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RAINFALL AND CROPPING PATTERNS

Volume V

HARYANA



GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE AND IRRIGATION
NEW DELHI

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MINISTRY OF AGRICULTURE AND **PUBLICATION**
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RAINFALL AND CROPPING PATTERNS--STATE SERIES

VOLUME NO.

STATE

I	ANDHRA PRADESH
II	ASSAM
III	BIHAR
IV	GUJARAT
V	HARYANA
VI	HIMACHAL PRADESH
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RAINFALL AND CROPPING PATTERNS

HARYANA

INTRODUCTION

1.1 The human population of the country is estimated to rise from the 1971 Census figure of 548 million to 935 million in 2000 AD. This rise calls for increased production. Land resources being limited emphasis has to be placed on increasing productivity per unit area. Temperature and other climatic conditions being favourable for crop production throughout the year over most parts of the country, it is possible to grow more than one crop in a year provided water, the most important input, is available. In some parts of the country, the rainy season is long enough to provide scope for double cropping. This potential is yet to be fully exploited. There is 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 even in 2000 AD as against 22 per cent 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.

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 water 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 so as to derive maximum possible benefit from rainfall and reduce dependence on irrigation.

This necessitates a close study of the existing cropping patterns vis-a-vis rainfall patterns aimed at determining the nature of changes needed in the former. The cropping patterns depend primarily on the soil and climatic factors but the evolution of a cropping pattern in course of time is the combined effect of soil, climate, food habits and requirements and economic factors. In the context of increasing production, it is necessary to examine the cropping patterns 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 or tehsil as unit of area. It covered several other relevant factors such as orography, land use data, human and livestock populations, soil and climate, the object being to make, as far as possible, an integrated assessment.

1.3 Chapter 14 on Rainfall and Cropping Patterns of the Commission's Report presents a consolidated account of the data collected together with analysis of their inter-relationships on all-India basis. In this analysis the Commission has been greatly benefited by the discussions with the concerned officers of State Governments. It was realised that by condensing the vast amount of information collected from each State into the small space of a chapter, many important and peculiar features of individual States were likely to be missed and hence the data and analysis of each State have been presented in separate volumes. The manner of presentation is similar to Chapter 14. It has also been considered desirable to include in each State volume the methodology and suggestions for future cropping patterns, which are practically the same as given in Chapter 14.

2 METHODOLOGY

2.1 The chief features of the study are (a) use of taluk or tehsil as unit of area for all basic data and analysis; (b) introduction of coded numerical forms to express patterns of distribution of monthly rainfall throughout the year, crops and livestock; (c) inclusion of information on orography, temperature, evapo-transpiration, rainfall, soil, irrigation, land use, human and livestock populations 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 and livestock on 1 : 1 million scale maps.

Rainfall Patterns

2.2. A major feature of Indian rainfall is that the south-west monsoon season (June to September) accounts for 70 to 95 per cent of the annual rainfall throughout the country except in the south-east peninsula and Kashmir and adjoining hill areas. The monsoon as well as the annual rainfall show large fluctuations from year to year but, as stated in Chapter 13 on Climate and Agriculture, there is no significant evidence of any trend or periodicity in either of them. Considered in relation to crop production, the total annual or seasonal rainfall does not have

much significance and what is important is its distribution during the period of growth of different crops. A relevant question, therefore, 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 the west coast, CV is higher and varies from 60 to 100 per cent. The variability of weekly or fortnightly rainfall being still greater, makes the use of either of them undependable as indicators of rainfall distribution. For a macro-study like the present, monthly rainfall data which are more dependable and also the most convenient to handle have been used.

2.3 In order to relate crop production with rainfall, certain norms have to be assumed depending on the duration of the crops and their water requirements. On the basis of available information and the fact that most crops mature in about 90 days, the following broad norms have been drawn up :—

- (i) Rainfall greater than 30 cm per month (cm pm) for at least three consecutive months would be suitable for a crop like paddy whose water need is very high.
- (ii) 20-30 cm 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 cm pm for at least three consecutive months would be suitable for crops requiring much less water, e.g., bajra and small millets.
- (iv) 5-10 cm pm for three consecutive months would be just sufficient for crops which have low water requirements, e.g., *moth* (*P. aconitifolius*) and ephemeral grasses.
- (v) Rainfall less than 5 cm pm for three consecutive months is not of much significance for crop production.

2.4 For denoting the year's rainfall distribution using monthly totals, a convenient code in letter symbols with numerical subscripts explained below, has been evolved. The letters A to E in Table 1 indicate the ranges of monthly rainfall and the subscripts to these refer to the number of months having these ranges of rainfall e.g. A₂ indicates two months with rainfall greater than 30 cm pm. The ranges correspond to those stated in the preceding paragraph.

TABLE 1
Code for Rainfall Data

Symbol	Monthly rainfall cm pm
A +	Greater than 30
B	20-30
C	10-20
D*	5-10
E*	Less than 5

+ An examination of monthly rainfall in the country shows that except for areas in the west coast and some hill stations in extreme northeast, normal monthly rainfall seldom exceeds 40 cm.

*In distributions containing ranges of rainfall covered by A or B termed briefly as A&B types amounts less than 10 cm are not so significant and their frequency is generally small. To reduce the number of combinations, D is omitted in A or B type distributions; instead E is used to denote less than 10 cm pm. Thus B₂E₂ would denote two months of 20-30 cm pm and two months less than 10 cm pm rainfall.

The south-west monsoon months of June to September being the principal rainy season dominate the rainfall distributions of the country. To indicate the season's importance, monthly rainfall distribution during June to September is shown in brackets in the annual pattern. To the right of the bracket is the distribution for the post-monsoon months, namely, October to January and to the left that for the pre-monsoon months namely, February to May. In order to explain how such a coded rainfall distribution written in symbols with numerical subscripts has to be interpreted, a hypothetical example may be considered. D₁ E₃ (A₂ B₁ C₁) C₁ D₃, in which for each of the three periods, the symbols are in order of decreasing rainfall which is not necessarily the calendar sequence, can be explained as under :—

- (i) D₁E₃ represents the period February to May in which one month's rainfall (usually May) is in the range of 5-10 cm and the remaining 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 rainfall, one month (September) gets 20-30 cm and the remaining month, i.e. June gets 10-20 cm.
- (iii) C₁ D₃ represents the period October to January in which October gets 10-20 cm rainfall and the rest 5-10 cm pm.

Boundaries of Rainfall Zones

2.5 Since differences in monthly, seasonal and annual rainfall are not large within short distances, linear interpolation of rainfall data is permissible. Rainfall data being point measurements, isolines for the same or nearly the same type of distribution of monthly rainfall can, therefore, be drawn. These isolines may not necessarily follow the boundaries of taluks which

are taken to be unit of area in this study and hence for delineation of boundaries the following procedure has been adopted :—

- (i) Where variations are small, isolines follow the taluk boundaries;
- (ii) where variations are large, isolines delineate the zone boundaries; and
- (iii) any taluk, more than three quarters of which lies outside of a zone is not considered a part of that zone.

2.6 If an identical distribution is observed over two or more adjacent taluks a pattern is said to have evolved and the area covered by it is distinguished as a zone and indicated suitably by a Roman numeral. 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 1950)¹ and the patterns and zones are depicted on all-India map which forms part of Chapter 14 on Rainfall and Cropping Patterns of the Commission's Report.

Cropping Patterns

2.7 The basic data for the study of cropping patterns of the country are the areas under different crops in each of the taluks. A large number of crops are grown in a taluk but most of them occupy small areas, often less than one per cent of the total cropped areas of the taluk. With a view to limiting the number of crops constituting a pattern only those crops are considered which individually occupy 10 per cent or more of the gross cropped area of the taluk. In this process, several crops have to be excluded, even though they may be otherwise important. The minimum limit has been fixed at 70 per cent, so that the number of crops, which together cover at least 70 per cent of the gross cropped area, and in which none occupies less than 10 per cent, is not large. Trial computations have shown that in such distributions any crop occupying more than 10 per cent area is rarely omitted and the number of crops hardly exceeds five. When the same distribution holds good for two or more adjacent taluks, a pattern is obtained.

2.8 As in the case of rainfall, percentage area coverage by crops is expressed by means of numerical subscripts affixed to crop symbols shown in Table 2. The list of crops given below is comprehensive and will hold good for all the States.

TABLE 2
Crop Symbols and Area Intervals

Crop	Symbol
1 rice	Pd
2 wheat	W
3 jowar (kharif)	Jk
4 jowar (rabi)	Jr
5 bajra	B
6 maize	M
7 ragi	R
8 small millets	Mt
9 barley	Ba

TABLE 2 (Contd.)

Crop	Symbol
10 Oats	Oa
11 Gram	G
12 pigeonpea (tur)	T
13 pulses other than pigeonpea and gram	Pu
14 groundnut	Gn
15 oilseeds other than groundnut	O
16 cotton	C
17 Jute	Ju
18 other fibres	Fb
19 sugarcane	S
20 potato	Pt
21 vegetables	V
22 fruits	Fr
23 tapioca	Ta
24 plantations	L
25 fodder	F
26 chillies	Ch
27 tobacco	To
Area interval (per cent)	Subscript
70 or more	1
50-70	2
30-50	3
10-30	4
less than 10	5

The crop code contains the crop symbol and the appropriate subscript. In writing crop distribution, the first crop has always the highest area but the rest may not necessarily follow the order of decreasing areas. For example, crop distribution, C₃ Jr₄ Mt₄, means that cotton area is 30-50 per cent, and jowar rabi and millets each occupies 10-30 per cent of the gross cropped area, the total being 70 per cent or more. Two or more taluks having the same distribution of crops constitute a pattern. Cropping patterns so derived have been indicated on maps of 1 : 1 million size.

Relative Yield Index of Crops

2.9 Besides the absolute figures, the yield of a crop has also been expressed as per cent of all-India average which is called Relative Yield Index (RYI). Relative Yield Index values have been computed for the principal crops on the basis of (1968-69 to 1970-71) data available in the records of the Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation.

Livestock Patterns

2.10 The livestock patterns are relevant only insofar as these are related to production of fodder and feeds. As taluk-wise data were not available for the livestock Census, 1972, those of 1966 Census as published by the States have been used. The animals considered for livestock analysis are shown in Table 3 together with their symbols.

¹ Memoirs of India Meteorological Department, Volume XXXI, Part 3, 1962.

TABLE 3
Livestock Symbols

Category	Symbol
cattle :	
male	
(over 3 years)	Cm
female	
(over 3 years)	Cf
young stock	
(under 3 years)	Cy
buffaloes :	
male	
(over 3 years)	Bm
female	
(over 3 years)	Bf
young stock	
(under 3 years)	By
sheep	S
goats	G
horses, mules and ponies	H
donkeys	D
camels	Ca
pigs	P

The livestock patterns are expressed in coded form in the same manner as the cropping patterns.

Soils

2.11 Soil data on a taluk basis are not available for all the areas of the country. As such, soils have been discussed in a general manner using the traditional nomenclature in describing their characteristics.

Other Data

2.12 The sources of other data featuring in the study are given below :

item	source
taluk area	States' Census Reports 1971 or from the data furnished by the States in their land-use returns.

item	source
orography	maps of the Survey of India and National Atlas Organisation.
temperature	Climatological Tables of observatories in India, India Meteorological Department, 1931-1960 normals
evapotranspiration	scientific Report No. 136 of the India Meteorological Department, 1971
human population	Census of India, 1971
irrigation and land use statistics	basic data pertaining to land utilisation statistics obtained from the States and refer mostly to 1969-70

Presentation of Information

2.13 The tables required for following the text are given in the text itself at appropriate places, whereas the basic data are appended as follows :

APPENDIX 1	Talukwise Land Use (1969-70) and Population Statistics, (arranged according to State rainfall zones)
APPENDIX 2	Talukwise Livestock Population—1966 (arranged according to State rainfall zones)
APPENDIX 3	Zonewise Information on Rainfall, Rainy days and Cropping Patterns
APPENDIX 4	Zonewise area under Principal Crops

2.14 Rainfall, cropping and livestock patterns of each State are indicated on maps in the 1 : 1 million scale and given in Appendices 5, 6 and 7 respectively. In the case of rainfall patterns, the zonal numbers in State maps have been given in Roman numerals and their all-India equivalents as used in Chapter 14 of the Commission's Report have been shown in three digit Arabic numerals within brackets.

3 GENERAL FEATURES

3.1 The State has an area of 44 thousand sq km and consists of seven districts. The biggest district is Hissar with about a third of the total area. Areas of three districts range from 2.7 to 4.0 thousand sq km and of the rest from 6 to 8 thousand sq km.

The total number of taluks or tehsils in the State is 32. The taluk areas range from less than 500 to 2824 sq km. The frequency distribution of taluk areas is given in Table 4.

TABLE 4
Frequency Distribution of Taluk Areas

District	Geographical area	Less than 500	501-1000	1001-1500	1501-2000	More than 2000	Total
Mohindergarh	3444	—	1	2	—	—	3
Jind	2693	1	1	1	—	—	3
Ambala	3736	1	—	3	—	—	4
Karnal	8030	—	—	3	—	2	5
Rohtak	6041	—	—	3	—	1	4
Gurgaon	6116	—	3	3	—	—	6
Hissar	13956	—	1	1	1	4	7
STATE		2	6	16	1	7	32

Elevation

3.2 The State is almost entirely plain with elevations ranging between 200 and 300 masl (metres above sea-level) except in Mohindergarh and Ambala. In Mohindergarh the elevations start from 200 to 300 masl and rise to a maximum of 650 masl in Narnaul. In Kalka, close to the hills, the minimum is 450 masl and maximum 900 masl.

Population

3.3 The State has moderately dense population with an average population density of 228 per sq. km. The district population density ranges from 153 (Hissar) to 300 (Rohtak). Among taluks, Loharu in Hissar district has a population density of 98 with the remaining taluks exceeding 130. More than half the number of taluks have population density exceeding 200, the highest being 431 in Ballabgarh.

Land Use

3.4 Area under forests is negligible, the State average being 2 per cent. Barren and lands under non-agricultural uses account for 11 per cent and fallow lands 4 per cent. For the State as a whole, the net sown area is 80 per cent of the geographical area, ranging from 54 per cent in Naraingarh to 89 per cent in Hissar.

Soils

3.5 There are two main soil types covering the State, with the eastern half covering Gurgaon, Ambala, Karnal, and Rohtak districts having alluvial soils with saline and alkaline patches and the remaining three districts of Hissar, Jind and Mohindergarh having calcareous soils.

Irrigation

3.6 The net area irrigated is 1.4 million hectares accounting for 40 per cent of the net sown area in the State and the gross area irrigated is 2.2 million ha which is 44 per cent of the gross cropped areas. Nearly a third of the total irrigated area in the State is in Hissar, followed by 25 per cent in Karnal, 16 per cent in Rohtak and 10 per cent in Gurgaon. Mohindergarh and Ambala have very little area under irrigation accounting for only 5 per cent of the State area. For the State as a whole, 66% of irrigation is by canals and the rest by wells. Gross and net area irrigated together with information on sources of irrigation in the districts is given in Table 5.

TABLE 5
Area and Sources of Irrigation

District	Gross area irrigated (000 ha)	Net area irrigated (000 ha)	Per cent irrigated by				
			Canals	Tubewells	Wells	Tanks	Other sources
Hissar	770	494	97.6	2.3	0.1	—	—
Rohtak	287	226	75.4	3.1	21.5	—	—
Gurgaon	160	146	18.1	42.0	38.8	1.0	—
Karnal	614	371	43.4	47.3	9.1	0.2	—
Ambala	73	39	11.5	—	78.8	—	9.7
Jind	215	99	96.1	3.6	0.2	—	—
Mohindergarh	40	33	29.7	1.8	22.7	45.4	0.4
STATE	2158	1408	67.5	18.4	12.6	1.2	0.3

Rainfall

3.7 Most parts of the State receive annually 40 to 50 cm rainfall, except Ambala which gets an average of 90 cm rainfall. July and August are the months of maximum rainfall and together account for 60 per cent of the annual total. The period, June to September accounts for 80 per cent of the total annual rainfall. The lowest rainfall is in June with 3.5 cm except in Ambala. The State has three consecutive months July to September with 10 cm pm or higher rainfall.

Rainfall Variability

3.8 The coefficient of variation (CV) in June is 100 or higher. July and August CV's range between 50 and 60 in the north eastern areas and 60 to 80 elsewhere. September CV is high exceeding 100.

Temperature

3.9 Normals of maximum, minimum and mean daily temperatures in and near the State are given in 2—772 D:pitt. of Agri./76

Tables 6, 7 and 8. The main features are briefly referred to below :

- The maximum temperature varies from 21°C in January, to 30°C in March and to 40-41°C in May and June, the hottest months of the year. The maximum decreases to 36°C in July and is steady at 34 to 35°C during August and September, the annual maximum temperature being 32°C.
- The minimum temperature is lowest in January 7°C. June has a minimum temperature of 27°C with July and August averaging between 25 and 26°C. The annual average is 17 to 18°C.
- The mean daily temperature is 14°C in January, the coldest month of the year and 34°C in June, the hottest month. The annual mean daily temperature is 25°C.

Potential Evapotranspiration (PE)

3.10 The annual PE is 150 cm in Ambala area and 160-170 cm in the rest of the State. PE is highest in May and June being 21 cm in Ambala area and 22-24 cm pm elsewhere. In July and August, PE generally varies between 14 and 16 cm. Monthly

and annual values of potential evapotranspiration for 3 observatory stations are given in Table 9.

Climatic Classification

3.11 Hissar area and neighbourhood is classified as arid; the rest of the State is semi-arid. North of Ambala, where rainfall is heavier, can be classified as dry sub-humid.

TABLE 6
Normals of Daily Maximum Temperature (°C)

Station	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Ambala	20.8	23.8	29.6	36.2	40.8	40.5	35.2	33.8	35.4	33.2	28.6	23.2	31.8
Karnal	20.2	24.0	29.4	35.7	39.7	39.6	34.9	32.9	33.3	31.5	27.2	22.8	30.9
Hissar	21.7	25.0	30.7	37.0	41.6	41.3	37.3	35.5	35.7	34.6	29.6	24.1	32.8
New Delhi	21.3	23.6	30.2	36.2	40.5	39.9	35.3	33.7	34.1	33.1	28.7	23.4	31.7

TABLE 7
Normals of Daily Maximum Temperature (°C)

Station	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Ambala	6.8	8.8	14.1	19.7	24.9	27.3	26.0	25.4	23.9	16.4	10.2	7.1	17.5
Karnal	7.0	9.2	14.1	19.3	24.2	26.6	25.7	25.0	23.6	17.3	11.9	8.4	17.7
Hissar	5.5	8.1	13.3	19.0	24.6	27.7	27.3	26.1	23.9	17.4	9.8	6.0	17.4
New Delhi	7.3	10.1	15.1	21.0	26.6	28.7	27.2	26.1	24.6	18.7	11.8	8.0	18.8

TABLE 8
Normals of Mean Daily Temperature (°C)

Station	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Ambala	13.8	16.2	21.9	28.0	32.9	33.9	30.6	29.6	29.7	24.8	19.4	15.2	24.7
Karnal	13.6	16.6	21.8	27.5	32.0	33.1	30.3	29.0	28.5	24.4	19.6	15.6	24.4
Hissar	13.6	16.6	22.0	28.0	33.1	34.5	32.3	30.8	29.8	26.0	19.7	15.1	25.2
New Delhi	14.3	16.9	22.7	28.6	33.6	34.3	31.3	29.9	29.4	25.9	20.3	15.7	25.3

TABLE 9
Normal Monthly and Annual Potential Evapotranspiration (mm)

Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Ambala	45.9	67.4	120.9	163.2	209.8	214.5	162.8	142.6	140.8	107.0	63.0	43.2	1481.6
Hissar	49.7	71.6	124.1	168.4	221.9	231.4	197.6	164.2	153.8	118.5	66.9	47.0	1615.6
New Delhi	60.1	84.6	141.8	184.5	239.9	237.9	162.1	139.6	149.7	121.2	77.7	59.1	1658.7

4 RAINFALL ZONES, THEIR CROPPING AND LIVESTOCK PATTERNS

4.1 The State is divided into 4 rainfall zones. These are indicated below together with the number of taluks included in each and their total approximate area :

Rainfall zone number	Rainfall pattern	Number of taluks with total approximate area in sq km
I	E ₄ (D ₃ E ₁)E ₄	3 (6656)
II	E ₄ (C ₂ D ₁ E ₁) E ₄	13 (19470)
III	E ₄ (C ₃ D ₁)E ₄	12 (14131)
IV	E ₄ (B ₂ C ₁ D ₁)E ₄	4 (3736)

Rainfall Zone I—E₄ (D₃ E₁) E₄

4.2 The district, taluks and the cropping patterns in the Zone are :

Cropping pattern	Taluk	District
G ₃ B ₄ W ₄ C ₄	Dabwali Sirsa	Hissar "
G ₄ B ₄ W ₄ C ₄ /J ₄	Fatehabad	"

4.3 The Zone has an area of 6656 sq km comprising of 3 taluks. The areas of taluks vary between 1400 and 2000 sq km. The population of the Zone is

about 8.8 lakhs. The population density is 133, varying between 110 and 144.

4.4 The area is plain and has an elevation of 200 masl.

4.5 Area under forest is negligible and fallow lands account for about 5 per cent of the reporting area. The net sown area of this Zone is 87 per cent of the geographical area.

4.6 Soils are calcareous (of alluvial origin). About 40-50 per cent of area is under irrigation.

4.7 The annual average rainfall of this Zone is less than 35 cm. July is the rainiest month followed by August and together these two months account for about 50 per cent of the annual rainfall.

4.8 Gram is the principal crop of the Zone occupying 30 per cent of cropped area followed by bajra (18 per cent), wheat (16 per cent) and cotton (14 per cent).

4.9 Area and Relative Yield Index values of crops are given in Table 10. Yield of Cotton, which is cultivated under irrigated conditions, is three times that of all-India average. Wheat is also fully irrigated but RYI is only 150, as compared to 181 in Punjab. Relative Yield Index of bajra is 137 and that of gram 120.

TABLE 10

Area and Relative Yield Index values of Crops in Zone I

	Area '000 ha	RYI*
gram	367	120
bajra	348	137
wheat	191	149
cotton	154	293

4.10 Sheep account for 16 per cent of the total livestock, followed by female and youngstock of buffaloes 15 per cent each and goats 14 per cent. The livestock pattern in the Zone is : Bf₄ By₄ S₄ G₄ Cf₄/Cy₄/Cm₄.

Rainfall Zone II—E₄ (C₂D₁E₁)E₄

4.11 The districts, taluks and the cropping patterns in the Zone are :

Cropping pattern	Taluk	District
B ₃ G ₃	Bhiwani Loharu Dadri	Hissar " Mohindergarh
W ₃ G ₄ B ₄ S ₄ /J ₄	Rohtak Gohana	Rohtak "
W ₃ Pd ₄ G ₄ S ₄ /J ₄	Kaithal Safidon	Karnal Jind

Cropping pattern	Taluk	District
W ₃ Pd ₄ M ₄ /G ₄	Gulha	Karnal
G ₄ B ₄ W ₄ C ₄ /J ₄	Hissar Hansi Jhajjar Jind Narwana	Hissar " Rohtak Jind "

4.12 This is the biggest of the four zones with an area of 19400 sq km, comprises 13 taluks spanning five districts—Hissar, Jind, Mohindergarh, Karnal and Rohtak. The population of the Zone is 4.2 million with an average population density of 216 per sq km. Taluk population density varies between 98 and 372.

4.13 The general elevation is 225 masl, with slight variation. In Dadri taluk the elevations range between 200 to 450 masl.

4.14 Area under forest is negligible and land not available for cultivation constitutes 8 per cent of the reporting area. The net sown area averages 84 per cent in the Zone, ranging between 80 and 89 per cent in its various taluks.

4.15 Soils are mostly calcareous. The Zone is moderately irrigated except in Dadri, Loharu and Bhiwani where the area under irrigation is negligible. Area under irrigation ranges from 40 per cent in Jind and Narwana to 80 per cent in Hansi taluk.

4.16 The annual rainfall in this Zone is less than 50 cm. July is the month of maximum rainfall and together with August accounts for about 50 per cent of the annual total rainfall.

4.17 In Mohindergarh, goats account for 20 per cent of total livestock and the pattern for this district is G₄ S₄ Bf₄ By₄ Cy₄/Cf₄. The remaining districts could all be grouped with female buffaloes as the main livestock and the patterns being :

Karnal Rohtak Jind Hissar	Bf ₄ By ₄ Cm ₄ Cf ₄ /Cy ₄ Bf ₄ By ₄ S ₄ G ₄ Cm ₄ /Cf ₄ /Cy ₄
------------------------------------	---

4.18 In Bhiwani, Loharu and Dadri taluks, bajra occupies 50 per cent of cropped area followed by gram (30 per cent) and the pattern is B₃ G₃. In Hissar, Hansi, Jind, Narwana and Jhajjar, gram, bajra, wheat and jowar form the pattern G₄ B₄ W₄ J₄. Wheat is the main crop in the remaining five taluks occupying about 30 per cent of the cropped area.

4.19 Area and Relative Yield Index values of crops in Jind, Hissar and Rohtak districts are given in Table 11. The yields of bajra, gram, rice and wheat are all above all-India level, though that of jowar is quite low.

*RYI or Relative Yield Index represents the yield in Hissar district expressed as percentage of the corresponding all-India average yield for 1968-69 to 1970-71.

TABLE 11
Area and Relative Yield Index Values of Crops in Zone II

Area in (000 ha) RYI in brackets

District	Bajra	Gram	Rice	Wheat	Jowar
Hissar	348 (137)	387 (120)	—	190 (149)	337 (43)
Rohtak	104 (160)	122 (165)	—	189 (161)	81 (46)
Jind	64 (162)	85 (155)	10 (110)	69 (141)	28 (47)

NOTE : Figures in brackets indicate the RYI or Relative Yield Index numbers. The RYI represents the district-yields as percentage of the corresponding all-India average yield for 1968-69 to 1970-71.

Rainfall Zone III—E₄ (C₃ D₁) E₄

4.20 The districts, taluks and the cropping patterns in the Zone are :

Cropping pattern	Taluk	District
B ₃ G ₃	Mohindergarh Narnaul	Mohindergarh "
B ₃ G ₄ M ₄	Gurgaon Rewari	Gurgaon "
W ₃ Pd ₄ M ₄ /G ₄	Thanesar Karnal	Karnal "
W ₃ Pd ₄ G ₄ S ₄ /J ₄	Panipat	"
W ₃ G ₄ B ₄ S ₄ /J ₄	Sonepat	Rohtak
W ₃ B ₄ G ₄ Ba ₄	Ballabhgarh	Gurgaon
W ₄ G ₄ B ₄ J ₄ Ba ₄	Palwal Nuh	" "
G ₄ B ₄ W ₄ C ₄ /J ₄	Ferozepur	Jhirka

4.21 The area of the Zone is 14 thousand sq km and comprises 12 taluks spread over four districts. Areas of three taluks range between 750 and 1000 sq kms and the rest exceed 1000 sq km. The population of the Zone is 3.9 million with an average population density of 273 per sq km. Nine taluks have population density exceeding 250, the highest being Ballabhgarh (432) and the lowest Mohindergarh (182).

4.22 Major portion of the Zone has an elevation between 200 and 300 masl. The maximum elevation rises to 450 masl in Gurgaon and to 650 masl in Mohindergarh.

4.23 Area under forests, fallow lands and pastures is negligible. Land not available for cultivation is 15 per cent and the net sown area is 77 per cent of the total reporting area.

4.24 In Mohindergarh and the adjoining areas in Rohtak district, soils are calcareous and elsewhere in the Zone alluvial soils with saline and alkaline patches prevail. Sixty per cent of the area in Karnal and Rohtak is irrigated followed by 30 per cent in Gurgaon and 10 to 15 per cent in Mohindergarh.

4.25 The annual average rainfall is about 60 cm in 33 rainy days. July is the month of maximum rainfall and together with August accounts for 55 per cent of the annual precipitation. In Karnal area, rainfall is heavier being 60 to 70 cm. All the three consecutive months July to September get more than 10 cm pm rainfall.

4.26 The principal crops grown in the Zone are bajra, wheat, gram, jowar and paddy; bajra being the principal crop in Mohindergarh, Narnaul, Rewari and Gurgaon taluks occupying 30 to 50 per cent of the cropped area. The zonal averages of crop-wise areas are : wheat (26 per cent), bajra (18 per cent), gram (15 per cent), rice (7 per cent), barley (6 per cent) and jowar and sugarcane (4 per cent) each.

4.27 The areas and relative yield index of crops grown in the Zone are given in Table 12. The yields of bajra, rice, wheat and gram are good and above all-India levels. Only jowar and sugarcane yields are quite low.

TABLE 12
Area and Relative Yield Index values of Crops in Zone III

(Area—thousand hectares)

District	Bajra	Wheat	Gram	Jowar	Sugarcane
Mohindergarh	196 (73)	—	98 (157)	—	—
Rohtak	104 (160)	189 (161)	122 (165)	81 (46)	49 (89)
Gurgaon	139 (139)	138 (146)	101 (128)	40 (35)	—
Karnal	—	317 (191)	93 (160)	21 (34)	39 (71)

NOTE : Figures in brackets indicate the Relative Yield Index numbers. RYI represent the district yields as percentage of corresponding all-India average yield for 1968-69 to 1970-71.

4.28 Except in Mohindergarh, female buffaloes dominate in the livestock population. The district livestock patterns are :

Karnal	}	Bf ₄ By ₄ Cm ₄ Cf ₄ /Cy ₄
Rohtak		
Gurgaon		Bf ₄ By ₄ Cm ₄ Cf ₄ Cy ₄
Mohindergarh		G ₄ S ₄ Bf ₄ By ₄ Cm ₄ /Cf ₄ /Cy ₄

Rainfall Zone IV—E₄ (B₂ C₁ D₁) E₄

4.29 The district, taluks and the cropping patterns included in the Zone are :

Cropping pattern	Taluk	District
W ₃ P ₄ M ₄ G ₄ /S ₄ /F ₄	Ambala Jagadhari	Ambala "
W ₄ Pd ₄ M ₄ G ₄ /S ₄ /F ₄	Kalka Naraingarh	" "

4.30 This is the smallest of the four zones with an area of 3,736 sq km and covering the whole of Ambala district with four taluks. Area of Kalka taluk is the smallest with 260 sq km and that of the other three taluk ranges between 1,000 and 1,300 sq km. The population is 1.1 million with an average population density of 300 per sq km.

4.31 The southern half is a plain area with an elevation of 250 to 300 masl. The minimum elevation rises to 300 in Naraingarh and 450 masl in Kalka. The maximum elevation is in Kalka at 900 masl.

4.32 Area under forests is 30 per cent of the reporting area in Naraingarh, 10 per cent in Jagadhari and negligible elsewhere. Land not available for cultivation constitutes 15 per cent, fallow land 3 per cent and net sown area more than 50 per cent of the total area.

4.33 Soils are alluvial with saline and alkaline patches. Area under irrigation is only 16 per cent of the net sown area.

4.34 Wheat is the predominant crop of the Zone occupying 27 per cent of the total cropped area followed by paddy, maize, gram and fodder crops each accounting for 12 per cent. All these crops cover three-fourths of the cropped area. Sugarcane is grown on per cent and pulses other than gram and tur on 6 per cent of cropped area. There are two almost similar, cropping patterns in the Zone, the only difference being the higher coverage of wheat in the southern portion of the Zone.

4.35 Area and relative yield index of different crops in the Zone are given in Table 13. Maize and sugarcane are cultivated under rainfed conditions. The yield of maize is close to the all-India level while that of sugarcane is rather low. The yield of rice in the Zone is satisfactory, the RYI being 94. The yield of wheat is substantially above the all-India level, the RYI being 124.

TABLE 13

Area and Relative Yield Index Values of Crops in Zone IV

	Area '000 ha	RYI*
rice	43	94
maize	39	93
wheat	90	124
gram	36	115
sugarcane	39	71

*RYI or Relative Yield Index represents Ambala district yields expressed as percentage of corresponding all-India average yields for 1968-69 to 1970-71.

4.36 Male cattle accounts for 21 per cent of total livestock followed by female buffaloes (18 per cent), young stock of cattle (16 per cent), female cattle and young stock of buffaloes each (13 per cent). The livestock pattern is Cm₄, Bf₄, Cy₄, Cf₄, By₄.

5 FUTURE CROPPING PATTERNS—SOME OBSERVATIONS

General

5.1 In the foregoing sections we have dealt with, in detail, the rainfall, cropping and livestock patterns which emerge from the existing information. We have also categorised the rainfall patterns into zones and discussed how the other patterns feature in those zones. Among other information that on soils, which ought to play an important role in determining cropping patterns, is lacking in such details as are wanted for this analysis. Data on orography and population density have featured in this analysis but their exact role on cropping and livestock patterns could not be brought out owing to lack of detailed information. We are, however, convinced that studies and analysis indicated in the preceding sections are important for the guidance they may give in deciding cropping and livestock patterns *vis a vis* rainfall patterns. The greater the accuracy of the primary information, and the more detailed such information is, the more

useful the data would be in drawing up the most efficient cropping and livestock patterns in an area or a zone. With this purpose in view the following procedures are suggested :

- (i) Delineation of rainfall zones;
- (ii) Identification of the existing cropping patterns;
- (iii) Assessment of area needed for each crop and its ideal distribution
- (iv) Comparison of (iii) with (ii) in order to determine possible changes; and
- (v) Consideration of other related factors like soil, irrigation facilities, density of population, livestock patterns and then arriving at the future cropping patterns.

5.2 The methods of delineating rainfall patterns or zones and cropping patterns have been fully dis-

cussed in Section 2. For the purpose of locating suitable areas for a crop, soil and topography of the land are important factors. The approximate area to be put under each crop will be decided by the demand for it not only at a State level but at the national level, either for internal consumption or for the purpose of export. The Departments responsible for crop planning of a State should, therefore, be cognizant of the demand for a crop, so that production efforts are not rendered futile because of lack of demand and marketing. The part that each of the factors mentioned in sub-para (v) of the previous para is likely to play in deciding cropping patterns has already been discussed. For this purpose not only detailed data but also knowledge about the correlation between these factors and crop performance would be necessary. Knowledge gained, through long experience, by farmers would also be most helpful.

5.3 We ought to mention that the rainfall intervals which form the basis of identifying rainfall patterns are subject to minor modifications. Thus, the condition that 30 cm of rainfall for three consecutive months is good for paddy may not be rigorously adhered to. If the soil is favourable with a high water retention capacity or, what is more important, water management is efficient with an eye to economise water use, rainfall lower than 30 cm for three months may sustain a good crop of paddy.

Some observations Pertaining to Haryana

5.4 The choice of a cropping pattern is not decided by the farmer only on technical grounds. He is also

guided by the profitability of the crops or requirements for his household consumption. Farmers may not be inclined to accept a crop unless the necessary inputs and infrastructure are assured. Of all the inputs water is the most important as is made evident by the spread of groundnut in the country, sugarcane in Gujarat, maize and cotton in Karnataka and recently of wheat in West Bengal. These are excellent instances of the manner of introduction of new crops in the cropping patterns of a State or a region.

5.5 The pattern and amount of rainfall received in the State is not enough for rainfed cultivation of a majority of crops, except in Ambala district which receives between 20-30 cms of rainfall per month during July-August. The southern districts of Hissar, Rohtak and Bhiwani constitute an arid/semi-arid zone. The irrigation system, however, is well developed in the major part of the State and is proposed to be extended even to the desert districts. Since cultivation is carried on under irrigated conditions, yields of most of the crops are good.

5.6 Sugarbeet cultivation could be undertaken in certain parts of the State and should find a place in future cropping patterns. It is also necessary to diversify the cropping patterns by inclusion of pulses, oilseeds and fodder crops (specially leguminous fodders). Growing of vegetables on a large scale around urban areas also needs to be encouraged.



APPENDIX 1
Talukwise Land Use (1969-70) and Population Statistics
HARYANA

(Area in thousand hectares)

District/taluk	Population 1971		forests	nac	cw	pp&gl	mtc&gl	fallow lands	net area sown
	total	per sq. km							
Rainfall Zone—I			..	..	..	..	Rainfall Pattern—E ₄ (D ₃ E ₁)E ₄		
Hissar									
Dabwali	163598	113	9 (6)	— (—)	1 (—)	— (—)	— (—)	7 (5)	128 (89)
Sirsa	370006	131	— (—)	17 (6)	5 (2)	— (—)	— (—)	16 (6)	244 (86)
Fatehabad	344382	144	— (—)	16 (7)	5 (2)	— (—)	— (—)	8 (3)	209 (88)
Rainfall Zone—II			..	..	..	..	Rainfall Pattern—E ₄ (C ₂ D ₁ E ₁)E ₄		
Hisar									
Bhiwani	295163	149	— (—)	10 (5)	6 (3)	— (—)	— (—)	23 (12)	159 (80)
Loharu	57113	98	— (—)	2 (4)	4 (6)	— (—)	— (—)	6 (10)	46 (80)
Mahendargarh									
Dadri	259706	179	0 (—)	8 (6)	2 (1)	5 (3)	— (—)	2 (1)	128 (88)
Rohtak									
Rohtak	497912	372	— (—)	11 (8)	7 (5)	— (—)	— (—)	2 (2)	114 (85)
Gohana	351508	245	3 (2)	21 (13)	1 (—)	1 (1)	— (—)	2 (2)	118 (82)
Karnal									
Kaithal	502504	238	2 (—)	17 (8)	1 (—)	2 (1)	— (—)	4 (2)	186 (87)
Jind									
Safidon	103994	267	— (—)	5 (14)	1 (2)	— (—)	— (—)	0.4 (1)	33 (83)
Karnal									
Gulha	176969	170	7 (7)	8 (8)	— (—)	3 (3)	— (—)	4 (4)	84 (84)
Hisar									
Hisar	499164	186	— (—)	19 (7)	16 (6)	— (—)	— (—)	11 (4)	219 (83)
	403520	193	— (—)	14 (7)	5 (2)	— (—)	— (—)	21 (10)	169 (81)
	525408	249	— (—)	19 (9)	10 (5)	— (—)	— (—)	6 (3)	176 (83)
	216374	265	0.4 (—)	7 (9)	1 (1)	— (—)	— (—)	3 (3)	70 (86)
	319242	215	— (—)	14 (9)	— (—)	— (—)	— (—)	2 (2)	133 (89)
Rainfall Zone—III			..	..	..	..	Rainfall Pattern—E ₄ (C ₃ D ₁)E ₄		
	368113	257	2 (1)	18 (13)	4 (3)	9 (6)	— (—)	6 (4)	103 (72)

in 500 hectares or 0.5 per cent)

on
activation
and other grazing lands
crops and groves not included in net area sown
represent percentages to total reporting area

APPENDIX 1 (Contd.)

District/taluk	Population 1971		forests	nac	cw	pp&gl	mtc&gl	fallow lands	net area sown
	total	per sq. km.							
Rainfall Zone—III (Contd.)			..	..	..	..	Rainfall Pattern—E ₄ (C ₃ D ₁)E ₄		
Karnal	571052	257	— (—)	25 (11)	10 (5)	1 (1)	1 (1)	2 (1)	183 (81)
Panipat	362665	295	— (—)	31 (25)	2 (2)	8 (7)	1 (1)	1 (1)	78 (63)
Rohtak									
Sonepat	410706	354	5 (4)	15 (13)	1 (1)	2 (1)	— (—)	4 (3)	93 (80)
Gurgaon									
Ballabgarh	323376	432	1 (1)	21 (27)	— (—)	1 (1)	— (—)	1 (2)	52 (69)
Gurgaon	296149	278	3 (3)	20 (19)	— (—)	6 (6)	— (—)	— (—)	77 (72)
Gurgaon									
Palwal	284387	284	1 (1)	12 (12)	— (—)	3 (3)	— (—)	1 (1)	84 (84)
Nuh	230663	220	4 (3)	17 (16)	— (—)	1 (1)	— (—)	5 (5)	78 (75)
Ferozpur Jhirka	187730	231	1 (2)	14 (17)	— (—)	— (—)	— (—)	3 (4)	63 (77)
Rewari	385064	268	2 (1)	16 (11)	— (—)	0.1 (—)	— (—)	5 (4)	121 (84)
Mahendragarh									
Mahendragarh	188972	182	1 (1)	12 (11)	— (—)	6 (6)	— (—)	2 (2)	83 (80)
Narnaul	242961	255	0.1 (—)	13 (13)	— (—)	4 (4)	— (—)	1 (1)	78 (82)
Rainfall Zone—IV			..	..	..	..	Rainfall Pattern—E ₄ (B ₂ C ₁ D ₁)E ₄		
Ambala									
Kalka	83975	319	— (1)	10 (40)	— (—)	0.3 (1)	1 (4)	1 (4)	13 (51)
Naraingarh	196500	171	32 (28)	14 (12)	2 (1)	3 (3)	— (—)	3 (2)	62 (54)
Jagadhri	386250	297	13 (10)	26 (20)	— (—)	2 (2)	1 (1)	4 (3)	84 (64)
Ambala	431680	420	1 (1)	10 (10)	4 (4)	1 (1)	— (—)	4 (4)	80 (80)

APPENDIX 2

Taluk-wise Livestock Population—1966

HARYANA

(thousands)

District/taluk	Cattle			Buffaloes			Sheep	Goats	Horses & ponies	Mules	Donkeys	Camels	Pigs	Total live-stock
	m	f	ys	m	f	ys								
Rainfall Zone—I							Rainfall Pattern—E ₄ (D ₃ E ₁)E ₄							
Hisar	na													
Dabwali	na													
Sirsa	24 (7)	35 (10)	37 (11)	3 (1)	48 (15)	49 (15)	53 (16)	51 (15)	1 (—)	— (—)	3 (1)	28 (9)	0.2 (—)	332
Fatehabad	33 (15)	20 (9)	22 (10)	1 (0.3)	39 (17)	38 (17)	32 (15)	24 (11)	1 (0.3)	— (—)	2 (1)	10 (4)	1 (0.3)	223
Rainfall Zone—II							Rainfall Pattern—E ₄ (C ₂ D ₁ E ₁)E ₄							
Hisar	na													
Bhiwani	8 (3)	35 (14)	36 (14)	0.3 (0.1)	20 (8)	23 (9)	46 (19)	58 (23)	0.3 (0.1)	0.1 (—)	3 (1)	20 (8)	2 (1)	251
Loharu	na													
Mohendragarh	na													
Dadri	10 (6)	20 (13)	26 (16)	0.1 (0.1)	20 (13)	25 (16)	17 (11)	24 (15)	0.2 (0.2)	— (—)	2 (1)	12 (8)	1 (1)	157
Rohtak	na													
Rohtak	41 (19)	20 (10)	23 (11)	0.3 (0.1)	47 (22)	43 (20)	13 (6)	9 (4)	1 (1)	1 (1)	4 (2)	2 (1)	7 (3)	21
Gohana	43 (20)	20 (10)	22 (10)	0.4 (0.2)	50 (24)	40 (19)	15 (7)	8 (4)	1 (0.4)	0.4 (0.2)	4 (2)	2 (1)	6 (3)	21
Karnal	na													
Kaithal	65 (19)	37 (11)	42 (12)	2 (1)	79 (24)	63 (19)	19 (6)	9 (3)	2 (1)	1 (—)	5 (1)	1 (—)	10 (3)	335
Jind	na													
Safidon	na													
Karnal	na													
Gulha	21 (17)	15 (12)	18 (15)	5 (4)	27 (22)	21 (17)	6 (5)	4 (4)	1 (1)	— (—)	1 (1)	1 (1)	1 (1)	121
Hisar	na													
Hisar	40 (14)	27 (10)	32 (11)	1 (0.2)	45 (16)	47 (17)	48 (17)	29 (10)	0.4 (—)	— (—)	3 (1)	7 (3)	3 (1)	282
Hansi	44 (18)	25 (10)	30 (12)	0.2 (—)	41 (17)	45 (19)	33 (14)	17 (7)	0.3 (0.1)	0.3 (—)	3 (1)	1 (—)	4 (2)	243
Rohtak	na													
Jhajjar	38 (18)	24 (11)	26 (12)	0.2 (—)	41 (20)	38 (18)	16 (8)	12 (6)	1 (1)	0.3 (—)	4 (2)	5 (2)	5 (2)	210
Jind	na													
Jind	34 (19)	19 (10)	23 (12)	1 (1)	34 (19)	31 (17)	19 (11)	8 (4)	1 (—)	0.2 (—)	3 (2)	1 (1)	8 (4)	182
Narwana	41 (18)	24 (10)	28 (12)	0.3 (0.1)	45 (19)	43 (18)	29 (12)	13 (6)	1 (—)	0.3 (—)	3 (1)	1 (—)	7 (3)	235
Rainfall Zone—III							Rainfall Pattern—E ₄ (C ₃ D ₁)E ₄							
Mahendragarh	na													
Mahendragarh	8 (6)	14 (11)	16 (12)	0.1 (—)	14 (11)	15 (11)	23 (17)	33 (25)	0.1 (—)	— (—)	1 (1)	8 (6)	0.4 (—)	132
Narnaul	13 (9)	11 (8)	13 (9)	0.1 (—)	19 (14)	21 (15)	25 (18)	28 (21)	0.4 (—)	— (—)	2 (2)	5 (4)	0.2 (0.1)	137

m = male

f = female

ys = youngstock

— = nil or negligible.

na = Not available.

NOTE : Figures in brackets represent percentages to total livestock population.

APPENDIX 2 (Contd)

District/taluk	Cattle			Buffaloes			Sheeps	Goats	Horses & ponies	Mules	Don- keys	Ca- mels	Pigs	Total live- stock
	m	f	ys	m	f	ys								
Rainfall Zone—III (Concl'd.)							Rainfall Pattern—E ₄ (C ₃ D ₁)E ₄							
Gurgaon	21 (16)	19 (14)	18 (13)	0.1 (—)	22 (16)	20 (15)	6 (4)	22 (16)	1 (1)	0.3 (—)	2 (2)	3 (2)	1 (1)	135
Rewari	26 (16)	19 (11)	19 (11)	0.1 (—)	26 (16)	27 (16)	13 (8)	25 (15)	1 (1)	0.2 (—)	3 (2)	5 (3)	1 (1)	165
Karnal														
Thanesar	48 (22)	31 (14)	37 (17)	3 (1)	43 (19)	34 (15)	13 (6)	5 (2)	1 (1)	— (—)	1 (1)	2 (1)	2 (1)	221
Karnal	68 (19)	44 (13)	49 (14)	8 (2)	74 (21)	59 (17)	22 (6)	7 (2)	3 (1)	1 (—)	4 (1)	5 (2)	7 (2)	351
Panipat	35 (20)	18 (10)	20 (11)	4 (2)	41 (23)	32 (18)	10 (6)	3 (2)	2 (1)	0.2 (—)	3 (2)	3 (2)	5 (3)	176
Rohtak														
Sonepat	37 (23)	14 (9)	17 (10)	1 (1)	41 (26)	27 (17)	1 (1)	5 (3)	2 (1)	0.4 (—)	3 (2)	4 (3)	6 (4)	158
Gurgaon														
Ballabgarh	22 (19)	13 (12)	13 (12)	1 (1)	23 (20)	17 (15)	5 (4)	12 (11)	1 (1)	0.2 (—)	2 (2)	1 (1)	2 (2)	112
Palwal	32 (22)	14 (9)	15 (10)	1 (1)	34 (23)	25 (17)	13 (8)	6 (4)	1 (1)	— (—)	3 (2)	2 (1)	4 (3)	150
Nuh	30 (20)	16 (11)	15 (10)	0.2 (—)	24 (16)	20 (13)	11 (8)	27 (18)	0.4 (—)	— (—)	2 (1)	2 (1)	3 (2)	150
Ferozepur														
Jhirka	22 (18)	10 (8)	10 (8)	1 (1)	19 (16)	16 (13)	7 (6)	30 (24)	1 (1)	— (—)	2 (2)	1 (1)	3 (2)	122
Rainfall Zone—IV							..	..	..	..	Rainfall Pattern—E ₄ (B ₂ C ₁ D ₁)E ₄			
Ambala														
Ambala	31 (21)	19 (12)	24 (16)	1 (1)	30 (20)	22 (15)	9 (6)	6 (5)	1 (—)	1 (1)	1 (1)	1 (—)	4 (2)	150
Jagadhari	41 (23)	27 (15)	34 (19)	1 (1)	32 (17)	24 (13)	8 (4)	11 (6)	1 (1)	0.3 (—)	1 (—)	0.4 (—)	3 (1)	183
Kalka							n.a.							
Naraingarh	30 (21)	19 (14)	23 (17)	0.1 (—)	22 (16)	16 (12)	4 (3)	18 (13)	0.3 (—)	0.1 (—)	1 (1)	1 (1)	3 (2)	137

APPENDIX 3
Rainfall and Cropping Patterns
HARYANA

Cropping patterns	District/ taluk	Geo- graphi- cal area (sq km)	Elevation (masl)		Annual rainfall		mmr	mr	md	*Consecutive months		
			max	min	total (cm)	rd				(a)	(b)	(c)
	<i>Rainfall Zone---I</i>	..	..	..	..	..				<i>Rainfall Pattern—E₄(D₃E₁)E₄</i>		
G ₃ C ₄ W ₄ B ₄	Hisar											
	Dabwali	1446	205	203					na			
	Sirsa	2825	212	203	32	21	7	17	10	No consecutive months		
G ₄ B ₄ W ₄ C ₄ /J ₄	Fatehabad	2385	216	206	34	22	7	18	10	No consecutive months		
	<i>Rainfall Zone---II</i>	..	..	..	..	..				<i>Rainfall Pattern—E₄(C₂D₁E₁)E₄</i>		
B ₃ G ₃	Hisar											
	Bhiwani	1982	342	212	41	25	7	22	12	7-2	22	12
	Loharu	581	293	249					na			
W ₃ G ₄ B ₄ S ₄ /J ₄	Mahendragarh											
	Dadri	1448	448	215	65	n.a.	8'	39	n.a.	7-3	52	n.a.
	Rohtak											
W ₃ Pd ₄ G ₄ S ₄ /J ₄	Rohtak	1339	219	215	51	30	7	26	14	7-3	37	18
	Gohana	1433	226	219	54	28	7-8	30	13	7-3	39	17
	Karnal											
W ₃ Pd ₄ G ₄ S ₄ /J ₄	Kaithal	2110	241	230	53	30	7	27	14	7-3	37	18
	Jind											
	Safidon	390	235	228					na			
W ₃ Pd ₄ M ₄ /G ₄	Karnal											
	Gulha	1040	246	235	52	29	7-8	27	14	7-2	27	14
	Hisar											
G ₄ B ₄ W ₄ C ₄ /J ₄	Hisar	2648	213	208	41	25	8-7	22	12	7-2	22	12
	Hansi	2089	236	215	41	25	7	22	12	7-2	22	12
	Rohtak											
W ₃ Pd ₄ M ₄ /G ₄	Jhajjar	2107	272	215	50	28	7	28	14	7-3	38	18
	Jind											
	Jind	816	228	225	51	28	7	27	13	7-3	37	17
W ₃ Pd ₄ M ₄ /G ₄	Narwana	1487	233	223	45	n.a.	7	30	na	7-2	30	na
	<i>Rainfall Zone---III</i>	..	..	..	..	..				<i>Rainfall Pattern—E₄(C₃D₁)E₄</i>		
B ₃ G ₃	Mahendragarh											
	Mahendragarh	1041	525	262	55	n.a.	8'	35	na	7-2	35	na
	Narnaul	954	652	300	72	n.a.	8'	47	na	7-2	47	na
B ₃ G ₄ W ₄	Gurgaon											
	Gurgaon	1067	300	230	61	35	7	33	17	7-3	45	23
	Rewari	1437	450	272	52	32	7	28	16	7-3	39	21
W ₃ Pd ₄ M ₄ G ₄	Karnal											
	Thaneswar	1430	251	246	64	33	7	34	16	7-3	46	20
	Karnal	2200	251	241	72	35	7	40	17	7-3	53	21
W ₃ Pd ₄ G ₄ S ₄ /J ₄	Panipat	1230	240	225	60	31	7	33	15	7-3	45	19
	Rohtak											
	Sonepat	1161	225	215	54	29	7	29	15	7-3	40	19
W ₃ B ₄ G ₄ Ba ₄	Gurgaon											
	Ballabgarh	749	320	208	64	34	7	35	17	7-3	48	22
	Palwal	1000	300	208	59	33	7	33	17	7-3	45	22
G ₄ B ₄ W ₄ C ₄ /J ₄	Nuh	1048	411	300	60	32	7	35	17	7-3	45	22
	Ferozepur-											
	Jhirka	814	307	300	64	36	8'	38	20	7-3	51	25

APPENDIX 3 (Contd.)

Cropping patterns	District/ taluk	Geo- graphi- cal area (sq km)	Elevation (masl)		Annual rainfall					*Consecutive months		
			max	min	total (cm)	rd	mmr	mr	md	(a)	(b)	(c)
	<i>Rainfall Zone—IV</i>	..	..	..	..					<i>Rainfall Pattern—E₄(B₂C₁D₁)E₄</i>		
	Ambala											
W ₃ Pd ₄ M ₄ G ₄ /S ₄ /F ₄	Ambala	1027	274	259	91	43	7	47	20	7-3	63	25
	Jagadhri	1300	300	272	91	43	7	52	21	7-3	68	26
W ₄ Pd ₄ M ₄ G ₄ /F ₄ /S ₄	Kalka	263	900	450				n.a.				
	Naraingarh	1146	480	300	105	49	7	59	24	6-4	86	35

masl = metres above sea level.

rd = rainy days

mmr = month of maximum rainfall

mr = total rainfall of mmr plus that of preceding or following month, whichever is higher, in cm.

md = number of rainy days of mmr plus that of preceding or following month, whichever has higher 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 months with more than 10 cm/month, separated by hyphen.

b = Total rainfall of consecutive months in 'a', in cm.

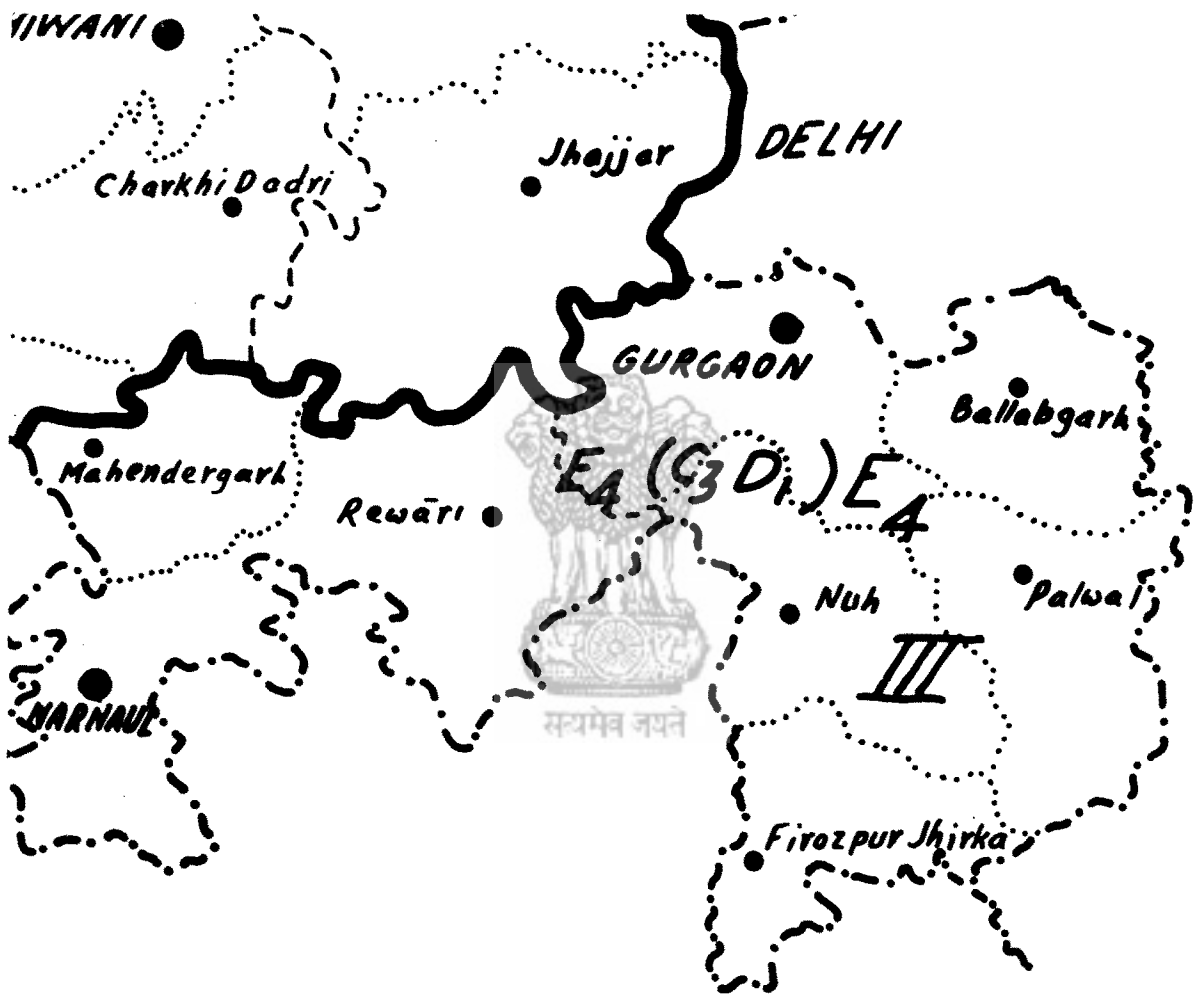
c = Total number of rainy days of consecutive months in 'a'.

na = not available.

NOTE : 1. Information on rainfall and rainy days based on Memoirs of India Meteorological Department, Vol. XXXI, Part III as on 12th May, 1961.

2. For explanation of coded form of rainfall and cropping patterns, reference may be made to section 2 in the text.



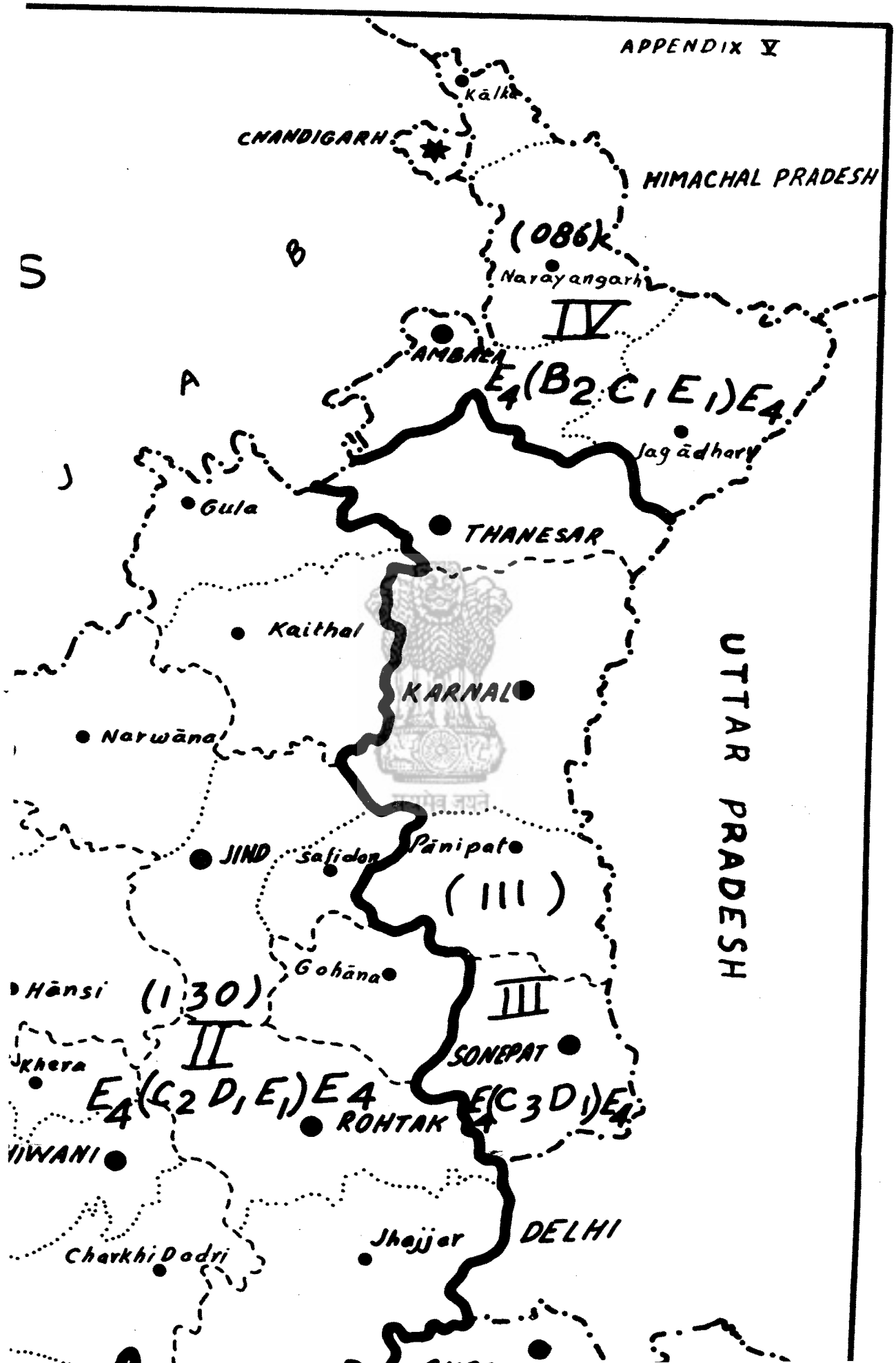


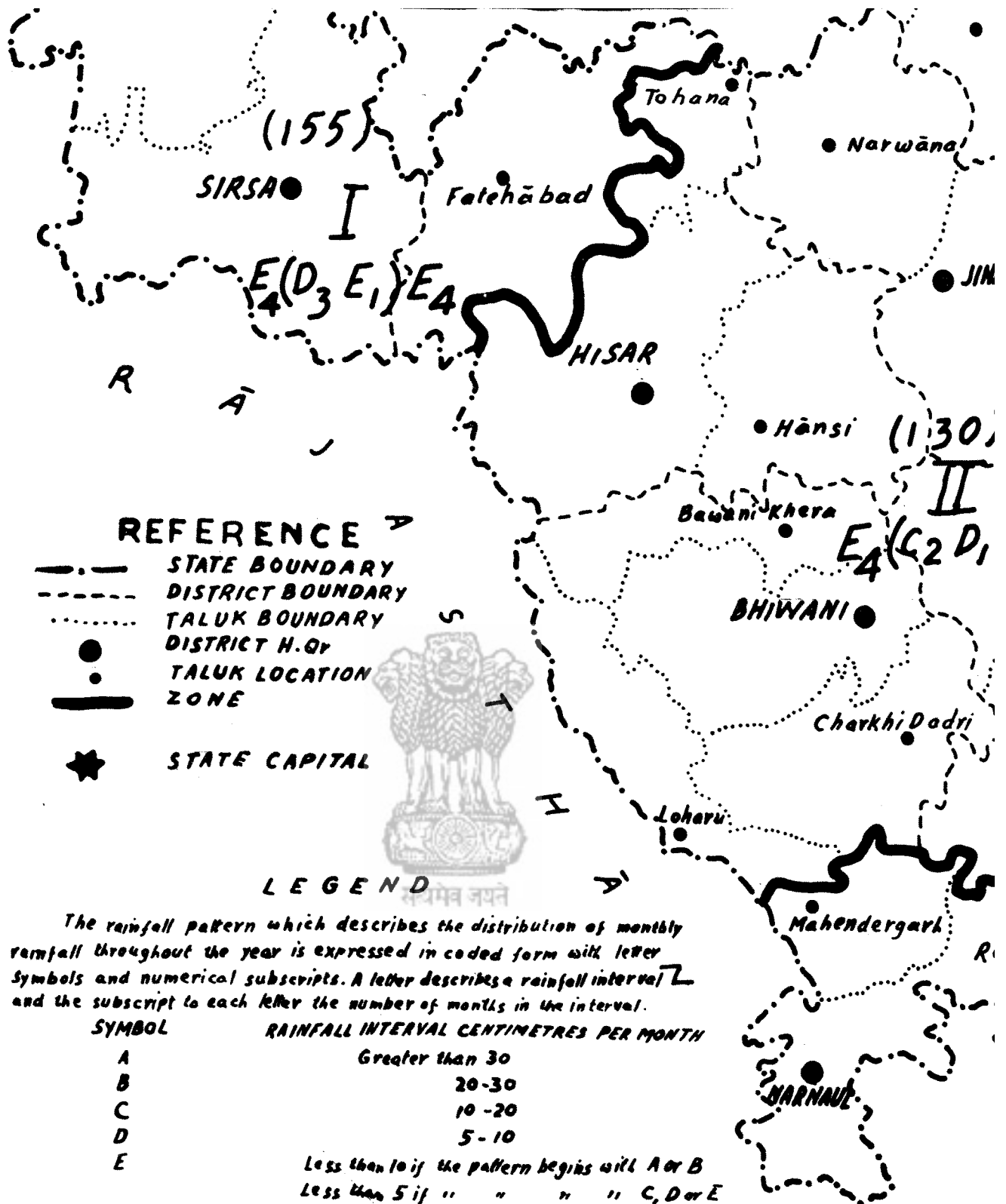
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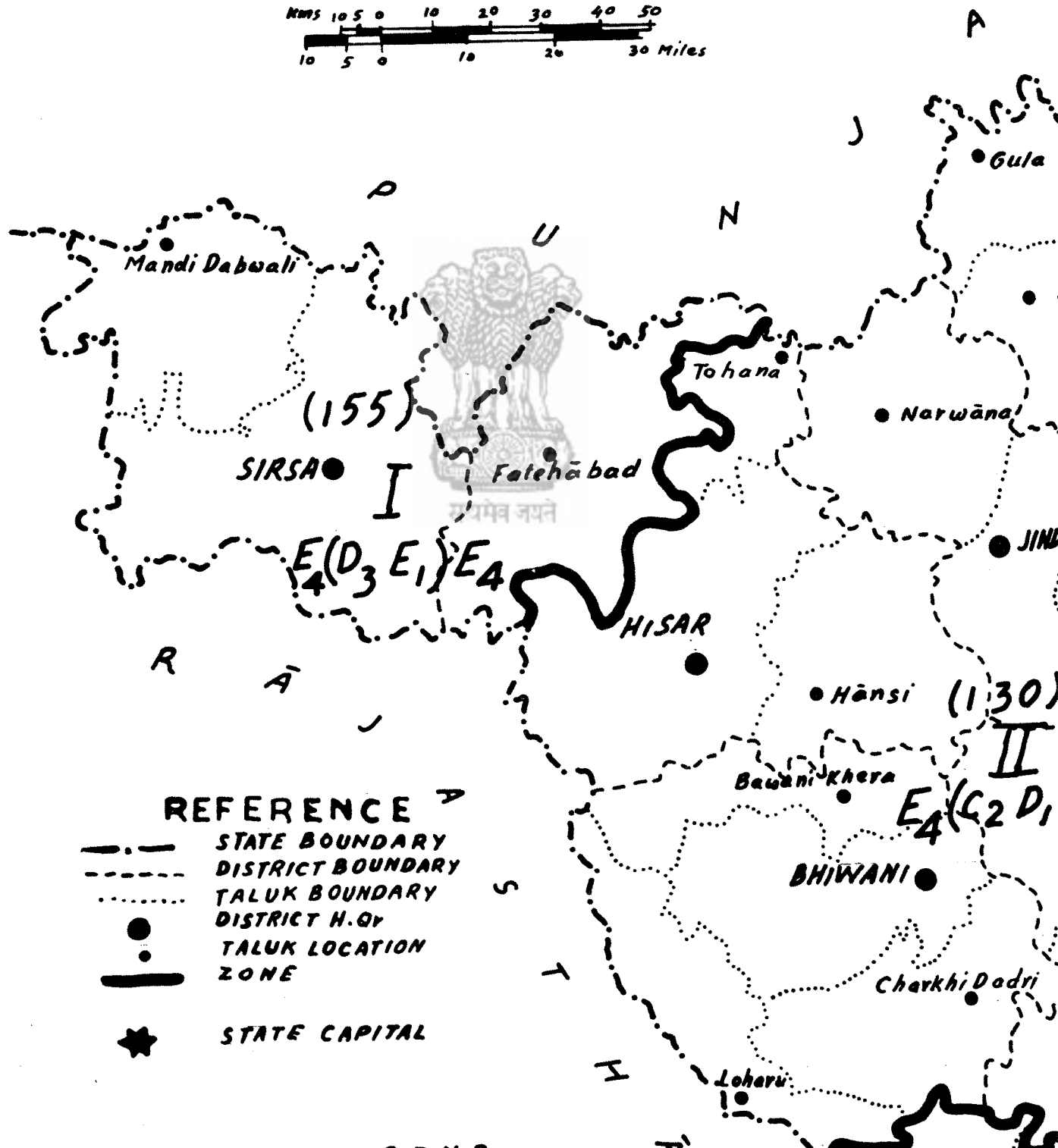
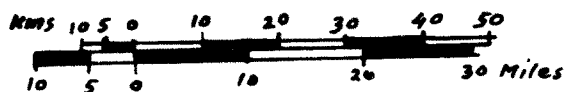
The coded form of pattern consists of three groups corresponding to the three seasons February to May, June to September and October to Jan. The central is entered in brackets.

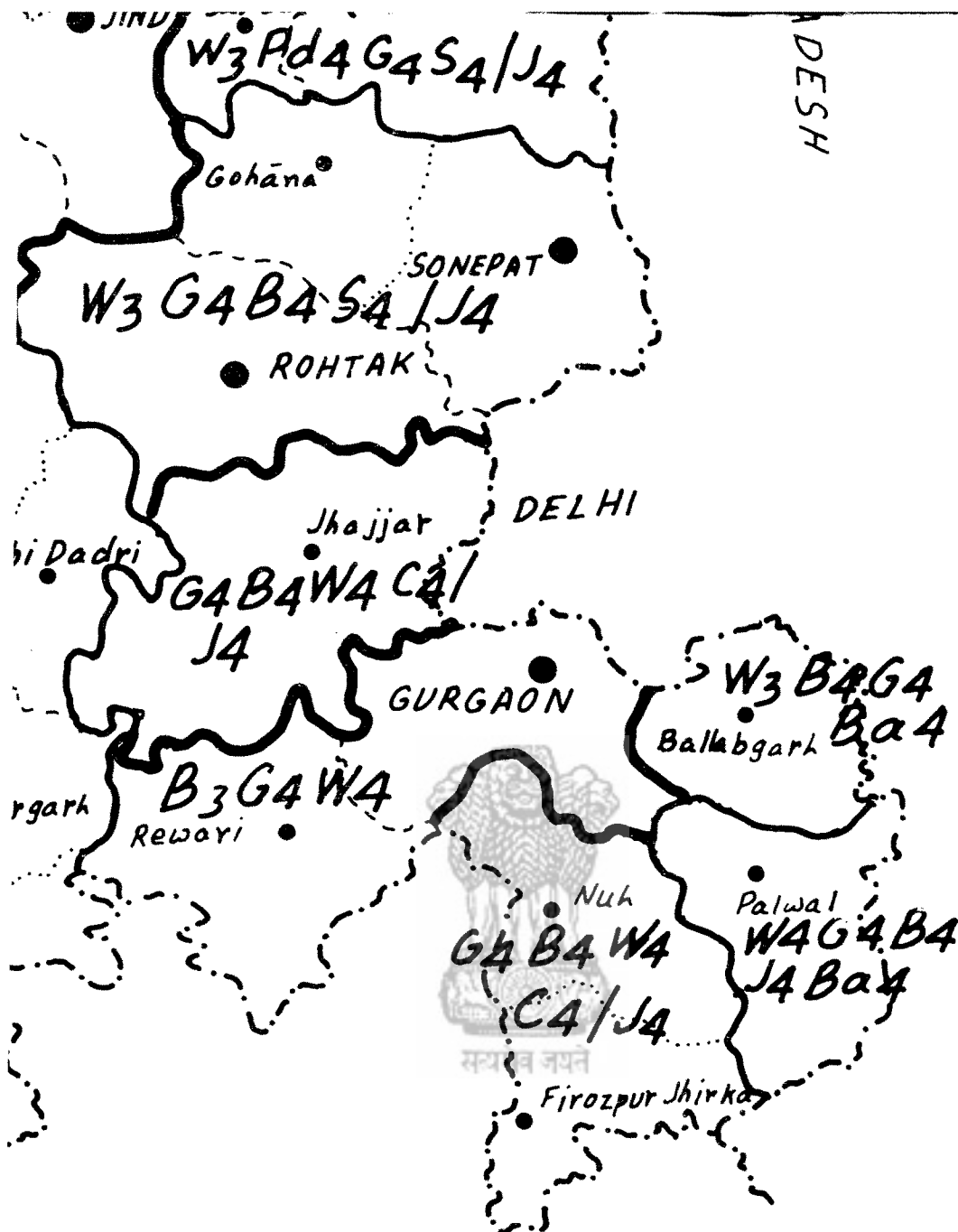
The area covered by a rainfall pattern is termed a zone and the zones in the map are serially numbered. Roman numbers indicate State rainfall zones and three-digit figures in Arabic numerals within brackets give their corresponding all-India equivalents.

72
at

HARYANA

RAINFALL PATTERNS





A Cropping pattern consists of one or more crops, each with a subscript which indicates the percentage area of the crop concerned

SUBSCRIPT

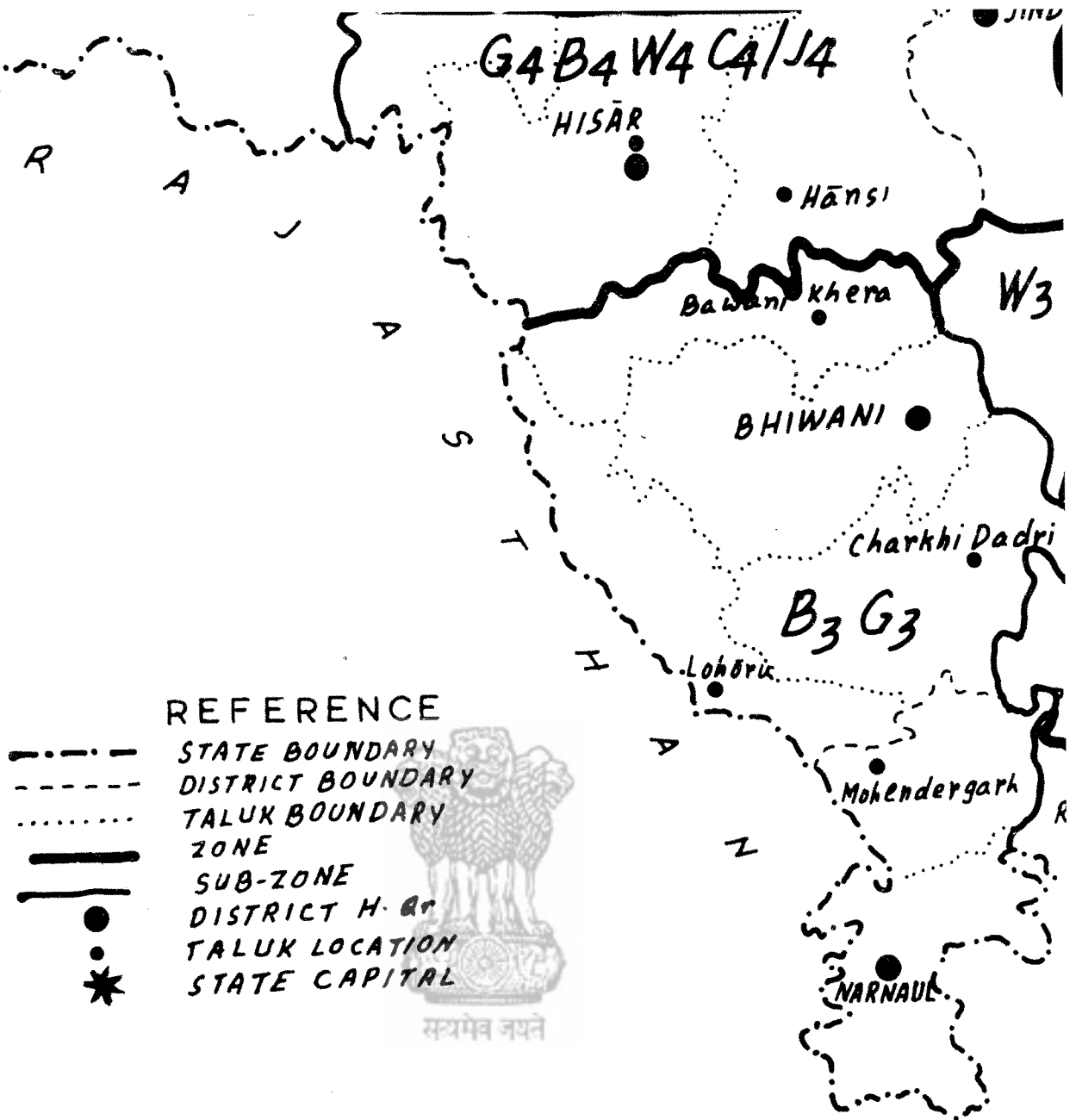
PERCENTAGE OF GROSS CROPPED AREA

1	Greater than 70
2	50-70
3	30-50
4	10-30
5	Less than 10

EXAMPLE:

- (i) Pd₁ Paddy covers more than 70% of gross cropped area
- (ii) B₃G₄W₄ Bajra (30-50%) area; Gram (10-30%) area and Wheat (10-30%) area





CROPS

Paddy
Plantations
Fodder
Ragi
Bajra
Small Millets
Vegetables
Jowar
Wheat
Maize

SYMBOLS

Pd
L
F
R
B
Mt
V
J
W
M

CROPS

Gram
Tur
Other Pulses
Cotton
Groundnut
Other Oilseeds
Sugarcane
Barley
Oats
Tobacco
Fruits

LEGEND

SYMBOLS

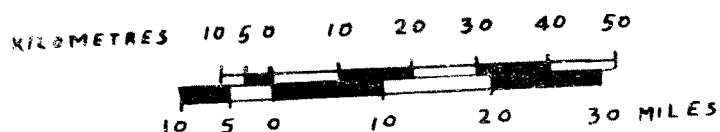
G
T
Pu
C
Gn
O
S
Ba
Oa
T
Fr

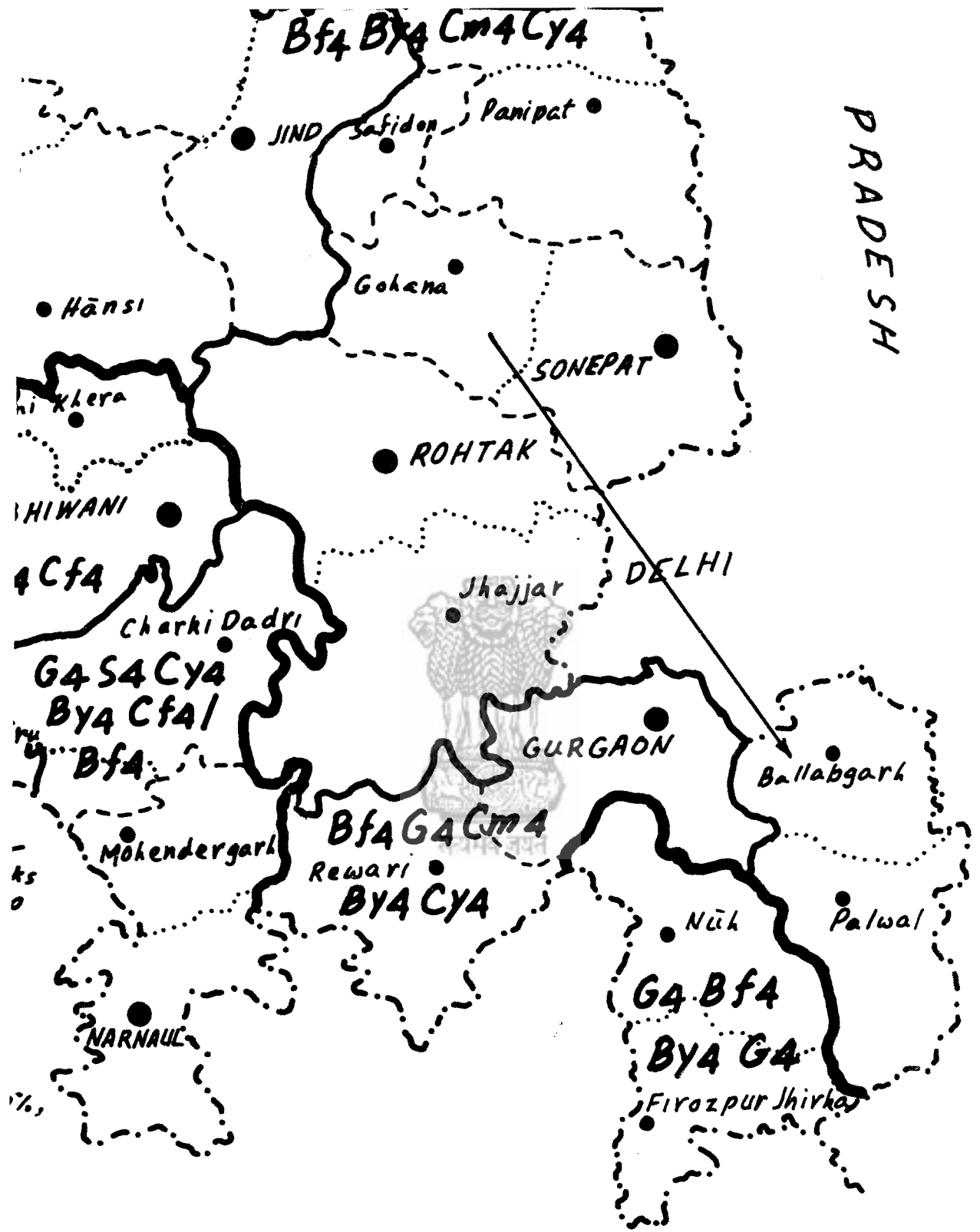
A crop which indicates the soil type

EXAMP

The administrative headquarters of Haryana & Punjab are at Chandigarh
Based upon Survey of India map with the permission of the Surveyor General of India.

CHANDIG





garh.

NS

CHANDIGARH

HIMACHAL PRADESH

Narayanganah

AMBALA

Cm4 Cy4 Bf4 Cf4/By4

Jagadhari

Gula

THANESAR

Kaithal

KARNAL

Narwana

Bf4 By4 Cm4 Cy4

JIND

Safidon

Panipat

Hansi

Gohana

SONEPAT

ROHTAK

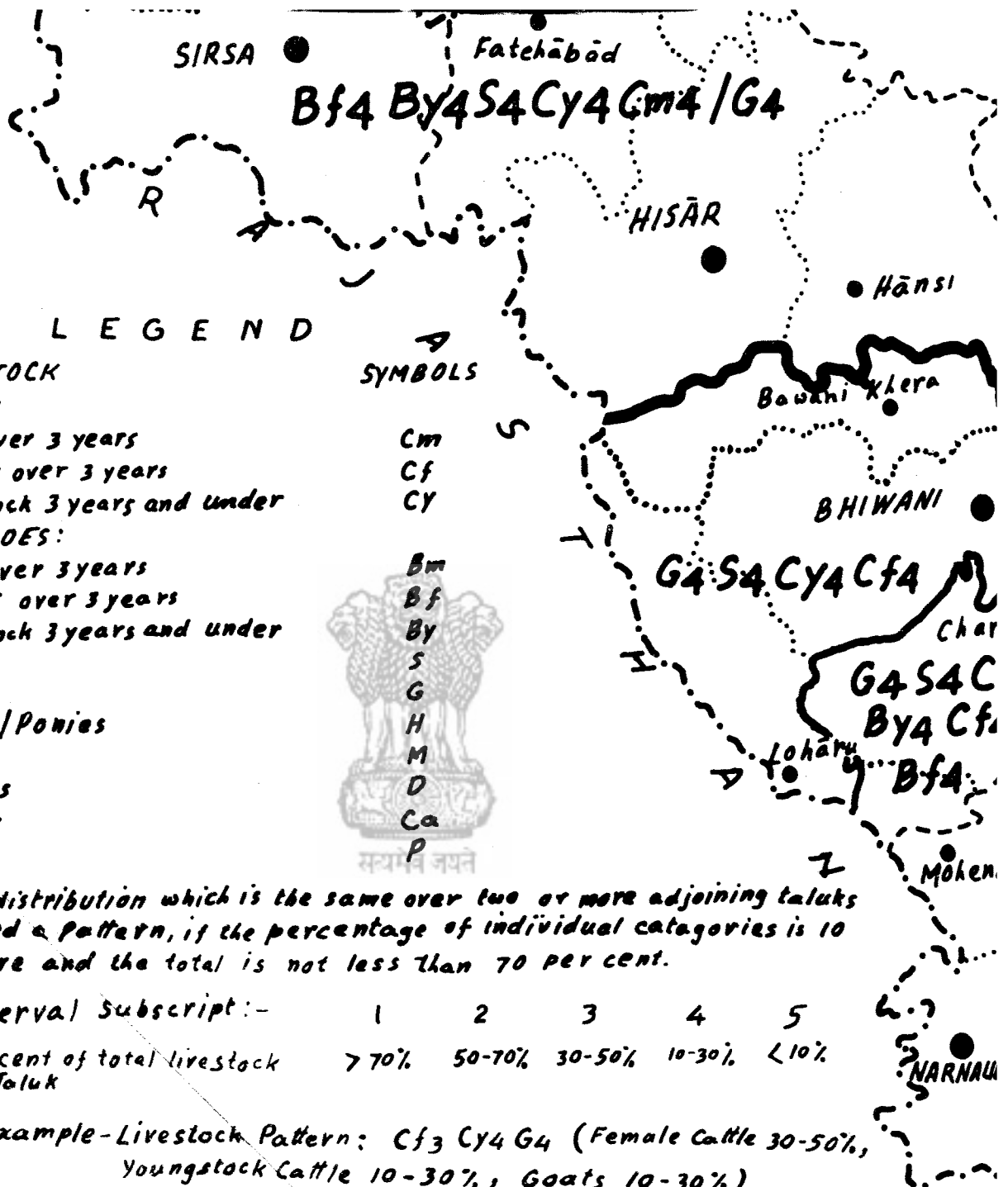
HIWANI

4 Cf4

Jhajjar

DELHI

UTAR PRADESH



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HARYANA

LIVESTOCK PATTERNS

REFERENCE

- STATE BOUNDARY
- DISTRICT BOUNDARY
- TALUK BOUNDARY
- DIST. H.Q.
- TALUK LOCATION
- ★ STATE CAPITAL
- ZONE
- SUB-ZONE

KILOMETRES 10 5 0 10 20 30 40 50
10 5 0 10 20 30 MILES

