn Cl A1 B1 C2 | 5 | $0 \cdot 10$ |
|  | 34 | Jn C1 A2 B1 C1 | 5 | 0.05 |
|  | 35 | Jn B1 A2 B1 C1 | 5 | 0.89 |
|  | 36 | Jn (A4/A3) OCl | 5 | 0.71 |
| VIII | May-5 to 7 consecutive months |  |  |  |
|  | 37 | My Cl Jn (A4/A3) | 5 | 0.26 |
|  | 41 | My C2 B1 C3 | 6 | 0.03 |
|  | 42 | My C1 B1 Al C2 | 6 | 0.02 |
|  | 44 | My C1 B1 A2 B1 C2 | 6 | 0.02 2.59 |
|  | 45 | My Cl Jn (A4/A3) OCl | 6 | 2.59 0.23 |
|  | 47 | My C2 B1 C2 B2 | 7 | 0.23 0.04 |
|  | 48 | My C1 B3 C1 | 5 | 0.04 1.37 |
|  | 49 | My Cl Jn (A4/A3) OB1 Cl | 7 | 1.37 0.27 |
|  | 55 | My B1 Jn (A4/A3) OB1 Cl | 7 | 0.27 0.77 |

RAINFALL AND CROPPING PATTERNS

| Group no. | Region no. | Rainfall pattern | Number of consecutive months | Gross cropped area (per cent of all-India) |
| :---: | :---: | :---: | :---: | :---: |
| IX | April/March <br> 6 to 8 consecutive months |  |  |  |
|  |  |  |  |  |
|  | 56 | Ap C1 B1 Al B1 |  |  |
|  |  | C2 B1 C1 | 8 | $0 \cdot 12$ |
|  | 57 | Ap C1 Bl C1 A2 B1 | 6 | $0 \cdot 20$ |
|  | 58 | Ap Cl Bl Jn (A4/A3) OCl | 7 | 0.66. |
|  | 59 | Ap C1 Bl Jn (A4/A3) OA1 B1 | 8 | $0 \cdot 59$ |
|  | 60 | Ap Cl Al Jn (A4/A3) OC1 | 7 | $1 \cdot 14$ |
|  | 61 | Ma Cl B1 A1 B1 A1 | 8 | $0 \cdot 23$ |
|  |  | $\begin{array}{lll}\mathrm{MaCl} 1 \mathrm{AlBlal} & 8 & 0.23\end{array}$ |  |  |
|  | 62 | Ma Cl A2 Jn (A4) OC1 | 8 | 0.23 |
| X | Two Seasons |  |  |  |
|  | 38 | My Cl-OCl |  | 0.08. |
|  | 39 | My C1-SC2 |  | 0.65 |
|  | 40 | My C1-Au C3 |  | $0 \cdot 50$ |
|  | 43 | Ja C2-J1 A2 Cl |  | 0.04 |
|  | 46 | Ja C2-J1 B1 C2 |  | 0.02 |
|  | 50 | Ja C3-J1 C2 |  | 0.05 |
|  | 51 | Ja C3-J1 $\mathrm{B}_{2} \mathrm{C}_{1}$ |  | 0.02 |
|  | 52 | Ja C3-J1 A2 C1 |  | 0.03 |
|  | 53 | $\mathrm{Ja} \mathrm{C3}^{\text {-Jn Cl A2 }} \mathrm{Bl} \mathrm{Cl}$ |  | 0.07 |
| XI | 54 | Ja C4 |  | $0 \cdot 12$ |

(v) Regions which have the same class or type of rainfall for 3 or 4 consecutive months during June to September.

| Region no. Rainfall pattern | Gross cropped <br> area (per cent <br> of all-India) | States |
| :--- | :--- | :--- |


| Jn (C4/C3) |  |  |  |
| :---: | :---: | :---: | :---: |
| 4 | Jn (C4/C3) | $16 \cdot 8$ | Himachal Pradesh, Pun- |
|  |  |  | jab, Haryana, Rajas- |
|  |  |  | than, Uttar Pradesh, |
|  |  |  | Madhya Pradesh, |
|  |  |  | Gujarat, Maharashtra, |
|  |  |  | Karnataka, Andhra |
| 30 | $\mathrm{Jn}(\mathrm{C} / \mathrm{C} 3) \mathrm{OCl}$ | $2 \cdot 6$ | Andhra Pradesh, |
|  |  |  | Karnataka, Orissa, Himachal Pradesh. |
|  | total for ${ }^{-} \mathrm{n}$ ( $\mathrm{C} 4 / \mathrm{C} 3$ ) | 19.4 |  |
| Jn (B4/B3) |  |  |  |
| 9 | Jn (B4/B3) | $2 \cdot 5$ | Andhra Pradesh, Uttar, |
|  |  |  | Pradesh, Bihar. |


14.5.4 The total cropped area under Jn (C4/C3), Jn (B4/B3) and $\mathrm{Jn}(\mathrm{A} 4 / \mathrm{A} 3)$ is 29.3 per cent of the gross cropped area of the country. It may be seen that Jn (A4/A3) patterns which number ten are having areas only in Kerala, Karnataka, Maharashtra, Gujarat (all in the West Coast and neighbourhood) and in Assam and Sub-Himalayan West Bengal areas; these account for only 5.1 per cent of the cropped area of the country. Jn (B4/B3) patterns cover areas in Assam, West Bengal, Andhra Pradesh, Bihar, Uttar Pradesh and Orissa and their total area is 4.8 per cent. In (C4/C3) has only two patterns but covers a vast area, 19.4 per cent of the gross cropped area of the country.
14.5.5 Map of Rainfall Regions : Appendix 14.8 (Map III) shows the rainfall Regions of the country. The rainfall pattern of each of the Regions is also entered in the Map.

## 6 CROPPING PATTERNS

14.6.1 The areas under different crops during the two decades from 1950-51 to 1970-71 are shown in Table 14.5:
table 14.5
All-India Area under Principal Crops as per cent of Gross Cropped Area


Gross cropped area has shown steady rise from 153 Mha in 1960-61 to 167 Mha in 1970-71. The overall percentage area under foodgrains declined from around 76 per cent of gross cropped area in 1950-51 to about 74 per cent in 1970-71. Share of crops like jowar, gram and all pulses has also shown some decline in per cent area. Area under wheat has on the other hand increased from 7.6 per cent in 1950-51 to 8.5 and 10.8 per cent in 1960-61 and 1970-71 respectively. Area under cotton remained steady at between 4.7 and 4.8 per cent during 1968-69 to 1970-71. There has been a slight decrease in the area under groundnut. Appendix 14.6-Statement I gives Statewise areas under different crops during 1969-70 and 1970-71. Main crops of each State which among themselves cover about 70 per cent or more of the gross cropped area of the State are listed below:

| State | . | Principal crops* | Code form |
| :--- | :--- | :--- | :--- |
| Assam . | . | . | Pd 71 |
| West Bengal | . | Pd 71 | Pd 1 |
| Orissa . | . | . | Pd54 Pu9 Fr5 |

Note: J denotes jowar

* The subscripts against crops represent percentage of area under the crop to the gross cropped area in the State.

| State | Principal crops | Code form |
| :---: | :---: | :---: |
| Bihar | Pd49 W10 Pu 11 | Pd2 W4 Pu4 |
| Madbya Pradesh | Pd21 W17 J11 Mt8 Pu9 G8 | Pd4 W4 J4 Mt5 Pu5 G5 |
| Uttar Pradesh | W24 Pd19 G10 M7 Pu5 S6 | W4 Pd4 G4 M4 Pu4 S5 |
| Himalhal Pradesh | W36 M28 Pd 11 | W3 M3 Pd4 |
| Jammu \& Kashmir | M30 Pd29 W11 | M3 Pd4 W4 |
| Punjab | W39 F14 M10 C7 Pd7 G7 | W3 F4 M4 Pd5/G5/C5 |
| Haryana | W21 B19 G22 Pd5 JS | W4 G4 B4 Pd5 J5 |
| Rajasthan | B30 W9 G9 F4 J8 | B3 W4 G4 F4 J5 |
| Gujarat | B20 J13 Gnl7 C17 Pd5 | B4 Gn4 C4 J4 Pd5 |
| Maharashtra | J28 B11 C14 Pu9 F6 | J4 C4 B4 Pu4 F5 |
| Karnataka | J21 Pd11 R9 Pu9 Gn9 C10 B5 | J4 Pd4 R4 Pu4 Gn4 C4 |
| Andhra Pradesh | Pd26 J20 Gni1 Pu9 Mt6 O5 B5 | Pd4 J4 Gn4 Pu4 Mt5/OS/B5 |
| Tamil Nadu | Pd35 J11 Gn13 Mt7 Pu5 B7 | Pd3 J4/Mt5 B5/Pu5 Gn4 |
| Kerala | L45 Pd30 | L3 Pd3 |

14.6.2 The cropping structure of the country has been analysed using taluk as unit of area. The method followed for identifying the cropping patterns is explained in Section 2. As a first step, the existing cropping patterns of the States were studied. As these have been considered in detail in the respective State Reports, we have only listed them here for ready reference in Appendix 14.6-Statement III. The frequency of cropping patterns beginning with each crop ( $\mathrm{Pd}, \mathrm{Jk}, \mathrm{Jr}, \mathrm{B}$ etc) is given in Appendix 14.6-Statement IV. These provide certain basic details of cropping patterns. The cropping patterns for the whole country are shown in Appendix 14.8 (Map IV).

Cropping Patterns of Regions
14.6.3 As explained in Section 5, the country is divided into sixty two (62) rainfall Regions arranged under eleven groups I to XI. The crop distribution in taluks included in each of the Regions has been analysed and the cropping patterns of the various Regions drawn up. The cropping patterns in each of the Regions is discussed in sequential order of Groups I to XI. For each Region, the distribution of rainfall and list of cropping patterns are indicated together with a brief account of the yield levels of the main crops. The discussion concludes with remarks on the suitability of crops grown in the Region and includes suggestions for improvement of production as also for growing alternate crops. Basic information on the following items have been included for each Region in Appendix 14. 6-Statement V :
(i) taluks with names of districts and States in which they are
(ii) cropping patterns of taluks included in each of the States in the Region;
(iii) geographical and gross cropped areas;
(iv) rainfall zone numbers of States included in each Region; and (v) district irrigated areas.
14.6.4 The cropping patterns of Regions*. 1 to 62 are discussed in the order listed below:

*The minimum rainfall considered is 10 cm pm .
Group I : No month with rainfall of 10 cm or more
14.6.5 Region I-E4 (E4) E4: There is only one Region in this group. This is the region with lowest rainfall in the country. Rainfall of less than 10 cm per month is received during the monsoon. It covers an area of 135.309 sq km forming 5 per cent of the total reporting area of the country. The Region accounts for 2.7 per cent of the all India gross cropped area spread over five States. The share of Rajasthan is 60 per cent and that of Punjab and Haryana together 36 per cent. Areas in Himachal Pradesh and Jammu \& Kashmir are negligible. While in the areas in Punjab and Haryana, rainfall of $5-10 \mathrm{~cm}$ pm occurs for three months from July to September, in the areas in Rajasthan it occurs in only two months i.e. July and August. In Ladakh area of Jammu \& Kashmir, rainfall is not more than 5 cm in any month. In the rest of that State, rainfall is $5-10$ cm pm in July and August as well as during January to May.
13-133 Diptt of Agri/76
14.6.6 The cropping patters of the region are listed below:
(i) Pd 2 M 4
(ii) $\mathrm{Pd} 3 \mathrm{M} 404 / \mathrm{V} 4 \mathrm{Fr} 4$
(iii) Bl
(iv) B 2 Pu 4
(v) B 3 Pz 3
(vi) Mt3 W4 Pu4/Ba4
(vii) Pu2 B3
(viii) Pu3 B3/F3
(ix) C4 W4 F4/G4
(x) G3 W4 B4 C4
(xi) G4 W4 B4 C4
(xii) W4 C4 F4/G4
(xiii) W3 F4 G4 C4/O4
(xiv) $\mathrm{Ba} 2 \mathrm{Pu} 4 / \mathrm{W} 4$
(xv) Ba 3 Mt 4 W 4

Crop patterns which include gram cover the largest area (35 per cent) and the patterns with bajra, wheat and other pulses cover 16 to 18 per cent of the gross cropped area in the region. Cotton pattern occupies 10 per cent of the gross cropped area.
14.6.7 Bajra is the dominant crop of the region with 23 per cent area followed by gram, fodder, wheat, and other pulses each in the range of 12 to 15 per cent. Considered statewise, bajra is the dominant crop in Rajasthan covering nearly a third of total cropped area followed by other pulses ( 21 per cent), fodder ( 12 per cent), gram ( 12 per cent) and wheat ( 6 per cent). In Haryana, area under gram is 31 per cent, bajra 18 per cent, wheat 16 per cent and cotton 13 per cent of gross cropped area. In Punjab, wheat and cotton are about 25 per cent and gram and fodder 15 per cent each. Paddy covers 40 per cent in Jammu \& Kashmir, maize and other oilseeds 20 and 10 per cent respectively, and wheat and small millets 6 per cent each. Irrigation facilities are good in the districts of Punjab and Haryana and Jammu \& Kashmir and in Ganganagar district of Rajasthan. Yields of paddy are good and it is mostly grown under irrigation in Srinagar and Anantnag districts of Jammu \& Kashmir. Cotton and wheat are also grown under irrigated conditions giving high yields.
14.6.8 Rainfall by itself is totally insufficient for growing crops other than millets. While RYI of rainfed crop of bajra in the districts of Rajasthan is low varying from 23 to 45 , it varies from 137 to 261 in various districts of Punjab and Haryana where the crop is irrigated. The RYI of wheat, gram, cotton and paddy are also well above the all-India average going beyond even 300 per cent where the crops are grown with full irrigation support. Where wheat is grown only under rainfed conditions, the RYI
is as low as 43. RYI of maize ranges from 65 to 70 in Jammu \& Kashmir State where it is taken as a rainfed crop.
14.6.9 This region gets the lowest rainfall in the country. Growing of arable crops will therefore have to be confined to low lying areas with good retentive soils. This can be done only after adopting appropriate soil conservation measures and water harvesting and other suitable agronomic practices. It is advisable to divert the areas from arable crops to forage and economic tree crops as sole crops or in mixture. More research and extension efforts will have to be put in with this objective in view.

Group II : Rainfall of 10 cm pm or more for one or two months during June to September
14.6.10 Regions-2,3,5 and 6 : This group includes four regions with 10 cm pm or more of rainfall during one or two of the four monsoon months, June to September, as indicated below :

| Region | Rainfall pattern | Rainfall types in |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | June | July | August | September |
| 2 | . E4 (Cl E3) E4 | E | C | E | E |
|  |  | E | E | E | C |
| 3 | $\mathrm{E} 4(\mathrm{C} 2 \mathrm{E} 2) \mathrm{E} 4$ | E | C | C | E |
|  |  | E | E | C | C |
|  |  | C | E | E | C |
| 5 | . E 4 (B1 C1 E2) E | E | B | C | E |
| 6 | . E4 (B2 E2) E4 | E | B | B | E |

14.6.11 Region 2-E4 (Cl E3) E4 : This region includes 85 taluks from Gujarat, Maharashtra, Andhra Pradesh and Karnataka with a croped area of 5 per cent of the total cropped area in the country. Only during July in the north or September in the south, 10 cm or higher rainfall is received. Rainfall during remaining three months is mostly $5-10 \mathrm{~cm}$ pm . In the Southern States rainfall is also $5-10 \mathrm{~cm}$ during October.
14.6.12 The 23 cropping patterns of the region are listed below:
(i) Jk3 Gn4 Mt4 Pd5
(ii) Jk 4 Gn4 Mt4 Pu4/Pd4 Jr4/C4 Pu4/C4 R4
(iii) Jk 4 Mt4 B4 Gn4/Pu4 O4
(iv) Bl
(v) B2 Jk4/Jr4/Pu4
(vi) B3 Gn3
(vii) B3 Jk4 Pu4/Gn4/Jr4 Gn4/F4 Pu4/F4 E4
(viii) B4 Jk4 Gn4 M4 Pu4
(ix) Mt4 Gn4 Jk4
(x) Pu4 F4 Jk4/B4
(xi) Pu4 Gn4 Mt4 W4 JK4 C4
(xii) Gn2 B4/Jk4
(xiii) Gn3 B3/Jk4
(xiv) Gn3 Jk4 Pu4/C4/To4 S4
(xv) Gn4 B4 (F4 Pu4/CE Jk4)/(Jr4 C4)/(Jr4 Jk4)
(xvi) Gn4 Jk4 C4 Mt4 Pu4
(xvii) C3 Gn4 Jk4/W4/Jr4 W4/Jr4 Jk4
(xviii) C3 Jr4 Pd4/Mt4
(xix) C4 Jk4 Gn4 Mt4/Pd4/Jr4/W4/W4 B4
(xx) C4 Jk4 Jr4 B4/Gn5/B4 Mt4
(xxi) Jrl
(xxii) Jr2 B4/Pu4
(xxiii) Jr3 B3/B4 C4/Gn4/C4 Jk4/C4 W4

Rabi jowar patterns cover a third of the cropped area, groundnut and cotton patterns 18 per cent each, bajra patterns 15 per cent and kharif jowar patterns 12 per cent. Pulses and minor millets patterns also occur in the region.
14.6.13 The RYI values of main crops of the region are as follows:

Relative Yield Indez (percentage of all India)

| District |  | Pd | JK | R | Pu | Gn | C | Jr | S | Mt | W |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Kutch |  |  | 19 | 127 | 31 | 106 | 177 |  |  |  |  |
| Jamnagar |  | . 25 | 121 |  | 77 | 151 |  |  |  |  |  |
| Amreli . |  | 61 | 193 |  | 96 |  |  |  |  |  |  |
| Bhavnagar |  | . | 35 | 167 |  | 93 |  |  |  |  |  |
| Sholapur |  | - |  | 48 |  |  |  |  | 63 |  |  |
| Poona |  | - |  | 80 |  |  |  | 52 | 136 |  |  |
| Satara |  | - |  | 85 | 72 |  |  | 113 |  |  |  |
| Ahmednagar |  | - |  | 65 | 54 |  |  | 72 |  |  |  |
| Sangli |  | - | 155 | 32 |  |  |  | 61 |  |  |  |
| Anantpur |  | - | 82 |  |  | 82 | 34 | 74 |  |  |  |
| Kurnool |  | - | 79 | 89 |  |  |  | 86 |  | 53 |  |
| Cuddapah |  | - | 92 |  |  | 98 |  |  |  | 50 |  |
| Bijapur . |  | - | 299 | 75 |  | 57 | 33 | 91 |  |  |  |
| Raichur |  | . 268 | 111 | 88 | 49 | 93 | 59 | 151 |  |  | 37 |
| Bellary . |  | 175 | 182 | 118 | 62 | 125 | 60 | 139 | 191 |  |  |
| Dharwar | . | . | 203 | 113 | 60 | 81 | 58 |  |  |  | 25 |

14.6.14 Reasons for low yields of bajra and rabi jowar in the districts of Maharashtra, those of cotton in Ahdhra Pradesh and Karnataka need to be studied with a view to take urgent measures either to increase the yields of these crops or for substituting them with more suitable crops.
14.6.15 Region 3-E4 (C2 E2) E4:This is one of the larger regions and includes 136 taluks in seven States from Himachal Pradesh and Punjab in the north to Andhra Pradesh in the south and accounts for 8.9 per cent of the gross cropped area of the country. The largest area of the region
is in Rajasthan. Areas in Andhra Pradesh and Himachal Pradesh are relatively smaller. There are only two months of $10-20 \mathrm{~cm}$ pm of rainfall and these are July and August in Gujarat and the northern areas, August and September in Andhra Pradesh and June and September in Maharashtra. In the remaining two months rainfall ranges from $5-10 \mathrm{~cm} \mathrm{pm}$ (except in Punjab and Haryana, where this much rainfall is received only in September. In Maharashtra, during October also there is $5-10 \mathrm{~cm}$ of rainfall and in Andhra Pradesh both October and November record $5-10 \mathrm{~cm}$ pm. Himachal Pradesh gets $5-10 \mathrm{~cm}$ pm of rainfall from January to March and $5-10 \mathrm{~cm}$ pm or higher from June to October.
14.6.16 Thirty cropping patterns have been identified in this region as indicated below :
(i) Pd3 Gn4 Jk4
(ii) M 2 Pu 4
(iii) M3 Pu4 Gn4/04
(iv) M3 G4 Ba4 .Pu4/Jk4/Pu4 05/W4 05
(v) M3 Ba4 Jk4 B4/(04 Gn4)
(vi) M4 Ba4 P4 W4 D4/Jk4
(vii) Jk3 B4 W4
(viii) Jk3 Gn4 S4/S4 To4
(ix) Jk4 M4 W4 G4

$$
\overline{04 \mathrm{B4}}
$$

(x) Bl
(xi) B2 Pu4/F4/D4/G4
(xii) B3 Pu3/Pu4/Pu4 G4/Fu4 F4/Pu4 W4/F4 D4/F4 Jk4/ Jk4 04/G3
(xiii) B3 Jk4 F4/Gn4/C4
(xiv) B3 Gn4 C4
(xv) B3 Pd4 Pu4/R4
(xvi) B4 Jk4 04 C4

F4 W5 05
(xvii) B4 Ba4 G4 $\frac{(\mathrm{W} 4 \mathrm{Pu} 5)}{\mathrm{Jk} 404}$
(xviii) B3 Jr3/W4
(xix) B4 Jr4 Gn4 Jk4
(xx) Pu3 B3
(xxi) 04 Pu4 F4 W4
(xxii) Gn3 Jk4 Pu4/S4/Mt4
(xxiii) G4 W4 B4/B4 S4/B4 Jk4
(xxiv) W3 G4 Pd4/Pd4 B4/Pd4 Jk4/Jk4 B4/Jk4 S4
(xxv) W3 F4 Pd4/M4/G4,'B4 B4 G4/B4/C4/C4 M4
(xxvi) W3 M4 Pd4
(xxvii) W3 Mt4 Pd4
(xxviii) W3 Mt4 Ba4 Pt4
(xxix) Jr2 B4
( xxx ) Jr3 B3/B4 S4/B4 W4
It is interesting to note that although there are 30 cropping patterns, bajra is grown over half and wheat over 27 per cent of the gross cropped area in the region. Though gram occurs in one pattern area covered by it is 9 per cent. Thus, the patterns including these three main crops cover 85 per cent of the gross cropped area of the region. Bajra has the largest area in three of the States including Rajasthan and is thus the major crop of the region. Maize is confined to Udaipur and Bhilwara districts. Wheat, the second most important crop of the region is largely confined to northern States. Although there is no pattern beginning with fodder, it is a significant crop in the northern States. Paddy area is extremely limited and it is one of the significant crops in wheat patterns of Punjab (W3 Pd4 M4/F4 etc.) and in Andhra Pradesh.
14.6.17 With only two months of $10-20 \mathrm{~cm} \mathrm{pm}$ rainfall and with high variability of monthly rainfall, the crops that can be grown are mostly millets. Even for millets the rainfall distribution is not entirely adequate which is perhaps the reason for the areas under jowar being limited. In Rajasthan, cropping patterns mostly include bajra and other pulses; maize over a small area in Udaipur, Bhilwara and Ajmer districts. In Udaipur the area under maize is 40 to 50 per cent of the gross cropped area.
14.6.18 In Punjab and Haryana, yields of gram are generally high at 131 per cent of the all India level. Wheat yield is of the order of 1.6 times of the all India yield and this crop is almost entirely irrigated. In Gujarat, bajra and cotton yields are very good, the State averages being about 150 per cent of the all India yields. Bajra yield in Rajasthan is generally low being less than 50 per cent of the all-India level though in a few districts the yields are higher and almost equal the latter. The RYI of maize is 89 per cent of all-India in Udaipur and 73 per cent in Bhilwara. Bajra yields in Maharashtra are generally low. In Sangli and Kolhapur, it is only a third of the all India level and in Ahmedanagar and Satara 65 per cent. Jowar yields are also low, the RYI being around 50 to 70 per cent. In Satara and Kolhapur, however, yields equal the all India level.
14.6.19 Excepting in Gujarat, the yield levels of crops without irrigation are on the low side, some of them being less than 50 per cent of all India as in the case of barja. It is, therefore, very necessary to remedy the situation either by substitution with more suitable crops or by improving the yield levels of existing crops by developing and adopting better varieties or agronomic practices including water management techniques.
14.6.20 Region 5-E4 (B1 C1 E2) E4-The region accounts for 1.9 per cent of the all-India gross cropped area; 85 per cent of it lies in Gujarat and balance 15 per cent in Rajasthan. Rainfall distribution is $20-30 \mathrm{~cm}$ in July, $10-20 \mathrm{~cm}$ in August and $5-10 \mathrm{~cm}$ in June and September.

The region has fifteen cropping patterns of which five are of groundnut, four of maize and three of bajra. Fifty one per cent of the cropped area of the region is covered by groundnut patterns and 23 per cent by bajra. There is only one cotton pattern (C2 Jk4/B4) and has subscript 2 indicating 50 to 70 per cent area but this covers 14 per cent of the region. Maize is grown mainly in Udaipur and Sirohi districts but the area covered by maize patterns is only 8 per cent. Fodder is a significant crop with a total area of about 4 per cent. Oilseeds and pulses, other than gram and tur, are also spread over significant areas. Groundnut is a major crop in Gujarat and maize in Udaipur and Sirohi districts of Rajasthan.
14.6.21 The cropping patterns in this Region are listed below :
(i) M 1
(ii) M2 Ba4 W4/W5 Mt5/W5 05
(iii) M3 Jk4Pd4/W4 C4
(iv) M3 W4 Pu4 O4
(v) B3 Gn4/Gn4 F4/Gn4 S4/Gn4/Jk4/Gn4/O4
(vi) B4 Pu4 O4 W4/F4/Mt4
(vii) B4 Jk4 W4 O4/Gn4/C4/O5 Pu5
(viii) E3 O4 M4
(ix) F4 O4 M4 B4
(x) GnI
(xi) Gn2 Jk4/B4/C4/J4
(xii) Gn3 Jk4 B4/C4
(xiii) Gn3 B4 F4/G4/Jr4/Jk4
(xiv) Gn4 Jr4 F4 C4/B4
(xv) C2 Jk4/B4
14.6.22 Groundnut yields in Gujarat show large variation the RYI ranging from 44 per cent in Surendranagar district to 137 per cent in Junagadh. RYI of all crops grown in this Region in many districts vary from 70 to 80 per cent. RYI of maize in Udaipur is 89 per cent and in Sirohi 85 per cent. Bajra yields in Gujarat are mostly higher than the all-India level. There is scope for improving the yield levels of maize and bajra in Rajasthan districts by adopting better water management and agronomic practices and by substituting groundnut in Surendranagar district of Gujarat with sunflower.
14.6.23 Region 6-E4(B2 E2)E4-This is a small region comprising 0.9 per cent of the country's gross cropped area. Seventy per cent of the total area of the region is in Rajasthan and the rest in Gujarat but for one taluk in Jammu \& Kashmir. July and August are the rainiest months with $20-30 \mathrm{~cm} \mathrm{pm}$. June gets 5 cm and September about 10 cm .
14.6.24 The cropping patterns of the region are as follows:
(i) M3 W4 Ba4/Ba4 O4/Mt4 B4 F4
(ii) M3 C4 O4 W4/Jk4/Jk4 F4
(iii) M4 W4 Jk4 (Ba4Gn4)

G4 F4
$\overline{\text { Gn4 (C5/Jk4) }}$
(iv) B3 F4 Jk4/Jk4 W5 Mt5
(v) B4 Gn4 W4 G4/G4 Jk4/Ba4 (Jk4/Pu4)
(vi) Jk3 G4 W4/W4 (Ba4/M4)
(vii) W3 M3
(viii) W4 B4 G4 Gn4 Ba4

Maize, bajra, jowar and wheat are the main crops. Patterns with bajra, maize and jowar (kharif) cover nearly equal areas and total to 95 per cent. Wheat patterns have a small area of 5 per cent. Rainfall distribution is suitable for crops like jowar, cotton and groundnut and almost favourable for maize. Rainfall is in excess of wheat is generally needed for bajra. Maize is grown mainly in Rajasthan with RYI of 70 to 80 per cent. About seventy per cent of the wheat area in Rajasthan is irrigated but its RYI is about 90 per cent. RYI of jowar is low at about 70 per cent. In Gujarat yields are better, the RYI of bajra being 145 per cent, of maize almost 100 per cent and of wheat 116 per cent. The RYI of jowar (kharif) is only 60 per cent. Cotton in Rajasthan has RYI of 111 per cent though 65 per cent of the area under the crop is irrigated while with only 16 per cent irrigation in Gujarat, yield is 144 per cent.
14.6.25 Although the crops grown in the Region are suited to the rainfall patterns, yield levels are low in Rajasthan districts. There is definitely good scope for improvement of productivity levels by ensuring adoption of improved varieties or hybrids and better agronomic practices.

Group III: Rainfall for three consecutive months from July or four from June with 10 cm pm or more.
14.6.26 This Group has 12 regions with medium to heavy amounts of rainfall for three or four consecutive months from July or from June respectively. Rainfall amounts vary from Class C in Region 4 to Class B in Regions 7 to 12 and class A in Regions 13 to 17. It can be seen that the Regions in this group generally get good rainfall from distribution point of view. It is, however, necessary to adjust the crops to suit the soil and other factors to get maximum yields.
14.6.27 Region 4-E4 (C4/C3) E4: This is the biggest rainfall region in the country with its cropped area being 17 per cent of the country's gross cropped area. It has a total of 287 taluks spanning areas in ten States from Karnataka and Andhra Pradesh in the south to Uttar Pradesh and Himachal Pradesh in the north. The largest number of taluks are in Maharashtra (103) followed by 60 in Andhra Pradesh and

34 in Uttar Pradesh. The per cent area covered in each State is as follows :


The region gets $10-20 \mathrm{~cm} \mathrm{pm}$ of rainfall for three consecutive months from July or four consecutive months from June. The cropping patterns identified number 57 and are distributed mainly among millets, paddy and wheat. These are shown in paragraph 14.6.30. The areas covered by the main crops are :

| Crop | W | Jk | Jr | B | C | Pu | Gn | Pd | O |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | ---: | ---: | ---: | ---: |
| per cent | 14 | 11 | 10 | 11 | 11 | 9 | 6 | 5 | 5 | area

Cotton, rabi jowar, bajra, gram, groundnut and other pulses are the main crops of Karnataka. Besides these crops, kharif jowar, small millets and paddy are important in Andhra Pradesh, paddy being almost entirely irrigated. Jowar (kharif and rabi), cotton and bajra dominate in Maharashtra. In Madhya Pradesh, jowar (kharif), cotton and other pulses are important. Bajra is the major crop in Rajasthan and Haryana areas with wheat and other pulses being other important crops. Wheat is more important in Haryana than in Rajasthan. Wheat dominates in Punjab accounting from 30 to 50 per cent of the area, the other important crops being gram, maize and paddy. Wheat is the major crop in Uttar Pradesh with gram and bajra also as other significant crops. Wheat and maize are the main crops of Himachal Pradesh and fruits and paddy are other important crops. Thus, the region is dominated by millets, cotton, wheat and other pulses. The first two crops of the cropping patterns in the portions of the States included in the Region, are shown in Paragraph 14.6.31.
14.6.28 Jowar (kharif) yields in the Region are around the all India level except in Gujarat where the RYI is 43 per cent, mainly because the crop is grown for fodder. Rabi jowar yield in Maharashtra, which has the largest area under this crop, is lower, RYI being 80 per cent but in

Karnataka and Andhra Pradesh also with large area yields are close to all India levels or higher. Yield of maize in Maharashtra is low at 72 per cent. Bajra is a major crop of the region with yields varying between 60 to 150 per cent, the lowest being in Rajasthan, at about 60 per cent. Gujarat, Haryana and Uttar Pradesh have higher yields. Rabi yield in Karnataka which has the largest area is around the all-India level. Wheat in the irrigated areas of the north has high yields but in Madhya Pradesh yield is low. The position about cotton is the same. In areas where the crop is rainfed, as in the southern States, the RYI is only 40 to 60 per cent, the exception being Gujarat where irrigation is hardly 15 per cent but the yield index is 144 per cent. Groundnut in the Region has all India level of yield. Gram yields are low, 40 to 60 per cent in the south but good in the north.
14.6.29 The rainfall distribution of $10-20 \mathrm{~cm} \mathrm{pm}$ for three or four months is suitable for millet crops; bajra and small millets in the lower ranges and jowar, cotton and groundnut in higher ranges i.e. with about 20 cm pm . The crop structure of the region largely reflects this distribution except where it is modified with irrigation. Inspite of the fact that the crops grown appear to be suitable to the rainfall situation, the yields are low in case of almost all crops grown in the region in Maharashtra, Madhya Pradesh and Rajasthan which suggests the need for detailed analysis and suitable remedial measures with regard to research as well as development efforts. This situation also holds good for Andhra Pradesh and Karnataka with regard to gram and other crops, the yield levels of which are low.
14.6.30 The cropping patterns in this region are listed below :

Paddy Patterns
(i) Pd3
$\frac{\frac{\mathrm{Jk} 4 \mathrm{Gn} 4}{\overline{\mathrm{Jk} 4 \mathrm{O}}}}{\frac{\overline{\mathrm{Jr} 4 \mathrm{M} 4}}{\frac{\mathrm{M} 4}{\mathrm{~F} 4 \mathrm{Y} 4}}}$
(ii) Pd3 R4 O4 W4
(iii) Pd4 Pu4 Jk4 (M4/O4/Gn4)
(iv) Pd4 Jk4 $\frac{\text { Gn4(Jr4/Pu4/Mt4) }}{\text { B4 (O4/Jr4) }}$

Jowar (Kharif) patterns
(i) Jk3 Gn4 C4/O4/S4/B4/Jr4 (Pd4/Mt4)/Pd4/(R4/Pu4)
(ii) Jk3 C4 Pu4/Pu4 (B4/Gn4)/O4/Mt4 Jr5
(iii) Jk4 Pu4 (B4 C4)/Gn4 T5 Jr5
(iv) Jk4 Pu4 O4 W4/B4/Gn4 (B4/Jז4/Jז4 T4/G5)
(v) Jk4 Pd4 (Jr4 O4/V4)/Pu4 O4/Mt4/Gn4 Mt4/R4 O4/C4 Mt4
(vi) Jk4 Gn4 B4 Pu4/Mt4/Pd4
(vii) Jk4 Gn4 C4 W4/(Pu4 B4 M4)
(viii) Jk4 Jr4 O4 V4

Maize patterns
(i) M3 Pd4 Jk4
(ii) M4 Pd4 Pu4/Jk4 (O4/R4)

Bajra patterns
(i) B 1
(ii) B2 Pu4
(iii) B3 G3/G3 W4/G4 (Pu4/W4/O4/Ba4)/Pu4 Ba4 V4/C4 Gn4
(iv) B3 W4 Jk4/Jk4 C4/F4 (Gn5/O5)
(v) B3 Pu4/Pu4 C4/Pu4 C4 O4/Pu4 Gn4
(vi) B3 Jr3/Jr3 Pd4/Jr4 Pd4/Jr4 Pd5
(vii) B4 W4 C4 F4
(viii) B4 W4 G4 Jk4/O4/F4/M4 Ba4
(ix) B4 W4 Pu4 G4/Ba4/Ba4 G4/O4/F4/Pd4 R4

Cotton patterns
(i) C 2 Jk 4
(ii) C3 Jk3/Jk4 (Pu4/W4/Pd4)
(iii) C3 Pu4 Jk4/B4/Jr4/Gn4/Fr4
(iv) $\mathrm{C} 3 \mathrm{Jr} 3 / \mathrm{Jr} 4 \mathrm{Mt} 4$
(v) C4 Pu4 (Jk4 (B4/Gn4)/Jr4(B4/Gn4/O4)/Gn4 B4
(vi) C4 Jr4 Jk4 Gn4/Gn4 (Pu4/Mt4)/Mt4 (Pd4/B4)
(vii) C4 Mt4 $\frac{\mathrm{Jk} 4 \mathrm{Gn} 4}{\mathrm{~J} 4 \mathrm{P} \text { Pd }}$

Other pulses patterns
(i) Pu3 Jk4 B5 C5
(ii) Pu4 Jr4 Jk4 (Gn4 T4)/M4 Pdi4

Pu4 Jr4 Gn (Gn4/Jk4)
$\frac{\mathrm{O} 4(\mathrm{Mt4/B4})}{\mathrm{T} 4 \mathrm{~B} 5}$
(iii) Pu4 B4 (C4 Jk4)
(Gn4 Jr4/W4)

## Gram pattern

G4 B4 W4 O4/Jk4/Jk4(Ba4/O4)

## Ragi pattern

(i) R3 Mt4 04 Pu 4 Pd 4

Groundnut patterns
(i) Gn3 B3 B4 Jk4
(ii) Gn4 Mt4 Jk4 Pu4/Jr4

Fruits pattern
(i) Fr4 W4 M4

Potato pattern
(i) Pt3 W4 M4

Wheat patterns
(i) W3 Pd4 M4/M4 F4/M5 G5/S4 B5 G5
(ii) W3 M4 Gn4/F4/F4 Gn4/Pt4
(iii) W3 Gn4 F4
(iv) W3 G4 (M4 Pd4)/Ba4 Jk4 F5
(v) W3 G4 Ba4 Pu4/Ba4 (Jk4/F5 Pu5/F5)
(vi) W3 B4 M4/Ba4(Pu4/M4 S5)
(vii) W4 B4 C4 Pd5
(viii) W4 B4 G4 O4/O5/G4(M4/Pu5)/Ba4 Pu4 M4
(ix) W4 M4 Pu4 B4 (Pd4/Ba4)
$\frac{\frac{\mathrm{S} 4}{\mathrm{~S} 4 \mathrm{~F} 4}}{\mathrm{Pd} 4 \mathrm{Gn} 5}$

Jowar rabi patterns
(i) Jrl
(ii) Jr2 T4/O4/Pu4/B4
(iii) Jr 3 B 4

Jr3 B4 S4/Pu4/O4/C4 (Pu4/O4)/C4/W4
(iv) Jr3 Pu4 O4/C4/O4/C4/W4/Pd4/Pd4 Jk4/Gn4/O4 R4/G4 Jk4
(v) Jr3 Gn4 Pd4/Mt4/Pd4 Mt4/B4 (T4/C4/O4)
(vi) Jr4 O4 T4/T4 B4/C4(Pu4/Gn4)
(vii) Jr4 Gn4 Pu4 Mt4/T4 (Jk4/O4)
(viii) Jr4 Pu4 Pd4/Pu4 G4/Jk4 (Pd4/O4)
14.6.31 The first two crops in the cropping patterns of portions of the States in the region are as follows:

| Karnataka | Andhra <br> Pradesh | Maharashtra | Gujarat | Madhya Pradesh | Rajasthan | Haryana | Punjab | Himachal Pradesh | Uttar Pradesh |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pu4 Jr4 | Pd4 M4/B4 | Pd3 Jk4 | Jk3 B4 | Jk3 C4 | B3 G3 | B3 G3 | W3 Gn4 | Fr4 W4 | W3 G4 |
| C3 Jr3 | Pd3 Jr4 | Pd3 R4 | B3 W4 | Jk4 C4 | B4 G4 | B3 G4 | W3 M4 | Pd3 W4 | W3 F4 |
| C4 Jr4 | Pd3 04 | Jk3 Gn4 | B4 C4 | Pu3 Jk4 | B4 Pu4 | G4 W4 | W3 Pd4 | W3 M4 | W3 B4 |
| Jr3 B4 | Pd4 Gn4 | Jk4 Pu4 | Gn3 B3 | C3 Jk4 | G3 B4 | W3 B4 |  |  | W4 B4 |
| Jr3 G4 | Pd4 Pu4 | B1 | C3 Jk4 |  | G4 B4 |  |  |  | W4 M4 |
| Jr4 O4 | M3 Pd4 | B2 Pu4 | C4 Jr4 |  |  |  |  |  |  |
| Jr4 Gn4 | M4 Pd4 | B3 Jr3 | W4 B4 |  |  |  |  |  |  |
|  | Jk3 C4 | B4 Pu4 |  |  |  |  |  |  |  |
|  | Jk3 Gn4 | Pu4 Jk4 |  |  |  |  |  |  |  |
|  | Jk4 B4 | Pu4 B4 |  |  |  |  |  |  |  |
|  | Jk4 Gr4 | C2 Jk4 |  |  |  |  |  |  |  |
|  | Jk4 Pd4 | C3 Jk3 |  |  |  |  |  |  |  |
|  | Gn4 Mt4 | C3 Pu4 |  |  |  |  |  |  |  |
|  | C3 Jr4 | C4 Pu4 |  |  |  |  |  |  |  |
|  | C4 Mt4 | Jr1 |  |  |  |  |  |  |  |
|  | Jr3 Gn4 | Jr2 Pu4 |  |  |  |  |  |  |  |
|  | Jr3 Pu4 | Jr3 B4 |  |  |  |  |  |  |  |
|  | Jr3 Gn4 | Jr3 Pu4 |  |  |  |  |  |  |  |
|  | Jr4 Jk4 | Jr4 O4 |  |  |  |  |  |  |  |
|  | Jr4 Pu4 | Jr4 Gn4 |  |  |  |  |  |  |  |
|  |  | R3 Mt4 |  |  |  |  |  |  |  |

rainfall and cropping patterns
14.6.32 The RYI values (percentage of all India) of the main crops for the different States in the Region are as follows :

| States |  |  |  | Pd | Jk | Jr | M | B | R | Mt | W | G | Total pulses | Gn | C |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Karnataka |  |  | - |  |  | 116 |  | 88 |  |  |  | 61 | 68 | 92 | 53 |
| Andhra Pradesh |  | . | . | 118 | 89 | 94 |  | 104 |  | 56 |  | 39 | 34 | 103 | 45 |
| Maharashtra |  | . | . | 99 | 107 | 80 | 72 | 77 | 97 | 104 |  | 44 | 60 | 91 | 56 |
| Gujarat |  | - | . |  | 43 | 173 |  | 147 |  |  |  |  |  | 96 | 144 |
| Madhya Pradesh |  | - | - |  | 115 |  |  |  |  |  |  | 98 | 85 |  | 65 |
| Rajasthan . |  | . | . |  |  |  |  | 61 |  |  | 92 |  | 71 |  |  |
| Haryana . |  | . | . |  |  |  |  | 128 |  |  | 162 | 131 |  |  |  |
| Punjab . |  | . | - | 142 |  |  | 138 |  |  |  | 181 | 124 | 156 |  |  |
| Himachal Pradesh |  | . | . | 103 |  |  | 161 |  |  |  | 70 |  |  |  |  |
| Uttar Pradesh . | - | . | . |  |  |  | 89 | 149 |  |  | 100 | 147 | 162 |  |  |

14.6.33 Region 7-E4 (B2 C1 E1) E4: This is one of the big regions which accounts for 8.7 per cent of total cropped area of the country. It covers 171 taluks in seven States from Madhya Pradesh to Jammu \& Kashmir. Uttar Pradesh has 86 taluks and Rajasthan and Madhya Pradesh 37 and 31 respectively. Punjab and Haryana together have 18 taluks. Rainfall is from July to September. Thirtyeight cropping patterns have been identified which are listed in paragraph 14.6.35. The areas covered by the cropping patterns are as follows :

| Crop |  |  |  | No. of <br> patterns | No. of <br> taluks | Per cent of total <br> cropped area |  |
| :--- | :--- | :--- | :--- | :--- | :---: | :---: | ---: |
| wheat (W) | . | . | . | . | 13 | 77 | $50 \cdot 8$ |
| gram (G) | . | . | . | . | 5 | 27 | $16 \cdot 4$ |
| paddy (Pd) | . | . | . | . | 5 | 18 | $12 \cdot 5$ |
| jowar (Jk) | . | . | . | . | 5 | 18 | $9 \cdot 4$ |
| maize (M) | . | . | . | . | 4 | 16 | $4 \cdot 4$ |
| bajra (B) | . | . | . | . | 3 | 11 | $3 \cdot 7$ |
| sugarcane (S) | . | . | . | . | 1 | 2 | $2 \cdot 0$ |
| barley (Ba) | . | . | . | . | 1 | 1 | $0 \cdot 4$ |
| fodder (F) | . | . | . | . | 1 | 1 | $0 \cdot 4$ |
| total | . | . | . | . | 38 | 171 | $100 \cdot 0$ |

The three major crops of the region are wheat, gram and paddy whose patterns together occupy 80 per cent of the cropped area. The other important crops are jowar, bajra and maize. Fodder is of some significance. Wheat yields are highest in Punjab and Haryana where 80 to 85 per cent of the crop is irrigated. Two-thirds of wheat crop in Uttar Pradesh and Rajasthan are irrigated but the yield is the same as all India average. Yield of wheat in Madhya Pradesh is low, less than 60 per cent of the national average; only 15 per cent of the crop is irrigated in the State. In Udaipur, Dungarpur, Banswara and Chittorgarh districts of Rajasthan, yield of maize was only $88,61,61$ and 100 per cent respectively of all-India; on the whole yields are below all India level. Yield of jowar in Madhya Pradesh is above all India and in Rajasthan area close to all-India level. Bajra is largely concentrated in Bharatpur and Swai Madhopur districts whose yields are 135 to 145 per cent. In Uttar Pradesh, area under bajra is small but yields are about 150 per cent. Gram is important in Uttar Pradesh with yield above all-India level. Paddy yields are low, only 70 per cent.
14.6.34 In spite of fairly good irrigation support the reason as to why wheat yields in Rajasthan and Uttar Pradesh should not be at almost the same level as in Punjab needs to be looked into. Similarly, exami-
nation is necessary with regard to maize in Rajasthan and paddy in Uttar Pradesh. The question as to what extent the yields of wheat grown under rainfed condition could be raised by providing irrigation support requires study. If it is not possible to provide irrigation support to wheat and raise its yields under rainfed conditions, it is worth considering as to why this area should not be diverted to safflower or such similar crops. Paddy yields cannot be high without irrigation support and, therefore, it may be advisable to divert paddy area to maize or other suitable crops after providing for proper drainage facilities.
14.6.35 Cropping patterns in this region are as follows:
(i) Pd3 W3
(ii) Pd3 W4 Ba4 Pu4/M4/Pu5
(iii) Pd4 W4 B4 Ba5/Ba4 G4/Ba4 T4
(iv) Pd4 W4 G4 S4/Pu5/Jk4/Ba4 Pu4/Ba4/Ba4 Jk4
(v) Pd4 W4 Ba4 Jk4/Pu4 Jk4/Pu4 M4
(vi) M3 Mt4 Pd4/W4
(vii) M3 W4 Ba4/Ba4 O4/G4 Pd4
(viii) M4 Pd4 Mt4 G4/W4
(ix) M4 Jk4 Gn4 W4
(x) Jk3 W4 F4/F4/Pu4/O4 G4/C4/C4 F4
(xi) Jk3 Gn4 C4/F4 C5 M5
(xii) Jk3 B4 O4 Pu4
(xiii) Jk3 Pu4 F4 W4/M4/Gn4
(xiv) Jk4 W4 F4 Gn4 Pu4
(xv) Jk4 W4 M4 Gn4/Pu4
(xvi) B3 G4 O4
(xvii) B3 W4 G4/Gn4/Gn4 G4
(xviii) B4 W4 G4 Gn4/O4
(xix) F4 M4 W4 Jk4 Gn4
(xx) G3 W3/W4 Jk4
(xxi) G4 W4 O4 Pu4/B4/T4/Jk4
(xxii) G4 Jk4 Ba4 W4 Pd4/B4
(xxiii) G4 Jk4 W4 B4/O4
(xxiv) G4 Pd4 Ba4 B4/B4 W4/B4 T4
(xxv) Ba4 Pd4 W4 B4 Pu4
(xxvi) W3 G4 Jk4/Pd4/Jk4 Pd4/Jk4 O4
(xxvii) W3 M4 Pd4/F4/F4 G4/Ba4/Pd4 Fr4
(xxviii) W3 S4 F4/Pd4/M4 F4 / M4 Ba4/Pd4 F4/Pd4 B4
(xxix) W4 Jk4 O4/F4/G4/F4 Mt4 Pu4
(xxx) W4 S4 F4
(xxxi) W4 Pd4 S4 F4/G4/G4 K5
(xxxii) W4 G4 B4 O4
(xxxiii) W4 M4 F4 G4 Gn4
(xxxiv) W4 Pd4 M4 G4/Ba4 Jk5/Ba5 S5
(xxxv) W4 Pd4 G4 S4/Pu4 Jk4/Gn4 Ba4/Ba4 Jk4/B4 Jk4/Jk5 S5
(xxxvi) W4 Pd4 M4 G4 B4/Ba4/5 Gn4/S5/Jk4/Jk5 S5/B4 O4/Gn4 Ba4
(xxxvii) W4 M4 Pu4 Jk4 G4
(xxxviii) W4 M4 B4 Gn4/5
14.6.36 Region 8-E4 (B2-C2) E4 : The region has 3.3 per cent of total cropped area and includes 55 taluks spread over six States from Bihar to Gujarat, Maharashtra and Andhra Pradesh, Madhya Pradesh has the largest area. July and August are the rainiest months in the region with $20-30 \mathrm{~cm} \mathrm{pm}$ and $10-20 \mathrm{~cm} \mathrm{pm}$ in June and September.
14.6.37 The twentythree cropping patterns of the region are as follows. Of these four are with paddy, five with jowar (kharif) and three each with cotton and wheat.
(i) $\mathrm{Pd} 2 \mathrm{Pu} 4 / \mathrm{M} 4$
(ii) Pd3 Pu4/M4 (Jk4/Pu4)
(iii) Pd3 Ba4 Pu4 W4/T4
(iv) Pd4 W4 Pu4/M4/M4 Pu4/G4 (Ba4/S4)
(v) M3 Pd4 Gn4/G4/G4 Gn4/Jk4 Mt4/Jk4 C4 G4
(vi) M4 Jk4 C4 F4 Mt4
(vii) Jk3 C3
(viii) Jk3 C4 Pu4/F4 (W4/G4)
(ix) Jk4 M4 Pu4 Gn4 C4/B4
(x) Jk4 C4 Jr4 Pu4/5
(xi) Jk4 W4 F4 G4/C4
(xii) Mt4 Pu4 Jk4 B4/M4
(xiii) Pu3 Pd4 W4/M4/G4
(xiv) Pu4 Jk4 Jr4 C4 Gn5 O5
(xv) C3 Jk3
(xvi) C3 Jr4 To4
(xvii) C4 Pu4 Gn4 F4 Mt4/W4 G4
(xviii) Jr4 Pu4 Pd4/Jk4/Gn4
(xix) B4 M4 Pd4 R4
(xx) W3 Jk4 G4/G4 S4
(xxi) W4 Pd4 G4 S4/Gn4 Ba4
(xxii) W4 G4 Jk4 F4/Pu4 F4
(xxiii) F4 Jk4 W4 G4

The main crops are paddy, wheat, jowar, cotton and maize. Gram and barley have significant areas in some of the taluks. One pattern starts with fodder and another has tobacco as a constituent crop. The near absence of bajra may be noted; the bajra pattern covers only a single taluk. While paddy with wheat and/or maize dominates Bihar and even Uttar Pradesh patterns, it gives place largely to millet and cotton in the rest of the region excepting for some paddy in Andhra Pradesh which is 14-133Deptt. of Agri/76
entirely irrigated. Rabi jowar is prominent in Andhra Pradesh. Rainfall distribution is not suitable for growing paddy but yet it has large areas in Bihar and Uttar Pradesh and to some extent even in Madhya Pradesh. Paddy in Andhra Pradesh is almost entirely irrigated. The paddy yield levels are low except where the crop is irrigated and the same is true of wheat also.
14.6.38 The region is endowed with good rainfall. There is no reason why the yield level should not improve. Growing of paddy and wheat where the yield levels are low without irrigation does not appear to be advisable. Either irrigation facilities should be developed wherever possible or areas should be diverted to other appropriate crops after study.
14.6.39 Region 9—E4 (B4/B3 E1) E4 : The cropped area is 2.5 per cent of total and includes areas in Bihar, Uttar Pradesh and Andhra Pradesh. Rainfall is $20-30 \mathrm{~cm}$ pm for three months from July or for four from June. There is uniformity in distribution of rainfall. Andhra Pradesh area is only 5 per cent but Uttar Pradesh covers half of the region.
14.6.40 Nine cropping patterns can be identified in the region, five of these are paddy oriented; and cover 85 per cent of the area. The following are the cropping patterns of the Region :
(i) Pd2 Pu4/W4/M4
(ii) Pd3 W4/W4/G4/Ba4/Pu4/Pu4 Ba4/Pu4 Ba4 S4/M4 S4/M4 Pu4
(iii) $\mathrm{Pd} 3 \mathrm{Pu} 4 \mathrm{Ba} 4 / \mathrm{Ba} 4 \mathrm{M} 4$
(iv) Pd3 Jr4 S4/Pu4
(v) Pd4 W4 Ba4 Mt4/M4 Pu4/(Pu4 G4/5)
(vi) M3 W4 Pd4/Pu4
(vii) Ba4 W4 M4 Pd4
(viii) G4 W4 Pu4 Pd4 M4/Ba4
(ix) Jr4 Jk4 Pu4 G4

The rainfall distribution is insufficient for paddy, but the large area under this crop in the Region reflects the desire of farmers to go in for this crop, expecting above normal conditions to prevail every year which may happen once in three years at the most. Consequently the yield level is low i.e. 70 to 80 per cent or less of all India. In Andhra Pradesh, rice crop is almost entirely irrigated.
14.6.41 This is another region much better endowed with good rainfall which is well distributed. Yield levels could be high but they are not so because a crop like paddy dominates for which rainfall is not sufficient and irrigation facilities required are not available. Yield levels of other crops are also low. Hence, careful examination is suggested.
14.6.42 Region 10-E4 (A1 C3) E4 : The entire region is in Gujarat and its cropped area is 0.4 per cent of all-India. It covers portions
of Junagadh, Surat and Broach districts. July is the rainiest month with more than 30 cm pm and the rest are in $10-20 \mathrm{~cm}$ class. Of the six cropping patterns two are with groundnut, three with cotton and one with jowar. Groundnut ( $47 \%$ ) and cotton ( $48 \%$ ) patterns cover together 95 per cent area. The major crops are groundnut in Junagadh area and cotton elsewhere. Yield of groundnut in Junagadh district is good at 137 per cent of all-India yield; that of cotton in Surat and Broach is 115 and 154 per cent respectively of all India. The cropping patterns in this region are listed below :
(i) Gn 1
(ii) Gn2 W4/C4/B4/F4 Jk4
(iii) Cl
(iv) C 2 Jk 4
(v) C2 Jr4/F4
(vi) Jk3 C4 Gn4 Pd4/Jr4
14.6.43 Looking to the amount and distribution of rainfall there can be a temptation for paddy cultivation. It is really gratifying that crops other than paddy are being cultivated in this region and with good yields. This can, therefore, be quoted as a very good example where the cropping patterns have been stabilized after taking the minimum rainfall, i.e. on lower side of the normal, into account. In the areas of above average rainfall drainage aspect is taken care of fully. In some other regions with almost similar rainfall patterns, paddy is grown resulting in unsatisfactory yield levels. The example of farmers of this Region is worth emulating by farmers in other Regions.
14.6.44. Region 11-E4 (A1 B1 Cl E1) E4: The cropped area of the region is 1.4 per cent of the country's gross cropped area. The 36 taluks of the Region belong to five States of which 14 taluks are from Gujarat and six from Madhya Pradesh. The rainy season is from July to September. Rainfall decreases from more than 30 cm in July to 20-30 cm in August and to 10 to 20 cm in September. June rainfall is 8 to 10 cm . There is no other month with even 5 cm rainfall.
14.6.45 The Region has thirteen cropping patterns as indicated below :
(i) Pd4 B4 Pu4 Ba4 W4 G5
(ii) M 2 Pd 4
(iii) M3 W3/W4 G4
(iv) M4 C4 Pd4 Gn4 O4/Mt4
(v) Jk3 C3/C4 G4/W4/G4
(vi) Jk3 C4 F4 M4/Gn4/W4
(vii) B3 Pd4 W4/To4 W4
(viii) B4 Pd4 Jk4 W4/F4/C4
(ix) Gn3 B4 C4
(x) Gn4 B4 C4/M4 C4/M4 Pd4
(xi) C4 Gn4 M4 B4/B5 Jk5
(xii) W3 M3
(xiii) W3 Jk4 O4/B4/G4/M44/M4

Wheat, maize, jowar and groundnut are the important crops. The main crops in each of the State areas in the Region are:

Himachal Pradesh
Rajasthan
Uttar Pradesh
Madhya Pradesh
Gujarat
maize and wheat
jowar, wheat and gram
wheat, maize, jowar, small millets, barley and paddy
jowar, cotton and fodder
groundnut, maize, bajra and cotton The cropping patterns centred around jowar, wheat, groundnut and paddy with about 30 per cent, 20 per cent, 16 per cent and 14 per cent respectively of the gross cropped area of the Region. Share of bajra and of maize are each about 8 to 9 per cent in total area.
14.6.46 Maize yield in Himachal Pradesh is above all India level but wheat is only 65 to 70 per cent. In Kotah district jowar yield is the same as all India but yield of wheat and of gram are only 67 per cent and 84 percent respectively. Cotton yield in Madhya Pradesh is about 60 per cent but jowar yield is above all India level. Wheat and barley yields in Uttar Pradesh area are only 80 per cent of the national level but that of maize is at par with all India yield and yields of small millets and jowar are even higher. In Pratapgarh district, where paddy dominates, the crop yield is only 55 to 60 per cent of all India.
14.6.47 In spite of the fact that rainfall is good for majority of crops grown in the Region, except paddy, yield levels of many of the crops are low except in Gujarat. Yields of jowar are fairly good but could have been better. Paddy yields cannot be expected to increase unless irrigation is provided. It is, therefore, necessary to go into the cropping structure in detail with a view to bringing about improvement in structure and productivity.
14.6.48 Region 12-E4 (Al B1 C2) E4: The Region includes 4 per cent of the gross cropped area of the country and extends over six States. Distribution of area among the States is as follows: Bihar ( 8 percent), Uttar Pradesh ( 9 per cent), Madhya Pradesh ( 29 per cent) Gujarat ( 16 per cent), Maharashtra ( 30 per cent) and Andhra Pradesh ( 8 per cent). Rainfall distribution begins with $10-20 \mathrm{~cm}$ in June, rises to more than 30 cm in July and decreases to $20-30 \mathrm{~cm}$ in August and $10-20 \mathrm{~cm}$ in September.
14.6.49 Twenty-nine cropping patterns have been identified and are listed below :
(i) Pdl
(ii) Pd 2 Pu 4
(iii) Pd3 Mt4 Pu4/O4/G4
(iv) Pd 2 Jr 4
(v) Pd4 M4 Pu4 Jr4/W4
(vi) M3 Pd4 Mt4
(vii) M4 Pd4 Mt4 [B4(C4/Gn4) ]/Gn5
(viii) Jk3 C4 O4/Pu4/Gn4/Pd4/W4/T4/F4
(ix) Jk3 Gn4 T4
(x) Jk4 C4 O4 Pu4/Jr4
(xi) Jk4 Mt4 W4 (O4 Pu4/G4)/(Pu4 G4/T4)
(xii) B3 To4 Mt4/Mt4 Pd4
(xiii) Mt3 W4 G4 Jk4
(xiv) Mt4 Pu4 Pd4 Gn4 C4
(xv) Jr4 O4 W4 Pd4 Jk4/Pu4/C4
(xvi) Jr4 C4 Pd4
(xvii) Gn4 Pd4 C4
(xviii) C1
(xix) C2 Jk4
(xx) C3 Jk3/Jk4/Jk4 W4
(xxi) C4 Pd4 (Mt4 Jk4)/(Mt4 Gn4)/(B4 M4)/(B4 To4 Jk4)
(xxii) C2 Jr4/Pd4
(xxiii) C3 Jr4 Jk4/Pd4/B4
(xxiv) C3 Jr4 Pd4 To4/B4 M4
(xxv) W3 Jk4 F4
(xxvi) W4 C4 O4/Jk4
(xxvii) W4 Pd4 Gn4 S5
(xxviii) W4 Pd4 G4 M4/S4/S4 B5/M4 S4
(xxix) To3 B4 Pd4

The number of patterns under different crops with respective per cent areas covered by them are as follows :

| Crop | Pd | M | Jk | B | Mt | Jr | Gn | C | W | To |
| :--- | ---: | :--- | ---: | :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| no. of patterns | S | 2 | 4 | 1 | 2 | 2 | 1 | 7 | 4 | 1 |
| per cent area covered | 16 | 3 | 28 | 2 | 3 | 6 | 0.5 | 27 | 14 | 1 |

For convenience the main crops in different States of the region are shown below in symbols.

| Bihar | Uttar Pradesh | Madhya Pradesh | Gujarat | Maharashtra | Andhra Pradesh |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Pd | W | Jk | C | C | Pd |
| Pu | Pd | W | Jr | Jk | Jk |
| M | G | Pd | Jk | Jr | Jr |
| W | S | F | B | Pu | Pu |
|  |  | 0 | Pd | W |  |
|  |  | G | M |  |  |
|  |  | C | Gn |  |  |

14.6.50 Paddy in Andhra Pradesh is almost entirely irrigated ar.d the yield is above all India level. Elsewhere, it is mostly rainfed with low yields of 70 per cent or less. 'Rainfall is insufficient for paddy. Cotton yields in Madhya Pradesh and Andhra Pradesh are low-less than 60 per cent, but in Gujarat where the crop is mostly rainfed the yields are well above the all-India level.
14.6.51 The rainfall distribution of the region seems more suited to millets, maize and cotton but not for paddy. Paddy growing without facilities for providing supplemental irrigation does not seem to be justifiable. Similarly, low yield standards of crops in some of the States on one hand and good levels in Gujarat, on the other, under similar rainfall conditions is difficult to explain. It is, therefore, recommended that cultural practices adopted in the State where the yields are good should be studied and extended to other areas in the region, in addition to carrying out the needed research.
14.6.52 Region 13-E4 (A2 C1 E1) E4 and Region 14-E4 (A2 C2) E4 : Rainfall distribution during July to September is the same in both the regions and hence these are discussed together. Both have areas in Madhya Pradesh, Uttar Pradesh and Himachal Pradesh and Region 13 covers in addition areas in Jammu \& Kashmir, Rajasthan and one taluk of Punjab. The cropped area in Regions 13 and 14 are 3.5 per cent and 2.4 per cent respectively of total. Ninetyone per cent of the cropped area of Region 14 is in Madhya Pradesh, 2 per cent in Himachal Pradesh and the rest in Uttar Pradesh. The Regions lie close to each other in the plains but are a little away, though close, in Himachal Pradesh and Jammu \& Kashmir.
14.6.53 The rainiest months are July and August with more than 3 C cm pm but rainfall in September is only $10-20 \mathrm{~cm}$ pm. In Region 14 June also gets $10-20 \mathrm{~cm}$. The sudden drop in rainfall in September and rapid rise from June to July may be noted. October rainfall is small and negligible. The high variability of September and October rainfall is another notable feature.
14.6.54 The cropping patterns of the regions are shown below side by side, for comparison :

| Region 13 | Region 14 |
| :--- | :--- |
| (i) Pd3W4 M4/Mt4/(Ba4G4)/ | (i) Pd1 |
| (Pu4 C5/G4/5) |  |
| (ii) Pd4 Ba4 W4 (G4 Jk4)/ (ii) Pd2 Mt4/Pu4 <br> (G4 Mt4 B4)/(B4/S4)  <br> (iii) M3 W4 Pd4/(G4 Pd4)/C4 Mt4/ (iii) Pd3 Mt4 O4/W4/Pu4/G4 <br> (Ba5 O5)  <br> (iv) M4 Pd4 Mt4 C4 G4 (iv) Pd3 W4 O4/Mt4/S4/G4 Mt4 Pu4 <br> (v) Jk3 M4 C4/W4 C4 (v) M3 W3 <br> (vi) Jk3 W4 G4/M4/G4 B4 (vi) Jk3 W4 F4/G4 |  |


| Region 13 | Region 14 |
| :--- | :--- |
| (vii) G3 W4 Jk4/Pd4/Jk4(T4/ | (vii) Mt3 Pd4 O4/Ba4/M4 |
| O4/Ba4)/O4 Ba4 | (viii) G3 W4 Pu4/Jk4 |
| (vii) W3 M3 Pd4 O4 | (ix) W3 C4/F4/Jk4 |
| (ix) W3 M4 B4/Pu4/Pu4 B4)/ |  |
| Pd4/Pu4 Pd4 | (x) W3 G4 Pu4/F4/O4 Pu4 |
| (x) W3 G4 Jk4 O4/Pd4(O4/G4)/ |  |
| Pd4 |  |
| (xi) W4 Mt4 Pd4 (O4/G4) | (xi) W3 Jk4 G4/F4/B4/G4 |
| (xii) W4 Mt4 F4 (Jk4 Pd4)/ | (xiii) W3 M3 /M4 (Pd4/Ba4) |
| Ba4/(B4/Pd4) | (xiv) W4 Pd4 G4/O4 Mt4/O4 |

Wheat and paddy patterns have the largest areas but in Region 13, jowar (kharif) and gram patterns also cover substantial areas.

| Patterns |  |  |  |  | Region 13 <br> (\% area) | Region 14 <br> (\% area) |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | ---: | ---: |
| paddy | . | . | . | 29.8 | 36.6 |  |  |  |
| wheat | . | . | . | . | . | . | 37.2 | 51.5 |
| gram | . | . | . | . | . | . | 14.5 | 1.9 |
| jowar (kharif) | . | . | . | . | . | . | 14.1 | 6.4 |
| small millets | . | . | . | . | . | . | - | 4.5 |
| maize | . | . | . | . | . | . | 4.9 | 0.6 |

14.6.55 Important crops of Region 13 are wheat, paddy, jowar and maize Grams and small millets have also significant areas. Wheat is the main crop in Himachal Pradesh, Jammu \& Kashmir, Madhya Pradesh and Punjab areas. In Uttar Pradesh area there is no pattern beginning with wheat but paddy and wheat go together in the paddy patterns. In Madhya Pradesh, wheat is predominant. In Rajasthan, jowar and wheat occupy considerable area but in Banswara district, maize dominates. Small millets, paddy and gram are also important. Gram is major in Banda district of Uttar Pradesh with G3 W4 Jk4 Pd4 pattern. In Region 14, wheat and paddy are the major crops. The other important crops are gram, pulses other than tur and gram, maize, oil. seeds other than groundnut and small millets. Paddy dominates the eastern areas and wheat in the rest of the region.
14.6.56 Wheat yields in Uttar Pradesh and Rajasthan are close to all-India but in Madhya Pradesh it is only 57 per cent and in Himachal Pradesh 70 per cent. This is due to the fact that two-third of wheat area is irrigated in Rajasthan and Uttar Pradesh whereas the irrigated area is only 15 per cent in the other two States. Rice yields in the principal areas are low and of the order of 70 per cent only. This is due to low and uncertain rainfall of September and lack of supplemental irrigation. Jowar yields are good ( $115 \%$ ) in Uttar Pradesh and Madhya Pradesb
but over 70 per cent in Rajasthan where the area is not large. Maize yields are 90 per cent or less except in Himachal Pradesh where the yield is as high as 161 per cent. Gram yield is about 95 per cent of all-India in Uttar Pradesh and Rajasthan but 78 per cent in Madhya Pradesh. The yield of small millets is low in Madhya Pradesh ( $62 \%$ ) and Rajasthan ( $83 \%$ ) but high in Uttar Pradesh ( $163 \%$ ) and Himachal Pradesh $(226 \%)$.
14.6.57 In brief, it can be stated that the yield levels of paddy and wheat, the two major crops of the Regions, are on the low side. The reason for this state of affairs cannot be any other than insufficient moisture supply. Rainfall, especially in September, is not sufficient to support rice crop and irrigation facilities are wanting for paddy as also for wheat. Yields of a few other crops are also low in some of the States in the Region. The only way to remedy the situation is to study the various aspects and evolve and adopt appropriate measures.
14.6.58 Regions 15 and 16-E4 (A2 B1 C1) E4 and E4 (A2 B2) E4 : Regions 15 and 16 have been grouped together as they have the same rainfall distribution during July to September. Their cropped areas are 7.6 and 7.2 per cent respectively of the total and cover adjoining areas to a large, extent. The distribution of areas in the different States is as follows :


July and August are the rainiest months with more than 30 cm pm but September gets only $20-30 \mathrm{~cm}$. June is $\mathbf{C}$ class in Region 15 and B in Region 16.
14.6.59 The Cropping Patterns of Regions 15 and 16 are as follows :

| Region-15 | Region-16 |
| :--- | :--- |
| (i) Pd1 | (i) Pd1 |
| (ii) Pd2 W4/Pu4/M4/Mt4/R4 | (ii) Pd2 Pu4/Mt4/O4/W4/M4/Jr4/ |
|  | Pu4 O5 |
| (iii) Pd3 W4/W4 G4 | (iii) Pd3 Jr4/Pu4/Pu4 M4/Pu4 W4 |
| (iv) Pd3 W4 S4/Pu4/Ba4/ | (iv) Pd3 Mt3/Mt4 O4/Mt4 O4 M4 |
| M4 Pu4/M4/Pu4 Mt4 |  |
| (v) Pd3 Mt4 O4/Pu4 |  |
| (vi) Pd3 M4 O4 Pu4/Mt4. | (v) Pd3 Pu4 W4/M4/M4 W4/Mt5 O5 |


| Region 15 | Region 16 |
| :--- | :--- |
| (vii) Pd4 W4 S4/M4/S4 G4/S4 | (vii) Pd4 R4 O4 Pu4/Mt4 Jk5 |
| (viii) Pd4 Mt4 O4 W4 Ba4 | (viii) C4 Jk4 Pd4 |
| (ix) Pd4 C4 Jk4 Gn4/Gn4 Mt4 | (ix) R4 O4 Pd4 Mt4 |
| (x) Jk4 C4 Pd4 Gn4 | (x) Mt3 Pd3 |
| (xi) Mt3 O4 (W4 G4)/W4 | (xi) Jr3 Pd4 |
| Pd4/Ba4 Pd4 |  |
| (xii) Mt3 Pu4 Jr4 C4 |  |
| (xiii) C2 Jr4 |  |
| (xiv) C3 Jr4 Pd4/Pd4 Gn4 |  |
| (xv) C4 Pd4 Pu4 Jk4/S4 |  |
| (xvi) C4 Pd4 Gn4 (Mt4 M4)/Jk4 Fr4 |  |
| (xvii) G4 W4 Pu4 Jk4 |  |
| (xviii) Jr2 Gn4 W4 |  |
| (xix) Jr3 Pd4 Gn4 Pu4/Jk4 |  |
| (xx) Jr3 Pu4 Pd4/O4 |  |
| (xxi) Jr4 Pd4 Mt4 O4 |  |
| (xxii) W3 Pd4 M4 |  |
| (xxiii) W3 O4 Pu4/G4 Pu4 |  |
| (xiv) W4 Pu4 O4 |  |
| (xxv) W4 Mt4 Pd4 G4/O4 |  |

14.6.60 Seventythree per cent of cropped area is covered by the nine paddy patterns in Region 15. In Region 16, 97 per cent of cropped area is under paddy patterns. The rainfall criterion for paddy of not less than three months with 30 cm pm or more is not satisfied, though it is nearly so. By proper water management, moisture stress during September could be met.
14.6.61 The position regarding yields is that in most of the States they are low and 70 to 80 per cent only. Paddy is the main crop of these regions but yields are low. One of the main reasons is insufficiency of rainfall especially in September and possibly in June. Providing for supplemental irrigation will go a long way in increasing and stabilising paddy yields. Where it cannot be done, it is better to divert paddy areas to other crops. These Regions are however more suitable for paddy than other crops and hence necessary steps should be taken for providing irrigation facilities.
14.6.62 Region 17-E4 (A3 B1) E4: The total cropped area of the Region is 0.2 per cent of all-India and includes taluks in Vasad, Dangs (Gujarat) and Thana and Nasik (Maharashtra). Rainfall is greater than 30 cm pm for three consecutive months and is well suited for growing rice. This is reflected in the cropping patterns which are as follows:
(i) Pdl
(ii) $\operatorname{Pd} 2 \mathrm{Pu} 4 / \mathrm{Mt} 4 / \mathrm{Fr} 4$
(iii) Pd3 R4 Pu4/Mt4
(iv) R3 O4 Pu4 M4/Mt4

At higher elevations and in tribal areas of Dangs, Dharampur etc., ragi and small millets assume greater importance. Paddy yield is 138 per cent in Thana and just at the all-India level in Bulsar. Ragi yields are about 90 per cent.
14.6.63 Water resources through rainfall are more than adequate for growing paddy in valleys and hill-millets in elevated areas. Paddy yields are fairly good and could be raised further especially in Bulsar district of Gujarat. There is good scope for increasing the yields of ragi by adopting better varieties and agronomic practices. Being heavy rainfall areas, there is scope for introducing improved varieties of grasses and forage legumes. It is worth trying soybean in rotation with ragi. Maize could also be tried. The Region is good for production forestry and economic tree crops.

Group IV : Rainy season from October for one to three months
14.6.64 Regions 18-22 : In this group five Regions ( 18 to 22 ) are included where effective rainfall of more than 10 cm pm occurs only in October or continues for one or two months thereafter i.e. only during post-monsoon months. The rainfall patterns for these Regions are given below :

Region 18-E4 (E4) Cl E3
Region 19-E4 (E4) C2 E2
Region 20-E4 (E4) B1 C2 E1
Region 21-E4 (E4) B2 C1 E1
Region 22-E4 (E4) A1 B2 E1
Rainfall varies from class $\mathbf{C}$ in Region 18 to Class A for one month and class B for two months in post-monsoon period in Region 22. These Regions cover portions of southern States, mostly Tamil Nadu, there are also small areas in Andhra Pradesh and Karnataka. Himachal Pradesh has a small pocket which is included in Region 18. The other area in Region 18 comprises of two taluks of dry districts of Chitradurga in Karnataka and it accounts for 96 per cent of the cropped area of the Region. Millets, cotton and other pulses are important crops of this Region. Rainfall is $10-11 \mathrm{~cm}$ in October, $9-10 \mathrm{~cm}$ in September, 5 cm in November and $5-8 \mathrm{~cm} \mathrm{pm}$ in August and May. Rainfall is very low and the yields of all crops are also low.
14.6.65 Region 19 is entirely in Tamil Nadu and is the biggest with 1.34 per cent cropped area. Rainfall is $10-20 \mathrm{~cm} \mathrm{pm}$ during October and November. September rainfall is $5-10 \mathrm{~cm}$. It has paddy, jowar, bajra and cotton as main crops. Paddy is entirely irrigated.
14.6.66 Regions 20 to 22 cover areas on the east coast of Tamil Nadu and Andhra Pradesh. Total cropped area is small being less than
0.2 per cent. Rainfall is heavier attaining A and B class in one or two months. Paddy is the main crop and mostly grown under irrigation. Jowar and other pulses are also important.
14.6.67 The cropping patterns of the Regions 18 to 22 together with names of the States included in the Regions are as follows :

| rainfall pattern | $\begin{gathered} \text { Region-18 } \\ \text { E4 (E4) C1 E3 } \end{gathered}$ | $\begin{gathered} \text { Region-19 } \\ \text { E4 (E4) C2 E2 } \end{gathered}$ | $\begin{aligned} & \text { Region-20 } \\ & \text { E4 (E4) B1 C2 } \\ & \text { E1 } \end{aligned}$ | Region-21 E4 (E4) E2 C1 E1 | $\begin{aligned} & \text { Region--22 } \\ & \text { E4 (E4) } \\ & \text { A1 B2 E1 } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| expanded form cropping patterns | OCl <br> (i) C4 Mt4 Jr4 Jk4 Pu4 B4 <br> (ii) Pu4 Jk4 Mt4 B4 <br> (iii) $\mathrm{Ba} 3 \mathrm{Mt} 4 / \mathrm{Mt} 4 / \mathrm{W} 4$ <br> (iv) Mt 3 Ba 4 | OC <br> (i) Pdl <br> (ii) Pd2 R4/Mt4 <br> (iii) Pd3 B4 C4/Mt4 C4/Mt4 L4 <br> (iv) Pd4 Gn4 Jk4 B4 $\mathrm{R} 4 / \mathrm{C} 4 / \mathrm{Ir} 5$ <br> (v) Pd4 Gn4 Mt4 $\underset{\text { B4 J C4 }}{ }$ <br> (vi) Jk3 C4 Pu4/Pur Gn4 <br> (vii) Jk4 Pd4 Mt4 Gn4 $\mathrm{C} 4 / \mathrm{J} 4$ <br> (viii) Jr3 Pd4 Mt4 Pu4 <br> (ix) Jr4 Pd4 Jk4 B4 Pu4 <br> (x) B3 C4 Mt4 <br> (xi) B3 Jk4 O4 <br> (xii) B4 Jk4 Mt4 Gn4 Jr4 <br> (xiii) C3 B4 Mt4/Pd4/F4 <br> (xiv) C4 Mt4 Pd4 $\frac{\text { Pu4 Jk4 }}{\frac{\text { Gn4 Jk4 }}{\text { Pu4 B4 }}}$ | O $\overline{\mathrm{C}} 1 \mathrm{B1} \mathrm{Cl}$ <br> (i) Pdl <br> (ii) Pd 3 S 4 Pu 4 G4 <br> (iii) Pd3 Mt4 B4 L4 | OB2 Cl <br> (i) Pd 1 <br> (ii) $\mathrm{Pd} 2 \mathrm{Jr} 4 / \mathrm{B} 4$ <br> (iii) Pd3 Jr4 Pu4 <br> (iv) Jr3 Pd4 Pu4 | $\begin{aligned} & \mathrm{OB2} \\ & \mathrm{Pd1} \end{aligned}$ |
| States with number of taluks | $\begin{aligned} & \text { Karnataka (2) } \\ & \text { Himachal Pradesh (4) } \end{aligned}$ | Tamil Nadu (29) | Tamil Nadu (5) | Andhra Pradesh (5) | Tamil $\overline{\text { Nadu (2) }}$ |
| area covered as percentage of all India | 0.09 | $1 \cdot 34$ | $0 \cdot 12$ | 0.14 | 0.08 |

14.6.68 Patterns begin with paddy, cotton, jowar or millets. There is one pattern with fruits, plantation crops and potato which is in Himachal Pradesh. Paddy yields are high. Yields of millets are very good in Tamil Nadu and moderate in Andhra Pradesh. Pulse yields are low. The reasons for the same are required to be looked into and improvement brought about.
Group V : Rainy season from September for two to four months
14.6.69 Regions 23-26: The following four regions have been considered in this group.

Region 23-E4 (C1 E3) C1 E3
Region 24-E4 (Cl E3) C2 E2
Region 25-E4 (Cl E3) B2 E2
Region 26-E4 (Cl E3) Al B1 Cl El
More than 10 cm pm of rainfall is received from September onwards for two to four months. While it is for two months in Region 23, it is 3-4 months in Regions 24-26. In Regions $25-26$ which are small areas, rainfall is higher than 20 cm pm for two months. These Regions are in the States of Andhra Pradesh, Tamil Nadu and Karnataka. Cropping patterns of the Regions are given in paragraph 14.6.73. Paddy is the major crop covering more than 50 per cent in regions 25 and 26; groundnut and millets are the other crops. In Kovur taluk of Nellore district, 89 per cent of the cropped area is under paddy.
14.6.70 Regions 23 and 24 are larger in area. The main crops of region 23 are groundnut, ragi and other millets; paddy also has two pat--terns. Other pulses do not cover large areas but in one pattern the area is comparatively higher than the rest. Plantation crops are important in Chikmagalur taluk in Karnataka along with ragi and paddy. As only the eastern half of this taluk is included, the area under plantations is likely to be less. Six of the 12 patterns of region 24 begins with paddy, three with groundnut and the rest with jowar (kharif), jowar (rabi) and tur. Two patterns are with jowar, one kharif and the other rabi.
14.6.71 Paddy predominates in all areas where irrigation is available. Elsewhere millets, groundnut, other pulses and cotton are important. In the more elevated areas of Karnataka ragi predominates. Groundnut also is important. One of the patterns begins with Gn 2 i.e. groundnut area is higher than 60 per cent and this is in Vayalpad of Chittor district. Ragi yield in Karnataka is the same as all-India. Groundnut yield in Andhra Pradesh is the same as all India level but 126 per cent in Tamil Nadu. Rainfall distribution is good for millets, groundnut and cotton in regions 24 to 26 which have not less than three months of $10-20 \mathrm{~cm} \mathrm{pm}$.
14.6.72 Paddy can be grown only with irrigation in these Regions 'which is being done. Conditions are nearl fa yvourable for maize in

Regions 25 and 26. Introduction of this crop along with soyabean is worth examining. Measures required to be taken to increase the yield levels of the existing crops also need examination.
14.6.73 Cropping patterns of Regions 23 to 26 are as follows:

| expanded form of rainfall (distribution) | $\begin{aligned} & \text { Region } 23 \\ & \mathrm{SC} 2 \end{aligned}$ | $\begin{aligned} & \text { Region } 24 \\ & \text { S C3 } \end{aligned}$ | $\begin{gathered} \text { Region } 25 \\ \text { S C1 B2 } \end{gathered}$ | $\begin{aligned} & \text { Region } 26 \\ & \text { S C1 B1 Al C1 } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| cropping patterns | (i) $\mathrm{Gn} 2 \mathrm{B4}$ | (i) Pd1 | (i) Pd1 | (i) Pd 1 |
|  | (ii) Gn4 Mt4 Pu4 Pd4 | (ii) Pd3 Gn3 | (ii) Pd 2 Jr 4 | (ii) Pd2 Gn4 |
|  | (iii) Gn4 Pu4 R4 B4 S4 | (iii) Pd3 Jk4 B4 | (iii) Jr4 Mt4 |  |
|  |  |  | B4 Pu4 |  |
|  | Pd4 Jk4 |  | R4 |  |
|  | (iv) Mt4 R4 Pu4 Gn4/Jk4 | (iv) Pd3 B3 R4 F4 |  |  |
|  | (v) Pd3 R4 Gn4 | (v) Pd4 Jk4 Gn4/B4 |  |  |
|  | (vi) Pd4 R4 Jk4 Pu4/Gn4 | (vi) Pd4 Jr4 B4 Gn4 T4 Mt4 |  |  |
|  | (vii) Pu4 Mt4 Pd4 R4 Gn4 | (vii) Jk4 Mt4 B4/C4/B4 Pu4 R4/Pd4 Pu4 |  |  |
|  | (viii) L 3 Pd 3 | (viii) Gn2 Pu4/Pd4/B4 |  |  |
|  | (ix) C4 Jk4 Mt4 Jr4/Pu4 | (ix) Gn3 Pd4 R4/B4 |  |  |
|  | (x) R3 Gn4 Pd4 | (x) Gn3 Jk4 Mt4 L4 |  |  |
|  | (xi) R3 Pu4 L4/Pd4/Gn4 | (xi) Jr4 Mt4 Pd4 To4 F4 |  |  |
|  | (xii) R4 Pu4 Jk4 L4 Pd4/ | (xii) To4 Mt4 Jr4 F4/Pd4 B4 |  |  |
|  | Gn4 Pd4/L4/Mt4/Mt4 C4 |  |  |  |
| states with number | Andhra Pradesh (6) | Tamil Nadu (8) | Andhra Pradesh (3) | Tamil Nadu (2) |
| of taluks | Karnataka (26) | Andhra Pradesh (13) |  | Andhra Pradesh (3) |
| cropped area as per cent of all India | 0.98 | 0.86 | $0 \cdot 10$ | 0-17 |

Group VI : Rainỳ season from August for four or five months
14.6.74 Regions 27-29: The regions included in this group receive rainfall of class $C(10 \mathrm{~cm} \mathrm{pm})$ and above from August onwards for 3 to 5 months. There are three Regions in this group with the following rainfall patterns

Region 27-E4 (C2 E2) C2 E2

> Cl E3

Region 28-E4 (C2 E2) B1 C2 E1
Region 29-E4 (C2 E2) A1 B1 C1 E1
Region 27 is the largest with 1.87 per cent of total cropped area and covers 61 taluks in three States. The cropping patterns of regions 27 to 29 are given in paragraph 14.6.76. Regions 28 and 29 are in Tamil Nadu and region 27 in Tamil Nadu, Andhra Pradesh and Karnataka. Paddy is the main crop in regions 28 and 29 with groundnut, bajra, ragi, jowar (kharif) and small millets, as the other crops. Region 27 has five paddy patterns but ragi and jawar (Kharif) are major crops. Two patterns begin with groundnut. An important feature of the rainfall is that there are three to five consecutive months from August with rainfall of 10 cm pm or more. In region 29, rainfall is higher with $20-30 \mathrm{~cm}$ in October and greater than 30 cm in November. Rainfall distribution favours millets like jowar, cotton and groundnut. Forty percent of the taluks in region 27 are in Karnataka where ragi predominates and the patterns begin with R2 and R3; the other crops are other pulses, paddy and small millets. Ragi yield in Karnataka is of the order of all-India yield. The two patterns with Gn3 are mainly of Andhra Pradesh, though it is an important crop in the other Regions also. Paddy is grown almost entirely under irrigation with good yields. These are clearly millet Regions and also suitable for cotton and groundnut.
14.6.75 There are possibilities of diverting areas from crops like paddy to protein yielding and fodder crops which may be examined along with the possibilities of increasing yield levels of existing crops.
14.6.76 Cropping Patterns of the Regions 27 to 29 in Group VI .are as follows.

| expanded form of rainfall distribution | $\begin{aligned} & \text { Region } 27 \\ & \text { A4(C4/C3) } \end{aligned}$ | $\begin{array}{r} \text { Region } 28 \\ \mathrm{Au} \mathrm{C3} \mathrm{Bl} \mathrm{Cl} \end{array}$ | $\begin{gathered} \text { Region } 29 \\ \text { Au C2 Bl Al Cl } \end{gathered}$ |
| :---: | :---: | :---: | :---: |
| cropping patterns | (i) $\mathrm{Pd1}{ }^{-}$ | (i) Pd 1 | (i) Pd 1 |
|  | (ii) Pd2 Gn4/Gn4/Gn4(Jk4/B4/Mt4/R4/G5) | (ii) Pd2 Gn4/R4 | (ii) Pd3 Gn B4 R4 |
|  | (iii) Pd3 Gn3/Gn4/Gn4/(Jk4/B4/Mt4/R4/G5) | (iii) $\mathrm{Pd} 3 \mathrm{Gn} 4 / \mathrm{R} 4$ |  |
|  | (iv) Pd3 Mt4 Gn4/Pu4/Jk4/Jk4/ Jr4 | (iv) Pd4 Mt4 Jk4 | /Gn4 B4 |
|  | (v) Pd4 Mt4 Gn4 Jk4/S4 |  |  |
|  | (vi) R2 Pd4/Pu4/Pd4 Mt4/Pu4 Pd4 |  |  |
|  | (vii) R3 Pu4 Pd4/L4 |  |  |
|  | (vii) R3 Gn4 Mt 4/Mt4 Pd4 |  |  |
|  | (ix) R3 (Go5 Pd5) M4 Pu4 |  |  |
|  | (x) R4 Mt4 Pd4 Gn4 |  |  |
|  | (xi) Jk3 Pd4 Mt4 |  |  |
|  | (xii) Jk4 C4 Gn4 Pu4 W4/Pd4 Jr4 |  |  |
|  | (xiii) Jk4 W4 Pu4 Pd4 F4 |  |  |
|  | (xiv) Gn3 Jk4 C4 To 4 |  |  |
|  | (xv) Gn3 Pd4 S4/B4/R4/Jk4 Jr4 |  |  |
|  | (xvi) Mt4 Pu4 Gn4/Jk4/R4 Pd4 |  |  |
| states with number of taluks | Tamil Nadu (30) | Tamil Nadu (17) | Tamil Nadu (5) |
|  | Andhra Pradesh (7) |  |  |
|  | Karnataka (24) |  |  |
| cropped areas as per cent of all-India | 187 | $0 \cdot 76$ |  |

Group VII : Rainy season for four months from July or five months from June and October $10-20 \mathrm{~cm} \mathrm{pm}$.
14.6.77 Regions $30-36$ : Rainfall is medium to heavy in the $\mathrm{Re}-$ gions included in this group. The patterns are given below :

Region 30-E4 (C4/C3) C1 E3
Region 31-E4 (B3 C1) C1 E3
Region 32-E4 (A1 C3) C1 E3
Region 33-E4 (A1 B1 C2) C1 E3
Reeion 34-E4 (A2 B1 C1) C1 E3
Region 35-E4 (A2 B2) C1 E3
Region 36-E4 (A4/A3) C1 E3
A major feature of the rainfall distribution in the regions of this groupis that there are four to five consecutive months from July or June with more than 10 cm pm and October is in $10-20 \mathrm{~cm}$ class. Regions 30,31 and 36 have three or more consecutive months of the same class. This is a large group of seven regions but total cropped area is only $5 \cdot 5$ per cent of all-India. Region 30 is the largest with nearly half the area-2.61 per cent. The Region covers areas in Karnataka, Andhra Pradesh, Maharashtra and Orissa and a small area in Himachal Pradesh. Three fourth of the taluks of Region 30 are in Andhra Pradesh. Region 35 and most of Region 31 are in Orissa. Region 32 and two thirds of Region 36 are in Maharashtra. The cropping patterns of these regions are given below :

14.6.78 All patterns of regions $31,33,35$ and 36 begin with paddy and the coverage is more than 50 per cent in many taluks. Region 36 has A type rainfall and is well suited for paddy; the general yield level in coastal Karnataka and coastal Maharashtra is well above all-India. Region 35 has two months of $A$ and near favourable conditions while 31 and 33 have mostly B type; the conditions are not favourable for growing paddy without supplemental irrigation. The yields in Orissa are not high being only 85 per cent of all-India level.
14.6.79 Paddy dominates whether rainfall is sufficient or not. The only good feature is that it is grown mostly under irrigation and yields are high. It may, however, be necessary to consider as to whether available water could be better utilised for raising other crops on larger areas with advantage. The suggestion especially applies to Regions 30 and 31, where the rainfall is good for raising crops like jowar, ragi, etc. Maize can be a good crop for these regions and may be tried. Similarly soyabean and cotton can be good crops in Regions 31 to 36 . Plantation crops should also be considered especially in Regions 33 to 36. Since there is rainfall in October in addition to monsoon months, possibilities of raising pulses and fodder crops in paddy follows with supplemental irrigation is worth considering.

Group VIII : Rainy season from May for five to seven months
14.6.80 Regions 37, 41, 42, 44, 45, 47-49 and 55 : Regions getting fairly heavy rainfall right from May for 5 to 7 months are included in this group. Cropping patterns of these regions are given below :

Region 37-C1 E3 (A4/A3) E4
Region 41-C1 E3 (B1 C3) C1 E3
Region 42-C1 E3 (A1 E2 C1) C1 E3
Region 44-Cl E3 (A2 B2) C1 E3
Region 45-C1 E3 (A4/A3) Cl E3
Region 47-C1 E3 (B1 C3) B2 E2
Region 48-C1 E3 (B3 C1) E4
Region 49-C1 E3 (A4/A3) B1 Cl E2
Region 55-B1 E3 (A3 B1) B1 C1 E2
Though rainfall is spread over five to seven months, Regions 41, 47 and 48 have no month with A type rainfall; in Region 41 there is only one month with type B rainfall, the rest being C. Region 42 has only one month-July with $\mathbf{A}$, the rest being $\mathbf{B}$ or $\mathbf{C}$. Only the remaining regions of this group have three or four months of A during June to September.
14.6.81 The Regions cover areas in the northeast and south and account for 5.6 per cent of the total cropped area. Cropping patterns prevailing in these regions are as follows :

| Region No. | Area in | Cropping pattern |
| :--- | :--- | :--- |
| 45 | Karnataka | Pd1, L2Pd3, L3Pd3 |
| 49 | Karnataka, Kerala | Pd1, Pd2 L4, Pd3 L3, L2 Pd4 |
| 47,55 | Kerala | Pd2 L4, L2 Pd4, L3 Pd3, L3 Ta4 |
| 41,42 | Assam | Pd1, Pd2 Ju4/Pu4 |
| 44,37 | Assam | Pd1, Pd2 Ju4/W5 Pu5 |
|  | West Bengal |  |
|  | Bihar |  |
|  | Orissa |  |
| 48 | West Bengal | Pd1, Pd3 Pu4 Ju4/G4/W4 |

The cropping structure is dominated by paddy, plantations and tapioca in Kerala and Karnataka. Elsewhere paddy and jute predominate with some wheat and other pulses.
14.6.82 The yield levels of paddy in the coastal regions of Kerala and Karnataka are well above all-India. In the northeastern States excepting West Bengal they are less than the all-India level. Yield levels in Bihar and Orissa are 71 per cent and 85 per cent respectively of the all India level while in West Bengal it is higher being 110 per cent.
14.6.83 Rainfall distribution in the northeast is not so favourable for paddy; most of the area has hardly two montbs of A type of rainfall. Moisture stress in September and floods affect the yields. There is scope
substitution of paddy with maize and similar crops in Regions 41, 44, 47 and 48 unless irrigation support can be provided. Soyabean too can be a good crop for these regions.

Group IX : Six to eight consecutive months of rainy season from April or March.
14.6.84 Regions 56 to 62 : Effective rains occur for a period of six to eight months beginning from April or March. There are seven regions (56 to 62) in this group. Rainfall patterns are given below :

Region 56-B1 C1 E2 (A1 B1 C2) B1 C1 E2
Region 57-E1 C1 E2 (A2 B1 C1) E4
Region 58-B1 C1 E2 (A4/A3) A1 B1 E2
Region 59—B1 C1 E2 (A4/A3) C1 E3
Region 60-A1 C1 E2 (A4/A3) C1 E3
Region 61-A1 B1 C1 E1 (A2 B2) C1 E3
Region 62-A2 C1 E1 (A4) C1 E3
It can be seen that except in Regions 56 and 57 rainfall is more than sufficient for supporting paddy.
14.6.85 The Regions cover a good portion of Assam and Kerala. The cropped/area of the regions is 4.3 per cent of all-India. Rainfall distribution of more than 10 cm pm is generally for 7 to 8 months.

Besides, except in two Regions, there are three to five months from June or July with more than 30 cm pm . Rainfall distribution is thus very favourable for growing paddy. A major difficulty faced in Assam is the large frequency of floods and heavy rains which affect considerably production levels. The position is not very different in Kerala.
14.6.86 Cropping patterns of Regions 56 to 62 are as follows:

|  | Region 56 | Region 57 | Region 58 | Region 59 | Regions 60-62 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Cropping L3Ta4/ Pd1    <br> patterns Ta4 Pd4 Pd2 L4/Ju4 L2 Pd4 Pd1 Pd1 <br>    L3 Pd3/ Pd2 LA/Ju4  <br>    Ta4 Pd4 Pd3 L3 M4  <br> States <br> covered Kerala Assam Kerala Assam and Assam and <br>     West Bengal West Bengal |  |  |  |  |  |

Paddy is the major crop of the above regions except in Regions 56 and 59 where plantations cover larger areas. Pd1 is the sole pattern of regions 60-62 while Pd 1 occurs along with Pd 2 etc. in the other regions. Plantations (excluding coconuts) are found in the more elevated locations and paddy in low-lying areas. In Kerala coconut plantations are developed on a large scale, covering 20 to 25 per cent of cropped area. Jute figures significantly only in a few areas in Assam.
14.6.87 Cropping structure appears to be satisfactory. In regions 56-57 paddy could be replaced in high lying areas with maize and soyabean with advantage. Possibilities of taking short duration pulses, oilseeds, fodder crops and vegetables appear to be feasible before and after papddy. The high lying areas where raising of plantation crops is difficult could be used for developing grasslands. These regions are generally good for production forestry and plantation crops. Tendency of opening up slopy lands for arable crops has to be discouraged.

Group X : Two rainy seasons
14.6.88 Regions $38-40$ : This group has two subgroups. In one subgroup the first rainy season is in May with $10-20 \mathrm{~cm}$ and the second from August, September or October for three months, two months and one month respectively, all of them being in class $10-20 \mathrm{~cm} \mathrm{pm}$. Regions $38-40$ come under this subgroup and their rainfall patterns are as follows :

Region 38-C1 E3 (E4) C1 E3
Region 39-C1 E3 (C1 E3) C1 E3
Region 40-C1 E3 (C2 E2) C1 E3
These cover areas mostly in Tamil Nadu and Karnataka and a small area in Himachal Pradesh. The cropping patterns of these regions are shown below :

The Cropping patterns of Regions 38 to 40 Group $V(a)$ are as follows :

14.6.89 In Region 40 , rainfall of $10-20 \mathrm{~cm} \mathrm{pm}$ is for three months from August. The crops grown are millets, other pulses groundnut and paddy. Rainfall distribution is suitable for crops like millets and groundnut. Paddy is grown under irrigation in Region 39 as rainfall of $10-20$ cm pm is only for two months from September and August is closer to 10 cm . The Region is mostly in Karnataka where millet yields are good. The Region is nearly suitable for millets and groundnut. Region 38 is small in area and rainfall too is scanty; $10-20 \mathrm{~cm}$ pm is received in May and October. August-September are in $5-10 \mathrm{~cm}$ pm class. Main crops grown are millets and other pulses. Only Region 40 is satisfactory from the point of view of rainfall for millet crops. Region 39 is nearly so but 38 receives low rainfall and needs to be supported with irrigation.
14.6.90 These regions belong to scanty rainfall tract where long breaks occur during the rainy season. It is, therefore, necessary to examine possibilities of putting larger areas under grasses and economic tree crops which can stand prolonged drought better than arable crops.
14.6.91 Regions 43, 46 and 50-53: The other subgroup X (b) of this group includes six Regions. Their rainfall patterns are as follows :

Region 43-C1 E3 (A2 C1 E1) C1 E3
Region 46-C1 E3 (B1 C2 E1) C2 E2
Region 50-C2 E2 (C2 E2) C1 E3
Region 51-C2 E2 (B2 C1 E1) C1 E3
Region 52-C2 E2 (A2 C1 E1) C1 E3
Region 53-C2 E2 (A2 B1 C1) C2 E2
The two rainy seasons are (a) from January for two to three months, and (b) from July for two to four months except in Region 53 where it is for five months from June. The Regions are in Himachal Pradesh and Jammu \& Kashmir and their cropped areas are very small 0.02 to 0.07 per cent of all-India. Together, they total to 0.23 per cent only. The main crops are maize and wheat but barley, paddy and small millets are important in a few taluks. The cropping patterns of the Regions are as follows:

| Region 43 | Region 46 | Region 50 | Region 51 | Region 52 | Region 53 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| M3 W3 | M2 W4 | (i) M1 | / Ml | (i) Ml <br> (ii) M2 W3 | (i) W3 Pd3 M4 <br> (ii) M3:W3 Ba4 |
|  |  | (ii) M3 W4 Ba4/ |  |  |  |
|  |  | Mt4 |  |  |  |
|  |  | (iii) Mt3 Ba4 W4 |  |  |  |
|  |  | (iv) W4 M4 Mt4 Ba4 Pd4 |  |  |  |

14.6.92 In Region 50, only July and August get $10-20 \mathrm{~cm}$ pm; Region 46 is better with $20-30 \mathrm{~cm}$ in July, and August to October in $10-20 \mathrm{~cm}$ class. Regions 43 and 52 have July and August with greater than 30 cm pm and $10-20 \mathrm{~cm} \mathrm{pm}$ in September. Region 53 rainfall is better with July and August greater than 30 cm pm, September $20-30 \mathrm{~cm}$ and $10-20$.
cm pm in June and October. Most of the regions are suitable for a crop like maize and Region 53 is nearly so, even for paddy. Maize yield in Jammu \& Kashmir is 80 per cent while in Himachal Pradesh it is very good with State average of 161 per cent of all-India level. Barley yield level is only half of all-India in Jammu \& Kashmir while it is 121 per cent in Himachal Pradesh. Paddy being almost entirely irrigated in the northern districts of Jammu \& Kashmir has high yields but in the southern districts the yield varies between 60 to 90 per cent of all-India level. Rice yields in Himachal Pradesh are 90 to 100 per cent and wheat 70 per cent of all-India level.
14.6.93 Cropping structure in general appears to be appropriate with long rainy seasons and milder temperature, it would be advisable to pay more attention to fruit crops and grassland development.
Group XI : Rainy season from January for four months
14.6.94 Region 54 : There is only one region in this group with rainfall pattern C3 E1 (E4) C1 E3. Rainfall is of the order of $10-20 \mathrm{~cm} \mathrm{pm}$ for four months from January onwards. The precipitation will naturally be in the form of snow and has no direct significance from crop growing point of view. This region is entirelyin Jammu and Kashmir with 11 taluks, cropped area being $0 \cdot 12$ per cent of all-India. The cropping patterns are as follows :
(i) Pd 2 M 4
(ii) Pd3 M3/M4 (W4/Pu4)
(iii) M1 W4 Ba4
(iv) M3 W4 Ba4
(v) M3 Mt4 Ba4/W4

Paddy and maize are the main crops with significant areas under wheat and barley. Paddy is irrigated and has hence higher yields. Barley yield is low. Wheat yields in the State during recent years are about 80 to 100 per cent of all-India level.
14.6.95 More attention to grassland and fruit crops development may be desirable.

## All India Cropping Patterns

14.6.96 Just as cropping patterns have been drawn up for each State and Region, it is both desirable and necessary to have an idea of the cropping patterns on all-India basis. Such a list would bring into focus the major aspects of the crop structure of the country. Even a cursory examination of the State lists would show that there are many patterns which are common; and this point has to be kept in view while drawing up an all-India list. For example, a crop pattern like Pdl occurs in several States but when considering for the whole country it would be
listed as only one. Similarly, in patterns beginning with Pd 2 which has also another crop, it would be more important to emphasise the predominance of paddy arsa (greater than 50 per cent) and therefore group together all Pd2 piaterns into one, showing the second crop, which varies, as alternate by oblique lines i.e. Pd2 Jk4/Jk4/Jr4/Gn4/etc. The emphasis, similarly, on two or three important crops in each cropping pattern has helped group together a number of patterns, the remaining crops in each pattern being shown as alternatives. The cropping patterns in the different States have been analysed on the above lines and a consolidated all-India list drawn up. The total number of all-India cropping patterns is 177 and these are detailed in Appendix 14.6-Statement VI. The distribution of cropping patterns according to crops and their subscripts 1 to 4 representing area intervals, is shown in Table 14.6. Cereals contribute 72 per cent of the patterns ( 128 out of 177). The maximum number of 30 is with paddy and jowar crops. Wheat and bajra have 19 and 20 patterns respectively. Cotton is the next largest with 16. Groundnut has 9 patterns but oilseeds other than groundnut only one. Fruits, tobacco, plantations and fodder have two each but there is none with sugarcane or tur. Pulses have in all fourteen patterns.
table 14.6
Number of al!-India Cropping Patterns beginning with different crops and subscriptions


## Crop Yields

14.6.97 In the foregoing analysis of the cropping patterns in the various rainfall regions, only a brief and general reference could be made to yield levels of crops and these mostly concerned the State yields. This, however, is not sufficient and a detailed examination of crop performance is both necessary and important while assessing suitability of different crops in the various parts of the country. District averages of yields based on data for three years, mostly 1968-69 to 1970-71, are available for the main crops. The district averages have also been expressed as per cent of all-India and these, which are termed as Relative Yield Index (\%) values, are also available. Frequency tables of district Relative Yield Index (RYI) values are given in Tables 14.7 to 14.18 and 14.20 for the following thirteen crops :
rice, maize, jowar (kharif), jowar (rabi) bajra, ragi, small millets, wheat, gram, tur, total pulses, groundnut, cotton.
Here, only a preliminary analysis of the district yields has been made using the frequency tables mentioned above. Detailed discussions on crop performance in relation to rainfall distribution and various other aspects are given in Chapters 21, 22 on Foodgrain Crops and Commercial Crops etc. For convenience in reference and use, Statewise and districtwise geographical and gross cropped areas together with districts rainfall patterns are contained in Appendix 14.6-Statements VII and VIII.
14.6.98 Rice: Table 14.7 shows the frequency distribution of district RYI values of rice together with the lowest and highest district RYI in each of the States.

About half of the total number of districts have yields less than 90 per cent of all-India and as many as 31 per cent of the district yields are less than 70 per cent of all-India. Only 10 per cent of the districts have yields exceeding 150 per cent of all-India and these are confined to Tamil Nadu, Karnataka and a few from Punjab, Jammu and Kashmir and Andhra Pradesh. It should also be mentioned that during the past few years Punjab and Haryana State yields have risen considerably and along with Tamil Nadu are among the highest in the country; the crop in these States is almost entirely irrigated. A major feature is the high frequency of low yields in the States of Orissa, Bihar, Uttar Pradesh and Madhya Pradesh. Out of 117 district yields in these four States, 57 are less than 70 per cent of all-India and 43 are between 70 and 90 per cent of all-India. As these four States have about 50 per cent of total area under rice in the country, the low yields have affected the all-India average which for the period $1968-69$ to $1970-71$ is just $10.9 \mathrm{q} / \mathrm{ha}$. The high yields are associated with irrigated areas only.
14.6.99 Maize : Frequency distribution of district RYI of maize is

Table 14.7
Frequency Distribution of District Relative Yield Index-Rice

| State |  |  | Area (thousand ha) | RYI | Number of districts with R YI of |  |  |  |  |  |  | Total number of districts | District RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | less <br> than or equal to 50 | $\begin{gathered} 50 \text { to } \\ 70 \end{gathered}$ | $\begin{gathered} 70 \text { to } \\ 90 \end{gathered}$ | $\begin{gathered} 90 \text { to } \\ 110 \end{gathered}$ | $\begin{aligned} & 110 \text { to } \\ & 130 \end{aligned}$ | $\begin{gathered} 130 \text { to } \\ 150 \end{gathered}$ | Greater than 150 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  | lowest | $\begin{aligned} & \text { high- } \\ & \text { est } \end{aligned}$ |
| Karnataka |  |  | 1,127 | 163 | - | - | - | 1 | 3 | 4 | 11 | 19 | 101 | 305 |
| Tamil Nadu |  |  | 2,585 | 159 | - | - | - | 1 | 1 | 1 | 10 | 13 | 92 | 202 |
| Punjab |  |  | 362 | 141 | - |  |  | 1 | 3 | 5 | 2 | 11 | 102 | 162 |
| Jammu \& Kashmir |  |  | 236 | 141 | - | 2 | 2 | 2 | 1 | - | 2 | 9 | 58 | 204 |
| Kerala |  |  | 874 | 132 | - | - | - | 1 | 4 | 4 | 1 | 10 | 94 | 161 |
| Haryana |  |  | 246 | 125 | 一 | - | - | 2 | 2 | 2 | $\bar{\square}$ | 6 | 94 | 142 |
| Andhra Pradesh |  |  | 3,238 | 118 | - | - | 2 | 4 | 6 | 4 | 2 | 18 | 83 | 157 |
| West Bengal |  |  | 4,939 | 111 | - | - | 3 | 6 | 3 | 3 | - | 15 | 83 | 144 |
| Himachal Pradesh |  |  | +99 | 103 | - | - | 2 | 6 | $\bigcirc$ | $\bigcirc$ | - | 8 | 88 | 108 |
| Maharashtra |  |  | 1,336 | 99 | 8 | 4 | 5 | 5 | 1 | 3 | - | 26 | 37 | 138 |
| Assam |  |  | 2,059 | 92 | - | - | 3 | 4 | 1 | - | - | 8 | 72 | 130 |
| Orissa |  |  | 4,258 | 85 | - | 1 | 9 | 3 | - | - | - | 13 | 70 | 94 |
| Gujarat |  |  | 488 | 79 | 1 | 9 | 3 | 3 | - | - | - | 16 | 34 | 109 |
| Rajasthan |  |  | 121 | 73 | 4 | 1 | 2 | 1 | - | - | 1 | 9 | 36 | 157 |
| Madhya Pradesh |  |  | 4,350 | 72 | 18 | 6 | 9 | 5 | - | - | - | 38 | 33 | 106 |
| Bihar |  |  | $5,280$ | $71$ | 1 | $\begin{array}{r}8 \\ \hline 19\end{array}$ | 5 | 3 | - | - | - | 17 | 45 | 105 |
| Uttar Pradesh | - |  | 4,336 | 70 | 4 | 19 | 20 | 5 | 1 | - | - | 49 | 45 | 119 |
| Total |  |  |  |  | 36 | 50 | 65 | 53 | 26 | 26 | 29 | 285 |  |  |
| per cent of total |  | - |  |  | 13 | 18 | 23 | 18 | 9 | 9 | 10 |  |  |  |

Rainfall and cropping patterns
given in Table 14.8 . Of the 227 districts where maize is grown 62 yields are less than 70 per cent of all-India and 126 ( 55 per cent of total) less than 90 per cent. Karnataka yields are the best in the country and they range between two to four times of all-India. Twenty two per cent of the yields exceed 110 per cent of all-India. In many of the States the yields are low. The all-India average is only $10.8 \mathrm{q} / \mathrm{ha}$, almost the same as rice.
14.6.100 Jowar (kharif) : Frequency of district yields is shown in Table 14.9. Maharashtra and Madhya Pradesh together account for 43 per cent of total area under this crop in the country; more than 50 per cent of the districts in these States have yields exceeding 110 per cent of all-India. Karnataka and Tamil Nadu yields are well above all-India. Lowest yields of less than 50 per cent are in parts of Uttar Pradesh, Rajasthan, Haryana and Gujarat and these may be due partly to the crop being grown for fodder purposes. Forty six per cent of the district yields in the country are above 110 per cent of all-India and about 25 per cent less than 70 per cent of all-India. In a number of districts in Karnataka which has a State average of 170 per cent of all-India, yields have exceeded two to three times of all-India.
14.6.101 Jowar (rabi) : Jowar (rabi) is confined mostly to the southern States. The largest area is in Maharashtra but the yields are generally low; only 4 of the 19 district yields are about 90 per cent of allIndia. Karnataka yields are better. The all-India average is less than $5 \mathrm{q} / \mathrm{ha}$. Frequency distribution of district RYI values of jowar (rabi) together with the lowest and highest district RYI values in each State is given in Table 14.10.
14.6.102 Bajra: Table 14.11 shows the frequency distribution of district yields in the different States. The all-India average yield is only $4.6 \mathrm{q} / \mathrm{ha}$ and the district yields show a wide range from 15 per cent of allIndia in parts of Rajasthan to about 260 per cent in Gujarat, Uttar Pradesh and Punjab. The average yield of the country is on the low side. About 55 per cent of the district yields exceed 110 per cent of all-India and 25 per cent yields are above 150 per cent of all-India. Rajasthan has the largest area of 4.7 Mha with State average of 61 per cent of allIndia and yield levels in 7 out of 19 districts are less than 50 per cent, Maharashtra with the next largest area of 2 Mha has also similar low yield levels; 5 out of 20 district yields are less than 50 per cent. Only Gujarat with a large area of 1.7 Mha has good yield distribution, 15 out of 17 districts being above 110 per cent. In Tamil Nadu area is not large, ( 0.47 Mha) but 11 of the twelve district yields are above 110 per cent.
14.6.103 Ragi : Table 14.12 shows frequency distribution of district yields of ragi. The all-India average yield is $7.0 \mathrm{q} / \mathrm{ha}$. About half the district yields are less than 90 per cent. The highest of district yields hardly reaches even twice of all-India. Some of the lowest yields
table 14.8
Frequency Distribution of District Relative Yield Index-Maize


Table 14-9
Frequency Distribution of District Relative yield Index-Jowar (Kharif)

| State |  |  | Area (thousand ha) |  | RYI | Number of districts with RYI of |  |  |  |  |  |  | $\begin{aligned} & \text { Total } \\ & \text { number } \\ & \text { of } \\ & \text { dis- } \\ & \text { tricts } \end{aligned}$ | District RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | less than or equal to 50 | $\begin{gathered} 50 \text { to } \\ 70 \end{gathered}$ | $\begin{gathered} 70 \text { to } \\ 90 \end{gathered}$ | $\begin{gathered} 90 \text { to } \\ 110 \end{gathered}$ | $\begin{aligned} & 110 \text { to } \\ & 130 \end{aligned}$ | $\begin{gathered} 130 \text { to } \\ 150 \end{gathered}$ | Greater than 150 | Jowest |  | highest |
| Karnataka |  |  |  | 1,528 |  | 172 | - | - | - | 1 | 2 | 2 | 11 | 16 | 110 | 358 |
| Orissa |  |  |  | 16 | 140 | - | - | - | 1 | - | 1 | 1 | 3 | 109 | 284 |
| Tamil Nadu |  |  |  | 553 | 136 | - | - | - | - | 4 | 4 | 4 | 12 | 113 | 212 |
| Uttar Pradesh |  |  |  | 760 | 118 | 4 | 3 | 3 | 6 | 5 | 4 | 12 | 37 | 31 | 267 |
| Madhya Pradesh |  | - |  | 2,263 | 115 | - | 1 | 5 | 7 | 12 | 6 | 8 | 39 | 62 | 159 |
| Maharashtra |  | . | . | 2,496 | 107 | - | 1 | 8 | 7 | 2 | 1 | 4 | 23 | 64 | 155 |
| Andhra Pradesh |  | . |  | 1,293 | 89 | - | 4 | 8 | 4 | 5 | - | - | 21 | 51 | 128 |
| Kerala |  | . | - | 1 | 85 | - |  | 1 | 1 | $\cdots$ | - | - | 1 | 85 | 85 |
| Rajasthan |  | - |  | 1,089 | 71 | 7 | 4 | 3 | 1 | 2 | - | - | 17 | 19 | 116 |
| Gujarat |  | - |  | 1,134 | 43 | 8 | 9 | - | - | 1 | - | - | 18 | 15 | 118 |
| Haryana |  | . | . | 216 | 42 | 6 | - | - | - | - | - | - | 6 | 34 | 47 |
| Total |  | . | - |  |  | 25 | 22 | 28 | 27 | 33 | 18 | 40 | 193 |  |  |
| per cent of total |  | . | . |  |  | 13 | 11 | 15 | 14 | 17 | 9 | 21 |  |  |  |

table 14.10
Frequency Distribution of District Relative Yield Index—Jowar (Rabi)

| State |  |  | Area (thousand ha) | RYI | Number of districts with RYI of |  |  |  |  |  |  | Total number of districts | District RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | less <br> than or <br> equal <br> to 50 | $\begin{aligned} & 50 \text { to } \\ & 70 \end{aligned}$ | $\begin{aligned} & 70 \text { to } \\ & 90 \end{aligned}$ | $\begin{aligned} & 90 \text { to } \\ & 110 \end{aligned}$ | $\begin{gathered} 110 \text { to } \\ 130 \end{gathered}$ | $\begin{gathered} 130 \text { to } \\ 150 \end{gathered}$ | Greater than 150 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { low- } \\ & \text { est } \end{aligned}$ | highest |
| Gujarat |  |  | 180 | 172 | - | - | - | - | - | 1 | 11 | 12 | 150 | 206 |
| Tamil Nadu |  |  | 172 | 170 | - | - | - | - | - | 2 | 9 | 11 | 140 | 266 |
| Madhya Pradesh |  |  | 24 | 140 | - | - | - | - | 1 | - | 2 | 3 | 127 | 185 |
| Karnataka |  |  | - 1,528 | 116 | - | - | 1 | 2 | 2 | 1 | 3 | 9 | 83 | 238 |
| Andhra Pradesh |  |  | - 1,339 | 94 | - | 2 | 5 | 11 | 3 | - | - | 21 | 55 | 128 |
| Maharashtra |  |  | - 3,237 | 80 | 1 | 5 | 5 | 4 | 3 | - | 1 | 19 | 50 | 156 |
| Total |  |  | - |  | 1 | 7 | 11 | 17 | 9 | 4 | 26 | 75 |  |  |
| per cent of total | . | - | - |  | 1 | 9 | 15 | 23 | 12 | 5 | 35 |  |  |  |

table 14.11
Frequency Distribution of District Relative Yield Index—Bajra

| State |  |  | Area <br> (thou- <br> sand ha) |  | RYI | Number of districts with RYI of |  |  |  |  |  |  | Total number of districts | District RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | than or equal to 50 | 70 | 90 | $110$ | $130$ | $150$ | than <br> 150 | lowest |  | highest |
| Punjab |  |  |  | 198 |  | 239 | - | - | - | 1 | - | 1 | 7 | 9 | 109 | 261 |
| Uttar Pradesh |  |  | - | 1,063 |  | 149 | 1 | 2 | 5 | 2 | 5 | 10 | 15 | 40 | 47 | 264 |
| Gujarat |  |  | . | 1,694 | 147 | - | 1 | 1 | - | 3 | 1 | 11 | 17 | 65 | 255 |
| Tamil Nadu |  |  | - | 462 | 143 | - | - | - | 1 | 4 | 4 | 3 | 12 | 108 | 167 |
| Haryana |  |  | . | 895 | 128 | - | - | 1 | - | - | 3 | 3 | 7 | 73 | 162 |
| Madhya Pradesh |  |  | - | 232 | 118 | - | 2 | 5 | 2 | - | 2 | 1 | 12 | 58 | 173 |
| Jammu \& Kashmir |  |  | . | 16 | 115 | - | - | - | - | 2 | - | - | 2 | 114 | 124 |
| Andhra Pradesh |  |  | . | 606 | 104 | - | 6 | 4 | 1 | 5 | 1 | 3 | 20 | 55 | 221 |
| Karnataka |  |  | . | 516 | 88 | - | 1 | 3 | 2 | 4 | - | - | 10 | 67 | 120 |
| Maharashtra |  |  | . | 2,029 | 77 | 5 | 6 | 6 | 2 | 1 | - | - | 20 | 27 | 111 |
| Rajasthan |  |  |  | 4,670 | 61 | 7 | 2 | 5 | 2 | 1 | 2 | - | 19 | 15 | 145 |
| Total |  |  | - |  |  | 13 | 20 | 30 | 13 | 25 | 24 | 43 | 168 |  |  |
| per cent of total |  |  | . |  |  | 8 | 12 | . 18 | 8 | 15 | 14 | 25 |  |  |  |

TABLE $14 \cdot 12$
Frequency Distribution of District Relative yield Index-Ragi

| State | Area (thousand ha) | RYI | Number of Districts with RYI of |  |  |  |  |  |  | Totalnumberofdistricts | DistrictRYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Less than or equal to 50 |  |  | $\begin{array}{r} 90 \\ \text { to } \\ 110 \end{array}$ | $\begin{gathered} 110 \\ \text { to } \\ 130 \end{gathered}$ | $\begin{gathered} 130 \\ \text { to } \\ 150 \end{gathered}$ | $\begin{gathered} \text { Greater } \\ \text { than } \\ 150 \end{gathered}$ |  |  |  |
|  |  |  |  | $\begin{gathered} 50 \\ \text { to } \\ 70 \end{gathered}$ | $\begin{gathered} 70 \\ \text { to } \\ 90 \end{gathered}$ |  |  |  |  |  | lowest | highest |
| Kerala | 5 | 164 | - | - | 1 | 1 | 1 | 2 | 3 | 8 | 89 | 212 |
| Tamil Nadu | 340 | 126 | - | - | - | 4 | 3 | 4 | 1 | 12 | 94 | 186 |
| Orissa | 158 | 110 | - | 1 | 3 | 4 | - | - | 1 | 9 | 60 | 152 |
| Karnataka | 887 | 99 | - | 2 | 2 | 10 | - | - | - | 14 | 64 | 109 |
| Maharashtra | 217 | 97 | - | - | 9 | 3 | 6 | 2 | - | 19 | 71 | 143 |
| Uttar Pradesh | 237 | 94 | - | - | 5 | 1 | - | - | - | 6 | 74 | 98 |
| Andhra Pradesh | 326 | 92 | 3 | 5 | 3 | 7 | 2 | 1 | - | 21 | 17 | 148 |
| Gujarat | 55 | 91 | - | - | 1 | 4 | - | - | - | 5 | 81 | 94 |
| Bihar | 178 | 71 | 2 | 5 |  | 4 | 1 | - | - | 13 | 43 | 115 |
| Total |  |  | 5 | 13 | 24 | 38 | 13 | 9 | 5 | 107 |  |  |
| Per cent of total |  |  | 5 | 12 | 22 | 36 | 12 | 8 | 5 |  |  |  |


rainfall and cropping patterns
are from Andhra Pradesh. Karnataka which has the largest area has all-India yield level.
14.6.104 Small millets: Table 14.13 gives the frequency distribution of district yields. The largest area under small millets is in Madhya Pradesh with 1.7 Mha ( 35 per cent of total) and Andhra Pradesh is next with 0.85 Mha . The average all-India yield is low and only $3.8 \mathrm{q} / \mathrm{ha}$. Thirty one per cent of yields exceed 150 per cent and 50 per cent are above 110 per cent. Although not requiring high rainfall, 30 per cent yields ( 51 out of 168 ) are less than 70 per cent. Twentytwo of 29 district yield in Madhya Pradesh, 15 out of 21 in Andhra Pradesh and 9 out of 22 in Maharashtra are less than 70 per cent. It is the low yields in these States that have depressed the all-India average.
14.6.105 Wheat : The all-India average yield of wheat is only 12.2. $\mathrm{q} / \mathrm{ha}$. The frequency distribution of yields is shown in Table 14.14. High yields are mainly in the Punjab and Haryana with State averages of 181 and 162 per cent of all-India. The highest district yields have not exceeded two and half times of all-India; only Ludhiana has the highest yield of 244 per cent of all-India. There was no other district yield in the country with twice that of all-India though some are close to it in Punjab and Haryana. A major feature is that but for Hoshiarpur district yield of 116 per cent, the rest of the yields in Punjab are higher than 150 per cent and five of the eleven are between 180 and 244 per cent of all-India. The crop is almost entirely irrigated in Punjab and Haryana. It would be both relevant and of interest to mention that West Bengal has taken to wheat cultivation in recent years and though the area is not large ( 0.3 to 0.4 Mha ) the yield levels are close to Haryana and Punjab and more than twice of all-India.
14.6.106 Uttar Pradesh has the largest area under wheat of 5.5 Mha followed by Madhya Pradesh with 3.3 Mha ; these two States together account for 50 per cent of total cropped area under wheat in the country. In Uttar Pradesh two-thirds of wheat area is irrigated but the yield level is just all-India. Madhya Pradesh yield level is only 57 per cent of all-India, the extent of irrigation being 16 per cent. Bihar and Rajasthan have also large areas of 1.2 and 1.3 Mha with yields of 73 and 92 per cent of all-India though the extent of irrigation is 51 and 66 per cent respectively. Of the 43 districts in Madhya Pradesh 10 districts have yields less than 50 per cent and 24 districts between 50 to 70 per cent; the range in yields vary between a low level of 32 per cent to a maximum of 95 per cent.
14.6.107 As may be expected because of the less favourable temperature and other conditions wheat yields in the southern State are very low. These range between 13 to 34 per cent in Karnataka and Andhra Pradesh ; Maharashtra is not much better, the State average being only 40 per cent. But for these States the all-Irdia average would be higher.
table $14 \cdot 14$
Frequency Distribution of District Relative Yield Index-Wheat

rainfall and cropping patterns
14.6.108 Gram : The frequency distribution of district yield of gram is shown in Table 14.15. The all-India average yield of gram is $6.7 \mathrm{q} / \mathrm{ha}$ and 23 per cent of the district yields are above 110 per cent of all-India. A general feature is the large number of low yields of less than 90 per cent of all-India in almost all the states. Only Punjab and Haryana yields are good with averages of about 130 per cent. Though UttarPradesh has a number of districts having low yields, it has also about 60 per cent districts exceeding 110 per cent of all-India and two district yields exceed 150 per cent; the state average being 115 per cent. Fifty two district yields out of 53 in the States of Maharashtra, Andhra Pradesh and Karnataka are less than 70 per cent and in none of these States the yield has exceeded 71 per cent.
14.6.109 Tur: Table 14.16 gives the frequency distribution of district yields of tur. One third of the district yields are less than 70 per cent and about 25 per cent are more than 130 per cent of all-India. The low yields are largely concentrated in the southern States. The all-India yield is only $7 \mathrm{q} / \mathrm{ha}$.
14.6.110 Total Pulses. Table 14.17 shows the frequency distribution of yields of total pulses. About a fifth of the district yields are less than 50 per cent of all-India level. Low yields are concentrated in Madhya Pradesh, Gujarat and the southern states. For example, in Andhra Pradesh the yield level of 20 out of 21 districts is less than 50 per cent. Higher yields are mainly in the northern States. Of a total of 66 districts in Uttar Pradesh, Punjab and Haryana, in 46 districts yields exceed 150 per cent of all-India level. Only four districts yields out of 50 from the other States, are as high as 150 per cent.
14.6.111 Groundnut : Table 14.18 shows the frequency distribution of districts yields of groundnut. Gujarat has the largest area under groundnut nearly 25 per cent of total, and Andhra Pradesh is next with 20 per cent. Maharashtra, Karnataka and Tamil Nadu each accounts for 12 to 14 per cent area under the crop. The number of district yields exceeding 150 per cent is small or negligible. The yields of 60 per cent of the districts are between 70 to 110 per cent of all-India level. Frequency of high yields of above 110 per cent in States with larger coverage is small except for Tamil Nadu where all vields exceed 100 per cent. A few remarks concerning Gujarat yields may be of interest.
table $14 \cdot 15$
Frequency Distribution of District Relative Yield Index-Gram

| State | Aera (Thousand ha) | RYI | number of districts with RYI of |  |  |  |  |  | Total number |  | strict RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Less <br> than <br> or equal to 50 | $\begin{aligned} & 50 \\ & \text { to } \\ & 70 \end{aligned}$ | $\begin{gathered} 70 \\ \text { to } \\ 90 \end{gathered}$ | 90 to 110 | $\begin{aligned} & 110 \\ & \text { to } \\ & 130 \end{aligned}$ | $\begin{array}{r} 130 \\ \text { to } \\ 150 \end{array}$ | Greater then 150 | of districts | lowest | highest |
| Haryana | 902 | 131 | - | - | 1 | 1 | 3 | - | 2 | 7 | 87 | 165 |
| Punjab | 2349 | 128 | - | T | 5 | 1 | 4 | 2 | 3 | 10 | 104 | 165 |
| Uttar Pradesh | - $\quad 2.163$ | 115 - | 1 | 2 | 5 | 11 | 14 | 12 | 2 | 47 | 33 | 201 |
| Bihar . | - 238 | 99 | - | 5 | 4 | 4 | 2 | - | - | 15 | 64 | 128 |
| Rajasthan | 1,292 | 96 | - | 6 | 10 | 2 | 3 | 1 | - | 22 | 57 | 133 |
| Gujarat - . | 45 | 91 | - | - | 1 | 5 | - | 1 | - | 6 | 89 | 105 |
| Himachal Pradesh. | 18 | 89 | - | 1 | 2 | 1 | - | 1 | - | 3 | 72 | 132 |
| Orissa . | 22 | 88 | - | 1 | 1 | 1 | - | 1 | - | 4 | 55 | 136 |
| Tamil Nadu | 55 | 79 | 2 | $\overline{16}$ | 10 | 1 | 1 | - | - | 11 | 75 | 105 |
| Madhya Pradesh | 1,552 | 78 | 2 | 16 | 20 | 4 | 1 | - | - | 43 | 46 | 121 |
| Karnataka . | 193 | 61 | 17 | 6 | 1 | - | - | - | - | 8 | 49 | 71 |
| Maharashtra | 357 | 44 | 17 | 7 | - | - | - | - | - | 24 | 34 | 63 |
| Andhra Pradesh | 80 | 39 | 17 | 4 | - | - | - | - | - | 21 | 13 | 64 |
| total | - |  | 38 | 47 | 55 | 30 | 27 | 17 | 7 | 221 |  |  |
| per cent of total | . |  | 17 | 21 | 25 | 14 | 12 | 8 | 3 |  |  |  |

table 14.16
Frequency Distribution of District Relative Yield Index-Tur

| State |  | Area (Thousand ha) | RYI | Number of Districts with RYI of |  |  |  |  |  |  | Total number of districts | District RYI |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Less <br> than or equal to 50 | $\begin{aligned} & 50 \\ & \text { to } \\ & 70 \end{aligned}$ | $\begin{aligned} & 70 \\ & \text { to } \\ & 90 \end{aligned}$ | $\begin{array}{r} 90 \\ \text { to } \\ 110 \end{array}$ | $\begin{array}{r} 110 \\ \text { to } \\ 130 \end{array}$ | $\begin{array}{r} 130 \\ \text { to } \\ 150 \end{array}$ | $\begin{aligned} & \text { Greater } \\ & \text { than } \\ & 150 \end{aligned}$ |  | lowest | highest |
| Uttar Prakesh |  | 597 | 163 | - | - | - | 1 | 6 | 17 | 19 | 43 | 93 | 267 |
| Bihar |  | 165 | 107 | 1 | 2 | - | 4 | 2 | 4 | 2 | 15 | 43 | 180 |
| Madhya Pradesh |  | 489 | 94 | - | 4 | 22 | 2 | 4 | 8 | 1 | 41 | 59 | 154 |
| Orissa . |  | 44 | 80 | - | 1 | 5 | 1 | 1 | 1 | - | 9 | 69 | 139 |
| Karnataka . |  | 198 | 71 | 7 | 3 | 12 | 5 | 1 | - | 1 | 16 | 61 | 291 |
| Maharashtra |  | 627 | 68 | 7 | 5 | 7 | 5 | 1 | - | - | 25 | 34 | 113 |
| Gujarat | . | 90 | 67 | 1 | 3 | 5 | - | - | - | - | 9 | 43 | 76 |
| Rajasthan |  | 25 | 57 | 2 | 2 | 1 | - | - | - | - | 5 | 45 | 76 |
| Tamil Nadu |  | 50 | 57 | 5 | 7 | $\cdots$ | - | - | - | - - | 12 | 46 | 67 |
| Kerala | - | 5 | 57 | 2 | 3 | 1 | - | - | - | - | 6 | 25 | 78 |
| Andhra Pradesh |  | 189 | 50 | 10 | 10 | 1 | - | - | - | 一 | 21 | 27 | 82 |
| total |  |  |  | 28 | 40 | 54 | 13 | 14 | 30 | 23 | 202 |  |  |
| per cent of total |  |  |  | 14 | 20 | 27 | 6 | 7 | 15 | 11 |  |  |  |

table 14.17
Frequency Distribution of Relative Yield Index-Total Pulses

table 14.18
Frequency Distribution of District RelativeYield Index-Groundnut


Table 14.19 shows the yields during the five years $1967-68$ to 1971-72 for the main States.

TABLE 14.19
Groundnut yields


In Tamil Nadu and Andhra Pradesh the crop is about 13 per cent irrigated. Gujarat shows large variations while the other State yileds are more stable. The high variability of rainfall in Saurashtra (Gujarat) where the crop is concentrated, could be a significant contributory factor to large fluctuations.
14.6.112 Cotton : The frequency distribution of district yields of cotton is given in Table 14.20. A good feature is that a third of the yields exceed 150 per cent of all-India. Of the 45 yields in this group, 24 are from Punjab, Haryana and Tamil Nadu where the crop is almost entirely irrigated and 13 from Gujarat, where it is mostly rainfed and irrigated area is about 15 per cent. The highest yields recorded are 3.4 and 3.5 times of all India and these are from Punjab and Tamil Nadu. Another equally important feature is the large percentage (41) of low yields of less than 50 per cent of all-India concentrated in the States of Madhya Pradesh Maharashtra, Andhra Pradesh and Karnataka, where the crop is almost entirely rainfed. Thirteen of the 21 very low yields of less than 50 per cent are from Andhra Pradesh. Maharashtra has the largest area under cotton in the country but its yield level is hardly half of all-India. The various problems connected with rainfed and irrigated areas have been considered in detail in Chapter 22 on Commercial Crops.
14.6.113 In paragraphs 14.6 .98 to 14.6 .112 , yields have been analysed for each crop individually. To obtain a broad idea of the performance of crops in each of the States, it would be necessary to specify a limit for crop yield as satisfactory. Average yields exceeding 110 per cent of allIndia could be regarded as a satisfactory base for a preliminary general survey. Table 14.21 gives the percentage of district average yields exceeding 110 per cent of all-India for the various crops in different States. In Punjab and Haryana with a high percentage of irrigation the percentage share of RYI values exceeding 110 per cent of all-India is good for most of the crops. Tamil Nadu is nearly similar except for wheat and pulses. Among rainfed States, Gujarat yields seem very satisfying for a number of important crops. In many of the States yields are high for a few individual crops.
table 14.20
Frequency Distribution of District Relative Yicld Index-Cotton


Table 14.21
Percentage of Districts in each State having RYI Values Exceeding 110-Cropwise


## State Cropping Patterns

14.6.114 Working papers were prepared in the Commission on Rainfall and Cropping Patterns of the various States and discussed with the respective State authorities. The following points were raised in the course of discussions :-
(i) Are existing cropping patterns efficient from agronomic as well as economic point of view?
(ii) If change is necessary, which are the areas where changes should be made?
(iii) In the case of existing cropping patterns being acceptable at some places, what is the scope for increasing productivity and how is this to be achieved?
(iv) In areas where change is considered necessary, what are the recommendations regarding substitute crops? The changes may be indicated separately for rainfed and irrigated conditions taking into consideration the soil factor also.
An idea of the scope and extent of the working papers on Rainfall and Cropping Patterns of the different States may be had from the abridged sample of Karnataka State Report given in Appendix 14.9. In a number of States, Committees of experts drawn from the various concerned departments and local agricultural university were constituted to consider the points which emerged from a discussion of the Working Papers. Five States, Karnataka, Kerala, Maharashtra, Assam and Orissa have made available to us their remarks and comments and these are briefly summarised in the succeeding paragraphs.
14.6.115 Orrissa : The State has suggested cropping patterns for four types of land on the basis of topography viz., very-high, high, medium and low lands for the rainfed area and for high, medium and low for irrigated areas. In the existing cropping patterns, paddy is the major crop and often Pdl or Pd2. They have proposed a number of changes. For example, in the case of Jaleswar (Balasore district) while Pd 1 is the existing cropping pattern, the suggested crops ${ }_{1}$ are as follows :-

Rainfed areas

| high land | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ | $\cdot$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| medium land | $\cdot$ | $\cdot$ | $\cdot$ |  | $\mathrm{Pd}-W / \mathrm{O} / \mathrm{Gn}$ <br> $\mathrm{Fb}-\mathrm{W} / \mathrm{O} / \mathrm{Gn}$ <br> $\mathrm{Pd}-\mathrm{Pu} / \mathrm{O}$ <br> $\mathrm{Fb}-\mathrm{Pu} / \mathrm{O}$ <br> $\mathrm{Fb}-\mathrm{Pu} / \mathrm{O}$ <br> low land |
|  |  |  |  |  |  |

[^21]Irrigated areas
high land . . . . . . $\mathrm{Pd}-\mathrm{P} / \mathrm{V} / \mathrm{W}-\mathrm{Pu} / \mathrm{O}$
medium land . . . . . Fd—Pd
$\mathrm{Fb}-\mathrm{Pd}-\mathrm{Pu} / \mathrm{O}$
$\mathrm{Fd}-\mathrm{Gn} / \mathrm{Pu}-\mathrm{O}$
low land
Pd—Pd
$\mathrm{Fb}-\mathrm{Pd}-\mathrm{Pd}$
$\mathrm{Fb}-\mathrm{Pd}-\mathrm{Pu} / \mathrm{O} / \mathrm{V}$.
14.6.116 Kerala : There are considerable variations in topography in the State. Plantations and paddy are the main crops with some tapioca. In drawing up the recommended patterns, they have been given separately for valley, slope and hill top areas. In the first area (which covers Onattukara) their suggestions are :
valley
autumn (virippu) . . . . . rice
winter (mundakan) . . . . rice
summer (punja) . . . . . sesamum, cowpea, vegetable, cucurbits
slope
perennial . . . . . . coconut
intercrops . . . . . . groundnut, rice, pulses (cowpea, green gram, black gram), banana, tapioca and tuber crops, foddergrass
hill top
only raised garden lands. The existing cropping patterns are the cumulative effort of the generations of farmers who through trial and error have evolved a system based on the natural resource endowments such as altitude, rainfall, topography, soil etc. Thus, in the high ranges of Kerala, tea, coffee and cardamom are grown showing preference for cool humid climatic conditions and welldrained soils. In the highland region, rubber, pepper, coconut etc. are found flourishing as high rainfall and extremely undulating topography provide moist but well-drained soil conditions. In the midland, where the topography is mild, a variety of annual and seasonal crops are grown which are quick ripening and requiring frequent disturbance of top soil. Rice and coconut are the two main crops in the coastal low land. In general, valleys are put to crops that tolerate excessive moisture such as rice. The hill tops and slopes of steep gradients, especially the upper portions, are put to perennial crops such as rubber, coconut, cashewnut etc. which can stand the moisture stress of the summer months and do not require disturbance of the soil that accelerates soil erosion. The slope with mild gradients are put to seasonal and annual crops which entail disturbance
of top soil but will not result in soil erosion. The lower purtions of the steeper slopes are put to crops like arecanut, pepper etc. demanding moist but well-drained soils. Efforts have been made to identify the agronomic environments obtaining in the various areas by them. By juxtaposing the agronomic requirements of the crops over the agronomic conditions obtaining in the agro-climatic zones as identified by them the cropping patterns suited to each of the zones were drawn up. Appendix 14.8 (Statement II) contains recommended patterns for a few areas taken from their report
14.6.117 Assan : Paddy is the dominant crop with seventy per cent or more area in general with some jute and plantations. The crop structure drawn up covers separately the three belts rice, jute and flood affected areas and for the three periods summer, kharif and rabi. While paddy will continue to be the main crop, emphasis will be on production of high yielding varieties (HYV) and increasing the area under rabi crops. They are also including fodder crops in the future crop patterns because of their importance in expanded animal husbandry programmes. Production of pulses will be encouraged. They are also taking up the question of perennial fodders such as grasses. Fodder should be grown as an intercrop in the Reserve Forest areas as well as on the hill slopes. Further experiments are proposed to evolve cropping patterns based on soil profile and irrigation facilities and also in the perennially flood affected areas such as Majuli, Sadia, Mankachar etc. Extension of irrigation facilities has become imperative in view of the expansion of rabi crop and changing pattern so as to advance the autumn paddy sowing date. The crop structure proposed by them is given in Appendix 14.8 (Statement III).
14.6.118 Maharashtra : The State is divided into sixteen rainfall zones. The major crops of the State are jowar (kharif and rabi), bajra and cotton. The State bas examined the existing cropping structure in each rainfall zone and made some suggestions for modification. They have stressed the need for increased use of high yielding varieties, conservation of moisture by water harvesting techniques and increasing irrigation potential and diversion of submarginal and marginal lands for pasture and dairy development. Lower jowar kharif yields are attributed to cultivation on even shallow black soils and partly due to less intensive cultivation methods. Cotton yields in the State are very low, less than 50 per cent of all-India. They have suggested the cultivation of hirsutum varieties and their extension in place of arborieum varieties which are taken at present even in deep soils. Cotton on marginal lands should be diverted to hybrid/bajra and hydrid jowar. A few illustrative examples from their report are given in Appendix 14.8 Statement IV.
14.6.119 Karnataka: The existing cropping patterns in different taluks have been critically examined in relation to the agronomic and
economic feasibility for each crop. Suggestions for substituting the existing less efficient crops by more efficient ones are based on (a) quantity and distribution of rainfall (b) soil type, altitude and topography (c) nature, extent and quantities of irrigation water available (d) existing cropping, patterns (e) available research data (f) experience and observations $n$ : scientists and (g) existing agricultural development programmes.

Karnataka State has 26 rainfall patterns and thus the State is divided into 26 rainfall zones. The State has for convenience grouped them according to (a) coastal belt (b) ghat region (c) transition belt and (d) dry belt. The cropping patterns under each rainfall pattern zone have been analysed and suggestions made. A feature of the report prepared by the State is detailed information on rainfall, existing crops, areas covered and crop yields. New crops to be tried, suggestions for change in practice and recommended cropping patterns are given for each of the taluks of the State. The report on cropping patterns for different rainfall zones and agroclimatic regions of Karnataka State made available to the Commission has been published in the University of Agricultural Sciences Technical Series No. 1 (1973) by the University of Agricultural Sciences, Bangalore. We are reproducing in Statement V, Appendix 14.7 four examples from the report to illustrate their approach ; one of the taluk tables is also included.

## 7 SUGGESTIONS FOR FUTURE CROPPING PATTERNS

14.7.1 Five steps are visualised in the formulation of future cropping patterns. These are :
(i) Delineation of rainfall patterns.
(ii) Identification of the existing cropping patterns.
(iii) An idea of the area needed for each crop for national self-sufficiency and ideal location for its distribution.
(iv) Juxtaposition of (iii) over (ii) and studying them together with (i) in order to determine possible changes.
(v) Consideration of related factors like soil, irrigation, pressure of population, needs of livestock, proportion of forest vegetation, cropped area etc., and then arriving at the future cropping pattems on the basis of (iv).
The scope of the study commenced within the Commission envisages ulti-• mately the inclusion of all the five steps. The Working Papers on States discussed with the State officials and experts already contain information on rainfall patterns, existing cropping patterns and related factors and, therefore, it was thought advantageous to set in motion the process of thinking at the State level independent of the efforts initiated within the

Commission. A brief summary of the comments and suggestions made by five of the States has already been given in the preceding Section. We would urge the remaining States and Union Territories to prepare similar studies on rainfall and cropping patterns of their respective areas urgently on a priority basis. The future cropping patterns of each State Union/ Territory should be discussed at various levels to enable improvements in the cropping patterns for increased production and productivity. The potential yields for various crops by 2000 AD have been indicated in Chapters 21, 22 on Foodgrains Crops, Commercial Crops etc. After each State has prepared and discussed its suggested patterns, these would have to be tested in the relevant areas and demonstrations held to convince the farmers of advantages of the new suggestions.

## Cropping Patterns under different Rainfall Distributions

14.7.2 Reference will now be made to some of the main problems of Indian agriculture under different rainfall distributions in the country. A major feature of the country's agriculture is its large dependence on only two good rainy months of July and August during the southwest monsoon months of June to September which form the principal rainy season of the country. What is, however, needed is as stated earlier in Section 2, that rainfall of the same type is required for not less than three consecutive months for growing different types of crops satisfactorily. Table 14.22 gives the percentage areas under different rainfall types and categories. In this Table, district (and not taluk) rainfall patterns contained in Appendix 14.6-Statement VII have been employed. This was done as yield data are available for districts only. The areas shown in Table 14.22 would, therefore, not be the same as shown in tables of sections 4 and 5 , the differences being generally small.
table 14.22
Areas under Different Rainfall Types/Categories

14.7.3. The areas under the same type of rainfall distribution for at least three months is less than 20 per cent. Thus, over about 80 per cent of the gross cropped area of the country, rainfall distributions only partially satisfy the criterion for growing different crops successfully. Irrigation support is also not adequate, being only 20 to 25 per cent. Under these conditions, it would be necessary to concentrate attention not only on the drought prone areas as usually understood and classified but also on the remainder of the area which is of the order of 50 per cent. Note in this connection should also be taken of the high variability of Indian rainfall even in the rainiest months of July and August (Chapter 13 on Climate and Agriculture). Besides riverine or water-logged conditions affect the crops in Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Orissa and Assam which have A2/B2 or A3/A4 rainfall types. It would therefore be almost futile to raise alarm against floods and droughts because these conditions are writ large over the country's weather patterns. Granting of loans or taking similar ameliorative measures could only be instant remedy but not a solution to these chronic problems. Crop insurance has also been suggested in this connection. A Committee set up by Government of India in 1970 held the view that this would not be feasible in the near future but suggested experimental trial schemes. The position has not materially changed since then. This subject has also been considered in Section 8 of Chapter 55 on Credit and Incentives. We, therefore, feel that a permanent solution lies only in reorienting farming methods to the realities of the weather situations as prevail in the country. Combinations of 'A2 to B2 categories though partial, represent the next best categories after the ideal conditions of $B 3 / B 4$ and $C 3 / C 4$. These categories cover the following areas.

Distribution of Gross Cropped Areas of States in A2 to B2 categories of rainfall
Most area
Himachal Pradesh
Uttar Pradesh
Madhya Pradesh
Bihar
Orissa
West Bengal
Half area Part area

Jammu \& Kashmir Punjab
Haryana
Rajasthan
Gujarat
Maharashtra
Andhra Pradesh Kerala
Of the above, the contiguous States of Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, West Bengal together with the northern parts of Maharashtra account for about 45 per cent of the average gross cropped area of the country and about $60-65$ per cent of the areas under wheat and rice. An idea of the performance of some important crops in these areas could be had from the following yield data.
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Relative Yield Index (RYI-State value expressed as percentage of all-India) of selected Crops
(1968-69-1970-71)

| State | Rice | Maize | Jowar | Bajra | Pulses(b) | Cotton | Wheat | Gram |
| :--- | :---: | :---: | :---: | :---: | :---: | ---: | ---: | ---: |
| Uttar Pradesh | 70 | 89 | 118 | 149 | 212 | 131 | 100 | 115 |
| Madhya Pradesh | 72 | 71 | 124 | 118 | 83 | 65 | 57 | 78 |
| Bihar . | 71 | 90 | 90 | 111 | 158 | 214 | 73 | 99 |
| Orissa . . | 85 | 77 | 139 | 156 | 133 | 256 | 102 | 88 |
| West Bengal . | 111 | 84 | 124 | 109 | 159 | - | 170 | 115 |
| Maharashtra . | $99(\mathrm{a})$ | 71 | 89 | 77 | 74 | 56 | 40 | 44 |

(a) includes Konkan area (A3-4).
(b) other than tur and gram.

But for jowar, bajra and pulses, the yields of crops in their areas of importance are either subnormal or not commensurate with the soil and other available resources. This is an alarming situation particularly for rice, maize and cotton in so far as kharif season is concerned. It should be clear that Indian rainfall by itself is not sufficient to sustain a rice crop over vast areas of the country; it is suited most to crops like millets. If rice or other crops have to be grown with high standards of yield, the situation warrants careful examination for adoption of suitable means.
14.7.4 Some important combinations of rainfall between A2 and B2 types are given below together with remarks on their defects and suggestions for improvement.
(i) A2 B2 $\quad-\quad$ This is the best condition next to A3-4 for rice cultivation. With suitable water conservation techniques, the position of water availability could be improved in B2 months which are invariably the months of June and Septemeber.
(ii) $\mathrm{A} 2 \mathrm{B1} \mathrm{Cl}-\quad$ This condition is not congenial for rice A 1 B 2 Cl except in low lying areas. A2 or A1 B1 A2 C2 (September not counted) conditions in July and August are good for crops like maize, soyabeen and urid, provided that there is no water-logging. For other crops, A2 or A1 conditions are harmful without proper drainage.
(iii) $\mathrm{B} 3 \mathrm{Cl} \quad-\quad \mathrm{B3}$ or $\mathbf{~ B 2} \mathbf{C l}$ (June not counted) conditions in July-September period are good for B2 C2 most of Kharif crops provided that there is even distribution and no water-logging.
(iv) B2 C1 - Rainfall insufficient during some periods requiring water conservation techniques. Moreover water-logging, when occurring due to concentrated spells, has to be countered with remedial measures.
Rice crop is prone to suffer in the rainfall categories A2 to B 2 unless due provision is made in the rainy months to collect and store water for irrigation in the lean spells or months. For other crops, there is always a danger from water-logging, which condition can be avoided (a) by agronomic methods like laying rows of the crops across the slope, (b) taking the crop on ridges and (c) by draining excess water and collecting it in suitable situations.
14.7.5 The problems of areas with B1 or less rainfall are critical in the absence of supplementary sources of water supply. The distribution of areas is as follows :

Distribution of Gross Cropped Areas in B1
or less categories of rainfall
Most area Half area Part area
Punjab Jammu \& Kashmir Himachal Pradesh Haryana
Rajasthan
Uttar Pradesh
Madhya Pradesh
Gujarat
Maharashtra
Karnataka
Andhra Pradesh
Tamil Nadu
The percentage of irrigated area corresponding to the gross cropped area of the concerned parts of these States is : Jammu \& Kashmir 60, Punjab 80, Haryana 43, Uttar Pradesh 64, Andhra Pradesh 31, Tamil Nadu 46, rest of the States below 15. The success of crops in many of these States is intimately related to irrigation. Moreover, the States in the north and south receive rainfall in one or more months of October to February also. As will be seen from discussions in the Chapters 21, 22 on Foodgrains Crops, Commercial Crops etc. the success in Gujarat is partly due to better farming methods too. Wherever all these conditions are not possible, the performance is low and those are the very areas which are designated as drought prone. The uplift in those areas also depends in principle upon the mothods which have been suggested here in the foregoing paragraphs.
14.7.6 An important way of bringing , success to crop cultivation in rainfed farming is through adjusting the time of sowing to such a date of commencement of rainfall which could ensure a reasonable supply of soil moisture to a given crop at least to begin with. To provide a second line
of defence, one has also to keep ready a schedule of other crops which could be sown depending upon the early or late occurrence of rainfall so that the chance of complete failure inherent in placing reliance only on one date and one crop could be minimised. Some studies to determine probable dates of sowing based on meteorological conditions have already been initiated in the India Meteorological Department. ${ }^{1}$

These should be completed for the entire country in close liaison with the scientists of Agricultural Universities and other concerned institutions so that the results after trials could be adopted with advantage in a practical manner. The prognosis of an all-India character has primarily to ensure that the area and yield levels must meet the changing needs of the country. This can obviously be done at the national level only for the major crops, but in this process many other equally vital crops, which either occupy less area or are of local importance only, are left out. These crops are : some bast fibres, sugarcane, tobacco, potato, vegetables, various condiments and spices, fruits and plantation crops. Moreover, full justice cannot be done in a broad national prognosis to local, edaphic, ecological, economic and social factors. Therefore the cropping patterns to succeed must evolve from the lowest level. This is going to be a long drawn process, in which the present efforts represent only a beginning. Even when local experts have developed the patterns, these have to pass the test of time in actual practice and in that course might require modification again and again. Thus, the determination of future cropping patterns is going to be a continuous process for sometime to come and until a fair degree of stability has been achieved, it will be difficult to assign the same arithmetic accuracy to different crops in fixing their proportions as has been possible in the case of existing cropping patterns. What is outlined in the following paragraphs concerns the laying down of certain principles around which a continuous thinking can go on for modifications.

## General Observations on Future Cropping Patterns

14.7.7 Rainfall distribution with regard to monthly amounts and spread have been analysed and presented in this chapter. Some of the inferences that can be drawn are discussed in the context of present cropping patterns and future possible changes that can be brought about in cropping patterns. We have attempted to give the guidelines in Karnataka Report and also for each crop in the Crop Chapters. Hence, it is intended to indicate here general principles on which changes could be attempted.
14.7.8 It has been pointed out at a number of places in this Chapter

[^22]that for raising a certain crop, certain types of distribution of rainfall are required for a specified period. It has been indicated that for paddy, rainfall of more than 30 cm pm is required for at least three consecutive months and for maize it is at least 20 cm per month and for bajra 10 cm pm . Such ideal conditions prevail only in small areas in the country. In most parts of the country, however, the rainfall distributions present combination of two to three classes of rainfall amounts. For instance, there is a vast area with A2 B2 pattern, viz., 30 cm or more in two months and 20 to 30 cm pm in the remaining two months. In some areas, it is only one month with A type, another month B type and third month with C type and so on. In about 25 per cent of the area, precarious conditions prevail ; rainfall being 10 to 20 cm pm in not more than two months in a year and these are not even consecutive months in some areas. The rainfall amounts indicated here are no doubt on an average but the extent of variability of monthly and seasonal rainfall is discussed in Chapter 13 on Climate and Agriculture. Variability is large from year to year which implies that in some years rainfall is more than normal, while in some others it would be lower. It has been usually observed in a three years period that one year is normal, one above and the third below normal. The situation in the low rainfall areas is very much more precarious because of higher variability. Only two out of five years have normal or above normal conditions thus reducing the chances of even fairly good yield to two out of five years. The position worsens further in slopy lands and lighter soils. Where the soils are heavy and retentive and where the lands are level, the position improves. Taking all these factors into consideration, steps required to be taken to increase and stabilise agricultural production in these areas should be worked out. One of the ways, no doubt, is to provide irrigation facilities. We would like to state here that highest priority should be given to these regions in providing facilities for bringing as much area as possible under irrigation through all means. The first step should be to provide flow irrigation through large medium and minor irrigation works. Second step would bs to explore the possibilities of tapping underground water resources wherever available. Detailed survey should be undertaken to locate underground water resources. Care, however, has to be taken to see that the resources are not over-exploited but that all necessary steps are taken for recharging arrangements. In addition, arrangements should be made to hold as much water as possible in farm ponds and in valleys by taking appropriate measures for gully plugging wherever possible. Adoption of all kinds of water harvesting techniques within each holding as well as outside on community basis will also help in stabilising production. Continuous improvements will have to be brought about in farming systems applicable to various local situations.
14.7.9 In spite of all the measures suggested above, there will be need
for changing the cropping patterns themselves. Because of pressure of population, land has been opened and used irrationally. Land use planning has to be done and implemented on scientific basis. In any scheme of land use planning, consideration will have to be given to the existing as well as future needs and the system of farming suitable for the land. At present, there is too much emphasis on arable crops irrespective of the suitability of land or sufficiency of rainfall. With the hope that the year would be normal or above normal, crops have been chosen and grown all these years.
14.7.10 All arable crops need rainfall on time but rainfall in these regions is most uncertain. It may be early or late. Crop failures are more often due to unseasonal rainfall rather than due to shortage in total amounts. Even in years of low total rainfall, the yields have been observed to be quite high if the rainfall is timely and well-distributed. In one of the studies, it has been shown that well-distributed rainfall of just 15 cm during the life span of bajra gave highest yield as against the years where the rainfall was much more but ill-distributed. Well-distributed rainfall may be expected only two or three times in a decade. It is, therefore, necessary to restrict growing of arable crops only to most favourable areas which have good retentive soils and are situated in valleys so that the rainfall that occurs could be well preserved in soil profiles and it would also be possible to adopt water harvesting techniques. The remaining areas should be put under forage and economic tree crops either as sole crops or in mixture. It is only by bringing about such changes in cropping patterns that stability can be brought to agricultural production under rainfed conditions in these low rainfall areas. It would also be possible to convince the farmers to switch over to such crops only if it can be demonstrated that it is economical to do so and arrange not only for supply of inputs and services etc. needed but also arrange for the use of output locally or for marketing wherever needed. All this is possible only if research efforts are intensified in this direction and suitable recommendations developed as applicable to different regions.
14.7.11 The remaining 75 per cent of the area in the country receives rainfall of 10 to 20 cm pm or more for three months or longer in a year. It should, therefore, be possible in such areas to get at least one good crop in a year. What is needed, therefore, is to decide on crops which fit best in different regions of the country taking into account the soil, rainfall and other factors into consideration. Every crop has a certain water use rhythm and every region has certain water supply rhythm. A crop can be said to be adapted to a region only when these two rhythms concur. The result would show up better according to the closeness of the rhythms. Attempt has, therefore, to be made to introduce such crops and varieties that fit best in the environmental rhythm of a place. No doubt, the existing
cropping patterns have evolved through ages and they represent the local environmental situations and needs. Cropping patterns have to be flexible and should be adjusted to meet the changing needs taking into consideration the advances in technology.
14.7.12 The studies carried out in the Commission with regard to rainfall and cropping patterns along with the existing productivity levels have clearly brought out that there is considerable scope for improving the cropping structure in different regions. It is clear that the synchronisation of the rainfall rhythm and crop rhythm does not appear to have been taking place in many cases. Hence, while discussing the cropping patterns in different Regions in Section 6, possible changes have been indicated.
14.7.13 One of the crops that is widespread and grown under varying conditions is paddy. As has been stated earlier, it requires rainfall of 30 cm pm for at least three consecutive months, but paddy is being grown even in areas where the rainfall is just 30 cm pm only in one month and without irrigation support. In such areas, it has been shown that yields are very low and uncertain. Just changing over from paddy to crops like maize would mean increased production by as much as two to three tonnes of grains per hectare. Paddy yields in these regions are as low as half a tonne per hectare. Maize yields under same situations can be as much as 4 tonnes per hectare. In addition, year to year variations in production will also be less.
14.7.14 There are a number of such examples in the country, It has been stated in earlier Sections that the cropping patterns adopted in Gujarat can be a good example to prove how good yields can be obtained by adjusting crops taking the minimum in the pattern into account but not the maximum. For instance, if the pattern includes $A, B$ as well as $C$ classes of rainfall amounts in each of the three months, then it is better to take the crops that require $\mathbf{C}$ or $\mathbf{B}$ amounts at the most into consideration rather than A while choosing the crops. The only problem, when choice is done in this manner, is the possibility of excess water conditions developing and hampering crop growth during the month of A type rainfall. This can, however, be got over to a very great extent by providing for drainage right from the beginning, anticipating such a situation. This is probably done in many areas of Gujarat. Even if A type occurs in one or two months in some regions which provides a temptation for taking paddy, Gujarat farmers have not gone for paddy but appear to have been content with cotton, jowar or maize or such similar crops. The yields are above the national average in case of many crops in Gujarat which can be seen from Appendix 14.6 (Statement II). As against such a good performance in Gujarat, the yields of paddy and many other crops are low in many of the eastern as well as central States like Bihar, Uttar Pradesh, Orissa, Madhya Pradesh and Maharashtra. Paddy is being grown in these States even
when rainfall is not sufficient for it and without irrigation support. Cotton yields in Maharashtra are much low as compared to Gujarat although rainfall patterns are not much different.
14.7.15 In Andhra Pradesh, Tamil Nadu and Karnataka, the position seems different. All irrigation resources are used for growing paddy instead of using these for growing other crops also under irrigation, taking full advantage of irrigation to supplement rain water resources rather than supplanting it. There might be strong and valid reasons for doing so ; but it is necessary to examine as to whether water resources can be put to better use than what is being done now both from socio-economic point of view as well as from human nutrition and other agronomic points of view. It may be advantageous to divert some water at least for growing like groundnut, pulses and even jowar and maize for animal consumption and also fodder legumes with a view to build up and maintain soil fertility. There is a case for restricting paddy to one season only in the southern States when rainfall amounts are in higher ranges in one or two months at least and utilising irrigation water for growing various crops other than paddy, keeping the points mentioned above in view. It is necessary to give a serious trial to this suggestion. As stated earlier, farmers will, no doubt, switch over only when it is demonstrated that it is economical to do so and the infrastructure is built to enable a smooth switch over. Research attempts are also wanting with these objectives in view and they should be intensified.
14.7.16 There is another example from Karanataka where in recent years maize is being taken in Tibetan colonies established to resettle Tibetan population that migrated to India from Tibet, instead of paddy which is commonly grown in surrounding areas. These colonies are in Mysore and Dharwar districts of Karnataka in the transitional belt where rainfall is not sufficient for paddy, but paddy is still the main crop in the region. The yield levels of maize on an average over a thousand hectares or more have been of the order of 3 to 4 tonnes per hectare as against not even one tonne of paddy in surrounding areas. There are vast areas in the country where paddy yields are low and the economy of the regions could be improved by changing over to maize, soyabean and cotton and thus release the paddy growing population from the shackles of poverty. Such potentialities are tremendous and as stated earlier, more research and extension efforts are needed with these objectives.
14.7.17 It is always argued that it is difficult to change cropping patterns because farmers are accustomed to growing the crops that they are growing for ages and it is difficult to change the food and other habits. It is also argued that the existing cropping patterns are proven ones and have stood the test of time. In this regard again, many examples can be quoted where changes have occurred and farmers have taken to new crops.

In the begining of the century, groundnut was not an important crop of the country, but now, India is one of the three leading groundnut growing countries of the world. Even during 1930s, groundnut was not an important crop in many areas. Farmers of Bardoloi tehsils in Surat district of Gujarat took to vegetable growing during war period on a large scale because it was economical. Then they changed over to banana. After 1955, they took to sugarcane cultivation and a sugar factory is running successfully now. A factory was recommended and established when sugarcane was not a major crop in that area. Farmers learnt the art of growing sugarcane in a short period and they have been successful sugarcane growers. Similarly, increase of area under maize especially in the southern parts of Karnataka where maize was unknown is another example how farmers do take to new crops provided the necessary arrangements are made to educate them and for marketing the produce. The way Varalakshmi cotton hybrid spread to non-cotton areas when fantastic yields were reported and prices ruled very high is a good example too. There are examples when a kilogram of cotton seed was sold at Rs 500 or more. Growing of wheat by farmers of West Bengal in recent years is yet another example. Yields of wheat in Bengal and maize in Karnataka are on the high side. New crops of sunflower and soyabean are getting popular in certain areas. Many other examples could be cited but the examples given here should be more than sufficient to show that cropping patterns can be changed provided advantages of doing so are clearly demonstrated. This implies greater research in the first instance and intensified extension efforts in later stages. Infrastructure needed is required to be built side by side. Apart from the suitability of the crop from the points of view of soils and climate the net return from the crop is also an important consideration which weighs with the farmer in the choice of a crop. This factor has also to be taken into account before the recommendations are made by the extension agencies.
14.7.18 We would like to remove any impression, if created, that, the limits of rainfall used in the study are sacrosanct and that it is only the rainfall that determines the yield levels. These limits are based on general experience and from available data. Lower amounts than those indicated here may be sufficient for getting good yields when the lands are level and soils have better water-holding capacity. When soils are of sandy type and lands are slopy, the rainfall amounts indicated as sufficient may not yield expected results. Better distribution would be naturally considered desirable under such situations rather than just total amounts. In addition, temperature and other climatic factors would also influence the production to a certain extent. In spite of all these limiting factors which vary from field to field and area to area, the study has brought out that rainfall distribution patterns with a knowledge of monthly variability could be used
as an important basis in any scheme for changing cropping patterns.
14.7.19 We have come to the conclusion that the rain water resources are good over vast parts of the country and productivity of every bit of land in the country could be raised considerably bringing about improvement in the cropping patterns in different regions in the country taking into account the rainfall patterns in general and taking lower limits of rainfall amounts in the patterns in particular. By adopting similar principles, productivity can be increased even in the remaining 25 per cent of the area where the rainfall is really very low to precarious, as discussed earlier. Keeping in view the findings of the analysis indicated here, recommendations have been made with regard to adjustment of various crops in the various crop chapters in the volume on Crop Production, Sericulture and Agiculture. It can, therefore, be said that it is the way the rainfall resources are used which contribute to low or high production rather than the rainfall itself. It is not intended to minimise the depressing influences that droughts and floods have on production, but the situation can be improved by containing them in all possible ways.
14.7.20 The changes will have to be brought about in the next 25 years as indicated in the crop chapters. The required steps will have to be initiated immediately on priority basis for determining and adopting more suitable cropping patterns than the existing ones. The first step is to take up detailed studies on the lines indicated here and formulate proposals for launching research and extension programmes to achieve the main objective of putting every hectare of land in the country to its best use. The material as available in each of the State reports published separately will provide the basic information for carrying cut the analysis and studies suggested here. The data published will have to be brought up-to-date and studied continuously.
14.7.2 To sum up, it can be said that Indian rainfall is variable from place to place, month to month and year to year. It is restricted to a few days in a year in some areas as in Rajasthan and is spread over a long period of 7 to 9 months in some areas like Assam and Kerala. This is a natural phenomenon and it is not possible to modify the same. When this is a known fact, it is essential to adjust the cropping plan to get the maximum yield per hectare on a sustained basis. The task is exacting and challenging and, therefore, calls for matching action.
14.7.22 A Report on Karnataka Rainfall and Cropping Patterns prepared on the above lines is given in Appendix 14.9.

## 8 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

14.8.1 The main conclusions and recommendations are summarised
in this Section. Our observations and suggestions regarding cropping. patterns in Rainfall Regions are as under :-
(i) Region 1 : This is the area of lowest rainfall distribution in the country. Arable crops will have to be restricted to low lying areas with good retentive soils. It is advisable to divert the areas from arable to for age and economic tree crops either as sole crops or in mixture. More research and extension efforts will have to be put in with this objective.
(Paragraph 14.6.9)
(ii) Region 2 : Reasons for low yields of bajra and rabi jowar in Maharashtra and cotton in Andhra Pradesh and Karnataka should be examined and necessary measures taken urgently to increase the yields of these crops or for substituting them with more suitable crops.
(Paragraph 14.6.14)
(iii) Region 3 : Excepting Gujarat, the yield levels of crops without irrigation are on the low side some of them being less than 50 per cent of all-India average as in the case of bajra. The position has to be remedied by adopting better varieties or agronomic practices or by substitution of more suitable crops.
(Paragraph 14.6.19)
(iv) Region 4 : Although the crops grown appear to be suitable according to rainfall distribution, the yields are low in the case of almost all crops grown in the portion of the Region covering areas in Maharashtra, Madhya Pradesh and Rajasthan. There is, thus great need for detailed analysis, research and developmental efforts. Similar efforts are needed in the case of gram and other crops which have low yields in Andhra Pradesh and Karnataka.
(Paragraph 14.6.29)
(v) Region 5 : There is need for adopting better water management and agronomic practices for improving the yields of maize and bajra in Rajasthan area; groundnut in Surendranagar district (Gujarat) may be substituted by sunflower after carrying out trials.
(Paragraph 14.6.22)
(vi) Region 6 : Though the crops grown are nearly suited to rainfall distribution, yield levels in Rajasthan area are low. These could be improved by adopting better agronomic practices and improved varieties or hybrids.
(Paragraph 14.6.25)'
(vii) Region 7 :
(a) In spite of fairly good irrigation support wheat yields in Rajasthan and Uttar Pradesh areas of the Region, are low.

The reason as to why these should not be at almost the same level as in the Punjab needs to be looked into. Similar remarks apply to maize in Rajasthan and paddy in Uttar Pradesh.
(b) In case it is not possible to provide irrigation support to wheat and if it is difficult to increase yields under rainfed conditions, it may be considered as to why this area should not be diverted to barley, gram, safflower or other such crops.
(c) Paddy yields cannot be high without irrigation support and it may be advisable therefore to divert paddy area to maize or other suitable crops after providing for proper drainage facilities.
(Paragraph 14.6.34)
(viii) Region 8 : Growing of paddy and wheat does not appear to be advisable in areas where yields are low for lack of irrigation support. In areas where irrigation development is not possible should be diverted to other appropriate crops after study.
(Paragraph 14.6.38)
(ix) Region 9 : Paddy crop dominates but rainfall is insufficient and required irrigation facilities are not available; yields of other crops are also low. Careful examination is necessary.
(Paragraph 14.6.41)
(x) Region 10 : The Region is entirely in Gujarat and with the rainfall distribution with A type in July there could be a temptation to go in for paddy. However, crops other than paddy are being taken with good yields. This could be cited as a good example of an area where cropping patterns have stabilised after taking the minimum likely rainfall into account. In areas with above average rainfall, drainage aspect is fully taken care of. This example of Gujarat is worth emulation by others.
(Paragraph 14.6.43)
(xi) Region 11 : Yield levles of many of the crops are low except in Gujarat areas, though rainfall distribution is good for majority of the crops. Paddy yields cannot be high unless crop is irrigated. The cropping structure of the Region should be examined in detail with a view to bringing about improvement in both structure and productivity.
(Paragraph 14.6.47)
(xii) Region 12 :
(a) Rainfall distribution seems more suited for millets, maize and cotton but not for paddy without supplemental irrigation.
(b) Reasons for low yields of crops in some States of the Region and good yields in others like Gujarat, need to be looked into.
(c) Cultural and other practices in States where the yields are good should be studied and extended to other areas in the Region, in addition to carrying out the needed research.
(Paragraph 14.6.50)
(xiii) Regions 13 and 14 : Yield levels of paddy and wheat, the two major crops of the Regions are on the low side. Rainfall in September is not sufficient to support paddy crop and irrigation facilities are wanting both for paddy and wheat. The crop distribution needs detailed examination for evolving and adopting appropriate measures.
(Paragraph 14.6.57)
(xiv) Regions 15 and 16 : Paddy is the main crop of these Regions but yields are low, the chief reason being insufficiency of rainfall in September. These Regions are more suitable for paddy than other crops and hence necessary steps should be taken for providing irrigation facilities. In case this cannot be done, paddy areas may be diverted to other crops.
(Paragraph 14.6.60)
(xv) Region 17 :
(a) Rainfall resources are more than adequate for growing paddy in valleys and hill millets in elevated areas. Paddy yield in Bulsar district (Gujarat) could be raised. There is good scope for increasing the yields of ragi by adopting better varieties and agronomic practices.
(b) There is scope for introducing improved varieties of grass and forage legubes. Soyabean in rotation with ragi could be tried. Maize also could be tried.
(c) Region is good for production forestry and economic tree crops.
(Paragraph 14.6.63)
(xvi) Regions 18 to 22 : Paddy yields are high in general. Millet yields are very good in Tamil Nadu and moderate in Andhra Pradesh. Pulse yields are low. The reasons for the same are required to be looked into and improvements brought about.
(Paragraph 14.6.68)
(xvii) Regions 23 to 26 : Paddy can be grown only with irrigation and this is what is being done. Conditions are nearly favourable for maize in regions 25 and 26. Introduction of this crop along with soyabean is worth examining. Measures required to be
taken to further increase the yield levels of the existing crops also need examination.
(Paragraph 14.6.72)
(xviii) Regions 27 to 29 : There are possibilities of diverting areas under crops like paddy with a view to introducing protein yielding crops and fodder crops which may be examined along with the possibilities of increasing yield levels of existing crops.
(Paragraph 14.6.75)
(xix) Regions 30 to 36 : Paddy dominates whether rainfall is sufficient or not. The only good feature is that it is grown mostly under irrigation and yields are high. It may, however, be necessary to consider as to whether available water could be better utilised for raising other crops on larger areas with advantage. This suggestion especially applies to regions 30 and 31 , where the rainfall is good for raising crops like jowar, ragi, etc. Maize can be a good crop for these regions and may be tried. Similarly soyabean and cotton can be good crops in Regions 31 to 36. Plantation crops should also be considered especially in regions 33 to 36. Since there is rainfall in October month in addition to monsoon months, possibilities of raising pulses and fodder crops in paddy fallows with supplementary irrigation is worth considering.
(Paragraph 14.6.79)
( xx ) Regions 37, 41, 42, 44, 45, 47, 48 and 55 : Paddy is the major crop of these Regions. Regions 41, 42, 44, 47 and 48 do not have favourable rainfall distribution for paddy. Regions 41 and 48 do not have even one month of A type rainfall. Region 42 has only one and 44 two months of A type. Moisture stress in September and floods affect the yields. There is scope for substitution of paddy with maize and similar crops in Regions 41, 44,47 and 48 . Soyabean too can be a good crop for these Regions.
(Paragraph 14.6.83)
(xxi) Regions 38 to 40 : These are scanty rainfall Regions with long interventing breaks. It is therefore necessary to examine possibilities of putting larger areas under grasses and economic tree crops which can stand prolonged drought better than arable crops.
(Paragraph 14.6.90)
(xxii) Regions 43, 46 and 50 to 53 : Cropping structure in general appears to be appropriate. With long rainy seasons and with milder temperature, it would be advisable to pay more attention to fruit crops and grassland development in high lying areas.
(Paragraph 14.6.93)
(xxiii) Region 54 : More attention to grassland and fruit crops may be desirable.
(Paragraph 14.6.95)
(xxiv) Regions 56-62 : Cropping structure appears to be satisfactory. In Regions $56-57$ paddy could be replaced in high lying areas with maize and soyabean with advantage. Possibilities of taking short duration pulses, oilseeds, fodder crops and vegetables appear to be feasible before and after paddy. The high lying areas where raising of plantation crops is difficult, could be used for developing grasslands. These regions are good for production forestry and plantation crops. Tendency of opening up slopy lands for arable crops has to be discouraged.
(Paragraph 14.6.87)
14.8.2 General observations and suggestions regarding cropping patterns etc. are as under :-
(i) Rice crop is prone to suffer in areas under rainfall categories $\mathbf{A}_{\mathbf{2}}$ to B 2 unless due provision is made in the rainy months to collect and store water for irrigation in the lean periods. For other crops there is always danger from water logging to avoid which suitable agronomic measures should be adopted right from the beginning.
(Paragraph 14.7.4)
(ii) Studies on optimum dates of sowing should be completed for the whole country in close liaison with the scientists of agricultural universities, institutions and departments for adoption of the results after large scale trials in the field.
(Paragraph 14.7.6)
(iii) In about 25 per cent area precarious conditions prevail, rainfall being 10 to 20 cm pm in not more than two months in the year which are not even consecutive months in some areas. Variability of rainfall in these areas is also high. High priority should be given to these regions in providing irrigation for as much as possible area. All kinds of water harvesting techniques within each holding as well as outside on community basis are necessary for stabilising production.
(Paragraph 14.7.7)
(iv) There is too much emphasis on arable crops irrespective of the suitability of land or sufficiency of rainfall. Land use planning has to be done on a scientific basis and implemented.
(Paragraph 14.7.9)
(v) Field crops should be restricted to most favourable areas which have good retentive soils and are situated in valleys so that the rainfall could be preserved in soil profiles and water harvesting
techniques adopted. The remaining areas should be put under forage and economic tree crops either as sole crops or in mixture. Research efforts in these directions should be intensified and suitable recommendations developed as applicable to different regions.
(Paragraph 14.7.10)
(vi) Attempt should be made to introduce crops and varieties which fit best in the environmental rhythm of a place. Cropping patterns should be flexible for adjustment to changing needs taking into consideration advances in technology.
(Paragraph 14.7.11, 14.7.3
\& 14.7.21)
(vii) If rainfall pattern of a Region includes $A, B$ and $C$ classes of rainfall amounts in each of the three consecutive months, it is better to go in for crops that require $\mathbf{C}$ or $\mathbf{B}$ amounts of rainfall and not A. In such cases, steps should be taken right from the beginning for drainage of excess water.
(Paragraph 14.7.14)
(viii) All irrigation resources in Andhra Pradesh, Tamil Nadu and Karnataka are used mainly for growing paddy. It is necessary to examine as to whether water resources could be put to better use from socio-economic as well as from human nutrition and other agronomic points of view.
(Paragraph 14.7.15)
(ix) There is a case for restricting paddy to one season only in the southern States with rainfall amounts in higher ranges in one or two months and utilising irrigation water for growing other crops. Farmers will switch over only when it is economical to do so. Research attempts should be intensified keeping these various objectives in view.
(Paragraphs 14.7.15 \&
14.7.17)
(x) Rainfall distribution patterns with a knowledge of monthly variability could be used as an important basis in any scheme for changing cropping patterns.
(Paragraph 14.7. 18)
(xi) Urgent steps would have to be initiated on priority basis for determining and adopting more suitable cropping patterns than the existing ones. Detailed studies should be taken up on the lines indicated and keeping in view the proposed targets and suggestions made in the crop chapters, formulate research and extension programmes to achieve the main objective of putting every hectare of land to its best use.
(Paragraph 14.7. 20)

## APPENDIX 14.1

(Paragraph 14.2.4)
Code form for Combinations of Rainfall of Four Months in Different Intervals


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## APPENDIX 14.1 (Contd.)

| Code form |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

3. Beginning with $C(10-20 \mathrm{~cm})$


## APPENDIX $14 \cdot 1$ (Contd.)



## APPENDIX 14.2

(Paragraph 14.3.2)
Statement I-Frequency of Districts in different Area Intervals

| State | Geographical area sq km | - Total no. of districts | Number of districts with area (thousand sq km) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $\begin{array}{r} \text { Less } \\ \text { than } \\ 5 \end{array}$ | 5-10 | 10-20 | $\begin{aligned} & \text { greater } \\ & \text { than } \\ & 20 \end{aligned}$ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Andhra Pradesh . | 276,754 | 21 | - | 6 | 15 | - |
| Assam* | 99,610 | 10 | 1 | 5 | 3 | 1 |
| Bihar . | 173,876 | 17 | 1 | 8 | 8 | - |
| Gujarat | 195,984 | 19 | 2 | 10 | 6 | 1 |
| Haryana | 44,222 | 7 | 3 | 3 | 1 | - |
| Himachal Pradesh | 55,673 | 10 | 4 | 5 | 1 | - |
| Jammu \& Kashmir | 222,236@ | 10 | 6 | 2 | 1 | 1 |
| Karnataka | 191,773 | 19 | 3 | 7 | 9 | - |
| Keraia | 38,864 | 10 | 8 | 2 | - | - |
| Madhya Pradesh . | 442,841 | 43 | 4 | 22 | 15 | 2 |
| Maharashtra | 307,762 | 26 | 1 | 1 | 16 | 1 |
| Manipur . | 22,356 | 5 | 4 | 1 | - | - |
| Meghalaya . | 22,489 | 2 |  | 1 | 1 | - |
| Nagaland | 16,527 | 3 | 1 | 2 | - | - |
| Orissa. | 155,842 | 13 |  | 4 | 8 | 1 |
| Punjab . | 50,362 | 11 | 7 | 3 | 1 | - |
| Rajasthan . | 342,214 | 26 | 1 | 10 | 10 | 5 |
| Tamil Nadu | 130,069 | 14 | 3 | 4 | 7 | - |
| Tripura | 10,477 | 3 | 3 | - | - | - |
| Uttar Pradesh | 294,413 | 54 | 29 | 23 | 2 | - |
| West Bengal | 87,853 | 16 | 8 | 6 | 2 | - |
| total |  | 339 | 89 | 132 | 106 | 12 |
| Union Territories total no. of districts. |  | $\begin{array}{r} 17 \\ 356 \end{array}$ |  |  |  |  |

- Includes Mizoram district.
: Includes area under illegal occupation of Pakistan and China.
(Paragraph ${ }^{14.3 .4)}$
Statement II-Frequency of Districts with Density of Population in different Intervals

| State | Geographical area (sq km) | Popula- Densitytion per1971 sq km(million) |  | Density intervals |  |  |  |  |  |  |  | Total no. of districts |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | less than or equal to 100 | $\begin{gathered} 101- \\ 150 \end{gathered}$ | $\frac{151-}{200}$ | $\begin{gathered} 201- \\ 300 \end{gathered}$ | $\begin{gathered} 301- \\ 500 \end{gathered}$ | $\begin{gathered} 501- \\ 750 \end{gathered}$ | $\begin{gathered} 751- \\ 1000 \end{gathered}$ | greater <br> than <br> 1000 |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| number of districts |  |  |  |  |  |  |  |  |  |  |  |  |
| 1. Andhra Pradesh | 276,754 | 43.5 | 157 | 2 | 8 | 4 | 5 | 2 |  |  |  | 21 |
| 2. Assam* . | 99,610 | $15 \cdot 0$ | 150 | 3 |  | 2 | 4 | 1 |  |  |  | 10 |
| 3. Bihar . | 173,876 | 56.4 | 324 |  | 2 | 2 | 1 | 8 | 4 |  |  | 17 |
| 4. Gujarat | 195,984 | $26 \cdot 7$ | 136 | 4 | 4 | 3 | 5 | 3 |  |  |  | 19 |
| 5. Haryana . | 44,222 | $10 \cdot 0$ | 227 |  |  | 1 | 6 |  |  |  |  | 7 |
| 6. Himachal Pradesh | 55,673 | $3 \cdot 5$ | 62 | 6 | 1 | 3 |  |  |  |  |  | 10 |
| 7. Jammu \& Kashmir | 222,236@ | $4 \cdot 6$ | 21 | 4 | 3 | 1 | 2 |  |  |  |  | 10 |
| 8. Karnataka . | 191,773 | 29.3 | 153 | 2 | 7 | 7 | 2 | 1 |  |  |  | 19 |
| 9. Kerala . | 38,864 | 21.3 | 549 |  |  |  |  | 3 | 5 |  | 2 | 10 |
| 10. Madhya Pradesh | 442,841 | 41.7 | 84 | 15 | 21 | 6 | 1 |  |  |  |  | 43 |
| 11. Maharashtra | 307,762 | $50 \cdot 4$ | 164 | 1 | 13 | 8 | 3 |  |  |  | 1 | 26 |
| 12. Manipur . | 22,356 | $1 \cdot 1$ | 48 | 4 | 1 |  |  |  |  |  |  | 5 |
| 13. Meghalaya . | 22,489 | 1.0 | 45 | 2 |  |  |  |  |  |  |  | 2 |
| 14. Nagaland | 16,527 | 0.5 | 31 | 3 |  |  |  |  |  |  |  | 3 |
| 15. Orissa. | 155,842 | 21.9 | 141 | 3 | 6 | 1 | 2 | 1 |  |  |  | 13 |
| 16. Punjab | 50,362 | $13 \cdot 6$ | 269 |  |  | 2 | 5 | 4 |  |  |  | 11 |
| 17. Rajasthan . | 342,214 | $25 \cdot 8$ | 75 | 14 | 8 | 4 |  |  |  |  |  | 26 |
| 18. Tamil Nadu | 130,069 | $41 \cdot 2$ | 317 |  |  | 2 | 4 | 6 | 1 |  | 1 | 14 |
| 19. Tripura | 10,477 | 1.6 | 149 |  | 2 |  | 1 |  |  |  |  | 3 |
| 20. Uttar Pradesh | 294,413 | $88 \cdot 3$ | 300 | 4 | 6 | 4 | 3 | 31 | 6 |  |  | 54 |
| 21. West Bengal . | 87,853 | $44 \cdot 3$ | 504 |  |  |  | 4 48 | 55 | 4 20 | 1 | 2 | 16 339 |
| Total . . |  |  |  | 66 | 82 | 50 | 48 | 65 | 20 | 1 | 6 | 339 |

## APPENDIX 14.2-Statement II (Contd.)

| Union Territory | Area <br> $(\mathrm{sq} \mathrm{km})$ | Popula- <br> tion <br> (million) | Density <br> per <br> sm |
| :--- | :---: | :---: | :---: | :---: |

APPENDIX 14.2-(Contd.)
Statement III-Work Force (Human and Animal) in Agriculture
(Paragraph 14.3.5)

| State/Union Territory | Total population 1971 (thousand) | Work force in agriculture (between 15-59 years) (thousand) | Percent of col. (3) to col. (2) | Total livestock 1972 (thousand) | Drought animals in agriculture (thousand) | Percent of col. (6) to col. (5) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Andhra Pradesh | 43,503 | 10,821 | $24 \cdot 9$ | 33,064 | 6,785 | $20 \cdot 5$ |
| Assam* . . | 14,958 | 2,794 | 18.7 | 8,210 | 2,305 | 28.1 |
| Bihar | 56,353 | 12,220 | 21.7 | 27,946 | 7,821 | 28.0 |
| Gujarat . | 26,697 | 4,802 | $18 \cdot 0$ | 15,098 | 3,070 | $20 \cdot 3$ |
| Haryana | 10,037 | 1,457 | 14.5 | 6,200 | 3,900 | 16.0 |
| Himachal Pradesh | 3,460 | 807 | $23 \cdot 3$ | 4,703 | 762 | $16 \cdot 2$ |
| Jammu \& Kashmir | 4,617 | 829 | 18.0 | 4,285 | 726 | 16.9 |
| Karnataka . | 29,299 | 5,931 | $20 \cdot 2$ | 22,424 | 3,885 | 17.3 |
| Kerala ${ }^{\text {a }}$ - | 21,347 | 3,087 | $14 \cdot 5$ | 4,936 | 603 | $12 \cdot 2$ |
| Madhya Pradesh | 41,654 | 10,375 | $24 \cdot 9$ | 39,989 | 9,487 | 23.7 |
| Maharashtra . | 50,412 | 10,369 | $20 \cdot 6$ | 26,361 | 6,345 | $24 \cdot 1$ |
| Manipur | 1,073 | 223 | 208 | 507 | 114 | $22 \cdot 5$ |
| Meghalaya | 1,012 | 310 | $30 \cdot 6$ | 760 | 110 | 14.5 |
| Nagaland | 516 | 167 | 32.4 | 335 | 10 | 3.0 |
| Orissa | 21,945 | 4,566 | $20 \cdot 8$ | 17.569 | 5,121 | 29.1 |
| Punjab | 13,551 | 1,974 | $14 \cdot 6$ | 9,295 | 1,752 | 18.8 |
| Rajasthan . . | 25,766 | 5,183 | $20 \cdot 1$ | 38,878 | 3,996 | $10 \cdot 3$ |
| Tamil Nadu . . | 41,199 | 8,197 | 19.9 | 23,979 | 4,765 | 19.9 |
| Tripura . . | 1,556 | 7279 | 17.9 | 738 | 194 | $26 \cdot 3$ |
| Uttar Pradesh . . | 88,341 | 7,810 | $20 \cdot 2$ | 49,099 | 15,233 | 31.0 |
| West Bengal ${ }^{\text {a }}$ - | 44,312 | 6,560 | 14.8 | 19,646 | 4,886 | 24-9 |
| Andaman and Nicobar Islands | 115 | 15 | 13.0 | 77 | 9 | 11.7 |
| Arunachal Pradesh . . | 468 | 188 | $10 \cdot 2$ | п.a. | n.a. | n.a. |
| Chandigarh ${ }^{\text {d }}$. | 257 | 4 | $1 \cdot 6$ | 19 | 2 | $10 \cdot 5$ |
| Dadra and Nagar Haveli . | \% 74 | 27 | $36 \cdot 5$ | 55 | 19 | $34 \cdot 5$ |
| Delhi - . | 4,066 | 49 | 1.2 | 238 | 21 | 8.8 |
| Goa, Daman and Diu | 858 | 105 | $12 \cdot 2$ | 237 | 68 | $28 \cdot 7$ |
| Lakshdweep . . | 32 172 | 61 | $\begin{array}{r}6.3 \\ \hline 12.9\end{array}$ | ${ }_{15}^{5}$ | п.a | n.a. |
| Pondicherry . . | 172 | 61 | 12.9 | 153 | 27 | 17.6 |

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* Ir.cluding Mizoram district.
n.a. Not available.


APPENDIX 14. 2-Statement IV (Contd.)

| State/Union Territory | Other uncultivated land excluding fallow land |  | Fallow land |  |  | Net area sown $\dagger$ | Area sown more than once $\ddagger$ | Net irrigated area $\ddagger$ | Gross irrigated area@@ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Fallow land other than current fallows $\dagger$ | Current fallows $\dagger$ | Total $\dagger$ |  |  |  |  |
|  | Culturable waste land $\dagger$ | Total $\dagger$ |  |  |  |  |  |  |  |
| 1 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Andhra Pradesh | 1,222 | 2,697 | 910 | 1,819 | 2,729 | 11,510 | 1,635 | 3,189 | 4,153 |
|  | (4.5) | (9.9) | (3.3) | (6.6) | $(9.9)$ 286 | (41.9) | (14.2) | (27.7) | (31.6) |
| Assam (b) | (294) | $(8 \cdot 3)$ | (2-2) | (1-5) | $\begin{gathered} 286 \\ (3 \cdot 7) \end{gathered}$ | $\begin{aligned} & 2,226 \\ & (28 \cdot 5) \end{aligned}$ | $(24 \cdot 6)$ | $(25 \cdot 7)$ | $\begin{gathered} 572 @ \\ (20 \cdot 6) \end{gathered}$ |
| Bihar | 534 | 895 | 907 | 1,527 | 2,434 | 8,395 | 2,668 | 2,279 | 2,741 |
|  | (3-1) | (5-2) | (5.2) | (8.8) | $(14.0)$ | (48.4) | (31.7) | (27.1) | (24.8) |
| Gujarat | 552 | 1,591 | $392$ | $690$ | 1,082 | 9,428 | 617 $(6.5)$ | 1,209 | 1,307 |
|  | $(3.0)$ 48 | $(8 \cdot 6)$ 109 | (2.1) | $(3.7)$ 160 | $(5 \cdot 8)$ 160 | $(50 \cdot 8)$ 3.548 | $(6 \cdot 5)$ 1393 | $(12.8)$ 1.408 | (13.0) |
| Haryana | $\begin{gathered} 48 \\ (1 \cdot 1) \end{gathered}$ | $\begin{gathered} 109 \\ (2 \cdot 5) \end{gathered}$ | - | $\begin{gathered} 160 \\ (3 \cdot 6) \end{gathered}$ | $\begin{gathered} 160 \\ (3 \cdot 6) \end{gathered}$ | $\begin{aligned} & 3,548 \\ & (80 \cdot 6) \end{aligned}$ | $\begin{aligned} & 1,393 \\ & (39 \cdot 2) \end{aligned}$ | $\begin{aligned} & 1,408 \\ & (39 \cdot 7) \end{aligned}$ | $\begin{aligned} & 2,158 \\ & (43 \cdot 7) \end{aligned}$ |
| Himachal Pradesh. | 161 | 1,390 | 2 | 60 | 62 | 544 | 367 | 91 | 156 |
|  | (3.2) | (27.4) | (0.0) | (1-2) | $(1 \cdot 2)$ | (10.7) | (67.4) | (16.7) | (17-1) |
| Jammu and Kashmir | $\begin{gathered} 155 \\ (3 \cdot 4) \end{gathered}$ | $\begin{gathered} 396 \\ (8 \cdot 8) \end{gathered}$ | $\begin{gathered} 15 \\ (0 \cdot 3) \end{gathered}$ | $\begin{array}{r} 86 \\ (1-9) \end{array}$ | $\begin{gathered} 101 \\ (2 \cdot 2) \end{gathered}$ | $\begin{gathered} 704 \\ (15 \cdot 6) \end{gathered}$ | $\begin{gathered} 164 \\ (23 \cdot 2) \end{gathered}$ | $\begin{gathered} 279(\mathrm{i}) \\ (39 \cdot 6) \end{gathered}$ | $\begin{array}{r} 338 \\ (38 \cdot 9) \end{array}$ |
| Kerala | 81 | 249 | 23 | 23 | 46 | 2,166 | 750 | 423 | 589 |
|  | (2-1) | (6.5) | (0.6) | (0.1) | (1.2) | (56-1) | (34.6) | (19.5) | (20-2) |
| Madhya Pradesh | 2,239 | 5.558 | 848 | 685 | 1,533 | 18,283 | 2,015 | 1,431 | 1,471 |
|  | (5-1) | (12.6) | (1.9) | (1-6) | (3.5) | (41-3) | (11.0) | (7.8) | (7-2) |
| Maharashtra | 708 | 2,254 | 1,105 | 1,082 | 2,187 | 18,462 | 973 | 1,431 | 1,623 |
|  | (2-3) | (7.3) | (3.6) | (3.5) | (7-1) | $(60 \cdot 0)$ | (4.7) | (7-8) | (8.4) |
| Manipur (d) | (i) | $\begin{gathered} 24 \\ (1 \cdot 1) \end{gathered}$ | - | (a) | (a) | $\begin{gathered} 179 \\ (8-1) \end{gathered}$ | $\begin{array}{r} 9 \\ (5.0) \end{array}$ | $\begin{array}{r} 65 \\ (36 \cdot 3) \end{array}$ | $\begin{array}{r} 75 \\ (39.9) \end{array}$ |

APPENDIX 14.2-Statement IV (Contd.)


APPENDIX 14.2-Statement IV (Contd.)

| 1 |  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Meghalaya (e) |  | - | - | - | -. | - | 163 | 32 | 37@ | 37@ |
| Karnataka |  |  |  |  |  |  | (7-3) | (19.6) | (22.7) | (19.0) |
| Karnataka |  | $\begin{gathered} 631 \\ (3 \cdot 4) \end{gathered}$ | $\begin{gathered} 2,572 \\ (13 \cdot 6) \end{gathered}$ | 621 $(3 \cdot 3)$ | 905 $(4.8)$ | 1,526 | 10,197 | 597 $\mathbf{5} 9.9)$ | 1,144 | 1,305 |
| Nagaland (f) |  | $(3 \cdot 4)$ |  | (3-3) | (4-8) | (8.1) | $(53.8)$ 100 | (5.9) | (11.2) | (12.1) 12 |
|  |  |  |  |  |  |  | (7-4) | (2.0) | (2.0) | $(11.8)$ |
| Orissa . |  | $\begin{gathered} 807 \\ (5 \cdot 2) \end{gathered}$ | $\begin{aligned} & 1,961 \\ & (12 \cdot 7) \end{aligned}$ | $\begin{gathered} 97 \\ (0 \cdot 6) \end{gathered}$ | $\begin{array}{r} 626 \\ (4.0) \end{array}$ | $\begin{array}{r} 723 \\ (4 \cdot 6) \end{array}$ | $\begin{array}{r} 6,094 \\ (39 \cdot 2) \end{array}$ | $\begin{array}{r} 2,283 \\ (37 \cdot 5) \end{array}$ | $\begin{array}{r} 1,027 \\ (16.9) \end{array}$ | $\begin{array}{r} 1,423 \\ (17 \cdot 0) \end{array}$ |
| Punjab |  | 89 | 99 | (06) | 150 | 150 | 4,027 | 1,472 | -2,836 | 4,080 |
|  |  | (1-8) | (2.0) | 3 ,008 | (3.0) | (3.0) | (80.0) | (36.5) | (70-4) | (74.2) |
| Rajasthan |  | $\begin{aligned} & 6,378 \\ & (18 \cdot 7) \end{aligned}$ | 8,224 | 3,008 | 2,556 | 5,564 | 13,095 | : 1,172 | 2,059 | 2,419 |
| Tamil Nadu |  | (18.7) | $(24 \cdot 1)$ 982 | (8.8) | (7.5) | (16.3) | (38.4) | (8.9) | (15.7) | (17-0) |
|  |  | (4.1) | (7.6) | (4.6) | 1,010 $(7.8)$ | 1,610 $(12.4)$ | 6,069 $(46 \cdot 7)$ | 1,092 $(17.9)$ | 2,507 $(41 \cdot 3)$ | 3,272 $(45 \cdot 7)$ |
| Tripura |  | 3 | 123 | ( 2 | 3 | (12) | 240 | 103 | 21 | 21 |
| Uttar Pradesh |  | ${ }_{1}^{(0 \cdot 3)}$ | (11.7) | $(0 \cdot 2)$ | (0.3) | ${ }_{1}^{(0 \cdot 5)}$ | (22.9) | $(42.9)$ | (8.8) | (6-1) |
| Uttar Pradesh |  | 1,373 | 2,724 | 558 | 792 | 1,350 | 17,357 | 5,611 | 6,814 | 7,929 |
| West Bengal |  | (4.6) | $(9.2)$ 607 | $(19)$ 330 | $(2 \cdot 6)$ $(\mathrm{j})$ | $(4 \cdot 5)$ 330 | $(58 \cdot 1)$ 5,542 | $(32 \cdot 3)$ 1,512 | $(39 \cdot 3)$ 1.489 | (34.5) |
| Union Territories |  |  | (6.9) | (3-7) | (j) | (3.7) | (62.6) | (27.2) | (26.9) | (21-8) |
| Andaman \& |  | 5 | 27 | 1 | 1 | 2 | 18 | (a) | - | - |
| Arunachal |  | (0.6) | (3-4) | (0-1) | (0.1) | (0.2) | (2.3) | (a) | - | - |
| Pradesh (k) |  | - | - |  |  | - | $155(\mathrm{~m})$ $(0.9)$ | n.a. | - | - |
| Dadra \& Nagar |  | - | 8 | 1 | - | 1 | 16 | 1 | (a) | (a) |
| Haveli . |  | - | (16.3) | (2.0) |  | (2.0) | $(32 \cdot 7)$ | (6-2) |  |  |
| Delhi . |  | 4 | 5 | 7 | 8 | 15 | 80 | 31 | 47 | 57 |
|  |  | (2.7) | (3-4) | (4.7) | (5.4) | (10-1) | ( $54 \cdot 1$ ) | (38.7) | (58.8) | $(51.4)$ |
| Goa, Daman \& | Diu | $\begin{gathered} 93 \\ (25 \cdot 1) \end{gathered}$ | $\begin{array}{r} 95 \\ (25 \cdot 7) \end{array}$ | - | 二 | ( | 133 $(35.9)$ | 6 $(4.5)$ | 8 $(6.0)$ |  |
| Lakshadweep |  | (25.1) | (a) | - | (a) | (a) | $(35 \cdot 9)$ 3 | (4.5) | $(6.0)$ (a) | $(5-8)$ (a) |
| Mizoram (l) |  | - | - |  |  | (a) | (100.0) | - | - | - |
|  | - | - | - | - | - | - | 39 | (2.6) | 2@ | (5.0) ${ }^{2 @}$ |
|  |  | - | - | - | - | - | (1-9) | ( $2 \cdot 6$ ) | ( $5 \cdot 1$ ) | (5.0) |

APPENDIX 14.2-Statement IV (Contd.)


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## APPENDIX 14. 2-Statement IV (Contd.)



Source: Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India.
Note: (a) Below 500 hectares.
(b) Data relate to the year 1968-69 except in case of net area sown and areas sown more than once.
(c) Excludes information of area under the unlawful occupation of China and Pakistan.
(d) Ad-hoc estimates.
(e) Data relate to Garo Hills and U.K. \& J. hills distts. of Assam State for the year 1968-69 except other. . - wise stated.
(f) Data relate to Naga hills district of Assam State for the year 1956-57.
(g) Data relate to the year 1967-68.
(h) Included under the head "Barren and unculturable land".
(i) Included under the head "Land under miscellaneous tree crops and groves etc."
(j) Included under the head "Fallow land other than current fallows".
(k) Data relate to the year 1956-57.
(l) Data relate to Mizo hills distt of Assam State for the year 1968-69 except otherwise stated.
(m) Relates to rice crop only.
(n) Includes area of 11 square kilometers in respect of Chandigarh for which other data are not available.
(o) The figures of reporting area in case of Uttar Pradesh and West Bengal are under verification.

- Adjusted.
(a) Relate to the year 1953-54.
n.a. Data not available.
$\dagger$ Figures in parantheses represent percentage to reporting area in col. 3.
@@ " " $\quad$ @ $\quad$ gross cropped area
(Paragraph 14.3.8)


## APPENDIX 14.2 (Contd.)

Statem:nt V-Frequency Distribution of Districts according to Percentages of Net Irrigated Area to Net Sown Area

| State | Net Irrigated area as per cent of area sown |  |  |  |  |  | Total number of districts | Refer* <br> of ence of year |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | less then 10 | 10-20 | 20-30 | 30-40 | 40-50 | greater than 50 |  |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Andhra Pradesh | 2 | 7 | 3 | 2 | 3 | 4 | 21 | 1970-71 |
| Bihar . | 7 | 3 | 4 | - | - | 3 | 17 | 1970-71 |
| Gujarat | 6 | 10 | 2 | - | - | - | 18 | 1969-70 |
| Haryana |  | 1 | 1 | 1 | 3 | 1 | 7 | 1970-71 |
| Himachal Pradesh | 5 | 2 | 2 | - | - | 1 | 10 | 1969-70 |
| Jammu and |  |  |  |  |  |  |  |  |
| Kashmir | 2 | 2 | 1 | - | 1 | 3 | 9 | 1967-68 |
| Karnataka . | 6 | 8 | 2 | 2 | 1 | - | 19 | 1970-71 |
| Madhya Pradesh | 31 | 6 | 4 | 2 | - | - | 43 | 1970-71 |
| Maharashtra . | 19 | 5 | 1 | - | - | - | 25 | 1969-70 |
| Orissa . | 5 | 5 |  | 2 | 1 | - | 13 | 1969-70 |
| Punjab . . |  | - | 2 |  | 1 | 8 | 11 | 1969-70 |
| Rajasthan | 9 | 5 | 6 | 1 | 3 | - | 24 | 1970-71 |
| Tamil Nadu |  | 1 | 1 | 6 | 1 | 3 | 12 | 1970-71 |
| Uttar Pradesh. | 3 | 6 | 10 | 13 | 10 | 12 | 54 | 1969-70 |
| West Bengal | 3 | - | 6 | 2 | 1 | 3 | 15 | 1964-65 |
| Tripura Union Territories | 1 | - | - | - | - | - | 1 | 1970-71 |
| Goa, Daman and Diu | $\lceil 1$ | - | - | - | - | - | 1 | 1970-71 |
| Pondicherry |  | - | - | - | - | 1 | 1 | 1970-71 |
| Delhi . |  | - | - | - | - | 1 | 1 | 1970-71 |
| total | 100 | 61 | 45 | 31 | 25 | 40 | 302 |  |

Note :-In the case of the following States irrigation data for some/all districts are not available or their irrigated areas are less than 500 hha. :-
Jammu and Kashmir . . . Rajouri district formed in 1967-68
Gujarat . . . . . Dangs district irrigated area less than 500 ha.
Maharashtra . . . . . Greater Bombay irrigated area less than 500 ha.
Rajasthan . . . . . Churu, Jaisalmer districts irrigated area less than 500 ha .
Tamil Nadu . . . . . Madras city and Nilgiris distrıcts irrigated areas less than 500 ha.
$\left.\begin{array}{l}\text { Assam } \\ \text { Kerala } \\ \text { Manipur } \\ \text { Meghalaya } \\ \text { Nagaland }\end{array}\right\}$.

- Irrigation data not available for all districts.


## APPENDIX 14.2 (Contd.)

(Paragraph 14.3.9)
Statement VI-Irrigated area according to Sources


Nots :-The data are for 1970-71 except for the following :
(a) Relates to the year 1953-54
(b) Relates to the year 1969-70
(c) Relates to the year 1967-68
(d) Ad-hoc estimates
(e) Relates to the year 1956-57
(f) Source-wise break-up estimated.

APPENDIX
Statement I-Livestock Categories as per cent of total Livestock

| SI. No. | State | Cattle |  |  | Buffaloes |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Years | males over 3 years | females over 3 years | young stock | males over 3 years | females over 3 years | young stock |
| 1 | 2 |  | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Andhra Pradesh |  | 1972 | 16.6 | $12 \cdot 8$ | 8.4 | $4 \cdot 1$ | $10 \cdot 6$ | $6 \cdot 7$ |
|  |  | 1966 | $17 \cdot 1$ | $13 \cdot 2$ | 8.8 | $4 \cdot 6$ | $10 \cdot 2$ | $6 \cdot 7$ |
| 2.3. | Assam | 1972 | $26 \cdot 3$ | 24-1 | $19 \cdot 3$ | 2.9 | 2.9 | 2.0 |
|  |  | 1966 | $28 \cdot 0$ | 21.9 | $22 \cdot 3$ | $2 \cdot 7$ | 2-1 | 1.6 |
|  | Bihar | 1972 | $26 \cdot 1$ | $15 \cdot 0$ | $12 \cdot 3$ | $2 \cdot 6$ | 6.8 | $3 \cdot 8$ |
| 3.4. |  | 1966 | $24 \cdot 2$ | $14 \cdot 3$ | 14.4 | $2 \cdot 6$ | 5.8 | $4 \cdot 4$ |
|  | Gujarat | 1972 | $20 \cdot 3$ | 12.0 | $10 \cdot 5$ | $0 \cdot 3$ | $13 \cdot 6$ | 9.1 |
| 4.5. |  | 1966 | $21 \cdot 6$ | $12 \cdot 4$ | 11.6 | 0.2 | $12 \cdot 7$ | 9.0 |
|  | Haryana | 1972 | $15 \cdot 1$ | $11 \cdot 5$ | $12 \cdot 4$ | 1.0 | 20.4 | $18 \cdot 7$ |
| 5. 6 |  | 1966 | $16 \cdot 6$ | $11 \cdot 1$ | $12 \cdot 6$ | 0.6 | $18 \cdot 3$ | $16 \cdot 1$ |
|  | 6. Himachal Pradesh |  | 1972 | 19.2 | $14 \cdot 3$ | $12 \cdot 8$ | $0 \cdot 3$ | $7 \cdot 7$ | 3.6 |
|  |  |  | 1966 | $16 \cdot 2$ | $14 \cdot 6$ | 14.2 | 0.4 | $6 \cdot 5$ | 3.1 |
| 7. Jammu and Kashmir |  | 1972 | $16 \cdot 1$ | $17 \cdot 9$ | $14 \cdot 1$ | $1 \cdot 2$ | $6 \cdot 7$ | $3 \cdot 7$ |
|  |  | 1966 | $13 \cdot 7$ | $16 \cdot 0$ | $14 \cdot 2$ | 1.0 | $6 \cdot 1$ | $3 \cdot 4$ |
| 8.9. | Karnataka | 1972 | $17 \cdot 3$ | 16.9 | 11.0 | 1.4 | $8 \cdot 3$ | $5 \cdot 1$ |
|  |  | 1966 | 17.9 | $17 \cdot 4$ | 11.9 | 1.4 | $8 \cdot 3$ | 4.6 |
|  | Kerala | 1972 | 7.9 | $26 \cdot 3$ | $23 \cdot 6$ | $4 \cdot 6$ | $3 \cdot 2$ | 1.8 |
| 9.10. |  | 1966 | 11.2 | $26 \cdot 3$ | $24 \cdot 1$ | $5 \cdot 5$ | 2.9 | 1.8 |
|  | Mdahya Pradesh | 1972 | 24.0 | $20 \cdot 3$ | 21.8 | 2.9 | $6 \cdot 4$ | $5 \cdot 3$ |
| 10. M |  | 1966 | 23.9 | $19 \cdot 1$ | 21.0 | $3 \cdot 2$ | $6 \cdot 1$ | $5 \cdot 3$ |
| 11. | Maharashtra | 1972 | $23 \cdot 5$ | $17 \cdot 4$ | $14 \cdot 8$ | 1-2 | $7 \cdot 1$ | $4 \cdot 3$ |
|  |  | 1966 | $25 \cdot 7$ | $17 \cdot 8$ | $14 \cdot 3$ | 1.3 | $6 \cdot 8$ | $3 \cdot 8$ |
| 12. | Manipur . | 1972 | $24 \cdot 7$ | $18 \cdot 7$ | $14 \cdot 6$ | $3 \cdot 2$ | 4-1 | 3.0 |
|  |  | 1966 | 25.9 | 19.0 | $19 \cdot 1$ | $4 \cdot 3$ | $3 \cdot 6$ | 2.9 |
|  | Meghalaya | 1972 | 19.9 | $22 \cdot 8$ | 19.0 | $1 \cdot 3$ | $2 \cdot 6$ | $2 \cdot 1$ |
| 13. M14. |  | 1966 | 19.7 | $22 \cdot 6$ | $17 \cdot 8$ | 2.0 | 1.9 | 1.6 |
|  | Nagaland | 1972 | 6.9 | 11.6 | 9.3 | 1.2 | 1.2 | 0.6 |
| 14. N15. |  | 1966 | 9.3 | $13 \cdot 0$ | 13.0 | 0.9 | 0.5 | $0 \cdot 5$ |
|  | Orissa | 1972 | $25 \cdot 5$ | 23.0 | 15.9 | 3.6 | 2.5 | 1.9 |
| 15.16. |  | 1966 | $26 \cdot 8$ | $20 \cdot 8$ | $17 \cdot 1$ | 3.6 | $2 \cdot 4$ | 1.7 |
|  | Punjab . | 1972 | $16 \cdot 2$ | $10 \cdot 5$ | $12 \cdot 1$ | 2.9 | $22 \cdot 5$ | $18 \cdot 3$ |
| 16.17. |  | 1966 | $17 \cdot 2$ | $11 \cdot 1$ | 13.9 | 3.4 | $20 \cdot 2$ | $16 \cdot 3$ |
|  | Rajasthan | 1972 | $10 \cdot 1$ | 11.9 | $10 \cdot 1$ | 0.4 | 6.4 | $5 \cdot 0$ |
| 17. P |  | 1966 | 10.9 | $12 \cdot 8$ | 11.3 | 0.4 | $5 \cdot 7$ | $5 \cdot 1$ |
|  | Tamil Nadu | 1972 | 19.8 | $15 \cdot 6$ | 9.5 | 1.7 | 6.3 | 4.0 |
| 18.19. |  | 1966 | $20 \cdot 1$ | $15 \cdot 1$ | 9.0 | 2.0 | $5 \cdot 5$ | 3.6 |
|  | Tripura . . | 1972 | 27.2 | $23 \cdot 2$ | $20 \cdot 7$ | $1 \cdot 1$ | 1.1 | 0.5 |
| 19. T20. U |  | 1966 | 26.0 | $22 \cdot 3$ | $24 \cdot 2$ | 2-2 | 2.5 | 1.5 |
|  | Uttar Pradesh | 1972 | 27.9 | $13 \cdot 7$ | 11.6 | 3.3 | $13 \cdot 5$ | 8.8 |
| 20. |  | 1966 | $26 \cdot 5$ | 13.5 | $12 \cdot 3$ | 12.9 | 12.0 | 8.0 |
| 21. | West Bengal | $\begin{aligned} & 1972 \\ & 1066 \end{aligned}$ | 24.5 | $19 \cdot 7$ | 17.9 | $2 \cdot 7$ | 1.1 | 0.5 |
|  |  | 1966 | $25 \cdot 5$ | 21.7 | $18 \cdot 1$ | $2 \cdot 8$ | 1.5 | $1 \cdot 1$ |

14.3
(Paragraph 14.3.11)
Population-Statewise (1972, 1966)

| Sheep | Goats | Horses \& ponies | Pigs | Camels | Other Livestock | Total livestock (thousands) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| $25 \cdot 2$ | $13 \cdot 2$ | $0 \cdot 1$ | $2 \cdot 1$ | - | $0 \cdot 2$ | 33,064 |
| 25-3 | 11.9 | 0.2 | 1.9 | - | $0 \cdot 2$ | 31,595 |
| $0 \cdot 3$ | $17 \cdot 8$ | 0.2 | 4.0 | - | $0 \cdot 2$ | 8,210 |
| 0.6 | $17 \cdot 3$ | 0.4 | $3 \cdot 1$ | - | - | 8,457 |
| $3 \cdot 5$ | $26 \cdot 4$ | 0.4 | $3 \cdot 1$ | - | $0 \cdot 1$ | 27,946 |
| $4 \cdot 4$ | $27 \cdot 2$ | 0.4 | $2 \cdot 3$ | - | $0 \cdot 1$ | 28,655 |
| $11 \cdot 4$ | $21 \cdot 3$ | 0.4 | $0 \cdot 1$ | $0 \cdot 4$ | $0 \cdot 7$ | 15,098 |
| 11.5 | $19 \cdot 3$ | 0.5 | $0 \cdot 0$ | $0 \cdot 3$ | $0 \cdot 8$ | 14,388 |
| $7 \cdot 3$ | $7 \cdot 6$ | 0.4 | $2 \cdot 3$ | $2 \cdot 1$ | 1.3 | 6,200 |
| $9 \cdot 4$ | 9.4 | 0.4 | 1.8 | $2 \cdot 4$ | 1.4 | 5,528 |
| $22 \cdot 1$ | $19 \cdot 3$ | 0.3 | $0 \cdot 1$ | - | 0.4 | 4,703 |
| $25 \cdot 0$ | $19 \cdot 4$ | $0 \cdot 3$ | $0 \cdot 1$ | 0.0 | $0 \cdot 3$ | 4,201 |
| $25 \cdot 0$ | $13 \cdot 3$ | 1.4 | $0 \cdot 0$ | $0 \cdot 1$ | $0 \cdot 7$ | 4,285 |
| $28 \cdot 2$ | 14.9 | 1.6 | - | 0-1 | 0.8 | 4,079 |
| 21.5 | 16.9 | 0.2 | 1.3 | - | $0 \cdot 3$ | 22,424 |
| 23-2 | $13 \cdot 6$ | $0 \cdot 3$ | 1.0 | - | $0 \cdot 2$ | 20,486 |
| $0 \cdot 2$ | 29.7 | - | $2 \cdot 6$ | - | - | 4,936 |
| $0 \cdot 3$ | $25 \cdot 6$ | 2.4 | - | - | - | 4,641 |
| $2 \cdot 5$ | $15 \cdot 4$ | 0.4 | 0.9 | - | $0 \cdot 1$ | 39,989 |
| $2 \cdot 6$ | $17 \cdot 2$ | 0.4 | 1.0 | $0 \cdot 1$ | $0 \cdot 2$ | 38,478 |
| $8 \cdot 1$ | $22 \cdot 4$ | 0.2 | 0.8 | - | $0 \cdot 2$ | 26,361 |
| $8 \cdot 7$ | $20 \cdot 1$ | 0.4 | 0.7 | $0 \cdot 0$ | $0 \cdot 3$ | 25,449 |
| $0 \cdot 4$ | $3 \cdot 2$ | $0 \cdot 2$ | $26 \cdot 4$ | - | 1.6 | 507 |
| 2.0 | 2.7 | $0 \cdot 2$ | $16 \cdot 7$ | - | $2 \cdot 7$ | 444 |
| $2 \cdot 4$ | $12 \cdot 6$ | 0.7 | 16.7 | - | - | 760 |
| 3.0 | $14 \cdot 5$ | $1 \cdot 3$ | $15 \cdot 6$ | - | - | 691 |
| - | $5 \cdot 4$ | 0.3 | 54.9 | - | $8 \cdot 7$ | 335 |
| - | $6 \cdot 0$ | 0.5 | $51 \cdot 6$ | - | $4 \cdot 7$ | 215 |
| $7 \cdot 8$ | 16.4 | $0 \cdot 2$ | $2 \cdot 2$ | - | - | 17,569 |
| $7 \cdot 2$ | $18 \cdot 8$ | 0.4 | $1 \cdot 1$ | - | $0 \cdot 1$ | 16,422 |
| $4 \cdot 7$ | $9 \cdot 6$ | 0.6 | 0.4 | $1 \cdot 3$ | $0 \cdot 9$ | 9,295 |
| 5.9 | $8 \cdot 3$ | 0.5 | 0.6 | 1.6 | 0.9 | 7,481 |
| $22 \cdot 0$ | $31 \cdot 3$ | $0 \cdot 1$ | $0 \cdot 3$ | 1.9 | 0.5 | 38,878 |
| $23 \cdot 5$ | $27 \cdot 5$ | $0 \cdot 2$ | $0 \cdot 2$ | $1 \cdot 7$ | $0 \cdot 5$ | 37,475 |
| $23 \cdot 4$ | $16 \cdot 8$ | $0 \cdot 1$ | $2 \cdot 4$ | - | 0.4 | 23,979 |
| 26.9 | 15.3 | $0 \cdot 1$ | 1.9 |  | 0.4 | 24,569 |
| $0 \cdot 3$ | 19.9 | - | $6 \cdot 0$ | - | - | 738 |
| $0 \cdot 2$ | $16 \cdot 3$ | 0.2 | $4 \cdot 6$ | - | - | 811 |
| $4 \cdot 0$ | $13 \cdot 4$ | 0.5 | $2 \cdot 7$ | $0 \cdot 1$ | 0.5 | 49,099 |
| 5.2 | $16 \cdot 3$ | 0.5 | $2 \cdot 3$ | $0 \cdot 1$ | $0 \cdot 5$ | 49,972 |
| $4 \cdot 1$ | 27.4 | $0 \cdot 1$ | 1.9 | - | $0 \cdot 1$ | 19,646 |
| $3 \cdot 3$ | $25 \cdot 1$ | $0 \cdot 1$ | 0.7 | - | - | 19,266 |

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## APPENDIX 14.3-



Statement I (Contd.)
(Percentages)

| Sheep | Goats | Horses \& ponies | Pigs | Camels | Other <br> Live- <br> stock | Total livestock (thousands) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 9 | 10 | ' 11 | 12 | 13 | 14 | 15 |
| - | 14.3 | - | $50 \cdot 7$ | - | - | 77 |
| - | $20 \cdot 0$ | - | $44 \cdot 0$ | - | - | 50 |
| $5 \cdot 3$ | 10.5 | " | - | - | - | 19 |
| $6 \cdot 3$ | 12.5 | - | $6 \cdot 3$ | - | - | 32 |
| $1 \cdot 7$ | 5.0 | $3 \cdot 4$ | $4 \cdot 6$ | 0.4 | $2 \cdot 5$ | 238 |
| $2 \cdot 3$ | $6 \cdot 5$ | $2 \cdot 3$ | $2 \cdot 8$ | 0.9 | $2 \cdot 3$ | 217 |
| $0 \cdot 8$ | 8.9 | - | 21.9 | - | - | 237 |
| $0 \cdot 4$ | $8 \cdot 7$ | - | $24 \cdot 8$ | - | - | 242 |
| - | 21.8 | - | - | - | - | 55 |
| - | $23 \cdot 6$ | - | - | - | - | 55 |
| - | $80 \cdot 0$ | - | - | - | - | 5 |
| - | 85.7 | - | - | - | - | 7 |



APPENDIX 14.3-Statement II (Contd.)


APPENDIX 14.3-Statement II (Contd.)


APPENDIX 14.3-Statement II (Contd.)



APPENDIX 14.3-Statement II (Contd.)

| Cm | Cf | G | P |
| :---: | :---: | :---: | :---: |
| Assam : |  |  |  |
| 1. Cm3 Cf4 Cy4/G4 |  | G4 Cm4 Cy4 | P4 G4 Cf4 Cy4/Bf4/By4 |
| 2. Cm4 Cf4 Cy4/G4 |  | G4 Cm4 Cf4 Cy 4 |  |
| 3. Cm4 P4 G4 Cf4/Cy4 |  |  |  |
| Meghalaya : |  |  |  |
| 1. Cm4 Cf4 Cy4 P4/G4 | Cf4 Cm4 Cy4 P4/G4 |  |  |
| Tripura : |  |  |  |
| 1. Cm 4 Cf 4 Cy 4 / G4 |  |  |  |
| Manipur : |  |  |  |
| 1. Cm4 Cf4 Cy4 P4 |  |  |  |
| Nagaland : |  |  |  |
|  |  |  | P2 Cm4 Cf4 |
| Mizoram : |  |  |  |
| 1. |  |  | $\begin{array}{ll}\text { P2 } 2 \mathrm{Cf4} \\ \text { P3 } & \text { Cy4 } 4 \text { Cf4/Cy4 }\end{array}$ |
|  |  |  | P3 |
| Arunachal Pradesh : |  |  |  |
| 1. |  |  | P1 |
| 2. |  |  | P2 Cm4/Cf4 |
| 3. |  |  | P3 G4 Cm4/Cf4 |

[^23]APPENDIX $14 \cdot 3$ (Concld.)
(Paragraph $14 \cdot 3 \cdot 13$ )
Statement III-Livestock Patterns-All India

1. $\mathrm{Cm} 3 \mathrm{Cf} 4 \mathrm{Cy} 4 / \mathrm{G} 4 / \mathrm{S} 4 / \mathrm{Cy} 4 \mathrm{G} 4$2. $\mathrm{Cm} 3 \mathrm{G} 4 \mathrm{Cf} 4 / \mathrm{Cy} 4 / \mathrm{Bf} 4$3. $\mathrm{Cm} 3 \mathrm{Bf} 4 \mathrm{By} 4 \mathrm{Cf} 4 / \mathrm{Cy} 4$4. $\mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{Cy} 4 / \mathrm{G} 4 / \mathrm{P} 4 / \mathrm{G} 4(\mathrm{Cy} 4 / \mathrm{Bf} 4 / \mathrm{P} 4) / \mathrm{Cy} 4 \quad(\mathrm{Bf} 4 / \mathrm{P} 4 / \mathrm{G} 4 / \mathrm{G} 4 \mathrm{Bf} 4) /(\mathrm{Bf} 4 /(\mathrm{Cf} 4 /$By4)
2. Cm 4 Bf 4 (By4 G4)/Cf4 (Cy4/G4)/By4/By4 (G4/Cy4)/By4 G4 (Cf4/Cy4/Cy4/S4)
3. $\mathrm{Cm} 4 \mathrm{G} 4 \mathrm{Cf} 4 \mathrm{Cy} 4 / \mathrm{S} 4 / \mathrm{Bm} 4$
4. $\mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{~S} 4 \mathrm{Cy} 4 / \mathrm{Bf} 4 \mathrm{Cy} 4$
5. Cf3 S4 G4/Cy4/Bm4
6. $\mathrm{Cf} 3 \mathrm{Cy} 3 / \mathrm{Cy} 4$ (Cm4/Bm4/S4/G4)
7. Cf4 Cm4 G4/Cy4/Cy4 (S4/G4/Bf4/P4)/G4 Bf4
8. $\mathrm{Cf} 4 \mathrm{Cy} 4 \mathrm{Cm} 4 / \mathrm{Cm} 4 \mathrm{Bf} 4 / \mathrm{Cm} 4 \mathrm{Bm} 4 / \mathrm{G} 4$
9. Cf4 Bf4 G4/Cy4
10. Cy3 Cm4 G4/Cf4 S4
11. $\mathrm{Cy} 4 \mathrm{Cm} 4 \mathrm{Cf} 4 / \mathrm{Cf} 4$ (Bf4/S4/G4)
12. Bf4 By4 Cm4/Cm4 G4
13. Bf4 S4 Cm4 Cf4/G4/G4 Cy4
14. Bf4 Cm4 G4/G4 (Bm4/By4/By4 Cy4)/By4
15. Bf4 Cm4 Cf4 By4/By4 (S4/Cy4/G4)/S4 Cy4
16. Bf4 Cm4 By4 Bm4/S4
17. G3 Cm4 S4/Cf4/Cy4/Bf4/Cf4 (Cy4/S4)
18. G3 S3/S4/S4 (Cf4/Cy4/D4/Cy4 Cm4/Cf4 (Cy4/By4)
19. G4 S4 Cm4/Cf4/Cf4 Cm4/Cf4 Cy4/Cm4 Cy4/Cm4 Cy4/Bf4/Cm4Bf4 By4/Cy4 By4 Cf4/ Cy4 By4 Bf423. G4 Cm4 Cy 4 Cf4/Bf4/Bf4 Cf4/Bf4 By4
20. G4 Cm4 Cf4/Bf4/Bf4 By4
21. S1
22. $\mathrm{S} 2 \mathrm{Cm} 4 / \mathrm{Cf} 4 / \mathrm{G} 4$
23. S3 G3/G4/G4 (Cf4/Cm4/Bf4/Cy4/Cm4 Cf4/Cm4 Cy4/Cf4 Cy4/Cf4 Cm4Bf4)
24. $\quad \mathrm{S} 3 \mathrm{Cm} 4 \mathrm{Cf} 4 / \mathrm{Bf} 4 / \mathrm{Bf} 4 \mathrm{Cf} 4 / \mathrm{Cf} 4 \mathrm{Cy} 4$
25. S4 G4 Cm4 Cf4/Bf4/Cy4/Cy4 Bf4/Cy4 Cf4/Bf4 By4/Bf4 Cf4/Bf4 Cf4 By4/Bf4 Cf4 Bm4.
26. S4 G4 Cy4/Cf4/Bf4 By4/Cf4 Bm4/Cf4 Cy4
27. $\mathrm{S} 4 \mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{Bf} 4 / \mathrm{Cy} 4$
28. P1
29. P2 Cm4/Cf4/Cf4 Cy4/Cm4 Cf4
30. P3 G4 Cf4/Cy4/Cm4
31. P4 G4 Cf4/Cy4/Bf4/By4
Note :-For symbols please refer to paragraph $14 \cdot 2 \cdot 10$

# APPENDIX 14.4 

(Paragraph 14.4.1)
Statement I-Rainfall Patterns-Statewise

## Notes :-

(i) Serial numbers in column 1 represent numbers of Rainfall Zones of the concerned State. These are shown in Roman figures (I, II etc.)
(ii) Rainfall patterns in column 2 is shown in three parts with the central in brackets. These cover four month periods (a) February to May, (b) June to September and (c) October to January. The coded form in each of the four month periods shows rainfall in decreasing order and not in calendar monthly sequence. In its decoded form according to calendar months, a blank entry indicates that rainfall in the concerned month is less than 5 cm . except when any of the periods (a) to (c) has rainfall beginning with A or $\mathbf{B}$ type and in such cases the blank indicates rainfall of less than $10 \mathrm{~cm} . \mathrm{e} . \mathrm{g}$. In A1 B2 E1, E is less than 10 cm . and in in C2 D1 E1, E Signifies less than 5 cm .
(iii) Number of months with rainfall greater than (a) 10 cm . (b) 20 cm . and (c) 30 cm . together with month of commencement. e. g. Ji2 in column 17 ndicates that for two consecutive months from July rainfall is greater than 20 cm . per month. Information in columns 16 to 18 enables one toknow the frequency or number of consecutive months with rainfall greater than 10,20 and 30 cm . respectively -
symbol for months are :

| symbol | month | symbol | month | symbol | month |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Ja | January | My . | May | S | September |
| F. | February | Jn | June | 0 | October |
| Ma | March | JI | July | N | November |
| Ap | April | Au | August | D | December |

(iv) symbols in patterns indicate rainfall amounts as follows :Symbol
cm.

A . . . . greater than 30
B . . . . 20-30
C . . . . $10-20$
D . . . . 5-10
E . . . . less than 5 or less than 10 as explained in (ii) above.
Subscript to symbol indicates number of months of rainfall indicated by symbol.
(v) Geographical area figures in col. 19 are based on reported areas of taluks except in Bihar, West Bengal and Assam where the areas refer to subdivisions. districts and police stations respectively.
(vi) Gross cropped area in col. 21 refers in general to 1969-70.

APPENDIX 14•4-Statement I (Contd.)


| XXVIII | D2E2(B3C1)C1D1E2 | 081 |
| :--- | :--- | :--- |
| Special | IE4(A1BIC2)CID1 | 069 |
| Special | E2 | IE4(A2B2)DIE3 |
| Special | IEADIE3(C2D2)C1D1 | 030 |
|  |  | E2 |


| D | C | B | B | B | C | D | Jn5 | J13 |  | 6,849 | $2 \cdot 5$ | 177 | 1.4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | C | A |  |  | C |  | Jn5 | J12 | J 11 | 3,105 | 1.1 |  | 0.3 |
|  | B | A | A | B | D | D | Jn4 | Jn4 | J12 | 1,616 | 0.6 | $21$ | - 2 |
| D | D | D | C | C | C | D | Au3 |  |  | 756 | 0.3 | 32 | 0.2 |
|  |  |  |  |  |  |  |  |  |  | 2,74,418 |  | 13,064 |  |

## ASSAM

| I | $\underset{\text { CIE3 }}{\text { CiD1E2(A1B2C1) }}$ |  |
| :---: | :---: | :---: |
| II | CIDIE2(AIC3)CIE3 | 073 |
| III | C1D1E2(A2B2)C1E3 | 035 |
| IV | C1D2E1(B1C3)C1E3 | 096 |
| V | $\begin{aligned} & \text { B1C1E2(A1B2C1) } \\ & \text { D1E3 } \end{aligned}$ |  |
| VI | $\begin{aligned} & \text { B1C1E2(A2B1C1) } \\ & \text { D1E3 } \end{aligned}$ |  |
| VII | BIC1E2(A3B1)C1E3 | 021 |
| VIII | BICIE2(A4)CIE3 | 007 |
| IX | B2E2(A3B1)C1E3 | 023 |
| X | B2C1EI(A4)C1E3 | 008 |
| XI | AIC1E2(A2B1C1) |  |
| X | AlCle2(A3B1)C1E3 | 024 |
| XIII | AlClE2(A4)ClE3 | 009 |
| XIV | A1B1E2(A4)C1E3 | 011 |
| XV | $\begin{gathered} \mathrm{A} 1 \mathrm{BIClE1}(\mathrm{~A} 1 \mathrm{~B} 3) \\ \text { C1DIE2 } \end{gathered}$ | 05 |
| VI | AlBlClel(A4)Cle3 | 012 |
| XVII | A2C1EI(A4)C1E3 | 013 |
| XVIII | A2C1E1(A4)B1E3 | 01 |

APPENDIX 14.4-Statement I (Contd.)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  | BIH | AR |  |  |  |  |  |  |  |  |  |
| 1 | E4(B2C2)E4 | 082 |  |  |  |  |  | C | B | B | C |  |  |  | Jn4 | J12 |  | 3,504 | $2 \cdot 0$ | 410 | $3 \cdot 7$ |
| 11 | E4(B2C2)D1E3 | 083 |  |  |  |  |  | C |  | B | C | D |  |  | Jn4 | J12 |  | 2,665 | 1.6 | 247 | $2 \cdot 2$ |
| III | E4(A1B1C2)E4 | 064 |  |  |  |  |  | C | A1 | B | C |  |  |  | Jn4 | J12 | J11 | 2,629 | $1 \cdot 5$ | 201 | 1.8 |
| IV | E4(A1B1C2)D1E3 | 065 |  |  |  |  |  | C | A | B | C | D |  |  | Jn4 | $J 12$ | J11 | 2,012 | $1 \cdot 2$ | 231 | $2 \cdot 1$ |
| V | $\mathrm{E} 4(\mathrm{AlB2Cl}) \mathrm{E} 4$ | 056 |  |  |  |  |  | C | A | B | B |  |  |  | Jn4 | J13 | J11 | 1,420 | $0 \cdot 8$ | 144 | $1 \cdot 3$ |
| VI | E4(A1B2C1)D1E3 | 057 |  |  |  |  |  | C | A | B | B | D |  |  | Jn4 | J13 | J11 | 15,151 | $8 \cdot 8$ | 1,321 | $12 \cdot 0$ |
| VII | E4(A2B1C1)E4 | 036 |  |  |  |  |  | C | A | A | B |  |  |  | Jn4 | J13 | J12 | 4,950 | 2.9 | , 344 | $3 \cdot 1$ |
| VIII | E4(A2B1C1)D1E3 | 037 |  |  |  |  |  | C | A | A | B | D |  |  | Jn4 | J13 | J 12 | 46,147 | $26 \cdot 8$ | 2,237 | $20 \cdot 2$ |
| 1 IX | E4(A2B2)D1E3 | 030 |  |  |  |  |  | B | A | A | B | D |  |  | Jn4 | Jn4 | J12 | 8,854 | $5 \cdot 1$ | 380 | $3 \cdot 4$ |
| $1 \times$ | D1E3(B2C2)D1E3 | 084 |  |  |  |  | D | C | B | B | C | D |  |  | Jn4 | J12 |  | 7,672 | $4 \cdot 5$ | 522 | $4 \cdot 7$ |
| XI | D1E3(A1B1C2)D1E3 | 066 |  |  |  |  | D | C | A | B | C | D |  |  | Jn4 | J 12 | J11 | 2,431 | $1 \cdot 4$ | 93 | 0.8 |
| XII | D1E3(A1B2C1)D1E3 | 058 |  |  |  |  | D | C | A | B | B | D |  |  | Jn4 | J13 | J11 | 3,475 | $2 \cdot 0$ | 304 | $2 \cdot 8$ |
| XIII | D1E3(A2B1C1)D1E3 | 039 |  |  |  |  | D | C | A | A | B | D |  |  | Jn4 | J13 | J 12 | 14,903 | $8 \cdot 7$ | 1,049 | 9.5 |
| XIV | D1E3(A2B2)D1E3 | 031 |  |  |  |  | D | B | A | A | B | D |  |  | Jn4 | J14 | J12 | 50,133 | $29 \cdot 1$ | 3,059 | 27.8 |
| XV | ClE3(A2B2)C1E3 | 034 |  |  |  |  | C | B | A | A | B | C |  |  | My6 | Jn4 | J12 | 1,782 | 1.0 | 104 | 0.9 |
| XVI | ClE3(A3B1)DIE3 | 019 |  |  |  |  | C | B | A | A | A | D |  |  | My5 | Jn4 | J13 | 2,666 | 1.5 | 257 | $2 \cdot 3$ |
| XVII | CIE3(A4)D1E3 | 003 |  |  |  |  | C | A | A | A | A | D |  |  | Mys | Jn4 | J14 | 1,934 | $1 \cdot 1$ | 156 | 1.4 |
|  |  |  |  |  |  |  |  |  |  |  | UJAR | RAT |  |  |  |  |  | 1,72,328 |  | 11,059 |  |
| I | E4(C1D1E2)E4 | 149 |  |  |  |  |  |  | C D | D |  |  |  |  | J/1 |  |  | 21,606 | $13 \cdot 5$ | 617 | $6 \cdot 3$ |
| II | E4(C1D3)E4 | 135 |  |  |  |  |  | D | C D | D D | D |  |  |  | J11 |  |  | 5,796 | $3 \cdot 6$ | 446 | $4 \cdot 5$ |
| III | E4(C2D1E1)E4 | 130 |  |  |  |  |  |  | C | C D | D |  |  |  | J 12 |  |  | 11,704 | $7 \cdot 3$ | 851 | 8.6 |
| IV | E4(C2D2)E4 | 117 |  |  |  |  |  | D | C | C | D |  |  |  | J 12 |  |  | 8,669 | $5 \cdot 4$ | 568 | 5.8 |
| V | E4(B1C1E2)E4 | 104 |  |  |  |  |  |  | B |  |  |  |  |  | J 12 | J11 |  | 36,913 | $23 \cdot 0$ | 2,504 | $25 \cdot 5$ |
| VII | E4(B1C2E1)E4 | 099 091 |  |  |  |  |  |  | $\underset{B}{ } \mathbf{B}$ |  |  |  |  |  | J 12 | J11 |  | 16,729 | $10 \cdot 4$ | 1,136 | 11.6 |
| VIII | $\mathrm{E} 4(\mathrm{~B} 2 \mathrm{E} 2) \mathrm{E} 4$ $\mathrm{E} 4(\mathrm{~B} 2 \mathrm{C} 2) \mathrm{E} 4$ | 091 082 |  |  |  |  |  | C | $\begin{array}{lll}\text { B } & \mathbf{B} \\ \mathbf{B} & \mathbf{B}\end{array}$ |  |  |  |  |  | J12 | J12 |  | 4,231 | $2 \cdot 6$ | 316 | $3 \cdot 2$ |
| IX | E4(A1C3)E4 | 071 |  |  |  |  |  | $\stackrel{C}{C}$ | B $\mathbf{A}$ $\mathbf{B}$ C | C | C |  |  |  | Jn4 | J12 | Jl1 | 5,054 | $3 \cdot 1$ | 306 | $3 \cdot 1$ |
| X | E4(A1B1CIE1)E4 | 061 |  |  |  |  |  | C | A B | C | C |  |  |  | J13 | J12 | J11 | 9,558 | 6.0 | 616 714 | $6 \cdot 3$ $7 \cdot 3$ |
| XII | E4(A1B1C2)E4 | 064 |  |  |  |  |  | C | A B | C | C |  |  |  | $J_{n} 4$ | J 12 | 311 | 15,950 | 9.9 | 1,051 | $10 \cdot 7$ |
| XII | E4(A2B1Cl)E4 | 036 |  |  |  |  |  | C | A $\mathbf{A}$ | B | B |  |  |  | Jn4 | J13 | 312 | 7,661 | 4.8 | +450 | $4 \cdot 6$ |
| XIII | E4(A2B2)E4 | 029 |  |  |  |  |  | B | A $\mathbf{A}$ | B | B |  |  |  | Jn4 | Jn4 | J12 | 2,195 | 1.4 | 110 | $1 \cdot 1$ |
| XIV | E4(A3B1)E4 | 015 |  |  |  |  |  | B | A $\mathbf{A}$ | A | A |  |  |  | Jn4 | Jn4 | J13 | 4,632 | 2.9 | 145 | 1.5 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 160,542 |  | 9,830 |  |

## HARYANA AND PUNJAB

Haxyana

| 1 | E4(D3E1)E4 | 155 |  | D | D | D |  |  | - | 6,656 | $15 \cdot 1$ | 722 | $14 \cdot 7$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| II | E4(C2D1E1)E4 | 130 |  | C | C | D | J12 |  |  | 19,470 | $44 \cdot 3$ | 2,320 | $47 \cdot 3$ |
| III | E4(C3D1)E4 | 111 | C | C | C | D | J13 |  |  | 14,131 | $32 \cdot 1$ | 1,540 | 31.4 |
| IV | E4(B2C1E1)E4 | 086 | B | B | C |  | J13 | J11 |  | 3,736 | $8 \cdot 5$ | 326 | $6 \cdot 6$ |
|  |  |  |  |  |  |  |  |  |  | 43,993 |  | 4,908 |  |


| Punjab |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| I | E4(D2E2)E4 | 159 |  |  |  |  |  | D | D |  |  | - | - | - | 2,738 | $5 \cdot 4$ | 235 | $4 \cdot 3$ |
| II | E4(D3E1)E4 | 155 |  |  |  |  |  | D | D | D |  |  | _ | - | 5,231 | $10 \cdot 4$ | 582 | $10 \cdot 6$ |
| III | E4(C2D1E1)E4 | 130 |  |  |  |  |  | C | C | D |  | J12 |  |  | 25,656 | 51.0 | 2,989 | $54 \cdot 4$ |
| IV | E4(C3D1)E4 | 111 |  |  |  |  | D | C | C | C |  | J13 |  |  | 7,629 | $15 \cdot 2$ | 896 | $16 \cdot 3$ |
| V | E4(B1C2E1)E4 | 099 |  |  |  |  |  | B | C | C |  | J13 | J11 |  | 775 | $1 \cdot 5$ | 84 | 1.5 |
| VI | E4(B2C1E1)E4 | 086 |  |  |  |  |  | B | B | C |  | J13 | J12 |  | 7,340 | $14 \cdot 6$ | 645 | 11.7 |
| VII | E4(A2C1E1)E4 | 050 |  |  |  |  |  | A | A | C |  | J13 | J12 | J12 | 936 | 1.9 | 68 | $1 \cdot 2$ |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 50,305 |  | 5,499 |  |
| HIMACHAL PRADESH |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| I | E4(A2B1C1)CID1E2 | 038 | D |  |  |  | C | A | A | B | C | Jn5 | J13 | J12 | 2,249 | $6 \cdot 4$ | 71 | $7 \cdot 8$ |
| II | D1E3(A1B1C1E1)D1E3 | 062 | D | D |  |  |  | A | B | C |  | J13 | J12 | J11 | 1,132 | $3 \cdot 2$ | 55 | 6.0 |
| III | D1E3(A1B1C1E1)D2E2 | 063 | D |  | D |  |  | A | B | C | D | J13 | J12 | J11 | 2,752 | 7.9 | 110 | $12 \cdot 1$ |
| IV | D2E2(C2D2)D2E2 | 128 | D | D | D |  | D | C | C | D | D | J12 |  | - | 387 | $1 \cdot 1$ | 41 | $4 \cdot 5$ |
| V | D2E2(B1C2E1)D2E2 | 101 | D | D | D |  |  | B | C | C | D | J13 | J11 | - | 908 | $2 \cdot 6$ | 32 | $3 \cdot 5$ |
| VI | D2E2(B2CIE1)D2E2 | 089 | D | D | D 1 |  |  | B | B | C | D | J13 | J 12 | - | 588 | 1.7 | 19 | $2 \cdot 1$ |
| VII | D2E2(A2C1EI)D1E3 | 051 | D | D | Dl |  |  | A | A | C |  | J13 | J 12 | J12 | 4,817 | $13 \cdot 8$ | 198 | 21.7 |
| VIII | D2E2(A2C2)D1E3 | 048 | D | D | D |  | C | A | A | C |  | Jn4 | J12 | J12 | 937 | $2 \cdot 7$ | 23 | 2.5 |
| IX | D2E2(A2C2)D2E2 | 049 | D | D | D ${ }^{\text {¢ }}$ |  | C | A | A | C | D | Jn4 | J12 | J 12 | 2,115 | 6.0 | 66 | $7 \cdot 2$ |
| X | D2E2(A2B1C1)D2E2 | 040 | D | D | D |  | C | A | A | B | D | Jn4 | J13 | J12 | 1,266 | $3 \cdot 6$ | 55 | 6.0 |
| XI | D3E1(B1C2E1)C1D1E2 | 103 | C | D | D D |  |  | B | C | C | D | Jal | J11 | - | 827 | $2 \cdot 3$ | 23 | $2 \cdot 5$ |
| XII | D4(E4)D1E3 | 173 | D | D | D D | D |  |  |  |  |  | J13 | - | - | 3,619 | $10 \cdot 4$ | 6 | $0 \cdot 7$ |
| XIII | D4(E4)C1D1E2 | 174 | C | D | D D | D |  |  |  |  | D | Jal |  | - | , 70 | $0 \cdot 2$ | 5 | 0.5 |
| XIV | D4(B2C1E1)D1E3 | 090 | D | D | D D | D |  | B | B | C |  | J13 | J12 | - | 2,715 | $7 \cdot 8$ | 27 | $0 \cdot 6$ |
| XV | C1D3(D3E1)C1D1E2 | 158 | C | C | D D | D |  | D | D | D | D | Ja2 |  |  | 28 | $0 \cdot 1$ | 2 | $0 \cdot 2$ |


| APPENDIX 14.4 －Statement II（Contd．） |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | N |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |  |
| XVI | ClD3（BlC2E1）C2DIE1 | 102 | C | C | D | D | D |  | B | C | C | C |  | D | $\begin{aligned} & \mathrm{Ja} 2 \\ & \mathrm{~J} 14 \end{aligned}$ | J11 | － | 2，845 | $8 \cdot 1$ | 35 | $3 \cdot 8$ |  |
| XVII | C2D2（C2D2）C1E3 | 129 | C | C | C | D | D | D | C | C | D |  |  |  | Ja3 |  |  | 4，600 | $13 \cdot 2$ | 34 | $3 \cdot 7$ |  |
| XVIII | C2D2（A2BICl）C2D1E1 | 042 | C | C | C | D | D | C | A | A | B | C |  | D | $\begin{aligned} & \text { Ja3 } \\ & \text { Jn5 } \end{aligned}$ | J13 | $\mathbf{J} 12$ | 3，105 | 8.9 | 110 | $12 \cdot 1$ |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 34，960 |  | 912 |  | z |
| JAMMU AND KASHMIR |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| I | E4（E4）E4 | 169 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 572 | 2.4 | 18 | $2 \cdot 1$ |  |
| II | D1E3（B2C1E1）D1E3 | 087 | D |  | D |  |  |  | B | B | C |  |  |  | J13 | J12 |  | 402 | 1.7 | 54 | $6 \cdot 2$ | 2 |
| III | D2E2（B2E2）D1E3 | 092 | D | D | D |  |  |  | B | B |  |  |  |  | 512 | J12 |  | 1，127 | $4 \cdot 7$ | 23 | $2 \cdot 7$ | 6 |
| IV | D2E2（A2C1E1）D1E3 | 051 | D | D | D |  |  |  | A | A | C |  |  |  | J13 | J12 | $J 12$ | 5，525 | $22 \cdot 8$ | 201 | $23 \cdot 2$ | $\bigcirc$ |
| V | D4（D2E2）DIE3 | 163 | D | D | D | D | D |  | D | D |  |  |  |  |  | － | $\bar{T}$ | 2，931 | $12 \cdot 1$ | 197 | $22 \cdot 7$ | 8 |
| VI | C1D1E2（A2C1E1）C1D1 E2 | 052 | C | C | D |  |  |  | A | A | C］ |  |  | D | $\begin{aligned} & \mathrm{Ja} 2 \\ & \mathrm{~J} 13 \end{aligned}$ | J12 | J12 | 3，256 | $13 \cdot 5$ | 70 | $8 \cdot 1$ | \％ |
| VíI | $\begin{aligned} & \text { C2D1E1(A2C1E1) } \\ & \text { C1D1E2 } \end{aligned}$ | 053 | C | C | C | D |  |  | A | A | C |  |  | D | Ja3 | J12 | J12 | 2，484 | $10 \cdot 3$ | 51 | $5 \cdot 9$ | 云 |
| VIII | C2D2（C2D2）C1D1E2 | 127 | C | C | C | D | D | D | C | C | D |  |  | D | Ja3 | － | － | 2，470 | $10 \cdot 2$ | 41 | 4－7 | O |
| IX | C2D2（B2C1E1）C1DIE2 | 088 | C | C | C | D | D |  | B | B | C |  |  | D | Ja3 | J12 |  | 1，143 | 4－7 | 29 | $8 \cdot 3$ |  |
| X | C3D1（D1E3）C1D1E2 | 168 | C | C | C | C | D |  |  | D |  |  |  | D | J134 | － | － |  | $5 \cdot 7$ |  |  |  |
| XI | C3D1（D3E1）C1DIE2 | 157 | C | C | C | C | D |  | D | D | D |  |  | D | Ja4 | 二 | 二 | 2，158 | 8.9 | 50 | 11.0 5.8 |  |
| XII | C3D1（D4）C1D1E2 | 154 | C | C | C | C | D | D | D | D | D |  |  | D | Ja4 | － | － | 750 | 3.0 | 37 | $4 \cdot 3$ |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 24，188 |  | 866 |  |  |
| KARNATAKA |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| I | E4（CID3）D1E3 | 136 |  |  |  |  |  | D | D | D |  | D |  |  | S1 |  |  | 18，422 | 9.6 | 1，532 | $14 \cdot 2$ |  |
| II | E4（C3D1）D1E3 | 112 |  |  |  |  |  | D | C | C |  | D |  |  | J13 |  |  | 10，496 | $5 \cdot 5$ | 1，782 | 7.2 |  |
| III | E4（C4）DIE3 | 106 |  |  |  |  |  | C | C | C |  | ${ }^{\text {D }}$ |  |  | Jn4 |  |  | 10，892 | $5 \cdot 7$ | 856 | 7.9 |  |
| IV | E4（B1C3）D1E3 | 094 |  |  |  |  |  | C | C | C |  | D |  |  | Jn4 | S1 |  | 5，451 | $2 \cdot 8$ | 407 | $3 \cdot 8$ |  |



APPENDIX $14 \cdot 4$-Stateme nt II (Contd.)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 910 | 111 | 112 | 213 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| VI | CID1E2(A3Cl)BIC1E2 | 028 |  |  |  | D | C | A | A | A | C | B | C |  | My7 | Jn3 | Jn3 | 4,037 | $10 \cdot 5$ | 326 | $11 \cdot 1$ |
| VII | B1E3(A3B1)B1C1E2 | 020 |  |  |  |  | B | A | A | A | B | B | C |  | My7 | My 6 | Jn3 | 16,887 | $43 \cdot 8$ | 1,221 | 41.7 |
| VIII | C2DIE1(B2C2)B1C1E2 | 085 |  |  | D | C | C |  | B | C | C | B | C |  | Ap8 | Jn2 |  | 1,071 | $2 \cdot 8$ | 41 | 1.4 |
| IX | D2E2(C4)B2C1E1 | 110 |  |  |  | D | D | C | C | C | C | B | B | C | Ju7 | 02 |  | 443 | $1 \cdot 1$ | 41 | 1.4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 38,542 |  | 2,931 |  |
| MADHYA PRADESH |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | E4(C4)E4 | 105 |  |  |  |  |  | C | C | C | C |  |  |  | Jn4 |  |  | 4,211 | $1 \cdot 1$ | 279 | 1.4 |
| II | E4(B1C3)E4 | 093 |  |  |  |  |  | C | B | C | C |  |  |  | Jn4 | J11 |  | 12,303 | $3 \cdot 3$ | 847 | $4 \cdot 2$ |
| 11 I | E4(B2C1E1)E4 | 086 |  |  |  |  |  |  | B | B | C |  |  |  | J13 | J12 |  | 46,939 | $12 \cdot 8$ | 2,348 | $11 \cdot 6$ |
| IV | E4(B2C2)E4 | 082 |  |  |  |  |  | C | B | B | C |  |  |  | Jn4 | J12 |  | 25,952 | $7 \cdot 1$ | 1,712 | $8 \cdot 5$ |
| V | E4(A1B1C1E1)E4 | 061 |  |  |  |  |  |  | A | B | C |  |  |  | 113 | J12 | J11 | 9,179 | $2 \cdot 5$ | 532 | $2 \cdot 6$ |
| VI | E4(A1B1C2)E4 | 064 |  |  |  |  |  | C | A | B | C |  |  |  | Jn4 | J12 | J11 | 28,760 | $7 \cdot 8$ | 1,580 | 7.9 |
| VII | E4(A1B1C2)D1E3 | 065 |  |  |  |  |  | C | A | B | C | D |  |  | Jn4 | J 12 | J11 | 3,925 | $1 \cdot 1$ | 324 | 1.6 |
| VIII | E4(A2C1E1)E4 | 050 |  |  |  |  |  |  | A | A | C |  |  |  | J13 | J12 | J12 | 24,778 | $6 \cdot 7$ | 1,258 | $6 \cdot 3$ |
| IX | E4(A2C2)E4 | 046 |  |  |  |  |  | C | A | A | C |  |  |  | Jn4 | J12 | J12 | 67,353 | $18 \cdot 3$ | 3,693 | $18 \cdot 4$ |
| X | E4(A2C2)D1E3 | 047 |  |  |  |  |  | C | A | A | C | D |  |  | Jn4 | J12 | J12 | 17,768 | $4 \cdot 8$ | 1,350 | $6 \cdot 7$ |
| XI | E4(A2B1C1)E4 | 036 |  |  |  |  |  | C | A | A | B |  |  |  | Jn4 | J13 | J12 | 24,908 | $6 \cdot 8$ | 1,234 | $6 \cdot 1$ |
| XII | E4(A2B1C1)D1E3 | 037 |  |  |  |  |  | C | A | A | B | D |  |  | Jn4 | J13 | J12 | 26,515 | $7 \cdot 2$ | 1,302 | $6 \cdot 5$ |
| XIII | E4(A2B2)D1E3 | 030 |  |  |  |  |  | B | A | A | B |  |  |  | Jn4 | Jn4 | J12 | 75,289 | $20 \cdot 5$ | 3,858 | $18 \cdot 2$ |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 367,880 |  | 20,317 |  |
| MAHARASHTRA |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| II | E4(C1D3)D1E3 | 136 |  |  |  |  |  | D | D | D | C | D |  |  | S1 |  |  | 26,002 | $8 \cdot 5$ | 1,961 | $10 \cdot 6$ |
| II | E4(C2D2)D1E3 | 118 |  |  |  |  |  | C | D | D | C | D |  |  | Jn1 |  |  | 16,950 | $5 \cdot 6$ | 1,261 | $6 \cdot 8$ |
| III | E4(C3D1)E4 | 111 |  |  |  |  |  | C | C | D | C |  |  |  | $\mathrm{Sn}_{\mathrm{Jn} 2}$ |  |  | 15,821 | $5 \cdot 2$ | 1,098 | $5 \cdot 9$ |
| IV | E4(C4)E4 | 105 |  |  |  |  |  | C | C | C | C |  |  |  | $\mathrm{Sl}_{\mathrm{J}} \mathrm{J} 4$ |  |  | 47,465 | $15 \cdot 6$ | 3,824 | $20 \cdot 7$ |
| V | E4(C4)D1E3 | 106 |  |  |  |  |  | C | C | C | C | D |  |  | Jn4 |  |  | +2,819 | 15.9 | 3,824 | 0.8 0.8 |
| VII | E4(B1C3)E4 | 093 |  |  |  |  |  | C | ${ }^{\text {B }}$ | C | C |  |  |  | Jn4 | J11 |  | 71,879 | $23 \cdot 6$ | 5,073 | 27.5 |
| VII | E4(B1C3)D1E3 | 094 |  |  |  |  |  | C | B | C | C | D |  |  | Jn4 J | J11 |  | 6,279 | $2 \cdot 1$. | ,281 | 1.5 |



[^24]


Statements II to IV-Geographical (reporting) Areas under each of the Rainfall Patterns of (i) June to September (ii) February to May and (iii) October to January.

Notes:

1. The Union Territories and the Eastern States of Meghalaya, Nagaland, Manipur and Tripura which account for about $5 \cdot 5$ per cent of the reporting area of the country have not been considered in the tables due to inadequacy of rainfall data and as some of them have large hill-areas.
2. Areas shown against different rainfall patterns in each of the seventeen States listed in Statements II to IV are based on taluk data except in Bihar, West Bengal and Assam where sub-division, district and police station are the respective units of area.
3. The geographical areas shown in the Statements represent reporting areas. The total of reporting areas in some of the States in the Statements II to IV differ from published figures due to exclusion of (a) hill areas in west Uttar Pradesh, Tamil Nadu (Nilgiris) etc, (b) Certain forest areas from taluk areas in Madhya Pradesh and (c) some areas in Gujarat. Rainfall data is also inadequate for zoning these areas. Details of area under (1) and (3) are given in 4.

Million sq. km.

| 4. Total Reporting area (1969-70) | . | . | . | . | . | . | 3.06 |  |
| :--- | :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Area under (1) above | . | . | . | . | . | . | . | 0.17 | | Area of remaining seventeen States | . | . | . | . | . | 2.89 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Area under (3) above | . | . | . | . | . | . |

5. The total area shown against each pattern in col. 20 is the total of the areas under each of the States (cols. 3 to 19). Col. 21 shows the areas in col. 20 as per cent to all-India total given at the bottom of the column.

## APPENDIX 14.4 (Contd.)

Statement II-Geographical (reporting) area under each of the Rainfall Patterns of June to September.
(Sq. Km.)

| $\begin{aligned} & \text { SI. } \\ & \text { No. } \end{aligned}$ | South-West Monsoon patterns |  |  |  | Assam | West Bengal | Orissa | Bihar | $\begin{aligned} & \text { Uttar } \\ & \text { Pradesh } \end{aligned}$ | Himachal Pradesh | Jammu \& Kashmir | Punjab | Haryana | Rajastha |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 |  | 2 |  |  | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | A4 | - | - |  | 37,706 | 12,706 |  | 1,934 |  |  |  |  |  |  |
| 2. | A3B1 | - | - | - | 19,453 |  | 7,768 | 2,666 |  |  |  |  |  |  |
| 3. | ${ }^{\text {A3C1 }}$ | - | . |  |  |  |  |  |  |  |  |  |  |  |
| 4. | A2B2 | - | . | - | 471 | 41,162 | 18,992 | 60,769 |  |  |  |  |  |  |
| 5. | $\mathrm{A}^{\mathrm{A}} \mathrm{BlCl}$ | . | . | - | 3,100 | 13,140 |  | 66,000 | 40,043 | 6,620 |  |  |  |  |
| 6. | A2C2 | - | - | - |  |  |  |  | 6,370 | 3.052 |  |  |  |  |
| 7. | A2ClE1 | - | - |  |  |  |  |  | 18,141 | 4,817 | 11,265 | 936 |  | 14,545 |
| 8. | A1B3 | . | - | - | 1,879 |  | 3,508 |  |  |  |  |  |  |  |
| 9. | A1B2Cl | - | - | - | 3,652 |  |  | 20,046 | 15,758 |  |  |  |  |  |
| 10. | A1B1C2 |  | . | - |  |  |  | 7,072 | 5,732 |  |  |  |  |  |
| 11. | A1B1ClE |  | - | - |  |  |  |  | 9,708 | 3,884 |  |  |  | 4,276 |
| 12. | A1B1E2 | - | - | - |  |  |  |  |  |  |  |  |  | 898 |
| 13. | A1C3 | - | . | - | 1,133 |  |  |  |  |  |  |  |  |  |
| 14. | ${ }^{\text {B4 }}$ | - | - | - |  |  | 6,131 |  |  |  |  |  |  |  |
| 15. | ${ }^{\mathrm{B} 3 \mathrm{Cl}}$ | - | . | . |  | 20,845 | 18,671 |  |  |  |  |  |  |  |
| 16. | ${ }_{\text {B2Cle }}$ | - | - | - |  |  |  | 13,841 | $\begin{aligned} & 10,498 \\ & 06201 \end{aligned}$ |  |  |  |  |  |
| 17. | ${ }_{\text {B2 }}$ | - | - | - |  |  |  |  | 96,391 | 3,303 | 1,545 1,127 | 7,340 | 3,736 | $\begin{aligned} & 36,618 \\ & 72774 \end{aligned}$ |
| 18. | B2E2 B1C3 | - | - | - | 795 |  |  |  |  |  | 1,127 |  |  | $22,724$ |
| 20. | B1C2E1 | - | - | - |  |  |  |  | 7,800 | 4,580 |  | 775 |  |  |
| 21. | B1C1E2 | - | - | - |  |  |  |  |  |  |  |  |  | 17,502 |
| 22. | C4 | - | - | . |  |  | 767 |  |  |  |  |  |  |  |
| 23. | C3D1 | - | - | - |  |  |  |  | 17,182 |  |  | 7,629 | 14,131 | 14,345 |
| 24. | C3E1 | - | - | - |  |  |  |  | 5,856 |  |  |  |  |  |
| 25. | C2D2 | - | - | * |  |  |  |  |  | 4,987 | 2,470 |  |  | 24,831 |
| 26. | C2D1E1 | - | - | - |  |  |  |  |  |  |  | 25,656 | 19,470 | 76,209 |
| 27. | C2E2 | - | - | - |  |  |  |  |  |  |  |  |  |  |

APPENDIX 14.4-Statement III(Contd.)


RAINFALL AND CROPPING PATTERNS

APPENDIX 14.4-Statement II (Contd.)


APPENDIX 14-4-Statement II (Contd.)


RAINFALL AND CROPPING PATTERNS

Statement III-Geographical (Reporting) Area under each of the Rainfall Patterns of February to May
(Sq. Km.)


APPENDIX 14.4-Statement III (Contd.)

| $\begin{aligned} & \text { Sl. } \\ & \text { No. } \end{aligned}$ | Rainfall pattern |  |  |  | Gujarat | Madhya Pradesh | Maharashtra | Andhra Pradesh | Karnataka | Tamil Nadu | Kerala | Total | Percent to Total of (Col. 20) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 2 |  |  | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 1. | E4 | - - |  | - | 160,542 | 367,880 | 297,631 | 217,848 | 45,261 | 15,517 |  | ,920,175 | 71.63 |
|  | D1 E3 | .. |  | . |  |  | 6,587 | 46,002 | 105,373 | 62,912 |  | '407,034 | $15 \cdot 18$ |
|  | D2 E2 | .. |  | - |  |  |  | 10,568 | -814 | 31,813 | 443 | 64,612 | $2 \cdot 41$ |
|  | D3 E1 | . . | - | . |  |  |  |  |  | 1,226 |  | 2,053 | 0.08 |
|  | D4 | . . |  | . |  |  |  |  |  |  |  | 9,335 | 0.35 |
|  | ${ }^{\text {C1 E3 }}$ - | - . | - | - |  |  |  |  | 16,468 | 11,948 |  | 64,562 | 2.40 |
| 7. | C1 D1 E2 | - | - | - |  |  |  |  | 23,427 | 1,920 | 4,608 | 78,265 | 2.92 |
| 8. | C1 D2 E1 | - $\cdot$ | - | - |  |  |  |  |  |  |  | 795 | 0.03 |
|  | C1 D3 . | - . | - | - |  |  |  |  |  |  |  | 2,873 | $0 \cdot 11$ |
|  | C2 D2 E1 ${ }^{\circ}$ | . | $\stackrel{\square}{\bullet}$ | $\stackrel{\square}{*}$ |  |  |  |  |  | 431 366 |  | 431 3.921 | 0.02 0.15 |
| 12. | C2 D2 ${ }^{\text {c }}$ | $\cdots \quad$. | - | - |  |  |  |  |  | 662 | 11,071 | 3,921 | $0 \cdot 15$ |
| 13. | C3 D1. | . | . | . |  |  |  |  |  | 625 | 11,943 | 1,943 | 0.45 0.16 |
|  | B1 E3 . | . $\cdot$ | . | - |  |  |  |  |  |  | 16,887 | 16,887 | 0.63 |
|  | B1 C1 E2 | . $\cdot$ | . | - |  |  |  |  |  |  | 10,976 | 31,161 | 1.16 |
|  | B2 E2 ${ }^{\text {. }}$ | - . | . | - |  |  |  |  |  |  |  | 1,934 | 0.07 |
|  | B2 C1 E1 | - . | - | . |  |  |  |  |  |  |  | 7,416 | 0.28 |
|  | A1 C1 E1 | - - | - | - |  |  |  |  |  |  | 4,557 | 28,636 | 1.07 |
|  | A1 B1 E2 | . $\cdot$ | . | - |  |  |  |  |  |  |  | 11,777 | 0.44 |
| 20. | A1 B1 Cl E1 | - . | . | . |  |  |  |  |  |  |  | 3,604 | $0 \cdot 13$ |
| 21. | A2 C1 E1 | - . | . | - |  |  |  |  |  |  |  | 8,822 | 0.33 |
|  |  | Total | - | - | 160,542 | 367,880 | 304,218 | 274,418 | 191,343 | 126,758 | 38,542 | 2,680,514 |  |

Statement IV—Geographical (Reporting) Area under each of the Rainfall patterns of October to January.

| $\begin{aligned} & \text { Sl. } \\ & \text { No. } \end{aligned}$ | Rainfall p | pattern |  | Assam | West Bengal | Orissa | Bihar | $\begin{gathered} \text { Uttar } \\ \text { Pradesh } \end{gathered}$ | Himachal Pradesh | $\begin{aligned} & \text { Jammu } \\ & \& \\ & \text { Kashmir } \end{aligned}$ | Punjab | Haryana | Rajasthan |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 |  |  | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | E4 |  |  |  |  |  | 12,503 | 209,545 |  |  | 50,305 | 43,993 | 341,063 |
| 2. | D1 E3 |  | - | 6,073 | 33,985 | 85,261 | 158,043 | 28,552 |  | 9,985 |  |  |  |
| 3. | D2 E2 |  |  |  |  |  |  |  | 8,016 |  |  |  |  |
|  | C1 E3 ${ }^{\text {c }}$ | - | - | -56,972 | 53,868 | 55,532 | 1,782 |  | 4,600 |  |  |  |  |
| 5. | C2 D1 E2 | - | - | ${ }^{5} 1,879$ |  | 15,044 |  |  | 3,174 | 13,631 |  |  |  |
| 6. | C2 D1 E1 | - | - |  |  |  |  |  | 5,950 |  |  |  |  |
| 8. | B1E3 * | $\bullet$ | $\bullet$ | 13,265 |  |  |  |  |  |  |  |  |  |
| 9. | B1 C1E2 |  | - |  |  |  |  |  |  |  |  |  |  |
| 10. | B1 C2 E1 |  | - |  |  |  |  |  |  |  |  |  |  |
| 11. | B2 E2 ${ }^{\text {. }}$ | - | - |  |  |  |  |  |  |  |  |  |  |
|  | B2 C1 E1 | - | - |  |  |  |  |  |  |  |  |  |  |
| 13. | A1 B1 E2 | - | - |  |  |  |  |  |  |  |  |  |  |
| 14. | A1B1Cl E1 | . | . |  |  |  |  |  |  |  |  |  |  |
| [15. | Al B2 E1 | - | . |  |  |  |  |  |  |  |  |  |  |
|  | Total | - | - | 68,189 | [87,853 | 155,837 | 172,328 | 238,097 | 134,960 | 24,188 | 50,305 | 43,993 | 341,063 |

## APPENDIX 14.4 - Statement IV (Contd.)

| SI. <br> No. | Rainfall patterns |  |  |  | Gujarat | Madhya Pradesh | Maharashtra | Andhra Pradesh | Karnataka | Tamil | Kerala | Total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 |  | 2 |  |  | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|  |  | . - | - | - | 160,542 | 244,383 |  |  |  |  |  | 1,206,240 | 45.00 |
| 2. | D1 E3 . | - $\quad$. | - | . |  | 123,497 | $128,072$ | 144,100 | -75,688 |  |  | -806,476 | 30.09 |
|  | D2 E2 . | . . | . | . |  |  |  | 6,299 |  |  |  | 14,315 | $0 \cdot 53$ |
|  | CIE3 ${ }^{\text {c }}$ | - - | . |  |  |  | 32,812 |  | 24,876 |  |  | 230,442 | $8 \cdot 60$ |
|  | CIDIE2 | $\cdots \quad$. | - | - |  |  | 32,812 | 63,476 | 86,156 | 12,134 |  | 195,494 | 7.29 |
|  | C2 D1 El | . . | - | - |  |  |  | 4,790 |  | 66,044 |  | 76,784 | $2 \cdot 86$ |
|  | $\mathrm{C2} 2^{\mathrm{E} 2}$. | $\cdots \quad$. | . | - |  |  |  | 33,426 |  | 13,763 |  | 37,189 | 1.39 |
|  | B1 E3 | . . | - |  |  |  |  |  |  |  |  | 3,265 | $0 \cdot 12$ |
|  | B1 Cl E2 ${ }^{\circ}$ | $\cdots \quad$. | - | - |  |  |  | 16,733 | 4,623 | 1,940 | 24,202 | 47,498 | 1.77 |
|  | B1 C2E1 | - . | . | . |  |  |  | 16,733 | 4,623 | 14,193 | 24,202 | 14,193 | $0 \cdot 53$ |
|  | $\mathrm{B}^{\text {E E2 }}$. | - $\cdot$ | - | - |  |  |  | 4,724 |  | 1,995 | 571 | 7,290 | 0.27 |
|  | B2 C1 E1 | $\cdots \quad$. | - | - |  |  |  | 6,804 |  | 8,214 | 443 | 15,461 | 0.58 |
|  | Al B1 E2 | - $\quad$ | . | - |  |  |  |  |  |  | 13,326 | 13,326 | $0 \cdot 50$ |
|  | Al Bl Cl El | - . | . | . |  |  |  | 4,066 |  | 6,568 |  | 10,634 | 0.40 |
| 15. | A1 B2 E1 | . . | . | . |  |  |  |  |  | 1,907 |  | 1,907 | 0.07 |
|  |  | Toral | - | - | 160,542 | 367,880 | 304,218 | 274,418 | 191,343 | 126,758 | 38,542 | 268,0514 |  |

RAINFALL AND CROPPING PATTERNS

## APPENDIX 14.4 (Contd.)

(Paragraph 14.4.3)
Statement V—Gross Cropped Area under each of the Rainfall patterns of (June-September)—1969-70
(thousand hectares)

| Sl. <br> No. | Patterns |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

APPENDIX 14.4-Statement V (Contd.)

| SI. No. |  | Patterns |  |  | Gujarat* | Madhya Pradesh | Maharashtra | Andhra <br> Pradesh | Karnataka | Tamil Nadu | Kerala | Total | $\begin{aligned} & \text { Per cent } \\ & \text { to } \\ & \text { All India } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 |  | 2 |  |  | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 1. |  | - |  | - |  |  | 583 |  | 356 |  | 285 | 3,539 | 2.24 |
| 2. | A3B1 | . $\cdot$ | , | - | 145 |  | 138 |  | 114 | 14 | 1,984 | 3,851 | $2 \cdot 44$ |
| 3. | $\mathrm{A}^{\text {a }}$ | . . | . | . |  |  | 27 |  | 253 |  | 326 | 606 | 0.38 |
| 4. | A2B2 | . . | . | . | 110 | 3,858 | 1,026 | 21 |  |  |  | 16,766 | 10.61 |
| 5. | A 2 BlCl | . . | . | . | 450 | 2,536 | 305 | 113 | 9 |  | 11 | 12,348 | $7 \cdot 81$ |
| 6. | $\mathrm{A}^{2} \mathrm{C} 2$ | . . | . | - |  | 5,043 |  |  |  |  |  | 5,533 | $3 \cdot 50$ |
| 7. | A2ClE1 | . . | . | . | - | 1,258 |  |  |  |  |  | 3,983 | $2 \cdot 52$ |
| 8. | A1B3 | . . | . | - |  |  |  |  |  |  |  | 312 | $0 \cdot 20$ |
| 9. | A1B2Cl | . | - | . |  |  |  |  |  |  |  | 3,479 | $2 \cdot 20$ |
| 10. | A1B1C2 | . . | - | - | 1,051 | 1,904 | 1,919 | 514 | 113 | - | 182 | 6,778 | $4 \cdot 29$ |
| 11. | A1B1ClE | - - | - | - | 714 | 532 |  |  |  |  |  | 2,203 | 1.39 |
| 12. | A1B1E2 | - $\cdot$ | - | - | 616 |  |  |  |  |  |  | 2, 15 | 0.01 |
| 13. | $\mathrm{AlC3}^{\text {d }}$ | - . | - | - | 616 | - | 262 |  |  |  |  | 901 | 0.57 |
| 14. | B4 | - $\cdot$ | - | - |  |  |  |  |  |  |  | 221 | $0 \cdot 14$ |
| 15. | $\mathrm{B3Cl}$ | - . | - | , |  |  |  | 395 |  |  |  | 3,757 | 2.38 |
| 16. | B2C2 | - . | - | . | 306 | 1,712 | 560 | 531 |  |  | 41 | 5,303 | 3.35 |
| 17. | B2C1E1 | - $\cdot$ | - | - |  | 2,348 |  |  |  |  |  | 13,818 | 8.74 |
| 18. | B2E2 | - | - | - | 316 | - |  |  |  |  |  | 1,446 | 0.91 |
| 19. | $\mathrm{B} 1 \mathrm{C} 3$ | - | . | - |  |  | 5,354 | 2,403 | 407 | 31 | 61 | 9,147 | $5 \cdot 79$ |
| 20. | B1C2E1 | - | - | - | 1,136 |  |  |  | 282. | $\frac{31}{20}$ |  | 2,335 | 1.48 |
| 21. | B1C1E2 | . . | . | - | 2,504 |  |  |  |  | 20 |  | 2,970 | 1.88 |
| 22. | $\mathrm{C} 4$ | . . | - | . |  | 279 | 3,967 | 2,214 | 856 | 18 | 41 | 7,440 | $4 \cdot 71$ |
| 23. | C3D1 | - . | . | - |  |  | 1,098 | 3,822 | 973 |  |  | 11,490 | 7.27 |
| 24. | $\mathrm{C}^{\text {C2E }}$ - | $\cdots \quad$. | - | - | 568 |  | 1,261 | 382 | 1,297 | 2,176 |  | 11.035 7.034 | 0.40 4.45 |

* Data relate`"to 1968-69.



## APPENDIX 14 -4-statement $V$ (Contd.)



Nores: 1. In preparing the Statement, gross cropped areas of the States of Meghalaya, Nagaland, Manipur and the Union Territories were not considered; these total to less than one per cent of the gross cropped area of the country. The total gross cropped areas of the remaining seventeen States is thus, for all practical purposes, taken as all-India gross cropped area and used in computing percentage areas of each of the patterns in terms of all India.
2 The gross cropped areas shown against each pattern under the various States are based on taluk data except in Bihar,West Bengal and Assam where the unit of area is subdivision, district and police station respectively. Kerala districts are divided into taluks but crop data could be had only for districts. The area under each pattern was calculated on proportionate basis.

## APPENDIX 14.4 (Contd.)

(Paragraph 14.4.4)

## Statement Vi-All-India Rainfall Patterns



## APPENDIX 14.4 Sfatement VI (Contd.)



APPENDIX 14.4-Statement VI (Contd.)


## APPENDIX 14.4-Statement VI (Contd.)

Zone No.
115
II

116
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134
135
136



138 . . . . . . E4 (C1 D3) C2 E2
139 . . . . . . E4 (C1 D3) A1 B1 C1 El
140 . . . . . . C1 E3 (C1 D3) C1 D1 E2
141 . . . . . . D1 E3 (C1 D3) C2 E2
142 . . . . . . D1 E3 (C1 D3) D1 E3
143 . . . . . . D1 E3 (C1 D3) C1 D1 E2
144 . . . . . . C1 D1 E2 (C1 D3) C1 D1 E2
145







152


154

Rainfall patterns
D1 E3 (C3 D1) C1 E3
C3 E1
E4 (C3 E1) E4
C2 D2
E4 (C2 D2) E4
E4 (C2 D2) D1 E3
E4 (C2 D2) D2 E2
E4 (C2 D2) C2 E2
E4 (C2 D2) B2 C1 E1
D1 E3 (C2 D2) C1 E3
D1 E3 (C2 D2) C1 D1 E2
D1 E3 (C2 D2) C2 D1 E1
D2 E2 (C2 D2) C2 D1 E1
C1 E3 (C2 D2) C1 D1 E2
C2 D2 (C2 D2) C1 D1 E2
D2 E2 (C2 D2) D2 E2
C2 D2 (C2 D2) C1 E3
C2 D1 E1
E4 (C2 D1 E1) E4
E4 (C2 D1 E1) A1 B1 C1 E1
D1 E3 (C2 D1 E1) C2 D1 E1
D1 E3 (C2 D1 E1) B1 C1 E2
D1 E3 (C2 D1 E1) B1 C2 E1
C1 D3
E4 (C1 D3) E4
E4 (C1 D3) D1 E3
E4 (C1 D3) D2 E2
E 4 (C1 D3) A1 B1 C1 El
Cl E3 (C1 D3) C1 D1 E2

## C1 D2 E1

E4 (C1 D2 C1) C2 E2

- E4 (C1 D2 E1) B1 C1 E2
- E4 (C1 D2 E1) B2 E2
- D1 E3 (C1 D2 E1) C1 D1 E2

C1 D1 E2
E4 (C1 D1 E2) E4
D1 E3 (C1 D1 E2) D1 E3
C1 E3 (C1 D1 E2) C1 D1 E2

- D1 E3 (C1 D1 E2) C2 D1 E1
. D1 E3 (C1 D1 E2) A1 B1 C1 E1 D4
C3 D1 (D4) C1 D1 E2


Note : Rainfall patterns above have been listed according to decreasing order of the rainfall patterns of the southwest monsoon months of June to September (A4 to E4).
type-SW monsoon
A
B
C
D
E
no. of all-India patterns
73
31
49
15
6


APPENDIX 14.5-Statement I (Contd.)

| Region no. $\quad$ Rainfall pattern | Geographical area (sq. km.) | $\begin{gathered} \text { \% to } \\ \text { all-India } \end{gathered}$ | Gross cropped area (thousand ha.) | $\begin{aligned} & \text { \% to } \\ & \text { all-India } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| 40. C1 E3 (C2 E2) C1 E3 . | 12908 | 0.48 | 795 | $0 \cdot 50$ |
| 41. C1 E3 (B1 C3) Cl E3 | 795 | 0.03 | 44 | 0.03 |
| 42. Cl E3 (A1 B2 C1) C1 E3 | 679 | 0.03 | 38 | 0.02 |
| 43. C1 E3 (A2 C1 E1) C1 E3 | 3256 | $0 \cdot 12$ | 70 | 0.04 |
| 44. Cl E3 (A2 B2) C1 E3 | 55076 | $2 \cdot 06$ | 4092 | $2 \cdot 59$ |
| 45. Cl E3 (A4/A3) C1 E3 | 9742 | $0 \cdot 36$ | 359 | $0 \cdot 23$ |
| 46. C1 E3 (B1 C2 E1) C2 E2 | 2845 | $0 \cdot 11$ | 35 | 0.02 |
| 47. C1 E3 (B1 C3) B2 E2 . | 571 | 0.02 | 61 | 0.04 |
| 48. C1 E3 (B3 C1) E4 | 20845 | 0.78 | 2167 | $1 \cdot 37$ |
| 49. C1 E3 (A4/A3) B1 C1 E2 | 8660 | $0 \cdot 32$ | 431 | 0.27 |
| 50. C2 E2 (C2 E2) C1 E3 | 7070 | 0.26 | 75 | 0.05 |
| 51. C2 E2 (B2 Cl E1) C1 E3 | 1143 | 0.04 | 29 | 0.02 |
| 52. C2 E2 (A2 C1 E1) C1 E3 | 2484 | 0.09 | 51 | 0.03 |
| 53. C2 E2 (A2 B1 C1) C2 E2 | 3105 | $0 \cdot 12$ | 110 | 0.07 |
| 54. C3 E1 (E4) C1 E3 | 4278 | $0 \cdot 16$ | 182 | 0.12 |
| 55. B1 E3 (A3 B1) B1 C1 E2 | 16887 | 0.63 | 1221 | $0 \cdot 77$ |
| 56. B1 C1 E2 (A1 B1 C2) B1 C1 E2 | 2207 | 0.08 | 193 | 0-12 |
| 57. B1 C1 E2 (A2 B1 C1) E4 | 6073 | 0.23 | 321 | $0 \cdot 20$ |
| 58. B1 C1 E2 (A4/A3) A1 B1 E2 | 13326 | 0.50 | 1048 | 0.66 |
| 59. B1 Cl E2 (A4/A3) C1 E3 | 24653 | 0.92 | 938 | $0 \cdot 59$ |
|  | 221,201 | $8 \cdot 26$ | 13419 | $8 \cdot 47$ |
| 60. A1 C1 E2 (A4/A3) C1 E3 | 34665 | 1.29 | 1806 | $1 \cdot 14$ |
| 61. A1 B1 C1 E1 (A1 B3) C1 E3 | 1879 | 0.07 | 38 | 0.02 |
| 62. A2 Cl E1 (A4) Cl E3 . | 10547 | 0.39 | 365 | 0.23 |
| total (18-62) | 680145 | $25 \cdot 37$ | 35098 | $22 \cdot 20$ |
| Special (two zones of Kerala and five of Tamil Nadu) | 4857 | $0 \cdot 18$ | 187 | 0-12 |
| All-India | 2680514 | 100 | 158074 | 100 |

## APPENDIX 14.5 (Contd.)

(Paragraph 14.5.3)
Statement II-Number of Taluks under each of the Rainfall Regions


APPENDIX 14.5-Statement II (Contd.)


## APPENDIX 14.5-Statement II (Contd.)



## APPENDIX 14.5-Statement II (Contd.)

| Region rainfall pattern and calendar No. month equivalents | states | number of districts | number of taluks |
| :---: | :---: | :---: | :---: |
| 40. C1 E3 (C2 E2) C1 E3 | Tamil Nadu | 2 | 9 |
| My Cl-Au C3 | Karnataka | 1 | 6 |
| 41. C1 E3 (B1 C3) C1 E3 My C2 B1 C3 | Assam | 1 | 2 |
| 42. C1 E3 (A1 B2 C1) C1 E3 My C1 B1 A1 B1 C2 | Assam | 1 | 2 |
| 43. C1 E3 (A2 C1 E1) C1 E3 Ja C2-J1 A2 Cl | J. \& K. | 1 | 3 |
| 44. Cl E3 (A2 B2) C1 E3 My Cl B1 A2 B1 C1 | Assam | 2 | 3 |
|  | Bihar | 1 | 1 |
|  | West Bengal | 6 |  |
|  | Orissa | 2 | 9 |
| 45. C1 E3 (A4/A3) C1 E3 My C1 Jn . $(\mathrm{A} 4 / \mathrm{A} 3) \mathrm{OC}$ | Karnataka | 4 | 10 |
| $\begin{aligned} & \text { 46. Cl E3 (B1 C2 E1) C2 E2 } \\ & \text { Ja C2-J1 B1 C3 } \end{aligned}$ | Himachal Pradesh | 1 | 2 |
| $\begin{aligned} & \text { 47. C1 E3 (B1 C3) B2 E2 My C2 B1. } \\ & \text { C2 B2 } \end{aligned}$ | Kerala | 1 | 1 |
| $\begin{aligned} & \text { 48. C1 E3 (B3 C1) E4 My C1 B3 C1 . } \\ & \text { 49. C1 E3 (A4/A3) B1 C1 E2 } \\ & \text { My C1 Jn (A4/A3) O B1 C1 } \\ & \text { 50. C2 E2 (C2 E2) C1 E3 Ja C3-J1 C2 } \end{aligned}$ | West Bengal | 4 |  |
|  | Karnataka | 1 | 4 |
|  | Kerala | 2 | 5 |
|  | Himachal Pradesh | 3 | 3 |
|  | Jammu \& Kashmir | 1 | 3 |
| 51. C2 E2 (B2 C1 E1) C1 E3 Ja C3-J1 C1 B2 | Jammu \& Kashmir | 1 | 2 |
| 52. C2 E2 (A2 C1 E1) C1 E3 Ja C3-J1 A2 C1 | Jammu \& Kashmir | 2 | 3 |
| 53. C2 E2 (A2 B1 C1) C2 E2 Ja C3-Jn Cl A2 B1 Cl | Himachal Pradesh | 2 | 3 |
| $\begin{aligned} & \text { 54. C3 E1 (E4) C1 E3 Ja C4 } \\ & \text { 55. B1 E3 (A3 B1) B1 C1 E2 My B1 } \\ & \text { A3 B2 C1 } \end{aligned}$ | Jammu \& Kashmir | 3 | 11 |
|  | Kerala | 6 | 21 |
| 56. B1 C1 E2 (A1 B1 C2) B1 Cl E2 . Ap C1 B1 A1 B1 C2 B1 C1 | Kerala | 2 | 5 |
| 57. B1 C1 E2 (A2 B1 C1) E4 Ap C1 . B1 A2 B1 C1 | Assam | 3 | 12 |
| 58. B1 C1 E2 (A4/A3) A1 B1 E2 Ap . C1 B1 Jn (A4/A3) O A1 Bi | Kerala | 4 | 23 |
| 59. B1 C1 E2 (A4/A3) C1 E3 | Assam | 4 | 35 |
| Ap C1 Bl Jn (A4/A3) O Cl | West Bengal | 1 |  |
| 60. A1 C1 E2 (A4/A3) C1 E3 | Assam | 4 | 30 |
| $\mathrm{Ap}^{\text {Cl Al }} \mathrm{Jn}$ (A4/A3) O Cl | West Bengal | 2 |  |

## APPENDIX 14.5-Statement II (Contd.)

| Region <br> No. | rainfall pattern and calendar <br> month equivalents | states |
| :--- | :--- | :--- |
| 61. A1 B1 Cl B1 (A1 B3) C1 E3 Ma | Assam | number of <br> districts |
| C1 B1 A2 B3 C1 | number of <br> taluks |  |
| 62. A2 C1 E1 (A4) C1 E3 Ma Cl <br> A6 C1 | Assam | 1 |

## Notes:-

1. While drawing boundaries of Rainfall Zones (and hence also of Regions) the unit of area is taluk excepting in Assam, West Bengal and Bihar where the unit is police station, district and subdivision respectively. The figures shown in the last column under taluks against Bihar and Assam thus represent subdivision and police station respectively. Against West Bengal the entry is left blank as only full districts are involved.
2. For want of data areas of 99 police stations (against a total of 103 ) only have been considered in Assam.
3. In taluks in or close to Western Ghats in Maharashtra and Karnataka, reinfall patterns vary in the same taluk and there are two in general. Because of this, a number Jof them are shown in two different Zones/Regions in parts as ( $\ddagger, \frac{1}{2}$ etc.). In Assam, haflong area is shown in two Zones/Regions. Details of these are contained in Appendix $14 \cdot 6$, Statement V. Here, for convenience the fractions of taluks have not been shown; each fractional taluk area has been taken as one for entry in the last column of this Statement.
4. For each rainfall pattern (Col. 2), all the months with 10 cm pm or higher are shown in calender sequence together with month of commencement e.g., E4 (C2 E2) E4 is JlC 2 i.e. rainfall is in $\mathbf{1 0 - 2 0} \mathrm{cm}$ pm class for two months from July.

APPENDIX 14.6
Statement I-Per cent of Gross Cropped Area under Principal Crops, (1969-70 and 1970-71)
(Paragraph 14.6.1)


APPENDIX 14.6-Statement I (Contd.)



APPENDIX 14．6－Statement I（Contd．）

|  |  | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tripura | 1969－70 | 0.9 | 0.9 | $10 \cdot 5$ | $0 \cdot 3$ | 1.7 | 0.9 | 0.2 | － | 343 |
| Tripura | 1970－71 | 0.9 | 0.9 | $10 \cdot 1$ | $0 \cdot 3$ | 1.7 | 0.6 | $0 \cdot 2$ | － | 345 |
| Uttar Pradesh ． | 1969－70 | $5 \cdot 4$ | 6.0 | 1.7 | $1 \cdot 5$ | 1.4 | 0.2 | － | $3 \cdot 3$ | 22968 |
|  | 1970－71 | $5 \cdot 1$ | $5 \cdot 8$ | 1.7 | 1.5 | $1 \cdot 6$ | $0 \cdot 2$ | － | $3 \cdot 3$ | 23207 |
| West Bengal | 1969－70 | $7 \cdot 0$ | $0 \cdot 6$ | $2 \cdot 2$ | r－ | $2 \cdot 3$ | 0 | $1 \cdot 2$ | － | 7054 |
| West Bengal | 1970－71 | 6.8 | J． 6 | $2 \cdot 3$ | － | 2.4 | － | $1 \cdot 2$ | － | 7092 |
| Andaman \＆Nicobar Islands | 1969－70 | － | － | $5 \cdot 6$ | － | － | － | 50.0 | － | 18 |
|  | 1970－71 | － | － | $5 \cdot 6$ | － | － | － | $50 \cdot 0$ | － | 18 |
| Arunachal Pradesh ． | 1969－70 | － | － | － | － | － | － |  | － | 55 |
|  | 1970－71 |  | － | － | － |  | － | － | － | 56 |
| Dadra and Nagar Haveli | 1969－70 | $17 \cdot 6$ | － | － | － | － | － | － | － | 17 |
|  | 1970－71 | 17.6 | 二 | $4 \cdot 5$ | － | － |  | $9 \cdot$ | － | 17 |
| Delhi | 1969－70 | 2.7 | 二 | 4．5 | － | 0.9 | － | 9．0 | － | 111 |
|  | 1970－71 | $2 \cdot 6$ | － | 4.3 29.5 | － | 0.9 | － | $8 \cdot 5$ | － | 117 |
| Goa，Daman and Diu | 1969－70 | － | 二 | 29.5 | － | 12.9 | － | $38 \cdot 1$ | － | 139 |
|  | $1970-71$ $1969-70$ | － | 二 | 28.8 | － | $13 \cdot 7$ | 二 | $38 \cdot 1$ $100 \cdot 0$ | － | 139 |
| Lakshadweep | 1970－71 | － | － | － | － | － | 二 | $100 \cdot 0$ | 二 | 3 |
| Mizoram | 1969－70 | － | 2.5 | $10 \cdot 0$ | － | － | $2 \cdot 5$ | － | － | 40 |
|  | 1970－71 | － | 2.5 | $10 \cdot 0$ |  |  | 2.5 |  | － | 40 |
| Pondicherry | 1969－70 | 9.8 | 2.9 | 2.9 | 5.9 | 3.9 | － | 4.0 | － | 51 |
|  | 1970－71 | 5.9 | $2 \cdot 9$ | 2.9 | $7 \cdot 8$ | $5 \cdot 9$ | － | 6.0 | － | 51 |
| All－India | 1969－70 | 7.7 | 1．7 | $2 \cdot 1$ | $4 \cdot 3$ | $4 \cdot 1$ | $4 \cdot 8$ | 1.4 | $4 \cdot 1$ | 163782 |
|  | 1970－71 | $7 \cdot 5$ | 1.6 | $2 \cdot 1$ | $4 \cdot 5$ | $4 \cdot 2$ | $4 \cdot 7$ | 1.4 | 4.4 | 167412 |

[^25]APPENDIX 14．6－Statement I（Contd．）
Percent of Gross Cropped Area under Plantation Crops（1969－70 and 1970－71）

|  |  | Pepper | Carda－ mom | Betel－ nut | Cashew－ nut | Coco－ nut | Coffee | Tea | Rubber | Total planta－ tions |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Andhra Pradesb | 1969－70 | － | － | － | 0.2 | $0 \cdot 3$ | － | － |  | 0.5 |
|  | －1970－71 | － | － |  | $0 \cdot 2$ | $0 \cdot 3$ | － | － | － | $0 \cdot 5$ |
| Assam | －1969－70 | － | － | 0.8 | － | $0 \cdot 1$ | － | $6 \cdot 5$ | － | $7 \cdot 4$ |
| Himachal Pradesh | －1969－70 | － | － | － | － |  | － | 0.4 | － | 0.4 |
| Kerala | －1969－70 | $4 \cdot 0$ | 1.6 | $2 \cdot 9$ | 3.4 | $24 \cdot 3$ | 1.0 | $1 \cdot 3$ | $6 \cdot 0$ | $44 \cdot 5$ |
|  | 1970－71 | $4 \cdot 0$ | 1.6 | $2 \cdot 9$ | $3 \cdot 5$ | $24 \cdot 5$ | $1 \cdot 1$ | $1 \cdot 3$ | $6 \cdot 1$ | $44 \cdot 1$ |
| Maharashtra | －1969－7\％ | － | － | － | $0 \cdot 1$ | － | － | － | － | 1.0 |
|  | 1970－71 | － | － | － | $0 \cdot 1$ | $0 \cdot 1$ | － | － |  | $1 \cdot 1$ |
| Meghalaya | －1969－70 | － | － | $3 \cdot 0$ | － | － | － | － | － | 3.0 |
|  | 1970－71 | － |  | 3.0 |  |  |  | － | － | $3 \cdot 0$ |
| Karnataka | －1969－70 | 一 | 0.2 | $0 \cdot 4$ | $0 \cdot 2$ | 1.2 | 1.0 | － | － | $3 \cdot 1$ |
|  | －1970－71 | － | $0 \cdot 2$ | $0 \cdot 4$ | $0 \cdot 2$ | 1.2 | 1.0 | － | $0 \cdot 1$ | $3 \cdot 1$ |
| Orissa | －1969－70， | － | － | － | － | $0 \cdot 1$ | － | － | － | $0 \cdot 1$ |
|  | 1970－71 | － | － | － | $0 \cdot 2$ | 0－1 | － | － | － | $0 \cdot 3$ |
| Tamil Nadu | －1969－70 | － | $0 \cdot 1$ | － | 0.7 | $1 \cdot 1$ | $0 \cdot 3$ | $0 \cdot 5$ | $0 \cdot 1$ | 2.8 |
|  | 1970－71 | － | $0 \cdot 1$ | 一 | $0 \cdot 7$ | 1.2 | $0 \cdot 3$ | $0 \cdot 5$ | $0 \cdot 1$ | 2.8 |
| Tripura | －1969－70 | － | － | － | － | － | － | $0 \cdot 2$ | － | $0 \cdot 2$ |
|  | $1970-71$ |  | $\cdots$ |  | － | － | － | $0 \cdot 2$ | － | $0 \cdot 2$ |
| West Bengal | －1969－70 | － | － | － | － | 0.1 | － | $1 \cdot 1$ | － | －1．2 |
|  | 1970－71 |  | － | － | － | $0 \cdot 1$ | － | $1 \cdot 1$ | － | 1.2 |
| Andaman \＆Nicobar Islands <br> Goa，Daman \＆Diu | 1969－70 | － | － | － | － | $50 \cdot 0$ | － | － | － | $50 \cdot 0$ |
|  | －1970－71 | － | － | － | － | $50 \cdot 0$ | － | － | － | $50 \cdot 0$ |
|  | －1969－70 | － | － | $1 \cdot 4$ | $23 \cdot 7$ | 12.9 | － | － | － | $38 \cdot 1$ |
|  | 1970－71 | － | － | 1.4 | $23 \cdot 0$ | $13 \cdot 7$ | － | － | － | $38 \cdot 1$ |
| Lakshadweep | －1969－70 | － | － | － | － | $100 \cdot 0$ | － | － | － | $100 \cdot 0$ |
|  | 1970－71 | － | － | － | $\cdots$ | $100 \cdot 0$ | － | － | － | $100 \cdot 0$ |
| Pondicherry | －1969－70 | － | － | － | 2.0 | 2.0 | － | － | － | $4 \cdot 0$ |
|  | 1970－71 | $\overline{-1}$ | － |  | $2 \cdot 0$ | 4.0 | $0 \cdot 1$ | $0 \cdot 2$ | $0 \cdot 1$ | $6 \cdot 0$ |
| All－India | －1969－70 | 0.1 0.1 | － | $0 \cdot 1$ $0 \cdot 1$ | $0 \cdot 1$ $0 \cdot 1$ | 0.6 0.6 | $0 \cdot 1$ $0 \cdot 1$ | 0.2 0.2 | 0.1 0.1 | 1.4 1.4 |

## APPENDIX 14.6 (Contd.)

(Paragraph 14.6.1)
Statement II-Relative Yield Index (RYI) values of Principal Crops(a)

| States/Union Territories | Rice | Wheat | Jowar | Bajra | Maize |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Jammu \& Kashmir | 141 | 80 | 198 | 115 | 91 |
| Himachal Pradesh | 103 | 70 | 79 | - | 161 |
| Punjab | 141 | 181 | 155 | 239 | 138 |
| Chandigarh . | - | - | - | - | - |
| Haryana | 125 | 162 | 42 | 128 | 98 |
| Delhi | 108 | 143 | 73 | 220 | 57 |
| Rajasthan | 73 | 92 | 71 | 61 | 74 |
| Uttar Pradesh | 70 | 100 | 118 | 149 | 89 |
| Madhya Pradesh | 72 | 57 | 124 | 118 | 71 |
| Bihar | 71 | 73 | 90 | 111 | 90 |
| Orissa | 85 | 102 | 139 | 156 | 77 |
| West Bengal | 111 | 170 | 124 | 109 | 84 |
| Arunachal Pradesh | 76 | - | - | - |  |
| Assam (b) | 92 | 49 | - | - | 50 |
| Nagaland | 80 | - | - | - | - |
| Manipur | 131 | - | - | - | 197 |
| Tripura | 79 | - | - | - | - |
| Gujarat | 79 | 116 | 60 | 147 | 97 |
| Maharashtra | 99 | 40 | 89 | 77 | 71 |
| Dadra \& Nagar Haveli . | 109 | - | - | - | - |
| Karnataka | 163 | 30 | 137 | 88 | 262 |
| Goa, Daman \& Diu | 121 | - | - | - | - |
| Andhra Pradesh | 118 | 19 | 89 | 104 | 111 |
| Kerala | 132 | - | 85 | - | - |
| Andaman \& Nicobar Islands . | 115 | - | - | - | - |
| Tamil Nadu | 159 | 27 | 146 | 143 | 100 |
| Lakshadweep | - | - | - | - | - |
| Pondicherry | 181 | - | - | 259 | - |
| All-India average yield (tonnes/ha) | 1.094 | $1 \cdot 228$ | $0 \cdot 506$ | 0.457 | 1.079 |

## APPENDIX 14.6-Statement II (Contd.)

| States/Union Territories | Small millets | Ragi | Barley | Tur | Gram |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Jammu \& Kashmir | 176 | - | 53 | - | 36 |
| Himachal Pradesh | 226 | 92 | 121 | 71 | 89 |
| Punjab | 194 | - | 101 | 92 | 128 |
| Chandigarh | - | - | - | - | - |
| Haryana | 258 | - | 121 | 61 | 131 |
| Delhi | - | - | 82 | - | 93 |
| Rajasthan | 77 | - | 126 | 57 | 96 |
| Uttar Pradesh | 163 | 94 | 94 | 163 | 115 |
| Madhya Pradesh | 62 | 34 | 90 | 94 | 78 |
| Bibar . . | 116 | 71 | 70 | 107 | 99 |
| Orissa . | 105 | 110 | - | 80 | 88 |
| West Bengal | 157 | 101 | 76 | 108 | 115 |
| Arunachal Pradesh | - | - | - | - | $\overline{75}$ |
| Assam (b) | 119 | - | - | 99 | 75 |
| Nagaland | - | - | - | - | - |
| Manipur | - | - | - | - | - |
| Tripura | - | - | - | 57 | - |
| Gujarat . | 188 | 91 | 38 | 67 | 91 |
| Maharashtra | 104 | 97 | 66 | 68 | 44 |
| Dadra \& Nagar Haveli | - | 100 | - | 59 | - |
| Karnataka | 67 | 99 | 68 | 71 | 61 |
| Goa, Daman \& Diu | - | - | - | - | - |
| Andhra Pradesh | 56 | 92 | - | 50 | 39 |
| Kerala . . | 137 | 164 | - | 57 | - |
| Andaman \& Nicobar Islands | - | - | - | - | - |
| Tamil Nadu | 199 | 126 | - | 57 | 81 |
| Lakshadweep | - | - | - | - | - |
| Pondicherry | - | 191 | - | - | - |
| All-India average yield (tonnes/ha) | $0 \cdot 378$ | 0.790 | 0.986 | 0.701 | $0 \cdot 666$ |

## RAINFALL AND CROPPING PATTERNS

## APPENDIX 14.6-Statement II_(Contd.)

| States/Union Territories | Other pulses | Groundnut | Sesamum | Linseed | $\begin{array}{r} \text { Castor } \\ \text { seed } \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Jammu \& Kashmir | 169 | 407 | 122 | 320 | - |
| Himachal Pradesh | 88 | 136 | 119 | 90 | - |
| Punjab - | 128 | 124 | 188 | 219 | - |
| Chandigarh | - | - | - | - | - |
| Haryana | 105 | 99 | 167 | 212 | - |
| Delhi | 94 | - | - | - | - |
| Rajasthan | 52 | 58 | 54 | 131 | 136 |
| Uttar Pradesh | 212 | 96 | 86 | 97 | 230 |
| Madhya Pradesh | 83 | 85 | 83 | 91 | 110 |
| Bihar . . | 158 | 91 | 149 | 255 | 152 |
| Orissa . | 133 | 160 | 234 | 154 | 219 |
| West Bengal . | 159 | - | 281 | 115 | - |
| Arunachal Pradesh | - | - | - | - | - |
| Assam (b) | 94 | - | 243 | 188 | 148 |
| Nagaland | - | - | - | - | - |
| Manipur | - | - | - | - | - |
| Tripura | 92 | - | 202 | - | - |
| Gujarat | 65 | 96 | 147 | - | 175 |
| Maharashtra | 74 | 91 | 107 | 81 | 52 |
| Dadra \& Nagar Haveli . | - | - | - | - | - |
| Karnataka . . | 73 | 92 | 130 | 100 | 168 |
| Goa, Daman \& Diu | - | - | - | - | - |
| Andhra Pradesh | 53 | 103 | 101 | 68 | 70 |
| Kerala . . | 98 | 197 | 164 | - | - |
| Andaman \& Nicobar Islands | - | - | - | - | - |
| Tamil Nadu | 57 | 126 | 159 | - | 139 |
| Lakshadweep | - | - | - | - | - |
| Pondicherry | - | 167 | 167 | - | - |
| All-India average yield (tonnes/ha) | $0 \cdot 378$ | 0.736 | 0.200 | 0.235 | $0 \cdot 303$ |

## APPENDIX 14.6-Statement II (Contd.)


*Sugarcane (gur)

## APPENDIX 14.6-Statement II (Contd.)


(a) Relative yield index-(RYI) is the State yield expressed as percentage of AllIndia and is based on data for the triennium ending 1970-71 as published in the Estimates of Area and production of principal Crops in India, 1971-72, Directorate of Economics and Statistics, Ministry of Agriculture \& Irrigation, Government of India.
(b) Includes Meghalaya \& Mizoram.

## APPENDIX 14.6 (Contd.)

(Paragraph 14.6.2)
Statement III-Cropping Patterns-Statewise
Notes :-

1. Cropping patterns of taluks with some dominant and some common crops but differing generally in one or two crops are grouped together and the differing crops shown as alternates by oblique lines e.g. $\mathrm{Pd}_{3} \mathrm{R}_{4} \mathrm{Pu}_{4} / \mathrm{Jk}_{4}$.
2. In a few cases taluk patterns have been shown under 'special' as they do not fit in with neighbourhood.
Andhra Pradesh
3. PD1
4. Pd2 Pu4/R4/Jr4/Gn4/B4/M4/S4/Fb4
5. Pd3 R4 O4
6. Pd3 Gn4 Fb4/Pu4
7. Pd3 Pu4 B4 O4
8. Pd3 Pu4 Fr4 O4/S4/To5
9. Pd3 Fr4 O4
10. Pd3 Pu4 Gn4 Jr4/Fr4
11. Pd3 Jr4 Mt4/Pu4
12. Pd3 B4 Fr4 R4
13. Pd3 Jr4 Jk4/S4/Pu4
14. Pd3 Jk4 O4/V4/F4
15. Pd4 M4 Jr4/S4/Pu4
16. Pd4 Pu4 M4 Jr4/Jk4
17. Pd4 Jk4 Gn4 Mt4/Jr4
18. Pd4 Ch4 Jr4 Pu4 To4/Gn4 Mt4
19. Pd4 To4 Jr4 F4/Mt4
20. Pd4 Jk4 Jr4 04 Pu4/B4
21. Jk3 C4Pu4/G4
22. Jk3 Gn4 Pd4 Mt4
23. Jk3 Pd4 O4 B4/Pu4
24. Jk3 Mt4 Gn4 C4 Pd5/Jr4
25. Jk4 Pu4 R4 Pd4 O4/Mt4
26. Jk4 Pd4 Jr4 O4 R4/Pu4
27. Jk4 Mt4 Gn4 Pu4/C4 Jr4
28. Jk4 Mt4 B4 O4/Pu4
29. Jk4 C4 Pu4 G4 Pd4
30. Jr3 Pu4 Pd4/O4/Jk4/Gn4
31. Jr3 Pd4 Gn4 Pu4
32. Jr3 Gn4 Mt4/Pd4
33. Jr4 Jk4 Pu4 O4
34. Jr4 Mt4 Pd4 To4 F4/G4 R4
35. Jr4 Pu4 Jk4/O4 Mt4/T4/Pd4/Gn4
36. Gn2 B4/Pd4
37. Gn3 Pd4 R4/S4/B4
38. Gn3 Jk4 Mt4/Pd4
39. Gn3 Pd4 Pu4 Mt4/R4 B4
40. Gn3 Pd4 Fb4/B4 Pu4
41. Gn4 Mt4 C4 Jk4/Jr4
42. Gn4 Mt4 Jk4 Jr4/Pu4
-41. O3 Jk4 B4
43. Pu3 Pd4 Mt4
44. Pu4 Pd4 B4 O4/Jk4 Gn4/Mt4/Jk4
45. Pu4 M4 Jk4 Pd4
46. M3 Pd4 Jk4/Pu4
47. M4 Pd4 Jk4 O4/R4
48. To4 Mt4 Jr4 F4/(Pd4 B4)
49. B4 R4 Pd4 O4
50. C3 Mt4 Jr4/(Gn4 Jr4)
51. Mt3 B4 Pd4 Jk4/Gn4
52. Mt4 B4 Pd4 Jk4 Ch4/Jr4

## Special

52. Pd4 Gn4 Fb4 B4 R4
53. Pd3 Gn4 Jk4 Mt5
54. Pd4 Mt4 Pu4 R4
55. R4 Pd4 Mt4 Pu4 Gn4
56. Mt4 Gn4 Pu4 R4 Jk4
57. Jk3 O4 Gn4
58. Jk4 Gn4 O4 Pu4 B4
59. Jk4 Jr4 O4 S4 V4
60. Jr4 Pd4 Pu4 G4

Assam

1. Pdl
2. Pd 2 L 4
3. Pd 2 Ju 4

Meghalaya

1. Pd 2 C 4
2. Pd 3 V 4 Fr 4

Tripura

1. Pd1

Manipur

1. Pdl

Nagaland

1. Pd2 Mt4/M4

Mizoram

1. Pd1

Arunachal Pradesh

1. Pdl
2. Pd2 M4/Mt4/O4

## Bihar

1. Pd1
2. Pd2 Pu4/W4/M4/Mt4
3. Pd3 Pu4 W4/M4/Ju4
4. Pd3 W4
5. Pd3 M4 Pu4 O4
6.' Pd4 M4 W'4 S4/Ba4/Pu4
6. Pu3 Pd4 W4
7. $\mathrm{M}_{3} \mathrm{Pd} 4 \mathrm{~N}_{4}$

## Gujarat

1. Pdl
2. Pd 2 Fr 4
3. Pd3 Pu4 Jk 4
4. Pd3 R4 Pu4/Jk4
5. Pd4 Jk4 Gn4 C4 Pu4/Mt4
6. B2 F4;Jk4
7. B3 Gn4 Jk 4 S4
8. B3 Gn4 C4 Jk4

## F4

9. B 3 Gn 3
10. B3 Jk 4 F4, C4
11. B3 F 4 Jk 4 PutiW 4
12. B3 Pd4 Mts Tof W4
13. B3 W $4 \mathrm{O}+\mathrm{F} 4$, Jh 4
14. B3 Jk 4 C4 WS
15. B4 Jk 4 Wi C4 Got Ot, Put, F4, Mits
16. B4 Jk 4 Pd 4 F 4 W 4
17. Jk 3 B +Gn 4 H 4
18. Jh 3 C 4 F 4
19. Jk 3 C4 Gind Pdt Frt
20. Jk 4 PJt C 4 Put Fr 4
21. Jr? Gnt Wis
22. Jr $\&$ PJ $4 \mathrm{C}+\mathrm{Ml} 4$
23. M3 WS Pd4C4
24. M3 Put Gn4 Mit G4
25. M4 PJ4 Gnt B -G 4
26. M4C4GntPJ4B4W4
27. M4 Mt+ W 4 F4 B4
28. Gnl
29. $\mathrm{Gn} 2 \mathrm{B4}$, Jht C 4
30. Gn3 B3
31. Gn3 B+ Jk4, C4
32. Gn3 C4 F4 Jr 4
33. Gn4 B4 C4 M4;Pd4
34. Gn4 Put B4 F4,Jh4
35. Gn4 Jr4 F4 B4
36. Cl
37. C2 Jr4/Jk4;B4
38. C3 Jk $4 \mathrm{~B} 4 / \mathrm{W} 4 ;$ Pd $\downarrow$
39. C3 Jr4 Jk4/Pd4
40. C3 Jr4 Pd4 Tot, Ml4 (B4, To4)
41. C4 Pd4 B4 M4/To4
42. C4 Pd4 Jr4 Frt,'Pu4

## APPENDIX 14.6-Statement III (Contd.)

43. C4 Pd4 Mt4 Gn4/Jr4/3k4/(Gn4, M4)
44. To3 B4 Pd4

## Special

45. Pd3 W4 B4 C4
46. B4 M4 Pd4 R4
47. W4 B4 C4 Pd4
48. Pu4 F4 Jk4 B4
49. Gn 4 B 4 C 4 Pd 4
50. C4 Gn4 M4 B4
51. R3 Mt4 04 Pd4

## Haryana

1. B3 G3
2. B3 G4 W4
3. G3 W4 B4 C4
4. G4 B4 W4 C4/J4
5. W3 Pd4 M4/G4
6. W3 Pd4 G4 S4/J4
7. W3 G4 B4 S4/J4
8. W3 G4 B4 Ba4
9. W4 Pd4 M4 G4
10. W4 G4 B4 J4 Ba4

Himachal Pradesh

1. W3 M3
2. W3 M3 Pd4/G4
3. W3 M4 Pd4/G4/P4/Ba4/Ba4 Mt4
4. W4 M4 Mt4
5. W4 Ba4 Pt4 Mt4/Mt4 Pd4
6. M2 W2
7. M3 W3
8. M3 W3 G4/Pd4
9. $\mathrm{Ba} 2 \mathrm{~W} 4 / \mathrm{Pu} 4$
10. Ba3 Mt4 W4
11. Mtl
12. Mt3 Bat
13. Pt3 W4 M4
14. Fr 4 W $4 \mathrm{M} 4 / \mathrm{Mt} 4$

Jammu and Kashmir

1. M1
2. M2 W4
3. M3 W3
4. M3 W4 Ba4/Pu4/Mt4/Pd4
5. Mt3 W4/ (W4 Pu4)
6. W3 M3
7. W3 M4 Pd4/B4
8. Pd3 M4 W4/O4/V4
9. Pd3 M4 Pu4/W4

## APPENDIX 14.6-Statement III (Contd.)

10. Pd3 M3
11. Pd3 W3
12. Pd2 M4

Karnataka

1. L2 Pd3
2. L3 Pd3
3. Gn3 B4 R4
4. Gn4 Jk4 To4 S5
5. Gn3 Jk4 C4/W4/Pu4
6. Gn4 Jr4 Jk4 B4/W4
7. Pu4 G4 Jk4 Jr4

Jr5 Mt5 Gn5
8. Pu4 Mt4 O4 B4 Jr4
9. Pu4 T4 Jr4 Gn4 O4/Jk4
10. Pu4 Gn4 Mt4 Jk4 W4 C4
11. Pu4 Jk4 Mt4 B4/Gn4/R4 Gn4
12. Jr4 Mt4 Gn4 Pu4
13. Jr4 B4 Jk4 Gn4
14. Jr4 B4 Jk4 Gn4/W4/M4
15. Jr3 G4 Pu4 Jk5
16. Jr3 O4 Gn4 T4/C4/T4 B4
17. Jr3 O4 T4
18. Jr3 B4 Gn4/C4
19. Jk3 Pu4 R4/Gn4
20. Jk4 Pu4 R4 Pd4/Gn5 Pd5
21. Jk4 C4 Gn4 R4/Pu4
22. Jk4 Mt4 B4 Gn4/C4/C4 Pu4
23. Jk4 C4 Gn4 W4/Pu4 Pd4 Jr4
24. C4 Jk4 Gn4
25. C3 Jk4 Mt4
26. C3 W4 Jr4
27. C3 Jr4 Mt4/Pd5
28. C4 Jk4 Pu4 Mt4 Gn4/S4/Pd4
29. C4 Mt4 Jr4 Jk4 Pu4
30. C4 Jr4 Jk4 Mt4/Gn4/Gn4 Pu4/B4/B4 Mt4
31. R2 Pu4/Pd4/Pu4 Pd4/Pu4 Pd5/Pu4 M4
32. R3 Pd4 Pu4 L4/Jk4
33. R3 Pu4 Nf4
34. R3 Gn4 Pd4/Mt4/Pu4/Pu4 Pd4
35. R3 Pu4 Pd4/LA
36. R4 L4 Pu4 Mt4/Jk4/Pd4/Mt4 Jk4
37. Mt4 R4 Jk4 Pu4
38. PdJ
39. Pd2 LA/B4/M5/V4/F4
40. Pd3 R4 L4/Pu4
41. Pd3 R4 F4 Jk5
42. Pd4 C4 Jk4 Mt4 Ch4

APPENDIX $14.6-$ Statement III (Contd.)
43. Pd4 C4 Gn4 Pu4
44. Pd4 R4 Jk4 Gn4/Pu4
45. Pd4 R4 Pu4 S4/Jk4
46. Pd4 R4 Pu4/L4
47. W3 C4 Jk4/Jr4
48. Nf2 Pd4 R4
49. B4 Jk4 M4 Pu4 Gn4 $\mathrm{Nf}=$ (Non-food crops)

## Kerala

1. L2 Pd4 (Ta4)
2. L3 Pd3 (Ta4)
3. L3 Ta4 Pd4
4. Pd2 L4
5. Pd3 L3

Madhya Pradesh

1. Pdl
2. Pd2 Mt4/Pu4
3. Pd3 Mt3
4. Pd3 Mt4 Pu4/G4/O4/W4
5. Pd3 W4 G4/Mt4/O4
6. Pd3 Mt4 Pu4 W4
7. Pd3 W4 G4 Mt4/Pu4
8. Pd4 G4 W4 Jk4 Ba4
9. Pd4 Mt4 G4 O4 W4
10. W2 G4/Pu4/Jk4/F4
11. W3 Pd4 O4/G4
12. W3 G4 Jk4/Pd4/O4/Pu4
13. W3 Jk4 F4/G4/O4/C4
14. W3 04 C4/Pu4
15. W3 O4 Pu4 G4
16. W3 Jk4 G4 F4/Pu4
17. W3 F4 Pu4
18. W4 Pd4 Mt4 G4/O4
19. W4 Pd4 Mt4 G4 O4
20. W4 Mt4 F4 O4 Ba4
21. W4 Mt4 F4 Jk4/Pd4
22. W4 Jk4 O4 F4/G4
23. W4 Jk4 O4 F4 Mt4 M4 Pu4
24. W4 G4 F4 Pu4 Jk4/C4
25. W4 G4 Pu4 O4
26. Jk3 C3
27. Jk3 C4 Pu4/F4/Gn5/W5
28. Jk3 W4 F4/G4/Pu4
29. Jk3 Gn4 T4
30. Jk3 C4 B4 Pu4/W4
31. Jk3 W4 F4 C4/G4
32. Jk3 F4 C4 M4/W4

## APPENDIX 14.6-Statement 111 (Contd.)

33. Jk3 F4 Gn4 M5
34. Jk3 Pu4 F4 Gn4/W4
35. Jk4 F4 W4 G4/C4
36. Jk4 F4 W4 G4 Pu4
37. Jk4 Mt4 W4 04 G4
38. Jk4 Mt4 W4 Pu4 G4/T4
39. Jk4 M4 Pu4 C4 Gn4/W4
40. Jk4 C4 Gn4 Pu4/W4
41. C3 Jk4 Pu4
42. C4 Jk4 Pd4 Mt4
43. C4 Pu4 Mt4 Gn4 F4
44. C4 Gn4 W4 G4 Pu4/F4
45. G4 W4 O4 B4/Jk4
46. G4 W4 O4 Ba4
47. G4 W4 Pu4 Jk4
48. Pu3 Jk4 B5 C5
49. Pu4 W4 G4 Jk4
50. Mt3 Pd4 O4/Ba4
51. Mt3 W4 G4 Jk4
52. Mt4 Pu4 Jk4 M4/B4
53. M3 Jk4 Pd4 Mt4/C4
54. M4 Jk4 C4 F4 Mt4
55. B3 O4 W4/G4
56. F4 Jk4 W4 G4
57. F4 W4 M4 Jk4 Gn4

Maharashtra

1. Pd1
2. Pd2 R4
3. Pd2 R4 Mt4
4. Pd2 Jr4
5. Pd2 Pu4
6. Pd2 Fr4 R4
7. Pd3 R4 Mt4
8. Pd3 Fr4 L4
9. Pd3 Gn4 Jk4 S4
10. Pd3 R4 Jr4 Mt4
11. Pd3 R4 Mt4 S4
12. Pd3 R4 O4 W4
13. Pd3 Jr4 Pu4
14. Pd4 Gn4 Jk4 Jr4 R4
15. BI
16. B2 Pu4
17. B2 Pu4 (Jr4)
18. B3 W4
19. B3 Jr3
20. B3 Jr4 Pd5 Gn5
21. B3 Pu4 Gn4 R5
22. B3 Pu4 C4 Jr4 W5

## APPENDIX 14.6-Statement III (Contd.)

23. B3 Jr4 Pu4 C4 O5
24. B3 Jr4 Pu4
25. B3 Gn4 Pu4 C4
26. B3 R4 Pd4 Pu5
27. B3 Jk3 Gn4
28. B4 W4 R4 Pd4 Pu4
29. B4 Jr4 Gn4 Jk4
30. Jr1
31. Jr2 B4
32. Jr2 T4 Gn4
33. Jr2 Pu4 OS
34. Jr3 B4 Pu4 O4
35. Jr3 B4 O5 W5
36. Jr3 B4 S4
37. Jr3 B3
38. Jr3 Pd4 R4 Gn4 (R5)
39. Jr3 Gn4 B4 Pu4 Pd4

40 Jr3 B3 Pd4
41. Jr3 B4 Pu4 O4
42. Jr3 C4 Pu4 O4/B4
43. Jr3 Pd4
44. Jr4 W4 O4 Pd4 C5 (Jk4)
45. Jr4 Pu4 Gn4 W4
46. Jr4 B4 Pu4 O4 W4
47. Jr4 Gn4 Pu4 O4 T4
48. Jk3 C4 Pu4
49. Jk3 C3 Pu4
50. Jk3 C4 T5
51. Jk3 C4 Gn4 Pu4
52. Jk3 Gn4 Pu4 S4
53. Jk3 Mt4 Pd4
54. Jk4 C4 Pu4 Jr4 O4
55. Jk4 C4 Pu4 Jr4 O5 Gn5
56. Jk4 Pu4 Gn4 O4 W5
57. Jk4 Gn4 Pu4 O4 T4
58. Jk4 Pu4 B4 Gn4 O4 W5
59. Jk4 Pd4 C4 Mt4
60. Mt3 Pu4 C4 Jr4 Gn4
61. R3 Mt4 O4 Pu4 Pd4
62. W3 R4 Pu4 O5 G5 Frs
63. C2 Jk4
64. C3 Jk3
65. C3 Pu4 Jk4
66. C3 Pu4 Jk4 Gu5
67. C4 Jr4 Pu4 Jk4
68. C4 Pu4 Jk4 B4
69. C4 Pu4 Jr4 B4
70. Gn4 Pd4 Jk4_Mt4

## APPENDIX 14.6-Statement III (Contd.)

71. Gn4 Jk4 Jr4
72. Pu4 Jk4 C4 B4

Orissa

1. Pd1
2. Pd2 Pu4/R4/G4/O4/Mt4/Pu4 O5/O4 Pu5
3. Pd3 Pu3
4. Pd3 Pu4 Mt4/R4
5. Pd3 Pu4 O5 Mt5
6. Pd3 Mt4 M4 O4
7. Pd3 R4 O4 Mt5
8. Pd4 R4 O4 V4/M4/Mt4 Pu4/Mt4 Pu5
9. R4 Pd4 O4 Mt4/T4

Punjab

1. W3 Pd4 F4/M4
2. W3 F4 M4/C4/Gn4/Pd4
3. W3 F4 G4 B4/Pd4
4. W3 F4 M4 C4
5. W4 M4 G4 F4/Pd4
6. C4 W4 G4/F4

Rajasthan

1. B1
2. B2 Pu4/F4/Jk4
3. B3 Pu3/F3
4. B3 Pu4 F4
5. B3 O4 Jk4/F4/Pu4
6. B3 G4 W4/Ba4
7. B3 Pu4 G4 Ba4/F4
8. B3 G4 W4 Gn4
9. B3 O4 Pu5 Jk4/W4
10. B4 O4 Pu4 Mt4/F4
11. B4 W4 O4/Ba4/Pu4/Gn4
12. B4 Ba4 W4 Pu4/G4/O4/Gn4
13. G3 F4 B4/W4/C4
14. G4 W4 B4 Jk4/O4
15. G4 W4 B4 Jk4/Ba4
16. M1
17. M2 Mt5 W5
18. M2 Pu4 Gn4/Ba4
19. M2 W4 Ba4/Mt4/Gn4
20. M3 Pd4 W4 G4/Mt4
21. M3 W4 Ba4 O4/Gn4/C4
22. M3 W4 O4 Mt4/Pu4
23. M3 O4 Ba5 (Pu4/W4/C4)
24. M4 Jk4 B4 Ba4
25. M4 W4 Jk4 Gn4/C4
26. M4 Pd4 G4 Mt4 C4/W4
27. M4 W4 Ba4 (F4/Jk4) O5

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## APPENDIX 14.6-Statement III (Contd.)

28. C4 W4 F4
29. W3 Jk4 G4/O4
30. W4 F4 G4 C4/O4
31. W4 Jk4 G4 B4
32. W4 G4 B4 O4
33. Jk3 W4 G4/M4/C4/Pu4
34. Jk3 C4 M4 B4/W4
35. Jk3 B4 (G4 W4) /(C4 Pu4)
36. Jk4 W4 G4 M4
37. Jk4 B4 O4 Pu4/M4
38. Pu2 B3
39. Pu3 B3
40. F3 O4 M4
41. F4 B4 O4 Jk4
42. C4 F4 B4 Pu4/M4

Special M3 Pd4 Jk4
Tamil Nadu

1. Pd 1
2. Pd $2 \mathrm{Gn} 4 / \mathrm{R} 4$
3. Pd 3 Gn 3
4. Pd3 Gn4 Mt4/B4/Jk4
5. Pd3 Gn4 B4 L4
6. Pd3 Gn4 Mt4 Jk4/B4
7. Pd3 Jk4 B4 Gn4
8. Pd3 Jk4 Gn4 Pu4/Jr4
9. Pd3 Jk4 Jr4 Mt4/B4
10. Pd3 Mt4 B4 C4/L4
11. Pd3 C4 B4
12. Pd3 Pu4 Gn5 Os $5 / \mathrm{Fr} 5$
13. Pd3 Ta4 L4
14. Pd4 Gn4 Mt4 Jk4 R4/B4 (Pu4)/(S4)
15. Pd4 B4 Gn4 Jk4 R4/C4
16. Pd4 Mt4 Gn4 C4 B4
17. Pd4 B4 Jr4 Gn4 Mt4 Jk5
18. Pd4 Jk 4 Pu4 Jr5 Mt5
19. Jk3 C4 Pu4
20. Jk3 C4 Pu4 Gn4
21. Jk3 Pd4 Mt4 B4/Gn4
22. Pu4 Mt4 Jk4 R4/Gn4/Pd5
23. Pu4 Jr4 Pd4 B4 Jk4
24. R3 Pu4 O4
25. R4 Jk4 Pu4 Gn4
26. B3 C4 Mt4
27. B3 O4 Jk4
28. B4 Gn4 Jr4 Pd4
29. B4 Jk4 Mt4 Gn4 Jr4

## APPENDIX 14.6-Statement III (Contd.)

30. Gn3 Pd4 S4 Jr4
31. Gn3 Jk4 B4 Pd4
32. Gn4 Pd4 Mt4 V4 Jk4/Jr4
33. C3 B4 Mt4/F4/Pd4
34. C4 Mt4 Pd4 F4 Gn4/B4
35. Pd4 Pu4 Mt4

Special
36. L1
37. L2 Pd4
38. L3 Pt3
39. Fr3 L4 Pt4
40. Jk4 Pd4 Mt4 Gn4 C4/Jr4
41. Jr3 Pu4 Mt4 Pd4
42. Gn3 Jk4 Mt4 L4 Pd5
43. C4 Jk4 Pd4 Pu4 Mt4
44. Pd4 B4 Gn4 C4 B4 (Ba4)
45. Jk3 Pd4 Mt4 (B4)

## Uttar Pradesh

1. Pd2 W4
2. Pd3 W4 M4/Pu4/G4/Ba4/S4/Mt4/G5
3. Pd3 W4 G4 Pus
4. Pd3 W4 Pu4 G5/Mt4/M4
5. Pd3 Ba4 Pu4
6. Pd3 Ba4 Pu4 W4/T4/ $\frac{\mathrm{S} 4 / \mathrm{M} 4 / \mathrm{G} 4 \text { : }}{}$
7. Pd3 W4 Ba4 Pu4/Jk4/M4
8. Pd4 W4 S4/G4
9. Pd4 W4 S4 G4/M4/Pu5
10. Pd4 W4 Ba4 G4/Pu4/Mt4/Jk4/M4
11. Pd4 W4 Ba4 B4 G4/Pu4/Pu5
12. Pd4 W4 Ba4 B4 G4 Mt4
13. Pd4 W4 Ba4 Jk4/Pu4/G4/Mt4
14. Pd4 W4 Ba4 Jk4 Pu4
15. Pd4 W4 Ba4 G4 M4
16. Pd4 W4 Ba4 B4 Pu5 S5 B5
17. Pd4 W4 Ba4 Pu5 S5 B5
18. G3 W3/W4
19. G3 W4 B4/Jk4/T4/Pd4
20. G4 Pd4 Ba4 B4
21. G4 W4 Pd4 Ba4 Jk4/B4/M4/Pu4
22. G4 Jk4 T4 B4/W4
23. S3 W4 F4
24. B4 G4 T4
25. B4 W4 G4 O4
26. M3 Pd4 W4
27. M4 Pd4 W4
28. Ba4 M4 Pd4_W4

## APPENDIX 14.6-Statement III (Contd.)

29. Ba4 Pd4 W4 B4 G4
30. Mt3 Pd4 Ba4/M4
31. W3 S4 F4/Pd4/M4
32. W3 S4 F4 M4
33. W3 S4 Pd4 G4/F4/B4
34. W3 Jk4 Mt4
35. W3 G4 Pd4
36. W3 G4 B4 $\frac{\mathrm{Pu}}{5} / \mathrm{O} 4$
37. W3 B4 M5 Ba5
38. W3 B4 M4 Gn4 Pu5/G5
39. W3 M4 G5 V4/V5 B5
40. W3 M4 S4 Pd5 B4/Gn4
41. W3 Ba4 G4 F5 B4/Jk4
42. W3 M4 Jk4 G4 Pu4
43. W4 Pd4 S4 F4/M4/G4/G5/O4/Gn4/G5 Pu5
44. W4 Pd4 M4
45. W4 Pd4 M4 G4/S4/B4
46. W4 Pd4 G4 B4 M4/O4/M4 Ba4/S4
47. W4 Pd4 G4 Ba4 Jk4/M4/M4 Ba4
48. W4 Pd4 G4 Pu5 S5/B5
49. W4 Pd4 G4 Jk5 B5 M5/S5
50. W4 Pd4 B4 G4/M4
51. W4 Pd4 G4 S4/Gn4/S5
52. W4 M4 B4 Pu4 Ba4/Pd4/G4
53. W4 M4 B4 Pu4/Pd4
54. W4 M4 B4 Gn5 G5/Pd5
55. W4 M4 Pd4 B5 Pu5
56. W4 M4 Pd4 Gn4 Ba4/G4
57. W4 M4 R4 Mt4
58. W4 M4 G4 Pd4
59. W4 M4 S4 Pu5
60. W4 B4 Pd4 G4 M4/O4/M4 Ba4
61. W4 B4 G4 Pu4/Pd4/M4/O4
62. W4 S4 F4 G4/M4/Pu4
63. W4 B4 G4 Gn4 Pu5 M5
64. W4 Gn4 G4 Ba4 M4/Pd4

West Bengal

1. PdI
2. Pd3 Pu4 Ju4
3. Pd 3 Pu4
4. Pcl3 M4 Te4

Statement IV-Number of Cropping Patterns-Statewise




## APPENDIX 14.6 (Contd.)

## Notes

1. The first column contains the Rainfall Pattern of the Rainfall Region and all-India Zone numbers included in the Region. The all-India Zone numbers denote the number in the all-India Zonal list given in Appendix 14.4, Statement VI. For symbols etc. sections 14.4 and 14.5 should be consulted
2. For facility of reference, the numbers of the Rainfall Zones of the States included in the Region are given in column 5 .
3. The geographical area included in column 6 is based on reporting areas of taluks etc.
4. The cropping patterns given in the last column are in respect of the State areas included in the Region.
5. GIA-Gross Irrigated Area. GCA-Gross Cropped Area. na -Not available.

| Rainfall <br> Pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in the State | Geographical area ('000 ha) | $\begin{aligned} & \text { GCA } \\ & \text { ('000 ha) } \end{aligned}$ | District <br> \% of GIA <br> to GCA | Cropping Patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Region-1 |  |  |  |  |
| E4(E4)E4 | Rajasthan | Jaisalmer | Jaisalmer, Pokaran | I | 11,356 | 2551 |  | $\begin{aligned} & \text { B1 } \\ & \text { B2 Pu4/F4/JK4 } \\ & \text { B3 Pu3/F3 } \end{aligned}$ |
| $\begin{aligned} & 155,159, \\ & 163,169, \\ & 173 . \end{aligned}$ |  | Barmer | Pachbhadra, Sheo |  |  |  | $2 \cdot 6$ | Pu2 B3 <br> Pu3 B3 <br> G3 F4 B4/W4/C4 |
|  |  | Jodhpur | Sliergarh, Phalodi |  |  |  |  | C4 W4 F4 <br> W4 F4 G4 C4/04 |
|  |  | Bikaner | Kolavat, Lunkaransar, Bikaner, Nokha |  |  |  | $0 \cdot 1$ |  |
|  |  | Churu | Sardar Shahr, Dungargarh |  |  |  | $0 \cdot 03$ |  |



APPENDIX 14.6-Statement V (Contd.)



| Rainfall <br> Patterns/ <br> all-India <br> Zone no(s) | State | District |
| :--- | :--- | :--- | :--- | :--- | :--- |

APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement V (Contd.)





APPENDIX 14. 6-Statement V (Contd.)



APPENDIX $14 \cdot 6$-Statement V (Contd.)



APPENDIX 14.6 Statement-V (Contd.)



APPENDIX 14.6-Statement V (Contd.)


APPENDIX $14 \cdot 6$-Statement $V$ (Contd.)


APPENDIX $14 \cdot 6$-Statement $V$ (Contd.)





APPENDIX $14 \cdot 6-S t a t c m e n t$ V (Contd.)

| Rainfall Pattern/ all-India Zone no(s) | State | District | Taluk $\quad$Rainfall <br> zone no(s) <br> in stato | Geographical area <br> ('000 ha) | Gross cropped area ('000 ha) | District <br> $\%$ of <br> GIA <br> to GCA | Cropping pattern |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Uttar Pradesh | Saharanpur | Deoband Roorkee, Saharanpur IV | d.) 9639 | 8594 | $91 \cdot 9$ | W3 S4 F4/M4/Pd4 W3 Pd4 S4 G4/F4/ B4 |
|  |  | Bijnor | Bijnor |  |  | $30 \cdot 0$ | W3 M4 S4 Pd5 B4/Gn4 <br> W3 B4 M4 Gn4 <br> Pu4/G5 |
|  |  | Muzaffarnagar | Muzaffarnagar, Jansath |  |  | 63.0 | $\begin{aligned} & \text { W3 M4 G5 V4/ } \\ & \text { V5 B5 } \end{aligned}$ |
|  |  | Meerut | Mawana, Sardhana, Meerut |  |  | $65 \cdot 7$ | W3 Pd4 Gn4/S4 |
|  |  | Moradabad | Moradabad, Amroha, Bilari, Hasanpur, Sambhal |  |  | $38 \cdot 6$ | W4 Pd4 S4 F4/M4 W4 S4 F4 Gn4/ M4/Pu4 <br> W4 Pd4 S4 G4 W4 Pd4 G4 Pu5 S5/BS |
|  |  | Rampur | Shahabad |  |  | $20 \cdot 0$ | W4 B4 G4 Gn4 Pus M5 <br> W4 B4 M4 Pu4 |
|  |  | Budaun | Budaun, Sahaswan, Bisauli, Dataganj |  |  | $32 \cdot 3$ | W4 B4 M4 Gn5 G5/Pd5 Pu5 W4 M4 Pd4 G4 |
|  |  | Barreilly | Aonla |  |  | $31 \cdot 5$ | W4 M4 Pd4 Gn4 Ba4/G4 <br> W4 Gn4 G4 Ba4 M4/Pd4 |
|  |  | Shahjahanpur | Tihar, Jalalabad |  |  | 26.9 | W4 B4 M4 Pd4 G4 W4 Pd4 B4 M4 |

pur

| Etah | Kasganj, Aliganj |  | W4 B4 Pd4 G4 M4/O4/M4 Ba4 W4 Pd4 Ba4 G4 Jk4/M4/M4B4 |
| :---: | :---: | :---: | :---: |
| Farrukhabad | Farrukhabad, Kaimganj, Chhibramau, Kannauj | 37.8 | W4 Pd4 G4 B5 S5 Jk5 <br> W4 Pd4 G4 S5 W4 Pd4 M4 |
| Hardoi | Shahabad, Hardoi, Bilgram, Sandila |  | Pd3 W4 G4/ <br> Ba4/Pu4 <br> Pd3 W4 G4 Pus |
| Agra | Bah |  | Pd3 W4 Ba4 Pu4/ G4/M4 <br> Pd3 W4 Ba4 Pu4/ Jk4 |
| Etawah | Etawah, Bharthana, Bidhuna, Auraiya |  | Pd4 W4 Ba4 <br> Jk4/Pu4/G4 <br> Pd4 W4 B4 Ba4 <br> Pu5/G4 |
| Jalaun | Konch Orai, Jalaun, Kalpi | $32 \cdot 2$ | Pd4 W4 Ba4 M4 |
| Kanpur | Bilhaur, Kanpur, Akbarpur, Derapur, Bhogipur, Ghatampur | $30 \cdot 1$ | G3 W3 <br> G3 W4 B4/Jk4/T4 <br> G4 W4 Pd4 Ba4 <br> Jk4/B4 |
| Unnao | Purwa, Unnao, <br> Hasanganj, <br> Safipur | 29.4 |  |
| Lucknow | Malihabad, Lucknow Mohanlalganj | $32 \cdot 6$ | G4 Pd4 Ba4/B4 <br> G4 Jk4 T4 W4/Ba4 S3 W4 F4 |
| Barabanki | Fatehpur, Haidargarh | 27.8 | $\begin{aligned} & \text { B4 G4 T4 } \\ & \text { Ba4 Pd4 W4 B4 G4 } \end{aligned}$ |
| Sitapur | Biswan, Sidhauli | $16 \cdot 7$ |  |
| Sultanpur | Musafirkhana, Amethi Sultanpur | $30 \cdot 1$ |  |
| Faizabad | Akbarpur | $42 \cdot 5$ |  |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall <br> Pattern/ <br> all-India <br> Zone no(s) | State | District | Taluk Rainfall <br> zone no(s) <br> in state | Geographical area <br> ('000 ha) | Gross cropped area ( 000 ha ) | District $\%$ of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| REGION-7 (Contd.) |  |  |  |  |  |  |  |
|  |  | Rae | Salon, Rae Bareli, |  |  | $36 \cdot 4$ |  |
|  |  | Bareli | Palmau |  |  |  |  |
|  |  | Fatehpur | Fatc hpur, Khaga, Bindki |  |  | $26 \cdot 3$ |  |
|  |  | Hamirpur | Maudaha, Mahoba, Charkhari, Rath, Hamirpur |  |  | $15 \cdot 4$ |  |
|  |  | Jhansi | Garautha, Mauranipur, Jhansi |  |  | $18 \cdot 7$ |  |
|  |  | Allahabad | Allahabad, Sirathu, Manjhanpur, Phulpur, Soraon Karchhana |  |  | $23 \cdot 1$ |  |
|  |  | Banda | Mau' |  |  | $16 \cdot 2$ |  |
|  |  | Jaunpur | Machhlishahr, Mariahu, Shahganj |  |  | $43 \cdot 1$ |  |
|  |  |  |  | 19473 | 13789 |  |  |



APPENDIX 14.6-Statement V (Contd.)

| Rainfall <br> Pattern/ <br> all-India <br> Zone no(s) | State | District | Taluk | Rainfall Zone no(s) in state | Geographical area <br> ('000 ha) | Gross cropped area ('000 ha) | District Cropping patterns $\%$ of GIA to GCA |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | REGION-8 (contd.) |  |  |  |  |  |  |
|  | Uttar <br> Pradesh | Ratlam | Ratlam, Saliana | V | 1,050 | 974 | 6.5 C4 Pu4 M4 Gn4 F4 <br> Mi4 Pu4 Jk4 B4/M4 |
|  |  | Dhar | Dhar, Badnawar, Mukshi, Sardarpur |  |  |  | $4 \cdot 8$ |
|  |  | Jhabua | Jhabua, Thandla, Petlawad, |  |  |  | $2 \cdot 2$ |
|  |  | Dewas Azamgarh | Alirajpur, Jobat Dewas |  |  |  | $2 \cdot 6$ |
|  |  |  | Ghosi, Sagri <br> Mohammadabad |  |  |  | Pd3 Ba4 Pu4 W4/ T4 |
|  |  | Lakhimpur | Lakhimpur, Mahamdi | I II X | 1384 | 1179 | $\begin{aligned} & 9 \cdot 8 \text { Pd4 W4 S4 M4/G4 } \\ & \text { Pd4 W4 Ba4 G4 } \end{aligned}$ |
|  |  | Sitapur | Sitapur, Misrikh |  |  |  | $\begin{gathered} 16 \cdot 7 \mathrm{~W} 4 \mathrm{Pd} 4 \mathrm{G} 4 \mathrm{~S} 4 / \\ \mathrm{Ba} 4 / \mathrm{Gn} 4 \end{gathered}$ |
|  | Bihar | Ghazipur <br> Patna <br> Saran <br> Bhagalpur Santhal Parganas | Zamania |  |  |  | $33 \cdot 0$ |
|  |  |  | Bihar Barh |  |  |  | $51.0 \begin{gathered}\text { Pd2 Pu4 }\end{gathered}$ |
|  |  |  | Chapra ${ }^{\text {Bhagalpur, Banka }}$ |  |  |  | 21-1.5 $\left\{\begin{array}{l}\text { Pd3 W4 } \\ \text { Pd4 M4 W4 Ba4 }\end{array}\right.$ |
|  |  |  | Godda |  |  |  | $8.8\left\{\begin{array}{l}\text { Pd4 M4 W4 Pu4 } \\ \text { Pu3 Pd4 W4 }\end{array}\right.$ |
|  |  |  |  |  | 7904 | 5262 |  |

APPENDIX 14.6-Statement V (Contd.)


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APPENDIX 14.6-Statement V (Contd.)

| Rainfall <br> Pattern/ <br> all-India <br> Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | $\begin{aligned} & \text { Geographical } \\ & \text { area } \\ & \text { ('000 ha) } \end{aligned}$ | Cross cropped area ('000 ha) | District Cropping patterns \% of GIA to to GCA |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| REGION-9 (Contd.) |  |  |  |  |  |  |  |
|  | Uttar Pradesh | Shahabad | Buxar |  |  |  | 60.5 M3 W4 Pd4 |
|  |  | Patna | Patna, |  |  |  | 51.0 |
|  |  |  | Sadar Patna City Dinapur |  |  |  |  |
|  |  | Darbhanga | Madhubani | VI VII | 462 | 487 | 9.3 W4 |
|  |  | Ballia | Rasra, Bansdih |  |  |  | $32 \cdot 9 \underset{\mathrm{M} 4}{\mathrm{Pd} 3} \mathrm{Ba} 4 \mathrm{~W} 4 / \mathrm{S} 5 /$ |
|  |  | Deoria | Salempur, Deoria |  |  |  | 37.7 Pd4 W4 Ba4 Mt4 |
| . |  |  |  |  |  |  | Pd4.W4 Ba4 M4 G4 |
|  | Andhra Pradesh | Nizamabad | Madnur, Banswada, | XIX | 494 | 218 | $43 \cdot 1 \begin{gathered} \text { Pd2M4 } \\ \text { Pd3 Jr4 Jk4/S4/ }_{\text {Pu4 }} \end{gathered}$ |
|  |  |  | Yellareddy, Nizamabad, Bodhan |  |  |  | Jr4 Pu4 Jk4 Gn4 |
|  |  |  |  |  | 4536 | 4007 |  |

APPENDIX 14. 6-Statement V (Contd.)


APPENDIX 14. 6-Statement V (Contd.)


APPENDIX $14 \cdot 6$-Statement V (Contd.)

| Rainfall Pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) state | $\begin{aligned} & \text { Geographical } \\ & \text { area } \\ & \text { ('000 ha) } \end{aligned}$ | Gross cropped area ('000 ha) | ```District Cropping Patterns \(\%\) of GIA to GCA``` |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | REG | N-12 |  |  |  |
| $\begin{aligned} & \text { EA(AIB1C2) E4 } \\ & 064 \\ & 065 \\ & 066 \end{aligned}$ | Andhra <br> Pradesh | Warrangal Adilabad | Parkal, Mulug Adilabad Boath, Mudhol, Utnur Khanapur, Nirmal | X | 1271 | 471 | $30 \cdot 6 \mathrm{Pd} 2 \mathrm{Jr} 4$ |
|  |  |  |  |  |  |  | 6.9 Pd3 M4 Pu4 |
|  |  |  |  |  |  |  | Pd4 Pu4 Jr4/Jk4 |
|  |  |  |  |  |  |  | Jk3 C4 O4/Pu4 |
|  |  |  |  |  |  |  | $\begin{aligned} & \text { Jk4 C4 Pu4 Pd4/ } \\ & \text { O5 } \end{aligned}$ |
|  | Gujarat | Kheda | Matar, Borsad, | XI | 1995 | 1051 | $21 \cdot 5 \mathrm{Cl}$ |
|  |  |  | Petlad, Thasra, |  |  |  | $\mathrm{C}_{2} \mathrm{Jr} 4$ |
|  |  |  | Balasinor |  |  |  | C3 Jr4 Jk4 |
|  |  |  | Anand |  |  |  | C3 JI4 Pd4 <br> C3 Jr4 Pd4 To4/M |
|  |  | Panchamahals | Santarampur, |  |  |  | $3 \cdot 1 \mathrm{Mt} /(\mathrm{B} 4 \mathrm{To4)}$ |
|  |  |  | Godhra, Kahal, |  |  |  | C4 B4 Pd4 M4/ To4 |
|  |  |  | Halal |  |  |  | C4 Pd4 Mt4 Gn4/ |
|  |  |  | Devgarbharia |  |  |  | $\mathrm{Jr}^{\mathrm{C} 4} \mathrm{Pd} 4 \mathrm{Jk} 4 \mathrm{Mt4}$ |
|  |  |  |  |  |  |  | M3 Pd4 Gn4/ |
|  |  |  |  |  |  |  | Mt4 G4 |
|  |  | Bharuch | Sagbara, Jhagadia, |  |  |  | $9 \cdot 0$ M4 Pd4 Gn4 Mt4/ B4 |
|  |  |  | Valia, Nanded |  |  |  | Pd3 W4 B4 C4 |
|  |  |  | (Rajpipla), |  |  |  | B3 Pd4 Mt5 To4/ |
|  |  |  | Bediapada |  |  |  | To 3 B4 Pd4 |
|  |  | Surat | Mangrol |  |  |  | 12.7 Jk3 C4 Gn4 Pd4/Jr4 |
|  |  |  |  |  |  |  | Gn4 Pd4 B4 C4 |
|  |  | Baroda | Sinor, Dabhai, <br> Karjan, Waghodia, <br> Vadodara, Padra |  |  |  | 13.0 Jr4 Pd4 C4 Mt4 |

APPENDIX $14 \cdot 6$-Statement V (Contd.)


|  | Sehore | Ashta |  |  |  | $3 \cdot 6$ | W3 Jk4 F4/C4/O4/ G4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Hoshanga- | Harda |  |  |  | 1.9 | Mt3 W4 G4 Jk4 |
|  | Kad | Harsud |  |  |  | 4-2 | C4 Jk4 Pd4 |
|  | Khandwa |  |  |  |  |  | C4 Jk4 Pd4 Mt4 Pd3 Mt4 Pu4/G4 |
| Uttar Pradesh | Bareilly | Bareilly, | IX | 573 | 570 | 31.5 | W4 Pd4 S4/G4/ GO5 |
|  |  | Faridpur |  |  |  |  |  |
|  | Shahja- | Powayan, |  |  |  | 26.9 | W4 Pd4 G4 Pu5 |
|  | hanpur | Shahjahanpur |  |  |  |  | S4/B5 |
|  | Rampur | Rampur, Milak, Suar |  |  |  | $20 \cdot 0$ | W4 Pd4 M4 G4/S4 |
| Bihar | Gaya | Nawada | III, IV, XI | 707 | 525 | 65.0 | Pd1 |
|  | Muzaffar- | Hajipur |  |  |  | 4.7 | Pd2 Pu4 |
|  | pur ${ }_{\text {Santhal }}$ |  |  |  |  |  | Pd4 M4 W4 Pu4 |
|  | Parganas | Deogarh |  |  |  | $8 \cdot 8$ | Pd4 M4 W4 Pu4 |

APPENDIX 14.6-Statement $V$ (Contd)



APPENDIX 14.6-Statement V (Cond.)


|  | Rajgarh | Biaora, |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Shajapur | Narsinghgarh <br> Sujalpur |  |  |  |  |
|  | Shahdol | Beohari, |  |  |  |  |
|  | Panna | Bandhugarh |  |  |  |  |
|  | Jabalpur | Murwara, |  |  |  |  |
|  |  | Patan |  |  |  |  |
|  | Bilaspur | Janjgir, |  |  |  |  |
|  |  | Bilaspur, Mungaoli |  |  |  |  |
|  | Raipur | Baloda Bazar |  |  |  |  |
|  | Surguja | Baikunthpur, Manendragarh |  |  |  |  |
|  | Durg | Bemetra |  |  |  |  |
| Uttar | Mirzapur | Robertsganj | XII | 637 | 401 | $\int \mathrm{Pd} 3 \mathrm{~W} 4 \mathrm{G} 5$ |
| Pradesh |  | Dudhi |  |  |  | Pu4/Mt4 |
|  | Bijnor | Dhampur |  |  |  | P Pd4 W4 S4/G4 |
|  | Moradabad | Thakurdwara |  |  |  | Mt3 Pd4 Ba4/ M4 |
| Himachal | Simla | Kandaghat, | VIII, IX | 305 | 89 | (M3 W3 |
| Pradesh! |  | Simla |  |  |  |  |
|  | Mahasu | Kasumpti |  |  |  | W3 M3 |
|  | Mandi | Mandi Sadar, |  |  |  | W3 M4 Pd4/ |
|  |  | Chichot, |  |  |  | Ba4/Ba4 Pd4 |
|  |  | Sundarnagar. |  |  |  | ( ${ }^{\text {a }}$ |



\begin{tabular}{|c|c|c|c|c|c|c|c|}
\hline \& Surguja Mandla Seoni \& \begin{tabular}{l}
Bharatpur \\
Mandla, Niwas, Dindori Seoni, Lakhnadon
\end{tabular} \& \& \& \& 0.9
0.6

6.6 \& $\left\{\begin{array}{l}\text { Pu4W4G4Jk4 } \\ \text { G4W4Pu4Jk4 }\end{array}\right.$ <br>
\hline \multirow[t]{9}{*}{Gujarat} \& Vadodara \& Sankheda, Tilakwada, Nas-vadi. Chbota-udaipur \& \multirow[t]{9}{*}{XII} \& \multirow[t]{9}{*}{766} \& \multirow[t]{9}{*}{450} \& 13.0 \& $\left\{\begin{array}{l}\mathrm{C} 2 \mathrm{Jr} 4 \\ \mathrm{C} 3 \mathrm{Jr} 3 \mathrm{Pd} 4\end{array}\right.$ <br>
\hline \& \multirow[t]{8}{*}{Panch Mahals Surat Gujarat (contd.)} \& Jambughoda \& \& \& \& $3 \cdot 1$ \& C4Mt4Pd4Jr4/ (Gn4M4) <br>
\hline \& \& Songadh,

Vyara, \& \& \& \& $12 \cdot 7$ \& $$
\left\{\begin{array}{l}
\mathrm{C} 4 \mathrm{Pd} 4 \mathrm{Mt4Gn} 4 / \mathrm{Jr} 4 \\
\mathrm{C} 4 \mathrm{Jk} 4 \mathrm{Pd} 4 \mathrm{Fr} 4 / \mathrm{Pu} 4
\end{array}\right.
$$ <br>

\hline \& \& Palsana \& \& \& \& \& Pd4Jk4Gn4C4Pu4/ <br>
\hline \& \& Mahuva, \& \& \& \& \& CM14 <br>
\hline \& \& Mandvi, \& \& \& \& \& $\left\{\begin{array}{l}\text { Jr4Pd4Mt4C4 }\end{array}\right.$ <br>
\hline \& \& Nizhar, \& \& \& \& \& Jk3C4Gn4Pd//Fr4 <br>
\hline \& \& Uchhal, \& \& \& \& \& Jk4Pd4Gn4/Fr4/ <br>
\hline \& \& Kamrej, \& \& \& \& \& Pu4 <br>

\hline \multirow[t]{15}{*}{Bihar} \& Gaya \& Gaya, Aurangabad \& \multirow[t]{15}{*}{$$
\begin{aligned}
& \text { VII, VIII, } \\
& \text { XIII }
\end{aligned}
$$} \& \multirow[t]{15}{*}{6600} \& \multirow[t]{15}{*}{3630} \& 65.0 \& Pdl <br>

\hline \& Saran \& Siwan \& \& \& \& $21 \cdot 1$ \& Pd2W4/Pu4/M4/ Mt4 <br>
\hline \& Shahabad \& Arrah, \& \& \& \& $60 \cdot 5$ \& Pd3W4 <br>
\hline \& \& Sasaram, Bhabua \& \& \& \& \& <br>
\hline \& Palamau \& Garhwa, \& \& \& \& $23 \cdot 1$ \& Pd3Pu4W4/M4 <br>
\hline \& \& Daltonganj \& \& \& \& \& Pd3M4Pu4O4 <br>
\hline \& \& Latehar \& \& \& \& \& <br>
\hline \& Hazaribagh \& Chatra, \& \& \& \& $6 \cdot 8$ \& Pd4M4W4Pu4/ <br>
\hline \& \& Hazaribagh ${ }^{\text {c }}$ \& \& \& \& \& Ba4/S4 <br>
\hline \& Ranchi \& Simdega \& \& \& \& $2 \cdot 8$ \& M3W4Pd4 <br>
\hline \& Dhanbad \& Dhanbad, \& \& \& \& $4 \cdot 1$ \& <br>
\hline \& \& Baghmara \& \& \& \& \& <br>
\hline \& Muzaffarpur \& Muzaffarpur \& \& \& \& $4 \cdot 7$ \& <br>
\hline \& Darbhanga \& Darbhanga, Samastipur \& \& \& \& $9 \cdot 3$ \& <br>
\hline \& Saharsa \& Saharsa \& \& \& \& $12 \cdot 9$ \& <br>
\hline
\end{tabular}

APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement $V$ (Contd.)


APPENDIX $14 \cdot 6$-Statement V (Contd.)



| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | Geogra phical area ('000 ha) |  | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { E4(A3B1)E4 } \\ 015, \\ 016 \end{gathered}$ | Gujarat | Valsad | Ambergaon <br> Pardi, Valsad, <br> Dharampur | $\begin{aligned} & \text { REGION-17 } \\ & \text { XIV } \end{aligned}$ | 463 | 145 | $7 \cdot 5$ | $\left\{\begin{array}{l} \text { Pd1 } \\ \text { Pd2Fr4 } \end{array}\right.$ |
|  |  |  |  |  |  |  | 0.2 | $\left\{\begin{array}{l} \text { Pd3R4Pu4/JK4 } \\ \text { R3Mt4O4Pd4 } \end{array}\right.$ |
|  | Maharashtra | Thana | Bassein, <br> Palghar, <br> Dahanu, <br> Talsani, <br> Jawhar | XV | 506 | 138 | 1.2 | Pd1 <br> Pd3R4Mt4 R3Mt4O4 Pu4Pd4 |
|  |  | Nasik | Peint, Surgana |  |  |  | 11.7 |  |
|  |  |  |  |  | 969 | 283 |  |  |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no.(s) | State | District | Taluk | Rainfall zone no(s) in state | Geographical area ('000 ha) | $\begin{aligned} & \text { Gross } \\ & \text { cropped } \\ & \text { area } \\ & \text { ('000 ha) } \end{aligned}$ | District <br> $\%$ of GIA <br> to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| E4(E4)ClE3 | Karnataka | Chitradurga | Hiriyur, Challakere | REGION-18 | 376 | 134 | $18 \cdot 5$ | C4Mt4Jr4Jk4Pu4 Pu4Jk4Mt4B4/Gn4/ R4Gn4 |
| $\begin{aligned} & \text { 174, } \\ & 166 \end{aligned}$ | Himachal Pradesh | Kinnaur | Hangrang, <br> Pooh Morang, Kalpa | XIII |  | 5 | 55.0 | $\begin{aligned} & \mathrm{Ba} 3 \mathrm{Mt} 4 \mathrm{~W} 4 \\ & \mathrm{Mt} 3 \mathrm{Ba} 4 \end{aligned}$ |
|  |  |  |  |  | 383 | 139 |  |  |



| APPENDIX $14 \cdot 6$ Statement V (Contd.) |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rainfall Pattern/ all-India Zone no(s) | State | District | Taluk | $\begin{aligned} & \text { Rainfall } \\ & \text { zone no(s) } \\ & \text { in state } \end{aligned}$ | ```Geogra- phical area ('000 ha)``` | Gross Cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \% \text { of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| $\underset{172}{\mathrm{E} 4(\mathrm{E} 4) \mathrm{B} 1 \mathrm{C} 2 \mathrm{E} 1}$ | Tamil Nadu | Tirunelveli | Tiruchendur, Nanguneri Tirunelveli, Ambasamudram. | $\begin{aligned} & \text { REGION-20 } \\ & \text { VI } \end{aligned}$ | 566 | 192 | $41 \cdot 4$ | $\left\{\begin{array}{l} \mathrm{Pd} 1 \\ \mathrm{Pd} 3 \mathrm{Pu} 4 \mathrm{Gn} 5 \mathrm{Os} 4 / \mathrm{Fr} 5 \\ \mathrm{Pd} 3 \mathrm{Mt} 4 \mathrm{~B} 4 \mathrm{C} 4 / \mathrm{L} 4 \end{array}\right.$ |
|  |  | Ramanathapuram | Ramanathapuram |  |  |  | $38 \cdot 0$ |  |
|  |  |  |  |  | 566 | 192 |  |  |

## APPENDIX $14 \cdot 6$-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | $\begin{aligned} & \text { Geogra- } \\ & \text { phical } \\ & \text { area } \\ & \text { ('000 ha) } \end{aligned}$ | Gross Cropped area ('000 ha) | District $\%$ of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \mathrm{E}(\mathrm{E}) \mathrm{B} \mathrm{~B}_{156} \mathrm{CIE} \\ \hline \end{gathered}$ | Andhra Pradesh | Nellore | Venkatagiri, Rapur, Atmakur, Nellore Gudur | $\begin{aligned} & \text { REGION-21 } \\ & \quad \text { I } \end{aligned}$ | 680 | 225 | $66 \cdot 6$ | Pd1 <br> Pd2Jr4/B4 <br> Pd3Jr4Pu4/ <br> Mt4 <br> Jr3Pu4Pd4 |
|  |  |  |  |  | 680 | 225 |  |  |

RAINFALL AND CROPPING PATTERNS

APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | $\begin{aligned} & \text { Rainfall } \\ & \text { zone no(s) } \\ & \text { in state } \end{aligned}$ | $\begin{aligned} & \hline \text { Geogra- } \\ & \text { phical } \\ & \text { areal } \\ & \text { ('000 ha) } \end{aligned}$ | Gross Cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping pattern |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\underset{160}{\mathrm{E} 4(\mathrm{E}) \mathrm{A} 1 \mathrm{~B} 2 \mathrm{EI}}$ | Tamil Nadu | Tanjore | Nagapattinam Thiruthuraipundi | REGON-22 <br> III | 191 | 127 | $76 \cdot 0$ | Pd1 |
|  |  |  |  |  | 191 | 127 |  |  |



APPENDIX $14 \cdot 6$-Statement $V$ (Contd.)

| Rainfal! pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no.(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District <br> \% of GIA <br> to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{E} 4\left(\mathrm{C}_{1} \mathrm{E}_{3}\right) \mathrm{C}_{2} \mathrm{E}_{2}$ | Tamil Nadu | Tiruchirapalli | Lalgudi, Musiri, Thuraiyur, Kulithali, Tiruchirappalli, Manapai | $\begin{aligned} & \text { REGION-24 } \\ & \text { XII Spl. VI } \\ & \text { Spl. IX } \end{aligned}$ | 854 | 554 | $36 \cdot 0$ | PdI <br> Pd3 Gn3 <br> Pd3 Jk4 B4 <br> Jr4/O4 |
| $\begin{aligned} & 138,141,145 \\ & 152,146 \end{aligned}$ | Andhra Pradesh | Coimbatore | Pollachi |  |  |  | $37 \cdot 8$ | Pd4 B4 Jr4 Gn4 Mt4 |
|  |  | Kanyakumari | Agasteeswaram |  |  |  | $53 \cdot 2$ | $\left\{\begin{array}{l} \mathrm{Jk4} 4 \mathrm{Pd} 4 \mathrm{Mt} 4 \\ \mathrm{O} 4 \mathrm{C} 4 \mathrm{Gn} 4 \end{array}\right.$ |
|  |  |  |  |  |  |  |  | Gn3 Jk4 Mt4 Pd4 |
|  |  | Chittoor | Madanapalle, Vayalpad, Punganur, Palamaminr | II, VII, | 2298 | 719 | $39 \cdot 4$ | Gn2 Pd4 <br> Gn3 Pd4 S4/ <br> B4/R4 |
|  |  | Ongole | Markapur, Podili, Kanigiri, Darsi. |  |  |  | $19 \cdot 1$ | $\int \mathrm{Pd} 3 \mathrm{B4}$ Fr4 R4 |
|  |  | Guntur | Vinukonda |  |  |  | $42 \cdot 9$ | Jk4 Mt4 B4 04/ |
|  |  | Cuddapah | Rajampet, Rayachoti | III |  |  | 31.5 19.1 | $\left\{\begin{array}{l}\text { Mt3 B4 Pd4 } \\ \text { Jk4/Gn4 } \\ \text { M } 4 \text { B4 Pd4 } \\ \text { Jk4 Ch4 }\end{array}\right.$ |
|  |  | Ongole | Kandukur, Ongole | III | 342 | 196 | $19 \cdot 1$ | $\left(\begin{array}{l}\text { Jr4 Mt4 Pd4 } \\ \text { (To4 F4)/ } \\ \text { B4 R4 } \\ \text { To4 Mt4 Jr4 } \\ \text { F4/Pd4 B4 }\end{array}\right.$ |
|  |  |  | Total Region |  | 3494 | 1469 |  |  |

## APPENDIX $14 \cdot 6$-Statemen V (Contd.)

| Rainfall <br> pattern/ <br> all-India <br> Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| REOION-25 |  |  |  |  |  |  |  |  |
| E4(C1E3)B2E2 | Andhra Pradesh | Nellore | Udayagiri | IV | 472 | 157 | $66 \cdot 6$ | $\int^{\mathrm{Pd} 1}$ |
| 147 |  |  | Kovur Kavali |  |  |  |  | $\left\{\begin{array}{l} \text { Pd3Jr4Mt4/Pu4 } \\ \text { Jr4Mt4Pd4B4R4 } \end{array}\right.$ |
|  |  |  |  |  | 472 | 157 |  |  |


| APPENDIX 14.6-Statement V (Contd.) |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Rainfall } \\ & \text { pattern/ } \\ & \text { all-India } \\ & \text { Zone no(s) } \end{aligned}$ | State | District | Taluk | Rainfall zone no.(s) in state | Geographical area ( 000 ha ) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \% \text { of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
|  |  |  |  | REGION-26 |  |  |  |  |
| $\mathrm{E} 4\left(\mathrm{C}_{1} \mathrm{E}_{3}\right) \mathrm{A}_{1} \mathrm{~B}_{1}$ | Tamil Nadu | Tanjore | Myuram Nannilam | II | 148 | 145 | 76.0 | Pd1 |
| $\mathrm{C}_{1} \mathrm{E}_{1} 139,153$ | Andhra Pradesh | Chittoor | Kalahasti Satyavedu | VIII | 407 | 117 | $39 \cdot 4$ | $\begin{aligned} & \mathrm{Pd1} \\ & \text { Pd2 Gn4 } \end{aligned}$ |
|  |  | Nellore | Sullurpet |  |  |  | $66 \cdot 6$ |  |
|  |  |  |  |  | 555 | 262 |  |  |

APPENDIX $14 \cdot 6$-Statement $V$ (Contd.)



APPENDIX 14.6 -Statement $V$ (Contd.)


RAINFALL AND CROPPING PATTERNS

| Rainfall pattern/ all-India Zone no(s) | State | District | taluk | Rainfall zone no(s) in state | Geogra- <br> phical <br> area <br> ('000 ha) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { E4(C2E2)A1B1 } \\ & \text { C1E1 } \\ & 131 \end{aligned}$ | Tamil Nadu | Chingleput <br> South <br> Arcot <br> Tanjore | Ponneri, Saidapet Chidambaram, Cuddalore Sirkali | REGION-29 |  |  |  |  |
|  |  |  |  |  | 446 | 321 | $72 \cdot 7$ | Pd1 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | 57.4 | Pd3Gn3L4B4 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | $76 \cdot 0$ |  |
|  |  |  |  |  | 446 | 321 |  |  |

APPENDIX 14.6-Statement V (Contd.)



| Rainfall pattern/ all-India Zone no.(s) | State | District | Taluk | Rainfall zone no(s) in State | Geogra- phical areal ('000 ha) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \% \text { of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Region-30 (Contd.) |  |  |  |  |  |  |  |  |
|  | Karnataka | Shimoga | Bhadrawati ( $\frac{1}{2}$ E) <br> Channagiri ( $\frac{1}{2}$ W) | X | 264 | 190 | 51.3 | Pd1 <br> Pd4 R4 Jk4 Gn4/- <br> Pu4 <br> Pd4 C4 Jk4 Mt4 <br> Ch4 |
|  |  |  | Honnali ( ${ }^{\text {a }} \mathrm{W}$ ) |  |  |  |  |  |
|  |  | Dharwar | Buadgi, Hirekerur |  |  |  | $5 \cdot 3$ |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | 6204 | 41101 |  |  |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | tate | District | Taluk | Rainfall zone no(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District <br> $\%$ of GIA <br> to GCA | Cropping patte $r_{\text {r }}$ ns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \mathrm{E4} \text { (B4/B3) C1 } \\ & \text { E3 O54, } \\ & \text { O74, O75, } \\ & \text { O78, O79, } \\ & \mathrm{O} 81 \end{aligned}$ |  |  |  | REGION-31 |  |  |  |  |
|  | Orissa | Cuttack | Kujang, <br> Kendrapara <br> Kanika, <br> Patamundai <br> Marsaghai, Aul | VI | 351 | $40 \cdot 4$ | 274 | $\begin{aligned} & \text { Pd1 } \\ & \text { Pd2 Pu4 } \end{aligned}$ |
|  | Orissa | Balasore | Jaleswar, Basta | V, XI | 613 | 221 | $12 \cdot 4$ | $\left\{\begin{array}{l}\text { Pd1 } \\ \text { Pd2 Pu4/G4 }\end{array}\right.$ |
|  |  | Puri | Nayagarb |  |  |  | 31.0 | \{ Pd3 Pu3 |
|  |  | Ganjam | R.udayagiri Surada |  |  | . | $38 \cdot 3$ | Pd3 Pu4 R4 |
|  | Andhra Pradesh | Srikakulam | Parvatipuram <br> Palakonda | XXVIII | 685 | 177 |  | $\left\{\begin{array}{l} \text { Pd2Pu4/R4/Fb4 } \\ \text { Pd3Gn4Fb4/Pu4 } \\ \text { Pu4 PdARANALILA } \end{array}\right.$ |
|  |  | East Godavari | Yellow-aram Ramachodavaram |  |  |  |  | $\left\{\begin{array}{l}\text { Pu4 Pd4B4O4/Jk4 } \\ \text { Gn4 Mt4/Jk4 }\end{array}\right.$ |
|  | Orissa | Koraput | Gunupur <br> Bissamcuttack <br> Rayagada | III, IV | 1867 | 708 | $3 \cdot 4$ | $\left\{\begin{array}{l} \text { Pd1 } \\ \text { Pd }{ }^{2} \text { Pu4 } \\ \text { Pd3Pu4R4 } \end{array}\right.$ |
|  |  | Phulbani | G.udayagire |  |  |  | $15 \cdot 6$ | \{Pd3O4M4Mt4 |
|  |  | Ganjam | Ghumusur, Aska |  |  |  | $38 \cdot 3$ | Pd3Pu4Mt4 |
|  |  |  | Digapahandiy, |  |  |  |  |  |
|  |  |  | Chikiti |  |  |  |  | Pd304R4Mt5 |
|  |  |  | Berhampur, Kodala Parlakhemundi |  |  |  |  | Pd4R404Pu4Mt4 |
|  |  | Puri | Puri, Banpur Krishna Prasad |  |  |  | 31.0 |  |
|  |  |  |  |  | 3516 | 1380 |  |  |

## APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in State | Geogra- <br> phical area ('000 ha) | $\begin{aligned} & \text { Gross } \\ & \text { Cropped } \\ & \text { area } \\ & \text { ( } 000 \mathrm{ha} \text { ) } \end{aligned}$ | District $\%$ of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| REGION-32 |  |  |  |  |  |  |  |  |
| E4(A1C3)C1E3 | Maharashtra | Poona | Vadgaon (Mawal) | IX | 562 | 262 | 10.7 | Pd2 Jr2 |
|  |  |  | (1/2 E), |  |  |  |  |  |
| $072,073$ |  |  | Mulshi (1/2E), |  |  |  |  | Pd3 R4 JT4 Mt4 |
|  |  |  | Haveli (1/2W), |  |  |  |  |  |
|  |  |  | $\text { Khed }(1 / 2 W)$ |  |  |  |  | Pd3 Gn4 Jk4 S4 |
|  |  |  | Ambegaon (1/2W), <br> Bhor (1/2E) |  |  |  |  | $\{\mathrm{B} 3 \mathrm{Jr} 3 \mathrm{Pd} 5$ |
|  |  | Kolhapur | Kolhapur (Karvir), |  |  |  | $13 \cdot 5$ | B3 Jr4 Pd4 Pus |
|  |  | Kohapur | Gadhinglaj, Kagal |  |  |  | 13. | B3 Jr4 Pd5 Gn5 |
|  |  | Sangli | Shirala (1/3 central) |  |  |  | $10 \cdot 5$ | Jr3 Pd4 Pu4 |
|  |  | Satara, | Satara (1/3 central) |  |  |  | $13 \cdot 7$ | GB4 (R5) <br> Gn4 Jk4 Jr4 Gn4 Pd4 Jk4 Mt4 |
|  |  |  |  |  | 562 | 262 |  |  |

APPENDIX $14 \cdot 6$-Statement V (Contd.)

| Rainfall <br> pattern/ <br> all-India <br> Zone no(s) | State | District | Taluk | Rainfall <br> zone no(s) <br> in state | Geogra- <br> phical <br> area <br> ('000 ha) | Gross <br> cropped <br> area <br> ('000 ha) | District <br> \% of GIA <br> to GCA | Cropping patterns |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

## APPENDIX 14.6 -Statement $V$ (Contd.)



APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement V (Contd.)


| Karnataka | Kolhapur | Mandangad Vengurla. |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Nasik | Bavda Igatpuri ( $1 / 4 \mathrm{~W}$ ) |  |  |  | 11.7 |  |
|  | North | Bhatkal, | XVII | 169 | 27 | 18.1 | Pd1 |
|  | Kanara | Kumta, Honavar |  |  |  |  | Pd 2 L4/B4/ M5/V4/F4 |
|  | North | Karwar, | XV, XVI | 722 | 114 | $18 \cdot 1$ | ${ }^{\text {Pd }}$ |
|  | Kanara | ${ }_{\text {Ankola, }}$ Siddapur |  |  |  |  | $\begin{aligned} & \mathrm{Pd} 2 \mathrm{~L} 4 / \mathrm{B} 4 / \\ & \text { M5/V4/F4 } \end{aligned}$ |
|  | Shimoga | Sagar (1/2W), |  |  |  | $51 \cdot 3$ | L2 Pd3 |
|  |  | Hosanagar (1/2W), Tirthahalli (2/3W) |  |  |  |  | L3 Pd3 |
|  |  |  |  |  |  | 12.5 |  |
|  | lur | Sringeri, |  |  |  |  |  |
|  |  | Mudigere |  |  |  |  |  |
| Orissa | Koraput | Motu Malkangiri Jeypore | X | 777 | 249 | 3.4 Pd 1 |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | Pd2 R4 |
| Maharashtra | Kolhapur | Chandgad | XIV | 968 | 27 | 13.5 | Pd3 R4 Mt4 S4 |
| Karnataka | North <br> Kanara <br> Belgaum <br> Shinoga | Supa, <br> Yellapur, <br> Sirsa | XIII, XIV | 875 | 118 | $\begin{array}{lll} 18 \cdot 1 & \mathrm{Pd1} \\ & \mathrm{Pd} 2 & \text { L4/B4/ } 4 / \\ 10.0 & \text { M5/V4/F4 } \end{array}$ |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  | Khanapur |  |  |  | $10 \cdot 8$ |  |
|  |  | Sagar (1/2E), |  |  |  | $51 \cdot 3$ |  |
|  |  | Tirthahalli ( $1 / 3 \mathrm{E}$ ), |  |  |  |  |  |
|  |  | Hosanagar (1/2E), |  |  |  |  |  |
|  |  | Sorab (1/3 W) |  |  |  |  |  |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall State <br> pattern/  <br> All-India  <br> Zone no.(s)  | District | Taluk | Rainfall zone no.(s) in state | $\begin{aligned} & \text { Geogra- } \\ & \text { phical } \\ & \text { area } \\ & \text { ('000 ha) } \end{aligned}$ | Gross Cropped area ('000 ha) | District \% of GIA to GCA |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { C1E3(A4/A3)E4 Bihar } \\ & 003 \text {, } \\ & 019 \end{aligned}$ | REGION-37 |  |  |  |  | $8.6 \text { Pd1 }$ |
|  | Purnea | Kishanganj | XVII | 193 | 156 |  |
|  | Purnea | Araria | XVI | 267 | 257 | 8.6 Pd2Pu4 |
|  | . |  |  | 460 | 413 |  |


| Rainfall pattern/ <br> all-India <br> Zone no.(s) | State | District | Taluk | Rainfall zone no.(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \% \text { of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \mathrm{C} 1 \mathrm{E} 3(\mathrm{E} 4) \mathrm{ClE} 3 \\ & 158,164 \end{aligned}$ | Karnataka | Mysore | Gundlupet | $\begin{gathered} \text { REGION-38 } \\ \text { XXIII } \end{gathered}$ | 264 | 127 | 14.0 | Jk3 Pu4 R4/Gn4 <br> Jk4 Pu4 R4 Pd4/ <br> Gn5 Pd5 <br> Mt1 |
|  |  |  | Chamrajnagar |  |  |  |  |  |
|  | Himachal Pradesh | Kinnaur | Sangle | XV | 3 | 2 | . 55.0 |  |
|  |  |  |  |  | 267 | 129 |  |  |



## APPENDIX 14 6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall <br> zone no.(s) <br> in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District <br> \% of GIA <br> to GCA | Cropping pattern |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { C1 E3 (C2 E2) } \\ \text { C1E3 } \\ 126 \end{gathered}$ | Tamil Nadu | Dharmapuri | Krishnagiri, Dharmapuri, Mettur, Omalur, Salem, Rasipuram, Sankari Tiruchengode, Namakkal | REGION-4 $\mathbf{X X}$ | 889 | 605 | $15 \cdot 2$ | $\left\{\begin{array}{l}\text { Gn3 Jk4 B4 Pd4 } \\ \text { Gn4 pd4 Mt4 V4 Jk4/ } \\ \text { Jr4 } \\ \text { R4 Jk4 Pu4 Gn4 } \\ \text { B4 Gn4 Jr4 Pd4 } \\ \text { Pu4, Mt4 Jk4 Pd5 } \\ \text { Pd4 Gn4 Mt4 Jk4 R4 } \\ \text { S4/Pu4 }\end{array}\right.$ |
|  | Karnataka | Bangalore | Ramanagram, <br> Bangalore(s) <br> Kanakpura, <br> Anekal, <br> Bangalore- $N$ <br> ( $\frac{1}{2} \mathrm{~S}$ ), <br> Channapatna | $\mathbf{X X}$ | 402 | 190 | $17 \cdot 3$ | $\left\{\begin{array}{l} \text { R2 Pu4/Pd4/Pu4 Pd4/ } \\ \text { Pu4 Pd5/Pu4 M4 } \\ \text { R3 Pd4 Pu4 L4/Jk4 } \\ \\ \end{array}\right.$ |
|  |  |  |  |  | 1291 | 795 |  |  |






APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no.(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District <br> \% of GIA <br> to GCA | Croping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { C1E3(B1C2E1) } \\ & \text { C2E2 } \\ & 102 \end{aligned}$ | Himachal Pradesh | Chamba | Chamba, Chaurah | $\begin{gathered} \text { REGION-46 } \\ \text { XVI } \end{gathered}$ | 285 | 35 | $12 \cdot 3$ | M2 W4 |
|  |  |  |  |  | 285 | 35 |  |  |

APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern all-India Zone no.(s) | State | District Taluk | Rainafall zone no(s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District $\%$ of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\underset{080}{\text { ClE3(B3Cl)E4 }}$ | W. Bengal | Nadia Murshidabad <br> Burdwan Birbhum | $\begin{aligned} & \text { REGION-48 } \\ & \text { II } \end{aligned}$ | 2085 | 2167 | $\begin{array}{r} 2 \cdot 7 \\ 24 \cdot 3 \\ 57 \cdot 4 \\ 73 \cdot 0 \end{array}$ | $\left\{\begin{array}{l} \text { pd1 } \\ \text { pd3 Pu4 Ju4 } \end{array}\right.$ |
|  |  |  |  | 2085 | 2167 |  |  |

APPENDIX 14.6-Statement V (Contd.)


| CIE3 (A4/A3) <br> B1C1E2 <br> O05, 028 | Karnataka | S. Kanara | Karkal, Puttur | REGION-49 | XXII | 462 | 105 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern all-India Zone no(s) | State | District | Taluk | $\begin{aligned} & \text { Rainfall } \\ & \text { zone no(s) } \\ & \text { in state } \end{aligned}$ | Geographical area <br> ('000 ha) | Gross cropped area ('000 <br> ('000 ha) | $\begin{aligned} & \text { District } \\ & \% \text { of GIA } \\ & \text { to GCA } \end{aligned}$ | $\begin{aligned} & \text { Cropping } \\ & \text { patterns } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{C} 2 \mathrm{E} 2(\mathrm{C} 2 \mathrm{E} 2)$CLE 3127,129 | REGION-S0 |  |  |  |  |  |  |  |
|  | H.P. | ${ }_{\text {Kulu }}$ | Kulu | XVII | 460 | 34 | $5 \cdot 3$ | $\begin{aligned} & \left\{\begin{array}{l} \text { Mt3 Ba4 } \\ \text { W3 M4 Ba4/Ba4 } \\ \text { Pd4 } \\ \text { W4 M4 Mt4 } \end{array}\right. \\ & \left\{\begin{array}{l} \text { M1 } \\ \text { M3 W Ba4/ } \\ \text { Pu4/M } 44 / \mathrm{Rd} 4 \end{array}\right. \end{aligned}$ |
|  |  | Kinnaur |  | VIII |  |  |  |  |
|  |  | Chamba | Brahmaur <br> Doda, Ramban, Bhaderwah |  |  |  | $12 \cdot 3$ |  |
|  | $\mathrm{J} \& \mathrm{~K}$ | Doda |  |  | 247 | 41 | $14 \cdot 5$ |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | 707 | 75 |  |  |

APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | Geographical area ('000 ha) | $\begin{aligned} & \text { Gross } \\ & \text { croped } \\ & \text { area } \\ & \text { (000 ha) } \end{aligned}$ | $\begin{aligned} & \text { Distrist } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Jammu \& Kashmir | Punch | Haveli, Mendhar | $\begin{aligned} & \text { REOION-51 } \\ & \text { IX } \end{aligned}$ | 114 | $29$ | 12.5 | M1 |
|  |  |  |  |  | 114 | 29 |  |  |

APPENDIX 14.6-Statcment V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | Geographie cal area (000 ha) | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\underset{\mathrm{ClE}}{\mathrm{C} 2 \mathrm{E} 2 \mathrm{C} 2 \mathrm{E} 1)}$ | Jammu \& Kashmir | Udhampur | Gool Gulab Garb | $\begin{aligned} & \text { REGION-52 } \\ & \text { VII } \end{aligned}$ | 248 | 51 | $10 \cdot 0$ | $\begin{aligned} & \text { M1 } \\ & \text { M2 W4 } \end{aligned}$ |
| 053 |  | Rajauri | Rajauri, Budhal |  | 248 | 51 | $12 \cdot 5$ |  |

APPENDIX 14.6-Statement V (Contd.)


| Rainfall pattern all-India Zone no(s) | State | District | Taluk | Rainfall <br> zone <br> no.(s) <br> (in state) | Geographi- <br> cal <br> area <br> ('000 ha) | Gross cropped area ( 000 ha ) | District <br> \% of GIA <br> to GCA | Croppping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | REGION-54 |  |  |  |  |
| C3El(E4)C1E3 | $\begin{aligned} & \text { Jammu } \\ & \& \\ & \text { Kashmir } \end{aligned}$ | Baramula | Baramula, <br> Sonawari <br> Bandipore, <br> Sopore, <br> Handwara, <br> Karnah, <br> Kupwara, <br> Gulmarg, <br> Uri | X, XII | 428 | 182 | $48 \cdot 0$ |  |
|  |  |  |  |  |  |  |  | [M3W4Ba4/Pu4/ |
|  |  |  |  |  |  |  |  | Mt4/Pd4 |
| $\begin{aligned} & 154,157 \\ & 168 \end{aligned}$ |  |  |  |  |  |  |  | \{ Pd2 M4 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | Pd3 M3 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | LPd3 M4 Pu4/W4 |
|  |  | Doda | Kishtwar |  |  |  | $14 \cdot 5$ |  |
|  |  | Anantnag | Kulgam |  |  |  | $60 \cdot 0$ |  |
|  |  |  |  |  | 428 | 182 |  |  |

APPENDIX $14 \cdot 6$-Statement (Contd.)

$1689 \quad 1221$

APPENDIX 14.6-Statement V (Coutd.)

| Rainfall pattern all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | ```Geographi- cal area ('000 ha)``` | Gross cropped area ('000 ha) | $\begin{aligned} & \text { District } \\ & \text { \% of GIA } \\ & \text { to GCA } \end{aligned}$ | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { B1C1E2 } \\ \text { (A1B1C2) } \\ \text { B1C1E2 } \\ 068, \\ 044 \end{gathered}$ | Kerala | Trivandrum | Chirayinkil Nedumangad Trivandrum | $\begin{aligned} & \text { ReGion-56 } \\ & \text { II } \end{aligned}$ | 162 | 182 | n.a. | L3 Ta4 (Pd4) |
|  |  | Quilon | Karunagapally, Quilon | III | 59 | 11 | n.a. | L3 Ta4 (Pd4) |
|  |  |  |  |  | 221 | 193 |  |  |

APPENDIX 14.6-Statement V (Coutd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | ```Gcographi- cal area ('000 ha)``` | Gross cropped area ( 000 ha ) | District $\%$ of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { B1C1E2 } \\ \text { (A2 B1C1) } \\ \text { E4 } \\ 043, \\ 060, \\ 045 \end{gathered}$ | Assam | Kamrup | Kamalpur, Gauhati, | $\begin{aligned} & \text { REGION-57 } \\ & \text { VI } \end{aligned}$ | 191 | 112 | n.a. | Pd1 |
|  |  |  | Jhalukbari Palasbari |  |  |  |  |  |
|  |  | Darrang | Kalaigaon, <br> Dalgaon, <br> Mangaldai | V | 297 | 139 | n.a. | $\begin{aligned} & \text { Pd2 LA } \\ & \text { Pd2 Ju4 } \end{aligned}$ |
|  |  | Nowgong Kamrup | Laherighat, Dhing, Rupahihat Rangia Hajo | XI | 119 | 70 | n.a. | Pd1 |
|  |  |  |  |  | 607 | 321 |  |  |



APPENDIX 14.6-Statement V (Contd.)


APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no(s) in state | Geographical area ('000 ba) | Gross cropped area ('000 ha) | Dstrict \% of GIA to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | REGI | N-60 |  |  |  |  |
| $\begin{aligned} & \text { A1C1E2 } \\ & \text { (A4/A3) C1E3 } \\ & 011, \\ & 024, \\ & 009 \end{aligned}$ | Assam | Goalpara | Gossaingaon, Sidli, Bijni, Kokrajhar | XIV | 1178 | 391 | n.a. | $\begin{aligned} & \text { Pd1 } \\ & \text { Pd2 L4 } \end{aligned}$ |
|  |  | Lakhimpur | Bihpuria, <br> North Lakhimpur <br> Dhakua-Khana, Dhemaji, Dibrugarh, Jonai |  |  |  |  |  |
|  |  | Goalpara | Abhayapuri, Goalpara, <br> Dudhnai, | XII | 981 | 529 | n.a. | Pd1 <br> Pd2 L4 |
|  |  | Kamrup | Sorbhog, Patachar, Kuchi, <br> Baghbor, Tarabari, Barama, Tamulpur, Nalbari, Chhaygaon, Boko, Barpeta |  |  |  |  |  |
|  |  | Darrang <br> Goalpara | Paneri <br> Golokganj, Dhubri, <br> Bilaspur, <br> South Salmara, <br> Mankachar, <br> Lakhipur | XIII | 344 | 152 | n.a. | Pd1 |
|  | West Bengal | Cooch-Behar |  | VI | 963 | 734 | $5 \cdot 2$ | Pd1 |
|  |  | Jalpaiguri |  |  |  |  | $21 \cdot 8$ |  |
|  |  |  |  |  | 3467 | 1806 |  |  |

## APPENDIX 14.6-Statement V (Contd.)

| Rainfall pattern/ all-India Zone no(s) | State | District | Taluk | Rainfall zone no (s) in state | Geographical area ('000 ha) | Gross cropped area ('000 ha) | District <br> \% of GIA <br> to GCA | Cropping patterns |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { A1B1C1E1 } \\ & \text { (A1B3)C1E3 } \end{aligned}$ | Assam | N.C. Hills | Haflong (1/2 N ) | $\begin{aligned} & \text { REOION-61 } \\ & \text { XV } \end{aligned}$ | 183 | 38 | n.a. | Pd1 |
| 055 |  |  |  |  | - 188 | 38 |  |  |



## APPENDIX 14.6 (Contd.)

(Paragraph 14.6.96)
Statement VI-All India Cropping Patterns


Paddy

1. Pdl
2. Pd2 M4/B4/Mt4/Pu4/O4/Fr4/Gn4/W4/V4/G4/F4/Jr4/B4/Jr4/Mt4 Pu4/Pu4 O5/ R4/S4/Fb4/Ju4/L4/W5 Pu5
3. Pd3 L3/L3 M4/M4
4. Pd3 M3/M4 JK4/M4 O4/M4 W4/M4 V4/M4 Pu4/M4 O4 Pu4/ M4 O4 Mt4
5. Pd3 Pu3/Pu4 R4/Pu4 Mt4/Pu4 G4/Pu4 W4/Pu4 Ju4/Pu4 Gn4/Pu4 S4 G4/Pu4 Gn4 Fb4/Pu4 O4/Fr4/Pu4 O5 Mt5/Pu4 Jk4 Fr4/Pu4 Jk4 R4
6. Pd3 R4/R4 O4/R4 S4/R4 Gn4/R4 Mt4/R4 Mt4 W4/R4 Pu4/R4 O4 W4/R4 B4 F4/R4 L4/R4 Jk4
7. Pd3 B4 C4/Mt4 C4/Mt4 L4/F4 V4
8. Pd3 M\&4 Pu4/O4/G4/W4/O4 M4/L4/B4
9. Pd3 Gn3 Gn4/Jk4 Mt4/Jk4 B4/Jk4 S4 /Jk4 O4/Jk4 Pu4/ Gn4 (B4/Jk4/M4/Pu4/R4/B4 R4/Mt4/Fb4)
10. Pd3 Jr3/Jr4 M4/Jr4 Jk4/Jr4 Pu4/Jr4 S4
11. Pd3 Ba4 Pu4/Pu4 T4/W4 S5 T4
12. Pd3 W3/W3 G4/W4 M4/Pu4/M4 Pu4/M4 Pu4/G4 Ba4/G4 S4/Mt4/S4/

Ba4/Ba4 G4/Pu4 G5/G4/M4 Ba4/S4 Ba4/O4/Mt4 Pu4/
W4 Pu4/Ba4 Pu4/5/Ba4 Pu5 S5/Ba4 Pu5 G5/Ba4 Mt4/
Ba4 M4 G4/Ba4 Pu4/G4/W4 O4 M4/S4/G4/Mt4 Pu4
13. Pd4 Pu4 Jk4 M4/D4/O4/Jr4
14. Pd4 Pu4 Jr4 M4/Jk4
15. Pd4 Pu4 O4 Mt4 R4/B4
16. Pd4 B4 Jk4 Gn4 R4/C4/JrS
17. Pd4 C4 Jk4 Gn4/Gn4 Mt4/Mt4 Ch4
18. Pd4 M4 Jk4 Gn4/Pu4/O4
19. Pd4 Mt4 Gn4 Jk4/(Jk4 Jr4)/(B4 C4)
20. Pd4 Jk4 Gn4/B4/(Jr4 Gn4)/Jr4 B4
21. Pd4 Ba4(B4 W5)/(Pu4 M4 G4)
22. Pd4 Ba4 W4(G4 Jk4)/(G4 Mt4 B4)/(Pu4 B4)/(Pu4 S4)/M(4 O4
23. Pd4 Ba4 W4 Jk4/Pu4/Pu4 Jk4/Pu4 M4

24 .Pd4 W4 S4/M4/S4 G4/S4 M5
25. Pd4 B4 W4 Ba5/Ba4 G4/Ba4 T4
26. Pd4 G4 W4 S4/Pu5/Jk5/Ba4 Pu4/Ba4 Jk4/Ba4

## APPENDIX 14.6-Statement VI (Contd.)

27. Pd4 R4 (Jk4 Pu4)/(Jk4 Gnt)/(Pu4 S4) $/(\mathrm{Pu} 4$ O4)/(Mt4 Jk5 O4)/
(L4 Pu4)/Pu4/L4
28. Pd4 Jr4 To4 F4/Mt4/Mt4 Fr4/Ch4 Pu4
29. Pd4 Jr4 B4 Gn4 T4 Mt4
30. Pd4 Gn4 (R4 B4 Fb4)/(M4 Jk4 Pu4)

Wheat

1. W2 G4/F4/Jk4
2. W3 M3/M3 Pd4/Pd3 M4/M4 (Pd4/Pd4 Fr4/F4/F4 Gn4/F4 G4/B4/Pu4 B4/Pu4 Pd4/Gn4/Ba4/Pt4/Pu4)
3. W3 Pd4 M4/M4 F4/M5 G5/S4 B5 G5/G4/O4/S4
4. W3 S4 Pd4/Pd4 F4/Pd4 B4/F4/M4 F4/M4 B4/Pd4 M4
5. W3 B4 M4/Ba4 Pu4/Ba4 M4 S5
6. W3 B4 G4 Ba4/Jk4/Ba4 F5 Pu5/Gn4 Ba4/Pu4/F5 O5
7. W3 Jk4 G4/G4 F4/F4/O4 C4
8. W3 O4 Pu4/C4/Pu4 G4
9. W3 F4 Gn4/G4 B4/G4 C4/G4 Pd4/M4/Pd4/Gn4 B4 C4/G4/B4/C4 M4
10. W3 G4 Pd4/Pd4 B4/Pd4 Jk4/O4/Pd4 O4/Pd4 M4/Jk4/Jk4 B4/Jk4 S4/Jk4 O4/O4 Pu4/Pd4 B4/Pd4 Jk4/O4/Pd4 O4/Pd4 M4/Jk4/Jk4 B4/Jk4 S4/Jk4 O4/O4 Pu4/Jk4 Ba4 F5/Pu4/F4/(Pu4/Jk4 F5 Pu5)
11. W4 F4 S4/G4/C4
12. W4 Pd4 S4/Mt4/Mt4 Ba4/Mt4 O4/Mt4 G4/Mt4 F4 Jk4/S4 F4/S4 M4/S4 G4/S4 Pu5/S5 Gn4/S4 G4 Jk5/B4 G4
13. W4 Pd4 S4/Pu4 Jk4/Ba4 Gn4/Ba4 Jk4/B4 Jk4/Jk5 S5/M4/M4 S4
14. W4 Mt4 Ba4 M4/Pt4/Pt4 Pd4/F4 O4/F4 Pd4
15. W4 M4 (Pu4 Jk4 G4)/(B4 Gn4/5 G4/Pu4)/(F4 G4 Gn4)/Mt4/Ba4 Pd4
16. W4 M4 Pu4 (B4 Pd4)/(B4 Ba4)/S4/S4 F4/Pd4 Gn5
17. W4 Jk4 O4/F4/F4 Mt4 Pu4
18. W4 Pd4 M4 G4/G4 B4/Gn4/Gn4 Ba4/S4/5/S4 Ba5/Jk4/Jk5 S5/B4 O4 Ba4 Jk5/Ba4/5/Ba5/ S5 B5 B4 C4
19. W4 G4 [B4 (O4/5/Pd4 M4/Pd4 Pu5 Ba4 Pu4 M4)/Gn4 Ba4]/(F Jk4/ Jk4 Pu4/Jk4 T5/Jk4)/(Pu4 O4)/C4
Bajra
20. B1
21. B2 Pu4/P4/Jk4/O4/G4/Pu3/Jr4
22. B3 Pu3/Pu4/Pu4 G4/Pu4 F4/Pu4 W4/Pu4 C4/Pu4 Gn4/Pu4 Ba4/Pu4 C4 O4/ Pu4 Ba4 V4/Pu4 Pd4/Pu4 R4 Pd4/F3 Jr4/F3/F4/F4 O4 Jk4/F4 O4/F4 Jk4/Jk4 O4/W4
23. B3 G3/G3 W4/G4 Pu4/G4 W4/G4 O4/G4/G4 F4/G4 Ba4
24. B3 W4 Jk4/Jk4 C4/F4 Gn5/F4 O5/Gn4 G4/G4/Gn4/Pd4/Pd4 To4/Pd4 Mt5/Ba4 G4
25. B3 Jk4 Pu4/Gn4/F4/F4/Pu4/F4 W4/F4 Gn4/O4/C4 Gn4/Jr4 Gn4/Jr4/C4
26. B3 Jr3/Jr3 Pd4/Jr4 Pd4/Jr4 Pd5
27. B3 To4 Mt4/Mt4 Pd4
28. B3 Gn3/Gn4/Gn4 Jk4/Gn4 F4/C4 Gn4/C4 Mt4/Gn4 S4/Gn4 O4
29. B4 Jk4 Gn4 Jr4/Jr4 Mt4/F4
30. B4 Jk4 O4 C4/(F4 W4 W5 O5)/(Gn4 M4 Pu4)
31. B4 JK4 Pd4 W4/F4/C4

## APPENDIX 14.6-Statement VI (Contd.)

13. B4 Gn4 W4 G4/G4 Jk4/Ba4 Jk4/Ba4 Pu4
14. B4 Jk4 W4 O4/Gn4/C4/O5 Pu5
15. B 4 Ba 4 G 4 (W4 PuS)/(Jk4 O4)
16. B4 W4 C4 F4
17. B4 W4 G4 (Gn4/O4)/Jk4/F4/M4 Ba4
18. B4 Pu4 O4 W4/F4/Mt4
19. B4 Pu4 W4 (Pd4 R4)/G4/Ba4/Ba4 G4/F4
20. B4 Pd4 R4 M4/O4

Jowar (Rabi)

1. Jrl
2. Jr2B4/Pu4/T4/O4/Gn4W4
3. Jr3/B3/B4/Gn4/Pd4/Pd4 Gn4 Pu4/Pd4 Gn4 Jk4/Pd4 Pu4/Pd4 Pu4 Mt4/Pd4/Gn4/ Gn4 Pd4 Mt4/Gn4 Mt4/Gn4 Mt4 Jk4/C4 Jk4/C4 W4
4. Jr3 B4 S4/Pu4/O4/C4/O4 C4/C4 Pu4/W4/Gn4 T4/Gn4 C4/Gn4 O4
5. Jr3 Pu4 O4/C4/O4C4/O4W4/O4 R4/Pd4/Pd4 Jk4/Gn4/G4 Jk4/5
6. Jr3 C3/C3 Gn4/C3 O4/C4 Pd4
7. Jr4 Pu4 Pd4/G4
8. Jr4 Pu4 Jk4 Pd4/O4/Gn4/O4 W4
9. Jr4 Gn4 Mt4/Pu4 Mt4
10. Jr4 Gn4 Pu4 (T4 Jk4)/(T4 O4)/(Jk4 Pd4)/(Jk4/Jk4 O4)
11. Jr4 O4T4/T4 B4/(C4 Pu4)/(C4 Gn4)/(Pd4Mt4)
12. Jr4 O4 W4 Jk4/Jk4 Pu4/C4 Pu4/C4 Pd4/C4 Pd4 Jk4/Pd4 Jk4/Pd4 Pu4
13. Jr4 Pd4 (Mt4 To4/B4R4)/(Jk4 B4 Pu4)

Groundnut

1. Gnl
2. Gn2 B4/Jk4/C4/W4/F4 Jk4/Pu4/Pd4/Jr4
3. Gn3 B3/B4/B4 F4/B4 C4/B4 Jk4/B4 Jr4/Jk4 C4/Jk4 Mt4/Jk4 Pd4/Jk4 To4/Jk4 Pu4/Jk4 S4/Jk4 L4 Mt4/Pd4 B4 Pu4/Pd4 Fb4
4. Gn3 Pd4 S4/B4/R4/Jk4 Jr4/Jk4
5. Gn4 Pu4 F4/B4/R4 (B4 S4)/R4 (Pd4 Jk4)
6. Gn4 Mt4 (Jk4 Pu4)/Jk4 Jr4/C4 Jk4/C4 Jr4/Pu4 Pd4/Jk4 C4 Pu4
7. Gn4 Jr4 Jk4 (B4/Pd4 Mt4)/F4 (C4/B4)
8. Gn4 Jk4 Pd4 S4/Mt4/(Mt4 Pu4)/Mt4 Jr4/B4 Jr4
9. Gn4 B4 Jk4/C4/Jk4 F4/C4 M4/M4 Pd4/C4 Pd4

Small millets

1. Mt 1
2. Mt3 Pd3/Pd4 O4/Pd4 Ba4/Pd4 M4/Pd4 O4 Ba4
3. Mt3 Ba4/Ba4 (W4/O4 Pd4)
4. Mt3 W4 Pu4/Ba4/O4 G4/O4 Pd4/G4 Jk4
5. Mt4 Pu4 (Jr4 C4)/Jk4 B4/Jk4 M4/R4 (Gn4/Jk4)/Pd4 Gn4 C4
6. Mt4 B4 Pd4 Jk4 Ch4/Gn4
7. Mi4 Gn4 Jk4

Ragi

1. $\mathrm{R} 2 \mathrm{Pd} 4 / \mathrm{Pu} 4 / \mathrm{Pd} 4 \mathrm{Mt} 4$
2. R3 Pu4 Pd4/L4/Gn4/Jk4/Pd4 Jk4/O4
3. R3 Gn4 Pu4/Pd4/Pu4 Pd4/Mt4

## APPENDIX 14.6-Statement VI (Contd.)

4. R3 O4 Pd4 M4/Mt4/Pu4
5. R4 Mt4 Pu4 (Jk4 Pd4)/(Jk4 Gn4)/(Pd4 Gn4)
6. R4 Pd4 Mt4/Mt4 O4
7. R4 Pu4 Jk4 L4/L4 Pd4/Gn4/Gn4 Pd4/Mt4/Mt4 C4

Other pulses

1. Pu 2 B 3
2. Pu3 B3/F3/Jk4 B5 O5
3. Pu4 Pd4 C4/M4/W4/R4 Mt4 Gn4
4. Pu4 Jk4 F4/C4 B4/Jk4 Mt4 (B4/R4/Pd4 Gn4)
5. Pu4 Jk4 Jr4 C4 Gn5 O5
6. Pu4 Jr4 [O4 (Gn4 B4)/(Gn4 G4)/(T4 B5)/(Mt4 B4)]/Jk4 (G4/Gn4 T4/G4 Gn4/G4 Mt4 Gn4)/(Mt4 Pd4)
7. Pu4 Gn4 B4 W4/W4 C4 Mt4 /Jr4

Barley

1. $\mathrm{Ba} 2 \mathrm{Pu} 4 / \mathrm{W} 4$
2. Ba3 Mt4/Mt4 W4
3. Ba4 W4 Pd4 M4/B4 Pu4

Fodder

1. F3 O4 M4/M4 B4
2. F4 M4 W4 Jk4 Gn4

Oilseeds other than groundnut

1. O4 Pu4 W4 F4/Ba4 F4

Fruits

1. Fr3 L4 Pd4
2. Fr4 W4 M4

Tobacco

1. To3 B4 Pd4
2. To4 Mt4 Jr4 F4/Pd4 B4

Potato

1. Pt 3 M 4 W 4

Gram

1. G3 W3/W4/W4 Jk4/Jk4 T4/Jk4 O4/Jk4 Ba4/B4 C4/B4 Jk4/B4 O4/F4/Pd4/Pu4
2. G3 (B4 Pu4)/(B4 F4) (C4 F4)
3. G4 W4 B4 Jk4/Jk4 O4/Jk4 Pu4/Jk4 Ba4/C4/O4
4. G4 W4 O4 Pu4/B4/T4/Jk4
5. G4 W4 Pu4 Pd4/Ba4/M4/Jk4/Pd4 (Ba4/M4)
6. G4 W4 Ba4 Pd4/B4/Pd4 B4/Jk4 Pd4/Jk4 B4
7. G4 Pd4 Ba4 B4/B4 T4

## Jowar (Kharif)

1. Jk3 pd4 Mt4
2. Jk3 B4 Gn4/04 pu4
3. Jk3 F4 Pu4/C4/pu4 B4/pu4 W4/pu4 M4/pu4 Gn4/Gn4 C5 M5

## APPENDIX 14.6-Statement VI Contd.

4. Jk3 C3/C4 G4/C4 F4 M4/C4 G4 Gn4/C4 F4 W4/C4 Pd4/C4 F4/ C4 Pd4 Gn4/ C4 M4/C4 W4/Pu4/C4 Pu4/C4 T4/C4 Gn4Pu4'C4 Pu4 B4/C4 O4/ C4 Gn4/C4 Mt Jr5
5. Jk3 W4 G4/Pu4/O4 G4/C4/F4/C4 F4/M4/G4 B4/B4/Ba4/Ba4 G4
6. Jk3 Gn4/S4/B4 S4/C4/O4/Jr4 Pd4/Jr4 Mt4 /R4 Pd4/Pd4 Pu4
7. Jk4 Mt4 W4 O4/G4/O4 G4/O4 Pu4/Pu4 G4/Pu4 T4/Mt4 Pd5/S4 T04/T4 Jk4 Mt4 Gn4/Gn4 B4/Gn4 R4/Gn4 Pu4/Gn4 W4 C4/S4 C4/B4/B4 C4/B4 Pu4 R4/Pu4/O4/O4/Pd4 Pu4 Gn4/Gn4 C4 (Pu4/R4)
8. Jk4 C4 Pd4/Pd4 Gn4/O4 Pd4/O4 Pu4/Pd4 Mt4/O4 Jr4, Jk4 C4 Gn4 W4/Pu4 B4/Pu4 M4/Pu4 B4 M4 Jk4 C4 Pu4 Gn4 B4/M4/Jr4/W4/Pd4 Jr 4
9. Jk4 Pd4 (Gn4 Mt4) /(Jr4 O4)/Pu4 O4)/Pu4 O4 Mt4/Pu4 R4 O4/R4 O4
10. Jk4 Pu4 (B4 C4)/Gn4 B4/(Gn4 T5 Jr5)/Gn4/(R5 Gn5 Pd5)/Gn4 B4
11. Jk4 Pu4 O4 W4/Gn4 G5/Gn4 Jr4/Gn4 Jr4 T4/Gn4 B4/B4
12. Jk4 W4 F4 (Pu4 Gn4)/(Gn5 Pu5)/Gn4 T5)
13. Jk4 W4 M4 Gn4/Pu4/G4/G4 C4
14. Jk4 R4 Gn4 Pd4/Pu4
15. Jk4 Jr4 $\mathrm{O}_{4} \mathrm{~V} 4$
16. Jk4 Pd4 Mt4 Gn4 C4/Jr4
17. Jk4 B4 Gn4 Pu4 Mt4 Pd4

Maize

1. M1
2. M2 Pu4/Ba4/Ba4 W4/W5 Mt5/W5 O5/Pd4/W4
3. $\mathrm{M} 3 \mathrm{~W} 3 / \mathrm{W} 4 \mathrm{G} 4$

M3 W4 Ba4/Ba4 O4/Gn4 O4/Gn4 Jk4/Pu4/Pu4/G4 Pd4/G4/
Pu4 O4/Pu4 F4/C4 Mt4/C4 O4/Jk4 C4/Mt4/Mt4 B4
4. M3 Ba4 Jk4 (B4/C4/Gn4 B4)

C4 (Pu4/O4/W4 O5)
5. M3 Pu4 Gn4/C4/C4 O4/O4
6. M3 Pd4 Jk4/Gn4/G4/G4 Gn4/G4 Jk4 C4/Jk4 Mt4/Gn4 B4/Mt4
7. $\mathrm{M} 3 \mathrm{Mt} 4 \mathrm{Pd} 4 / \mathrm{W} 4 / \mathrm{G} 4 / \mathrm{Ba} 4$
8. M3 C4 O4/Jk4 O4/O4 Jk4 F4
9. M4 Pd4 Pu4/Jk4 O4/Jk4 F4/C4 Gn4 04/Jk4 R4
10. M4 Pd4 Mi4 G4/W4/Gn4/B4 C4/B4 Gn4/C4 Gn4/C4 G4
11. M4 Jk4 (Pu4 Pd4)/(C4 F4 Mt4)
12. M4 W4 (Jk4 Ba4)/(Jk4 Ba4 F4)/Jk4 G4/Jk4 O4/Jk4 Gn4/G4 F4

Cotton

1. Cl
2. $\mathrm{C} 2 \mathrm{Jk} 4 / \mathrm{B} 4 / \mathrm{J} 4 / \mathrm{Pd} 4 \mathrm{Jr} 4 / \mathrm{F} 4 \mathrm{Pd} 4$
3. C3 Jk3/Jk4/B4/Jk4 B4/Jk4 W4/Jk4 Pd4/Jk4 Pd4 Gn4/Jk4 Jr4/B4 Mt4/B4 F4/Jr4
4. C3 Gn4 Jk4/W4/Jr4 (W4/Jk4)
5. C3 Pu4 Jk4/B4/Jr4/Gn4/Fr4
6. $\mathrm{C} 3 \mathrm{Pd} 4 \mathrm{~B} 4 / \mathrm{B} 4 \mathrm{Mt} 4 / \mathrm{Mt} 4 / \mathrm{F} 4$
7. $\mathrm{C} 3 \mathrm{Jr} 3 / \mathrm{Jr} 4 / \mathrm{C} 3 \mathrm{Jr} 4 \mathrm{Pd} 4 / \mathrm{Jk} 4 / \mathrm{Mt} 4 / \mathrm{To4} / \mathrm{Pd} 4$ T04/B4/B4 Pd4 M4/Pd4 Gn4
C4 Gn4 M4 B4/5

APPENDIX $14 \cdot 6$ Statement-VI (Contd.)
9. C4 Gn4 Mt4 Jk4/Pu4 Jk4
10. C4 Pd4 Mt4 Pu4/Jk4 Jr4/Pu4 B4/Gn4 Jk4/Pu4 Jk4
11. C4 Pd4 Pu4 Jk4 /(S4)
12. C4 Pd4 Gn4 (Mt4 M4)/(Jk4 Fr4)/(Jr4 M5/Jk4)
13. C4 Pu4 Gn4 F4 Mt4/W4 G4
14. C4 Pu4 (Jk4 B4)/(Jk4 Gn4)/(Gn4 B4)/(Gn4 Jr4)/B4 Jr4/Jr4 O4/Jk4 Mt4
15. C4 Jr4 Jk4 B4/Mt4/Pu4/Gn4/Gn4 Pu4/Gn4 Mt4/Pd4 Mt4/ Pu4 B4 Mt4/B4 Mt4/Mt4 04
16. C4 W4 F4/G4/Jk4 Gn4/Jk4 Gn4 B4

Plantation

1. L2 Pd4
2. L3 Pd3/Ta4 Pd4/Ta4
(Paragraph 14.6 .97 )
Statement VII-Number of Districts, Geographical and Gross Cropped
Area-Statewise


## APPENDIX 14.6-Statement VII(Contd.)



Includes an area of $8,411,200$ ha under illegal occupation of Pakistan and China .

## APPENDIX 14.6 (Contd.) (Paragraph 14.9 .97 )

 Statement VIII-District Rainfall Patterns1. Rainfall Patterns are based on district normals of monthly rainfall contained in Memoirs of the Indian Meteorological Department, Vol. XXXI, Part 3. The normals of individual stations on which district normals have been worked out are based on all available data during the years 1901 to 1950, with a minimum of five years. The same code which has been used in drawing up rainfall patterns of taluks as explained under 'Methodology' in Section $\mathbf{1 4 . 2}$ above is employed for drawing up district patterns. Briefly stated, monthly rainfall is coded in one of five classes A to E viz. A is for 30 cm or more, B 20 to $30 \mathrm{~cm}, \mathrm{C} 10$ to $20 \mathrm{~cm}, \mathrm{D} 5$ to 10 and E less than 5 cm . Numerical subscripts are affixed to the letters A to E to denote the number of months in which the rain fall lies as specified by the concerned letter. For example, A 3 implies rainfallof more than 30 cm pm for three months. The entire years' rainfall is written in coded form in three continuous parts of four months each, for February to May, June to September and October to January. The pattern in each four month period is written in decreasing order and the pattern for June to September is entered in brackets. Reference to Statement I Appendix 14.4 which contains decoded versions according to calendar sequence, of rainfall patterns of Zones in the different States, would facilitate writing the monthly sequence in the case of district patterns also.
2. Geographical area: This has been taken from the Census of India 1971.
3. Gross cropped area is the average of three years, generally 1968-69 to 1970-71 and the periods are indicated in the introductory Statement VII for the different States and Territories.


Includes an area of $8,411,200$ ha under illegal occupation of Pakistan and China.

## APPENDIX $14 \cdot 6$ Statement VIII (Contd.)



APPENDIX $14 \cdot 6$-Statement VIII (Contd.)

| serial number | district |  |  | ```geographical area (hectares)``` | ```average gross cropped area (hectares)``` | rainfall pattera |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Haryana |  |  |  |  |  |  |
| 1. | Ambala |  |  | 383,300 | 324,761 | E4 (E2 C1 E1) E4 |
| 2. | Mahendragarh |  |  | 345,900 | 405,553 | E4 (C3 D1/C2 D1 E1) E4. |
| 3. $K$ | Karnal |  |  | 806,800 | 864,326 | E 4 (C3 El) E4 |
| 4. | Gurgaon |  |  | 614,600 | 633,587 | E4 (C3 E1) E4 |
| 5. R | Rohtak |  |  | 604,300 | 679,035 | E4 (C2 D1 E1) E4 |
| 6. | Hissar |  |  | 1,398,200 | 1,468,197 | E4 (C2 D1 El/D3 E1)E4. |
| 7. J | Jind |  | . | 269,100 | 339,405 | E4 (C2 D1 E1) E4 |
| State total |  |  | - | 4,422,200 | 4,714,864 |  |
| Delhi |  |  |  |  |  |  |
| 1. 1 | Delhi | - | - | 148,500 | 109,057 | E4 (C3 D1) E4 |
| Rajasthan |  |  |  |  |  |  |
| 1. J | Jhalawar |  | - | 621,600 | 326,085 | E4 (A2 C2) E4 |
| 2. | Banswara |  |  | 503,700 | 245,079 | E4 (A1 B1 C2) E4 |
| 3. | Kota |  |  | 1,243,700 | 624,060 | E4 (Al B1 Cl D1) E4 |
| 4. | Sirohi |  |  | 513,500 | 179,643 | (1) E4 (A1 B1 D2) E4. <br> (2) E4 (C2 D1 E1) E4 |
| 5. B | Bharatpur . |  |  | 809,300 | 634,529 | E4 (B2 C1 D1) E4 |
| 6. B | Bundi |  |  | 5 5,000 | 251,041 | E4 (B2 C1 Dl) E4 |
| 7. | Chittaurgarh | . |  | 1,085,800 | 398,786 | E 4 (B2 C1 D1) E4 |
| 8. | Dungarpur |  |  | 377,000 | 147,406 | E4 (B2 C1 D1) E4 |
| 9. | Sawai Madhopu |  |  | 1,059,300 | 552,501 | E4 (B2 D2) E4 |
| 10. | Tonk | . | * | 720,000 | 469,154 | E4 (B2 D2) E4 |
| 11. B | Bhilwara |  |  | 1,045,000 | 367,100 | E4 (B2 D2) E4 |
| 12. | Udaipur |  |  | 1,726,700 | 416,984 | E4 (B1 C2 D1) E4 |
| 13. | Alwar |  |  | 838,200 | 615,299 | E4 (C3 D1) E4 |
| 14. | Ajmer |  | - | 847,900 | 422,790 | E4 (C2 D2) E4 |
| 15. | Jaipur |  |  | 1,400,000 | 886,773 | E4 (C2 D1 E1) E4 |
| 16. J | Jalore |  | - | 1,064,000 | 588,932 | E4 (C2 D1 El) E4 |
| 17. J | Jhunjhunun | . | . | 592,900 | 500,491 | E4 (C2 D1 E1) E4 |
| 18. N | Nagaur |  |  | 1,771,800 | 1,174,648 | E4 (C2 D1 E1) E4 |
| 19. | Pali |  |  | 1,239,100 | 572,615 | E4 (C2 D1 E1) E4 |
| 20. | Sikar |  | . | 773,200 | 569,811 | E4 (C2 D1 E1) E4 |
| 21. B | Barmer |  | . | 2,838,700 | 930,152 | E4 (C1 D1 E2) E4 |
| 22. J | Jod |  | - | 2,286,000 | 1,057,180 | E4 (C1 D1 E2) E4 |
| 23. | Bikaner |  |  | 2,723,100 | 503,854 | E4 (D2 E2) E4 |
| 24. | Churu |  |  | 1,682,900 | 1,189,901 | E4 (D2 E2) E4 |
| 25. | Ganganagar | - |  | 2,062,900 | 1,345,958 | E4 (D2 E2) E4 |
| 26. J | Jaisalmer | - | - | 3,840,100 | 89,222 | E4 (D2 E2) E4 |
|  | State total |  | - | 34,221,400 | 15,059,994 | - |

## APPENDIX $14 \cdot 6$-Statement VIII (Contd.)

| serial <br> number | district <br> area <br> (hectares) $)$ | gross <br> cropped <br> area <br> (hectares) |
| :--- | :--- | :--- |

Uttar Pradesh


## APPENDIX 14.6-Statement VIII (Contd.)

| serial district number |  |  | geographical area (hectares) | average gross cropped area (hectares) | rainfall pattern |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Uttar Pradesh (Continued) |  |  |  |  |  |
| 31. Fatehpur |  | - | 416,800 | 358.858 | E 4 (B2Cl D1) E4 |
| 32. Allahabad |  |  | 725,500 | 609,286(d) | E4 (B2 C1 D1) E4 |
| 33. Jhansi |  |  | 1,006,900 | 511,775(d) | E4 (B2 C1 D1) E4 |
| 34. Jalaun |  | - | 454,900 | 379,987 | $\mathrm{E4}$ (B2 C1 D1) E4 |
| 35. Hamirpur |  | - | 719,200 | 524,288 | E4 (B2 C1 D1) E4 |
| 36. Banda |  |  | 764,500 | 575,970 | E4 (B2 C1 D1) E4 |
| 37. Jaunpur |  |  | 404,000 | 382,186 | $\mathrm{B4}$ (B2 C1 D1) E4 |
| 38. Lucknow |  | . | 252,800 | 205,272 | E4 (B2 C1 D1) E4 |
| 39. Unnao | - | , | 458,600 | 383,759 | E4 (B2 C1 D1) E4 |
| 40. Rai-Bareilly | . | . | 460,300 | 374,878(d) | E4 (B2 C1 D1) E4 |
| 41. Sitapur | . | - | 573,800 | 548,336 | E4 (B2 C1 D1) E4 |
| 42. Hardoi | . | - | 601,200 | 507,422(d) | E4 (B2 C1 D1) E4 |
| 43. Pratapgarh | - | . | 373,000 | 313,322(d) | E4 (B2 C1 D1) E4 |
| 44. Barabanki | . | - | 442,200 | 420,911 | E4 (B2 C1 D1) E4 |
| 45. Agra . | - | - | 481,600 | 430,777(d) | E4 (B1 C2 D1) E4 |
| 46. Mcerut | - | - | 594,400 | 688.282 | E4 (C3 D1) E4 |
| 47. Bulandshahr | - | - | 489,500 | 556,604(d) | E4 (C3 D1) E4 |
| 48. Aligarh | . | . | 502,400 | 577,922 | E4 (C3 D1) E4 |
| 49. Matbura | - | - | 379,700 | 398,094 (d) | E4 (C3 E1) E4 |
| 50. Almora | - | - | 702,300 | - | - |
| 51. Tehri-Garhwal | - | - | 442,100 | - | - |
| 52. Uttar Kashi | - | - | 801,600 | - | - |
| 53. Chamoli | - | - | 912,500 | - | - |
| 54. Pithoragarh | - | - | 721,00 | - | - |
| hilly region | - | - | - | 744,216 | - |
| mixedcrop | - | - | - | 3,168,184 | - |
| State total | - | - | 29,441,300 2 | 25,888,152 | - |

(d) Based on averages for the years 1966-67 to 1968-69

## APPENDIX 14.6-Statement VIII (Contd.)

| serial <br> number | geographical <br> area <br> (hectares) | average <br> gross <br> cropped <br> area <br> (hectares) |
| :--- | :--- | :--- | :--- |

Madhya Pradesh

| 1. | Balaghat |  | 924,500 | 370,148 | E4 (A2 B2) D1 E3 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2. | Surguja |  | 2,233,700 | 588.937 | E4 (A2 B2) D1 E3 |
| 3. | Raigarh |  | 1,291,000 | 533.498 | E4 (A2 B2) D1 E3 |
| 4. | Durg |  | 1,967,000 | 1,353,234 | E4 (A2 B2) D1 E3 |
| 5. | Raipur |  | 2,125,100 | 1,127,941 | E4 (A2 B2) D1 E3 |
| 6. | Bastar |  | 3,906,000 | 728,802 | E4 (A2 B2) D1 E3 |
| 7. | Shahdol |  | 1402,800 | 493,561 | $\mathrm{E} 4(\mathrm{~A} 2 \mathrm{~B} 1 \mathrm{Cl}) \mathrm{E} 4$ |
| 8. | Sehore |  | 901,500 | 492,762 | E4 (A2 B1 C1) E4 |
| 9. | Raisen |  | 839,500 | 386,246 | E4 (A2 B1 C1) E4 |
| 10. | Hoshangabad |  | 1,001,600 | 440,170 | E 4 ( A 2 B 1 C 1$) \mathrm{E4}$ |
| 11. | Narsinhapur |  | 513,800 | 277,585 | E4 (A2 B1 C1) E4 |
| 12. | Mandla |  | 1,325,700 | 483,592 | E4 (A2 B1 C1) Di E3 |
| 13. | Seoni |  | 875,200 | 399,337 | E4 (A2 B1 C1) D1 E3 |
| 14. | Guna. |  | 1,101,700 | 538,851 | E4 (A2 C2) E4 |
| 15. | Satna |  | 749,500 | 385,807 | E4 (A2 C2) E4 |
| 16. | Rewa. |  | 631,500 | 415,062 | E4 (A2 C2) E4 |
| 17. | Sidhi |  | 1,053,200 | 388,759 | E4 (A2 C2) E4 |
| 18. | Rajgarh |  | 616,300 | 414,501 | E4 (A2 C2) E4 |
| 19. | Vidisha |  | 743,300 | 495,710 | E4 (A2 C2) E4 |
| 20. | Sagar |  | 1,024,600 | 522,841 | E4 (A2 C2) E4 |
| 21. | Damoh |  | 730,100 | 293,018 | E4 (A2 C2) E4 |
| 22. | Jabalpur |  | 1,016,400 | 537,438 | E4 (A2 C2) E4 |
| 23. | Chindwara |  | 1,182,400 | 508,903 | E4 (A2 C2) D1 E3 |
| 24. | Bilaspur |  | 1,990,500 | 980,150 | E4 (A2 C2) D1 E3 |
| 25. | Tikamgarh |  | 304,700 | 257,979 | $\mathrm{E} 4(\mathrm{~A} 2 \mathrm{Cl} \mathrm{D1)} \mathrm{E4}$ |
| 26. | Chattarpur |  | 869,000 | 345,527 | E4 (A2 C1 El) E4 |
| 27. | Panna |  | 712,200 | 218,793 | E4 (A2 C1 E1) E4 |
| 28. | Indore |  | 391,000 | 270,450 | E4 (A1 B1 C2) E4 |
| 29. | Dewas |  | 701,400 | 351,579 | E4 (A1 B1 C2) E4 |
| 30. | Shajapur |  | 620,100 | 370,828 | E4 (A1 B1 C2) E4 |
| 31. | Betul |  | 1,006,100 | 423,149 | $\mathrm{E} 4(\mathrm{~A} 1 \mathrm{B1} \mathrm{C2}) \mathrm{E} 4$ |
| 32. | Mandsaur |  | 972,600 | 572,105 | E4 (B2 C2) E4 |
| 33. | Ratlam |  | 485,900 | 323,963 | E4 (B2 C2) E4 |
| 34. | Ujjain |  | 608,100 | 476,640 | E4 (E2 C2) E4 |
| 35. | Jhabua |  | 678,100 | 354,411 | E4 (B2 C2) E4 |
| 36. | Dhar |  | 814,900 | 527,102 | E4 (B2 C2) E4 |
| 37. | Morena |  | 1,158,600 | 416,890 | E 4 ( $\mathrm{B} 2 \mathrm{Cl} \mathrm{E1)} \mathrm{E}$ |
| 38. | Bhind |  | 446,700 | 342,048 | E 4 (B2 C1 E1) E4 |
| 39. | Gwalior |  | 521,300 | 255,600 | E 4 (B2 C1 E1) E4 |

## APPENDIX 14.6-Statement VIII (Contd.)

| serial numb | district | geographical area (hectares) | average <br> gross <br> cropped <br> area <br> (hectares) | rainfall pattern |
| :---: | :---: | :---: | :---: | :---: |
| 40. Datia <br> 41. Shivpuri <br> 42. Kharagaon (West Nimar) |  | 203,400 | 130,410 | E4 (B2C1E1) E4 |
|  |  | 1,028,500 | 366,539 | E4 (B2 C1 E1) E4 |
|  |  | 1,344,100 | 652,521 | E4 (B1 C3) E4 |
| 43. | Nirmar) non-reporting areas | 1,070,500 | $\begin{array}{r} 438,927 \\ 95,547 \end{array}$ | E 4 (B1 C3) E 4 |
|  | State total | 44,284,100 | 20,352,861 | - |
|  |  | Bihar |  |  |
| 1. | Gaya | 1,234,400 | 940,808 | E4 (A2 B2/A2 B1 C1) E4 |
| 2. | Champaran | 919,600 | 879,177 | D1 E3 (A2 B2) D1 E3 |
| 3. $P$ | Purnea | 1,101,300 | 910,109 | C1 E3 (A2 B2) D1 E3 |
| 4. S | Santhal Praganas | 1,412,900 | 621,939 | D1 E3 (A2 B2) Di E3 |
| 5. P | Ranchi | 1,833,100 | 789,520 | E4 (A2 B2) D1 E3 |
| 6. S | Singhbhum. | 1,344,700 | 416,960 | D1 E3 (A2 B2) D1 E3 |
| 7. S | Shahabad | 1,132,000 | 1,129,029 | E4 (A2 B1 Cl) D1 E3/E4 |
| 8. H | Hazaribagh | 1,805,000 | 408,073 | $\mathrm{E} 4(\mathrm{~A} 2 \mathrm{~B} 1 \mathrm{C} 1) \mathrm{D} 1 \mathrm{E} 3$ |
| 9. P | Palamau | 1,267,700 | 296,667 | E4 (A2 B1 C1) Di E3 |
| 10. D | Dhanbad | 299,400 | 96,498 | E4/D1 E3 (A2 B1 C1) DiE3 |
| 11. S | Saharsa | 588,500 | 484,171 | D1 E3 (A1 B3) D1 E3 |
| 12. $S$ | Saran | 695,200 | 675,936 | E4 (A1 B2 C1) D1E3 |
| 13. D | Darbhanga | 867,900 | 818,732 | D1 E3 (A1 B2 C1) D1 E3 |
| 14. M | Monghyr | 982,700 | 646,417 | E4 (A1 B2 Cl) D1E3 |
| 15. M | Muzaffarpur | 783,800 | 805,296 | D1 E3 (B3 C1) DiE3 |
| 16. Pa | Patna | 552,800 | 643,597 | E4 (B2 C2) E4 |
| 17. B | Bhagalpur | 565,600 | 389,470 | D1 E3 (B2 C2) D1E3 |
|  | State total | 17,387,600 | 10,952,399 |  |

APPENDIX 14.6-Statement VIII (Contd.)


## APPENDIX 14.6-Statement VIII (Contd.)



## APPENDIX 14. 6 Statement VIII (Contd.)

| serial | district | geographical <br> area <br> number | average <br> gross <br> (hactares) |
| :--- | :--- | :--- | :--- |
|  |  | rainfall pattern |  |
|  |  | area |  |
|  |  |  |  |



Gujrat

1. Bulsar (Valsad) . . 523,800 319,628 E4 (A3 B1) E4
2. The Dangs . . $168,300 \quad 49,873$ E4 (A3 B1) E4
3. Surat . . . 774,500 472,416 E4 (A3 B1/A2 B1 C1) E4
4. Baroda (Vadodara) . 778,800 556,468 E4 (A1 B1 C2) E4
5. Broach (Bharuch) . 904,500 462,085 E4 (A1 B1 C2) E4
6. Panch Mahals . . 886,600 519,845 E4 (A1 B1 C2) E4
7. Kaira (Kheda) . . 719,400 573,452 E4 (A1 B1 C1 D1) E4
8. Sabarkantha . . 739,000 496,356 E4 (A1 Bl C1 D1) E4
9. Junagadh . . . 1,060,700 629,182 E4 (A1 C3/B1 C1 E2) E4
10. Banaskantha . . 1,270,200 915,043 E4 (B2 D2/C2 D1 E1) E4
11. Ahmedabad . $870,700 \quad 627,873$ E4 (B1 C1 D2) E4
12. Gandhinagar. . $64,900 \quad 57,144$ E4 (B1 C1 D2) E4
13. Mahesana . . . 902,700 772,161 E4 (B1 C1 D2) E4
14. Amreli . . . 676,000 513,085 E4 (B1 C1 E2/C1 D3) E4
15. Bhavnagar . . . 1,115,500 630,857 E4 (B1 Cl E2) E4
16. Jamnagar . . $1,412,500 \quad 620,447$ E4 (B1 C1 E2) E4
17. Rajkot . . . $1,120,300 \quad 762,117$ E4 (B1 C1 E2) E4
18. Surendranagar . . $1,048,800 \quad 689,410$ E4 (B1 Cl E2) E4
19. Kutch . . . 4,561,200 599,782 E4 (C1 D1 E2) E4

State total . . 19,598,400 $10,257,224$

APPENDIX 14.6-Statement VIII (Contd.)


APPENDIX 14.6 Statement VIII (Contd.)


APPENDIX 14.6-Statement VIII (Contd.)

| serial number district | geographical area (hectares) | average gross cropped area (hectatres) | rainfall pattern |
| :---: | :---: | :---: | :---: |
| Goa, Daman and Diu |  |  |  |
| 1. Goa | 370,100 |  | E4 (A4) Cl E3 |
| 2. Daman | 7,200 |  | E4 (A3 B1) E4 |
| 3. Diu | 4,000 |  | E 4 ( BlClE 2$) \mathrm{E} 4$ |
| Total | 381,300 | 139,177 |  |

## Andhra Pradesh



## APPENDIX 14.6-Statement VIII (Contd.)

| serial |
| :--- | :--- | :--- | :--- |
| number |$\quad$| geographical |
| :--- |
| area |
| (hectares) |$\quad$| average |
| :--- |
| gross |
| cropped |
| area |
| (hectares) |$\quad$ rainfall pattern

Kerala

| 1. | Ernakulam |  |  | 327,100 | 277,342 | B1 C1 D1 E1 (A4/A3B1) A1 B1 D1 E1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2. | Kottayam |  |  | 638,900 | 372,895 | B1 C1 D1 E1 (A4/A3 B1) Al B1 D1 E1 |
| 3. | Cannanore |  |  | 570,600 | 359,104 | $\begin{array}{ccc} \text { C1 D1 E2 } \\ \text { B1 C1 } & \text { E2 } \end{array}$ |
| 4. | Kohikode |  |  | 372,900 | 271,368(e) | B1 D1 E2 (A3B1) <br> B1 C1 E2 |
| 5. | Malappuram | - | . | 363,800 | 252,557(e) | B1 D1 E2 (A3B1) B1 C1 E2 |
| 6. | Palaghat | . |  | 440,000 | 331,299(e) | C1 D1 E2 (A3B1) B1 Cl E2 |
| 7. | Trichur |  | . | 303,200 | 237,575 | B1 D1 E2 (A3B1) B1 C1 E2 |
| 8. | Alleppey | - | - | 188,400 | 234,732 | B1 C1 D1 E1 (A3 B1) <br> A1 B1 D1 E1 |
| 9. | Quilon |  | . | 462,300 | 346,301 | B1 C1 D1 E1 (A3 Bl) <br> A1 B1 D1 E1 |
| 10. | Trivandrum | . | . | 219,200 | 238,049 | Bl Cl D1E1 (A1 B1 C2) <br> A1 C1 D2 |
|  | State total |  |  | 86,400 | 21,222 |  |

Andaman and Nicobar Island

1. Andaman \& Nicobar Islands . . . 829,300 11,326 A1 D1 E2 (A4)

B2 Cl E1
(e) These figures relate to $1970-71$ as comparable data for $1968-69$ and $1969-70$ for these reorganised districts are not available.

## APPENDIX 14. 6 Statement-VIII (Contd.)

| serial numbe | ber district | geographical area (hectares) | average <br> gross <br> cropped <br> area <br> (hectares) | rainfall pattern |
| :---: | :---: | :---: | :---: | :---: |
| Tamil Nadu |  |  |  |  |
| J. | Kanyakumari | 168,400 | 113,306 | C2 D1 E1 (B1 Cl D2) B2 D1 E1 |
|  | Chingleput | 792,000 | 427,481 | E4 (C2 D2) A1 B1 C1 E1 B2 C1 E1 |
| 3. N | North Arcot | 1,226,500 | 626,303 | D1 E3 (C2 D2) C2 D1 E1 |
|  | Salem | 864,300 | 455,153 | D1 E3 (C2 D2) C1 D1 E2 |
|  | Dharmapuri | 964,300 | 451,528 | D1 E3 (C2 D2) C1 D1 E2 |
|  | South Arcot | 1,089,800 | 698,453 | D1 E3 (C2 D1 E1) B2 C1 E1 |
|  | Tiruchirapalli | 1,429,100 | 805,163 | D1 E3 (C2D1 E1) C2D1E1 |
|  | Thanjavar . | 973,500 | 848,778 | ```D1 E3 (C1 D1 E2) A1 B1 C1 D1/ B1 C2 D1/ C3 D1``` |
|  | Coimbatore | 1,567,300 | 811,767 | $\begin{aligned} & \text { D2 E2 (D2 E2/D1 E3) } \\ & \text { C2 E2 } \end{aligned}$ |
| 10. M | Madurai | 1,262,900 | 634,574 | D2 E2 (D2 E2) C2 D1 E1 |
| 11. R | Ramanathapuram | 1,257,800 | 646,361 | D1 E3 (D2 E2) C2 D1 E1 |
| 12. T | Tirunelveli | 1,143,300 | 556,830 | D1 E3 (E4) B1 C2 D1/ C2 D1 E1 |
| 13. N | Nilgiris | 254,900 | 52,583 | .. |
| 14. M | Madras | 12,800 | .. | . |
| State total |  | 13,006,900 | 7,128,280 | . |
|  |  | Lakshadweep |  |  |
| 1. $\mathbf{L}$ | Lakshadweep | 3,200 | 2,771 | $\underset{\mathrm{E} 1}{\mathrm{C} 1} \mathrm{E}(\mathrm{~A} 1 \mathrm{~B} 2 \mathrm{C} 1) \mathrm{C} 2 \mathrm{D} 1$ |
|  |  | Pondicherry |  |  |
| 1. Po | Pondicherry | 29,000 |  |  |
| 2. K | Karaikal | 16,100 |  |  |
| 3. M | Mahe | 900 |  |  |
| 4. Y | Yanam | 2,000 |  |  |
|  | Total | 48,000 | 49,995 | $\begin{aligned} & \text { D1 E3 (Cl D1 E2) A1 B1 } \\ & \text { C1 E1 } \end{aligned}$ |

## APPENDIX 14.7

## (Paragraph 14.6 1)

Statement I- Rainfall and Cropping Patterns of Orissa State
The National Commission on Agriculture in their working paper on Rainfall and Cropping patterns of Orissa have delineated the State into twelve rainfall zones. The State was divided into nine cropping patterns. The working paper was discussed by the State and O. U. A.T. officials in a meeting where it was decided to collect rainfalldata from all the recording stations and group them in the appropriate rainfallzones and examine the efficiency of the existing patterns from the point of view of Agronomic (soil. topography) and economic considerations and to suggest substitution or clange on the basis of trials/experiments for different soil types under rainfed conditions as wellas under various intensities of irrigation facilities.

In accordance with this discussion the railnfall data in respect of Taluks for which such data was not incorporated in the working paper were collected. Suggested patterns for high, medium and low lands for rainfed and irrigated areas were worked out on the basis of the trials/experiments and successful demonstrations of the patterns and changes which have been accepted by the farmers. As a preliminary exercise the patterns which will be suitable from Agronomic and economic point of view in the different rainfall pattern zones have been worked out and given in the following statements. The crop patterns have been suggested for four types of lands on the basis of their topography viz. very-high, hiah, medium and low lands for the rainfed areas and for only three types of land viz, high, medium and low for irrigated areas. Further division for irrigation of various intensitics, viz, perennialirrigation, two scason irrigation, one seasonirrigation and supplementaryirrigation has not been made but for command areas of liftirrigation points, dug-wells, tanks, cross bunds, etc. cropping patterns having low to medium water requirement have been suggested along with heavy duty cropping patterns for the command areas of conals providing perennial irrigation.

The percentage of area to be devoted to each pattern in individual taluks taking into consideration the preportion of high medium and low lands and texture of soils and irrigation facilities available has not been shown. This willrequire detailed examination of proportion of difierent types of land, crops now being grown on these lands, results of trials, demonstrations conducted in each Taluk, farmers' preferences and changes which have already been accepted by the farmers of the area. Such talukwise study necessarily, will take long time.

The codes and the numerical subscripts used in the statements are the same as adopted in the working paper of the National Commission on Agriculture. Some additions have been made to these codes. The codes and symbols used in the statement are described below :-

1. Rainfall Zoncs :


## APPENDIX 14.7-Statement I (Contd.)

The subseripts $1,2,3 \& 4$ used indicate the number of months receiving the amount of rainfall shown against the interval symbols. The year has been divided into three seasons, February to May, Jnue to September and October to January. The letters and subsripts in each pattern are given for the three seasons respectively, with the centrat group for June-September entered in brackets. Example -
$\begin{array}{llllllll}C_{1} & D_{1} & E_{2} & \left(D_{2}\right. & E_{2} & C_{1} & D_{1} & E_{2}\end{array}$
$C_{1} \quad D_{1} \quad E_{2}-$ February to May
$\left(D_{2} \quad E_{2} \rightarrow\right.$ June to September
$C_{1} \quad D_{1} \quad E_{2}$-October to January

## II Cropping Patterns



The distribution of crops is shown by subscripts to the symbols.

| Subscript |  | Percentage area |  |  |
| :---: | :--- | :--- | :--- | :---: |
| 1. | . | . | . |  |
| 2. | . | Greater than 70 |  |  |
| 3. | . | . | . |  |
| 4. | . | $50-70$ |  |  |
| 5. | . | . | . |  |

III. Suggested Patterns :

In the patterns suggested for different classes if land under rainfed andirigation. the signs used are :-
$\ddagger$ mixed cropping as for example $T+P d$.
/Alternate crops suggested as for example $\mathrm{JK} / \mathrm{M} / \mathrm{T}$ which means either Jowar, Maize or Tur can be grown.
-One crop following another es. Pd-Pu paddy followed by pulses.

## APPENDIX $14 \cdot 7$-Statement I (Contd.)

zone I
Red and Yellow soils with black soil patches, undulating topography having several drought prone pockets, general rainfall pattern E4 (A2 B2) D1 E3-150 cms. per year/70 rainy days. Cropping pattern Pd1 or Pd2, but in Koraput Pd4 Pu4.

| Districts | Rainfall pattern | Soils | Suggested patterns for the zone |  |  |  |  |  |  | Remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Rainfad Areas |  |  | Irrigated Areas |  |  |  |
| Taluks | Existing cropping pattern |  | Very high land | High land | Medium Jand | Low | High land | Medium land | $\begin{aligned} & \text { Low } \\ & \text { land } \end{aligned}$ |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

1. Sundergarh E4(B1 A2B1) DIE3


| 2. Hemgiri |  | Red |
| :---: | :---: | :---: |
| 3. Panposh |  | Red |
| 4. Bonai | $\begin{aligned} & \text { E3 D1 (B1 } \\ & \text { A2 B1) } \\ & \text { E3 } \end{aligned}$ | Red |
|  | Pd1 |  |
| 5. Rajgangpur |  | Red |

## Sambalpur

| 1. Sambalpur | $\cdot \underset{\mathrm{B} 1)}{ } 4 \underset{\mathrm{D} 1}{\mathrm{D}} \mathrm{~B}_{\mathrm{E}}$ | Red \& Yellow. |
| :---: | :---: | :---: |
|  | Pd1 |  |
| 2. Jharsuguda | E4 (B1 A2 | Red |
|  | B1) D1 E3 |  |
|  | Pd1 | Yellow |
| 3. Bargarh | . E 4 (B1 A2 | Red |
|  | B1) E4 |  |
|  | Pd1 05 |  |
| 4. Deogarh | $\begin{aligned} & \text { E3 D1 (B1 } \\ & \text { A2 B1) C1 E3 } \end{aligned}$ | Red |

5. Rairakhol . Red

## APPEKDIX 14.7 Statement I (Contd.)

zone I (Contd.)

6. Padmapur

7. Kuohinda Do.
Dhenkanal

Phulbani

1. Baudh . E4 (B1 A2 Red \& B1) D1 E3 black.

## Bolangir

1. Birmaharaj-
pur
Patnagarh

|  |  | Red |
| :--- | :--- | :--- | :--- |
| E4 (B1 A2 | Do. |  |
| B1) D1 E3 |  |  |
| Pd2 Pu4 |  |  |
| E4 (B1 A2 | Do. |  |
| B1) D1 E3 |  |  |
| Pd2 Pu4 |  |  |

4. Bolangir $\quad \underset{\text { B1) }}{\text { E4 }} \underset{\text { D1 }}{\text { B1 }}$ A2 $\underset{\text { black }}{\text { Red }}$ B1) D1 E3 black
5. Sonepur . EA (B1 A2 Red \&

|  |
| :--- |
| B1) D1 E3 black |
| PdI Pu5 |

in

## APPENDIX 14.7 Statement I (Contd.)

zone II
Clay and red loam soils, plain and low lyingland with saline strips near the coast. Rainfall pattcrn D1 E3 (OT)
C1 D1 E2; $120 \mathrm{~cm} . / 56$ days Cropping pattern Pd2 Pu4.


## APPENDIX 14.7 Statement I (Contd.) <br> ZONB III

Red loam soils with lateritic patches; hilly and undulating terrain, rainfall pattern D1 E3 (B3 Cl) Cl E3; $120 \mathrm{~cm} . / 70$ days. Cropping pattern Pd3 Pu4 Mt4. This zone has more draught-prone pockets


## APPENDIX 14.7 Statement I (Contd.)

zONE IV
Red and sandy soils with costal alluvium having lateritic patches and saline strips; Topography plain in the coast and undulating in the interior
Rainfall pattern $D_{1} E_{3}\left(B_{3} C_{6}\right) C_{1} D_{1} E_{2} 120-140$ cms. cropping pattern $P_{2} P_{u_{4}}$


Ganlam
Chumusar


## APPENDIX 14.7 Statement I (Contd.)

ZONE V
Red and alluvial soils; Terrain level in Jaleswar and Basta and undulating in Nayagarh; rainfall pattern D1 E3 (B4) C1 E3; $135 \mathrm{cms} / 75$ days cropping pattern PdJ or Pd2 Pu4

| District | Rainfall pattern | Soils | Suggested |  |  |  | patterns for the zone |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Existing cropping pattern |  | Rainfed Areas |  |  |  |  | Irigated Areas |  |  |
| Taluks |  |  | Very high land | High land | Medium land | Low land | High land | Medium land | Low land |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Balasore |  |  |  |  |  |  |  |  |  |  |
| Jaleswar . | $\underset{\mathrm{E} 3}{\mathrm{E} 3 \mathrm{Cl}(\mathrm{~B} 4) \mathrm{Cl}}$ | Deep alluvial soils. | Nil | $\begin{array}{ll} \text { 1. } \mathrm{Pd}-\mathrm{W} / & \text { 1. } \mathrm{Pd}-\mathrm{Pu} / \\ \text { O/Gn } & \mathrm{O} \\ \text { 2. } \mathrm{Fb}-\mathrm{W} / & \text { 2. } \mathrm{Fb}-\mathrm{Pu} / \\ \mathrm{O} / \mathrm{Gn} & \mathrm{O} \\ & \text { 3. } \mathrm{Fb}-\mathrm{Pd}- \\ \mathrm{O} / \mathrm{Pu} \end{array}$ |  | $\begin{aligned} & \text { Pd-Pu/ } \\ & \text { O } \\ & \text { Fb-Pd- } \\ & \text { O/Pu. } \end{aligned}$ | $\begin{aligned} & \text { Pd-P/ } \\ & \text { V/W- } \\ & \mathbf{P u} / \mathbf{O} \end{aligned}$ | 1. $\mathrm{Pd}-\mathrm{Pd}$ 1. $\mathrm{Pd}-\mathrm{Pd}$ <br> 2. Fb-Pd- 2. Fb-Pd- <br> $\mathrm{Pu} / \mathrm{O} \quad \mathrm{Pd}$. <br> 3. $\underset{\mathrm{Pu}-\mathrm{O}}{\mathrm{Pd} / \mathrm{Gn}} \begin{aligned} & \text { 3. } \\ & \mathrm{Pu}-\mathrm{Pb} / \mathrm{O} / \mathrm{V}\end{aligned}$ |  |  |
|  | Pd1 |  |  |  |  |  |  |  |  |  |
| Basta | Pd1 | Do. | Nil |  |  |  |  | , |  |  |  |
| Puri |  |  |  |  |  |  |  |  |  |  |
| Nayagarh | $\begin{gathered} \text { E3D1(B4) } \\ \text { C1E3 } \end{gathered}$ |  <br> laterite <br> soils <br> with <br> patches <br> of <br> alluvial <br> on the <br> river <br> basins. | 1. $\mathrm{JK} / \mathrm{M} /$ R/Gn <br> 2. $T+R /$ Pd. | $\begin{aligned} & \text { 1. } \mathrm{Pd}-\mathrm{Pu} / \text { 1. } \mathrm{Pd}-\mathrm{Pu} / \\ & \mathrm{O}^{\mathrm{O}} \mathrm{Pd}-\mathrm{W}+ \\ & \mathrm{Pu} / \mathrm{O} . \end{aligned}$ |  | 1. Pd$\mathrm{Pu} / \mathrm{O}$ | $\begin{aligned} & \text { 1. } \mathrm{Pd} / \mathrm{R} / \\ & \mathrm{MV} / \mathrm{W} / \\ & \mathrm{P}-\mathrm{Pu} / \mathrm{O} \end{aligned}$ | 1. Pd-V- 1. Pd-Pd O/V <br> 2. Sugar- 2. Fb-Pd- <br> 3. Pd-W$\mathrm{Pu} / \mathrm{V} / \mathrm{O}$. <br> Pu <br> 4. Pd-Gn0 |  |  |
|  | Pd2 Pu4 |  |  |  |  |  |  |  |  |  |

## APPENDIX 14.7 Statement I (Contd.)

zONE VI
Alluvial soils, terrain coastal Plain, Rainfall pattern D1 E3 (A1 B3) C1 E3; $150 \mathrm{~cm} / 70$ days cropping pattern Pd1/P2 Pu4;


1. ${ }^{*}$ Recommended for lands on river.

3 \&4. Light duty patterns are for L.I. areas.
2. For canal irrigated lands.

Heavy duty patterns are for canal irrigated areas.

# APPENDIX $14 \cdot 7$ Statement I (Contd.) <br> zone VII 

Red loams, Red and Ycllow soils with black and lateritic patch es, having undulating terrain, rainfall pattern D1 E3 (A2B2) D1 E3 150 cm . Cropping pattern-Pd1 Pd204 (Koraput), Pd3, Pu4 O5 Mt5 R4




APPENDIX 14.7-Statement I (Contd.)
zone VIII
Red loamy laterite soils with a narraw strip of coastal alluvium, undulating terrain, rainfall pattern $1.50 \mathrm{~cm} . / 77$ days Cropping pattern Pd1, Pd2 Pu4, Pd2, O1, Pu5




## APPENDIX 14.7-Statement I (Contd.)

 zONE IXRed loamy and coastal alluvium undulatirg in thr inland areas and plain in coastal tract, Rainfall pattern D1 E3 (A2 B2) Cl DI E2-150-190 cm./in 70 days; cropping pattern Pd2 Pu4


APPENDIX 14.7-Statement I (Contd.)
ZONE-X
Red loamy soil undulating terrain rainfall pattern D1 E3 (A3 B1) D1 E3 160-200 cm. in 90 days crop pattern Pd1/Pd2 R4

| $\frac{\text { District }}{\text { Taluks }}$ | Rainfall <br> Pattern$\|$Existing <br> cropping <br> pattern | Soils | Suggested cropping patterns for the zone |  |  |  |  |  |  | Remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Rainfed Areas |  |  |  | Irrigated Areas |  |  |  |
|  |  |  | Very high land | High land | Medium land | $\begin{aligned} & \text { Low } \\ & \text { land } \end{aligned}$ | High land | Medium land | Low land |  |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Koraput |  |  |  |  |  |  |  |  |  |  |
| Matu <br> Malkangiri | $\begin{aligned} & \text { E4 (B1 A3) } \\ & \text { C1 E3 } \end{aligned}$ | Red <br> Red | $\begin{aligned} & \text { 1. } \mathrm{JK} / \mathrm{M} \\ & \mathrm{~B} / \mathrm{R} / \\ & \mathrm{V} / \mathrm{O} \end{aligned}$ |  | 1. $\mathrm{Pd}-\mathrm{Pu} / 1$ 0. | $\text { 1. } \begin{aligned} & \mathrm{M} / \mathrm{R} / \mathrm{Pd} / \mathrm{P} \end{aligned}$ | $\begin{aligned} & \text { 1. } \mathrm{Pd}-\mathrm{U} / \\ & \mathrm{O} . \mathrm{Pu} \end{aligned}$ |  | . Pd-Pd |  |
|  | Pd 1 |  | 2. $\begin{aligned} & \mathrm{T}+\mathrm{M} \\ & \mathbf{P u / R} \end{aligned}$ | R/Pd O/T/ Fb. |  | $\text { 2. } \begin{aligned} & \text { V/M/- } \\ & \text { V/O- } \\ & \text { V/Pu. } \end{aligned}$ | 2. $\begin{aligned} & \mathrm{Pd}-\mathrm{O} \\ & \mathrm{Pd} \end{aligned}$ |  | $\begin{aligned} & \mathrm{Fb}-\mathrm{Pd}- \\ & \mathrm{Pd} \end{aligned}$ |  |
|  |  |  | 3. $\underset{\mathrm{Fb} / \mathrm{M}}{\mathrm{R} / \mathrm{T}}$ |  |  |  |  |  | $\begin{gathered} \mathrm{Fb}-\mathrm{Pd}- \\ \mathrm{Pu} / \mathrm{V} / \\ \mathrm{O} \end{gathered}$ |  |
| Jeypore . |  | Do. |  |  |  |  |  |  |  |  |
|  | Pd2 R4 |  |  |  |  |  |  |  |  |  |

APPENDIX 14.7-Statement I (Contd.)
zone XI (Contd.)

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APPENDIX 14.7-Statement I (Contd.)
zONE XII (Contd.)


[^26]
## APPENDIX 14.7 (Contd.)

Statement II : Agro Climatic Zones and recommended Cropping Patterns-Kerala (Selected examples)

| Zone | Valley |  |  | Slope |  |  |  | Hill top |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Autumn (Virippu) | Winter (Mundakan) | Summer (Punja) | Seasonal | Annual | Perennial I | Intercrop | Perennial | Intercrop |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  |  |  |  | Winter Sesamum Horsegram | - $\quad$. | Pineapple Lemongrass | ass $\quad$. | $\cdots$ | $\cdots$ |
| V. (Northern Midland) | Rice | Rice | 1. Vegetable (cucurbits) <br> 2. Pulses (cowpea) | Autumn <br> Upland Rice (Chennellu) Winter and Summer Vegetables | Banana <br> Ginger <br> Tapioca | Arecanut <br> Coconut | Pepper <br> Nutmeg <br> Plantains <br> Fodder <br> grass Pulses Tapioca Nutmeg | Cashewnut | Fodder grass |
| VI. (Northern . Midland) Malappuram (Type) | Rice <br> Banana Vegetables | Rice <br> Banana Vegetables | Pulses <br> (Cowpea) <br> Vegetables <br> (Cocurbits) <br> Vegetables <br> Vegetables | Vegetables | Banana Ginger Tapioca | Arecanut <br> Coconut | Pepper Plantain Nutmeg | Cashewnut | Tapioca Pincapple with SCP Fodder grass Pineapple |
| XI. Kuttanad Koleland and Kari | Fallow Kulapala (Upper) Kuttanad) | Rice | Rice | - | - | Coconu 1. | 1. Plantain <br> 2. Minor (tubers) Colocasia | Only built up garden lands are found. |  |

APPENDIX 14.7-Statement-II (Contd.)

|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| XII. | River bank <br> Alluvium | Rice <br> Sugarcane | Rice] | 1. Rice (Irri.) <br> 2. Pulses rice (Cowpea) <br> 3. Sesamum | Autumn Upland <br> Winter <br> Pulses Sesamum | Sugarcane | Arecanut <br> Coconut | Plantain <br> Tapioca <br> Arecanut | Uplands are of mild gradients that it is hardly distinguishable into slope and hill top | $\cdots$ |
| XIII | High ranger | Rice Millets | Rice Vegetables Wheat Oats | Vegetables | Antumn <br> Millets <br> Groundnut <br> Winter <br> Potato (SCP) Wheat Sesamum. | Sugarcane | Coffee <br> Tea Cardamom <br> Orange <br> Fruits | . | Coffee Tea Orange <br> Cardamom Grassland |  |

## APPENDIX 14.7 (Contd.)

Statement III-Suggested Cropping Patterns for Assam

1. Rice Belt (non flood affected areas)
A. Under Rainfed conditions

| Type of soil | Summer | Kharif | Rabi |
| :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 |
| (a) Low land | . Rice : Varieties : Ch-63 Direct seeding : Early April Harvesting middle July. | Rice : Monohar Sali Transplanting Early August Harvesting. End of November. | Wheat : December to March |
| (b) Medium land | . Rice : Variety, Pusa 2-21 Direct Seeding : Early April. Harvesting : Early July. | Rice : 'IR-8'/Jaya' Transplanting. Late July to middle of August Harvesting : Early to Middle of November. | Wheat : September <br> Seeding : Late November <br> Harvesting : Middle of March |
| (c) Upland | . Rice : Variety, Pusa 2-21 Direct Seeding : Early April Harvesting : Middle of July. | Pusa 2-21 (Direct Seeding) Late July-Middle of November. | Potato/Mustard .Late Novem-ber-Middle of March. |
| B. Under irrigated condition <br> (a) Low land . . . . Rice : ‘Ch-63’ Transplanting : Rice : ‘Monohar Sali’ Trans- Wheat : (Early December-Late During April Harvesting : planting: August Har- March). During July. vesting : Late November. |  |  |  |
| (b) Medium to high land | . Rice : Pusa-2-21 Transplanting: April Harvesting : June to July | Rice : 'In-8’/Jaya' Transplanting July to August Harvesting: November. | Wheat/Potato/Mustard |
| 2. Jute Belt |  |  |  |
| A. Under Rainfed condition <br> (a) Low land | Jute (Capsularies) : 'JRO-212’ Sowing : March-April Harvesting : End July. | Paddy : 'Monohar Sali' Transplanting : Early August harvesting : End November | Wheat (December-March) |
| (b) Medium land . | . Jute (Olitorius 'JRO-7835' <br> Sowing : April-Mid-May Harvesting : End July. | Paddy : IR-8'/Jaya' Transplanting : upto middle August. | Wheat/Potato Late November-March. |

A. Under Rainfed condition Sowing vesting : End July. planting : Early August harvesting : End November.解 August.

# APPENDIX 14.7-Statement III (Contd.) 



## APPENDIX 14.7 (Contd.)

(Paragraph $14 \cdot 6 \cdot 116$ )
Statement IV-Suggested Cropping Patterns for Maharas'ltra Selected Examples)
Zone No. I: This zone has 18 talukas in 6 districts as given below :
The total area exceeds 20,000 sq. kilometers.

District

1. Sangli

Taluka

1. Miraj
2. Tasgaon
3. Jath
4. Islampur
5. Vita (Khanapur)
6. Satara.
7. Vaduj
8. Dahiwadi
9. Poona
10. Baramati
11. Phaltan
12. Dhond
13. Indapur
14. Sholapur . . . 12. Karmala
15. Ahmadnagar . . 13. Shrigonda
16. Sholapur . . . 14. Pandharpur
17. Sangola
18. Mangalwedha
19. Malsiras
20. Madha

The above area is in the scarcity zone.
II. Annual Rainfall: Rainfall (Annual) of this zone is between 45 to 65 cms ., but $2 / 3 \mathrm{rd}$ of the zone receives rainfall less than 55 cms . Talukas of Sangli, Islampur. Tasgaon and Miraj have average higher than 60 cms . The normal distribution of the rainfall in pre-monsoon monsoon and post-monsoon, period is as under-
Pre-monsoon Monsoon Post-monsoon

Feb. to May
Less than 5 cmpm

June to Aug. 5 to 10 cmpm . Sept. 10 to 20 cmpm .

Oct. 5 to 10 cmpm Nov. to Jan. Less than 5 cmpm .

June to September receives about 75 per cent of the annual rainfall. Monthly rainfall particularly of July to August is highly variable compared to September showers.
III. Soils: The Zone has light to medium soils on an average though some area has deep soils on banks of river flowing.
IV. Existing Cropping Pattern : Rabi Jowar is predominant in medium and heavy soils while Bajra is predominant in shallow soils. Kharif jowar is grown on large scale in Miraj and Tasgaon talukas of Sangli district. From the rainfall data it is seen that in July and August the area receives fairly good showers. Other crops grown are pulsed and groundnut.
V. Remarks of the Commission : The rainfall in this zone can support only crops like jowar and bajra but the crops cannot be satisfactory without irrigation. This is because of the highly uncertain character of the rainfall.

## APPENDIX 14.7 Statement IV (Contd.)

VI. Changes suggested in the crop pattern : Considering the rainfall behaviour, soils and existing cropping pattern suggestions are offered for changing or adjusting the sowing period of the crops grown. Such changes suggested are indicated in the following table:-

| Soil type | When the onset of monsoon is early to normal and sowings are possible in June | Late by 3-4 weeks and sowings are in latter half of July | very late and sowings are delayed till middle of August |
| :---: | :---: | :---: | :---: |
| Sallow Soils | Bajra, HB3, pulses, cowpea/ sunflower, til-sesamum. | Hy. Bajra, Sunflower. | Hy. Bajra |
| Medium and Medium deep soils | (i) Hy. Bajra HB 3 <br> (ii) Hy. Jowar CSH4 CSH5 <br> (iii) Groundnut (early varieties) In rabi season follow on crop of safflower, gram may be taken after Hy. bajra or jowar on the residuary moisture available. |  |  |

It may further be added that evolving early varieties of groundnut will help to increase the area under groundnut in this area. Till crop may also be tried in this zone in shallow soils as it requires less water for its growing period and it also thrives fairly well in shallow soils.

In this zone much emphasis is necessary on conservation of moisture by adopting various water harvesting measures. Similarly, priority for increasing irrigation potential has to be given because of the uncertainty of the monsoon rains.

Zone No. IV : This Zone has 34 talukas in 6 districts
Particulars are as below :-

## District

1. Osmanabad

Taluka

1. Osmanabad
2. Tuljapur
3. Udgir
4. Ahmedpur
5. Latur
6. Ausa
7. Kallam
8. Lahora (Omerga)
9. Nilanga
10. Bhum
11. Paranda
12. Akalkot
13. Sholapur
14. Mohol
15. Barsi

## APPENDIX 14.7-Statement IV (Contd.) <br> District <br> Taluka

3. Bhir
4. Aurangabad
5. Jalgaon
6. Dhulia
7. Bhir
8. Kaij
9. Ambejogai
10. Georai
11. Manjilegaon
12. Patoda
13. Ashti
14. Aurangabad
15. Paithan
16. Gangapur
17. Khuldabad
18. Saogaon
19. Pachora
20. Parola
21. Amalner
22. Chilisgaon.
23. Sindhkheda
24. Dhulia
25. Nandurbar

Total area of the zone is about $45,000 \mathrm{sq} . \mathrm{km}$.
The elevation is between 600 to 900 metres above sea level.
II. Annual Rainfall: The rainfall in this area is 60 to 70 cm . About 75 per cent of the annual rainfall occurs in the months of June to September.

There is practically no rain before June except very few anti-monsoon showers.
Sholapur and Bhir area the month of maximum rainfall is September while in Jalgaon and Dhulia July is the month of bighest rainfall.'. The main feature in this zcre is tha all the months i. e. June to September gets on an average 10 cm . or more rainfall per month.

The distribution of rainfall is as below :-

Pre-Monsoon
Monsoon
Feb. to May. .Less than
5 cmpm .

## Post-Monsoan

Oct. to Jan... Less than 5 cmpm .
III. Soils : In the entire area, the soils are mostly medium black with patches of deep black soils. In some talukas of Aurangabad and also Bhir, shallow black soils are also present.
IV. Existing Cropping Pattern: Cropping patterns in this zone are numerous. The most significant is the jowar crop which is a predominant crop of this zone. Afew talukas have Bajra as a dominant crop and Jalgaon and Aurangabad have two patterns with cotton as a dominant crop. In all the patterns pulses (except Gram and Tur) are to the extent of about 10 per cent.
V. Changes Suggested in the Cropping Pattern: Low yield of Kahrif jowarin: Osmanabad, Bhir nad Aurangabad districts is partly due to cultivation of jowar even on shallow black soils and partly due to less intensive cultivation methods adepted in these districts and especially the use bf fertilisers. Groundnut yields are also low because its cultivation is not restricted to suitable areas only but being a cash crop it is cultivated even in shallow soils. Sometimes'September rainsfall which is also responsible for reducing the yield.

## APPENDIX 14.7-Statement IV (Contd.)

Following suggestions are offered :-
(1) In shallow deep lands cultivation of Hybrid Bajra should be undertaken.
(2) Coverage of part of area of Jowar by Hy, varieties should be encouraged. If the rainfall is received in early July conditions are favourable for kharif jowar sowing and should be taken up on extensive scale. Rabi jowar sowing should be taken up in the middle of August for getting maximum advantage of September rains for the grand growth period of the crop. Reduction of area under Tur in Tuljapur, Osmanabad and Georai, Manjilegaon of Bhir district by expanding Mung and Urd area which are short duration is recommended. In rabi, a second crop of jowar is to be taken in medium deep soil after the pulse crop in the kharif season. For some areas, safflower as a second crop may also be tried. Replacement of part of the area of groundnut by sunflower is a short duration crop and which thrives better in less moisture conditions is recommended.
VI. For increasing cotton yields it should be taken up in medium deep soils and its cultivation in marginal lands should be discouraged. American cotton varieties like Buri 147, 1007 and Hy. 4 may be introduced in place of Arborium varieties. Part of the area may be diverted to chilli crop. Application of fertilisers should be encouraged for getting better yields.
N.B. : It is necessary to evolve short duration high yielding varieties of Tur and Groundnut as these crops cannot be replaced to a significant scale by other varieties of crops.
Zone No. VI : This is the biggest zone with 37 talukas in 9 districts of the State as below:-

## District

1. Nanded
2. Patheni
3. Buldhana .
4. Jalgaon
5. Aurangabad

## Taluk

1. Kandahar
2. Basmat
3. Jintur
4. Partur
5. Hingoli
6. Parthri
7. Chikli
8. Mekhar
9. Malkapur
10. Khamgaon
11. Jalgaon

12 Chopda
13. Jamner
14. Dhadgaon
15. Erandol
16. Yaval
17. Baver
18. Pachora
19. Ambad
20. Jalna
21. Jeffarabad
22. Bahradi

## APPENDIX 14.7-Statement IV (Contd.)



The total area of this zone is 60,000 sq. kms . Most of the zone has elevation ranging. between 300 to 1600 metres above sea level. Terriain is a relliry plain. Ecnc area is hilly. This zone falls in assured rainfall zone with mainly krarif crop.
II. Annual Rainfall: July is the highest rainfall month with 20 to 25 cr r m . Jure, August and September, are of the same order- 12 to 18 cmpm . Rainfall in other monthsis negligible. More than 80 per cent of annual rainfall occurs during the monsoon period.

The distribution of rainfall is as under:-

| Pre-monsoon | Monsoon | Post-monsoon |
| :--- | :--- | :--- |
| Feb. to May-Less than | June, Aug. Sept. 10 to | Oct. to Jan.—Less than <br> 5 cmpm. |
|  |  | 5 cmpm. |

III. Soils : This zone has mainly medium black soils.

Existing Cropping Patterns : Cotton is the predominant crop while the second important crop is jowar. In fact cotton and jowar are the two common factors in the cropping structure of this zone.

Changes Suggested in Cropping Pattern : The zone falls in assured rainfall area. For increasing the yield of cotton the cultivation of hirsutum varieties like Buri 147, 1007, Hy. 4, MCUS etc. need to be extended in place of Arbarium varieties which are taken at present even in deep soils. Further it is necessary to discourage cultivation of cotton on marginal lands. Such lands be diverted to hybrid Bajra and Hy. Jowar.
(ii) For increasing the Jowar yield replacing about 50 per cent of the area under the existing jowar varieties by hybrid varieties like CSH1, CSH4, etc. is recommended. Use of fertilisers shoud also be boosted up.

Cultivation of improved varieties of pulses, (Urid Mung) is recommended for increasing the yield of pulses. The second crop after pulses like rabi jowar should te encouraged.

Crop of un-irrigated chillies can be introduced in heavy soils.
N.B. : It is necessary to evolve high yielding varieties of pulses and aslo short duration. varieties of Tur for this zone.

## APPENDIX 14.7 (Contd.)

(Paragraph 14.6.119)
Statement V-Suggested Cropping Patterns for Karnataka (Selected examples)
(i) Rainfall Pattern No. XXI-C1 E3 (A4) C1 D1 E2-zone

This rainfall pattern zone covers the coastal taluka of Udipi, Coondapur, Mangalore and Bantwal of South Kanara District. The total rainfall is 3564 mm , distributed mostly from May to November. About 200 to 280 cm rainfall is received during the months of June to July with 51 to 54 rainy days. In this rainfall pattern, 10 to 20 cm rainfall is received during May, compared to 5 to 10 cm in patterns No. XV and XVII. In view of heavy rainfall, paddy is the most important crop in monsoon. Irrigation potential is 46 per cent in Bantwal, 36 per cent in Udipi, 32 per cent in Mangalore and 18 per cent in irrigation is mostly through tanks, wells and lifts on rivers. The soils are mostly coastal Coondapur taluk. The alluvium in all the taluks except some laterites occurring in Mangalore.

The existing cropping pattern for this region is paddy in 70 per cent plantation crops in 9 to 15 per cent, pulses 4 to 5 per cent, sugarcane 1 to 2 per cent and foodder crops 1 to 3 per cent.

In view of increased irrigation resources and extended crop growing period, it is a common practice to take 2 crops of paddy with supplementary irrigation. Where irrigation is assured, a third crop of paddy or other crops having lower water requirements are aslo to be taken. The research work on multiple cropping conducted at Mangalore indicated that it is possible to grow crops like, cowpea, ragi and paddy profitably in summer. The other crops which could be tried are groundnut and pulses.

The average yields of paddy can be increased from $13.5 \mathrm{q} / \mathrm{ha}$ to about $25 \mathrm{q} / \mathrm{ha}$ by adoption of high yielding varieties, application of adequate fertilisers and adoption of plant protection measures, as there is gallfly menace during monsoon in this area. The results of experiments conducted at the Medium Research Station, Mangalore, have indicated that an average yield of $5,000 \mathrm{Kg} / \mathrm{ha}$ can be obtained from high yielding varieties by adopting recommended practices. The yields of second crop can be further enhanced in view of lesser incidence of pests. The important plantation crops in this region coconut arecanut cashewnut, pineapple and pepper. The yields of plantations crops can also be considerably increased by adoption of recommended practices. The results of simple fertiliser trials in cultivators fields have indicated that increase in yield by 11 to 52 per cent can be obtained by application of manures and fertilisers in case of arecanut. There is also experimental evidence to indicate that application of lime increases the yield of arecanut by about 16 per cent over application of NPK alone. The results of experiments carried at Kasargod indicate that the yields of coconut can be increased by about 30 per cent by application of manures and fertilizers.

There are large areas of fallow lands ranging from 4 to 8 per cent and cultivable wastes ranging from 7 to 18 per cent in this region. At least a part of this land could be brought under crops like cashew, pineapple, mango and banana. It is further recommen.ded that fodder crops like Napier Grass (Hybrid-2) and Elephant grass should be extended round about cities in fallow and waste lands and river beds which would also serve the purpose of controlling soil erosion.

The recommended cropping pattern in this region will be paddy in 68 per cent, plantation crops in 20 per cent, pulses 9 per cent, groundnut 10 per cent, fodder crops 5 per cent, vegetables 12 per cent and sugarcane 1 per cent.

## APPENDIX 14.7-Statement V (Contd.)

(ii) Rainfall Pattern Zone No. XXVI-C1 D1 E2 (A4) C1 D1 E2

This rainfall pattern covers $1 / 2$ western part of Virajpet and whole of Mercara. taluk of Coorg District. The total rainfall received is more than 297 cm distributed mostly from April to November. July is the month of highest rainfall.

The soils are red loams. The existing cropping pattern is paddy in 33 to 45 per cent, cardamon 1 to 2 per cent, citrus 5 to 13 per cent, coffee 30 to 40 per cent and other horticultural crops in 6 to 20 per cent area. The total area under plantation crops is 39 per cent in Virajpet and 57 per cent in Mercara.

The irrigation potential is 6 per cent in Virajpet and 3 per cent in Mercara,mostly. from small tanks and canals. Since the heavy rainfall is extending up to the end of September, paddy is the important crop in monsoon season. In uplands, an early duration. pulse crop can be sown after the harvest of paddy during the early part of October and November. In about 30 to 40 per cent of the area under plantations, inter-crops like pepper, mandrin and citrus can be grown. In this region, there is possibility of increasing the area under rubber, cocoa, nutmeg, vanilla, cloves, turmeric and ginger. The area under coconut, pineapple, banana, jack fruit, cardamom and citrus could also be increased. New crop that can be introduced is tapioca. Parts of the areas under cultivable waste and fallows can be brought under plantation and forage crops.

The recommended cropping pattern for this region is coffee in 32 to 40 per cent, paddy in 32 to 35 per cent, cardamom in 10 per cent, citrus in 20 per cent and other new plan-tation crops and spices suggested can cover upto 10 per cent
(iii) Rainfall Pattern No. III-E4 (C4) D1 E3

This rainfall pattern covers the taluks of Seram Chincholi, Gulberga, Aland, Afzalpur, Andala and Chittapur. The average annual rainfall is 803 mm mostly distributed from June to September. September is the month of highest rainfall.

The soils are medium to deep black, except in Aland, where some laterites occur. The existing cropping pattern is rabi jowar 30 to 50 per cent, bajra, groundnut, tur and other oilseeds 10 to 30 per cent each. The yields of jowar are about 110 per cent of national average and 80 per cent of State average. The yields of bajra and groundnut. are 123 and 99 per cent respectively of national average. The high yields are mostly due to better distributed rainfall.

The irrigation potential in this area is 1 to 2 per cent, except in Andala (Jewargi), where it is 4 per cent. Irrigation is mostly through wells.

It is possible to take an early duration kharif crop of pulses, groundnut or bajra, followed by a rabi crop of jowar, wheat or safflower in moisture retentive soils. Mixtures of hybrid jowar and cotton, cotton-onion, cotton and chilly, groundnut and cotton could also be exploited. Use of adequate fertilizers would increase the crop yields by about 40 to 50 per cent.

The suggested cropping pattern is paddy 1 per cent, Kharif jowar 2 per cent, rabi jo-war 28 per cent, bajra 9 per cent, wheat 3 per cent, small millets 2 per cent, gram 4 per cent, tur 12 per cent, other pulses 8 per cent, groundnut 9 per cent, other oilseeds 11 per. cent and cotton 7 per cent.

## (iv) Rainfall Pattern-Zone No. VII-DIE3(C1D3)C1DIE2

This rainfall pattern covers Hoskote Taluk of Bangalore District, Malur, Bangarpet, Mulbagal, Srinivaspur, Chintamani, Bagepalli, Gudibanda, Gowribidanur and Kolar:

## APPENDIX 14.7-Statement $V$ (Contd)

Taluks of Kolar district; Madhugiri, Koratagere, Sira, Chikkanayakanahalli, Pavagada taluks of Tumkur district; Hosadurga, Holakere, Chitradurga, Harihar, Davangere, Jagalur and Molakalmuru of Chitradurga District.

This area receives a total average rainfall of 664 mm , ranging from 545 to 763 mm . September and October receive rainfall, ranging from 10 to 20 cm , while in the remaining months of May to November, the rainfall ranges from 5 to 10 cm .

The soils are mostly red sandy, except red loams in the taluks of Chitradurga, Chikkanayakanahalli, Koratagere, Madhugiri, Srinivaspur, Mulbagal, Bagepalli, Pavagada and Sira; laterites in the taluks of Mulur, Hoskote, Chintamani; laterites and loamy in Kolar, Bangarpet, $\frac{1}{2} \mathrm{~N}$ of Gowribidanur, mixed red and black in Holalkere and Hosadurga and deep black in Davangere, Harihar and Jagalur.

The existing cropping pattern is ragi in 50 to 70 per cent, paddy 10 to 20 per cent, groundnut 10 to 20 per cent and pulses 10 to 20 per cent in Kolar district. In Chikkanayakanahalli of Tumkur District and Hosadurga of Chitradurga district, plantation crops occur in 21 and 18 per cent are a respectively. In Chitradurga district, ragi is grown to an extent of 10 to 30 per cent, Kharif jowar 10 to 30 per cent and paddy 10 to 30 per cent. In Molakalmuru and Challakere taluks, pulses and small millets occur in 10 to 30 per cent area.

The yield levels of jowar, paddy and ragi are more than national average. Groundnut yields are near about the national average, but the cotton yields are low. Ragi crop needs to be continued, but the yields can be increased considerably by application of adequate fertilizers and growing short duration varieties like Purna and Sharada. If the early rains fall, it is better to sow ragi or sunflower in place of groundnut. Cowpea is suitable for dry land and its use needs to be exploited. Castor is an important crop which can be introduced in this area. The yields of RE 1377 (S.A. 2) have been recorded to an extent of 12 Q/ha.

About 21 per cent of the area hasirrigation facilities. Parts of Harihar and Davanrege, receive irrigation through Bhadra project, while other taluks have irrigation mostly through tanks and wells. 50 to 60 per cent of the area in Harihar and Davangere is irrigated. Irrigation potential is between 20 to $_{0} 35$ per cent in the taluks of Kolar, Malur, Kortagere, Madhugiri, Bangarpet, Sirinivaspur, Mulabagal Gowribidanpur and Sira. 10 to 20 per cent of the area is irrigated in the taluks of Hoskote, Chintamani, Bagepalli and Pavagada.

The cropping pattern for the irrigated areas may be recommended as under :

1. Hybrid jowar : Wheat
2. Hybrid maize . Wheat or Bengalgram
3. Ragi . . Bengalgram or wheat or
4. Ragi-Wheat . Maize
5. Maize . . Wheat
6. Hybrid jowar

- Radish

7. Ragi-beans . Potato
8. Paddy . . Wheat
9. Paddy . . Beans or vegetables

Hybrid jowar or bajra or ragi
Hybrid jowar or bajra or ragi.
Hybrid bajra or ragi or groundnut.
Beans
Ragi-Leafy vegetables.
Beans or Peas-Hybrid bajra.
Maize
Maize or jowar or bajra or groundnut.
Paddy.

## APPENDIX 14.7-Statement V (Contd.)

Paddy may be restricted to low-lying areas only. The above cropping pattern may be followed depending upon the locality, soil type and water for irrigation.

The average recommended cropping pattern for the taluks under Chitradurga district is paddy 8 per cent, kharifjowar 20 per cent, rabijowar 2.5 per cent, ragi 17 per cent, bajra 1 per cent, small millets 9 per cent, tur 6 per cent, sugarcane 0.2 per cent, other pulses 12 per cent, groundnut 7 per cent, cotton 4 per cent, sunflower 2 per cent, other oilseeds 2 per cent, castor 0.2 per cent and plantation crops 3.6 per cent. The average recommended cropping pattern for the taluks of Kolar district is paddy 8 per cent, maize 5 per cent, ragi 31 per cent, bajra 4 per cent, kharif jowar 9 per cent, small millets 5 per cent, gram 0.37 per cent, tur 1 per cent, other pulses 11 per cent, sugarcane, $1 \cdot 37$ per cent, groundnut 18 per cent, sunflower 2 per cent, castor 0.37 per cent and other crops 5 per cent. The average recommended cropping pattern for Tumkur district is paddy 6 per cent, maize 2 per cent, kharif jowar 12 per cent, rabi jowar 0.4 per cent, ragi 23 per cent, smallmillets 8 per cent, gram 0.4 per cent, tur 4.0 per cent, sugarcane 0.4 per cent, other pulses 16 per cent, groundnut 13 per cent, plantations 5 per cent, sunflower 2 per cent, castor 1 per cent, other oilseeds 2 per cent and other crops 5 per cent.

Taluk example

1. Rainfall pattern :

| February to May | 1 month (May) <br> 3 months |
| :---: | :---: |
| June to September | $\begin{aligned} & 1 \text { month (Sept.) } \\ & 3 \text { month } \end{aligned}$ |
| October to January | 1 month (Oct.) <br> 1 month (Nov.) <br> 2 months |

5-10 cm. less than 5 cm .
$10-20 \mathrm{~cm}$.
$5-10 \mathrm{~cm}$.
$10-20 \mathrm{~cm}$. $5-10 \mathrm{~cm}$. less than 5 cm .
2. Monthly rainfall :

$$
\mathrm{mm}
$$

| January | 2.8 | May | $85 \cdot 1$ | September | $81 \cdot 0$ |  |
| :--- | ---: | :--- | ---: | :--- | ---: | :--- |
| February | $6 \cdot 1$ | June | 54.9 | October | 130.1 |  |
| March | 4.3 | July | 87.9 | November | $45 \cdot 2$ |  |
| April | $38 \cdot 1$ | August | 65.3 | December | 10.9 Total | 611.7 |
| 3. | Soils |  | Deep black |  |  |  |
| 4. Land-use : |  |  |  |  |  |  |

Geographical area
Per cent of geographical area under : net area sown . . . . . 56
culturable waste . . . . . 1
pastures . . . . . . 15
forests . . . . . . 11
fallow . . . . . . 5

## APPENDIX 14.7-Statement V (Contd.)

5. Area under principal crops

|  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Paddy |  |  |  |  |  | (Thousand ha) | | Per cent of gross |
| :---: |
| cropped area |

6. Relative Yield Index (Per cent of all-India Yield) ;

| Paddy | . | . | . | 193 | Tur | . | . |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Kharif Jowar | . | . | 93 |  |  |  |  |
| Rabi Jowar | . | . | . | 161 | Groundnut | . | 138 |
| R | 113 | Cotton | . | . | 55 |  |  |

Ragi . . . . 88
7. Cropping Pattern Pd4 R4 Jk4 Gn4
8. Percentage of net irrigated area to net area sown $38 \%$
9. Modifications suggested: In view of better rainfall distribution double cropping underrainfallconditions is recommended. Hybrid jowar+Cotton mixture, pulse followed by chillior cotton, groundnut or sunflowerfollowed by rabi jowar or gram paddy followed by pulse, coriander and sesamum followed by rabi jowar or sunflower, pulses followed by rabi jowar, setaria followed by cotton, hybrid jowar followed by bengal gram and pulses or sesamum followed by ragi. Tobacco is an important crop that can be extended in this area. Underirrigation 3 to 4 crops can be grown. Paddy should be restricted to an low-lying areas.

Important crop sequences that can be adopted are :

1. Paddy

Wheat, Gram, Vegetables Paddy
2. Paddy . . . Groundnut Maize, Fodder or Green gram.
3. Groundnut or Ragi Onion, Chilli or Cotton or Hybrid Jowar or Hybrid or Maize or Onion Gram or Vegetables. Bajra or Hybrid Maize or Chillies or Cowpea or Hybrid Bajra or
4. Chillies

- Cotton

5. Pulses . . . Sea Island Cotton
or Fodder crops or vegetables.
Fodder or Pulses
Paddy.

Suitable crops depending upon water availability and soil tye can be grown. Area under Sea Island Cotton to be extended.
10. Proposed cropping pattern : Paddy-20, K. Jowar-20, Rabi Jowar-10, Ragi -15, Small millets-5, Tur-5, Other pulses-15, Cotton-5, Safflower-2, Other crops-3.
11. Remarks : $\ddagger$. Ref. Rainfall Pattern $\mathbf{X}$.

## APPENDIX $14 \cdot 8$ <br> (Maps)

MAP I Rainfall Patterns (Paragraph 14.4.5)
MAP II Month of Maximum Rainfall (M) together with (a) Totals of rainfall (Rf) and rainy days ( Rd ) of two consecutive months-month of maximum and of preceding or following whichever is higher and (b) Number of consecutive months ( n ) with month of commencement ( m ) of rainfall of 10 cm pm or higher ( $\mathrm{b}_{\mathrm{mm}}$ ) with totals of rainfall (Rf) and rainy days (Rd) for these months.

Entries in each taluk are shown thus:
(i) • $\quad \mathrm{M}$
Rf/Rd
(ii) bmm
Rf/Rd

MAP III Rainfall Regions (Paragraph 14.5.5)
MAP IV Cropping Patterns (Paragraph 14.6.2)
MAP V Livestock Patterns (Paragraph 14-3.14)
MAP VI Population Density (District Map) (Paragraph 14.3.3)
MAP VII Net Irrigated Area as Percentage of Net Sown Area (1970-71)
(Paragraph 14.3-8)

Rainfall and Cropping Patterns-<br>KARNATAKA

## 1 introduction

1.1 The population of the country is estimated to reach 935 million mark in 2000 AD, which surely necessitates increased agricultural production. Land resources being limited, emphasis has to be placed on increasing productivity per unit area. Temperature and other climatic conditions being favourable throughout the year over most parts of the country, it is possible to grow more than one crop per year provided water is available. In some parts of the country, spread of rainy season is long enough to provide ample scope for double cropping. This potential is yet to be exploited. There is undoubtedly scope for increasing irrigation water resources in the country, but our estimates show that the area under irrigation is not expected to be more than 42 per cent of the total cropped area even in 2000 AD , although it would mean considerable improvement over the existing percentage of 22 (1970-71). Therefore, judicious utilisation of direct rainfall and irrigation water, singly and in combination, will have to be thought of for increasing production.

1:2. Farming technology has so advanced that it is possible to increase yields of crops even under rainfed conditions, but their choice would have to depend upon the amount and distribution of the prevailing rainfall. Additionally, it will be necessary that the maximum possible quantity of rain-water is conserved in ponds and pools situated either within the farm area or elsewhere, in soil profiles and underground storages so that the same could be readily used to save crops in times of stress. Not only in rainfed farming but even under irrigated conditions, one will have to plan for the most economic and efficient use of water to derive maximum possible benefit from rainfall re-- ducing dependence on irrigation so that the advantage of water availability could be extended to as large an area as possible. This necessitates a close study of the existing cropping patterns vis-a-vis rainfall patterns aimed at determining the nature of changes needed in cropping patterns to make the maximum use of rain-water. The cropping patterns, as they evolve, represent the integrated effect of the requirements, local habits and economic factors through time. In the context of increasing production, it is necessary to examine them from a scientific angle and find out possible alternative patterns having higher potential. Accordingly, the Commission undertook a comprehensive study of the rainfall and cropping patterns of the country. The study covered several other relevant factors also to facilitate an integrated assessment, viz. orography, land use, human and livestock, populations, operational holdings, power availability for cultural operations, soils and climate.
1.3 The information on rainfall and crops could enable one to delineate the country into suitabe agroclimatic regions because crops in themselves represent an interplay of several natural factors including soils. The data thus collected during the course :of the study should prove useful for various planning and reference purposes at levels ranging from taluk to all-India, besides its utility for the main purpose of arriving at the future cropping patterns. It has, therefore, been decided to present the basic results of the study together with all relevant data and maps in the form of State volumes but these State Reports will be issued separately, though along with the main Report. This Appendix dealing with Karnataka rainfalland cropping patterns is meant to serve as an illustration. It consists of six parts, the first being introduction. The second is on methodology, the third deals with general information giving a brief account of related factors such as 34-133 Deptt. of Agri, $/ 76$
orography, land use, soils etc. Rainfall and cropping patterns are analysed in parts four and five respectively. The concluding part gives the guidelines for future cropping patterns.

## 2 METHODOLOGY AND SOURCES OF DATA

2.1 The mothodology adopted in the study is described in this Section. The chief features of the study are (a) use of taluk (or tehsil) as unit of area; (b) introduction of the concept of numerical form to express patterns of distribution of rainf.ll, crofs and livestock and assigning them suitable codes and (c)inclusion of information on orography, temperature, evapotranspiration, rainfall, soils, irrigation, land use, size of operational holdings, human and livestock populations, power availability for field operations and yield performance of crops, all of which influence in different ways and degrees the cropping patterns of a place. The information so coded is then presented on maps of $1: 1$ million scale.

## Rainfall Patterns

2.2 A major feature of Indian rainfall is that more than 70 per cent of it occurs during the south west monsoon months of June to September throughout the country, except the south east Peninsula and Kashmir. The monsoon as well as annual rainfall show large fluctuations from year to year, but there is no evidence of any significant trend or periodicity in them when examined over a long period. Because of the lack of such trend, it is possible to classify regions in the country possessing characteristic rainfall patterns. When the examination of rainfall is considered in relation to crop production, the annual or seasonal totals do not have much significance compared with smaller intervals. Then, a pertinent question to answer is whether rainfall should be considered on a weekly, fortnightly or monthly basis. The coefficient of variation of rainfall is as high as 40-50 per cent even in the rainiest month of July, over most of the central, northern and eastern India. The variability of weekly or fortnightly rainfall is many times greater. This is a major difficulty in using weekly and fortnightly averages as dependable indicators of rainfall distribution. Therefore, while studies for individual or specific problems on the basis of weekly or fortnightly rainfall data have their own utility in spite of their high variability, for a macro studylike the present one involving the whole country, monthly data are most convenient.
2.3 In order to facilitate examination of the distribution of rainfall during periods of crop growth, limits of rainfall which have closer relation to broad requirements of crops, have ;been drawn up. The time span of crops is usually of the order of 90 days or longer. Keeping this in view, the following limits have been used in the study :-
(i) Rainfall of greater than 30 cm per month (pm) for at least three consecutive months would be suitable for a croplike paddy whose water need is very high.
(ii) $\mathbf{2 0 - 3 0} \mathrm{cm}$ pm for not less than three consecutive months, would be suitable for crops whose water need is high but less than paddy, for example, maize and blackgram.
(iii) $10-20 \mathrm{~cm}$ pm for at least three consecutive months is considered suitable for crops requiring much less water, e.g., bajra and small milltes.
(iv) $5-10 \mathrm{~cm}$ pm is just sufficient for Crops which have low water requirements, e.g. moth ( $P$. aconitifolius) and ephemeral grasses.
(v) Rainfall less than 5 cm pm is not of much significance for agriculture.
2.4. For denoting the year's rainfall distribution, the Iimits of rainfall have been designated by symbols as follows :-

| Symbols | rainfall cm pm |
| :---: | :---: |
| A | greater than 30 |
| B | $20-30$ |
| C | $10-20$ |
| D | $5-10$ |
| E | less than 5 |

In distributions involving higher amounts of rainfall of A or B type, lower association of D type are more common than $\mathbf{E}$. Therefore, in order to reduce the number of symbols in distributions beginning with $\mathbf{A}$ or $\mathbf{B}$ and at the same time give an idea of the possibility of occurrence of rainfall of even less than 5 cm pm , symbol E has been used to denote amounts of less than 10 cm pm , skipping the use of symbol D. Such instances are not many. A numerical subscript is affixed to these alphabets in order to indicate the number of months in which a particular amount of rainfall is received. As JuneSeptember period is important in most parts of the country, this is shown in the coded form by a bracket, the four months of Feb-May being on its left and the remaining four months October-January on the right. An example of a yearly distribution is D1 E3 (A2 B1 C1) C1 D3, in which for each of the three periods the symbols are in order of decreasing rainfall but not necessarily in order in which they occur in the calendar. Its numerical interpretation is as follows :-
(i) D1 E3 represents the period February to May, in which one month's rainfall (usually May) belongs to $5-10 \mathrm{~cm}$ type and the remainder three months get less than 5 cm pm .
(ii) A2 B1 C1 represents the period June to September, in which two months (usually July and August) get more than 30 cm pm , one month (September) belongs to $20-30 \mathrm{~cm}$ type and the remaining month i.e. June to $10-20$ "cm type.
(iii) C1 D3 represents the period October to January, in which October belongs to $10-20 \mathrm{~cm}$ type and the rest to $5-10 \mathrm{~cm}$ pm type.
2.5 If an identical distribution occurs over two or more adjacent taluks, it is designated as pattern and the area covered by a pattern is distinguished as a zone and indicated by Roman numerals. Rainfall patterns have bzen identified, following the above procedures by utilising the 50 year normals of about 2,700 rain gauge stations as contained in the India Meteorological Department's Memoirs XXXI(III) 1962 and depicted on maps of $1: 1$ million scale. The terminology which has been adopted usually while discussing rainfall is indicated below :

(i) rainfall pattern . . . when a season's or all the 12 months' distribution is meant.
(ii) type . . . . . when rainfall of any of the 5 rainfall limits is discussed, e. g., A type, B type etc.
(iii) category . . . . . when a range between a few types is described, e.g., A2-B2 category. $\mathrm{Bl}-\mathrm{C} 4 / \mathrm{C} 3$ category etc.

## Cropping Patterns

2.6 The study of cropping patterns has been based on the gross cropped area at the taluk level for 1969.70, obtained from the States. An attempt has been made to cover as many Crops as possible in the analysis. Because
the number of crops is large and vary from taluk to taluk, only these crops which individually occupy 10 per cent or more of cropped area have been considered for inclusion in cropping patterns. As such crops having lesser area spread have been often excluded even though they might be of local importance e.g., vegetables, potato, tabacco, sugarcane, grapes. The minimum limit of the area to be accounted for by a cropping pattern has been fixed at 70 per cent, after many trial computations. By adopting this criterion the number of crops to be considered in a pattern does not usually exceed four or five. Thus, a combination of crops, each occupying not less than 10 per cent of the gross cropped area of taluk and making a total of 70 per cent or more of the gross cropped area, is considered sufficient to constitute a cropping pattern provided that it extends over at least two adjacent taluks.
2.7 The crops codes together with percentage area coverage as used in the study is given below:

| Crop | Code | Crop | Code |  |
| :---: | :---: | :---: | :---: | :---: |
| paddy <br> pulses other than <br> pigeonpea and gram <br> potato <br> wheat <br> maize <br> small millets other than ragi | Pd | groundnut | Gn? |  |
|  |  |  | 0 |  |
|  | $\mathrm{Pu}_{\mathrm{Pt}}$ | groundout | Oa |  |
|  | W | cotton | C | area |
|  | M | other fibres | $\underset{\mathrm{Fb}}{ }{ }^{\text {F }}$ | Covereage* |
|  |  | fodder] | F | (percent) |
|  | Mt | fruits | Fr | 70 or more |
| jowar kharif | Jk | plantations | $L$ | 50.70 |
| jowar rabi | Jr | sugarcane | $\stackrel{5}{\mathbf{S}}$ | 30-50 3 |
| jute | Jy | vegetables | $\stackrel{\mathrm{V}}{\mathrm{C}}$ | $\begin{array}{ll}10-30 & 4 \\ \text { less }\end{array}$ |
| bajra barley | $\stackrel{\text { B }}{\text { Ba }}$ | ${ }_{\text {chillies }}^{\text {pigeonpea (tur) }}$ | $\mathrm{Ch}_{\mathrm{T}}$ | ${ }_{10}$ |
| ragi gram | R | tapioca | T 2 | overlapping points are suitably adjusted. |

The code number indicating the percentage area coverage by a particular crop is affixed as a subscript to the crop symbol concerned. For example, C3 Jr4 Mt4 would indicate that cotton area is $30-50$ per cent and jowar rabi and millets each occupy 10-30 per cent of the gross cropped area. Where each of the crops occupies say, $10-30$ per cent of the area, e.g., in the cropping pattern C4 Jk4 Jr4 Mt4/Gn4 the crop covering the largest area would be placed first, but the subsequent crops do not follow in any particular sequence. The cropping patterns so derived have been indicated on maps of $1: 1$ million size.

## Livestock Patterns

2.8 Since talukwise figuresibased on Livestock Census 1972 have not become available, 1966 Census figures as published by the States have been used. The categories of animals included are shown below together with the symbols used in the present study.

> Category Symbol
cattle :
males over 3 years $\quad \mathbf{C m}$
females over 3 years Cy
young stock 3 years and under Cy

| Category | Symbol |
| :--- | :---: |
| buffaloes : |  |
| males over 3 years |  |
| females over 3 years | $\mathbf{B m}$ |
| young stock 3 years and under | $\mathbf{B f}$ |
| sheep | $\mathbf{B y}$ |
| goats | $\mathbf{S}$ |
| horses, mules and ponies | $\mathbf{G}$ |
| donkeys | $\mathbf{H}$ |
| camels | $\mathbf{D}$ |
| pigs | $\mathbf{C a}$ |

Following the same procedure and percentage intervals as in cropping patterns, livestock patterns have been identified and expressed in coded form.
2.9 Soil data corresponding to the scale used for the rainfall, crops and livestock patterns are not available for all the areas of the country. Out of about $\mathbf{3 0 5}$ Mha of the country's surveyable area, only about 90 Mha have been surveyed by one method or the other, but some of these areas need resurveying. In some States like Bihar and West Bengal, which have been covered almost wholly by reconnaisance survey, the work in soil correlation has not made much progress. Because of this we have recommended in our Interim Report on Soil Survey and Soil Map of India (August, 1972) that expeditious measures should be undertaken to prepare a soil map in $1: 1$ million scale. We envisaged that a useful soil map of India could be prepared within about 10 years' time, if necessary steps to organise soil survey parties in accordance with specific requirements are commenced urgently. In view of the present status of oil survey work it has been possible only to give a broad description of soil types based on the information available in the map prepared by the All-India Soil and Land Use Survey, Indian Agricultural Research Institute (1972 Edition).

## Operational Holdings

2.10 In regard to operational holdings, information has become available only very recently as part of the Agricultural Census 19701. The number and area under different class intervals of holdings ranging from 0.5 to 50 ha or above as percentages of the total number of holdings and the total area operated, for all the districts have been taken from the census report for the present study.

## Power Availability for Crop Production

2.11. The components of power are human, animal, mechanical and electrical. Human power reckoned here comes from cultivators, agricultural labour and those engaged in livestock, forestry, fishery, plantations etc., as reported in the Population Census, 1971. In the case of animal power, the data are based on the Livestock Census 1972. Information

[^27]on Agricultural machinery has also been obtained from the same source. The contribu tion of each of the power components has been taken to be as follows.


## Other Factors

2.12 The sources of data pertaining to other factors included in the study are given below :
factor
taluk area
orography
temperature

Evapotranspiration
Human population
irrigation and land use statistics
relative yield index (RYI-The district or State yield average expressed or as per cent of all-India average)
source
States, Census Report 1971 or from the data furnished by the States in their land use returns.
maps published by the Survey of India and National Atlas Organisation.
Climatological Tables of Observatories in India, India Meteorological Department, 1931-60 normals.
Scientific Report No. 136 of the India Meteorological Department, 1971.
Census of India, 1971.
Basic data pertaining to land utilisation statistics was obtained from the States and mostly relating to 1969-70.
Directorate of Economics and Statistics, Ministry of Agticulture and Irrigation. Data on crop yields are available only for districts and, therefore, district averages (1968-69 to 1970-71) have been utilized.

Presentation of Information
2.13 The tables, which are of direct use to the text, are included in Annexure 1. This consists of the following 10 statements:-
Statement I . . . Districtwise Frequency Distribution of Areas of Statement II . . . Taluks in Different Class Intervals of Area.

2.15 The basic data, on which the present study is based, are elabroate in nature. To facilitate reference to these data the follwoing Annexures have also been included:Annexure 3 . . . Zonewise (according to rainfall zones) Land Use and Population Statistics.
Annexure 4 . . . . Zonewise Livestock Statistics.
Annexure 5 . . . . Zonewise Information on Rainfall, Rainy Days and Cropping Patterns of the concerned Taluks.
Annexure 6 . . . . Zonewise Information on Crops of the concerned Taluks.
Annexure 7 . . . . Statement I-Districtwise Rainfall, Cropping and Livestock Patterns together.
Statement II-Rainfall, Cropping and Livestock Patterns of Taluks in each of the Districts. Statement III-Zonewise Arrangement of Cropping and Livestock Patterns together.
2.16 The maps, which are of $1: 1$ million size, have been given at the end in Annexure 8. These will prove of constant use in the understanding of rainfalls and cropping patterns. Their titles are :

| Map I | Rainfall Patterns. <br> Map II |
| :--- | :--- |
|  | Month of Maximum Rainfall <br> Days of Two Consecutive Months including the |
| Map III | Month of Maximum. |
| Croping Patterns. |  |

## 3 GENERAL INPORMATION

3.1 The geographical area of Karnataka is about $190,000 \mathrm{sq} \mathrm{Km}$. The State is divided into 19 districts, varying in area from $4,000 \mathrm{sq}$. Km . (Coorg) to over $17,000 \mathrm{sq} \mathrm{km}$ (Bijapur) as shown below:

Number of districts with area (thousand sq, km) of

| $4-6$ | $6-8$ | $8-10$ | $10-12$ | $12-14$ | $14-16$ | $16-18$ | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3 | 3 | 3 | 5 | 3 | 1 | 1 | 19 |

The State has 175 talukseach with an average area of $1,100 \mathrm{sq} \mathrm{Km}$. The frequency distribution of areas of taluks in each district in different intervals of area is given in Annexure 1-Statement I.

## Orography

3.2 The principal orographic feature of the State is the Western Ghats running north to south along or close to western boundary of Belgaum, Dharwar through Chikamagalur and Hassan to Mysore. The Ghats are at elevations ranging up to $1,500 \mathrm{~m}$. (Metres above sea level) and at places are as high as 1,700 to $1,900 \mathrm{~m}$. The Ghats divide the state into the coastal and Ghat regions to their west and a wide plateau area on their eastern be side. The coastal belt is less than 200 m in height and 50 km in width. Almost the entire district of Coorg is at elevation of 900 to 1800 m except for the small area of Virajpat, which is at an elevation of 150 m . On the lee side, the heights vary from 600 m in the south to more than $1,500 \mathrm{~m}$ over the Ghats. The plateau elevation generally ranges between 400 and 600 m in the northern districts, particularly Bijapur, Gulbarga and Raichur.

## Temperatures

3.3 The temperature conditions of the State (Annexure 1-Statements II to IV) are summarised below:
coast

> interior
(i) Mean daily temperature : The annual normal is $27^{\circ} \mathrm{C}$.
Range of monthly variation is small ( $25-29^{\circ} \mathrm{C}$ )

July-September temperatures are uniform ( $25-26^{\circ} \mathrm{C}$.)
(ii) Maximum temperature : The highest is in April-May (32-34 ${ }^{\circ}$ )
(iii) Minimum temperature :

December to February tempera- December :and January have the lowest tures area the lowest $\left(19-22^{\circ} \mathrm{C}\right)$. normals ( $14-17^{\circ} \mathrm{C}$ ).

## Potential Evapotranspiration

3.4 Penman's formula, based on energy balace and aerodynamic considerations has been utilised for the calculation of potential evapotranspiration (PE). Monthly and annual values of PE for 17 stations in the State ${ }^{1}$ are given in Annexure I-Statement V . The annual PE variations range from between 130 and 150 cm in the coastal and southern plateau areasJandfbetween $160 \& 200 \mathrm{~cm}$ in the northern areas. The annual PE for Raichur is 195 cm . PE is 9 to 10 cm per month in the coastal areas and much higher at 14 to 16 cm pm in some interior areas during the months of June to September. PE is considerably less than rainfall in the coastal areas but is of the same order or higher in the interior even in the rainy months.

Soils
3.5 A narrow coastal strip is classified as coastal alluvium. Adjacent to it and extending from south to north with a width of about a third to half degree the soil is lateritic. This belt is followed by another of red loamy soils. In the rest of the State, two main groups of soils prevail :
(i) Red sandy soils-These occur to the south of Latitude $15^{\circ} \mathrm{N}$. There are however patches of (a) laterites in North Kolar and surrounded by red loam area in northern Bangalore, portions of Kolar and eastern third of Tumkur district and (b) medium or deep black and a small area of mixed red and black soils in Chitradurga district.
(ii) Medium black soils-These contain patches of (a) mixed black and red in Raichur, Bellary, Belgaum, Bijapur and Dharwar districts. (b) sizable area of deep black running north of Lat. $20^{\circ} \mathrm{N}$. (a third of a degree in extent) and (c) laterite in South Bidar and adjoining Gulbarga districts. Map V of Annexure 8 shows the soils of Karnataka States.

## Irrigation

3.6 The gross irrigated area in the State in $1969-70$ was about 1.3 Mha which represented 12 per cent of the gross cropped area for that year. Fifteen districts out of 19 have less than 20 per cent irrigated area. District-wise position of irrigated area (An-nexure-1-Statement VI, Annexure 2-Map XVI) can be summarised in the following manner :-

Percentage of gross cropped area irrigated

5 or less
5.1 - 10.0
$10 \cdot 1-15.0$
$15 \cdot 1-20 \cdot 0$
$26 \cdot 1-34 \cdot 0$ 51
districts

Gulbarga, Bihar, Bijapur, Dharwar. Coorg, Bellary.
Belgaum, Raichur, Chikmagalur, Mysore.
Tumkur, Bangalore, Hassan, N. Kanara Chitradurga.
Kolar, S. Kanara, Mandya Shimoga.

1 RaO K. N., George, C. J. and Ram Sastry, K. S. Potential Evapotranspiration over India. Prepublished Scientific Report No. 136, India Metrological Department.

Examination of taluk data shows that about 70 per cent of the taluk have less than 20 per cent irrigation. Better irrigated taluks liesin the southern districts. The taluks in three adjoining districts i.e. Bijapur, Gulbarga and Bidar, have the lowest irrigation with only two taluks having 10 per cent irrigation. Only 4 of the 17 taluks of Dharwar District have more than 10 per cent irrigation, 3 talukas have $10-20$ per cent irrigation and one taluk lies in the $40-50$ per cent interval. Of the seven taluks with more than balf the area irrigated five are in Shimoga ( 50 to 100 per cent) and one each in Mandya and Chitradurga. All the taluks rely more on tanks and wells, which account for 60 per cent of the irrigated area. Canals account for 33 per cent of the irrigated area, but in the majority of the taluks (116) the area catered by them is less than 10 per cent of the irrigated area, where as the area served by tanks and wells in 120-130 taluks is of higher order.

## Land Use

3.7 District wise land-use is given in Annexure 1-Statement VII and Annexure 2Map XV. It will be seen that 15 per cent of the geographical area of the State is under forests. Areas not available for cultivation, pastures and fallow lands each constitute 8 to 9 per cent of the total area with cultivable waste constituting another 3 per cent. Forests dominate the coastal and adjoining areas, Coorg and the southern parts of Mysore. In Kanara District eightyone per cent of the North Kanara taluk and 91-93 per cent of the Supa and Yellapur taluks is under forests. Fifty per cent area of Khanapur adjoining Supa is also forest area. In Coorg, eastern taluks of South Kanara and Chikmagalur and the southern taluks of Bangalores and Mysore are $30-40$ per cent of the area is forest; in Kollegal taluk area under forests is higher than 70 per cent. The spread of areas under permanent pastures also varies. In Shimoga and Kolar, permanent pastures cover 25-26 per cent of total area, in Chikmagalur 22 per cent and in the other southern districts $12-15$ per cent. In other parts of the State the extent of such areas is negligible.
3.8 The State average for cultivable waste is indeed small, there being only 9 taluks where more than 10 per cent of the geographical area comes under this category. In Nagamangla taluk the incidence of cultivable waste lands is highest at 30 per cent of the total area. Fallow lands are of the order of $15-20$ per cent in Hassan, Tumkur and Bidar. In Raichur District an average of 12 per cent of the total arealies fallow and in the remaining districts extent of fallow lands is less than 8 per cent. The State average of net sown area is 54 per cent. In the coastal belt (Kollegal and Heggaddevankote taluks) net sown area is the lowest at 20 per cent or less of the total area. In Coorg this proportion is 29 per cent and in Kolararea it is 38 per cent.
It is $40-60$ per cent over most of the area up to about Lat!
$15-16^{\circ} \mathrm{N}$. and mostly $70-95$ per cent elsewhere. Supa and Yellapur are the lowest with 3-5 per cent and there are two significant areas of about 90 per cent surrounding (i) Navalgund and Nargund and (ii) another in Bagewadi-Sindgitaluks. The frequency distribution of taluks falling in different class intervals of netsown area is shown below:
table 2
Number of taluks with net area sown as per cent of geographical area of

| less than | $10-$ | $20-$ | $30-$ | $40-$ | 50 | $60-$ | $70-$ | $80-$ | $90-$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|  | 20 | 12 | 29 | 21 | 22 | 20 | 25 | 18 | 6 |

Net area sown accounts for only 10 per cent of the geographical area in North Kanara. The corresponding percentages for the southern district are mostly beiween 30- 50 per cent. Bellary and Bidar are 61 per cent, Beigaum, Raichur and Gultarea $7 \mathrm{C}-75$ per cent and Bijapur and Dharwar over 80 per cent.
3.9 The area sown more than once is only 6 per cent of the net sown area of the State. The cropping intensity is thus only 106 per cent. It is highest in South Kanara district (143 per cent). Mysore and Bihar are the next highest with 120 per cent. The cropping intensity among taluks is shown below :-

Number of taluks with cropping intensity of

| less than 110\% | 110-120\% | 120-130\% | 130-140\% | 140-150\% | 150-160\% |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 131 | 23 | 8 | 7 | 5 | 1 |
| (174-9)* | (13-1) | (4-6) | (4.0) | (2.8) | (0.6) |

There are only six taluks with intensity in the range of 140 to 160 percent; are in South Kanara district and one each in Shimoga and Mysore districts. The maxi-mum crop intensity of 160 per cent is in Udipi taluk.
3.10 The total population of the State is 29.3 million and the average density is 153 per $s q . \mathrm{km}$. The percentage rural population of the total in the State is 77 per cent. Bangalore district has the lowest rural population of 45 per cent only. It will be seen from Annexure 1-Statement VIII, Annexure 2- Map XVII that among the districts,. Bangalore has the highest density of 419 per sq. km . and the next highest are Mandya and South Kanara with a density of about 235 per sq . hm . The density of other districts varies between 83 (North Kanara) and 185 (Kolar). Analysis of taluk distritution shows higher density of population from Kolar and Bangarpet taluks to Mysore in south and from Udipi to Bantwal over the coast. All but 2 of the 9 taluks with density of more than $300 \mathrm{sq} . \mathrm{km}$. are in these two areas. Belgaum and Hubli taluks are the remaining two. A nearly north to South belt running from Khanpur through Supa and Xellapur to Manjarabad has density of less than 100 per cent $\mathrm{sq} . \mathrm{km}$. Supa and Yellapur have the lowest with 19 and 34 per sq. km . respectively. In general, the density of northern taluks is not high. A number of taluks in Raichur district have density of less than 100 per sq. km.

## Operational Holdings

3.11 The total number of operational holdings in the State in 1970-71 was 3,551 thousaands covering a total area of 11.367 Mha of not sown area, current followins cultivable waste and area not available for cultivating. The following table gives the per cent fiequency of holdings in different class intervals of area and also the per cent of total area covered by each of the class intervals :


- Figures in parantheses represent percentage to total number of taluks.

A close examination of the data in Annexure 1-Statement IX shows that larger size of holdings are concentrated in the northern half of the leeward side of the Ghats. Due to factors like irrigation and pressure of population of the size holdings is smaller in the southern half.

## Livestock

3.12 Fourteen livestock patterns bave been identified for the State. These are classi. fied below into six groups according to predominance of different species :

I Sheep predominant
1 S3 G4 Cf4/Cm4/Bf4
2 S3 Cm4 Cf4 G4/Cy4/Bf4
3 S4 Cm4 Cf4 G4/Bf4/Cy4
4 S4 G4 Cm4 Cf4 /Bf4
II Goats predominant
1 G4 S4 Cm4 Cf4/Cy4/Cy4 Bf4
III Male cattle (Cm) predominant
${ }_{1} \mathrm{Cm} 3 \mathrm{Cf} 4 \mathrm{Cy} 4$
$2 \mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{Cy} 4 / \mathrm{P} 4$
$3 \mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{Cy} 4 \mathrm{~F} 4 / \mathrm{S} 4 / \mathrm{Bf} 4$
IV Female cattle predominant
1 Cf3 S4 Cy4/G4/Cm4
$2 \mathrm{Cf} 3 \mathrm{Cy} 4 \mathrm{Cm} 4 / \mathrm{Bm} 4$
3 Cf4 Cy $4 \mathrm{Cm} 4 / \mathrm{Cm} 4$ Bm4
$V$ Female buffaloes predominant
1 Bf 4 Cm 4 By 4 Cf4
VI Young stock of cattle predominant
1 Cy C 4
2 Cy 3 Cf 4 Cm 4 S 4
3.13 The livestock pattern of the State as a whole is $\mathrm{S} 4 \mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{G} 4 / \mathrm{Cy} 4$. The largest in numbers is sheep, being nearly a quarter of total livestock populations of $\mathbf{2 0 . 5}$ million. Sheep predominate in about two-third of the taluks in the State, covering mostly the eastern and central parts and extending from Gundlupet in the extreme south to Yadgir in the north east and Chikodi of Belgaum district in the northwest excluding some of the southern taluks of Bijapur district. Goats have higher percentage than the other categories of livestock in a large part of Bijapur district and neighbourhood. In the remainder of the State, male or female cattle predomiate. Female buffaloes and male cattle have nearly the same percentage in Belgaum and Bailhongal taluks and these are grouped in a pattern beginning with Bf. In a few of the taluks of South Kanara percentage of male buffaloes is significant enough to enter into a pattern as an alternate category. Pigs are significant in Mercara and Virajpet. The patterns for the districts could be expressed as follows :-

## Patterns

S3 G4 Cma Cf4
S4 G4 Cm4 Cf4/Cy 4
S4 G4 Cm 4 Bf4
G4 S4 Cm4 Cf4
Cm4 Cf4 Cy4 S4/G4/Bf4
Cm5 Cf4 Cy4
Cf4 Cm4 S4 G4/Cy 4
-Cf4 Cm4 Cy4 Bm4

Districts
-Tumkur, Kolar, Mandya, Chitradurga.
-Bangalore, Bellary, Raichur.
-Belgaum.
-Bijapur.
-Chikmagalur, Shimoga, Gulbarga, Bidar, Dharwar.
-N. Kanara, Coorg.
-Mysore, Hassan.
-S. Kanara.

Power Availability for crop Production (Annexurb 1-Statbmbnt X, Annexurs 2-Map XVIII)
3.14 The agricultural working population is only one-fifth of the total population of the State, which is the same as in the country as a whole. The availability of power per hectare of cultivated area from different sources totals to 0.28 HP , the per cent contribution of individual components being as follows :
$\left.\begin{array}{llllllllllll} \\ \text { component } & & & & & & & & & & & \\ & & & & & & & & & & & \\ \text { Per cent } \\ \text { of total }\end{array}\right)$

It has been assumed that only 80 per cent of the human and animal power and half of the tractor power is utilised for cultural operations.
3.15 It may be noted that the above estimates of power availability are for all the operations-tillage, interculture, irrigation, plant protection and post-harvest. It would be necessary to estimate the power avaiability for each cultural operation like tillage and interculture. This information is given in Col. 2 of Table 1. The power available for cultural operations in Bangalore, Belgaum, Bidar, Bijapur, Kolar, South Kanara and Tumkur is less than half of the total availability (within 35-45 per cent). This is because the total power availability is boosted due to diesel engines and electric motors, whose share in these districts is considerable-(Bengalore 61, Belaum 50, Bidar 56, Bijapur 51, Kolar 63, S. Kanara 53 and Tumkur 53 per cent). It is important to note that animal power dominates in cultural operations ranging between 70 and 80 per cent except in the case of Bangalore ( 59 per cent). Human power comes next accounting for $\mathbf{1 5 - 3 0}$ per cent of the total power availability. The contribution of mechanical power is very small, generally around 5 per cent of the total except in case of coorg, Raichur and Shimoga ( $8-10$ per cent) and Bangalore ( 16 per cent). A reference to Annexure 2-Map XVII would show that the southern half of the State has higher power availability compared to the northern half. The coastal belt has higher power availability of $0-30-0.5 \mathrm{HP}$ per hectare presumably on account of the fact that the extent of cultivable area is comparatively lower in this area.

TABLE 1
Power available for Cultural Operations

| District |  |  |  |  | Power available for cultural operations |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | actual (HP/ha) | $\%$ of total per cent of total contributed power for by |  |  |  |
|  |  |  |  |  |  | tions | human | animal | $\begin{gathered} \text { mecha- } \\ \text { nical } \end{gathered}$ |
| Bangalore | - | - | - | - | $0 \cdot 19$ | 35 | 25 | 59 | 16 |
| Belgaum | - | - | - | . | $0 \cdot 14$ | 44 | 20 | 75 | 5 |
| Bellary . | . | - | - | - | $0 \cdot 12$ | 58 | 17 | 77 | 6 |
| Bidar . | - | - | - | - | 0.09 | 38 | 20 | 78 | 2 |
| Bijapur . | - | - | . | - | 0.07 | 45 | 21 | 73 | 6 |
| Chikmagalur | . | - | - | . | 0.27 | 78 | 13 | 81 | 6 |
| Chitradurga | - | - | - | - | $0 \cdot 22$ | 56 | 17 | 77 | 6 |
| Coorg . | - | - | - | - | 0-29 | 80 | 13 | 79 | 8 |
| Dharwar | - | $\bullet$ | - | - | $0 \cdot 11$ | 68 | 18 | 77 | 5 |
| Gulbarga | - | - | - | - | 0.08 | 67 | 16 | 82 | 2 |
| Hassan . | - | - | . | - | 0.22 | 80 | 15 | 81 | 4 |
| Kolar . | - | - | - | - | 0.31 | 32 | 21 | 75 | 4 |
| Mandya | - | - | - | - | 0.23 | 64 | 19 | 80 | 1 |
| Mysore . | - | - | - | - | 0.22 | 67 | 18 | 80 | 2 |
| N. Kanara | - | - | - | - | 0.45 | 73 | 15 | 84 | 1 |
| Raichur | - | - | - | - | $0 \cdot 11$ | 73 | 15 | 75 | 10 |
| Shimoga | . | - | . | - | 0.32 | 77 | 12 | 79 | 9 |
| S. Kanara | - | - | - | . | 0.38 | 43 | 17 | 81 | 2 |
| Tumkur | - | - | - | - | 0.19 | 44. | 20 | 78 | 2 |
| State - | - | $\bullet$ | - | - | 0.15 | 54 | 18 | 77 | 5 |

## 4. Rainfall Patterns

4.1 The rainfall zones together with their patterns, gross cropped area, number of taluks and districts are mentioned in Table 2 and arealso depicted in the map (Annexure 8-Map 1), A narrow belt comprising Zones XI. XII, XVIII and part XXV runs in a north south direction along the Ghats separating the coastalside to west and leeside to east in which the cropped area constitutes 4.9 per cent of the total gross cropped area of the State. The coastal belt to west accounts for 5.5 and rest of the State to east of

Ghats 89.6 per cent of the grosscropped area. Interms of the category of rainf:ill during the south west monsoon season, the distribution of gross cropped arces is indicated below :

| Rainfall category (SW monsoon) |  | Zones | Gross cropped area |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  |  | $\begin{aligned} & \text { actual } \\ & \text { (Mha) } \end{aligned}$ | per cent of total |
| A4 to $\mathrm{A}_{1}$ | $\cdots \cdot$ - | XII to XVIII, XXI <br> XXII, XXV, XXVI | 0.84 | 7.8 |
| $\mathrm{B}_{1}$ | - . . . | IV, IX | 0.69 | $6 \cdot 4$ |
| $\begin{aligned} & \mathrm{C} 4 \text { to } \mathrm{C}_{1} \text { (mostly } \\ & \text { types) } \end{aligned}$ | ombinations of C\&D | I to III, VI to IX, X , XIX, XX, XXIV | 9.00 | $83 \cdot 4$ |
| D2 E2 total |  | V, XXIII | $\begin{array}{r} 0.26 \\ 10.79 \end{array}$ | $\begin{array}{r} 2.4 \\ 100.0 \end{array}$ |

table 2
Particulars Regarding Rainfall Zones

\begin{tabular}{|c|c|c|c|c|c|c|}
\hline \multirow[t]{2}{*}{Zone} \& \multirow[t]{2}{*}{Rainfall pattern} \& \multirow[t]{2}{*}{Gross cropped area (M ha)} \& \multicolumn{3}{|l|}{Number of Taluks} \& \multirow{2}{*}{districts} <br>
\hline \& \& \& full \& \& part \& <br>
\hline 1 \& 2 \& 3 \& \& 4 \& 5 \& 6 <br>
\hline I \& E4 (C1 D3) D1 E3 . \& $1 \cdot 53$ \& \& \& (1)-2/3 \& Bijapur, Raichur. <br>
\hline II \& E4 (C3 D1) D1 E3 \& 0.78 \& \& 6 \& (1) $-1 / 3$ \& Gulbarga, Raichur. <br>
\hline III \& E4 (C4) D1 E3 . . \& 0.85 \& \& 7 \& \& Gulbarga. <br>
\hline IV \& E4 (B1 C3) D1 E3 . \& 0.41 \& \& 5 \& \& Bidar <br>
\hline V \& $$
\begin{aligned}
& \text { D1 E3 (D2 E2) C1 D1 } \\
& \text { E2 }
\end{aligned}
$$ \& $0 \cdot 13$ \& \& 2 \& \& Chitradurga <br>
\hline VI

VII \& D1 E3 (C1 D3) D1 E3 \& $2 \cdot 29$

$1 \cdot 14$ \& \& 24
21 \& (1) $-1 / 2$

(5) $-1 / 2$ \& | Belgaum, |
| :--- |
| Raichur, |
| Dharwar, |
| Bellary, |
| Chitradurga. | <br>

\hline VII \& $$
\begin{aligned}
& \text { D1 E3 (Cl D3)Cl D1 } \\
& \text { E2 }
\end{aligned}
$$ \& $1 \cdot 14$ \& \& 21 \& (5)-1/2 \& Dharwar, Shimoga, Chitradurga, Tumkur, Kolar, Bangalore, Chikmagalur. <br>

\hline VHI \& D1 E3 (C2 D2) C1 E3 ] \& 10.62 \& \& 9 \& \& Belgaum, Dharwar. <br>

\hline IX \& $$
\begin{aligned}
& \text { D1 E3 (C2 D2) C1 D1 } \\
& \text { E2 }
\end{aligned}
$$ \& 0.49 \& \& 12 \& (3)-1/2 \& Tumkur, Kolar Bangalore. <br>

\hline X \& D1 E3 (C3 D1) C1 E3 \& $0 \cdot 19$ \& \& 2 \& (3)-1/2 \& | Dharwar, |
| :--- |
| Shimoga. | <br>

\hline
\end{tabular}

table 2 (Contd)

4.2 Parts of the State receives rainfallduring the pre and post-monsoon periods also. The contribution of the rainfall of these periods in different zones is examined in Table 3 against different categories of rainfall of the southwest monsoon period. The pre and post monsoon period rainfallis mostly of Cl or ClDl type - Cl being either in May or October. Zones having rainfall both in pre as well as post monsoon periods in these categories cover only about 15 per cent of the total gross cropped area of the State and are confined to about 37 taluks of the southern districts of Chikmagaiur, South Kanara, Hassan, Coorg, Mysore, Mandya, Bangalore and Tumkur. Zones having rainfall of Cl or CIDl type in the post monsoon period only cover 30 per cent of the area spread over 80 taluks in the districts of Belgaum, Dharwar, North Kanara, Shimoga, Chitradurga, Chikmagalur, Hassan, Tumkur, Kolar and Bangalore. The districts which are least benefitted by the pre-and post-monsoon showers are Bellary, Raichur, Bijapur,

Gulbarga and Bidar accounting for a total of 43 taluks, although these districts do receive some significant rainfallin October.

TABLB 3
Position of Pre-Monsoon and Post-Monsoon Rainfall
(area = Mha)


## 5 EXISTING CROPPINO PATTERNS

5.1 The gross cropped area in the State in 1969-70 was 10.79 Mha . Fifty five per cent of the cropped area was under cereals and 13 per cent under pulses. Even though horsegram (Dolichos difiorus) is locally important, it is not recorded separately but is included under other pulses in the all-India statistics. Amongst cereals, ragi has an important placeinthe State. Cerealsand pulsestogether account for nearly 70 percent of the gross

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cropped area. Oilseeds cover 12 per cent in area, cotton 10 per cent and plantations 3 per cent. Oilseeds, cotton and plantations together contribute a quarter of the gross croppdarea. Fodder crops are alsosignificant in the State's cropping pattern. However, there does not seem to be any uniformity in the reporting of area under them. Nature grown grasses on the hillslopes and plateau areas are fed as green and also cut and stacked as hay after rainy season. In the erstwhile Bombay State such grasses were reported in the crop returns. As a legacy of this practice, the areas contiguous with Maharashtra even now continue to report these. In some other parts, cultivated fodders are also sometimes reported Due to the lack of systamatic reporting of fodder with a clear distinction between the cultivated and nature grown fodder there is a serious lacuna in the available data. Utilising the available crop data, 48 cropping patterns have been distinguished for the State which are summarised in Table 4 :

TABLB 4
Summary of Cropping Patterns .
$\left.\begin{array}{llllllll}\hline \text { Predominant crop } & \begin{array}{l}\text { Patterns } \\ \text { beginning } \\ \text { with }\end{array} & \begin{array}{c}\text { Number } \\ \text { of patterns }\end{array} & \begin{array}{c}\text { Number } \\ \text { of taluks }\end{array} & \begin{array}{l}\text { Total } \\ \text { patterns }\end{array} & \begin{array}{l}\text { Total } \\ \text { taluks }\end{array} & \begin{array}{c}\text { Gross } \\ \text { cropped } \\ \text { area of }\end{array} \\ \text { taluks } \\ \text { (M ha) }\end{array}\right]$

## Cropping Patterns of zones with ' A ' type of Rainfall

5.2 Cropping patternsinvolving ' $A$ ' type of rainfall in the $S W$ monsoon season are mentioned in Table 5. Paddy dominates the arable crops and maize comes next to paddy Because of abundance of rainfall, natural grasses also grow in these parts and, therefore, fodder appears in a number of cropping patterns. Cattle rearing is common in these parts owing to availability of grass fodder. However, as the grasses are inferior, lacking
specially in calcium and phosphorus due to the poor nature of soils, the animalsare short statured and weak (malnad breed). The next significant feature of many of these zones is the presence of plantation crops, e.g.,pepper, cardamom, arecanut, cashewnut, coconut, tea, coffee and rubber. These are chiefly confined to hilly belt with the exception of arecanut and coconut . Coffee and coconut are important crops from area point of view. Their distribution is shown in Table 6.

## table 5 <br> Cropping Patterns under Al-A4 Categories

| Zone |  | Rainfall pattern | Cropping pattern |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| XII | . | . | . | D1 E3 (A1 B1 C2) C1 E3 | Pd4 R4 F4 JK5 |

TABLE 6
Arca under Plantation Crops in the Producing Districts of Karnataka

| District | Pepper | Cardamom | Arecanut | Cashewnut | Coconut | Coffee | Tea | Rubber | Total |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  | actual | $\%$ of district gross cropped area | district gross crop ped ar ea |
| 1. Coorg . | 0.7 | 10.9 | 0.5 | 0.6 | 0.4 | $44 \cdot 4$ | 0.2 | $1 \cdot 1$ | 58.8 | $46 \cdot 4$ | 126.7 |
| 2. Chikmagalur | - | 3.8 | $6 \cdot 1$ | $0 \cdot 1$ | 16.6 | $42 \cdot 2$ | 1.7 | $0 \cdot 1$ | $70 \cdot 8$ | 29.0 | $243 \cdot 9$ |
| 3. Hassan | - | 9.5 | 1.3 | - | $26 \cdot 6$ | 24.9 | $0 \cdot 3$ | - | $62 \cdot 6$ | 18.5 | $337 \cdot 5$ |
| 4. South Kanara | 0.5 | $0 \cdot 1$ | $10 \cdot 5$ | $12 \cdot 4$ | 12.0 | $0 \cdot 1$ | - | $2 \cdot 3$ | 37.9 | $14 \cdot 1$ | 269.7 |
| 5. North Kanara | 0.8 | $0 \cdot 3$ | $7 \cdot 3$ | 0.9 | 4.7 | - | - | - | 14.0 | $12 \cdot 0$ | 116.9 |
| 6. Tumkur | - | - | $3 \cdot 6$ | - | 35.0 | - | - | - | 38.6 | $8 \cdot 1$ | $477 \cdot 5$ |
| 7. Chitradurga | - | - | $2 \cdot 2$ | - | $14 \cdot 1$ | - | - | - | $16 \cdot 3$ | $3 \cdot 2$ | $512 \cdot 7$ |
| 8. Shimoga | $0 \cdot 1$ | - | $7 \cdot 4$ | $2 \cdot 6$ | 0.5 | $0 \cdot 1$ | - | - | 10.7 | $3 \cdot 1$ | 341.8 |
| 9. Mandya | - | - | 0.6 | - | $7 \cdot 1$ | - | - | - | $\begin{array}{r} 7 \cdot 7 \\ 317 \cdot 4(\mathrm{a}) \end{array}$ | 2.7 11.7 | $\begin{array}{r} 283 \cdot 6 \\ 2,710 \cdot 3 \end{array}$ |

$(a)=$ This represents 2.9 per cent of the total gross cropped area of the State.

## Cropping Patterns of Zones with B Type of Rainfall

5.3 There are only 2 zones which begin with B type rainfall of the southwest monsoon season. These are :

> Zone IV—E4 (B1 C3) D1 E3-Gross cropped area 0.41 M ha Zone XI-D1 E3 (B1 C2 E1) C1 E3-Gross cropped area 0.28 M ha

In both the zones, B1 happens to be the month of July, but their characteristics with regard to cropping patterns differ because of their situation. The two are situated far apart. Zone IV is in the northern extreme covering parts of Bidar district and its cropping patterns are more in line with the contiguous zones II and III, which willbe described in the next paragraph. Zone XI adjoins the leeside Zones XU and XVIII of the Ghat belt. Its cropping patterns are given below :

```
Pd2 L4/B4/F4/M5/V4
Pd3 R4 L4/Pu4
R3 Pu4 Pd4/L4
```

Although the rainfall in this zone is not directly adequate to support a crop of rice, yet it is found insvarying proportions in all the cropping patterns. Thisis because of the proximity of hills from which the resulting downflow of water can be easily impounded. Because of elevations, plantation crops too figure in this zone, so also fodder grasses. Ragi appearsin this zone in significant proportionin some cropping patterns; this happens in the southern taluks adjoining the main ragi belt.

## Cropping Patterns of Zones with 'C' type of Rainfall in SW Monsoon Season

5.4 Rainfall Zones II to IV cover 18.9 per cent of gross cropped area in the northern districts of Bidar, Gulbarga and Raichur. Their patterns are mentioned below :

| Zone | rainfall pattern | cropping pattern |
| :--- | :--- | :--- |
| IV |  | E4 (B1 C3) D1 E3 |

The monsoon rainfall in these zones is predominantly of C type and the month of October receives $D$ type of rainfall. The amount of rainfall is not sufficient for high water requiring crops and, therefore, cropstaken are millet group including jowar, pulses, groundnut and other oilseeds during kharif in general. Cotton figures in heavy soils but not prominently. Another deep rooted crop, namely, pigeonpea (tur) is also grown. Because of C and $D$ types of rainfall respectively in the consecutive months of September and October,
rabijowar is also taken in varying proportions. It is important in many taluks of the two northern districts of Bidar and Gulbarga where it occurs in 30 to 50 per cent of the gross cropped area. Another crop in rabi which significantly occurs in Bidar in some of the cropping patterns in the range of 10 to 30 per cent area, is gram. It is significant to note tuat the crops chosen for rabi are such that they could carry through with stored soil noisture. The rainfall of November onwards is very meagre.
5.5 The rainfall pattern of Zone X is D1 E3 (C3 D1) C1 E3. It occupies 1.8 per cent of the gross cropped area. In this case too, the rainfall of the monsoon months of July to August is of $\mathbf{C}$ type. However, the month of October also receives $\mathbf{C}$ type of rainfall instead of $D$ as in the case in Zones II to IV. This zone represents a narrow strip adjoining to Zone XI and coversparts of 3 taluks of Shimoga district. Because of irrigation facilities,. paddy figuressignificantly in the cropping patterns, which are mentioned below :

> Pd1
> Pd4 R4 JK4 Gn4/Pu4
> Pd4 C4 JK4 Mt4

Cropping Patterns in D2 E2 Rainfall Zones of SW Monsoon Season
5.6 The SW monsoon season is least useful from rainfall point of view in Zones $V$ and XXII representing parts of Chitradurga and Mysore districts and covering 2.4 per cent of cropped area. Their particulars are mentioned below :

| zune | rainfall pattern | cropping pattern |
| :---: | :---: | :---: |
| V | D1 E3 (D2 E2) C1 D1 E2 | C4 Mt4 Jr4 Jk4 Pu4 Pu4 Jk4 Mt4 B4/Gn4/R4 Gn4 |
| XXIII | C1 D1 E2 (D2 E2) C1 D1 E2 | Jk3 Pu4 R4/Gn4 Jk4 Pu4 R4/Pd4/Gn5/Pd5 |

A somewhat redeeming feature of these zones is the rainfall of August to November which could be represented as D2 C1 D1 and read in the order of calendar months. Pulses like horsegram and Dolichos lablad, crops of millet group and even cotton and groundnut are preferred. Paddy can hardly be sustained by rainfall, but it is also taken to some extent in Zone XXIII under irrigaticn.

Cropping Patterns of the Remaining Areas
5.7 The gross cropped area in the rest of the State constitutes 66.5 per cent of the total. It comprises of eight rainfall zones. Zones I, VI and VII cover partly or wholly the northern districts of Bijapur, Raichur, Belgaum, Dharwar and Bellary and Zones VII, IX, XIX, XX and XXIV the southern districts of Chitradurga, Chikmagalur, Tumkur, Kolar, Bangalore, Mandya, Hassan and Mysore. The rainfall of June and July is of D type, that of August is either D or C, whereas September rainfall is of $C$ type. October and November are the other two succeeding months which have either $\mathbf{C}$ or $\mathbf{D}$ type of rainfall. These zones can be essentially grouped into two, viz., (a) with September rainfall mostly of C type and October rainfall of D type and (b) with September and October rainfall of C type and November rainfall of D type. The month of maximum rainfall in these areas is either September or October (September predominating). The rainfall of pre-monsoon months
is predominatly of E type. Strategy of crop production is built with September as the key month. Even when kharif crops are taken, attempt is to take advantage of SeptemberOctober rains for the late vegetative phase, otherwise reliance is on a good croppingseason commencing with sowing in September. In light soils, kharif crops are taken and rabi crops are preferred in heavy soils. In medium soils, both kharif and rabicrops are taken depending upon the rainfall in early monsoon months.
5.8 Tabe 7 presents the cropping patterns of the above mentioned zones. Inareas where the rainy season extends upto October, the emphasis is on cotton, jowar and groundnut iduring kharif (in light to medium soils) and jowar during rabi (in heavy soils). In Navalgund area of Dharwar even wheat assumes a significant proportion mainly because of heavy nature of soil, although this crop occupies a minor place in the cropping patterns in many other isolated peckets also. Ragi stands very conspicuously in many patterns in areas with C-D type of rainfall extending up to November. It suits very much to be fitted as a second crop after an early kharifcropin D1 C1 conditions of April-May. This practice is of recent adoption. Paddy figures in many patterns of both the groups, but it even constitutes a prominent component of some patterns specially in (b)group, whererainy season extends upto November. The rainfall in itself is not sufficient to sustain this crop. The tendency is to take this crop in places where tank water is available. Attempts are made to fit in many other crops like horsegram, pigeonpea, sesamum and niger. The propertion of crops is invariably within $10-30$ per cent area range so that if failure occurs, it would not be extensive and at least a few crops could even then succeed according to rainfall and soil pecularities. This is an ample proof that the area under the eiaht zones under consideration is precarious from rainfall point of view. Because of the type of rainfall distribution, population in many significant stretches haslow density andirrigation facility is scarce with the result that the land holdings are large and arable farming is such that it does not require intensive methods. There is a marked tendency to rear sheep and goats, which fits in with the overall circumstances.
table 7
Cropping Patterns in Rainfall Zones accounting for 66.5 per cent of Gross
Cropped area.


Jowar kharif
Jk4 C4 Gn4 R4/Pu4
Jk4 C4 Gn4 W4/Pu4 Pd4 Jr4
Jk4 Mt4 B4 Gn4/C4/C4Pu4
Jowar rabi
Jr3 B4 © $\mathrm{nn} 4 / \mathrm{C} 4$
Jr4 B4 Jk4 Gn4/M4 W4

Groundnut
Cn3 Jk4 C4/W4/Pu4
Gn4 Jk4 To4 S5
Gn4 Jr4 J:4 B4/W4
Others
Pd4 C4 Gn4 Pu4
B4 Jk4 M4 Pu4 Gn4
Pu4 Gn4 Mt4 JK4 W4 C4
W3 C4 Jk4 Jr4

## table 7 (Contd.)

C3 Jk4 Mt4
Jk3 Pu4 R4/Gn4
Gn3 B4 R4
L3 Pd3
Paddy

Pd4 R4 Jk4 Gn4/Pu4
Pd4 R4 Pu4/L4
Pd4 R4 Pu4 S4/Jk4
Others

Jk4 Mt4 B4 Gn4/C4/C4/Pu4
Jk4 Pu4 R4 Pd4/Gn5 Pd5
Pu4 Jk4 Mt4 B4/Gn4/R4 Gn4

## Yield Performance of Crops

5.9 Districtwise Relative Yield Index (RYI) for different crops of Karnataka is presented in Table 8. The performance of rice, sugarcane, jowar, maize, ragi, groundnut and sesamum is above the all-India average in varying degrees, but that of pigeonpea, gram, cotton and wheat is below average with State RYI being 71, 61, 53 and 30 respectively. The performance of bajra shows large variations with the State RYI of about 90 . The success of crops like rice and sugarcane is due to irrigation and intensive care, otherwise the area represents a millet-Cotton-groundnut economy.

Table 8
Relative Yield Index of Crops


Notes (a) RYI = Relative Yield Index = District/State yields expressed as percentage of all-India average yield for 1968-69 to 1970-71.
Coumn (2)-Summer-sown (3) $=$ Kharif (4)-Winter sown.

## 6 OUIDBLINES OF FUTURE CROPPING PATTERNS

6.1 The work on formulation of future cropping patterns will consist of following five stages:-
(i) Delineation of rainfall patterns.
(ii) Identification of the existing cropping patterns.
(iii) Assessment of area needed for each crop for nationel self-sufficiency and the ideal locations for its distribution.
(iv) Juxtaposition of (iii) over (ii) for studying them together with (i) in order to determine possible changes.
(v) Consideration of related factors like soil, irrigation, pressure of population, needs of livestock, proportion of forest vegetation, cropped area \& c., and then arriving at the future cropping patterns on the basis of (iv).
The scope of our study envisages ultimately the inclusion of all the five steps. Information on rainfall patterns, existing cropping patterns and related factors was presented in a Working Paper for discussion with the officials of Government of Karnataka. It was also considered advantagcous to set in motion the process of thinking at the State level independent of the efforts initiated by the Commission.
6.2 A summary of questions posed by the Commission to the State is given below:
(i) Are existingcropping patterns efficient from agronomic as well as economic point of view?
(ii) If change is necessary, which are the areas where changes should be made?
(iii) In the case of existing cropping patterns being acceptable at some places; what is the scope for increasing the production level and how?
(iv) At the place where change is desired, what substitute crops willbe recommended? The changes have to be indicated separately for rainfed and irrigated conditions taking into consideration the soil factor.
A Committee of Experts drawn from various Departments of Government of Karnataka and the Universtiy of Agricultrual Sciences, Bangalore was constituted under the Chairman ship of the Director of Research of the University to consider various points which emerged from a discussion of the Working Paper. The results of their deliberations were published ${ }^{1}$.
6.3 The prognosis of an all-India character has primarily to ensure that the area and yield levels envisaged should be in the context of the needs of the country. This can obviously be done at the national level only for the major crops, but in this process many other equally vital crops, which either occupy less area or are of local importance only, are left out. These crops are : bast fibres, sugarcane, tobacco, potato, vegetables, various condiments and spices, fruits and plantation crops. Moreover, full justice cannot be done in a broad national prognosis to local edaphic, ecological, economic and social factors. It is therefore necessary to evolve cropping patterns from the lowest level. This would be a long drawn process for wich we have made a beginning. Even when local experts have developed the patterns, these have to pass the test of time in actual practice and might require repeated modifications. Thus the process of determination of future cropping patterns would be a continuous one spread over a long time span till a fair degree of stability is achieved. It will be difficult to fix proportions of various crops in the overall crop mix with the same degree of preciseness as in the case of existing cropping patterns. We intend to lay down in our present study, principles and guidelines for this long drawn out process of evolving suitable cropping patterns over time.

[^28]i6.4 At the outset, it is necessary to state that the cropping patterns will have to be thought of separately for the irrigated and unirrigated area. If this is done, many crops, which occupy minor proportions of area, may come out prominently in the irrigated cropping patterns and if so, it would automatically suggest a corrective to any lopsided allocation of water. Salient points pertaining to some crops, which could pe considered in future crop planning in Karnataka are mentioned below:

Rice
(i) The rice area of the State falling in different rainfall categorics of the SW monsoon season is indicated below :

| rainfall | \% State rice |
| :--- | :---: |
| category | area |
| A4/A3 | 33 |
| A1/B2 | 14 |
| B1 or less | 53 |

But for 33 per cent of rice area which falls in the coastal strip, the rainfall by itself is not sufficient to support this crop in the State and certainly not so in about half the area covered by 'B1 or less' categories. Kharif sown crop accounts for about 92 per cent of area and winter sown crop 8 per cent. The summer sown crop is also found scattered here and there, but the percentage area is less than one. Both high and low lying areas are covered under paddy. High lying areas suffer considerably due to long breaks and as a result, yields are low. It is specially so in drilled paddy tract of the State. It is obvious that water from all possible sources is being diverted to raising of this crop. The contours of the State are such that the impounding of water is made possible in many areas. Even taking note of this fact and making allowance for the low lying situations, there is considerable scope for making a reduction in rice area; the area could profitably be stabilised around 1 M ha. Barring the coastal strip and valley situations, the crop could be kept confined to the low lying positions in command areas of tanks. The upper reaches of command areas of tanks can be released with advantage for other crops.

## Maize

(ii) The area under maize has gone up from 6,000 hectares to more than 100,000 hectares and yield levels have been among the highest in the country. There is considerable scope for replacing paddy in high lying areas with maize. It does well under irrigation both in kharif as well as rabi seasons in most parts of the State.

## Cotton

(iii) The eight districts which grow cotton in 10,000 ha or more are Bidar, Gulbarga, Belgaum, Bijapur, Raichur, Dharwar, Bellary and Chitradurga. The SW monsoon rainfall is B1 C3 in Bidar, B1 C3 or C2 D2 in parts of Dharwar, C4 in Belgaum and Gulbarga, C2 D2 in Bijapur and, C1 D3 in Raichur, Bellary and Chitradurga. But for about 10 per cent irrigated area in Belgaum irrigation for the crop is nominal. The crop performance in relation to all-India average varies between 33 and 60 per cent. It is no point taking the crop rainfed under the prevalent rainfall conditions. The area under rainfed cotton in scarcity areas could be diverted to more remunerative oilseed crops like safflower and rape-mustard. Rainfed cotton could be retained in assured rainfall zones and
better practices developed. For getting higher yields, it should receive irrigation support. From the national point of view there is need and scope for increasing irrigated cotton area. The coverage can be increased from the present 1 M ha to 1.5 M ha with $70 \%$ of it at least under irrigation. In recent years, performance of new hybrids of cotton under irrigation is noted to be very promising and highest yields ever. obtained in the country are being reported fron Bellary and Raichur districts. The possibility of shifting the irrigated crop to more assured parts of the State and bringing considerably larger area i.e. about 1 M ha under irrigation should therefore be examined. Insofar as the water availability is concerned, it is probably not going to be a problem.

## Sugarcane

(iv) Karnataka has to play a significant role in sugarcane production also because of its high yield potential. The present area is only is 0.1 M ha ; it could be increased to 0.4 M ha and all of it will have to be irrigated.

Other crops
(v) The existing area of potato is 9,000 ha; possibility of increasing it to 20,000 ha is worth considering.
(vi) The needs of green fodder, vagetables, flowers and furits are going to so increase that every village should be able to set apart at least $30,2,1$ and 7 ha respectively on an average. In practice the proportion of area may vary from plaee to place depending upon various factors, but the central point not be overlooked is that all perishable commodities should be produced as near the place of consumption as possible.
(vii) Some new crops like sunflower and soyabean can be introduced with advantage in rainfed as well as irrigated areas. Soyabean is likely to do well in humid transitional bilt in rotation with maize and sunflower all over the low rainfall areas in ight as well as heavy soils.
(viii) Karnataka has good scope for increasing its area under tapicca from the present level of 500 ha to $125,000 \mathrm{ha}$. It can take up cacao in about $4,000 \mathrm{ha}$. South Kanara and adjoining parts offer a promise for extension of rubber plantation. The State offers scope for increasing its cashew area too. No. doubt that all these crops will be taken in the high rainfall areas towards the Chats, yet there will pe pressure on irrigation resources too for raising nurseries and tending young plantations.
6.5 There is considerable need as well as scope for changing the cropping patterns in irrigated areas. The present emphasis on paddy can be reduced and other crops like cotton, oilseeds, pulses and forage crops could be introduced with advantage. In heavy rainfall zones and transitional belts, maize, cotton and oilseeds could be introduced especially in high lying areas in place of paddy. Maize and soyabean products will have increasing uses in expanding cattle feed and other industries. Maize has been catching the imagination of farmers in the State already. Research and development work on soyabean will have to be intensified to identify suitable areas for it in the State. In some parts of the State, double cropping is a distinct possibility even in rainfed areas, where two peaks of rainfall occur in May and September-October. Groundnut yields are low in light soils and the crop does not come up well in heavy soils, especially if saline. Sunflower has performed well under such conditions. Sufflower has also performed well both under dry and irrigated conditions specially in heavy soils. This crop could be a good substitute for wheat and cotton in dry areas and for wheat under irrigated eonditions.
6.6 The scope for increasing production in certain dry areas of the State where existing cropping patterns might require no change over time has also to be examined. For this purpose, besides increased use of various kinds of inputs, success would depend to a great extent upon the following two factors :
(i) Better water management practices-such practices would have to be developed and demonstrated. Farm ponds in every holding to store excess water for giving irrigation during critical periods are already proving popular in dry areas. Similar innovations should $\mathbf{b} \approx$ developed, demonstrated and adopted.
(ii) Appropriate land use planning-Alternative crops and their varieties will have to be tried and kept ready at hand for sowing according to the early or late arrivals of rains in differcnt years. This cafeteria approach, which is already gaining ground amongst agronomists nceds to be more intensively followed in future. For the success of this approach, a knowledge of optimum time of sowing of different crops in relation to the most likely dates of commencement of the rainy spells of required amounts is very necessary. A study of this type has been initiated recently in the India Meteorological Department, which could be given a trial in some selected areas when completed.
The agricultural scientists would have to be constantly busy formulating and trying cropping patterns on the above principles, which in course of time would assume relative stability. Evolution of corpping patterns has to be a gradual process of adujstment. A befitting example is that of groundnut, which was not a significant crop in the country even during the thirt ies of the century, but India has now become one of the leading ground-nut producing countries of the world. The only difference $\mid$ is that such changes have been gradual, few and far beiween in the past, but now more : expeditious and deliberate efforts have to te made with a !view to make "the "country self-re iant as quickly as possible.

ANNEXURE 1
Statement I-District-wise Frequancy Distribution of Areas of Taluks in Different class Intervals of Area

| District | Number of taluks with area (sq. km.) of |  |  |  |  | $\begin{gathered} \text { Total } \\ \text { no. of } \\ \text { taluks } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | less than or equal to 500 | $\begin{aligned} & 501- \\ & 1000 \end{aligned}$ | $\begin{aligned} & 1001- \\ & 1500 \end{aligned}$ | $\begin{aligned} & 1501- \\ & 2000 \end{aligned}$ | $\begin{aligned} & 2001- \\ & 3000 \end{aligned}$ |  |
| 1. Bangalore | 2 | 8 | - | 1 | - | 11 |
| 2. Belgaum | 1 | 2 | 4 | 4 | - | 10 |
| 3. Bellary | 1 | 2 | 3 | 2 | - | 8 |
| 4. Bidar | - | 2 | 3 | - |  | 5 |
| 5. Bijapur . | 1 | 3 | 4 | 1 | 3 | 11 |
| 6. Chikmagalur | 1 | 2 | 3 | 1 | - | 7 |
| 7. Chitradurga | 1 | 3 | 1 | 1 | 1 | 9 |
| 8. Coorg ${ }^{\text {8. }}$. | 2 | 11 | 1 | 1 | - | 3 17 |
| 10. Gulbarga |  | 1 | 2 | 7 | 二 | 10 |
| 11. Hassan . | 1 | 4 | 3 | $\underline{-}$ | - | 8 |
| 12. Kolar . | 1 | 10 | - | - | - | 11 |
| 13. Mandya. | 1 | 5 | 1 |  |  | 7 |
| 14. Mysore. | 1 | 6 | 2 | 1 | 1 | 11 |
| 15. N. Kanara | 1 | 7 | 2 | 1 | - | 11 |
| 16. Raichur . | - |  | 4 | 5 |  | 9 |
| 17. Shimoga | - | 3 | 5 | 1 |  | 9 |
| 18. S. Kanara | 一 | 5 | 2 | 1 | - | 8 |
| 19. Tumkur . |  | 4 | 5 | 1 |  | 10 |
| Total - | 12 | 79 | 51 | 28 | 5 | 175 |
| Pencentage of total | 6.9 | $45 \cdot 1$ | $29 \cdot 1$ | $16 \cdot 0$ | 2.9 |  |

ANNEXURE I (contd.)
Statement II-Mean Daily Temperature( 0 C ) for Observatories in Karnataka

|  | Station | January | February | March | April | May | June | July | August | September | October | November | December | Annual |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1. | Karwar | $24 \cdot 7$ | $24 \cdot 8$ | $26 \cdot 7$ | 28.5 | $28 \cdot 9$ | $27 \cdot 1$ | $26 \cdot 0$ | $26 \cdot 0$ | $26 \cdot 1$ | $26 \cdot 7$ | $26 \cdot 3$ | 25.8 | $26 \cdot 5$ |
| 2. | Honavar | $26 \cdot 0$ | 25.9 | $27 \cdot 3$ | $28 \cdot 8$ | $29 \cdot 1$ | $26 \cdot 7$ | $25 \cdot 9$ | $25 \cdot 9$ | $26 \cdot 0$ | $26 \cdot 9$ | $27 \cdot 2$ | 26.8 | 26.9 |
| 3. | Mangalore (Bajpe) | $26 \cdot 8$ | $27 \cdot 3$ | $28 \cdot 3$ | $29 \cdot 3$ | 28.4 | $26 \cdot 1$ | $25 \cdot 3$ | $25 \cdot 4$ | $25 \cdot 6$ | $26 \cdot 5$ | $27 \cdot 1$ | 26.7 | 26.9 |
| 4. | Mangalore . | $26 \cdot 6$ | 27.0 | $28 \cdot 1$ | 29.3 | $29 \cdot 1$ | $26 \cdot 7$ | $26 \cdot 0$ | $26 \cdot 1$ | $26 \cdot 1$ | $26 \cdot 9$ | $27 \cdot 2$ | 26.8 | $27 \cdot 1$ |
| 5. | Bidar | $22 \cdot 4$ | 24.9 | $28 \cdot 3$ | $30 \cdot 7$ | $32 \cdot 3$ | $28 \cdot 1$ | $25 \cdot 2$ | $24 \cdot 9$ | 24.9 | $25 \cdot 1$ | $23 \cdot 0$ | 21.7 | 26.0 |
| 6. | Gulbarga | $23 \cdot 2$ | 26.0 | 29.3 | $32 \cdot 1$ | $33 \cdot 3$ | $29 \cdot 4$ | 27.0 | $26 \cdot 7$ | $26 \cdot 5$ | $26 \cdot 5$ | 24.0 | $22 \cdot 3$ | $27 \cdot 2$ |
| 7. | Bijapur | $23 \cdot 2$ | $25 \cdot 5$ | $28 \cdot 7$ | $30 \cdot 9$ | $31 \cdot 2$ | $27 \cdot 9$ | 25.9 | $25 \cdot 7$ | 25.9 | $25 \cdot 8$ | $23 \cdot 6$ | $22 \cdot 1$ | $26 \cdot 4$ |
| 8. | Raichur | $24 \cdot 4$ | 26.9 | $30 \cdot 2$ | $32 \cdot 5$ | $33 \cdot 1$ | $29 \cdot 6$ | $27 \cdot 5$ | $27 \cdot 4$ | $27 \cdot 2$ | $27 \cdot 1$ | $25 \cdot 1$ | $23 \cdot 6$ | $27 \cdot 9$ |
| 9. | Belgaum | $22 \cdot 1$ | 23.7 | $26 \cdot 5$ | - 27.6 | 27.3 | $24 \cdot 1$ | $22 \cdot 5$ | $22 \cdot 5$ | 23.0 | $24 \cdot 4$ | $23 \cdot 2$ | 21.6 | $24 \cdot 1$ |
| 10. | Belgaum (Sambre) | $22 \cdot 1$ | $23 \cdot 8$ | $26 \cdot 5$ | 27.8 | $27 \cdot 1$ | $24 \cdot 6$ | $22 \cdot 8$ | $22 \cdot 5$ | $23 \cdot 1$ | $23 \cdot 8$ | $22 \cdot 6$ | 21.9 | $24 \cdot 0$ |
| 11. | Gadag . . | $23 \cdot 5$ | $25 \cdot 8$ | $28 \cdot 5$ | 29.9 | $29 \cdot 6$ | $26 \cdot 5$ | 24.9 | 24.9 | $25 \cdot 1$ | $25 \cdot 5$ | $24 \cdot 1$ | 22.8 | $26 \cdot 0$ |
| 12. | Bellary | $24 \cdot 0$ | 26.6 | 29.7 | 31.8 | 31.9 | $29 \cdot 2$ | $27 \cdot 8$ | $27 \cdot 5$ | $27 \cdot 3$ | $26 \cdot 8$ | $24 \cdot 8$ | $23 \cdot 4$ | $27 \cdot 6$ |
| 13. | Chitradurga | $23 \cdot 0$ | $25 \cdot 6$ | $28 \cdot 2$ | 29.5 | $28 \cdot 7$ | 26.0 | $24 \cdot 5$ | $24 \cdot 3$ | $24 \cdot 7$ | $25 \cdot 0$ | $23 \cdot 4$ | $22 \cdot 4$ | $25 \cdot 5$ |
| 14. | Shimoga . | $22 \cdot 6$ | $24 \cdot 5$ | $27 \cdot 2$ | 29.0 | $28 \cdot 2$ | 25.4 | 24.0 | $24 \cdot 1$ | $24 \cdot 3$ | $24 \cdot 8$ | 23-2 | 21.7 | 24.9 |
| 15. | Balehonnur | 21.1 | 22.6 | 24.4 | 25.0 | $24 \cdot 5$ | $22 \cdot 0$ | $20 \cdot 6$ | $20 \cdot 9$ | $21 \cdot 3$ | $22 \cdot 0$ | 21.3 | $20 \cdot 6$ | 22.2 |
| 16. | Hassan | 21.4 | $23 \cdot 2$ | $25 \cdot 6$ | $26 \cdot 7$ | 25.9 | $23 \cdot 1$ | 21.9 | $22 \cdot 2$ | $22 \cdot 6$ | $23 \cdot 1$ | $22 \cdot 0$ | 20.9 | $23 \cdot 3$ |
| 17. | Bangalore | 21.0 | $23 \cdot 1$ | $25 \cdot 7$ | $27 \cdot 3$ | $26 \cdot 9$ | $24 \cdot 3$ | $23 \cdot 2$ | $23 \cdot 3$ | $23 \cdot 3$ | $23 \cdot 2$ | $21 \cdot 8$ | $20 \cdot 5$ | $23 \cdot 6$ |
| 18. | Bngalore (Airport) | 21.7 | $23 \cdot 5$ | 26.0 | $27 \cdot 7$ | $27 \cdot 1$ | $24 \cdot 8$ | $23 \cdot 6$ | $23 \cdot 7$ | $24 \cdot 0$ | $23 \cdot 8$ | 22.5 | 21.2 | 24-1 |
| 19. | Mysore | $22 \cdot 4$ | $24 \cdot 7$ | 26.9 | $27 \cdot 7$ | $26 \cdot 9$ | $24 \cdot 6$ | $23 \cdot 5$ | $23 \cdot 8$ | 24.0 | 24.0 | $22 \cdot 9$ | 21.8 | 24.4 |
| 20. | Mercara | $19 \cdot 4$ | 21.0 | $22 \cdot 6$ | $22 \cdot 9$ | $22 \cdot 3$ | 19.7 | $18 \cdot 7$ | 18.9 | 19.5 | $20 \cdot 4$ | 19.9 | 19.5 | $20 \cdot 3$ |

ANNEXURE I (Contd:)
Statement LII-Mean Daily Maximum Temperature ( ${ }^{\circ} \mathrm{C}$ ) for Observatories in Karnataka

|  | Station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | annual |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Karwar | $30 \cdot 5$ | $30 \cdot 8$ | 30.9 | 31.6 | 31.5 | 29.4 | 28.0 | 27.9 | 28.4 | 29.7 | 31.6 | $32 \cdot 1$ | 30.2 |
| 2. | Honavar | 31.9 | 31.3 | 31.9 | $32 \cdot 4$ | $32 \cdot 3$ | $29 \cdot 3$ | 28.2 | 28.3 | 28.8 | $30 \cdot 6$ | $32 \cdot 5$ | $32 \cdot 7$ | 30.9 |
| 3. | Mangalore (Bajpe) | $32 \cdot 5$ | 32.8 | 33.0 | $33 \cdot 7$ | $32 \cdot 2$ | $29 \cdot 1$ | 27.8 | 28.0 | 28.6 | $30 \cdot 0$ | 31.8 | $32 \cdot 3$ | 31.0 |
| 4. | Mangalore . | 31.4 | 31.1 | 31.7 | $32 \cdot 4$ | $32 \cdot 1$ | 29.4 | 28.5 | 28.5 | 28.7 | 29.8 | 31.1 | 31.7 | $30 \cdot 5$ |
| 5. | Bidar | $28 \cdot 3$ | $31 \cdot 1$ | $34 \cdot 6$ | 36.9 | $38 \cdot 6$ | $33 \cdot 3$ | 29.0 | 28.7 | 28.8 | 29.5 | 27.9 | $27 \cdot 1$ | 31.2 |
| 6. | Gulbarga | $30 \cdot 4$ | 33.4 | $36 \cdot 8$ | $39 \cdot 1$ | $40 \cdot 2$ | 35.0 | $31 \cdot 4$ | 31.2 | 31.1 | 31.9 | $30 \cdot 4$ | 29.5 | 33.4 |
| 7. | Biiapur | $30 \cdot 2$ | 32.9 | 36.0 | 38.0 | 38.5 | 33.3 | $30 \cdot 1$ | $30 \cdot 1$ | $30 \cdot 6$ | 31.0 | 29.7 | 29.0 | 32.5 |
| 8. | Raichur | $30 \cdot 2$ | 33.2 | $36 \cdot 6$ | 38.7 | 39.6 | $35 \cdot 1$ | 32.0 | 31.9 | 31.6 | 31.7 | 30-1 | 29.1 | 33.3 |
| 9. | Belgaum | $30 \cdot 1$ | 32.2 | 35.0 | 35.7 | 34.0 | 27.5 | 25.2 | 25.6 | 27.0 | $30 \cdot 1$ | 29.3 | 29.3 | $30 \cdot 1$ |
| 10. | Belgaum (Sambre) | 29.0 | 31.5 | $34 \cdot 3$ | $35 \cdot 2$ | 33.3 | 28.7 | $25 \cdot 4$ | 25.2 | 26.9 | 28.3 | 28.2 | $28 \cdot 2$ | 29.5 |
| 11. | Gadag | $30 \cdot 3$ | 33.0 | 36.0 | 37.3 | $36 \cdot 5$ | 31.1 | 28.5 | 28.9 | 29.7 | $30 \cdot 8$ | 29.8 | 29.1 | 31.8 |
| 12. | Bellary | $30 \cdot 3$ | 33.3 | 36.4 | $38 \cdot 1$ | 37.9 | 33.7 | 31.5 | 31.4 | 31.5 | 31.3 | 29.9 | 29.3 | 32.9 |
| 13. | Chitradurga | 28.9 | $32 \cdot 0$ | 34.9 | $36 \cdot 3$ | $35 \cdot 1$ | $30 \cdot 6$ | 28.1 | 28.1 | $29 \cdot 1$ | $39 \cdot 6$ | 28.4 | $28 \cdot 0$ | $30 \cdot 8$ |
| 14. | Shimoga - | $30 \cdot 5$ | 32.9 | $35 \cdot 3$ | $35 \cdot 7$ | $33 \cdot 8$ | 29.0 | 26.8 | $27 \cdot 1$ | $28 \cdot 6$ | 29.2 | $29 \cdot 1$ | 28.9 | $30 \cdot 6$ |
| 15. | Balehonnur | $27 \cdot 3$ | 29.3 | 31.3 | 30.9 | 29.4 | $25 \cdot 1$ | $22 \cdot 7$ | 23.2 | $24 \cdot 5$ | $26 \cdot 1$ | 26.2 | $26 \cdot 2$ | 26.9 |
| 16. | Hassan | 28.1 | $30 \cdot 5$ | 32.9 | $33 \cdot 2$ | 31.5 | $26 \cdot 8$ | 24.8 | 25.5 | $26 \cdot 7$ | $27 \cdot 6$ | 27.0 | 26.8 | 28.5 |
| 17. | Bangalore | 26.9 | 29.7 | $32 \cdot 3$ | 33.4 | $32 \cdot 7$ | 28.9 | $27 \cdot 2$ | $27 \cdot 3$ | $27 \cdot 6$ | 27.5 | $26 \cdot 3$ | $25 \cdot 7$ | 28.8 |
| 18. | Bangalore (Airport) | 28.0 | $30 \cdot 6$ | 33.2 | 34.0 | 32.9 | 29.7 | $27 \cdot 8$ | 27.9 | $28 \cdot 6$ | 28.3 | $27 \cdot 5$ | 26.9 | 29.6 |
| 19. | Mysore | $28 \cdot 3$ | 31.2 | $33 \cdot 5$ | $34 \cdot 0$ | $32 \cdot 6$ | 28.9 | 27.3 | 27.9 | 28.7 | 28.4 | 27.4 | $27 \cdot 0$ | $29 \cdot 6$ |
| 20. | Mercara | $24 \cdot 6$ | 26.8 | 28.5 | $27 \cdot 9$ | $26 \cdot 3$ | 21.9 | $20 \cdot 2$ | $20 \cdot 7$ | $22 \cdot 0$ | 23.7 | $23 \cdot 6$ | $23 \cdot 5$ | $24 \cdot 1$ |

ANNEXURE I (Contd.)


ANNEXURE I (Contd.)
Statement V-Normal Monthly and Annual Potential Evapotranspiraticn (TE) Selcacd Obscrvetorics in Karnataka

|  | station | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | annual |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | $K$ rwar | 106 | 110 | 144 | 141 | 128 | 91 | 83 | 87 | 95 | 100 | 105 | 103 | 1294 |
| 2. | Kanavar . | 121 | 121 | 146 | 141 | 134 | 98 | 92 | 94 | 96 | 106 | 112 | 118 | 1379 |
| 3. | Mangalore (Bajpe) | 140 | 141 | 169 | 162 | 132 | 95 | 90 | 92 | 98 | 105 | 113 | 127 | 1463 |
| 4. | Mangalore. . | 136 | 136 | 164 | 154 | 141 | 96 | 91 | 95 | 100 | 109 | 116 | 128 | 1465 |
| 5. | Bidar . | 122 | 138 | 184 | 192 | 217 | 173 | 135 | 128 | 116 | 127 | 114 | 109 | 1754 |
| 6 | Gulbarga | 125 | 144 | 191 | 210 | 235 | 185 | 152 | 148 | 131 | 146 | 130 | 118 | 1913 |
| 7. | Biapur | 109 | 123 | 165 | 180 | 197 | 157 | 137 | 135 | 124 | 123 | 102 | 97 | 1650 |
| 8. | Raichur | 132 | 145 | 193 | 202 | 224 | 189 | 170 | 164 | 143 | 142 | 126 | 121 | 1951 |
| 9. | Belgaum | 113 | 125 | 167 | 171 | 132 | 114 | 92 | 95 | 100 | 117 | 110 | 106 | 1481 |
| 10. | Belgaum (Sambre) | 137 | 154 | 197 | 195 | 192 | 142 | 111 | 107 | 112 | 117 | 123 | 129 | 1717 |
| 11. | Gadag . . | 121 | 131 | 173 | 179 | 184 | 145 | 130 | 131 | 123 | 113 | 113 | 112 | 1664 |
| 12. | Bellary . | 115 | 129 | 171 | 181 | 195 | 167 | 156 | 153 | 138 | 123 | 106 | 104 | 1738 |
| 13. | Chitradurga | 124 | 134 | 172 | 171 | 172 | 138 | 121 | 120 | 119 | 117 | 107 | 111 | 1606 |
| 14. | Shimoga . | 109 | 118 | 153 | 153 | 1.45 | 110 | 95 | 98 | 101 | 101 | 99 | 99 | 1380 |
| 15. | Hassan | 111 | 119 | 157 | 149 | 146 | 111 | 110 | 104 | 106 | 105 | 98 | 100 | 1406 |
| 16. | Bangalore | 117 | 130 | 166 | 158 | 157 | 127 | 116 | 114 | 109 | 105 | 98 | 103 | 1501 |
| 17. | Mysore | 128 | 134 | 166 | 154 | 148 | 124 | 116 | 117 | 117 | 111 | 106 | 114 | 1534 |

## ANNEXURE 1 (Contd.)

## Statement VI-Irrigation Statistics

| district |  |  |  | Irrigated area as \% of cropped area (gross) |  |  |  |  | \% of net irrigated area served by different sources |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | for distt. as a whole | number of taluks with irrigated area of |  |  |  | canals | tanks | weils | other sources |
|  |  |  |  |  | $\begin{aligned} & 10 \% \text { or } \\ & \text { less } \end{aligned}$ | $\begin{gathered} 10.1 \%- \\ 20 \% \end{gathered}$ | $\begin{gathered} 20.1 \% \\ -50 \% \end{gathered}$ | greater than $50 \%$ |  |  |  |  |
| Gulbarga |  |  |  | 2 | 10 | - | - | - | 2.5 | $28 \cdot 6$ | $54 \cdot 5$ | 14-4 |
| Bidar | - | . |  | 3 | 5 | - | - | - | - | $8 \cdot 4$ | $85 \cdot 6$ | $6 \cdot 0$ |
| Bijapur |  | . |  | 4 | 10 | 1 | - | - | $18 \cdot 3$ | $11 \cdot 6$ | $67 \cdot 9$ | $2 \cdot 2$ |
| Dharwar | - | - |  | 5 | 13 | 3 | 1 | - | 11.0 | $70 \cdot 2$ | $11 \cdot 3$ | $7 \cdot 5$ |
| Coorg |  | - |  | 7 | 2 | 1 | - | - | $45 \cdot 6$ | $30 \cdot 1$ | - | $24 \cdot 3$ |
| Bellary |  | . |  | 10 | 6 | 2 | - | - | 67.0 | 14.7 | 16-2 | $2 \cdot 1$ |
| Belgaum |  |  |  | 11 | 4 | 5 | 1 | - | 32.6 | $9 \cdot 5$ | $46 \cdot 3$ | 11.6 |
| Raichur |  | . |  | 11 | 6 | 2 | 1 | - | $86 \cdot 7$ | $2 \cdot 6$ | $10 \cdot 0$ | $0 \cdot 7$ |
| Chikmagalur |  | . |  | 13 | 4 | 2 | 1 | - | $29 \cdot 6$ | 61.6 | $4 \cdot 8$ | 4.0 |
| Mysore | - | . | . | 14 | 4 | 5 | 2 | - | $64 \cdot 9$ | $20 \cdot 4$ | $12 \cdot 8$ | 1.9 |
| Tumkur | . | . | . | 16 | 2 | 5 | 3 | - | $1 \cdot 3$ | $50 \cdot 0$ | 40-3 | $8 \cdot 4$ |
| Bangalore |  | - |  | 17 | - | 8 | 3 | - | $4 \cdot 3$ | $53 \cdot 2$ | 38-2 | $4 \cdot 3$ |
| Hassan |  | . |  | 18 | 1 | 2 | 5 | - | $14 \cdot 7$ | $63 \cdot 4$ | 4.4 | $17 \cdot 5$ |
| N. Kanara |  | - |  | 18 | 4 | 4 | 3 | -. | $6 \cdot 6$ | $56 \cdot 4$ | $6 \cdot 3$ | $30 \cdot 7$ |
| Chitradurga | . | . |  | 19 | 4 | 3 | 1 | 1 | $58 \cdot 1$ | $24 \cdot 8$ | $16 \cdot 5$ | $0 \cdot 6$ |
| Kolar |  |  |  | 26 | - | 2 | 9 | - | $1 \cdot 5$ | 51.9 | $46 \cdot 2$ | 0.4 |
| S. Kanata |  | . | . | 32 | - | 2 | 6 | - | - | $18 \cdot 0$ | $22 \cdot 1$ | 59.9 |
| Mandya |  | - | - | 34 | - | 1 | 5 | 1 | $75 \cdot 0$ | $16 \cdot 2$ | $6 \cdot 6$ | $2 \cdot 2$ |
| Shimoga | . | - | - | 51 | $\overline{75}$ | $\frac{1}{48}$ | 4 | 5 | $43 \cdot 3$ | 45.8 | 1.8 | $9 \cdot 1$ |
| State | . | . | - | 12 | 75 | 48 | 45 | 7 | 34-8 | $32 \cdot 5$ | $22 \cdot 8$ | 9.9 |

ANNEXURE I (Contd.)
Statement VII-Land Use Statistics-Percentage of Reporting Arca (1969-70)

|  | districts | forests | land put to non-agricultural use | barren and un-cultivable land | total of 3 <br> and 4 <br> not available for cultivation | culti- <br> vable <br> waste | permanent pastures and other grazing lands | land under mis-. cellaneous trees, crops and groves | total of 6 , 7 \& 8other uncultivated land | current fallow | other fallow lands | total of 10 \& 11 | net area sown | arca <br> sown <br> more <br> than once as per cent of net sown area |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1. | Bangalore | $10 \cdot 5$ | $8 \cdot 3$ | $5 \cdot 5$ | $13 \cdot 8$ | $2 \cdot 1$ | 14.4 | 1.8 | $18 \cdot 3$ | $6 \cdot 0$ | 0.2 | $6 \cdot 2$ | $51 \cdot 2$ | $2 \cdot 1$ |
| 2. | Belgaum | $14 \cdot 2$ | $3 \cdot 1$ | 3.8 | 6.9 | $1 \cdot 6$ | 1.9 | $0 \cdot 1$ | $3 \cdot 6$ | $3 \cdot 6$ | $1 \cdot 5$ | $5 \cdot 1$ | $70 \cdot 2$ | $2 \cdot 1$ |
| 3. | Bellary | $12 \cdot 3$ | $7 \cdot 6$ | $6 \cdot 5$ | $14 \cdot 1$ | $4 \cdot 3$ | 1.0 | 0.6 | 5.9 | $4 \cdot 4$ | $2 \cdot 0$ | $6 \cdot 3$ | 61.4 | $3 \cdot 1$ |
| 4. | Bidar . | 1.8 | 5.4 | $3 \cdot 1$ | $8 \cdot 5$ | $2 \cdot 1$ | 4.7 | 4.5 | $11 \cdot 3$ | $7 \cdot 7$ | 9.4 | $17 \cdot 1$ | $61 \cdot 3$ | $21 \cdot 6$ |
| 5. | Bijapur | 4.9 | $2 \cdot 6$ | 3.0 | $5 \cdot 6$ | 0.5 | 1.0 | $0 \cdot 1$ | 1.6 | $2 \cdot 6$ | 1.6 | $4 \cdot 2$ | 83.7 | $1 \cdot 3$ |
|  | Chikmagalur | $24 \cdot 5$ | $4 \cdot 2$ | $5 \cdot 3$ | 9.5 | $4 \cdot 4$ | $22 \cdot 1$ | $1 \cdot 6$ | $28 \cdot 1$ | $3 \cdot 3$ | 2.9 | $6 \cdot 2$ | $31 \cdot 7$ | $8 \cdot 0$ |
|  | Chitradurga | - 7.9 | $5 \cdot 4$ | 3.7 | 9.1 | $5 \cdot 1$ | $13 \cdot 2$ | $1 \cdot 3$ | 19.6 | $9 \cdot 4$ | $10 \cdot 7$ | $20 \cdot 1$ | $43 \cdot 3$ | $9 \cdot 7$ |
| 8. | Coorg | - 33.0 | $7 \cdot 1$ | $5 \cdot 6$ | $12 \cdot 7$ | 9.6 | 5.9 | 9.7 | $25 \cdot 2$ | $0 \cdot 1$ | 0.4 | $0 \cdot 5$ | $28 \cdot 6$ | $8 \cdot 3$ |
| 9. | Dharwar | $8 \cdot 3$ | $1 \cdot 6$ | 2.0 | $3 \cdot 6$ | 0.8 | 2.8 | $0 \cdot 3$ | $3 \cdot 9$ | $1 \cdot 8$ | 1.5 | $3 \cdot 3$ | $80 \cdot 9$ | $2 \cdot 2$ |
| 10. | Gulbarga | - $4 \cdot 4$ | $2 \cdot 9$ | $5 \cdot 2$ | $8 \cdot 1$ | 1.4 | 3.6 | 0.2 | $5 \cdot 1$ | $5 \cdot 6$ | $1 \cdot 3$ | $7 \cdot 0$ | $75 \cdot 4$ | $3 \cdot 5$ |
| 11. | Hassan | $3 \cdot 7$ | 8.0 | $4 \cdot 1$ | $12 \cdot 1$ | $5 \cdot 3$ | $15 \cdot 2$ | 1.0 | 21.5 | 9.9 | $5 \cdot 5$ | $15 \cdot 4$ | $47 \cdot 3$ | $9 \cdot 5$ |
| 12. | Kolar | - ${ }^{\text {- }} 9.4$ | $8 \cdot 3$ | $6 \cdot 3$ | $14 \cdot 7$ | 1.9 | $25 \cdot 8$ | 1.7 | 29.4 | $6 \cdot 1$ | $2 \cdot 3$ | $8 \cdot 3$ | $38 \cdot 2$ | $2 \cdot 3$ |
| 13. | Mandya | - 4.9 | 10.2 | $3 \cdot 5$ | 13.7 | $10 \cdot 6$ | 11.6 | 0.3 | $22 \cdot 5$ | $4 \cdot 2$ | 1.3 | $5 \cdot 4$ | $53 \cdot 5$ | $9 \cdot 0$ |
| 14. | Mysore | 26.3 | $5 \cdot 1$ | $6 \cdot 4$ | 11.5 | 3.5 | 14.4 | $1 \cdot 1$ | $19 \cdot 0$ | 1.9 | 4.0 | $5 \cdot 9$ | $37 \cdot 3$ | $18 \cdot 1$ |
| 15. | North Kanara | - 81.4 | $1 \cdot 7$ | 1.7 | 11.5 | -1. 3 | 1.8 | 0.3 | $3 \cdot 3$ | $0 \cdot 5$ | 1.0 | 1.4 | $10 \cdot 3$ | $10 \cdot 6$ |
| 16. | Raichur | - 2.0 | 3-1 | 4.4 | 7.5 | $1 \cdot 1$ | 3.4 | 0.8 | $5 \cdot 4$ | $7 \cdot 4$ | $4 \cdot 3$ | 11.8 | $73 \cdot 3$ | $1 \cdot 8$ |
| 17. | Shimoga | - 20.7 | 7.0 | $3 \cdot 7$ | $10 \cdot 7$ | 4.9 | $25 \cdot 2$ | 1.9 | 31.9 | $2 \cdot 3$ | $5 \cdot 2$ | 7.5 | $29 \cdot 2$ | $12 \cdot 6$ |
| 18. | South Kanara | $29 \cdot 4$ | $8 \cdot 3$ | $8 \cdot 7$ | 17.0 | 9.2 | $4 \cdot 0$ | 11.4 | $24 \cdot 6$ | $4 \cdot 2$ | $2 \cdot 2$ | $6 \cdot 4$ | $22 \cdot 6$ | $42 \cdot 5$ |
| 19. | Tumkur | $4 \cdot 3$ | 6.0 | $5 \cdot 0$ | 11.0 | $7 \cdot 1$ | $13 \cdot 5$ | $2 \cdot 4$ | $23 \cdot 1$ | 11.7 | 6.4 | $18 \cdot 0$ | $43 \cdot 6$ | $2 \cdot 8$ |
|  | STATE | $15 \cdot 1$ | $4 \cdot 5$ | $4 \cdot 9$ | 9.4 | $3 \cdot 3$ | $8 \cdot 6$ | 1.6 | $13 \cdot 6$ | $4 \cdot 8$ | $3 \cdot 3$ | $8 \cdot 1$ | $53 \cdot 8$ | $5 \cdot 8$ |

ANNEXURE I (Contd.)
Statement VIII-Frequency of Taluks in Different Ranges of Population Density
density per sq. km.


ANNEXURE I (Contd.)
Statement IX-Percentage of Operational Holdings and Area Operated

|  |  |  |  | no. of holdings (thousand) | arca of holdings (thousand ha.) | 0.1 to 2.0 ha. |  | 2.1 to 5.0 ha. |  | 5.1 tp 20.0 ha. |  | 20.1 ha. and above |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  | per cent holdings | per cent area | per cent holdings | per cent area | per cent holdings | per cent area | per cent holdings | per cent area |
| 1. | North Kanara |  |  | $106 \cdot 2$ | $147 \cdot 8$ | $77 \cdot 6$ | 31.0 | 16.9 | 37.4 | $5 \cdot 3$ | 29.5 | $0 \cdot 2$ | $1 \cdot 8$ |
| 2. | South Kanara |  |  | 129.9 | 205.9 | $75 \cdot 4$ | $39 \cdot 6$ | $20 \cdot 0$ | 36.8 | $4 \cdot 4$ | $21 \cdot 2$ | $0 \cdot 1$ | $2 \cdot 3$ |
| 3. | Belgaum |  |  | $298 \cdot 3$ | $971 \cdot 5$ | $52 \cdot 2$ | $14 \cdot 2$ | $28 \cdot 4$ | 27.7 | $18 \cdot 3$ | $48 \cdot 6$ | $1 \cdot 1$ | $9 \cdot 5$ |
| 4. | Dharwar |  |  | $268 \cdot 6$ | 1128.7 | $38 \cdot 0$ | $10 \cdot 4$ | $35 \cdot 2$ | $26 \cdot 8$ | $25 \cdot 4$ | $53 \cdot 6$ | $1 \cdot 5$ | $9 \cdot 3$ |
| 5. | Shimoga |  |  | $147 \cdot 2$ | $326 \cdot 6$ | $64 \cdot 0$ | $28 \cdot 6$ | $27 \cdot 2$ | $37 \cdot 0$ | $8 \cdot 4$ | $30 \cdot 1$ | $0 \cdot 3$ | $4 \cdot 4$ |
| 6. | Chibmagalur |  |  | 92.0 | $248 \cdot 8$ | $59 \cdot 6$ | $22 \cdot 0$ | $28 \cdot 6$ | $32 \cdot 1$ | $10 \cdot 8$ | $32 \cdot 8$ | $1 \cdot 2$ | $13 \cdot 0$ |
| 7. | Hassan |  |  | $166 \cdot 7$ | 359.9 | $64 \cdot 9$ | $28 \cdot 2$ | $26 \cdot 7$ | $37 \cdot 3$ | $8 \cdot 0$ | 29-2 | 0.4 | $5 \cdot 4$ |
| 8. | Coorg |  |  | $36 \cdot 8$ | $136 \cdot 3$ | $50 \cdot 8$ | 13-2 | $29 \cdot 9$ | $25 \cdot 6$ | $17 \cdot 4$ | $40 \cdot 4$ | 1.9 | $20 \cdot 8$ |
| 9. | Bidar |  |  | $87 \cdot 6$ | 479.4 | $30 \cdot 4$ | $6 \cdot 1$ | $32 \cdot 3$ | $19 \cdot 4$ | $34 \cdot 1$ | $58 \cdot 1$ | $3 \cdot 3$ | $16 \cdot 6$ |
| 10. | Gulbarga |  |  | $212 \cdot 7$ | $263 \cdot 2$ | $26 \cdot 3$ | $4 \cdot 8$ | $32 \cdot 6$ | $18 \cdot 2$ | $37 \cdot 2$ | $58 \cdot 5$ | $3 \cdot 8$ | $18 \cdot 4$ |
| 11. | Bijapur |  |  | $247 \cdot 4$ | $1454 \cdot 6$ | $25 \cdot 4$ | $5 \cdot 0$ | $33 \cdot 8$ | $18 \cdot 8$ | $37 \cdot 3$ | $59 \cdot 2$ | $3 \cdot 5$ | $16 \cdot 9$ |
| 12. | Raichur |  |  | 229.5 | 1121.5 | $30 \cdot 2$ | $7 \cdot 0$ | $36 \cdot 5$ | $24 \cdot 2$ | $31 \cdot 3$ | $56 \cdot 5$ | $2 \cdot 2$ | 11.9 |
| 13. | Bellary |  |  | $127 \cdot 8$ | $553 \cdot 2$ | $36 \cdot 6$ | $9 \cdot 1$ | $36 \cdot 9$ | 27.4 | $24 \cdot 5$ | $49 \cdot 5$ | 1.9 | $14 \cdot 0$ |
| 14. | Chitradurga |  |  | $177 \cdot 3$ | 705.8 | 41.7 | 11.5 | $35 \cdot 0$ | $27 \cdot 5$ | $21 \cdot 5$ | $47 \cdot 8$ | 1.8 | $13 \cdot 2$ |
| 15. | Tumkur |  |  | 285-3 | $613 \cdot 5$ | $67 \cdot 7$ | $26 \cdot 7$ | $22 \cdot 9$ | $32 \cdot 4$ | 8.9 | $34 \cdot 2$ | $0 \cdot 5$ | $6 \cdot 7$ |
| 16. | Kolar |  | . | $209 \cdot 3$ | $394 \cdot 0$ | $70 \cdot 8$ | $32 \cdot 9$ | $22 \cdot 7$ | 35.9 | $6 \cdot 4$ | $26 \cdot 6$ | 1.9 | $4 \cdot 5$ |
| 17. | Bangalore |  | . | $240 \cdot 7$ | $448 \cdot 7$ | $71 \cdot 3$ | $33 \cdot 0$ | $22 \cdot 2$ | $36 \cdot 1$ | $6 \cdot 3$ | $26 \cdot 9$ | $0 \cdot 3$ | $4 \cdot 7$ |
| 18. | Mandya |  | - | 215 -8 | 294.6 | $78 \cdot 9$ | $42 \cdot 5$ | $17 \cdot 7$ | $38 \cdot 1$ | $3 \cdot 3$ | $18 \cdot 2$ | $0 \cdot 1$ | $1 \cdot 2$ |
| 19. | Mysore |  | . | 271.9 | $513 \cdot 8$ | $69 \cdot 3$ | $34 \cdot 7$ | 24-5 | $38 \cdot 5$ | $6 \cdot 1$ | $24 \cdot 7$ | $0 \cdot 1$ | $2 \cdot 0$ |
|  | STATE | - | - | $3551 \cdot 0$ | 11367.0 | $54 \cdot 1$ | $15 \cdot 5$ | 27.9 | $27 \cdot 3$ | $16 \cdot 9$ | $46 \cdot 1$ | $1 \cdot 2$ | $11 \cdot 1$ |

## ANNEXURE I (Concld.)

Statement X-Availability of Power (HP) per Hectare of Cultivated Area

|  | district | Gross cropped area (ha) | Human | Animal | Tractors | Power tillers | Power sprayers -dusters | Diesel engines | Electric motors | Electrically operated sugarcane crushers | Total power |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Bangalore | 380043 | 0.0464 | $0 \cdot 1145$ | $0 \cdot 0288$ | 0.0029 | $0 \cdot 0052$ | 0.0155 | 0.9306 | 0.0082 | $0 \cdot 5521$ |
| 2. | Belgaum | 968279 | 0.0265 | $0 \cdot 1020$ | $0 \cdot 0067$ | $0 \cdot 0003$ | $0 \cdot 0078$ | 0-1069 | 0.0527 | $0 \cdot 0085$ | 0.3114 |
| 3. | Bellary | 604882 | 0.0206 | 0.0897 | 0.0077 | 0.0001 | $0 \cdot 0032$ | $0 \cdot 0074$ | $0 \cdot 0620$ | 0.0130 | $\theta \cdot 2037$ |
| 4. | Bidar | 413317 | 0.0190 | 0.0733 | $0 \cdot 0019$ | - | 0.0064 | 0.0512 | $0 \cdot 0913$ | $0 \cdot 0066$ | $0 \cdot 2497$ |
| 5. | Bijapur | 1474485 | 0.0146 | $0 \cdot 0512$ | 0.0042 | $0 \cdot 0003$ | 0.0030 | $0 \cdot 0364$ | 0.0456 | $0 \cdot 0012$ | $0 \cdot 1565$ |
| 6. | Chikmagalur | 231212 | 0.0343 | 0.2159 | 0.0155 | 0.0010 | $0 \cdot 0206$ | $0 \cdot 0071$ | $0 \cdot 0453$ | 0.0038 | $0 \cdot 3435$ |
| 7. | Chitradurga | 420048 | 0.0366 | $0 \cdot 1700$ | 0.0132 | $0 \cdot 0006$ | $0 \cdot 0063$ | $0 \cdot 0097$ | $0 \cdot 1565$ | 0.0036 | 0-3971 |
| 8. | Coorg | 116343 | 0.0392 | 0.2336 | 0.0249 | 0.0010 | $0 \cdot 0131$ | 0.0214 | $0 \cdot 0401$ | 0.0007 | 0.3740 |
| 9. | Dharwar | 1139295 | 0.0202 | 0.0838 | 0.0053 | $0 \cdot 0001$ | 0.0039 | 0.0084 | 0.0375 | $0 \cdot 0027$ | $0 \cdot 1619$ |
| 10. | Gulbarga | - 1257151 | $0 \cdot 0141$ | 0.0677 | $0 \cdot 0016$ | 0.0003 | 0.0078 | $0 \cdot 0163$ | 0.0162 | $0 \cdot 0015$ | 0.1252 |
| 11. | Hassan | 328145 | 0.0341 | $0 \cdot 1813$ | 0.0085 | $0 \cdot 0005$ | 0.0065 | 0.0063 | 0.0358 | $0 \cdot 0070$ | $0 \cdot 2800$ |
| 12. | Kolar | 256032 | $0 \cdot 0634$ | $0 \cdot 2280$ | $0 \cdot 0120$ | $0 \cdot 0024$ | $0 \cdot 0197$ | $0 \cdot 0218$ | $0 \cdot 5933$ | $0 \cdot 0152$ | 0.9458 |
| 13. | Mandya | 274226 | $0 \cdot 0438$ | 0. 1804 | 0.0026 | $0 \cdot 0005$ | $0 \cdot 0022$ | 0.0128 | 0.0997 | 0.0159 | $0 \cdot 3579$ |
| 14. | Mysore | 512024 | 0.0380 | 0.1727 | 0.0038 | 0.0014 | 0.0062 | 0.0051 | 0.0582 | 0.0019 | $0 \cdot 3245$ |
| 15. | N. Kanara | 124845 | 0.0651 | $0 \cdot 3734$ | $0 \cdot 0072$ | $0 \cdot 0007$ | $0 \cdot 0247$ | $0 \cdot 0266$ | $0 \cdot 1093$ | $0 \cdot 0026$ | 0.6096 |
| 16. | Raichur | 1046694 | $0 \cdot 0158$ | $0 \cdot 0784$ | 0.0107 | $0 \cdot 0001$ | $0 \cdot 0049$ | $0 \cdot 0068$ | $0 \cdot 0255$ | 0.0018 | $0 \cdot 1440$ |
| 17. | Shimoga | 323472 | 0.0382 | $0 \cdot 2564$ | 0.0183 | $0 \cdot 0086$ | $0 \cdot 0188$ | $0 \cdot 0059$ | $0 \cdot 582$ | $0 \cdot 0129$ | 0.4173 |
| 18. | S. Kanara | 272669 | 0.0654 | $0 \cdot 3124$ | $0 \cdot 0021$ | $0 \cdot 0045$ | 0.0212 | $0 \cdot 1549$ | $0 \cdot 3283$ | $0 \cdot 0016$ | $0 \cdot 8904$ |
| 19. | Tumkur | 481577 | 0.0368 | $0 \cdot 1477$ | $0 \cdot 0025$ | $0 \cdot 0012$ | $0 \cdot 0037$ | $0 \cdot 0198$ | 0-2147 | $0 \cdot 0045$ | 0.4309 |
|  | STATE per cent to total | $\text { . } 10588739$ | $\begin{aligned} & 0.0269 \\ & 9.5 \end{aligned}$ | $\begin{aligned} & 0 \cdot 1174 \\ & 41 \cdot 5 \end{aligned}$ | $\begin{aligned} & 0.0073 \\ & 2.6 \end{aligned}$ | $\begin{aligned} & 0 \cdot 00086 \\ & 0 \cdot 3 \end{aligned}$ | $\begin{aligned} & 0.00705 \\ & 2.5 \end{aligned}$ | $\begin{gathered} 0.02843 \\ 10 \cdot 1 \end{gathered}$ | $\begin{aligned} & 0.09003 \\ & 31 \cdot 8 \end{aligned}$ | $\begin{aligned} & 0.00488 \\ & 1.7 \end{aligned}$ | 0.2826 |

Notes : 1. Human population is based on 1971 census. Data on Draft animals and power appliances taken from 1972 Livestock Census.
2. Only $80 \%$ of the active agricultural population (ages $15-60$ ) and draft animals and $50 \%$ of the tractors are considered for cultural operations.
3. Contribution in HP per unit assumed for different categories is : man $=0 \cdot 06$, bullock $=0.040$, tractor $=25 \cdot 0$, power tiller $=7 \cdot 0$, power sprayer $=2 \cdot 0$, diesel engine $=7 \cdot 0$, electric motor $=6 \cdot 0$, electrically operated crushers $=6 \cdot 0$.
4. Gross cropped area represents average of three years 1967-68 to 1969-70.


## KARNATAKA

MAY
$I$

Rainfall cm .


Coefficiant of Variation of Rainfall (percent)

II


Annexure 2
Maps I-II: Rainfall and Coefficient of Variation (CV) for the month of May.

The te:ritorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.


The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line

## KARNATAKA

JULY
$y$


Coefficient of Variation of Rainfall (Yercent)

81


Annexure 2
Maps V-VI: Doinfall and Coefficient of Varlation (CV) for
the tonth of July.

The territorial waters of India extend into the sea to a distance of twelve natical miles measured from the appropriate base line.

## KARNATAKA

## AUGUST

VII

Rainfall cm.


Coefficient of Variation of Rainfall(percent)

VIII

Annexure 2


Maps VII-VIII: Rainfall and Coefficient of Variation (CV) for the month of August. .

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

## KARNATAKA

## SEPTEMBER

IX

Rainfall cm.


Coefficient of Variation of Rainfall(percent)

X ,


Annexure 2
Maps IX-X: Rainfall and Coefflcient of Variation (CV). for the month of September.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

# KARNATAKA <br> OCTOBER 

XI


Coefficient of Variation of Rainfall (percent)

XII


Annexure 2
Maps XI-XII: Ralnfall anc Coefricient of Variation (CV) for the manth of October.

The territorial waters of India extend into the sea to a distance of twelve nauticat miles measured from the appropriate base lina

## KARNATAKA

ANNUAL

## Xin



Cocfficient of Variation of Rainfall (percent)

XTX


Annaxure 2
Maps XIIL-XIV: Rainfall and Coefficient of Variation (CV) Annual

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.


Annexure 2
Map XV - Net Sown Area as per cent of Geographical Area
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line:


Annaxure 2
Map XVI - Irrigated Area as per cent of Gross Cropped Area The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base ine.


Map XVII - Density of Population (persuns per sa. Kin)
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.


Abnexure 2
Map XVIII - Total power Ayailable for cultural operations
The teritorial waters of India extend into the sea to a distance of
twelve nautical miles measured from the approprlate base iine.
553

ANNEXURE 3
Land Use and Population Statistics of Taluks according to State Rainfall Zones
KARNATAKA

$\begin{aligned}- & =\text { nil or negligible. } \\ \text { nac } & =\text { not available for cultivation. }\end{aligned}$
$\mathrm{cw}=$ culturable waste.
$\mathrm{pp} \& \mathrm{gl}=$ permanent pastures and other grazing lands.
mte \& $\mathrm{g}=$ miscellaneous tree crops and groves not included in net area sown.
Note :-Land categories expressed as per cent of geographical area (reporting) are given to the nearest integer value when per cent is 0.5 or higher. Due to this approximation, the total of all the categories is generally within one per cent of hundred.
Land use statistics relates to the year 1969-70.

ANNEXURE 3 (Contd.)
area - '000 ha.
( ) - per cent of geographical area

|  | district/taluk |  |  | Population |  | forests | nac | cw |  | mtc\&g | fallow lands | net area sown. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | total | per sq. km. |  |  |  |  |  |  |  |
| Raichur |  |  |  | Rainfall Zone-I |  | . | . | . | .. Rainfall Pattern E4_(C1 D3) D1 E3 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\underset{2 / 3 \mathrm{~W}}{\text { Lingsugar }}$ | - . | - | - | 114,082 | 88 | $\begin{gathered} 3 \\ (2) \end{gathered}$ | $(114)$ | $\stackrel{1}{(1)}$ | $(3)^{5}$ | $(-)$ | $\begin{array}{r} 28 \\ (22) \end{array}$ | $\begin{array}{r} 79 \\ (61) \end{array}$ |
| Bijapur |  |  |  |  |  |  |  |  |  |  |  |  |
| Badami | . . . | - | - | 184,052 | 132 | $\begin{array}{r} 31 \\ (22) \end{array}$ | $\begin{aligned} & 12 \\ & (9) \end{aligned}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $(\overline{-})$ | $\overline{(6)}$ | $\stackrel{8}{(7)}$ | $\begin{array}{r} 87 \\ (62) \end{array}$ |
| Raichur Rainfall Zones-II .. .. .. .. Rainfall Pattern E4 (C3 D1) D1 E3. |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Raichur | - - | . | - | 209,513 | 133 | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | (3) | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 7 \\ (5) \end{array}$ | $\begin{array}{r} 31 \\ (21) \end{array}$ | $\begin{aligned} & 102 \\ & \text { (67) } \end{aligned}$ |
| Deodurg | - • | . | - | 126,352 | 84 | (3) | $14$ (9) | $\begin{array}{r} 2 \\ (2) \end{array}$ | $\begin{array}{r} 8 \\ (5) \end{array}$ | (-) | $\begin{gathered} 22 \\ (14) \end{gathered}$ | 101 |
| Manvi | . . . | - | - | 156,846 | 88 | $\stackrel{2}{(1)}$ | $\begin{gathered} 4 \\ (3) \end{gathered}$ | $\underset{(1)}{2}$ | $\stackrel{6}{(3)}$ | $\square$ | $\begin{array}{r} 13 \\ (7) \end{array}$ | $\begin{aligned} & 151 \\ & (85) \end{aligned}$ |
| Gulbarga |  |  |  |  |  |  |  |  |  |  |  |  |
| Shorapur | - - | - | . | 175,607 | 94 | $\left(3^{5}\right.$ | $\begin{array}{r} 19 \\ (10) \end{array}$ | ${ }_{(2)}^{3}$ | $\begin{array}{r} 9 \\ (5) \end{array}$ | (1) | $\begin{aligned} & 14 \\ & (7) \end{aligned}$ | $\begin{aligned} & 135 \\ & (72) \end{aligned}$ |
| Shahapur | - . - | . | - | 159,347 | 109 | (3) | $\begin{array}{r} 7 \\ (5) \end{array}$ | $\begin{array}{r} 2 \\ (1) \end{array}$ | $\begin{array}{r} 3 \\ (2) \end{array}$ | $\begin{gathered} 0.2 \\ 0.2 \\ (0.1) \end{gathered}$ | 9 (6) | $\begin{gathered} 121 \\ (83) \end{gathered}$ |
| Raichur |  |  |  |  |  |  |  |  |  |  |  |  |
| Lingsugar 1/3W | . . . | - | - | 57,041 | 88 | $\stackrel{1}{(2)}$ | $\begin{gathered} 7 \\ (11) \end{gathered}$ | $\begin{aligned} & 1 \\ & (1) \end{aligned}$ | $\begin{gathered} 2 \\ (3) \end{gathered}$ | $(-)$ | $\begin{array}{r} 14 \\ (22) \end{array}$ | $\begin{array}{r} 40 \\ (61) \end{array}$ |
| Gulbarga |  |  |  |  |  |  |  |  |  |  |  |  |
| Yadgir | - - - | - | - | 196,259 | 115 | $\underset{(14)}{24}$ | $\begin{gathered} 19 \\ (11) \end{gathered}$ | ${ }_{(1)}^{2}$ | $\begin{array}{r} 7 \\ (4) \end{array}$ | $(-)$ | (4) | $\begin{aligned} & 113 \\ & (65) \end{aligned}$ |



## ANNEXURE 3 (Contd.)

$$
\text { area }={ }^{\prime} 000 \mathrm{ha} .
$$




ANNEXURE 3 (Contd.)
area $=$ '000 ha.
( ) = per cent of geographical area

| district/taluk | Population |  | forests | nac | cw | pp \& gl | $\mathrm{mtc} \& \mathrm{~g}$ | ${ }_{\text {fallow }}^{\text {lands }}$ | net areasown |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | total | per sq.km. |  |  |  |  |  |  |  |
|  | Rainfall Zone-VI (Contd.) |  |  | . .. |  | Rainfall Pattern D1 E3 (C1 D3) D1 E3 |  |  |  |
| Yelburga | 140,918 | 95 | (0.2) | (3) | (1) | ${ }_{(1)}^{2}$ | 二 | ${ }_{(12)}^{18}$ | (83) |
| Bellary |  |  |  |  |  |  |  |  |  |
| Hospet | 187,830 | 211 | (23) | (11) | (4) | (3) | (1) | ${ }_{(2)}^{2}$ | $\underset{(52)}{46}$ |
| Ratchur |  |  |  |  |  |  |  |  |  |
| Gangawathi | 178,814 | 135 | $\begin{gathered} \binom{0}{(2)} \end{gathered}$ | 18 (14) | (3) | (5) | (-) | ${ }_{(98}^{8}$ | (72) |
| Chitradurga | Rainfall Zone-VII |  | .. .. |  | - .. | Rainfall Pattern | D1 E3 | 1 D3) C1 D1 E2 |  |
| Davenagere | 276,747 | 289 | (2) | ${ }^{8}$ | (1) | ${ }^{5}$ |  | 35 | (44) |
| Harihar | 124,112 | 256 | 1 | 4 | (1) | ${ }^{2}$ |  | ${ }^{8}$ | 32 |
| Shimoga ${ }_{\text {a }}$ |  |  |  |  |  |  |  |  |  |
| Honnali 1/2E | 68,381 | 153 | ${ }^{5}$ | ${ }^{6}$ | 0.4 | 7 | $\square$ | 3 | 25 |
| Channagiri | 87,989 | 146 |  |  | 1 |  |  |  | ( 39 |
|  |  |  |  |  |  |  |  |  |  |
| Molkalmuru 1/2 S | 36,636 | 99 |  |  |  |  |  |  |  |
| Jaglur |  |  | (21) | ${ }^{(7)}$ | (1) | (18) |  | (4) | (49) |
| Jaglur | 97,340 | 101 | (14) | (5) | 0.3 $(0.3)$ | (10) | (3) | (18) | (58) |
| Chitradurga | 209,915 | 153 | ${ }_{(9)}^{12}$ | (9) | (1) | 19 (14) | (2) | (11) | 74 (54) |



ANNEXURE 3 (Contd.)




|  |  |  |  | Rainfall Zone－XI |  |  |  |  | Rainfall Pattern D1E3（B1C2E1）C31E3 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| North Kanara |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mundgod 1／2E |  | － | － | 22，232 | 67 | $\underset{(77)}{26}$ | (3) | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | $\begin{gathered} 0.5 \\ \text { (2) } \end{gathered}$ | $\overline{(1)}$ | $\underset{(5)}{2}$ | $\begin{array}{r} 4 \\ (12) \end{array}$ |  |
| Shimoga |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bhadravati 1／2W | ． | ． | ． | 101，719 | 295 | $\begin{gathered} 2 \\ (6) \end{gathered}$ | $\left(\begin{array}{c} 4 \\ (11) \end{array}\right.$ | $\underset{(6)}{2}$ | $\begin{array}{r} 12 \\ (33) \end{array}$ | $(\overline{)}$ | $\underset{(9)}{2}$ | $\begin{aligned} & 14 \\ & (38) \end{aligned}$ |  |
| Shikaripur |  | － | ． | 130，467 | 143 | $\begin{array}{r} 17 \\ (19) \end{array}$ | $\begin{aligned} & 11 \\ & (12) \end{aligned}$ | $\begin{array}{r} 9 \\ (10) \end{array}$ | $\begin{aligned} & 14 \\ & (15) \end{aligned}$ | $(\overline{-})$ | 8 （9） | $\begin{aligned} & 35 \\ & (35) \end{aligned}$ |  |
| Shimoga |  | － | － | 208，337 | 188 | $\begin{gathered} 15 \\ (14) \end{gathered}$ | $\begin{gathered} 12 \\ (11) \end{gathered}$ | $\begin{array}{r} 7 \\ (6) \end{array}$ | $\begin{array}{r} 29 \\ (29 \end{array}$ | $\begin{gathered} 0.4 \\ \text { (1) } \end{gathered}$ | $\begin{array}{r} 7 \\ (6) \end{array}$ | $\begin{array}{r} 29 \\ (26) \end{array}$ | \％ |
| Dharwar |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hangal | ． | － | － | 142，578 | 184 | $\begin{gathered} 8 \\ (11) \end{gathered}$ | (1) | （1） | $\begin{array}{r} 8 \\ (11) \end{array}$ | (1) | 3 $(4)$ | $\begin{array}{r} 55 \\ (71) \end{array}$ | $\stackrel{\text { aren }}{ }$ |
| Kkalghatgi |  | － | － | 80，723 | 117 | $\begin{gathered} 20 \\ (29) \end{gathered}$ | $\begin{gathered} 5 \\ (7) \end{gathered}$ | （3） | （1） | （－） | （3） | (57) | 多 |
| Hassan |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Balur | ． | － | ． | 121，578 | 148 | $\underset{(1)}{1}$ | $\begin{array}{r} 7 \\ (10) \end{array}$ | $\underset{(6)}{4}$ | $\begin{gathered} 11 \\ (15) \end{gathered}$ | $\begin{array}{r} 0.1 \\ (0.2) \end{array}$ | $\begin{array}{r} 16 \\ (22) \end{array}$ | $\begin{array}{r} 33 \\ (46) \end{array}$ | － |
| Alur |  | ． |  | 60，203 | 132 | $0.3$ (1) | $\begin{array}{r} 4 \\ 4 \\ (9) \end{array}$ | $\begin{array}{r} 7 \\ (17) \end{array}$ | $\begin{array}{r} 8 \\ (18) \end{array}$ | $\begin{gathered} 0.1 \\ (0.3) \end{gathered}$ | $\begin{array}{r} 8 \\ \text { (19) } \end{array}$ | $\begin{aligned} & 15 \\ & (35) \end{aligned}$ | 云 |
| Arkalgud | － | － | － | 127，960 | 189 | $\underset{(2)}{2}$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.3) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{array}{r} 36 \\ (56) \end{array}$ | 9 |
|  |  |  |  | Rainfall | ne－XII | $\cdots$ | ．． |  | Rainf | Pattern | （A1B | C1E3 | 芴 |
| Shimoga |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sorab 2／3E | － | － | － | 79，436 | 104 | $\begin{gathered} 16 \\ (22) \end{gathered}$ | $\begin{aligned} & 6 \\ & (8) \end{aligned}$ | $\begin{aligned} & 4 \\ & (6) \end{aligned}$ | $\begin{gathered} 10 \\ (14) \end{gathered}$ | $\begin{gathered} 1 \\ \text { (2) } \end{gathered}$ | $\xrightarrow[(20)]{15}$ | $\begin{array}{r} 20 \\ (28) \end{array}$ |  |
| N．Kanara |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mundgod 1／2 W |  | ． | － | 22，232 | 67 | $\begin{gathered} 26 \\ (77) \end{gathered}$ | (2) | $0.3$ (1) | （2） | （－） | （5） | $\begin{array}{r} 4 \\ (12) \end{array}$ |  |
| Haliyal |  | ． | － | 85，107 | 100 | $\begin{gathered} 61 \\ (72) \end{gathered}$ | $\begin{array}{r} 4 \\ (4) \end{array}$ | $\begin{gathered} 1 \\ 1 \\ (1) \end{gathered}$ | （1） | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{gathered} 16 \\ (19) \end{gathered}$ |  |
| Belgaum | － | － | － | 429，022 | 414 | $\begin{array}{r} 23 \\ (22) \end{array}$ | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\underset{(2)}{2}$ | $\underset{(2)}{2}$ | $(-)$ | $\begin{gathered} \mathbf{2} \\ (2) \end{gathered}$ | $\begin{array}{r} 67 \\ (64) \end{array}$ | \％ |




ANNEXURB 3 (Contd.)





ANNEXURE 4
Livestock Statistics (1966) of Taluks arranged according to State Rainfall Zone

|  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { Jnit }= \\ & (\mathrm{S})= \end{aligned}$ | number $\%$ of | in th otal liv | sands ocks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| district |  | cattle |  |  | faloes |  | sheep | goats | horses | mules | onkeys | camels | pigs |  |
| taluk | male | female | young <br> stock | male | female | young <br> stock |  |  | ponies |  |  |  |  | ock |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|  | Rainf | Zone | I |  |  | . | $\ldots$ | . | . | R | infall P | tterns-E | $4(\mathrm{C1D}$ | 1E3 |
| Bijapur |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bijapur | $\begin{gathered} 27 \\ (15) \end{gathered}$ | $\begin{gathered} 23 \\ (13) \end{gathered}$ | $\underset{(12)}{21}$ | $\begin{gathered} 1 \\ (0.3) \end{gathered}$ | $\begin{aligned} & 11 \\ & (6) \end{aligned}$ | $\begin{gathered} 8 \\ (5) \end{gathered}$ | $\begin{gathered} 44 \\ (24) \end{gathered}$ | $\stackrel{41}{(23)}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $(\overline{)}$ | $(\overline{( })$ | (-) | $\underset{(1)}{2}$ | 179 |
| Bagevadi | $\begin{array}{r} 26 \\ (18) \end{array}$ | $\begin{aligned} & 14 \\ & \text { (10) } \end{aligned}$ | $\begin{array}{r} 16 \\ (12) \end{array}$ | $\begin{gathered} 0.4 \\ (0.3) \end{gathered}$ | $\begin{aligned} & 12 \\ & \text { (9) } \end{aligned}$ | $\begin{array}{r} 9 \\ (7) \end{array}$ | $\begin{array}{r} 28 \\ (28) \end{array}$ | $\begin{gathered} 31 \\ (23) \end{gathered}$ | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | (-) | $\begin{gathered} 0.4 \\ (0.3) \end{gathered}$ | $(\bar{\square})$ | $\begin{gathered} 1 \\ (\cdot 4) \end{gathered}$ | 178 |
| Jamkhandi | (14) | $\begin{array}{r} 11 \\ (10) \end{array}$ | $\begin{gathered} 12 \\ (12) \end{gathered}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $\underset{(10)}{10}$ | (9) | $\begin{gathered} 21 \\ (21) \end{gathered}$ | $\begin{gathered} 22 \\ (22) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | (-) |  | (-) | ${ }_{(1)}^{1}$ | 101 |
| Bilji | $\begin{array}{r} 12 \\ (15) \end{array}$ |  | $(11)^{9}$ | $\begin{gathered} 0.1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{array}{r} 7 \\ (9) \end{array}$ | $\begin{array}{r} 5 \\ (7) \end{array}$ | $\begin{array}{r} 18 \\ (23) \end{array}$ | $\begin{gathered} 20 \\ (25) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0 \cdot 2) \end{gathered}$ | (-) | (-) | (二) | $\begin{aligned} & 0 \cdot 1 \\ & (\cdot 1) \end{aligned}$ | 80 |
| Madhol | $\begin{gathered} 13 \\ (14) \end{gathered}$ | $\begin{array}{r} 17 \\ (19) \end{array}$ | $\begin{array}{r} 8 \\ (9) \end{array}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\begin{aligned} & 8 \\ & (9) \end{aligned}$ | (7) | $\begin{array}{r} 19 \\ (21) \end{array}$ | $\begin{gathered} 17 \\ \text { (19) } \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.3) \end{gathered}$ | (-) | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | $(-)$ | (1) | 88 |
| Indi | $\begin{gathered} 26 \\ (15) \end{gathered}$ | $\begin{array}{r} 24 \\ (13) \end{array}$ | $\begin{array}{r} 21 \\ (12) \end{array}$ | $(0.4)$ | (7) | $\begin{aligned} & 10 \\ & \text { (9) } \end{aligned}$ | $\begin{array}{r} 30 \\ (17) \end{array}$ | $\begin{gathered} 50 \\ (28) \end{gathered}$ | (1) | (-) | (0.1) | (-) | $\begin{array}{r} 3 \\ \text { (2) } \end{array}$ | 179 |
| Sindgi | $\begin{gathered} 28 \\ (21) \end{gathered}$ | (11) | $\begin{aligned} & 18 \\ & (13) \end{aligned}$ | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | $\begin{aligned} & 11 \\ & (8) \end{aligned}$ | $\begin{gathered} 9 \\ (7) \end{gathered}$ | $\begin{gathered} 22 \\ (16) \end{gathered}$ | $\begin{gathered} 31 \\ (23) \end{gathered}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | (-) | $\begin{gathered} 0.4 \\ (0.3) \end{gathered}$ | $(-$ | ${ }_{(1)}^{1}$ | 137 |
| Muddebihal | $\begin{array}{r} 23 \\ (19) \end{array}$ | $\begin{array}{r} 12 \\ (10) \end{array}$ | $\begin{gathered} 13 \\ (11) \end{gathered}$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | $\begin{array}{r} 12 \\ (10) \end{array}$ | $\begin{gathered} 9 \\ (8) \end{gathered}$ | $\begin{gathered} 23 \\ (19) \end{gathered}$ | $\begin{gathered} 25 \\ (21) \end{gathered}$ | (1) | (-) | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | (-) | (1) | 119 |
| Hungund. | $(15)$ | $\begin{gathered} 13 \\ (9) \end{gathered}$ | $\begin{gathered} 13 \\ (9) \end{gathered}$ | $\begin{array}{r} 0.3 \\ (0.2) \end{array}$ | $\begin{aligned} & 14 \\ & \text { (9) } \end{aligned}$ | $\begin{aligned} & 10 \\ & \text { (7) } \end{aligned}$ | $\begin{array}{r} 35 \\ (24) \end{array}$ | $\begin{gathered} 39 \\ (26) \end{gathered}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(\square)$ | $\begin{gathered} 0.3 \\ (0.2) \end{gathered}$ | (-) | $\begin{aligned} & 1 \\ & \text { (1) } \end{aligned}$ | 148 |
| Bagalkot | $\begin{gathered} 18 \\ (17) \end{gathered}$ | $\begin{gathered} 10 \\ (10) \end{gathered}$ | $\begin{gathered} 11 \\ (10) \end{gathered}$ | $\begin{array}{r} 0.1 \\ (0 \cdot 1) \end{array}$ | $\begin{array}{r} 10 \\ (10) \end{array}$ | $\begin{gathered} 7 \\ (6) \end{gathered}$ | $\begin{array}{r} 26 \\ (25) \end{array}$ | $\begin{array}{r} 23 \\ (21) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.2) \end{array}$ | $(-)$ | $(\overline{( })$ | (-) | (1) | 106 |


| Raichur |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\operatorname{Lingsugur}_{2 / 3 W}$ |  | $\begin{gathered} 20 \\ (21) \end{gathered}$ | $\begin{gathered} 13 \\ (14) \end{gathered}$ | $\begin{gathered} 11 \\ (11) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | $\begin{gathered} 7 \\ (7) \end{gathered}$ | $\begin{array}{r} 6 \\ (6) \end{array}$ | $\begin{array}{r} 22 \\ (23) \end{array}$ | $\begin{array}{r} 16 \\ (16) \end{array}$ | $0.4$ (1) | $(-)$ | $[(-)$ | $(\overline{\text { ( }}$ | $(\bar{\square})$ | 100 |
| Bljapur . ${ }^{\text {a }}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Badami | - | $\begin{gathered} 25 \\ (15) \end{gathered}$ | $\begin{gathered} 17 \\ (10) \end{gathered}$ | $\begin{gathered} 17 \\ (10) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.2) \end{gathered}$ | $\begin{gathered} 16 \\ (10) \end{gathered}$ | 11 <br> (7) | $\begin{aligned} & 41 \\ & (24) \end{aligned}$ | $\begin{gathered} 39 \\ (23) \end{gathered}$ | $\begin{gathered} 0 \cdot 3 \\ (0 \cdot 2) \end{gathered}$ | $(\overline{-})$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | (-) | $\underset{(1)}{1}$ | 168 |
| Rainfall Zone-II .. .. .. .. .. . Rainfall Pattern-E4(C3D1)D1E3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Gulbarga


## Rainfall Zone-III

Rainfall Pattern-E4(C4)DIE3


```
Rainfall Zone-VI .. .. .. .. .. .. .. Rainfall Pattern-D1E3(C1D3)D1E3
```

| Bellary |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Bellary | $\begin{gathered} 17 \\ (24) \end{gathered}$ | $\begin{gathered} 10 \\ (14) \end{gathered}$ | $\begin{gathered} 7 \\ (9) \end{gathered}$ | $0.4$ (1) | $\begin{array}{r} 6 \\ (8) \end{array}$ | $\begin{array}{r} 3 \\ (4) \end{array}$ | $\begin{array}{r} 13 \\ (18) \end{array}$ | $\begin{array}{r} 14 \\ (19) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.4) \end{array}$ | $(-)$ | $\begin{array}{r} 0.3 \\ (0 \cdot 4) \end{array}$ | $(-)$ | $\begin{array}{r} 1 \\ (2) \end{array}$ | 73 |
| Siruguppa | $\begin{array}{r} 18 \\ (22) \end{array}$ | $\begin{array}{r} 9 \\ (11) \end{array}$ | $\begin{array}{r} 8 \\ (10) \end{array}$ | (1) | $\begin{array}{r} 7 \\ (8) \end{array}$ | $\begin{array}{r} 5 \\ (6) \end{array}$ | $\begin{array}{r} 21 \\ (26) \end{array}$ | $\begin{array}{r} 13 \\ (15) \end{array}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 3) \end{gathered}$ | $(-)$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $(-)$ | (1) | 83 |
| Raichur Sindhanur | $\begin{array}{r} 5 \\ (6) \end{array}$ | $\begin{array}{r} 8 \\ (10) \end{array}$ | $\begin{array}{r} 9 \\ (11) \end{array}$ | $\begin{array}{r} 0.2 \\ (0 \cdot 3) \end{array}$ | $\begin{array}{r} 8 \\ (10) \end{array}$ | $\begin{array}{r} 10 \\ (12) \end{array}$ | $\begin{array}{r} 23 \\ (28) \end{array}$ | $\begin{array}{r} 18 \\ (22) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.4) \end{array}$ | $(\overline{-})$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{array}{r} 0 \cdot 3 \\ (0 \cdot 4) \end{array}$ | 83 |
| Dharwar Nargund | $\begin{array}{r} 6 \\ (17) \end{array}$ | $\begin{array}{r} 3 \\ (8) \end{array}$ | $\begin{array}{r} 3 \\ (8) \end{array}$ | $\begin{gathered} 0.2 \\ (1) \end{gathered}$ | $\begin{array}{r} 3 \\ (8) \end{array}$ | $\begin{array}{r} 2 \\ (6) \end{array}$ | $\begin{array}{r} 10 \\ (28) \end{array}$ | $\begin{array}{r} 9 \\ (24) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 2) \end{gathered}$ | $(-)$ | $(\overline{\text { ( }}$ | $(-)$ | $(\overline{-})$ | 35 |
| Belgaum Saundatti | $\begin{gathered} 23 \\ (17) \end{gathered}$ | $\begin{gathered} 14 \\ (10) \end{gathered}$ | $\begin{gathered} 13 \\ (10) \end{gathered}$ | $\begin{gathered} 2 \\ (1) \end{gathered}$ | $\begin{array}{r} 15 \\ (11) \end{array}$ | 11 <br> (8) | $\begin{array}{r} 32 \\ (24) \end{array}$ | $\begin{array}{r} 25 \\ (18) \end{array}$ | $\begin{gathered} 1 \\ (0 \cdot 4) \end{gathered}$ | $(-)$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | $(-)$ | ${ }_{(1)}^{1}$ | 136 |
| Bellary Sandur | $\begin{gathered} 18 \\ (21) \end{gathered}$ | $\begin{gathered} 16 \\ (18) \end{gathered}$ | $\begin{gathered} 11 \\ (12) \end{gathered}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 2) \end{gathered}$ | $6$ (7) | $\begin{gathered} 3 \\ (4) \end{gathered}$ | $\begin{gathered} 18 \\ (21) \end{gathered}$ | $\begin{array}{r} 15 \\ (16) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 2) \end{array}$ | $(-)$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{array}{r} 1 \\ 0.4 \\ (0.4) \end{array}$ | 88 |
| Bellary Kudligi | $\begin{array}{r} 35 \\ (18) \end{array}$ | $\begin{array}{r} 24 \\ (12) \end{array}$ | $\begin{aligned} & 18 \\ & (9) \end{aligned}$ | $\begin{gathered} 0 \cdot 3 \\ (0 \cdot 2) \end{gathered}$ | $\begin{aligned} & 15 \\ & (7) \end{aligned}$ | $\begin{gathered} 9 \\ (4) \end{gathered}$ | $\begin{gathered} 66 \\ (33) \end{gathered}$ | $\begin{array}{r} 34 \\ (17) \end{array}$ | $(\bar{\square})$ | $(\overline{)}$ | $\begin{gathered} 0.4 \\ (0 \cdot 2) \end{gathered}$ | $(\square)$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | 201 |
| Chitrodirga Malakalmuru $\frac{1}{2} \mathrm{~N}$ | $\begin{gathered} 8 \\ (17) \end{gathered}$ | $\begin{gathered} 5 \\ (11) \end{gathered}$ | $3$ <br> (8) | $0 \cdot 5$ <br> (1) | $\begin{gathered} 3 \\ (6) \end{gathered}$ | $\begin{gathered} 2 \\ (4) \end{gathered}$ | $\begin{array}{r} 14 \\ (31) \end{array}$ | $\begin{array}{r} 9 \\ (21) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.4) \end{array}$ | $(-)$ | 0.2 <br> (1) | $(\overline{\text { ( }}$ | $(0 \cdot 3)$ | 44 |
| Bellary <br> Harpanabhalli | $\begin{aligned} & 25 \\ & (20) \end{aligned}$ | $\begin{aligned} & 19 \\ & (15) \end{aligned}$ | $\begin{aligned} & 15 \\ & (12) \end{aligned}$ | $\begin{aligned} & 0 \cdot 3 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & 17 \\ & (13) \end{aligned}$ | 10 (8) | $\begin{aligned} & 17 \\ & (21) \end{aligned}$ | $\begin{aligned} & 14 \\ & (11) \end{aligned}$ | $\underset{(0 \cdot 1)}{0 \cdot 2}$ | $(-)$ | $(-)$ | $\overline{(-)}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 2) \end{gathered}$ | 128 |
| Belgaum Ramdurg | $\begin{array}{r} 17 \\ (14) \end{array}$ | $\begin{gathered} 11 \\ (9) \end{gathered}$ | $\begin{aligned} & 10 \\ & (9) \end{aligned}$ | $\stackrel{1}{(1)}$ | $\begin{aligned} & 10 \\ & (8) \end{aligned}$ | $\begin{gathered} 7 \\ (6) \end{gathered}$ | $\begin{array}{r} 35 \\ (30) \end{array}$ | $\begin{array}{r} 26 \\ (22) \end{array}$ | $\begin{aligned} & 0 \cdot 2 \\ & (0 \cdot 2) \end{aligned}$ | $(-)$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | (二) | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | 117 |
| Gokak | $\begin{array}{r} 26 \\ (15) \end{array}$ | $\begin{array}{r} 13 \\ (8) \end{array}$ | $\begin{gathered} 12 \\ (7) \end{gathered}$ | $\begin{array}{r} 3 \\ (2) \end{array}$ | $\begin{array}{r} 21 \\ (12) \end{array}$ | $\begin{array}{r} 13 \\ (8) \end{array}$ | $\begin{gathered} 45 \\ (26) \end{gathered}$ | $\begin{gathered} 35 \\ (21) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.2) \end{gathered}$ | $(-)$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{)}$ | $\underset{(1)}{2}$ | 170 |
| Athni | $\begin{array}{r} 28 \\ (17) \end{array}$ | $\begin{array}{r} 19 \\ (12) \end{array}$ | $\begin{array}{r} 19 \\ (12) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $\begin{gathered} 19 \\ (12) \end{gathered}$ | $\begin{array}{r} 16 \\ (10) \end{array}$ | $\begin{array}{r} 24 \\ (15) \end{array}$ | $\begin{gathered} 35 \\ (21) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{-})$ | (—) | $(-)$ | $1$ | 163 |
| Raibag | $\begin{array}{r} 17 \\ (14) \end{array}$ | $\begin{array}{r} 9 \\ (8) \end{array}$ | $\begin{array}{r} 8 \\ (7) \end{array}$ | $(1)$ | $\begin{aligned} & 13 \\ & \text { (11) } \end{aligned}$ | $\begin{array}{r} 10 \\ (9) \end{array}$ | $\begin{array}{r} 37 \\ (30) \end{array}$ | $\begin{array}{r} 24 \\ (20) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(-\overline{)}$ | $(-)$ | $(-)$ | $\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}$ | 120 |

## RAINFALL AND CROPPING PATTERNS

|  |  |  |  |  |  |  |  |  |  | $\begin{array}{r} \text { nit }=1 \\ 1=1 \end{array}$ | umber $\%$ of | $\begin{aligned} & 0 \\ & \text { al li } \end{aligned}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|  | Rainfall Zone - VI (Contd.) |  |  |  |  |  |  |  |  | fall Pat | ern- | E3(C1 | )3D1E3 |  |
| Dharwar Navalgund <br> Belgaum | $\begin{array}{r} 15 \\ (26) \end{array}$ | $(10)^{6}$ | $(10)^{6}$ | $\underset{(1)}{0.4}$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{array}{r} 5 \\ (8) \end{array}$ | $\begin{array}{r} 8 \\ (14) \end{array}$ | $(10)$ | $\begin{gathered} 0.4 \\ (1) \end{gathered}$ | $(\overline{(-)}$ | (-) | (-) | (-) | 58 |
| Belgaum Chikodi | $\begin{array}{r} 30 \\ (10) \end{array}$ | $\left({ }^{9}\right)$ | $\begin{aligned} & 6 \\ & (2) \end{aligned}$ | $(1)$ | $\begin{gathered} 42 \\ (14) \end{gathered}$ | $\begin{aligned} & 21 \\ & (7) \end{aligned}$ | ${ }_{(47)}^{140}$ | $\begin{gathered} 46 \\ (15) \end{gathered}$ | $(0.4)$ | $(\overline{-})$ | (-) |  | $(1)^{3}$ | 300 |
| Dharwar <br> Gadag <br> Ron | $\begin{array}{r} 18 \\ (19) \\ 20 \end{array}$ | $\begin{aligned} & { }^{8}{ }^{(9)} \\ & 10 \end{aligned}$ | 8 <br> 9 <br> 9 | $\begin{gathered} 0.2 \\ (0.2) \\ 0.4 \end{gathered}$ | $\begin{gathered} 10 \\ (11) \\ (13 \end{gathered}$ | 6 <br>  <br> 6 <br> 8 <br> 8 | $\begin{aligned} & 25 \\ & (27) \\ & 21 \end{aligned}$ | $\begin{aligned} & 17 \\ & (18) \\ & 22 \end{aligned}$ | $\begin{gathered} 0.2 \\ (0.3) \\ 0.3 \end{gathered}$ | $(\overline{-})$ | $\begin{gathered} 0.4 \\ 0.2 \\ 0.2 \end{gathered}$ | (-) | $\begin{array}{r} 0.4 \\ (0.4) \\ 0.4 \end{array}$ | 93 105 |
| Ralchur Koppal. | $\begin{aligned} & \text { (21) } \\ & 24 \\ & (24) \end{aligned}$ | $\begin{array}{r} (9) \\ \quad 14 \\ (14) \end{array}$ | $\begin{array}{r} (9) \\ 12 \\ (12) \end{array}$ | $\begin{array}{r} (0.4) \\ 1 \\ (1) \end{array}$ | $\begin{array}{r} (12) \\ 9 \\ (9) \end{array}$ | $\begin{array}{r} (8) \\ \mathbf{8}^{6} \\ (6) \end{array}$ | $\begin{array}{r} (20) \\ 17 \\ (18) \end{array}$ | $\begin{gathered} (21) \\ (16 \\ (16) \end{gathered}$ | $(0 \cdot 3)$ $(-)$ | $(-)$ | $\begin{gathered} (0.2) \\ 0.3 \\ (0.3) \end{gathered}$ | (-) | $\begin{array}{r} (0.4) \\ 0.3 \\ (0.3) \end{array}$ | 99 |
| Bellary Mallapuram | $(22)^{6}$ | $(18)^{5}$ | $(13)^{3}$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $\underset{(8)}{2}$ | $\stackrel{1}{(4)}$ | $\begin{array}{r} 7 \\ (25) \end{array}$ | $(10)$ | (-) | (-) | (-) | ( $\square$ | (-) | 27 |
| Hadagali | $\begin{gathered} 21 \\ (21) \end{gathered}$ | $\begin{gathered} 14 \\ (15) \end{gathered}$ | $\begin{gathered} 12 \\ (12) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\begin{gathered} 10 \\ (11) \end{gathered}$ | $\underset{(7)}{6}$ | $\underset{(21)}{20}$ | $\begin{gathered} 12 \\ (12) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | (-) | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | (-) | $\begin{gathered} 0.1 \\ (0 \cdot 1) \end{gathered}$ | 96 |
| Dharwar Mundargi | $\begin{array}{r} 13 \\ (21) \end{array}$ | $\begin{array}{r} 7 \\ (11) \end{array}$ | $\begin{array}{r} 7 \\ (\mathrm{II}) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (\cdot 2) \end{gathered}$ | $(8)$ | $\begin{array}{r} 3 \\ (5) \end{array}$ | $\begin{array}{r} 14 \\ (22) \end{array}$ | $\begin{gathered} 13 \\ (21) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\square)$ | $\begin{gathered} 0.4 \\ (1) \end{gathered}$ | (-) | $\underset{(0 \cdot 3)}{0}$ | 62 |
| Raichur Kushtagi | $\underset{(23)}{25}$ | $\begin{gathered} 15 \\ (14) \end{gathered}$ | $\stackrel{16}{(15)}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | $\begin{gathered} 8 \\ \text { (7) } \end{gathered}$ | (6) | $\begin{aligned} & 18 \\ & (16) \end{aligned}$ | $\begin{gathered} 19 \\ (17) \end{gathered}$ | 1 $(1)$ | (-) | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | 109 |
| Yelburga | $\begin{array}{r} 20 \\ (25) \end{array}$ | $\begin{gathered} 10 \\ (12) \end{gathered}$ | $\begin{array}{r} 10 \\ \text { (12) } \end{array}$ | $\begin{gathered} 0.3 \\ (0.4) \end{gathered}$ | $\begin{array}{r} 7 \\ (9) \end{array}$ | $\begin{gathered} 5 \\ (6) \end{gathered}$ | $\begin{array}{r} 16 \\ (18) \end{array}$ | $\begin{gathered} 13 \\ (16) \end{gathered}$ | (1) | $(-)$ | $0.4$ (1) | (-) | $\begin{aligned} & 0.2 \\ & (0.2) \end{aligned}$ | 82 |
| Bellary <br> Hospet | $\begin{array}{r} 19 \\ (19) \end{array}$ | $\begin{array}{r} 13 \\ (13) . \end{array}$ | $\begin{gathered} 11 \\ (11) \end{gathered}$ | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | $\begin{gathered} 8 \\ (8) \end{gathered}$ | $\begin{gathered} 5 \\ (5) \end{gathered}$ | $\begin{gathered} 22 \\ (22) \end{gathered}$ | $\underset{(20)}{20}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | $(\overline{( })$ | $\begin{gathered} 0.3 \\ (0.3) \end{gathered}$ | $(\overline{-})$ | (1) | 101 |


| Raichur |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Gaugawathi | $\begin{gathered} 28 \\ (24) \end{gathered}$ | $\begin{array}{r} 16 \\ (14) \end{array}$ | $\begin{array}{r} 14 \\ (12) \end{array}$ | $\stackrel{1}{(1)}$ | $\begin{aligned} & 10 \\ & (8) \end{aligned}$ | $\underset{(5)}{6}$ | $\begin{gathered} 24 \\ (21) \end{gathered}$ | $\begin{gathered} 17 \\ (14) \end{gathered}$ | $\begin{array}{r} 0.4 \\ (0 \cdot 3) \end{array}$ | $(-)$ | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | $(-)$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | 117 |
|  | Rainfall Zone - VII |  |  |  | .. | .. | .. | .. | Rainfall Pattern-D1E3(CID3)C1DIE2 |  |  |  |  |  |
| Chitradurga |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Davanagere | $(22)$ | $\begin{array}{r} 22 \\ (18) \end{array}$ | $\begin{gathered} 18 \\ (18) \end{gathered}$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | $\begin{gathered} 18 \\ (15) \end{gathered}$ | $\begin{aligned} & 10 \\ & (8) \end{aligned}$ | $\begin{gathered} 13 \\ (10) \end{gathered}$ | $\begin{gathered} 16 \\ (14) \end{gathered}$ | $\left(\begin{array}{l} 1 \\ (0 \cdot 4) \end{array}\right.$ | $\overline{(-)}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{-})$ | (2) | 121 |
| Haribar | $\begin{gathered} 11 \\ (22) \end{gathered}$ | $\begin{array}{r} 7 \\ (14) \end{array}$ | $\begin{gathered} 4 \\ (8) \end{gathered}$ | $(0 \cdot \overline{1})$ | $\begin{array}{r} 9 \\ (18) \end{array}$ | $\begin{array}{r} 5 \\ (10) \end{array}$ | $\begin{array}{r} 7 \\ \text { (14) } \end{array}$ | $\begin{gathered} 7 \\ (14) \end{gathered}$ | $\begin{gathered} 0.3 \\ (0.4) \end{gathered}$ | (-) | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (\cdot 2) \end{aligned}$ | 51 |
| Shimoga |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Honnalite | $\begin{gathered} 12 \\ (21) \end{gathered}$ | $(18)$ | $\begin{array}{r} 7 \\ (13) \end{array}$ | $\begin{aligned} & 0.3 \\ & \text { (1) } \end{aligned}$ | $\begin{array}{r} 9 \\ (16) \end{array}$ | $\begin{array}{r} 4 \\ (7) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{gathered} 7 \\ (12) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ |  | (1) | $(-)$ | $(\overline{-})$ | 57 |
| Channagiri $\frac{1}{2} \mathrm{E}$ | $\begin{array}{r} 15 \\ (23) \end{array}$ | $\begin{array}{r} 13 \\ (19) \end{array}$ | $\begin{array}{r} 9 \\ (13) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | $\begin{gathered} 10 \\ (15) \end{gathered}$ | $\begin{gathered} 5 \\ (7) \end{gathered}$ | $\begin{gathered} 7 \\ (10) \end{gathered}$ | $\begin{gathered} 8 \\ (13) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0 \cdot 4) \end{gathered}$ | (-) | $(-)$ | (-) | $\stackrel{\square}{(-)}$ | 66 |
| Chitradurga |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Malakalmura | $\frac{1}{2} \mathrm{~S} 8$ | 5 | 3 | 0.4 | 3 | 2 | 14 | 9 | 0.2 | - | 0.2 |  | 0.2 | 44 |
|  | (17) | (11) | (8) | (1) | (6) | (4) | (31) | (21) | (0.4) | (-) | (1) | (-) | (0.3) |  |
| Jagalur | $\begin{array}{r} 19 \\ (20) \end{array}$ | $\begin{aligned} & 14 \\ & (15) \end{aligned}$ | $\begin{array}{r} 10 \\ (10) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $\begin{array}{r} 10 \\ (10) \end{array}$ | $\begin{array}{r} 6 \\ 6 \end{array}$ | $\begin{gathered} 26 \\ (28) \end{gathered}$ | $\begin{gathered} 10 \\ (10) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\overline{(-)}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | (-) | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | 95 |
| Chitradurga | (19) | $\begin{aligned} & 23 \\ & (14) \end{aligned}$ | $\begin{aligned} & 15 \\ & \text { (10) } \end{aligned}$ | $\begin{array}{r} 1 \\ (0 \cdot 3) \end{array}$ | $\begin{array}{r} 19 \\ (11) \end{array}$ | $11$ | $\begin{gathered} 38 \\ (23) \end{gathered}$ | $\begin{array}{r} 24 \\ (15) \end{array}$ | $\begin{gathered} 1 \\ (0 \cdot 4) \end{gathered}$ | (-) | $\begin{gathered} 1 \\ (0 \cdot 3) \end{gathered}$ | (-) | $\begin{gathered} 1 \\ (0.3) \end{gathered}$ | 164 |
| Kolar (19) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Kolar | $\begin{array}{r} 19 \\ (12) \end{array}$ | $\begin{gathered} 22 \\ (14) \end{gathered}$ | $\begin{aligned} & 10 \\ & (7) \end{aligned}$ | $\begin{gathered} 1 \\ (0 \cdot 3) \end{gathered}$ | $\underset{(8)}{12}$ | $\begin{gathered} 8 \\ (5) \end{gathered}$ | $\begin{array}{r} 59 \\ (38) \end{array}$ | $\underset{(14)}{22}$ | $\begin{gathered} 0.2 \\ (0.1) \end{gathered}$ | $(\overline{-})$ | $(0.3)^{1}$ | (-) | $(1)^{2}$ | 156 |
| Malur | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\begin{gathered} 23 \\ (22) \end{gathered}$ | $\begin{gathered} 11 \\ (10) \end{gathered}$ | $\begin{gathered} 0 \cdot 4 \\ (0.3) \end{gathered}$ | $\begin{array}{r} 7 \\ (7) \end{array}$ | $\begin{array}{r} 3 \\ \mathbf{3} \\ \text { (3) } \end{array}$ | $\begin{array}{r} 37 \\ (35) \end{array}$ | $\begin{array}{r} 13 \\ (12) \end{array}$ | $\begin{aligned} & 1 \\ & 1 \\ & (1) \end{aligned}$ | (二) | $\begin{gathered} 0.4 \\ (0.3) \end{gathered}$ | (-) | (1) | 104 |
| Bangalore |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hoskote | $\begin{aligned} & 13 \\ & (9) \end{aligned}$ | $\begin{array}{r} 26 \\ (18) \end{array}$ | $\begin{gathered} 13 \\ (9) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\begin{aligned} & 13 \\ & (9) \end{aligned}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 50 \\ (34) \end{array}$ | $\begin{array}{r} 23 \\ \text { (16) } \end{array}$ | $\begin{array}{r} 0.2 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{gathered} 1 \\ (0.4) \end{gathered}$ | ( | $\begin{gathered} 1 \\ (0.4) \end{gathered}$ | 146 |
| Tumkur |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C. N. Halley | $\begin{gathered} 24 \\ (15) \end{gathered}$ | $\begin{array}{r} 23 \\ (15) \end{array}$ | $\begin{aligned} & 13 \\ & (8) \end{aligned}$ | $\begin{array}{r} 1 \\ (0.3) \end{array}$ | $\begin{array}{r} 8 \\ (5) \end{array}$ | $\stackrel{4}{(3)}$ | $\begin{array}{r} 58 \\ (37) \end{array}$ | $\begin{array}{r} 25 \\ (16) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.1) \end{array}$ | (-) | $\begin{gathered} 0.2 \\ (0.1) \end{gathered}$ | (-) | ${ }_{(1)}^{1}$ | 157 |
| Koratgere $\frac{1}{2} \mathrm{~N}$ | $\begin{array}{r} 8 \\ (15) \end{array}$ | $\begin{array}{r} 10 \\ (18) \end{array}$ | $\begin{array}{r} 5 \\ (10) \end{array}$ | $\begin{array}{r} 0.1 \\ (0.2) \end{array}$ | $\begin{array}{r} 3 \\ 3 \\ (5) \end{array}$ | (3) | $\begin{aligned} & 17 \\ & (31) \end{aligned}$ | $\begin{array}{r} 8 \\ (16) \end{array}$ | $\begin{aligned} & 0.1 \\ & (0.2) \end{aligned}$ | (-) | $\begin{gathered} 0.2 \\ (0.3) \end{gathered}$ | (-) | $\begin{gathered} 0.4 \\ (1) \end{gathered}$ | 54 |
| Madhugiri | $\begin{gathered} 25 \\ (13) \end{gathered}$ | $\begin{aligned} & 18 \\ & \text { (9) } \end{aligned}$ | $\begin{aligned} & 11 \\ & (6) \end{aligned}$ | $\begin{gathered} 2 \\ (1) \end{gathered}$ | $\begin{aligned} & 12 \\ & (6) \end{aligned}$ | $\begin{array}{r} 6 \\ \text { (3) } \end{array}$ | $\begin{array}{r} 91 \\ (46) \end{array}$ | $\begin{array}{r} 28 \\ (14) \end{array}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $\overline{(-)}$ | (1) | (-) | $(1)^{3}$ | 198 |

ANNEXURE 4 (Contd.)


| Dharwar |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Ranebennur | $\begin{array}{r} 21 \\ (14) \end{array}$ | $\begin{array}{r} 11 \\ (8) \end{array}$ | $\begin{array}{r} 9 \\ (6) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 1) \end{array}$ | $\begin{array}{r} 17 \\ (12) \end{array}$ | $\begin{array}{r} 8 \\ (5) \end{array}$ | $\begin{array}{r} 54 \\ (38) \end{array}$ | $\begin{array}{r} 21 \\ (15) \end{array}$ | $\stackrel{1}{(1)}$ | $\overline{(-)}$ | $\begin{aligned} & 0 \cdot 3 \\ & (0 \cdot 2) \end{aligned}$ | $(-)$ | $\begin{aligned} & 0.3 \\ & (0 \cdot 2) \end{aligned}$ |

Rainfall Zone - VIII .. .. .. .. .. .. Rainfall Pattern-DIE3 (C2D2)CIE3

| Dharwar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Shiggaon | $\begin{array}{r} 22 \\ (29) \end{array}$ | $\begin{array}{r} 13 \\ (16) \end{array}$ | $\begin{array}{r} 14 \\ (18) \end{array}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{array}{r} 9 \\ (11) \end{array}$ | $\begin{gathered} 6 \\ (7) \end{gathered}$ | $\begin{gathered} 4 \\ (5) \end{gathered}$ | $\begin{gathered} 9 \\ (12) \end{gathered}$ | $0.4$ <br> (1) | $(-)$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 1) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 1) \end{aligned}$ | 77 |
| Belgaum |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Bailhongal . | $\begin{array}{r} 22 \\ (23) \end{array}$ | $\begin{gathered} 11 \\ (11) \end{gathered}$ | $\begin{array}{r} 10 \\ (11) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{array}{r} 22 \\ (22) \end{array}$ | $\begin{array}{r} 13 \\ (13) \end{array}$ | $\begin{array}{r} 1 \\ (1) \end{array}$ | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\begin{gathered} 0.4 \\ (0 \cdot 4) \end{gathered}$ | $(\overline{(-)}$ | $(-)$ | (- | $8$ (8) | 98 |
| Dharwar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Dharwar | $\begin{array}{r} 25 \\ (27) \end{array}$ | $\begin{array}{r} 13 \\ (15) \end{array}$ | $\begin{array}{r} 14 \\ (16) \end{array}$ | $\begin{array}{r} 1 \\ (1) \end{array}$ | $\begin{array}{r} 15 \\ (17) \end{array}$ | $\begin{array}{r} 9 \\ (10) \end{array}$ | $\begin{array}{r} 5 \\ (5 \end{array}$ | $\begin{array}{r} 8 \\ (9) \end{array}$ | $\begin{array}{r} 0.2 \\ (0 \cdot 3) \end{array}$ | $(\text { (一) }$ | $(-)$ | $(\overline{-})$ | $(\overline{)}$ | 92 |
| Hubli. | $\begin{array}{r} 15 \\ (26) \end{array}$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{array}{r} 8 \\ (13) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 3) \end{array}$ | $\begin{array}{r} 10 \\ (18) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{gathered} 3 \\ (5) \end{gathered}$ | $\begin{gathered} 8 \\ (14) \end{gathered}$ | $\begin{gathered} 0 \cdot 3 \\ (1) \end{gathered}$ | $(-)$ | (-) | $(-)$ | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | 58 |
| Kundagol | $\begin{array}{r} 14 \\ (29) \end{array}$ | $\begin{array}{r} 5 \\ (11) \end{array}$ | $\begin{array}{r} 5 \\ (11) \end{array}$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 3) \end{array}$ | $\begin{array}{r} 9 \\ (18) \end{array}$ | $\begin{array}{r} 5 \\ (11) \end{array}$ | $\begin{array}{r} 5 \\ (11) \end{array}$ | $\begin{array}{r} 4 \\ (9) \end{array}$ | $0.4$ (1) | $(-)$ | (-) | $(\overline{-})$ | $(-)$ | 48 |
| Haveri | $\begin{array}{r} 23 \\ (24) \end{array}$ | $\begin{array}{r} 13 \\ (13) \end{array}$ | (11) | (1) | $\begin{aligned} & 13 \\ & (14) \end{aligned}$ | $\begin{gathered} 8 \\ (8) \end{gathered}$ | $\begin{array}{r} 18 \\ (17) \end{array}$ | $\begin{gathered} 12 \\ (12) \end{gathered}$ | $\begin{gathered} 0-4 \\ (0 \cdot 4) \end{gathered}$ | $(-)$ | $(-)$ | $(-)$ | $\begin{gathered} 0.3 \\ (0.4) \end{gathered}$ | 98 |
| Savanur | $\begin{array}{r} 22 \\ (28) \end{array}$ | $\begin{array}{r} 13 \\ (16) \end{array}$ | $\begin{array}{r} 14 \\ (18) \end{array}$ | ${ }^{1}$ | $(12)^{9}$ | ${ }_{(7)}{ }^{6}$ | $(5)^{4}$ | $(12)^{9}$ | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $(\overline{)}$ | $(-)$ | $(\boxed{(-)}$ | $(\overline{)}$ | 77 |
| Dharwar Shirahatti | $\begin{array}{r} 17 \\ (21) \end{array}$ | $\begin{array}{r} 10 \\ (13) \end{array}$ | $\begin{array}{r} 10 \\ (13) \end{array}$ | $\begin{array}{r} 0.2 \\ (0 \cdot 2) \end{array}$ | $\begin{array}{r} 9 \\ (12) \end{array}$ | $6^{5}$ | $\begin{array}{r} 15 \\ (19) \end{array}$ | $\begin{array}{r} 12 \\ (15) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 3) \end{gathered}$ | $(\square)$ | $\begin{array}{r} 0.2 \\ (0.3) \end{array}$ | $(\overline{-})$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 2) \end{array}$ | 79 |
| Belgaum Hukkeri | 24 $(15)$ | $\begin{gathered} 9 \\ (5) \end{gathered}$ | $\begin{gathered} 6 \\ (4) \end{gathered}$ | $5$ <br> (3) | $\begin{gathered} 26 \\ (16) \end{gathered}$ | $14$ <br> (9) | $\begin{aligned} & 42 \\ & (26) \end{aligned}$ | $\begin{aligned} & 28 \\ & (17) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 1) \end{aligned}$ | $(\overline{)}$ | $(-)$ | $(-)$ | $8$ <br> (5) | 162 |
|  | Rainfall Zone-IX |  |  | . | $\cdots$ | . | . | . |  | Rainfall Pattern-D1E3 (C2D2)C1D1E2 |  |  |  |  |
| Bangalore |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Magadi | $\begin{array}{r} 14 \\ (8) \end{array}$ | $\begin{array}{r} 52 \\ (30) \end{array}$ | $\begin{array}{r} 23 \\ (14) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 1) \end{array}$ | $\begin{array}{r} 9 \\ (5) \end{array}$ | $\begin{array}{r} 4 \\ (3) \end{array}$ | $\begin{array}{r} 45 \\ (26) \end{array}$ | $\begin{array}{r} 23 \\ (13) \end{array}$ | $\begin{array}{r} 0.3 \\ (0 \cdot 2) \end{array}$ | $(-)$ | $(0 \cdot 3)$ | $(-)$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | 173 |
| Davanhalli | $\begin{array}{r} 13 \\ (13) \end{array}$ | $\begin{array}{r} 14 \\ (15) \end{array}$ | $\begin{array}{r} 7 \\ (7) \end{array}$ | $\begin{array}{r} 1 \\ (1) \end{array}$ | $\begin{array}{r} 11 \\ (11) \end{array}$ | $\begin{array}{r} 5 \\ (5) \end{array}$ | $\begin{array}{r} 34 \\ (35) \end{array}$ | $\begin{gathered} 11 \\ (11) \end{gathered}$ | $\begin{array}{r} 0-2 \\ (0 \cdot 2) \end{array}$ | $(-)$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $(-)$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | 98 |

ANNEXURE 4 (Contd.)


Rainfall Zone-X .. .. .. : .. .. Rainfall Pattern - D1E3(C3D1)C1E3

| Shimoga |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Bhadravati ; <br> $\frac{1}{2} \mathrm{E}$ | $\begin{array}{r} 11 \\ (29) \end{array}$ | $\begin{array}{r} 9 \\ (24) \end{array}$ | $(17)$ | $\begin{gathered} 0.1 \\ (0.3) \end{gathered}$ | $(11)$ | $\begin{array}{r} 2 \\ (5) \end{array}$ | $\underset{(4)}{2}$ | $\begin{gathered} 3 \\ (8) \end{gathered}$ | $\begin{gathered} 0.2 \\ (1) \end{gathered}$ | $(-)$ | $\begin{gathered} 0.1 \\ (0 \cdot 1) \end{gathered}$ | $\overline{(-)}$ | $\begin{gathered} 0.1 \\ (0 \cdot 3) \end{gathered}$ | 37 |
| Cbannagiri | 15 | 13 | 8 | 0.4 | 10 | 5 | ${ }^{7}$ | ${ }^{8}$ | $0.3$ | ( |  | $(\overline{)}$ | (-) | 66 |
| $\frac{1}{2} \mathrm{~W}$ | (23) | (19) | (13) | (0.4) | (15) | (7) | (10) | (13) | $(0 \cdot 4)$ | (-) | $(-)$ | $(-)$ | $(-)$ |  |
| Honnali $\frac{1}{2} \mathrm{~W}$ | $\begin{aligned} & 12 \\ & (21) \end{aligned}$ | $\begin{array}{r} 10 \\ \text { (18) } \end{array}$ | $\begin{array}{r} 8 \\ \text { (13) } \end{array}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{array}{r} 9 \\ (16) \end{array}$ | $\begin{gathered} 4 \\ (7) \end{gathered}$ | $\left(\begin{array}{r} 6 \\ (10) \end{array}\right.$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{-})$ | (2) | (二) | $(\overline{-})$ | 57 |
| Dharwar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Byadgi | $\begin{gathered} 12 \\ (25) \end{gathered}$ | $\begin{array}{r} 8 \\ (1)^{8} \end{array}$ | $(12)^{6}$ | $\underset{(1)}{0.4}$ | $\begin{gathered} 7 \\ (15) \end{gathered}$ | $\stackrel{4}{(8)}$ | $\begin{aligned} & 4 \\ & (8) \end{aligned}$ | $\begin{gathered} 7 \\ (15) \end{gathered}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 2) \end{gathered}$ | $(\overline{( })$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $\begin{gathered} 0.1 \\ (0.2) \end{gathered}$ | 50 |
| Hirekerur | $\begin{array}{r} 25 \\ (22) \end{array}$ | $\begin{gathered} 18 \\ (16) \end{gathered}$ | $\begin{aligned} & 13 \\ & \text { (12) } \end{aligned}$ | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | $\begin{gathered} 17 \\ (15) \end{gathered}$ | $\begin{aligned} & 8 \\ & (7) \end{aligned}$ | $\begin{gathered} 14 \\ (12) \end{gathered}$ | $\begin{array}{r} 16 \\ (15) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(-)$ | $\begin{gathered} 0.1 \\ 0 \\ (0.1) \end{gathered}$ | $(\overline{-})$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | 111 |
|  | Rai | 12 Zon |  |  |  |  |  |  |  | infa | attern | D1E3 | 1 C 2 E | 1E3 |
| N. Kanara Mundgod $\frac{1}{2}$ $\qquad$ | $(34)^{4}$ | $\begin{array}{r} 3 \\ (25)^{3} \end{array}$ | $(23)^{3}$ | $\begin{array}{r} 1 \\ (4) \end{array}$ | $\begin{gathered} 1 \\ (5) \end{gathered}$ | $\stackrel{1}{(5)}$ | $\begin{gathered} 0.2 \\ (1) \end{gathered}$ | $\begin{gathered} 0.2 \\ \text { (1) } \end{gathered}$ | (-) | (-) | $(-)$ | $(-)$ | (-) | 13 |
| Shimoga <br> Bhadrawathi $\frac{1}{2}$ W | $\underset{(29)}{11}$ | $\left(\begin{array}{c} 94 \end{array}\right.$ | $(17)$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 3) \end{gathered}$ | (11) | $\begin{gathered} 2 \\ (5) \end{gathered}$ | $\stackrel{2}{(5)}$ | $\underset{(5)}{2}$ | $\begin{aligned} & 0.2 \\ & \text { (1) } \end{aligned}$ | (-) | (-) | $(\overline{)}$ | $\begin{gathered} 0.1 \\ (0.3) \end{gathered}$ | 37 |
| Shikarpur . | $\begin{gathered} 26 \\ (27) \end{gathered}$ | $\begin{gathered} 23 \\ (24) \end{gathered}$ | $\begin{gathered} 18 \\ (18) \end{gathered}$ | (1) | $\begin{aligned} & 11 \\ & \text { (11) } \end{aligned}$ | $\begin{gathered} 6 \\ \text { (6) } \end{gathered}$ | $\begin{gathered} 1 \\ \text { (1) } \end{gathered}$ | $\begin{gathered} 11 \\ (11) \end{gathered}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $(-)$ | $(-)$ | $(\overline{(-)}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | 97 |
| Shimoga | $\begin{array}{r} 24 \\ (23) \end{array}$ | $\begin{array}{r} 27 \\ (25) \end{array}$ | $\begin{array}{r} 22 \\ (20) \end{array}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{gathered} 12 \\ (11) \end{gathered}$ | $\begin{gathered} 7 \\ (7) \end{gathered}$ | $\begin{gathered} 6 \\ (6) \end{gathered}$ | $\begin{gathered} 8 \\ (8) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\overline{(-)}$ | $(-)$ | $(\overline{-})$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | 108 |
| Dharwar Hangal | $\begin{gathered} 28 \\ (29) \end{gathered}$ | $\begin{array}{r} 17 \\ (18) \end{array}$ | $\begin{array}{r} 16 \\ (17) \end{array}$ | (1) | $(10)$ | $\stackrel{6}{6}$ | $\mathbf{6}_{6}^{6}$ | (11) | $\begin{gathered} 0.3 \\ (0.3) \end{gathered}$ | (-) | $\overline{(-)}$ | $(-)$ | $\begin{gathered} 0.2 \\ (0 \cdot 2) \end{gathered}$ | 95 |
| Kalghatgi | $\begin{array}{r} 20 \\ (32) \end{array}$ | $\begin{array}{r} 13 \\ (19) \end{array}$ | (22) | $\begin{array}{r} 2 \\ (3) \end{array}$ | $\begin{array}{r} 7 \\ (11) \end{array}$ | $\begin{aligned} & 5 \\ & (7) \end{aligned}$ | $\begin{aligned} & 1 \\ & (1) \end{aligned}$ | (5) ${ }^{3}$ | (-) | (-) | (-) | $(-)$ | $(\bar{\prime})$ | 64 |
| Hassan Belur | $\begin{gathered} 30 \\ (28) \end{gathered}$ | $\begin{array}{r} 36 \\ (33) \end{array}$ | $\begin{gathered} 23 \\ (21) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.3) \end{gathered}$ | $\begin{gathered} 3 \\ (3) \end{gathered}$ | $\begin{gathered} 2 \\ (2) \end{gathered}$ | (4) | $\stackrel{8}{(7)}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | (-) | (-) | (-) | $\underset{(2)}{2}$ | 108 |
| Alur | $\begin{array}{r} 16 \\ (29) \end{array}$ | $\begin{array}{r} 18 \\ (33) \end{array}$ | $\begin{array}{r} 12 \\ (22) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.4) \end{array}$ | $\begin{array}{r} 3 \\ 3 \\ (5) \end{array}$ | $\begin{array}{r} 2 \\ \mathbf{2} \\ \hline \end{array}$ | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | $\begin{array}{r} 3 \\ (6) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | (-) | (-) | $(\overline{)}$ | $\begin{aligned} & 0.3 \\ & (1) \end{aligned}$ | 54 |


| ANNEXURE 4 （Contd．） |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  | ) | $\begin{aligned} & \text { Unit = } \\ & \% \text { of } \end{aligned}$ | numbe otal liv |  | N |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |  |
|  | Rainfall Zone－XI－Contd． |  |  |  | ． | ． | ． |  |  | Rainfall Pattern－D1E3（B1C2El）C1E3 |  |  |  |  |  |
| Arkalgud ． | $\begin{array}{r} 16 \\ (15) \end{array}$ | $\begin{array}{r} 36 \\ (33) \end{array}$ | $\begin{array}{r} 16 \\ (14) \end{array}$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $\begin{array}{r} 9 \\ (8) \end{array}$ | $\begin{array}{r} 4 \\ (4) \end{array}$ | $\begin{gathered} 12 \\ (11) \end{gathered}$ | $\begin{gathered} 15 \\ (14) \end{gathered}$ | $\stackrel{1}{(0 \cdot 4)}$ | $(\overline{(-)}$ | $(-)$ | $(-)$ | $\stackrel{1}{(1)}$ | 110 |  |
| Hassan |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Belur | $\begin{array}{r} 30 \\ (28) \end{array}$ | $\begin{array}{r} 36 \\ (33) \end{array}$ | $\begin{array}{r} 23 \\ (21) \end{array}$ | $\begin{array}{r} 0.4 \\ (0 \cdot 3) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\stackrel{2}{(2)}$ | $\begin{array}{r} 4 \\ (4) \end{array}$ | $\begin{gathered} 8 \\ (7) \end{gathered}$ | $\begin{gathered} 0.4 \\ (0.4) \end{gathered}$ | $(-)$ | $(\square)$ | $(-)$ | $\begin{array}{r} \mathbf{2} \\ (2) \end{array}$ | 108 | 2 |
| Alur | $\begin{array}{r} 16 \\ (29) \end{array}$ | $\begin{array}{r} 18 \\ (33) \end{array}$ | $\begin{array}{r} 12 \\ (22) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.4) \end{array}$ | $\begin{array}{r} 3 \\ (5) \end{array}$ | $(3)$ | $\begin{aligned} & 0 \cdot 3 \\ & (1) \end{aligned}$ | $\begin{array}{r} 3 \\ (6) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $(-)$ | $(-)$ | $\begin{gathered} 0 \cdot 3 \\ (1) \end{gathered}$ | 4 | $\xrightarrow{2}$ |
| Arkalgud | $\begin{array}{r} 16 \\ (15) \end{array}$ | $\begin{gathered} 36 \\ (33) \end{gathered}$ | $\begin{gathered} 16 \\ (14) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{gathered} 9 \\ (8) \end{gathered}$ | $\begin{gathered} 4 \\ (4) \end{gathered}$ | $\begin{gathered} 12 \\ (11) \end{gathered}$ | $\begin{aligned} & 15 \\ & \text { (14) } \end{aligned}$ | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | $(\overline{-})$ | $(\bar{\square})$ | (二) | $\begin{gathered} 1 \\ (1) \end{gathered}$ | 110 | $\stackrel{8}{8}$ |
|  | Rainfall Zone－XII |  |  | － | ． | $\cdots$ | $\cdots$ | $\ldots$ | ． | Rainfall Pattern－D1E3（A1B1C2）ClE3 |  |  |  |  | 0 |
| Shimoga Sorab 2／3E | $\begin{array}{r} 23 \\ (31) \end{array}$ | $\begin{array}{r} 17 \\ (22) \end{array}$ | $\begin{array}{r} 13 \\ (18) \end{array}$ | $(2)^{2}$ | $\begin{array}{r} 7 \\ (9) \end{array}$ | ${ }_{(5)}^{4}$ | $\mathbf{( 2 )}^{2}$ | $\begin{array}{r} 8 \\ (11) \end{array}$ | $\begin{array}{r} 0.1 \\ (0.2) \end{array}$ | $(-)$ | $(-)$ | (-) | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | 76 | 令 |
| N．Kanara Mundgod $\frac{1}{2} W$ | $\begin{array}{r} 4 \\ (34) \end{array}$ | $\begin{array}{r} 3 \\ (23) \end{array}$ | $\begin{gathered} 3 \\ (23) \end{gathered}$ | $\begin{aligned} & 0.3 \\ & (3) \end{aligned}$ | $\left(\begin{array}{c} 1 \\ \hline \end{array}\right.$ | $\left(\begin{array}{r} 1 \\ (7) \end{array}\right.$ | $\begin{gathered} 0 \cdot 2 \\ (1) \end{gathered}$ | $\begin{aligned} & 0 \cdot 1 \\ & (1) \end{aligned}$ | $(-)$ | $(\overline{-})$ | $(\overline{(-)}$ | $(\overline{-})$ | $(\overline{-})$ | 12 | ？ |
| Haliyal | $\begin{array}{r} 14 \\ (32) \end{array}$ | $\begin{array}{r} 10 \\ (22) \end{array}$ | $\begin{array}{r} 9 \\ (21) \end{array}$ | $\begin{array}{r} 2 \\ (4) \end{array}$ | $\begin{array}{r} 4 \\ (9) \end{array}$ | $\begin{array}{r} 3 \\ (7) \end{array}$ | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | (3) | $(\overline{-})$ | $(\overline{-})$ | $(-)$ | $(-)$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 4) \end{array}$ | 43 | 柋 |
| Belgaum Belgaum | $\begin{array}{r} 29 \\ (24) \end{array}$ | $\begin{gathered} 11 \\ (9) \end{gathered}$ | $\begin{array}{r} 8 \\ (7) \end{array}$ | $\begin{array}{r} 3 \\ (2) \end{array}$ | $\begin{array}{r} 29 \\ (24) \end{array}$ | $\begin{array}{r} 14 \\ (11) \end{array}$ | $\begin{array}{r} 16 \\ (13) \end{array}$ | $\begin{gathered} 11 \\ (9) \end{gathered}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $(-)$ | $(\bar{\square})$ | $\begin{array}{r} 0.4 \\ (0 \cdot 3) \end{array}$ | 123 |  |
|  | Rainfall Zone－XIII |  |  | － | ． | － | $\cdots$ | ． | $\cdots$ | Rainfall Pattern＿D1E3（A3C1）C1E3 |  |  |  |  |  |
| N．Kanara Supa ． | $\begin{array}{r} 8 \\ (26) \end{array}$ | $\begin{gathered} 8 \\ (27) \end{gathered}$ | $\stackrel{8}{(27)}$ | $\begin{gathered} 2 \\ (8) \end{gathered}$ | $\stackrel{1}{(5)}$ | $\begin{gathered} 1 \\ (5) \end{gathered}$ | $0.3$ <br> （I） | 0.4 （1） | $(\underset{)}{ }$ | $(-)$ | $(\bar{\square})$ | $(-)$ | $(\overrightarrow{-})$ | 30 |  |
| Yellapur | $\begin{gathered} 10 \\ (20) \end{gathered}$ | $\begin{array}{r} 12 \\ (24) \end{array}$ | $\begin{gathered} 11 \\ (22) \end{gathered}$ | $\begin{array}{r} 3 \\ (7) \end{array}$ | $\begin{array}{r} 7 \\ (14) \end{array}$ | $\begin{array}{r} 5 \\ (11) \end{array}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{array}{r} 0 \cdot 3 \\ (1) \end{array}$ | $(-)$ | $(-)$ | $(\overline{-})$ | $(-)$ | $(-)$ | 48 |  |


Rainfall Zone - XIV
Rainfall Pattern - D1E3(A3C1)C1D1E2
Shimoga

| Sagar $\frac{1}{2} \mathrm{E}$ | $\begin{array}{r} 14 \\ (27) \end{array}$ | $\begin{gathered} 14 \\ (27) \end{gathered}$ | $\begin{gathered} 12 \\ (22) \end{gathered}$ | ${ }_{(3)}^{2}$ | $(11)^{5}$ | $\begin{gathered} 3 \\ (6) \end{gathered}$ | $(1)$ | $\left(\begin{array}{c} 2 \\ \hline \end{array}\right.$ | $\begin{array}{r} 0.2 \\ (0.3) \end{array}$ | $(-)$ | (-) | (-) | (-) | 52 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Trithahalli | 10 | 14 | 11 | $0 \cdot 3$ | 3 | 2 | $0 \cdot 3$ | 1 |  |  |  |  | $0 \cdot 3$ | 62 |
| ${ }_{3} \mathrm{E}$ | (26) | (33) | (25) | (1) | (7) | (4) | (1) | (2) | $(-)$ | $(-)$ | $(-)$ | $(-)$ | (1) |  |
| Hosanagar . | 10 | 15 | 13 | 3 | $3$ | $2$ | 1 | 2 | ( |  | ( | ( |  | 48 |
| $\frac{1}{2} \mathrm{E}$ | (22) | (32) | (27) | (5) | (5) | (4) | (1) | (4) | $(-)$ | $(-)$ | (-) | $(-)$ | $(0 \cdot 1)$ |  |
| Sorab ${ }_{3} \mathrm{~W}$ | 11 | ${ }^{8}$ | (18) | 1 | 3 | ${ }^{2}$ | 1 | (11) | 0.2 | (-) | $(-)$ | (-) | (0.1 | 38 |
| N. Kanara | (31) | (22) | (18) | (2) | (9) |  | (2) |  |  | (-) | (-) |  |  |  |
| Sirsi | $\begin{array}{r} 19 \\ (28) \end{array}$ | $\begin{gathered} 17 \\ (25) \end{gathered}$ | $\begin{array}{r} 14 \\ (20) \end{array}$ | $\underset{(2)}{2}$ | ${ }_{(15)}^{10}$ | $\underset{(7)}{5}$ | $\stackrel{1}{1}$ | $\begin{gathered} 1 \\ (2) \end{gathered}$ | $(-)$ | (-) | (-) | (-) | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | 70 |

Rainfall Zone-XV .. .. .. .. .. .. .. Rainfall Pattern-D1E3(A3B1)C1E3

| N. Kanara |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Karwar | $\begin{array}{r} 9 \\ (32) \end{array}$ | $\begin{array}{r} 5 \\ (18) \end{array}$ | $\left(\begin{array}{r} 5 \\ (18) \end{array}\right.$ | $(12)^{3}$ | ${ }_{(10)}^{3}$ | (6) | $0.2$ (1) | $0.2$ (1) | (-) | $(\square)$ | $(-)$ | (-) | $\begin{aligned} & 0.4 \\ & (2) \end{aligned}$ | 27 |

Rainfall Zone-XVI .. .. .. .. .. .. Rainfall Pattern-D1E3(A3B1)C1DIE2

| N. Kanara Ankola | $(37)$ | $\begin{array}{r} 7 \\ (24) \end{array}$ | $\begin{array}{r} 6 \\ (20) \end{array}$ | $\left(n^{3}\right.$ | $\underset{(7)}{2}$ | (3) | (二) | $(\bar{\square})$ | (-) | -) | (-) | (-) | (-) | 30 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Shimoga (3) (-) (-) (-) (-) (-) (-) ( |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sagar $\frac{1}{2}$ W | $\begin{array}{r} 14 \\ (27) \end{array}$ | $\begin{array}{r} 14 \\ (27) \end{array}$ | $\left(\begin{array}{l} 11 \\ (22) \end{array}\right.$ | $(3)^{2}$ | $(11)^{6}$ | $\stackrel{3}{6}^{3}$ | $(1)^{1}$ | $(3)$ | $\begin{gathered} 0.2 \\ (0.3) \end{gathered}$ | (二) | $(-)$ | (-) | $(\overline{)}$ | 52 |
| Hosanagar . $\frac{1}{2} \mathrm{~W}$ | $\begin{array}{r} 10 \\ (22) \end{array}$ | $\begin{array}{r} 15 \\ (31) \end{array}$ | $\begin{array}{r} 13 \\ (27) \end{array}$ | $\begin{array}{r} 3 \\ (5) \end{array}$ | $\begin{array}{r} 3 \\ (5) \end{array}$ | $\begin{gathered} \mathbf{2} \\ (4) \end{gathered}$ | $\begin{array}{r} 0.3 \\ (0.4) \end{array}$ | $\begin{array}{r} 2 \\ (4) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | (-) | (-) | (-) | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | 48 |
| Trithahalli . 2/3 W | $\begin{array}{r} 21 \\ (26) \end{array}$ | $\begin{array}{r} 28 \\ (34) \end{array}$ | $\begin{array}{r} 21 \\ (25) \end{array}$ | (1) | (7) | $\begin{array}{r} 3 \\ (4) \\ \hline \end{array}$ | (1) | (1) | (-) | (-) | $(-)$ | (-) | (1) | 62 |

# ANNEXURE 4 (Contd.) 

|  |  |  |  |  |  | XUR | 4 | .) |  |  |  | $\begin{aligned} & \text { Uni } \\ & \% \end{aligned}$ | num <br> total | $\begin{aligned} & \text { ‘000 } \\ & \text { tock } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|  | Rainfall Zone-XVI Contd. |  |  |  |  |  | - | - | . | Rainfall Pattern-D1E3 (A3 B1) CiD1E2 |  |  |  |  |
| N. Kanara Siddapur | $\begin{array}{r} 15 \\ (29) \end{array}$ | $\begin{array}{r} 13 \\ (25) \end{array}$ | $\begin{array}{r} 9 \\ (19) \end{array}$ | ${ }_{(1)}^{1}$ | $\begin{array}{r} 8 \\ (15) \end{array}$ | $\begin{array}{r} 3 \\ (7) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (1) \end{array}$ | $\begin{array}{r} 2 \\ (3) \end{array}$ | $(-)$ | (—) |  |  | $(-)$ | 51 |
| Chikmaglur Kорра | $\begin{array}{r} 17 \\ (25) \end{array}$ | $\begin{array}{r} 20 \\ (31) \end{array}$ | $\begin{array}{r} 18 \\ (27) \end{array}$ | ${ }_{(3)}^{2}$ | $\left(6^{4}\right.$ | (3) | $\begin{array}{r} 0.2 \\ (0 \cdot 2) \end{array}$ | (1) | $(-)$ | $(-)$ | $(-)$ | $\text { ( }-$ | 3 $(4)$ | 65 |
| Siringeri | 3 $(21)$ | (33) | $\begin{array}{r} 4 \\ (26) \end{array}$ | $\begin{gathered} 0 \cdot 2 \\ (1) \end{gathered}$ | $(7$ | $\begin{gathered} 1 \\ (7) \end{gathered}$ | $0 \cdot 1$ <br> (1) | $\begin{gathered} 0 \cdot 1 \\ (1) \end{gathered}$ | $(\square)$ | $(-)$ | $(-)$ | $(-)$ | $\begin{array}{r} 0.2 \\ (2) \end{array}$ | 15 |
| Mudigere | $\begin{array}{r} 19 \\ (30) \end{array}$ | $\begin{array}{r} 17 \\ (25) \end{array}$ | $\begin{array}{r} 13 \\ (20) \end{array}$ | (6) | $\left({ }^{4}\right)^{4}$ | $\begin{array}{r} 2 \\ (3) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.3) \end{array}$ | $\left.{ }^{2}\right)^{2}$ | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | $(-)$ | $(-)$ | $(-)$ | $\begin{array}{r} 5 \\ (7) \end{array}$ | 66 |
|  | Rainfall Zone-XVII |  |  | - | -• |  | - |  | - | Rainfall Pattern-D1E3(A4)C1D1E2 |  |  |  |  |
| N. Kanara Bhatka' | $\begin{array}{r} 6 \\ (24) \end{array}$ | $\begin{array}{r} 6 \\ (24) \end{array}$ | $\begin{array}{r} 5 \\ (20) \end{array}$ | $\begin{array}{r} 3 \\ (12) \end{array}$ | $\begin{array}{r} 3 \\ (12) \end{array}$ | $\begin{gathered} 1 \\ (4) \end{gathered}$ | $\begin{gathered} 0.3 \\ (2) \end{gathered}$ | $0.4$ (2) | $(\overline{)}$ | $(\overline{-})$ | (-) | (-) | (-) | 24 |
| Kunta | $\begin{array}{r} 12 \\ (30) \end{array}$ | $\begin{gathered} 11 \\ (29) \end{gathered}$ | $\begin{array}{r} 9 \\ (23) \end{array}$ | $\begin{array}{r} 2 \\ (5) \end{array}$ | 3 $(9)$ | (4) | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 2) \end{array}$ | (-) | (-) | (-) | (-) | (-) | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | 39 |
| Honavar | $\begin{array}{r} 16 \\ (24) \end{array}$ | $\begin{array}{r} 23 \\ (35) \end{array}$ | $\begin{array}{r} 19 \\ (28) \end{array}$ | (3) | $\begin{array}{r} 5 \\ (7) \end{array}$ | $\begin{array}{r} 2 \\ (3) \end{array}$ | $\begin{array}{r} 0.2 \\ (0 \cdot 3) \end{array}$ | $(-)$ | (-) | $(-)$ | $(-)$ | $(-)$ | $(\overline{)}$ | 67 |
|  | Rainfall Zone-XVIII |  |  | . | . | -• | . . | .. | Rainfall Pattern-D2E2(A2B1C1)C1D1E2 | Rainfall Pattern-D2E2(A2B1C1)C1D1E2 |  |  |  |  |
| Chikmaglur N. Rajapur. | $\begin{array}{r} 11 \\ (28) \end{array}$ | $\begin{array}{r} 12 \\ (31) \end{array}$ | $\begin{array}{r} 10 \\ (25) \end{array}$ | $\begin{gathered} 1 \\ (3) \end{gathered}$ | $\underset{(3)}{1}$ | $\begin{gathered} 1 \\ (3) \end{gathered}$ | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | 1 | $(-)$ | $\bar{\square} \quad(\bar{\square}) \quad(\bar{\square}) \quad(3) \quad 39$ |  |  |  |  |
|  | Rainfall Zone-XIX |  |  | $\cdots$ | $\cdots$ | - | $\cdots$ | $\cdots$ | .. | Rainfall Pattern-C4E3(CID1E2)C1D1E2 |  |  |  |  |
| Mandya <br> Maddur | $\begin{array}{r} 23 \\ (15) \end{array}$ | $\begin{array}{r} 24 \\ (16) \end{array}$ | $\begin{gathered} 10 \\ (6) \end{gathered}$ | $\left(\begin{array}{l} 1 \\ (1) \end{array}\right.$ | $\begin{array}{r} 17 \\ (12) \end{array}$ | $\begin{array}{r} 7 \\ (5) \end{array}$ | $\begin{array}{r} 44 \\ (30) \end{array}$ | $\begin{array}{r} 18 \\ (13) \end{array}$ | $\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}$ | $(\overline{-})$ | $\begin{array}{r} 1 \\ (1) \end{array}$ | $(-)$ | ${ }_{(1)}^{1}$ | 147 |


| Mandya | $43$ | 24 | 10 |  | 29 | 15 | 78 | 20 | $0.4$ |  |  |  | ${ }^{2}$ | 222 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | (11) | (5) | (0.3) | (13) | (7) | (35) | (9) |  | (-) | (0.1) |  | (1) |  |
| Srirangapatna | $\begin{aligned} & 13 \\ & \text { (18) } \end{aligned}$ | $\begin{gathered} 16 \\ (22) \end{gathered}$ | $\begin{array}{r} 7 \\ (10) \end{array}$ | $\begin{gathered} 0.3 \\ (0.4) \end{gathered}$ | $\begin{array}{r} 7 \\ (10) \end{array}$ | $\begin{aligned} & 2 \\ & \text { (3) } \end{aligned}$ | $\begin{array}{r} 19 \\ (26) \end{array}$ | $\begin{array}{r} 7 \\ (10) \end{array}$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $(\overline{-})$ | $\begin{aligned} & 0.3 \\ & (0.4) \end{aligned}$ | $\overline{(-)}$ | $\begin{array}{r} 0.3 \\ (0.4) \end{array}$ | 71 |
| Nagamangala | $19$ | 21 <br> (9) | $\begin{array}{r} 9 \\ (4) \end{array}$ | $\begin{gathered} 0.4 \\ (0.2) \end{gathered}$ | $\begin{aligned} & 14 \\ & (6) \end{aligned}$ | ${ }_{(3)}^{6}$ | $\begin{array}{r} 123 \\ (54) \end{array}$ | $\begin{aligned} & 32 \\ & \text { (14) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (0.3)^{1} \end{aligned}$ | (-) | $\begin{array}{r} 0.3 \\ (0.1) \end{array}$ | (-) | $\begin{array}{r} 1 \\ (0.3) \end{array}$ | 227 |
| Pandavapura | $\begin{array}{r} 14 \\ \text { (13) } \end{array}$ | $\begin{gathered} 16 \\ \text { (15) } \end{gathered}$ | (7) | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\begin{gathered} 9 \\ (8) \end{gathered}$ | (3) | 43 <br> (39) | $\begin{aligned} & 16 \\ & (15) \end{aligned}$ | $\begin{array}{r} 0.3 \\ (0 \cdot 3) \end{array}$ | $(-)$ | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | $(\underset{)}{ }$ | (1) | 111 |
| Malvalli | $\begin{array}{r} 13 \\ (8) \end{array}$ | $\begin{array}{r} 34 \\ (24) \end{array}$ | $\begin{gathered} 14 \\ (9) \end{gathered}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $\begin{array}{r} 16 \\ (11) \end{array}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 40 \\ (28) \end{array}$ | $\begin{gathered} 215) \\ (15) \end{gathered}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(-)$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(\overline{-})$ | $\begin{array}{r} 0.4 \\ (0 \cdot 3) \end{array}$ | 147 |
|  | Rainfall Zone-XX |  |  |  |  |  |  |  | Rainfall Pattern-C1E3(C2D2) C1D1E2 |  |  |  |  |  |
| Bangalore |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ramanagaram | $\begin{gathered} 7 \\ (6) \end{gathered}$ | $\begin{array}{r} 30 \\ (29) \end{array}$ | $\underset{(13)}{14}$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | $\stackrel{6}{6}^{6}$ | $\underset{(2)}{2}$ | $\begin{array}{r} 27 \\ (26) \end{array}$ | $\begin{gathered} 18 \\ (17) \end{gathered}$ | (1) | (-) | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | (-) | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | 106 |
| Bangalore (S) | $\begin{array}{r} 5 \\ (10) \end{array}$ | $\begin{array}{r} 14 \\ (24) \end{array}$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{gathered} 1 \\ \text { (1) } \end{gathered}$ | $\begin{gathered} 5 \\ (8) \end{gathered}$ | $\begin{array}{r} 2 \\ (4) \end{array}$ | $\begin{gathered} 18 \\ (31) \end{gathered}$ | 5 (9) | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | (-) | (1) | (-) | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | 58 |
| Kanakpura | $\begin{aligned} & 13 \\ & (6) \end{aligned}$ | $\begin{array}{r} 79 \\ (34) \end{array}$ | $\begin{array}{r} 30 \\ (13) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.1) \end{array}$ | $\begin{array}{r} 6 \\ (3) \end{array}$ | $\begin{array}{r} 3 \\ (1) \end{array}$ | $(18)$ | $\begin{array}{r} 55 \\ (24) \end{array}$ | $\begin{array}{r} 1 \\ (0.4) \end{array}$ | (-) | (1) | (-) | $\begin{array}{r} 0.4 \\ (0.2) \end{array}$ | 230 |
| Anekal | $\begin{array}{r} 7 \\ (8) \end{array}$ | $\begin{array}{r} 27 \\ (28) \end{array}$ | $\begin{aligned} & 14 \\ & (15) \end{aligned}$ | $\begin{array}{r} 0.3 \\ (0.3) \end{array}$ | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\begin{array}{r} 3 \\ \text { (3) } \end{array}$ | $\begin{array}{r} 26 \\ (27) \end{array}$ | $\begin{aligned} & 10- \\ & (10) \end{aligned}$ | $\begin{array}{r} 0.1 \\ (0.1) \end{array}$ | (-) | (1) | (-) | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | 97 |
| Channapatna | $\begin{aligned} & 9 \\ & \text { (9) } \end{aligned}$ | $\begin{array}{r} 24 \\ (23) \end{array}$ | $10$ | $\begin{gathered} 0.3 \\ (0.3) \end{gathered}$ | (9) | $\begin{aligned} & 4 \\ & \text { (4) } \end{aligned}$ | $\begin{array}{r} 31 \\ \text { (30) } \end{array}$ | $\begin{array}{r} 15 \\ (14) \end{array}$ | (1) | (-) | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | (-) | $\begin{array}{r} 1 \\ \text { (1) } \end{array}$ | 103 |
| $\underset{\left(\frac{1}{2} S\right)}{\text { Bangalor } N)}$ | $\begin{gathered} 5 \\ (9) \end{gathered}$ | $\begin{array}{r} 16 \\ (29) \end{array}$ | $(16)$ | $\begin{aligned} & 0.2 \\ & (0.3) \end{aligned}$ | $\begin{array}{r} 7 \\ (12) \end{array}$ | $\begin{gathered} 2 \\ (3) \end{gathered}$ | $\begin{array}{r} 11 \\ (20) \end{array}$ | $\begin{array}{r} 5 \\ (8) \end{array}$ | $\begin{gathered} 0.4 \\ (1) \end{gathered}$ | (-) | $0.4$ | (-) | $\begin{gathered} 1 \\ \text { (1) } \end{gathered}$ | 56 |
|  | Rainfall Zone-XXI $^{\text {l }}$ |  |  |  | . | . | .. | $\cdots$ | Rainfall Pattern - |  |  | $\mathrm{ClE}_{3}(\mathrm{~A} 4) \mathrm{ClD1E2}$ |  |  |
| S. Kanara |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Buntwal | $\underset{(21)}{21}$ | $\underset{(22)}{22}$ | $\begin{array}{r} 20 \\ (20) \end{array}$ | $\begin{array}{r} 18 \\ \text { (18) } \end{array}$ | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\begin{array}{r} 5 \\ (5) \end{array}$ | $(\square)$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $(-)$ | (-) | (-) | (-) | $(3)^{3}$ | 100 |
| Mangalore . | $\begin{array}{r} 7 \\ (8) \end{array}$ | $\begin{array}{r} 26 \\ (27) \end{array}$ | $\begin{array}{r} 24 \\ (25) \end{array}$ | $\begin{array}{r} 17 \\ (18) \end{array}$ | 7 | $\begin{array}{r} 3 \\ (3) \end{array}$ | (-) | 8 $(8)$ | (-) | (-) | (-) | (二) | $\begin{aligned} & 3^{3} \\ & \text { (3) } \end{aligned}$ | 94 |
| Udipi. | $\begin{gathered} 14 \\ (10) \end{gathered}$ | $\begin{gathered} 38 \\ (28) \end{gathered}$ | $\begin{array}{r} 44 \\ (32) \end{array}$ | $\begin{gathered} 28 \\ (21) \end{gathered}$ | $\begin{array}{r} 7 \\ (5) \end{array}$ | $\begin{aligned} & 3 \\ & \text { (2) } \end{aligned}$ | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ | (1) | (-) | (-) | (-) | (-) | (1) | 135 |
| Coondapur | $\begin{gathered} 22 \\ (19) \end{gathered}$ | $\begin{array}{r} 36 \\ (31) \end{array}$ | $\begin{array}{r} 32 \\ (27) \end{array}$ | $\begin{array}{r} 14 \\ (13) \end{array}$ | (6) | $\begin{array}{r} 3 \\ 3 \\ (3) \end{array}$ | (-) | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | (-) | (-) | (-) | (-) | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | 116 |



| Mysore | $\begin{array}{r} 26 \\ (15) \end{array}$ | $\begin{array}{r} 36 \\ (21) \end{array}$ | $\begin{array}{r} 20 \\ (11) \end{array}$ | $\begin{array}{r} 0 \cdot 3 \\ (0 \cdot 2) \end{array}$ | $\begin{gathered} 16 \\ (9) \end{gathered}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 45 \\ (26) \end{array}$ | $\begin{array}{r} 22 \\ (13) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.2) \end{array}$ | $(\overline{)}$ | $\left(\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}\right.$ | $(\overline{-})$ | $\begin{gathered} 0.3 \\ (0.2) \end{gathered}$ | 172 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| H. D. Kote | $\begin{array}{r} 41 \\ (28) \end{array}$ | $\begin{array}{r} 36 \\ (25) \end{array}$ | $\begin{array}{r} 27 \\ (18) \end{array}$ | $\begin{aligned} & 0 \cdot 3 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{array}{r} 2 \\ (2) \end{array}$ | (1) | $\begin{array}{r} 9 \\ (7) \end{array}$ | $\begin{array}{r} 28 \\ (19) \end{array}$ | $(\square)$ | $(-)$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $(\bar{\square})$ | 145 |
| Hunsur | $\begin{array}{r} 29 \\ (21) \end{array}$ | $\begin{array}{r} 36 \\ (26) \end{array}$ | $\begin{array}{r} 18 \\ (13) \end{array}$ | $\begin{aligned} & 0 \cdot 2 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{array}{r} 4 \\ (3) \end{array}$ | $\begin{array}{r} 2 \\ (1) \end{array}$ | $\begin{array}{r} 19 \\ (14) \end{array}$ | $\begin{array}{r} 29 \\ (21) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{)}$ | $(\overline{(-)}$ | $(-)$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 1) \end{array}$ | 137 |
| P. Patna | $\begin{array}{r} 22 \\ (17) \end{array}$ | $\begin{array}{r} 41 \\ (33) \end{array}$ | $\begin{array}{r} 19 \\ (15) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $\begin{array}{r} 5 \\ (4) \end{array}$ | $\begin{array}{r} 2 \\ (2) \end{array}$ | $\begin{array}{r} 14 \\ (12) \end{array}$ | $\begin{array}{r} 22 \\ (17) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $(-)$ | $(-)$ | $(\bar{\square})$ | $\begin{array}{r} 0.3 \\ (0.2) \end{array}$ | 127 |
| Mandya K. R. Pet | $\begin{array}{r} 27 \\ (17) \end{array}$ | $\begin{array}{r} 26 \\ (16) \end{array}$ | $\begin{array}{r} 10 \\ \text { (6) } \end{array}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $\begin{aligned} & 15 \\ & (9) \end{aligned}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 49 \\ (32) \end{array}$ | $\begin{array}{r} 24 \\ (15) \end{array}$ | $\left.\begin{array}{c} 1 \\ (0 \cdot 3 \end{array}\right)$ | $(\overline{(-)}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $\stackrel{1}{(0 \cdot 3)}$ | 158 |
| Hassan <br> Holenarsipur | $\begin{array}{r} 9 \\ (9) \end{array}$ | $\begin{array}{r} 18 \\ (18) \end{array}$ | $\begin{array}{r} 8 \\ (8) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{array}{r} 10 \\ (10) \end{array}$ | $\begin{array}{r} 4 \\ (4) \end{array}$ | $\begin{array}{r} 37 \\ (37) \end{array}$ | $\begin{array}{r} 14 \\ (14) \end{array}$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{array}{r} 0 \cdot 1 \\ (0 \cdot 1) \end{array}$ | $(-)$ | $\begin{array}{r} 0 \cdot 3 \\ (0 \cdot 3) \end{array}$ | 100 |
| Hassan | $\begin{array}{r} 34 \\ (21) \end{array}$ | $\begin{array}{r} 40 \\ (24) \end{array}$ | $\begin{array}{r} 21 \\ (13) \end{array}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $\begin{aligned} & 12 \\ & (7) \end{aligned}$ | $\begin{array}{r} 6 \\ (4) \end{array}$ | $\begin{array}{r} 39 \\ (24) \end{array}$ | $\begin{aligned} & 10 \\ & (5) \end{aligned}$ | $\begin{array}{r} 1 \\ (1) \end{array}$ | $(\overline{(\overline{)}}$ | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $(\overline{(-)}$ | (1) | 164 |
| Mysore Kollegal | $\begin{array}{r} 27 \\ (16) \end{array}$ | $\begin{array}{r} 56 \\ (33) \end{array}$ | $\begin{array}{r} 21 \\ (13) \end{array}$ | $\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}$ | $\begin{array}{r} 9 \\ (6) \end{array}$ | $\begin{array}{r} 4 \\ (2) \end{array}$ | $\begin{array}{r} 29 \\ (17) \end{array}$ | $\begin{array}{r} 20 \\ (12) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(-)$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 1) \end{array}$ | $(\overline{-})$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | 168 |
| Hassan Arsikere | $\begin{array}{r} 38 \\ (18) \end{array}$ | $\begin{array}{r} 40 \\ (19) \end{array}$ | $\begin{array}{r} 20 \\ (10) \end{array}$ | $\begin{array}{r} 0.4 \\ (0 \cdot 2) \end{array}$ | $\begin{gathered} 12 \\ (6) \end{gathered}$ | $\begin{array}{r} 5 \\ (2) \end{array}$ | $\begin{array}{r} 59 \\ (29) \end{array}$ | $\begin{array}{r} 32 \\ (15) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.2) \end{array}$ | (二) | $\begin{gathered} 0 \cdot 2 \\ (0 \cdot 1) \end{gathered}$ | $(-)$ | $\begin{gathered} 1 \\ (0 \cdot 4) \end{gathered}$ | 207 |
| C. Patna | $\begin{array}{r} 27 \\ (12) \end{array}$ | $\begin{array}{r} 66 \\ (28) \end{array}$ | $\begin{gathered} 12 \\ (5) \end{gathered}$ | $\begin{array}{r} 0 \cdot 3 \\ (0 \cdot 1) \end{array}$ | $\begin{gathered} 17 \\ (7) \end{gathered}$ | $\begin{array}{r} 8 \\ (3) \end{array}$ | $\begin{array}{r} 82 \\ (35) \end{array}$ | $\begin{aligned} & 22 \\ & (9) \end{aligned}$ | $\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}$ | $(-)$ | $\begin{array}{r} 1 \\ (0 \cdot 4) \end{array}$ | $(-)$ | $\begin{array}{r} 1 \\ (0 \cdot 3) \end{array}$ | 238 |
| Tumkur Tiptur ( $\frac{1}{2} \mathrm{~W}$ ) | $\begin{array}{r} 11 \\ (17) \end{array}$ | $\begin{array}{r} 10 \\ (16) \end{array}$ | $\begin{array}{r} 6 \\ (10) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{array}{r} 3 \\ (6) \end{array}$ | $\begin{array}{r} 2 \\ (3) \end{array}$ | $\begin{array}{r} 23 \\ (36) \end{array}$ | $\begin{array}{r} 7 \\ (11) \end{array}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $(\overline{(-)}$ | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | $(\square)$ | $\begin{array}{r} 0.4 \\ (0.4) \end{array}$ | 64 |
|  | Rainfall Zone - XXV |  |  | $\cdots$ | $\cdots$ | $\cdots$ | . | $\cdots$ | . Rainfall Pattern-CiD1E2(A3Cl)C1D1E2 | Rainfall Pattern-CiDIE2(A3Cl)C1D1E2 |  |  |  |  |
| Coorg |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Virajpet $\frac{1}{2} \mathrm{E}$ | $(25)^{9}$ | $(21)^{8}$ | $\begin{array}{r} 7 \\ (19) \end{array}$ | $(9)^{3}$ | ${ }_{(4)}^{2}$ | $\left(3^{1}\right.$ | $0.4$ <br> (1) | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & \text { neg. } \\ & (0 \cdot 2) \end{aligned}$ | $(\overline{(1)}$ | $(\overline{(-)}$ | $(-)$ | $\begin{array}{r} 6 \\ (17) \end{array}$ | 37 |
| Somvarpet . | $\begin{array}{r} 19 \\ (25) \end{array}$ | $\begin{array}{r} 23 \\ (30) \end{array}$ | $\begin{array}{r} 18 \\ (24) \end{array}$ | $\begin{array}{r} 2 \\ (2) \end{array}$ | $\begin{array}{r} 4 \\ (5) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.4) \end{array}$ | $\begin{array}{r} 4 \\ (5) \end{array}$ | $\begin{array}{r} 0 \cdot 2 \\ (0 \cdot 3) \end{array}$ | $(-)$ | $(-)$ | $(-)$ | $\left(6^{5}\right.$ | 78 |



ANNEXURE

elevation = metres above sea level (masl)
$=$ rainy days
$\mathrm{mmr}=$ month of maximum rainfall
$\mathrm{mr}=$ total rainfall of mmr plus that of preceding or following month, whichever is higher, in cm .
md $=$ number of raindays of mmr plus that of preceding or following month, whichever has rainfall.

* Consecutive months with rainfall of more than 10 cm per month.
$a=$ Initial month with more than 10 cm of rainfall and number of consecutive mounths with more than 10 cm / month, separated by hyphen.
$b=$ Total rainfall of consecutive months in ' $a$ ' in cm .
$c=$ Total number of rainy days of consecutive months in ' $a$ '
na $=$ not available.

ANNEXURE 5 (Contd.)

| cropping patterns | district/taluk | geog- elevation |  |  | annual rainfall |  | mmr | mr | md | consecutive months* |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\begin{aligned} & \text { area } \\ & (\mathrm{sq} \mathrm{~km}) \end{aligned}$ | max | min | total (cm) | rd |  |  |  | a | b | c |
| G4Jr4Jk4Mt4/Gn4/ Gn4Pu4/B4/B4Mt4 | Rainfall Zone-II | . | . |  |  |  | . |  | Rainfall | ttern | C3D |  |
|  | Raichur |  |  |  |  |  |  |  |  |  |  |  |
|  | Raichur | 1514 | 401 | 349 | 66 | 44 | 9 | 27 | 17 | 7-3 | 39 | 26 |
|  | Deodurg | 1508 | $576$ | 450 | 69 | na | 9 | 31 | na | 7-3 | 44 | na |
| C3Jr4Mt4/Pd5 | Manvi . | 1793 | 472 | 450 | 60 | na | 9 | 26 | na | 7-3 | 37 | na |
| C4Jr4Jk4M44/Gn4/ Gn4Pu4/B4/B4Mt4 | Gulbarga |  |  |  |  |  |  |  |  |  |  |  |
|  | Shorapur |  |  | $450$ |  | na |  | 31 | na | 7.3 |  | na |
|  | Shahapur | $1461$ | $600$ | $450$ | $74$ | na | 9 | 31 | na | 6-4 | $57$ | na |
|  | Raichur |  |  |  |  |  |  |  |  |  |  |  |
| Jr4Mt4Gn4Pu4 . | Lingsugur $(1 / 3 \mathrm{E})$ | 649 | 572 | 450 | 54 | 38 | 9 | 23 | 14 | 8-2 | 23 | 14 |
|  | Gulbarga Yadgir | 1708 | 689 | 366 | 67 | 49 | 9 | 28 | 18 | 7-3 | 41 | 29 |
| $\begin{aligned} & \mathrm{Jr} 3 \mathrm{O} 4 \mathrm{Gn} 4 \mathrm{~T} 4 / \mathrm{C} 4 / \\ & \mathrm{T} 4 \mathrm{~B} 4 \end{aligned}$ | Rainfall Zone-III | - | $\cdots$ | - | $\cdots$ |  | $\cdots$ | . | Rainfall Pattern-E4(C4)D1E3 |  |  |  |
|  | Gulbarga |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | $598$ |  | $74$ | na | 9 | 33 | na | 7.3 | 54 | na |
|  | Gulbarga | $1728$ | $454$ | $450$ | $73$ | 45 | 9 | 32 | 17 | 6-4 | 56 | 33 |
|  | Afzalpur | 1299 | 523 | 450 | 71 | na | 9 | 29 | na | 6-4 | 55 | na |
| B4 | Jevargi (Andola) | 1806 | 464 | 437 | 68 | na | 9 | 30 | na | 6-4 | 52 | na |
| Jr304T4 | Sedam | 971 | 600 | 450 | 91 | na | 9 | 38 | na | 6-4 | 71 | na |
| $J_{\text {r 304Gn4T4/C4/T4B4 }}$ | Chitapur | 1792 | 455 | 450 | 80 | na | 9 | 33 | na | 6-4 | 63 | na |
| Pu4T4Jr4Gn404/Jk4 | Chincholi | 1563 | 453 | 450 | 79 | na | 9 | 36 | na | 6.4 | 66 | na |



ANNEXURE 5 (Contd.)



## ANNEXURE 5 (Contd.)




ANNEXURE 5 (Contd.)



ANNEXURE 5 (Conld.)



ANNEXUREI 5 (Contd.)



ANNEXURE
Areas under Crops in Taluks arranged


## Raichur

Lingsugar ( $2 / 3 \mathrm{w}$ ) . $\quad . \quad . \quad 79 \cdot 7 \quad \begin{array}{ccccccc}11 & 8 & 12 & - & -\end{array}$
Bijapur


Gca $\Rightarrow$ gross cropped area.
Note: 1. Figures in brackets represent percentages to gross cropped area. These have $0 \cdot 5$. Due to this approximation, the total of percentage values of the crops 1969-70.
2. For other symbols refer to paragraph 2.7.

6
) according to State Rainfall Zones
area $={ }^{\prime} 000$ ha
( ) = per cent of gross cropped area


| 16 | - | - | 3 | 4 | 10 | $0 \cdot 4$ | 12 | 13 | 24 | - | $0 \cdot 4$ | 1 |
| ---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $(8)$ | $(-)$ | $(-)$ | $(1)$ | $(2)$ | $(4)$ | $(0 \cdot 2)$ | $(6)$ | $(6)$ | $(11)$ | $(-)$ | $(0 \cdot 2)$ | $(1)$ |
| 20 | - | $0 \cdot 2$ | 3 | 2 | 4 | - | 10 | 9 | 27 | - | $0 \cdot 3$ | 1 |
| $(11)$ | $(-)$ | $(0 \cdot 1)$ | $(2)$ | $(1)$ | $(2)$ | $(-)$ | $(5)$ | $(5)$ | $(15)$ | $(-)$ | $(0 \cdot 2)$ | $(1)$ |
| 5 | - | - | 1 | 1 | 3 | 1 | 4 | $0 \cdot 4$ | 9 | - | 1 | 3 |
| $(5)$ | $(-)$ | $(-)$ | $(1)$ | $(1)$ | $(3)$ | $(1)$ | $(4)$ | $(0 \cdot 3)$ | $(9)$ | $(-)$ | $(1)$ | $(3)$ |
| 4 | - | - | 1 | 1 | 3 | - | 3 | 2 | 8 | - | $0 \cdot 3$ | $0 \cdot 2$ |
| $(7)$ | $(-)$ | $(-)$ | $(2)$ | $(2)$ | $(4)$ | $(-)$ | $(5)$ | $(4)$ | $(13)$ | $(-)$ | $(1)$ | $(\cdot 3)$ |
| 12 | - | $0 \cdot 2$ | 2 | 1 | 4 | 1 | 3 | 3 | 7 | - | - | 1 |
| $(15)$ | $(-)$ | $(0 \cdot 3)$ | $(2)$ | $(1)$ | $(5)$ | $(1)$ | $(4)$ | $(3)$ | $(9)$ | $(-)$ | $(-)$ | $(1)$ |
| 7 | - | - | 2 | 4 | 7 | $0 \cdot 4$ | 33 | 7 | 11 | - | - | 1 |
| $(3)$ | $(-)$ | $(-)$ | $(1)$ | $(2)$ | $(4)$ | $(0 \cdot 2)$ | $(17)$ | $(3)$ | $(6)$ | $(-)$ | $(-)$ | $(0 \cdot 4)$ |
| 9 | - | $0 \cdot 4$ | 1 | 3 | 8 | 3 | 16 | 7 | 18 | - | $0 \cdot 2$ | 3 |
| $(4)$ | $(-)$ | $(0 \cdot 2)$ | $(0 \cdot 4)$ | $(2)$ | $(4)$ | $(0 \cdot 2)$ | $(8)$ | $(4)$ | $(9)$ | $(-)$ | $(0 \cdot 1)$ | $(1)$ |
| 7 | - | $0 \cdot 3$ | 3 | 4 | 5 | - | 10 | 6 | 33 | - | $0 \cdot 2$ | $0 \cdot 1$ |
| $(5)$ | $(-)$ | $(0 \cdot 2)$ | $(3)$ | $(3)$ | $(4)$ | $(-)$ | $(7)$ | $(5)$ | $(25)$ | $(-)$ | $(0 \cdot 1)$ | $(n e g)$. |
| 7 | - | 9 | 3 | 2 | 3 | - | 8 | 3 | 34 | - | - | $0 \cdot 2$ |
| $(0)$ | $(-)$ | $(7)$ | $(2)$ | $(1)$ | $(3)$ | $(-)$ | $(7)$ | $(3)$ | $(28)$ | $(-)$ | $(-)$ | $(0 \cdot 1)$ |
| 5 | - | 1 | 2 | 2 | 3 | - | 4 | 7 | 18 | - | $0 \cdot 3$ | 1 |
| $(7)$ | $(-)$ | $(2)$ | $(3)$ | $(2)$ | $(4)$ | $(-)$ | $(6)$ | $(9)$ | $(25)$ | $(-)$ | $(0 \cdot 4)$ | $(1)$ |

$$
\begin{array}{rcccccccccccc}
3 & - & 10 & 2 & 5 & - & - & 6 & 7 & 15 & - & - & 1 \\
(3) & (-) & (13) & (3) & (6) & (-) & (-) & (7) & (9) & (19) & (-) & (-) & (-)
\end{array}
$$

| 3 | - | 4 | 1 | 3 | 6 | $0 \cdot 1$ | 26 | 1 | 7 | - | - | 0.2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $(3)$ | $(-)$ | $(3)$ | $(1)$ | $(3)$ | $(7)$ | $(0 \cdot 1)$ | $(28)$ | $(2)$ | $(8)$ | $(-)$ | $(-)$ | $(0 \cdot 3)$ |

$\mathrm{Mc}=$ miscellaneous crops.
been approximated to the nearest integer except when percentage is less than may differ by a per cent from hundred. Area statistics relate to the year 3. area negligible or crop not grown.

ANNEXURE


Rainfall Zone--III
Gulbarga
Aland

| 142.7 | 2 <br> $(1)$ | 5 <br> $(4)$ | 40 <br> $(28)$ | 19 <br> $(13)$ | $(-)$ | $(-)$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |

Gulbarga

| 138.4 | 1 | 3 | 41 | 22 | $0 \cdot 2$ | $0 \cdot 1$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | (1) | $(2)$ | $(30)$ | $(16)$ | $(0 \cdot 1)$ | $(0 \cdot 1)$ |

Afzalpur

| $105 \cdot 3$ | 0.3 | - | 35 | 9 | - | $(-$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $(0.3)$ | $(-)$ | $(34)$ | $(9)$ | $(-)$ | $(-)$ |
| $152 \cdot 5$ | 0.3 | 3 | 43 | 9 | $(-$ | $(-)$ |
|  | $(0.2)$ | $(2)$ | $(28)$ | $(0)$ | $(-)$ |  |

Sedam
Chitapur
Chincholi

| $71 \cdot 5$ | 1 | 1 | 19 | 1 | - | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $(2)$ | $(1)$ | $(27)$ | $(2)$ | $(-)$ | $(1)$ |
| $148 \cdot 0$ | $0 \cdot 3$ | 3 | 44 | 18 | - | $(-$ |
|  | $(0 \cdot 2)$ | $(2)$ | $(30)$ | $(12)$ | $(-)$ | $(-)$ |
| $97 \cdot 8$ | 1 | 4 | 16 | 5 | - | - |
|  | $(1)$ | $(4)$ | $(17)$ | $(6)$ | $(-)$ | $(-)$ |

Rainfall Zone-IV

| Bidar |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Bidar |  | . |  | $84 \cdot 0$ | $\begin{aligned} & 2 \\ & (3) \end{aligned}$ | $6$ | $\begin{gathered} 31 \\ (36) \end{gathered}$ | $\begin{gathered} 3 \\ (4) \end{gathered}$ | $(-)$ | $(\overline{-})$ |
| Basava-kalyan |  | - |  | $71 \cdot 2$ | $\begin{aligned} & 4 \\ & (6) \end{aligned}$ | $\begin{gathered} 5 \\ (\eta) \end{gathered}$ | $\begin{gathered} 8 \\ (11) \end{gathered}$ | $\begin{array}{r} 8 \\ (12) \end{array}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 2) \end{gathered}$ | - |
| Humnabad |  | . |  | $45 \cdot 4$ | $\begin{gathered} 1 \\ (3) \end{gathered}$ | $\begin{gathered} 4 \\ (9) \end{gathered}$ | $\begin{gathered} 4 \\ (9) \end{gathered}$ | $\underset{(5)}{2}$ | $0.4$ (1) | $\begin{gathered} (-1 \\ 0.1 \\ (0.3) \end{gathered}$ |
| Bhalki | . |  |  | $87 \cdot 0$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{gathered} 10 \\ (12) \end{gathered}$ | $\begin{gathered} 9 \\ \text { (11) } \end{gathered}$ | (1) | $\left(\begin{array}{r}1 \\ (-)\end{array}\right.$ | (-) |
| Aurad | - | - |  | 119.2 | $\begin{array}{r} 2 \\ (2) \end{array}$ | $\begin{array}{r} 18 \\ (15) \end{array}$ | $\begin{gathered} 8 \\ (6) \end{gathered}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $\begin{array}{r} 0.4 \\ (0.3) \end{array}$ | $(-)$ |

6 (Contd.)

| W | Ba | Mt | G | T | Pu | S | Gn | 0 | C | $L$ | F | Mc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | Rainfall Pattern-E4 (C3 D1) D1 E3 |  |  |  |  |  |
| (1) | $(\overline{-})$ | $\begin{array}{r} 9 \\ (9) \end{array}$ | (1) | $\underset{(2)}{2}$ | $\stackrel{6}{(6)}$ | $(-)$ | $\begin{gathered} 7 \\ (7) \end{gathered}$ | $\begin{gathered} 5 \\ (5) \end{gathered}$ | $\begin{gathered} 31 \\ (30) \end{gathered}$ | (-) | (-) | (1) |
| (1) | (-) | $\begin{gathered} 12 \\ (12) \end{gathered}$ | $\begin{gathered} 3 \\ \text { (3) } \end{gathered}$ | $\begin{gathered} 4 \\ (4) \end{gathered}$ | $\begin{gathered} 2 \\ (2) \end{gathered}$ | $(-)$ | $\begin{array}{r} 9 \\ 9 \\ (9) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{array}{r} 28 \\ \text { (29) } \end{array}$ | (-) | (-) | 0.2 $(0.2)$ |
| 2 | - | 4 | 1 | 1 | 4 | ) | 7 | 2 | 61 |  | - | $0 \cdot 2$ |
| (1) | $(-)$ | (3) | (1) | (1) | (3) | $(-)$ | (5) | (1) | (40) | $(-)$ | $(-)$ | (0-1) |
| $\begin{array}{r} 4 \\ (3) \end{array}$ | ( - | $\underset{(2)}{2}$ | $\begin{gathered} 3 \\ (2) \end{gathered}$ | $\begin{gathered} 8 \\ (6) \end{gathered}$ | $\begin{gathered} 15 \\ (10) \end{gathered}$ | $(\overline{-})$ | $\begin{gathered} 21 \\ (15) \end{gathered}$ | $\begin{aligned} & 10 \\ & (7) \end{aligned}$ | $\begin{array}{r} 32 \\ (23) \end{array}$ | (-) | (-) | $\begin{gathered} 0.1 \\ (0.1) \end{gathered}$ |
| (1) | (-) | $\begin{array}{r} 7 \\ (6) \end{array}$ | $\begin{array}{r} 0.3 \\ (0.2) \end{array}$ | $\begin{array}{r} 6 \\ (5) \end{array}$ | $\begin{gathered} 7 \\ 7 \end{gathered}$ | (-) | $\begin{array}{r} 23 \\ (19) \end{array}$ | $\begin{gathered} 7 \\ (6) \end{gathered}$ | $\begin{array}{r} 28 \\ (23) \end{array}$ | $(-)$ | $(-)$ | 0.2 $(0.1)$ |
| (3) | $(-)$ | $\underset{(13)}{5}$ | $\underset{(3)}{1}$ | (6) | $(-)$ | (-) | 7) | $\begin{gathered} 3 \\ (9) \end{gathered}$ | $\begin{gathered} 8 \\ (19) \end{gathered}$ | (-) | (-) | Neg. (-) |
| (1) | $(\overrightarrow{)}$ | $\begin{gathered} 20 \\ (17) \end{gathered}$ | $\begin{gathered} 1 \\ (1) \end{gathered}$ | $\begin{gathered} 8 \\ (7) \end{gathered}$ | $\begin{gathered} 14 \\ (12) \end{gathered}$ | (-) | $\underset{(17)}{21}$ | $\begin{gathered} 5 \\ (4) \end{gathered}$ | (1) |  |  | 1 |
|  |  |  |  |  |  |  | Rainfall Pattern-D E (C4) D1 E3 |  |  |  |  |  |
| 4 ${ }^{4}$ | (-) | $\begin{gathered} 4 \\ (3) \end{gathered}$ | (4) | $\begin{gathered} 17 \\ (12) \end{gathered}$ | $\begin{gathered} 7 \\ \text { (5) } \end{gathered}$ | $\begin{array}{r} 1 \\ (-4) \end{array}$ | $\underset{(15)}{21}$ | $\begin{gathered} 9 \\ (7) \end{gathered}$ | $\begin{gathered} 0.2 \\ (0.1) \end{gathered}$ | (-) | (-) | 8 $(5)$ |
| (2) | (-) | $\stackrel{2}{2}$ | $\begin{gathered} 2 \\ (1) \end{gathered}$ | $\begin{array}{r} 18 \\ (13) \end{array}$ | $\begin{aligned} & 13 \\ & \text { (9) } \end{aligned}$ | $\begin{array}{r} 0.2 \\ (0.1) \end{array}$ | $\begin{aligned} & 16 \\ & (12) \end{aligned}$ | $\begin{gathered} 11 \\ (8) \end{gathered}$ | (2) | (-) | (-) | 3 $(2)$ |
| 5 | $\square$ | 0.4 | 6 | 4 | 2 | (0.4 | 11 | 16 | 15 | - | ( | 1 |
| (5) | $(-)$ | (0.4) | (6) | (3) | (2) | (0.4) | (11) | (15) | (14) | $(-)$ | $(-)$ | (1) |
| (4) | $(-)$ | (0.4) | (3) | 10 (7) | (5) | $(-)$ | ${ }_{(8)}^{12}$ | $\begin{array}{r} 20 \\ (13) \end{array}$ | $\begin{array}{r} 35 \\ (23) \end{array}$ | (-) | $(-)$ | (0.4) |
| 1 |  | ) | (4) | (25) | 5 | $(-)$ | (4) | 12 | (-) | $\square$ | $\rightarrow$ | (4) |
| (2) |  | (3) | (4) | 30 | 7 |  | 13 | 17 | 0.3 |  |  | 5 |
| (2) | $(-)$ | (1) | (4) | (20) | (5) | $(-)$ | (9) | (12) | (0.2) | (-) | $(-)$ | (3) |
| (1) | $(-)$ | $\begin{gathered} 6 \\ (6) \end{gathered}$ | $\begin{array}{r} 5 \\ (5) \end{array}$ | $\begin{array}{r} 16 \\ (16) \end{array}$ | $\begin{array}{r} 20 \\ (20) \end{array}$ | $\begin{array}{r} 0.2 \\ (0.2) \end{array}$ | $\begin{aligned} & 6 \\ & (6) \end{aligned}$ | $\begin{aligned} & 11 \\ & \text { (11) } \end{aligned}$ | (-) | ( - | - | (7) |

Rainfall Pattern-AE4 (B1 C3) D1 E3

| $1$ | ( | ${ }_{(3)}^{2}$ | $(14$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{array}{r} 8 \\ (10) \end{array}$ | $\begin{array}{r} 3 \\ (3) \end{array}$ | $\begin{array}{r} 5 \\ (6) \end{array}$ | (3) | -) | -) | ) | (3) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 1 | 10 | 4 | 1 | 14 | 1 | 2 | (3) | ) |  |  |  |
| (1) | (2) | (14) | (6) | (1) | (19) | (1) | (2) | (13) | (3) | (-) | (-) | 2) |
| 2 | , | 1 | 3 | ) | 10 | 2 | 9 | 2 | - | - |  |  |
| (4) | (1) | (2) | (6) | (9) | (21) | (4) | (20) | (4) | $(-)$ | $(-)$ | (-) | 2) |
| 2 | 4 | (1) | 16 | 5 | 26 | 0.4 | 9 | 2 | 2 | - |  |  |
| (2) | (0.4) | (1) | (18) | (6) | (30) | (0-4) | (10) | (3) | (3) | $(-)$ | $(-)$ | (1) |
| 0.2 |  | (8) | 15 | (3) | 28 |  | 8 | ${ }^{6}$ | 7 | - |  | 13 |
| -2) | (-) | (8) | (13) | (3) | (23) | $(-)$ | (7) | (5) | (6) | $(-)$ | (-) | (11) |

[^29]
## ANNEXURE



6 (Contd.)

| W | Ba | Mt | G | T | Pu | S | Gn | O | C | L | F | Mc |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

$$
\begin{array}{rrrrrrrrrrrrr}
0.1 & - & 8 & 1 & 2 & 5 & 1 & 2 & 2 & 13 & 2 & (-) & 1 \\
(0.3) & (-) & (14) & (1) & (4) & (10) & (2) & (4) & (3) & (24) & (4) & (-) & (2) \\
- & - & 11 & - & 4 & 16 & - & 4 & 3 & 5 & 1 & - & 1 \\
(-) & (-) & (15) & (-) & (5) & (21) & (-) & (5) & (4) & (6) & (1) & (-) & (1)
\end{array}
$$

Rainfall Pattern-D1 E3 (Cl D3) D1 E3

(1) (-)
$\begin{array}{rr}4 & 2 \\ (3) & \end{array}$
$\begin{array}{rr}3 & 6 \\ (3) & (5)\end{array}$
$\begin{array}{rr}1 & 5 \\ (1) & (4)\end{array}$
$\begin{array}{ccc}3 & 46 \\ (2) & (36) & (\square)\end{array}$
(1)

$$
\begin{array}{rrrrrrrrrrr}
13 & (-) & (-) & 2 & 0.2 & 1 & - & 0.4 & 3 & 11 & (-) \\
\{31) & (-) & (0.4) & (3) & (-) & (1) & (6) & (27) & (-) & (-)
\end{array}
$$

$\begin{array}{rrrrrrrrrrrrr}20 & (-) & 9 & 2 & 3 & 8 & 1 & 16 & 4 & 24 & (-) & (-) & (2)\end{array}$
$\begin{array}{llrllllllllll}- & (-) & 7 & (-) & 1 & 3 & 0.4 & 2 & 0.4 & 4 & - & (-) & 0.4 \\ (-) & (-) & (-) & (3) & (8) & (1) & (6) & (1) & (10) & (-) & (-) & (1)\end{array}$
$\begin{array}{rrrrrrrrrrrrr}0.2 \\ (0.3) & (-) & (12) & 0 \cdot 1 & (0 \cdot 1) & (4) & (7) & (0.3) & (27) & (3) & (10) & (1) & (-)\end{array}$
$\begin{array}{llccccccccccc}\square & (-) & (-) & (-) & 0.4 & 2 & (-) & 2 & 0.4 & 2 & (-) & (-) & 1\end{array}$
$\begin{array}{ccccccccccccc}0 \cdot 1 & - & 9 & (-) & 2 & 8 & 0 \cdot 2 & 12 & 2 & 9 & 0 \cdot 1 & (-) & 2\end{array}$

| 13 | - | 3 | 2 | 2 | 0 | 1 | 13 | 5 | 7 | - | - | 0.4 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| $(14)$ | $(-)$ | $(4)$ | $(2)$ | $(2)$ | $(8)$ | $(1)$ | $(14)$ | $(5)$ | $(7)$ | $(-)$ | $(-)$ | $(0.4)$ |
| 7 | - | 4 | 2 | 2 | 6 | 3 | 11 | 2 | 6 | $(-$ | 0.3 | 5 |
| $(6)$ | $(-)$ | $(4)$ | $(2)$ | $(2)$ | $(5)$ | $(2)$ | $(10)$ | $(2)$ | $(5)$ | $(-)$ | $(0 \cdot 2)$ | $(4)$ |
| 9 | - | 6 | 3 | 9 | 6 | 19 | 4 | 10 | - | 0.3 | 3 |  |
| $(6)$ | $(-)$ | $(-)$ | $(4)$ | $(2)$ | $(6)$ | $(4)$ | $(12)$ | $(3)$ | $(6)$ | $(-)$ | $(0.2)$ | $(2)$ |
| 3 | - | $0 \cdot 1$ | 1 | 1 | 7 | 3 | 7 | 1 | 2 | $(-$ | - | 3 |
| $(4)$ | $(-)$ | $(0 \cdot 1)$ | $(1)$ | $(2)$ | $(10)$ | $(4)$ | $(10)$ | $(1)$ | $(3)$ | $(-)$ | $(-)$ | $(4)$ |

$\begin{array}{rrrrrrrrrrrrr}39 & (-) & (-) & (2) & 1 & 1 & (3) & (-) & (5) & (5) & (25) & (-) & (\square) \\ (1) & (1)\end{array}$




Rainfall Pattern D1E3 (C1D3) CID1E2

$\begin{array}{rrrrrrrrrrrrr}\square & (-) & 2 & (-) & 0.4 & 3 & 1 & 3 & 0.4 & 1 & (- & (- & 3 \\ (-) & (-) & 1 & 1 & (2) & (10) & (1) & (13) & (2) & (3) & (-) & (-) & (6) \\ (-) & (-) & (3) & (2) & (2) & (7) & 0.2 & 1 & 1 & 2 & 0.4 & (4) & (2) \\ (6) & (1) & (-) & (5)\end{array}$
$\begin{array}{ccccccccccccc}- & - & 2 & - & 0.4 & 2 & - & 2 & 0.2 & 2 & (- & (-) & 0.4 \\ (-) & (-) & (13) & (-) & (3) & (11) & (-) & (9) & (2) & (13) & (-) & (-) & (2) \\ (-) & (-) & 12 & (-) & 3 & 5 & - & 2 & 3 & 0.3 & 0.1 & - & 1 \\ (6) & (11) & (-) & (4) & (5) & (1) & (0.3) & (-) & (3)\end{array}$

$\left(\begin{array}{llllllllllll} & (-) & 0.2 & (\square) & (1) & (3) & (-) & (11) & (-) & (7) & 0.2 & (1)\end{array}(\square) \quad(-) \quad(-) \quad(6)\right.$

ANNEXURE





## ANNEXURE



## 6 (Contd.)

| W | Ba | Mt | G | T | Pu | S | Gn | 0 | C | L | F | Mc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | Rainfall Pattern D1E3 (C2D2) C1D1E2 |  |  |  |  |  |
| $\underset{(1)}{0 \cdot 1}$ | (-) | $\begin{aligned} & 1 \\ & (5) \end{aligned}$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (\cdot 4) \end{aligned}$ | $2$ (10) | $\begin{aligned} & 0 \cdot 1 \\ & (1) \end{aligned}$ | 2 <br> (7) | $\begin{aligned} & 0 \cdot 1 \\ & (1) \end{aligned}$ | $\overline{(-)}$ | $\overline{(-)}$ | $\overline{(-)}$ | $\begin{gathered} 3 \\ (15) \end{gathered}$ |
| (-) | (-) | ${ }_{\text {(5) }}^{0.4}$ | $(-)$ | ${ }_{\text {(1) }}^{0 \cdot 1}$ | $\stackrel{1}{(8)}$ | $\begin{aligned} & 0 \cdot 2 \\ & (3) \end{aligned}$ | $\begin{aligned} & 2 \\ & (22) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ | (-) | (-) | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ | $\begin{gathered} 0.2 \\ (3) \end{gathered}$ |
| $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\overline{(-)}$ | $9$ <br> (20) | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\begin{aligned} & 0 \cdot 2 \\ & (0 \cdot 3) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (0.4) \end{aligned}$ | 3 | $\begin{aligned} & 9 \\ & (21) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (1) \end{aligned}$ | $(-)$ | $\overline{(-)}$ | $(-)$ | $\begin{gathered} 3 \\ 3 \\ (7) \end{gathered}$ |
| (-) | $\overline{(-)}$ | $\stackrel{2}{(11)}$ | $\overline{(-)}$ | $\begin{aligned} & 0 \cdot 1 \\ & (\cdot 3) \end{aligned}$ | $\begin{aligned} & 1 \\ & (5) \end{aligned}$ | $\underset{(1)}{0 \cdot 1}$ | $\begin{aligned} & 3 \\ & (14) \end{aligned}$ | $\begin{aligned} & 1 \\ & (4) \end{aligned}$ | $\overline{(-)}$ | $\underset{(1)}{0.2}$ | $(-)$ | $0.4$ (2) |
| - |  |  |  |  | . | . | Rainfall Pattern D1E3 (C3D1) C1E3 |  |  |  |  |  |
| (-) | (-) | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 3) \end{aligned}$ | $\overline{(-)}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (3) \end{aligned}$ | $\stackrel{1}{(4)}$ | $\begin{aligned} & 0.4 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\underset{(1)}{0.1}$ | $\begin{gathered} 0.1 \\ (0.3) \end{gathered}$ | $(\overline{-})$ | $\underset{(1)}{0.2}$ |
| (-) | (-) | ${ }_{\text {(3) }}$ | ${ }^{1}$ | 1 <br> (2) | $3$ (7) | $\begin{aligned} & 0.2 \\ & (0.4) \end{aligned}$ | $\begin{gathered} 2 \\ 2 \\ (4) \end{gathered}$ | $\begin{aligned} & 0 \cdot 4 \\ & \text { (2) } \end{aligned}$ | $\begin{gathered} 3 \\ 3 \\ (6) \end{gathered}$ | $0.4$ <br> (1) | (一) | $\begin{gathered} 3 \\ \mathbf{( 4 )} \end{gathered}$ |
| (-) | (-) | $\begin{aligned} & 2 \\ & (7) \end{aligned}$ | $(-)$ | $\begin{aligned} & 0.4 \\ & \text { (2) } \end{aligned}$ | $\begin{aligned} & 3 \\ & (10) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & \text { (2) } \end{aligned}$ | 4 <br> (13) | $\begin{aligned} & 0.4 \\ & \text { (2) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (3) \end{aligned}$ |  | $(\square)$ | (6) |
| (-) | (-) | $\begin{aligned} & 3 \\ & (9) \end{aligned}$ | (-) | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 3 \\ & \text { (9) } \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 4) \end{aligned}$ | $\begin{aligned} & 3 \\ & (8) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 3) \end{aligned}$ | 4 (12) | (-) | $\underset{(1)}{0.2}$ | $\begin{array}{r} 6 \\ (16) \end{array}$ |
|  | (-) | $\begin{aligned} & 5 \\ & (8) \end{aligned}$ | (-) | ${ }_{(2)}^{\prime}$ | $\begin{gathered} 5 \\ (8) \end{gathered}$ | $\begin{aligned} & 0.3 \\ & (0.4) \end{aligned}$ | $\begin{aligned} & 5 \\ & (8) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & 10 \\ & (17) \end{aligned}$ | $(-)$ | $\underset{(3)}{2}$ | $\begin{array}{r} 9 \\ (14) \end{array}$ |
|  |  |  |  | . | - | - | Rainfall Pattern D1E3 (B1C2E1) C1E3 |  |  |  |  |  |
| $(-)$ | $(-)$ | (-) | $(-)$ | $(-)$ | $\begin{aligned} & 0.2 \\ & (4) \end{aligned}$ | $(-)$ | $(-)$ | $(-)$ | (-) | (-) | $(-)$ | $0.2$ (4) |
| (-) | (-) | $\begin{gathered} 0 \cdot 1 \\ \text { (1) } \end{gathered}$ | (-) | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 0.4 \\ & \text { (2) } \end{aligned}$ | $\stackrel{1}{(4)}$ | $\begin{aligned} & 0.4 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & \text { (1) } \end{aligned}$ | 0.1 $(0.4)$ | $(-)$ | $0.2$ (1) |
| (-) | (-) | ${ }_{\text {(1) }}^{0.2}$ | $\underset{(1)}{0.2}$ | (-) | $\begin{aligned} & 2 \\ & (6) \end{aligned}$ | $\underset{(1)}{0.4}$ | $\begin{aligned} & \mathbf{1} \\ & (2) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\stackrel{1}{(4)}$ |  | $(-)$ | $\stackrel{3}{(7)}$ |
| (-) | (-) | $1$ | (-) | (-) | $\begin{aligned} & 3 \\ & \text { (9) } \end{aligned}$ | $1$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $(-)$ | $\begin{aligned} & 0.2 \\ & \text { (1) } \end{aligned}$ | $(\overline{-})$ | (2) |
| (-) | (-) | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | (-) | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\begin{aligned} & 3 \\ & (5) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (0 \cdot 3) \end{aligned}$ | $\underset{(4)}{2}$ | ${ }_{(1)}^{0.3}$ | $\begin{aligned} & \mathbf{3} \\ & (5) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 1) \end{aligned}$ | $\stackrel{8}{(14)}$ | 3 $(5)$ |
| (-) | $(-)$ | $\frac{1}{(2)}$ | (-) | $\begin{aligned} & 0 \cdot 3 \\ & (1) \end{aligned}$ | $\begin{aligned} & 3 \\ & (8) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 4) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & \mathbf{( 4 )} \end{aligned}$ | $(-)$ | 6 <br> (16) | (2) |
| (-) | (-) | (-) | (-) | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{aligned} & 2 \\ & (6) \end{aligned}$ | $\begin{aligned} & 1 \\ & \text { (2) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $\stackrel{1}{(2)}$ | $\begin{aligned} & 1 \\ & \text { (2) } \end{aligned}$ | $\underset{(16)}{6}$ | $\begin{aligned} & 1 \\ & (3) \end{aligned}$ | (6) |
|  |  | Г | - | $0 \cdot 1$ |  | $0 \cdot 1$ | $\square$ |  | - |  | - | $0.2$ |
| (-) | (-) | (-) | (-) | (1) | (17) | (1) | (-) | (-) | (-) |  | (-) | (1) |
| (-) | (-) | $\begin{aligned} & 0.2 \\ & (0.4) \end{aligned}$ | $\underset{(2)}{1}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | $\underset{(20)}{8}$ | $(-)$ | $\begin{aligned} & 0 \cdot 3 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (3) \end{aligned}$ | $\begin{aligned} & 1 \\ & (3) \end{aligned}$ | $\begin{aligned} & 3 \\ & (6) \end{aligned}$ | (4) |



6 (Contd.)

| W | Ba | Mt | G | T | Pu | S | Gn | 0 | C | L | F | Mc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | Rainfall Pattern D1E3 (A1B1C2) ClE3 |  |  |  |  |  |
| $(-)$ | $(-)$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 4) \end{aligned}$ | $\underset{(1)}{0 \cdot 1}$ | $\begin{aligned} & 1 \\ & (4) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 4 \end{aligned}$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 3) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $(-)$ | (4) |
| $(-)$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & \text { (2) } \end{aligned}$ | $(-)$ | $\overline{(-)}$ | $\begin{aligned} & 0.2 \\ & \text { (4) } \end{aligned}$ | (-) | (-) | $\overline{(-)}$ | $\overline{(-)}$ | $(-)$ | $\overline{(-)}$ | $\begin{aligned} & 0.2 \\ & (4) \end{aligned}$ |
| (-) | $(-)$ | $\begin{aligned} & 0.2 \\ & \text { (1) } \end{aligned}$ | $\underset{(1)}{0 \cdot 1}$ | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ | $\underset{(8)}{1}$ | $\begin{aligned} & 0 \cdot 1 \\ & (1) \end{aligned}$ |  |  |  |  | (-) | 0.2 (2) |
| $\begin{aligned} & 1 \\ & (1) \end{aligned}$ | $\overline{(-)}$ | ${ }_{(1)}^{1}$ | $\stackrel{1}{(1)}$ | $\begin{aligned} & 1 \\ & (1) \end{aligned}$ | $\begin{aligned} & 5 \\ & (7) \end{aligned}$ | $\begin{aligned} & 3 \\ & (4) \end{aligned}$ | $\begin{gathered} 2 \\ (3) \end{gathered}$ |  |  | $(-)$ | $\begin{aligned} & 17 \\ & (25) \end{aligned}$ | ${ }_{(9)}^{6}$ |
|  |  |  |  |  | - |  | Rainfall Pattern D1E3 (A3C1) C1E3 |  |  |  |  |  |
| $\begin{aligned} & (-) \\ & (-) \end{aligned}$ | $\begin{aligned} & (-) \\ & (-) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (2) \\ & (-) \end{aligned}$ | $\begin{aligned} & \overline{( }) \\ & (-) \end{aligned}$ | $\begin{aligned} & (-) \\ & (-) \end{aligned}$ | $\begin{aligned} & \overline{( }) \\ & (-) \end{aligned}$ | $\begin{aligned} & \overrightarrow{(-)} \\ & 1 \\ & (2) \end{aligned}$ | (-) (-) | $\begin{aligned} & \overline{(-)} \\ & (-) \end{aligned}$ | $\begin{aligned} & \overline{(-)} \\ & (\square) \end{aligned}$ | $\begin{aligned} & 0 \cdot 1 \\ & (2) \\ & 1 \\ & (19) \end{aligned}$ | $\begin{aligned} & (-) \\ & (-) \end{aligned}$ | 0.1 (2) 0.4 (5) |
| (- | $\overline{1}$ | $\begin{aligned} & \mathbf{2} \\ & (5) \end{aligned}$ | $(-)$ | $(-)$ | $\begin{gathered} \mathbf{3} \\ (6) \end{gathered}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ |  | $\begin{gathered} 0.2 \\ (\cdot 2) \end{gathered}$ |  | $(-)$ | (29) | (2) |
|  |  |  |  |  |  |  | Rainfall Pattern D1 E3 (A3Cl) C1D1E2 |  |  |  |  |  |
| (-) | (- | (-) | (-) | $\overline{( })$ | $\begin{aligned} & 0.2 \\ & \text { (2) } \end{aligned}$ | $\begin{aligned} & 0.2 \\ & \text { (2) } \end{aligned}$ |  | $(-)$ | (二) | $\stackrel{1}{(10)}$ | (-) | (11) |
| $(-)$ |  |  |  |  | (-) | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ |  |  | (-) | $\stackrel{1}{(14)}$ | (-) | (1) |
| (-) | (- | (-) | (-) | (-) | (-) | $\begin{aligned} & 0.2 \\ & \text { (3) } \end{aligned}$ | (-) |  | (-) |  | (-) | $0 \cdot 1$ (3) |
| (-) |  |  | (-) | (-) | $\begin{aligned} & 0.2 \\ & \text { (2) } \end{aligned}$ | (-) |  |  | $(-)$ | $\underset{\text { (2) }}{0.2}$ | $\overline{(-)}$ | $\stackrel{-3}{ }(3)$ |
| $(-)$ | (-) | $\underset{(1)}{0 \cdot 1}$ | $(-)$ | $\overline{(-)}$ | $\begin{aligned} & 0.3 \\ & \text { (2) } \end{aligned}$ | $\underset{\text { (1) }}{0.2}$ | (-) |  |  | $\begin{aligned} & 3 \\ & (18) \end{aligned}$ | (5) | $\underset{(8)}{2}$ |
|  |  |  |  |  |  | - | Rainfall Pattern D1E3 (A3B1) C1E3 |  |  |  |  |  |
| $(-)$ | (- |  |  | $(-)$ | $\underset{\text { (2) }}{0.2}$ | $\begin{aligned} & 0 \cdot 1 \\ & \text { (1) } \end{aligned}$ | $(-)$ | $\underset{\text { (1) }}{0 \cdot 1}$ | $(-)$ | $\stackrel{1}{(8)}$ | $\underset{\text { (1) }}{0 \cdot 1}$ | 0.4 (3) |
| - |  |  |  |  | - | - | Rainfall Pattern D1E3 (A3B1) C1D1E2 |  |  |  |  |  |
| (-) | $(-)$ | 1 | $(-)$ | $\overline{(-)}$ | $\begin{gathered} 0.2 \\ (2) \end{gathered}$ | $\begin{aligned} & 0.2 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (4) \end{aligned}$ | $\overline{(-)}$ | $(-)$ | $\stackrel{1}{(9)}$ | (-) | $\underset{(20)}{2}$ |
| $\overline{(-)}$ | (-) | $(-)$ | $(-)$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (2) \end{aligned}$ | (-) | $\overline{(-)}$ | $\stackrel{\square}{(-)}$ | ${ }_{(10)}$ | $(-)$ | (11) |
| (- | (-) | $(-)$ |  | (-) | (-) | $0.2$ (3) |  |  | (-) | $\begin{gathered} 0.4 \\ (5) \end{gathered}$ | (-) | $0 \cdot 1$ (3) |
| - |  |  | - |  | - | 0.2 |  |  |  |  |  | $0 \cdot 1$ |
| (-) | (-) | (-) | (-) | (-) | (-) | (1) |  | (-) | $(-)$ | (15) | (-) | (1) |

## ANNEXURE



6 (Contd.)
)

. Rainfall Pattern D2E2 (A2B1C1) C1D1E2



Rainfall Pattern C1E2(C2D2)C1D1E2



Note: In case of Yelandur taluk about

6 (Contd.)

| W | Ba | Mt | G | T | Pu | S | Gn | 0 | C | L | F | Mc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | Rainfall Pattern ClE3(A4)CLE1E2 |  |  |  |  |  |
| $\bar{L}$ | $(-)$ | (-) | (-) | (-) | $\underset{(4)}{1}$ | $(\square)$ | (-) | ( $\rightarrow$ | (-) | $\begin{gathered} 6 \\ (10) \end{gathered}$ | $(\overline{-})$ | $\begin{array}{r} 3 \\ (10) \end{array}$ |
| (-) | (-) | (-) | (-) | (-) | $\begin{aligned} & 1 \\ & (4) \end{aligned}$ | $0.4$ | $(\square)$ | (-) | (-) | 4 | $1$ $\stackrel{1}{(3)}$ | $\begin{gathered} 4 \\ (12) \end{gathered}$ |
| (-) | (-) | (-) | $\square$ | (-) | $\begin{aligned} & 3 \\ & (5) \end{aligned}$ | $\begin{aligned} & 1 \\ & \text { (1) } \end{aligned}$ | $0.4$ | $(\overline{)}$ |  | 6 | $\frac{(3)}{(-)}$ | $\begin{gathered} 13 \\ \text { (22) } \end{gathered}$ |
| (-) | (-) | (-) | $(-)$ | (-) | $\begin{aligned} & 3 \\ & (7) \end{aligned}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $\underset{( }{\infty}$ | $\stackrel{\square}{\square}$ | $(\overline{-})$ | $\begin{gathered} 4 \\ (12) \end{gathered}$ | $\begin{gathered} 0.2 \\ (1) \end{gathered}$ | $\begin{gathered} 2 \\ (5) \end{gathered}$ |
|  |  |  |  |  |  |  |  | Rainfall Pattern C1E3(A4)B1CIE2 |  |  |  |  |
| $(-)$ | (-) | $(-)$ | $\rightarrow$ | (-) | (4) | $\begin{aligned} & 0.1 \\ & (0.3) \end{aligned}$ | (-) | (-) | (-) | $\underset{(14)}{6}$ | (-) | (6) |
| $\cdots$ | - | (-) | $\cdots$ | (-) | (3) | (-) | $(-)$ |  | ( | 4 | ( | 3 (9) |
| - |  | - | - | - | 0.3 |  |  | 0.1 |  | 5 | 1 | 4 |
| $(-)$ | (-) | $(-)$ | (-) | $(-)$ | (1) | (-) | $(-)$ | (0.3) | (-) | (20) | (4) | (18) |
| $(-)$ | (-) | (-) | (-) | (-) | (-) | (-) | (-) | $(-)$ | $(\square)$ | $\frac{6}{(45)}$ | $(-)$ | $\begin{aligned} & 1 \\ & (8) \end{aligned}$ |
|  |  |  |  |  |  |  | Rainfall Pattern C1D1 E2(D2E2)C1D1E2 |  |  |  |  |  |
| $(-)$ | (-) | $\begin{aligned} & \mathbf{1} \\ & (2) \end{aligned}$ | $\stackrel{1}{(1)}$ | $\underset{(3)}{2}$ | $\begin{aligned} & 13 \\ & (22) \end{aligned}$ | $\begin{aligned} & 0.1 \\ & (0.2) \end{aligned}$ | $\begin{aligned} & 10 \\ & (16) \end{aligned}$ | $\begin{aligned} & 3 \\ & (4) \end{aligned}$ | $(-)$ | $\begin{gathered} 1 \\ \text { (2) } \end{gathered}$ | $\stackrel{\leftrightarrows}{\square}$ | $\begin{gathered} 3 \\ (4) \end{gathered}$ |
| (-) | $(-)$ | $\frac{1}{(1)}$ | $\begin{aligned} & 0 \cdot 2 \\ & (0 \cdot 3) \end{aligned}$ | $\frac{1}{(2)}$ | $\begin{aligned} & 13 \\ & (20) \end{aligned}$ | $\begin{aligned} & 1 \\ & (1) \end{aligned}$ | $\begin{aligned} & 3 \\ & \text { (5) } \end{aligned}$ | $\begin{aligned} & 2 \\ & (2) \end{aligned}$ | $(-)$ | $\begin{gathered} \mathbf{3} \\ (4) \end{gathered}$ | $(-)$ | $\begin{gathered} 15 \\ (23) \end{gathered}$ |
|  |  |  |  |  |  |  | Rainfall Pattern C1DIE2(C1D3)CIDIE2 |  |  |  |  |  |
| $(-)$ | $(-)$ | $\underset{(-)}{1}$ | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | (3) | $\stackrel{6}{(16)}$ | $\underset{(3)}{0.1}$ | $\begin{gathered} 2 \\ (5) \end{gathered}$ | $\stackrel{1}{(3)}$ | $(-)$ | $\stackrel{1}{(3)}$ | (-) | $\begin{gathered} \mathbf{3} \\ \mathbf{( 6 )} \end{gathered}$ |
| (-) | $\square$ | $2$ | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\begin{aligned} & 2 \\ & (2) \end{aligned}$ | $\begin{aligned} & 5 \\ & (7) \end{aligned}$ | $(\overrightarrow{-})$ | $\begin{aligned} & 6 \\ & \text { (9) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & \text { (1) } \end{aligned}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $(-)$ | $\begin{gathered} 9 \\ 9 \\ (13) \end{gathered}$ |
| - | - | 0.4 | 1 | 1 | 7 | 1 | 1 | 0.4 | - | 0.1 | - | 10 |
| (-) | (-) | (1) | (1) | (1) | (14) | (2) | (3) | (1) | $(-)$ | (0.1) | (-) | (21) |
| (-) | $(\rightarrow)$ | $\rightarrow$ | (-) | $(-)$ | ${ }_{(6)}^{1}$ | $\underset{(2)}{0.2}$ | (-) | (-) | $(-)$ | $\begin{gathered} 0 \cdot 2 \\ (3) \end{gathered}$ | $\begin{aligned} & 1 \\ & (9) \end{aligned}$ | $\begin{gathered} 5 \\ (53) \end{gathered}$ |
| 1 | ( | (-) | $\begin{aligned} & 0 \cdot 1 \\ & (0 \cdot 2) \end{aligned}$ | (2) | 16 | - | $5$ | (2) | - | 1 | $0 \cdot 1$ 0 (1) | (5) |
| - |  | (-) | $\begin{aligned} & (0.2) \\ & 0.4 \end{aligned}$ |  |  | (-) |  |  | (-) | (2) $0 \cdot 1$ | (1) | (4) |
| $(-)$ | $(-)$ | 0.4 | (1) | (1) | (21) | (0.2) | (3) | (5) | (1) | (0.2) | $(-)$ | (6) |
| (-) | (-) | (-) | $(\square)$ | $\begin{aligned} & 1 \\ & \text { (2) } \end{aligned}$ | $\stackrel{8}{(17)}$ | $(-)$ | $\begin{aligned} & 3 \\ & (6) \end{aligned}$ | $\begin{aligned} & 3 \\ & (6) \end{aligned}$ | $\begin{aligned} & 2 \\ & (4) \end{aligned}$ | ${ }_{(1)}^{0.3}$ | (-) | (6) |
| (-) | (-) | (-) | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (\mathrm{l}) \end{aligned}$ | $\begin{aligned} & 8 \\ & (20) \end{aligned}$ | (-) | $\frac{1}{(2)}$ | $\frac{1}{(1)}$ | $\begin{gathered} 2 \\ (4) \end{gathered}$ | $\underset{(i)}{0.3}$ | (-) | $\begin{gathered} \mathbf{S} \\ (12) \end{gathered}$ |
| $(-)$ | $\stackrel{\square}{\square}$ | $\begin{aligned} & \frac{1}{(2)} \end{aligned}$ | $(-)$ | $\begin{array}{r} 1 \\ (2) \end{array}$ | $\begin{array}{r} 14 \\ (31) \end{array}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\begin{aligned} & 1 \\ & (2) \end{aligned}$ | $(\square)$ | $\begin{aligned} & 2 \\ & (5) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (1) \end{aligned}$ | $\stackrel{1}{(2)}$ |
| $(-)$ | $(\square)$ | $(-)$ | $(-)$ | $\stackrel{\square}{\square}$ | $\begin{aligned} & 1 \\ & (5) \end{aligned}$ | $\begin{gathered} 0.3 \\ (1) \end{gathered}$ | $\stackrel{1}{(3)}$ | $(\square)$ | $(\square)$ | $\begin{gathered} 1 \\ (3) \end{gathered}$ | (-) | $0.4$ (2) |
| $50 \%$ area is under other non-food crops. 42-133 Deptt. of Agri/76 |  |  |  |  |  |  |  |  |  |  |  |  |

ANNEXURE

| District/ |  |  | Gca | Pd | Jk | Jr | B | M | R |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Rainfall Zone XXIV (Contd.) |  |  |  |  | - | - |
| Hassan . . | - - | - | 41-3 | $\begin{aligned} & 7 \\ & (18) \end{aligned}$ | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | $\overline{(-)}$ | $\overline{(-)}$ | $1$ <br> (2) | $\begin{gathered} 19 \\ (46) \end{gathered}$ |
| Mysore |  |  |  |  |  |  |  |  |  |
| Kollegal . | - - | - | $55 \cdot 5$ | $\begin{array}{r} 2 \\ (4) \end{array}$ | $\begin{array}{r} 1 \\ (2) \end{array}$ | $(-)$ | $\begin{array}{r} 1 \\ (2) \end{array}$ | $0 \cdot 4$ <br> (1) | $\begin{gathered} 19 \\ (34) \end{gathered}$ |
| Hassan |  |  |  |  |  |  |  |  |  |
| Arsikere | - | - | $69 \cdot 2$ | $1$ (2) | $\begin{gathered} 5 \\ (7) \end{gathered}$ | $\stackrel{1}{(1)}$ | $(-)$ | $\begin{aligned} & 0 \cdot 2 \\ & (0 \cdot 2) \end{aligned}$ | $\begin{gathered} 35 \\ (50) \end{gathered}$ |
| C. Patna | - - | - | $466 \cdot 0$ | 5 <br> (8) | 1 <br> (2) |  | $\overline{(-)}$ | $\begin{gathered} 0 \cdot 1 \\ (0 \cdot 1) \end{gathered}$ | $\begin{array}{r} 24 \\ (36) \end{array}$ |
| Tumkur |  |  |  |  |  |  |  |  |  |
| Tiptur . . | - | - | $15 \cdot 0$ | 1 <br> (8) | $0.4$ <br> (4) | $\overline{(-)}$ | $\overline{(-)}$ | $\overline{(-)}$ | $\begin{gathered} 5 \\ (30) \end{gathered}$ |
|  |  |  | Rainfall | Zone- | -XXV |  |  | - | - |
| Coorg |  |  |  |  |  |  |  |  |  |
| Virajpet $\frac{1}{2}$ E | - | - | $25 \cdot 7$ | $\begin{aligned} & 12 \\ & (45) \end{aligned}$ | $\overline{(-)}$ | $\overline{(-)}$ | $(-)$ | $(-)$ | $(-)$ |
| Somvarpet | - | - | $42 \cdot 1$ | $\begin{aligned} & 12 \\ & (28) \end{aligned}$ |  |  | $(-)$ | $0.4$ <br> (1) | $\begin{gathered} 4 \\ (9) \end{gathered}$ |
| Hassan |  |  |  |  |  |  |  |  |  |
| Sakleshpur | - | - | $41 \cdot 0$ | $\begin{aligned} & 13 \\ & (31) \end{aligned}$ | $(-)$ | $\overline{(-)}$ | $\overline{( })$ | $\begin{aligned} & 0 \cdot 2 \\ & \text { (1) } \end{aligned}$ | $0.2$ (1) |
| Chikmagalur |  |  |  |  |  |  |  |  |  |
| Chikmagalur $\frac{1}{2}$ W | - • | - | 25-8 | 6 (24) | 1 <br> (4) | $\begin{aligned} & 0.1 \\ & (\cdot 2) \end{aligned}$ | $\overline{(-)}$ | $\begin{aligned} & 0 \cdot 1 \\ & (\cdot 1) \end{aligned}$ | 4 $(15)$ |
|  |  |  | Rainfall Zone-XXVI |  |  |  |  | - | - |
| Coorg |  |  |  |  |  |  |  |  |  |
| Virajpet $\frac{1}{2} \mathbf{W}$. | - - | - | $25 \cdot 8$ | 11 <br> (43) | $(\square)$ | $\overline{(-)}$ | $(-)$ | $(-)$ | (-) |
| Mercara - | - - | - | $33 \cdot 1$ | $\begin{aligned} & 11 \\ & (34) \end{aligned}$ | $\overline{(-)}$ | $(-)$ | $-$ | $\overline{(-)}$ | $(-)$ |


| W | Ba | Mt | G | T | Pu | s | Gn | 0 | C | L | F | Mc |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  | Rainfall Pattern ClDIE2(CID3)CIDIE2 |  |  |  |  |  |
| $($ | $(\rightarrow)$ | $\begin{aligned} & 0.1 \\ & (0.2) \end{aligned}$ | $\begin{aligned} & 0.2 \\ & (1) \end{aligned}$ | $\rightarrow$ | ${ }_{(15)}^{6}$ | ${ }^{1}$ (2) | $\frac{1}{(2)}$ | $\begin{aligned} & 0.4 \\ & (1) \end{aligned}$ | ${ }_{(0.4)}^{0.2}$ | ${ }_{(3)}^{1}$ | (-) | ${ }_{(8)}^{3}$ |
| $($ | $(-)$ | $\stackrel{4}{(7)}$ | (-) | (-) | ${ }_{(22)}^{12}$ | ${ }_{(1)}^{1}$ | ${ }_{(2)}^{1}$ | ${ }_{(1)}^{1}$ | $\underset{(0.1)}{0.1}$ | $\stackrel{1}{(2)}$ | $(-)$ | (12) |
| (-) | $(-)$ | $\begin{gathered} 0.2 \\ (0.2) \end{gathered}$ | $\begin{aligned} & 0.3 \\ & (1) \end{aligned}$ | $\begin{aligned} & 0 \cdot 3 \\ & (1) \end{aligned}$ | $\stackrel{5}{(7)}$ | (-) | (1) | $\begin{gathered} 3 \\ (5) \end{gathered}$ | $\stackrel{2}{(2)}$ | $\begin{gathered} 13 \\ (18) \end{gathered}$ | 3 $(4)$ | (1) |
| (-) | (-) | ${ }_{(3)}^{2}$ | $\begin{aligned} & 0.4 \\ & \text { a } \end{aligned}$ | (1) | ${ }_{(12)}^{12}$ | ${ }_{(1)}^{1}$ | (1) | (2) | $\stackrel{-}{(-)}$ | ${ }_{(18)}^{12}$ | $\stackrel{3}{5}$ | (2) |
| (-) | $(-)$ | $\underset{(1)}{0.2}$ | $(-)$ | $\begin{aligned} & 0 \cdot 1 \\ & (1) \end{aligned}$ | $\stackrel{2}{(12)}$ | (-) | $\begin{gathered} 0 \cdot 1 \\ (0.4) \end{gathered}$ | $\underset{(1)}{0.2}$ | (-) | $\stackrel{6}{(40)}$ | $\underset{(1)}{0.2}$ | ${ }_{0}^{0.2}$ |
|  |  |  |  |  |  |  | Rainfall Pattern C1D1E2(A3C1)CID1E2 |  |  |  |  |  |
| (-) | (- | (-) | $(-)$ | $($ | $(-)$ | (-) | (-) | (-) | (-) | $\stackrel{10}{(39)}$ | (-) | (19) |
| $(-)$ | (-) | (-) | $\stackrel{1}{(2)}$ | ( | $\begin{aligned} & 3 \\ & (7) \end{aligned}$ | (-) | $\underset{(1)}{0.4}$ | 0.1 $(2)$ | $\begin{aligned} & 0.4) \\ & (\cdot 4) \end{aligned}$ | $\underset{(45)}{19}$ | $(-)$ | ${ }_{(6)}$ |
| $(-)$ | $(-$ | (-) | $(-)$ | $(-$ | ( | ( | ( - | (-) | $(-)$ | ${ }_{(6)}^{27}$ | $\begin{aligned} & 0.3 \\ & (1) \end{aligned}$ | (-) |
| $(-)$ | $(-$ | $(-)$ | $(-)$ | $\square$ | $\begin{aligned} & 1 \\ & (4) \end{aligned}$ | $\begin{aligned} & 0 \cdot 2 \\ & (1) \end{aligned}$ |  | ${ }_{(3)}^{1}$ | ( - |  | ( | (s) |
|  |  |  | - |  | - |  | Rainfall Pettern CIDIE2(A4)CIDIE2 |  |  |  |  |  |
| (-) | (-) | (-) | $(-)$ | $(-)$ | (-) | (-) | (-) | (-) | (-) | 11 $(42)$ | (-) | (15) |
|  |  |  |  |  |  |  |  |  |  | (57) | (-) | (9) |

ANNEXURE 7
Statement I : District-wise List of Rainfall, Cropping and Livestock Patterns

| Taluks | Rainfall Patterns | Cropping Patterns | Livestock Patterns |
| :---: | :---: | :---: | :---: |
| $B A N G A L O R E \mathrm{dt}$. |  |  |  |
| Hoskote | D1 E3 (Cl D3) Cl D1 E2 | R2 Pu4/Pd4 Pu4/Pd4/Pu4 Pd 5/ Pu4 M4 | S3 Cms Cf4 G4/Cy 4/Bf4 |
| Devananhalli | D1 E3 (C2 D2) Cl Dl E2 |  |  |
| Doddballapur |  |  | Cf3 S4 Cy4/G4/Cm4 |
| Melamangala |  |  |  |
| Bangalore North 1/2 N |  |  |  |
| Bangalore North 1/2 S Kanakpura | Cl E3 (C2 D2) Cl Dl E2 |  |  |
| Ramanagaram |  |  |  |
| Bangalore South Anekal |  |  | S3 Con4 Ci 4 G4/Cy4/Br4 |
| Channapatna |  | R3 Pd4 Pu4 Jk4/L4 | S4 Cm4 Cf4 G4/Bf4/Cy4 |
| $B E L G A U M$ dt. |  |  |  |
| Athani | D 1 E3 (Cl D3) Dl E3 | Jr4 B4 Jk4 Gn4 <br> Jr4 B4 Jk4 Gn4/M4/W4 | G4 S4 Cm4 Cf4/Cy4/Cy 4 Bf4 S4 G4 Cm4 Cf4 Bf 4 |
| Ramdurg |  | Jr4 B4 Jk4 Gn4/M4/W4 | S4 G4 Cm4 Cf4 /Bi4 |
| Saundatti |  | Jk4 C4 Gn4 W4 /Pu4 Pd4 Jr4 |  |
| Raibag |  | B4 Jk4 M4 Pu4 Gn4 |  |
| Chikodi |  | Gn4 Jk4 To4 S5 | S3 G4 Cm4/Bf4 |
| Hukeri | D 1 E3 (C2 D2) Cl E3 |  | S4 G4 Cm4 Cf4/Bf4 Bf4 Cm4 By4 Cf4 |
| Bailhongal Belgaum | Dl E3 (Al Bl C2) Cl E3 | Jk4 C4 Gn4 W4/Pu4 Pd4 Jr 4 Pd4 R4 F4 Jk5 |  |
| Khanapur | D1 E3 (A3 C1) C1 E3 | Pd2 L4/B4/M5/V4/F4 | Cm3 Cf4 Cy4 |
| $B E L L A R Y \mathrm{dt}$. |  |  |  |
| Kudligi <br> Sandhur | D1 E3 (C1 D3) D1 E3 | Jk4 Mt4 B4 Gn4/C4/C4 P44 | S3 G4 Cm4/Cf4 S4Cm4 Cf4 G4/Bf4/Cy4 |
| Harpanahalli |  | Jk4 C4 Gn4 R4/Pu4 |  |
| Hadagalli |  | Gn3 Jk4 C4/W4/Pu4 |  |
| Mallapuram |  |  |  |
| Hospet |  | C4 Jk4 Pu4 Mt4 Gn4/S4 Pd4 |  |
| Siruguppa Bellary |  | C3 Jr4 Mt4/Pd 5 | Cm4 CF4 S4 G4 |


| BIDAR dt. |  |  |  |
| :---: | :---: | :---: | :---: |
| Bidar | E4 (BI C3) DI E3] | Jr3 G4 Pu4 Jk5 | Cm4 Cf4 Cy4 G4/S4/Bf4 |
| Basava Kalyan Humnabad |  | Pu4 Mt4 O4 B4 Jr4 <br> Pu4 T4 Jr4 Gn4 O4/Jk4 |  |
| Bhalki |  | Pu4 G4 Jk4 Jr4/Jr5 Mt5 Gn5 |  |
| Aurad |  |  | Cy 3 Cf 4 Cm 4 S 4 |
| BIJAPUR dt. |  |  |  |
| Bagevadi | E4 (Cl D3) Di E3 | Jr3 B4 Gn4/C4 | G4 S4 Cm4 Cf4/Cy4/Cy4 /Cy4 Bf4. |
| Bijapur |  |  |  |
| Bilgi |  |  |  |
| Indi |  |  |  |
|  |  |  |  |
| Modhol S4 G4 Cm4 Cf4/Bf4 |  |  |  |
| Badami |  | Gn4 Jr4 Jk4 B4/W4 |  |
| Bagalkot |  | C4 Jr4 Jk4 Mt4/Gn4/ |  |
|  |  | Gn4 Pu4/84/B4/Mt4 |  |
| Hungund <br> Muddebihal |  |  | G4 S4 Cm4 Cf4/Cy4/Cy4 Br4 |
| CHIKMAGALUR dt. |  |  |  |
| KadurTarikere $\quad$ D1 E3 (Cl D3) Cl Dl E2 $\quad$ R4 L4 Pu4 M64/Jk4/Pd4/Mt4 Jk4 $\quad \begin{aligned} & \text { S4 } \\ & \text { Cm4 }\end{aligned}$ |  |  |  |
|  |  |  |  |
| Chikmagalur 1/2 E L3 Pd3 Cf3 Cy4 Cm4/Bm4 |  |  |  |
| Koppa ${ }_{\text {Sringeri }}$ D1 E3 (A3 B1) C1 D1 E2 |  |  |  |
| Mudigere $\quad \mathrm{L} 2 \mathrm{Pd} 3 \quad \mathrm{Cm} 4 \mathrm{Cf4} \mathrm{Cy} 4 / \mathrm{P} 4$ |  |  |  |
| N. R. Pura Chikmagalur $1 / 2 \mathrm{~W}$ | D2 E2 (A2 B1 Cl) Cl D1 E2 | Pd2 L4/B4/M5/V4/F4 L3 Pd3 | Cf3 Cy $4 \mathrm{Cm} 4 / \mathrm{Bm} 4$ |
| CHITRADURGA dt. |  |  |  |
| Hiriyur | D1 E3 (D2 E2) C1 D1 E2 | C4 Mt4 Jr4 Jk4 Pu4 | S3 G4 Cm4/Cf4 |
| Challakere $1 / 2 \mathrm{~N}$ |  | Pu4 Jk4 Mt4 B4/Gn4/R4 Gn4 |  |
| Molakalmuru 1/2 N | D1 E3 (C1 D3) D1 E3 | Jk4 Mt4 B4 Gn4/C4/ C4 Pu4 |  |
| Malakalmuru $1 / 2 \mathrm{~S}$ Hosadurga | D1 E3 (C1 D3) C1 D1 E2 | R4 L4 Pu4 Mt4/Jk4/Pd4/Mt 4 Jk4 |  |

ANNEXURE 7-Statement I (Contd.),

| Taluks | Rainfall Patteros | Cropping Patterns | Livestock Patterns |
| :---: | :---: | :---: | :---: |
| Holakere |  |  | S4 Con 4 Cf4 G4/Bf4/Cy 4 |
| Jagalur |  | Mt4 R4 Jk4 Pu4 |  |
| Davangere |  | Pd4 R4/JK4 Gn4/Pu4 | Cm4 Cf4 Cy4 S4/ G4/Bi4 |
| COORG dt. |  |  |  |
| Sornwarpet | C1 D1 E2 (A3 C1) C1 D1 E2 | L3 Pd3 | Cf3 Cy4 Cm4/Bm4 |
| Verajpet 1/2 E <br> Virajpet 1/2 W | C1 D1 E2 (A4) C1 D1 E2 |  |  |
| Mercara |  | L2 Pd3 |  |
| DHARWAR dt. |  |  |  |
| Ron <br> R Gadag Mundargi | D1 E3 (C1 D3) D1 E3 | Gn4 Jr4 Jk4 B4/W4 Gn3 Jk4 C4/W4/Pu4 | S4 G4 Cm4 Cf4/Bf4 |
| Navalgund Nargund |  | W3 C4 Jk4/Jr4 C3 W4 Jr4 | Cm4 Cf4 Cy4 S4/G4/Bf4 G4 S4 Cm4 |
| Ranebennur | D1 E3 (C1 D3) C1 D1E2 | C3 Jk4 Mt4 | S3 G4 Cm4 |
| Kundagol | D1E3 (C2 D2) ClE3 | C4 Jk4 Gn4 | Cm4 Cf4 Cy 4 S4/G4/Bf4 |
| Shirahatti |  | Gn3 Jk4 C4/W4/Pu4 |  |
| Dharwar |  | Jk4 C4 Gn4 W4/Pu4 Pd4 Jr4 |  |
| Hubli |  | Jk4 C4 Gn4 R4/Pu4 |  |
| Shiggaon |  | Pd4 C4 Gn4 Pu4 |  |
| Byadgi | D1 E3 (C3 D1) C1 E3 | Pd4 C4 Jk4 Mt4 Ch4 |  |
| Hirekerur <br> Hangal Kalghatgi | D1 E3 (B1 C2 E1) Cl E3 | Pd2 L4/B4/M5/V4/F4 | Cm3 Cf4 Cy4 |
| GULBARGA dt. |  |  |  |
| Shahapur | E4 (C3 D1) D1 E3 | C4 Jr4 Jk4 Mt4/Gn4/Gn4 Pu4/ B4/B4/Mt4 | S4 Cm4 Cf4 G4/Bf4/Cy4 |
| Shorapur Yadgir |  | Jr4_Mt4_Gn4 Pu4 |  |


| Jevargi <br> Sedam <br> Gulbarga <br> Chitapur <br> Afzalpur <br> Chincholi <br> Chiach | E4 (C4) DI E3 | Jr 3 O4 Gn4 T4/C4/T4 B4 Jr3 04 T4 <br> Jr3 O4 Gn4 T4/C4/T4 84 <br> Pu4 T4 Jr4 Gn4 O4/Jk4 | Cm4 Cf4 Cy 4 G4/S4/Bf4 |
| :---: | :---: | :---: | :---: |
| HASSAN dt. |  |  |  |
| Alur | D1 E3 (81 C2 E1) C1 E3 | Pd3 R4 L4/Pu4 | Cf3 Cy $4 \mathrm{Cm} 4 / \mathrm{Bm} 4$ |
| Belur Arkalgud |  | R3 Pu4 Pd4/L4 |  |
| Hassan | Cl D1 E2 (C1 D3) C1 D1 E2 |  | S4 Cm4 Cf4 G4/Cy4 |
| Arsikere ${ }^{\text {Channarayapatna }}$ |  |  | S3 G4 Cm4/Cr4 |
| Holenarsipur |  | R2 Pu4/Pd4/Pu4 Pd4/Pu4 Pd5/ Pu4 M4 | S3 C4, |
| Saklespur | Cl D1 E2 (A3 C1) C1 D1 E2 | L2 Pd3 | Cm4 Cr4 Cy 4 /P4 |
| KOLAR dt. |  |  |  |
|  | D1 E3 (C1 D3) C1 D1 E2 | Gn3 B4 R4 <br> R3 Gn4 Pd4/Mt4/Pu4/Pu4 Pd4 | S3 G4 Cf4/Cm4 S4 Cm4 Cf4 G4 |
| Bangarpet |  |  | S3 G4 Cf4/Cm4 |
| Chintamani Mulbagal |  |  |  |
| Kolar |  | R2 Pu4/Pd4/Pu4 Pd4/Pu4 Pd5/ Pu4 M4 |  |
| Malur Chikballapur Gauribidanur Gudibanda | D1 E3 (C2 D2) C1 D1 E2 | R3 Gn4 Pd4/Mt4/Pu4/Pu4 Pd4 | S3 Cm4 Cf4 G4/Cy4/8f4 |
| Sidalghata |  |  | S3 G4 C14/Cm4 |
| MANDYA dt. |  |  |  |
| Mandya Maddur | C1 E3 (Cl D1 E2) C1 D1 E2 | Pd4 R4 Pu4 S4/Jx4 | $\mathrm{S} 3 \mathrm{G4} \mathrm{Cm} 4 / \mathrm{Cr} 4$ $\mathrm{~S} 4 \mathrm{Cm} 4 \mathrm{CT} 4 \mathrm{G} 4 / \mathrm{B4} 4 / \mathrm{Cy} 4$ |
| Srirangapatna |  |  |  |
| Magamangala |  | R3 Pd4 Pu4 L4/5k | S3 G4 Cm4/Cl4 |
| Pandavapura K. R. Pet | C1 D1 E2 (C1 D3) C1 D1 E2 |  |  |

ANNEXURE 7-Statement I (Contd.)


```
    Deodurg
    Manvi
SIMOGA dt.
```



```
    Honnali & E
    Honnali }\frac{1}{2}\mathbf{W
    Channagiri }\frac{1}{2}\mathrm{ W
    Bhadravati }\frac{1}{2}\mathrm{ E
    Bhadravati 1/2 W
    Shikarpur
    Shimoga
    Sorab 2/3 E
    Sorab 1/3 W
    Sagar 1/2 E
    Hosanagar }\frac{1}{3}\textrm{E
    Tirthahalli 1/3 E
    Tirthahalli 2/3 W!
    Hosanagar }\frac{1}{2}\mathbf{W
    Sagar t }\frac{1}{2}
SOUTH KANARA dt.
    Coondapur
    Buntwal
    Mangalore
    Udipi
    Karkal
    Beltangady
    Puttur
    Suliya
TUMKUR dt.
    Pavagada
    Sira
    C. N. Halii
    Madhugiri
    Koratgere 1/2 N
    Koratgere 1/2 S
    Tumkar
    Kunigal
    Turuvekere
    Gubbi
    Tiptur }12\textrm{E
    Tiptur 章 W
DIE3 (CI D3)Cl DI E2
```


## C3 Jr4 M44/Pd5

Pd4 R4 Jk4 Gn4/Pu4

Pd1
Pd2 L4/B4/M5/V4/F4
PdI
D1 E3 (A3C1)C1DE2
D1 E3 (A3C1)C1D E2

D1 E3 (A3 B1) CI D1 E2

Cl E3 (A4) C1 D1 E2 Pd1

C1 E3 (A4) B1 Cl E2?
Pd2 L4/B4/M5/V4/F4

D1 E3 (C1 D3) C1 D1 E2

D1 E3 (C2 D2) C1 D1 E2
Mt 4 B4/Gn4/R4 Gn4
R3 Pu4 Pd4/LA
R3 Gn4 Pd4/Mt4/Pu4/Pu4 Pd4

R2 Pu4/Pd4/Pu4 Pd4/Pu4/Pd4 /Pd 4/M4
R3 Pu4 Pd4/L4

Cm4 Cf4 Cy 4 S4/G4/Bf4

Cm 4 Cf 4 Cy 4
$\mathrm{Cf} 3 \mathrm{Cy} 4 \mathrm{Cm} 4 / \mathrm{Bm} 4$

Cm4 Cf4 Cy4

Cf3 Cy $4 \mathrm{Cm} 4 / \mathrm{Bm} 4$ $\mathrm{Cf} 4 \mathrm{Cy} 4 \mathrm{Cm} 4 / \mathrm{Cm} 4 \mathrm{Bm} 4$

Cm4 Cf4 Cy4/P4

S3 G4 Cm4/C14

S3 Cm4 Cf4 G4/Cy4/Bf4
$\mathrm{S} 3 \mathrm{G} 4 \mathrm{Cm} 4 / \mathrm{Cf} 4$

Statement II: Rainfall, Cropping and Livestock Patterns in each Zone with area under Forests and Irrigation


| III | 10,892 | $37 \cdot 2$ |  | E4 (C4) D1 E3 <br> Gulbarga : Aland, Gulburga, Afzalpur, Jevargi, Sedam, Chitapur, Chincholi | 77 | 856 | $78 \cdot 6$ | 833 | $13 \cdot 3$ | $1 \cdot 2$ |  | Jr3 04 T4 <br> Jr3 O4 Gn4 T4 C4/T4 B4 <br> Pu4 T4 Jr4 Gn4 04/Jr4 | Cm4 Cf4Cy 4 G4/S4/Bf4 <br> S4 Cm4 Cf4 G4/ Bf4/Cy4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| IV | 5,451 | 10.0 | 1.9 | $\begin{aligned} & \text { E4 (B1C3) D1 E3 } \\ & \text { Bidar : Bidar, } \\ & \text { Aurad, Bhelki, } \\ & \text { BKalyan, } \\ & \text { Humnabad } \end{aligned}$ | 82 | 407 | $74-7$ | 335 | $11 \cdot 8$ | $1 \cdot 0$ | $3 \cdot 5$ | Jr3 G4 Pu4 Jk5 Pu4 Mt4 O4 B4 Jr4 <br> Pu4 T4 Jr4 Gn4 04/Jk4 Pu4 G4 Jk4 Jr4/ Jr5 Mt5 Gns | Cy3 Cf4 Cm4 S4 Cm4 Cf4 Cy4 G4/ S4/Bf4 |
| V | 3,763 | 19.0 | $5 \cdot 0$ | D1E3 (D2E2) CID1E2 <br> Chitradurga: <br> Hiriyur, Challakere | 50 | 134 | $35 \cdot 6$ | 125 | $17 \cdot 6$ | $1 \cdot 5$ | $14 \cdot 1$ | C4 Mt4 Jr4 Jk4 Pu4 <br> Pu4 Jk4 Mt4 B4/ Gn4/R4 Gn4 | S3 G4 Cm4/Cf4 |
| VI | 30,427 | $214 \cdot 4$ | $7 \cdot 0$ | D1E3(C1D3) D1 E3 <br> Bellary : Bellary, <br> Siruguppa, Sandur, <br> Kudigi, <br> Harpanhalli, <br> Hospet, Mala- <br> puram, Hadagalli <br> Raichur: Sindhanur, <br> Koppal, Kushtagi, <br> Yelburga, <br> Gangawat <br> Dharwar : Nargund, <br> Navalgund, <br> Gadag, Ron, <br> Mundargi | 60 | 2,286 | $75 \cdot 1$ | 2,235 | $173 \cdot 3$ | $15 \cdot 2$ | $7 \cdot 8$ | C3 W4 Jr4 <br> C3 Jr4 Mt4/ <br> Pd5 <br> C4 Jk4 Pu4 <br> Mt 4 Cm4/S4/ <br> Pd4 <br> W3 C4 Jk4/Jr4 <br> Gn3 Jk4 C4/W4/ <br> Pu4 <br> Gn4 Jr4 Jk4 <br> B4/W4 <br> Gn4 Jk4 To4 <br> S5 | S3 G4 Cm4/Cf4 S3 C4 Cm4/Bf4 <br> S4 G4 Cm4 Cf4/ Bf/4 <br> S4 Cm4 CY4 G4/ Bf4/Cy4 <br> G4 S4 Cm4 <br> G4 S4 Cm4 Cf4 Cy4/Cy4 Bf4 <br> Cm4 Cf4 S4 G4 |

districts are italicised

ANNEXUREX 7 -Statement İ_(Contd.)


|  |  |  |  | Tumkur: CN Hally, <br> Sira, Pavgada, <br> Koratgere (1/2 N) <br> Madhugiri <br> Chikmagalur : <br> Hadur, Tarikere, <br> Chikmagalur (1/2 E) <br> Dharwar: Rane- <br> bennur |  |  |  |  |  |  |  | Jk4 Mt4 B4 Gn4/C4/C4 Pu4 Mt4 R4 JK4 Pu4 Pu4 Jk4 Mt4 B4/ Gn4/R4 Gn4 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| VIII | 7,499 | 640 | $8 \cdot 5$ | D1E3(C2D2) C1E3 <br> Dharwar : Shiggaon, <br> Dharwar, Hubli, <br> Kundgol, Haveri, <br> Savanur, <br> Shirhatti <br> Belgaum : <br> Bailhongal, <br> Hukeri | 72 | 616 | $82 \cdot 1$ | 598 | $30 \cdot 6$ | $2 \cdot 7$ | $5 \cdot 1$ | Gn3 Jk4 C4/W4/ Pu4 Gn4 Jk4 To4 S5 <br> Jk4 C4 Gn4 R4/ Pu4 Jk4 C4 Gn4W4/ Pu4 Pd4 Jr4 <br> C4 Jk4 Gn4 Pd4 C4 Gn4 Pu4 | Cm4 Cf4 Cy4 S4/ G4/Bf4 <br> Bf4 Cm4 By 4 Cf4 <br> S4 G4 Cm4 Cf4/ <br> Bf4 |
| IX | 10,252 | $63 \cdot 0$ | $6 \cdot 4$ | D1E3(C2D2)C1D1E2 <br> Bangalore : Magadi, <br> Devanhalli <br> Nelmangla, <br> Dodballapur, <br> Bangalore- - $\mathrm{N}(1 / 2 \mathrm{~N}$ ) <br> Tumkur; Tumkur, <br> Kunigal, Gubbi, <br> Turuvekere, Tiptur <br> (1/2 E), Koratgere (1/2S) <br> Kolar : Chikballapur, <br> Siddlaghata, Gudibanda, <br> Gauribidnur. | 75 | 491 | $47 \cdot 8$ | 471 | $89 \cdot 7$ | $7 \cdot 8$ | 19.0 | R2 Pu4 Pd4/ Pu4 Pd4/Pu4 Pd5/Pu4 M4 R3 Pu4 Pd4/L4 R3 Gn4 Pd4/Mt4/ Pu4/Pu4 Pd4 | Cf3 S4 Cy4/G4/ Cm4」 <br> S3 Cm4 Ci4 G4/ Cy4/Bf4 <br> S3 G4 Cm4/Cr4 |

ANNEXURE 7-Statement $\boldsymbol{1}$-(Contd.)



ANNEXURE 7-Statement II (Contd.)

| 1 | 23 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| XXI | 3,758 $\quad 77.0$ | $20 \cdot 5$ | C1E3(A4) C1D1E2 | 365 | 165 | 43.9 | 114 | 41.4 | $3 \cdot 6$ | $36 \cdot 3$ | Pd1 | Cf3 Cy $4 \mathrm{Cm} 4 / \mathrm{Bm} 4$ |
| $\because$ |  |  | S. Kanara : Bantwal, Mangalore, Udipi, Coondapur |  |  |  |  |  |  |  |  | Cf4 Cy $4 \mathrm{Cm} 4 /$ Cm4 Bm4 |
| XXII | \| 4,623 169.0 | $36 \cdot 5$ | C1E3 (A4)BICIE2 | 438 | 105 | 22.7 | 75 | $34 \cdot 2$ | 3.0 |  | Pd1 | Cf4 Cy 4 Cm4/ Cm4 Bm4 |
|  |  |  | S. Kanara : Karkal, Puttur, Belthangadi, Suliya |  |  |  |  |  |  |  | $\begin{aligned} & \text { Pd2 L4/B4/M5/ } \\ & \text { V4/F4 } \end{aligned}$ | $\underset{\mathrm{P} 4}{\mathrm{Cm}} \mathbf{~ C f 4 ~ C y} 4 /$ |
| XXIII | 2,637 $75 \cdot 0$ | $28 \cdot 3$ | CIDIE2(D2E2) | 68 | 127 | $48 \cdot 2$ | 101 | $5 \cdot 8$ | 0.5 | 5.8 | Jk 3 Pu4 R4/Gn4 | $\underset{\mathrm{Bf} 4 / \mathrm{Cy} 4}{\mathrm{~S} 4 \mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{G} 4 /}$ |
|  |  |  | C1DIE2 <br> Mysore : Gundlupet, Chamrajnagar |  |  |  |  |  |  |  | Jk4 Pu4 R4 Pd4/ Gn5 Pd5 |  |
| XXIV | 14,806 $265 \cdot 0$ | 17.9 | CIDIE2 (CID3)CIDE2 76 |  | 676 | $45 \cdot 7$ | $600^{\circ}$ | $97 \cdot 4$ | $8 \cdot 5$ | 16.2 | R2 Pd4 | S3 G4 Cm4/ Cf4 <br> S4 Cm4 Cf4G4/ <br> Cy <br> S4 Cm4 Cf4 G4/ <br> Bi4/Cy4 <br> Cf3 Cy4 Cm4/ <br> Bm4 <br> Cf3 S4 Cy4/G4/ <br> Cm4 |
|  |  |  | Mysore : KR Nagar, Nanjangud, TN Pura, |  |  |  |  |  |  |  | R3 Pu4 Nf4 |  |
|  |  |  | Yelandor, Mysore, HD Kote Hunsur |  |  |  |  |  |  |  | ${ }_{14} 3$ Pu4 Pd4 |  |
|  |  |  | ${ }^{\text {P Patna, Kollegal }}$ |  |  |  |  |  |  |  | Nf2 Pd4 R4 |  |
|  |  |  | Mandya KR Pet |  |  |  |  |  |  |  | Jk3 Pu4 R4/Gn4 |  |
|  |  |  | Hassan: <br> Holenarsipur, Hassan, Arsikere, C Patna |  |  |  |  |  |  |  | Jk4 Pu4 R4/Pd4/ Gn5 Pd5 | $\begin{gathered} \text { Cf4 Cm4 Cy } 4 / \mathrm{S} 4 \end{gathered}$ |
|  |  |  | Tumkur :Tiptur ( ${ }^{(12} \mathbf{W}$ ) |  |  |  |  |  |  |  | Pd4 R4 Pu4/L4 | Cm4 Cf4 Cy4/P4 |
|  |  |  |  |  |  |  |  |  |  |  | Pd 4 R4 Pu4 S4/ Jk4 |  |

Hassan:
Hassan Arsik
C Patna
Tumkur :Tiptur ( ${ }_{2}^{2} \mathbf{W}$ )

Pd 4 R4 Pu4 S4/

| XXV | 3,705 | $90 \cdot 0$ | $24 \cdot 3$ | ```C1D1E2 (A3CI) ClD1E2 Coorg : Virajpet ( \(\frac{1}{2} \mathrm{E}\) ), Somvarpet Hassan: Sakleshpur Chikmagalur : Chikmagalur ( \(\frac{1}{2} \mathrm{~W}\) )``` | 203 | 135 | $36 \cdot 4$ | 127 | $22 \cdot 5$ | $2 \cdot 0$ |  | 12 Pd 3 <br> L3 Pd3 | $\begin{aligned} & \mathrm{Cf} 3 \mathrm{Cy} 4 \mathrm{Cm} 4 / \\ & \mathrm{Bm} 4 \\ & \mathrm{Cm} 4 \mathrm{Cf} 4 \quad \mathrm{Cy} 4 / \\ & \mathrm{P} 4 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| XXVI | 2,279 | $82 \cdot 0$ | $35 \cdot 9$ | C1D1E2(A4)C1D1E2 <br> Coorg : Virajpet <br> ( $\frac{1}{2}$ W) Mercara |  | 59 | 25.9 | 55 | $2 \cdot 4$ |  |  | $\begin{gathered} \text { L3 Pd3 } \\ \text { L2 Pd3 } \end{gathered}$ | $\underset{\mathrm{P} 4}{\mathrm{Cm} 4 \mathrm{Cf} 4 \mathrm{Cy} 4 /}$ |
|  | 1,91,343 2, | ,875•6 | $15 \cdot 0$ |  |  | 10.794 | $56 \cdot 4$ | ,204 | 1,142 2 |  | 11.2 |  |  |

ANNEXURE 8
Rainfall and Cropping Patterns, Karnataka)
This Annexure contains the following large size maps on $1: 1 \mathrm{M}$ scale:-
MAP I Rainfall Patterns
MAP II Month of Maxmimum Rainfall together with Rainfall Amount and: Rainy Days of Two Consecutive Months including the Month of Maximum
MAP III Cropping Patterns
MAP IV Livestock Patterns
MAP V Soils'


[^0]:    1 Forecasting Manusi. India Mctecrclegical Department, Poona.

[^1]:    *The minimum wind speed in a cyclonic storm is 34 knots and in depressi ons 33 knots or less.

[^2]:    *Ibid., p. 5
    1 Srinivasan, V. and Ramamurthy, K. 1971.' Weather over the Indian Seas during the Post-monsoon season, Forecasting Manual, Part III-4.1, India Meteorological Department, Poona.

[^3]:    1 1971. Poona, Rainfall Atlas of India, India Meteorological Department.

[^4]:    1 Rao K. N., George, C. J., Abhyankar, V. P., 1972. Nature of the frequency distribution of Indian rainfall : Monsoon and annual. Indian Journal of Meteorology and Geo-physics, 23 (4) : 507-514.

[^5]:    1968. Tracks of Storms and Depressions in the Bay of Bengal and Arabian Sea, 1877-1960. India Meteorological Department.
    1969. ${ }^{7}$ 'Tracks of Storms and Depressions in the Bay of Bengal and Arabian Sea, 1961 | 1970. India Meteorological Depattment.
[^6]:    1 Raman, C. R. V., Venkataraman, S. and Krishnamurthy, V., 1971. Dew over India and its Contribution to winter Crop-Water Balance-Prepublished Scientific Report No. 147, India Meteorological Department.

[^7]:    Rao K. N., and H. R. Ganesan 1972. Sunshine over India, Prepublished Scientific Report‘ India Meteorological Department, Poona.

[^8]:    Rao K. N. and Ganesan, H. R., 1972. Global Solar and Diffuse Solar Sky Radiation over India. Monograph, Climatology, No. 2, India Meteorological Department, Poona.

[^9]:    1 1962. Weather and the Indian Farmer, India Meteorological Department.

[^10]:    1 Rao, K. N. and V. K. Raghavendra, 1973. Time Series Analysis of 158 ' years' Rainfall of Madras (India) (Period 1813-1970). Meteorological Monograph, Climatology, No. 7, India Meteorological Department, Poona.

[^11]:    1 Thornthwaite, C. W., 1948. An approach toward a rational classification of Climate,-Geographical Review, USA, Vol. 38, No. 1.

[^12]:    1 Leather, J. W., 1910. Water requirements of Crors in India, Momoirs of the Department of Agriculture, India. (chemical series), 1(8).

[^13]:    1 Smith, L (P.), 1970. Weather and Animal diseases, WMO Technical Note No. 113, World Meteorological Organisation (WMO) Geneva, Switzerland.
    4-133Deptt. of Agrl./76

[^14]:    1 Ibid, 2 (p. 27).
    2 Rao, K. N., C. J. George and K. S. Ramasastry, 1972. Agro-Climatic Classification of India, Meteorological Monograph, Agrimet No. 4, India Meteorological Department, Poona.
    3 George, C. J., K. S. Ramasastri and G. S. Rentala, 1973. Incidence of Droughts in India, Meteorological Monograph, Agrimet No. 5. India Meteorological Department, Poona

[^15]:    1 Rao, K. N., C. J. George, P. E. Moray and N. K. Mehta, 1973, Spectral Analysis of Drought Index (Palmer) for India, Indian Journal of Meteorology and Geophysics Vol. 24, No. 3, pp. 257-270.
    2 Landsberg, H.E., 1974. Drought-Summary of Lectures and Discussions, Geneva June, 1974. WMO Bulletin, XXIII (4) : 226

[^16]:    1 1962. Weather and Indian Farmer, India Meteorological Department, Poona.

[^17]:    1 Minhas, B. S., K. S. Parikh and T. N. Srinivasan, 1973. Towards the Structural of a Production Function for wheat Yields with Dated Inputs of Irrigation Water. Discussion paper No. 59, Planaing Unit, Indian Statistical Institute, New Delhi.
    2 Thomas F. Weaver, 1968. Irrigation Eluation under Monsoon Rainfall PatternsA case study for Raipur District. Madhya Pradesh, India. Cornell International Agricultural Development Bulletin 10, New York State College of Agriculture.

[^18]:    1 1974. Indian Agriuclture in Brief Thirteenth Edition New Delhi. Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India.

[^19]:    -The total for the country given in Appendix 14.4 Statements II to IV does not include areas of the northeastern States/Territories and occupied areas, due to want of necessary rainfall data etc. This, however, is not likely to affect significantly the major rainfall zonal or pattern areas. The geographical area considered for these statements is the reporting area as received from the States.

[^20]:    * Due to paucity or absence of rainfall data patterns do not cover most of the North Eastern States/Territory hill areas and some of the other Union Territories; in most of the cases areas are also not large.

[^21]:    1 Orissa Government's report on rainfall and cropping patterns forms Appendix 14.8-Statement I.

[^22]:    1 Raman, C. R. V., 1974. Analysis of Commencement of Monsoon Rains over Maharashtra State for Agricultural Planning, Poona, Mcteorological Office, Meteorological Department.

[^23]:    Note :-For symbols please refer to paragraph 14.2.10.

[^24]:    Rainfall and cropping patterns

[^25]:    Note ：－Details under plantations are shown in accompanying Table． ＊Figures for $1969-70$ repeated in 1970－71 to arrive at the all－India total．

[^26]:    -1 Flooded areas.

    * 2 In saline belts and soils richer in silt content.

[^27]:    1 Agricultural Census Commissioner, Government of Karnataka, 1974. Ce nsus of Agricultural Holdings in Karnataka-1970-71.

[^28]:    1 Croppiog Pattern from Different Rainfall Patterns and Agro-Climatic Regions of Mysore State, UAS, Tech. Series October 1973, the University of Agricultural Sciences, Hebbal, Bangalore-560024.

[^29]:    41-133 Depit. of Agri/76

