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Agro-climatic Zones of India

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Abstract: Different methods followed to classify Indian sub-continent into homogeneous agro-climatic zones have been summarized and an attempt made to regroup the 126 agro-climatic zones identified by ICAR under the NARP programme. The present exercise was made to combine contiguous zones, having similar soil, climatic, physiographic and cropping patterns, thereby reducing the total number of zones to a manageable number of 60, in addition to the 2 zones representing Andaman-Nicobar islands and Lakshadweep islands.

Key words : Agro-climatic zones, regrouping of NARP zones, Indian region.

Identification of homogeneous agro-climatic zones for regional planning is essential for proper utilization of land, water and other resources through transfer of suitable technology, choice of crops, adoption of uniform policy and distribution of management inputs etc., among the climatic analogues. Department of Agricultural Research and Education (DARE) of the Indian Council of Agricultural Research (ICAR) also gave much emphasis on agriculture policy and programmes based on agro-climatic zonal approach. With the diverse climate-soil-crop situations that exist in vast areas of the Indian sub-continent, no single technology or practice satisfies overall planning of agricultural systems. Therefore, regional planning based on agro-climatic zones is much relevant to achieve higher crop production. In this paper, some of the earlier attempts made for classification of agro-climates of India have been reviewed and an attempt was made for regrouping of agro-climatic zones identified under the National Agricultural Research Project (NARP).

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Methods used for classifying agro-climates of India

Many attempts have been made to classify the agro-climatic zones of India. One of the earlier attempts made by Subrahmanyam (1956) was to classify India according to the Koeppon's classification. Based on Thornthwaite and Mather's (1955) approach, Subrahmaniam *et al.* (1965) classified India's climate into 6 types ranging from arid to per-humid zones and 5 thermal efficiency types.

Krishnan and Singh (1968) attempted to classify the soil climatic zones from agricultural point of view, by superimposing the moisture index of Thornthwaite and mean air temperature isopleths on a soil map of India showing major soil types. Based on this, the country was demarcated into 63 soil climatic zones. Krishnan (1988) later, utilizing extended data of raingauge network, considered 8 climatic types and reduced the soil climatic zones to 40.

Subramaniam (1983) classified the agro-ecological zones of India based on the index of moisture adequacy superimposed on the soil map of India. Based on these criteria,

the country was divided into 29 agro-ecological zones (classified as part of six agronomic groups), indicating the potential regions for different field and plantation crops.

Alagh *et al.* (1989) and Khanna (1989) identified 15 resource development regions in the country and attempted to bring integration of plans and policies of the agro-climatic regions with the State and National Plans. Sehgal *et al.* (1989) also demarcated the country into 54 agro-ecological zones and in total considered 19 physiographic conditions, 15 soil types, 6 climatic types and 7 growing periods, to delineate the country into arid, semi-arid, sub-humid, humid and per-humid, coastal and island ecosystems. They also suggested the landuse and forest type of vegetation that can be considered for each region, along with the species best suited to these regions.

Regrouping of ICAR (NARP) zones

Agricultural research, based on agro-climatic zone, was initiated by ICAR in 1979 under the auspices of NARP, with an objective for upgrading each agro-climatic zone, for generating location specific and need based data to identify the major problems limiting agricultural growth in each of these zones through the analysis of agro-ecological cropping pattern. Under NARP, the zones were classified based on certain ecological parameters like topography, rainfall pattern, soils, cropping pattern and irrigation availability (Ghosh, 1991). Taking the above variables, homogeneous zones were identified as continuous areas within the state boundary with each zone covering 2-4 districts and as much as 40-45 km^2. Accordingly, the country

Table 1. Agro-climatic zones of India

RAZ	State-wise NARP zone No.	NARP zone No.	Region	Rainfall (mm)	Major soils
1	AP 1	1	Krishna Godavari	800-1100	Deltaic aluvium/deep black/red sandy
2	AP 2	2	North coastal AP	1000-1100	Red sandy/coastal alluvium
	O 3	76	NE plateau of Orissa	1550-1600	Deltaic alluvial
	O 4	77	E and SE Orissa coast	1200-1450	Coastal alluvial/laterite/red loamy
3	AP 3	3	Southern AP	700-1050	Red sandy/coastal alluvium/laterite
	TN 1	98	NE Tamil Nadu	1025-1215	Red loamy/red sandy
4	AP 4	4	Northern Telengana	900-1150	Deep black/medium black/red sandy
	MR 8	72	Central Vidharbha	1100-1150	Medium black/shallow black
	MR 9	73	Eastern Vidharbha	1400-1550	Medium to deep black
5	AP 5	5	Southern Telengana	700-900	Red sandy/medium black/deep black
	KK 1	38	Northeast transition zone	829-919	Medium black/lateritic
	KK 2	39	Northeast dry zone of KK	633-806	Medium black/deep black
6	AP 6	6	Scarce rainfall zone of AP	500-700	Red loamy/medium black
	KK 4	41	Central dry zone of KK	455-717	Red sandy/deep black/medium black
7	AP 7	7	High altitude zone of AP	> 1400	Red loamy/red sandy
	O 5	78	NE Ghat of Orissa	1550-1625	Red loamy/laterite
	O 6	79	E Ghat highland of Orissa	1500-1550	Red loamy/red sandy
	O 7	80	SE Ghat of Orissa	1500-1521	Red loamy
	MP 2	54	Bastar plateau	1500-1600	Red sandy/red and yellow
8	AS 8	8	S. Arunchal Pradesh	950-1025	Alluvial (Recent)

(Contd.)

RAZ	State-wise NARP zone No.	NARP zone No.	Region	Rainfall (mm)	Major soils
9	AS 2	9	Upper Brahamputra Valley	>2000	Alluvial
	AP 3	10	Central Brahmputra Valley	600-1600	Alluvial/red loamy
	AS 4	11	Lower Brahmputra Valley	>1700	
10	AS 5	12	Barak valley of AS	>2000	Alluvial/red loamy
11	–	–	Tripura, Mizoram, Manipur	>2000	Alluvial/red loamy
12	AS 6	13	Nagland, Meghalya and hill zone of AS	>2500	Red loamy/lateritic
13	B 1	14	North west alluvial plain	1200-1225	Alluvial (Recent)/calcareous alluvial
	B 2	15	North east alluvial plain	1350-1425	Alluvial (Recent)
	UP 8	112	NE Plains of UP	1460-1525	Alluvial/tarai
14	B 3	16	South Bihar alluvial plain	1000-1050	Alluvial
	UP 6	110	Central plains of UP	885-1160	Alluvial
	UP 9	113	Eastern plain zone of UP	800-825	Alluvial
15	B 4	17	Central plateau of Bihar	1300-1325	Red loamy
	B 5	18	Wastern plateau of Bihar	1400-1425	Red and yellow
	O 1	74	NW plateau of Orissa	1600-1675	Red sandy/red and yellow
	O 2	75	North central Orissa plateau	1500-1550	Red and yellow
	WB 5	119	Laterite and red soil region of WB	1100-1300	Red loamy/red and yellow
16	B 6	19	South eastern Bihar plateau	1275-1325	Mixed red and black
17	G 1	20	South Gujarat	>1500	Deep black/coastal lluvium
	G 2	21	South Gujarat	1000-1500	Deep black/coastal alluvium
18	G 3	22	Middle Gujarat	800-1000	Meduiu black/grey brown
	MP 12	64	Jhabua hills	600-700	Shallow red/medium black
	R 8	96	Southern humid plains of Rajasthan	700-1000	Mixed red and black/grey brown
19	G 4	23	North Gujarat	625-875	Grey brown
	R 7	95	Sub-humid southern Rajasthan	500-700	Red and yellow/grey brown
20	G 5	24	North west Gujarat	250-500	Grey brown/deltaic alluvium/red sandy/ medium black
21	G 6	25	North Saurashtra	400-700	Medium black
22	G 7	26	South Saurashtra	750-1000	Coastal alluvium/medium black
	G 8	27	Bhal and coastal	625-1000	Coastal alluvium/grey brown
23	H 1	28	Eastern zone of Haryana	>500+	Alluvial (Recent)/calcareous alluvial
	UP 3	107	Western plain of UP	700-1200	Alluvial
	UP 5	109	SW Semi-arid area of UP	750-780	Alluvial
24	H 2	29	Western zone of Haryana	<500	Calcareous/sierozemic
	P 4	87	Western plains of Punjab	400-500	Calcareous/sierozemic
	P 5	88	Western zone of Punjab	< 400	Old alluvial
	R 2	90	Irrigated north Rajasthan	100-350	Desert/alluvial/calcareous/sierozemic
25	HP 1	30	Sub-montane/low hills of HP	100-1200	Brown hill soils
	HP 2	31	Mid hills sub-humid zone of HP	1500-3000	Brown hill soils
	JK 2	35	Intermediate zone of JK	1200-1478	Sub-mountane/alluvial (Recent)
	UP 1	105	Hill zone of UP	800-3000	Brown hill soils

RAZ	State-wise NARP zone No.	NARP zone No.	Region	Rainfall (mm)	Major soils
26	HP 3	32	High hills temperate zone of HP	800-300 <1000	Hill forest soils
27	HP 4	33	High hills	250-350	Hill soils
	JK 4	37	Temperate zone of JK	132-661	Montane meadow/sub-montane/skeletal soils
28	JK 1	34	Sub-tropical zone of JK	1050-1075	Brown hill/alluvial (Recent)
	P 1	84	Sub-montane land of Punjab	900-1100	Alluvial (Recent)
	P 2	85	Undulating plains of Punjab	800-900	Alluvial (Recent)
29	JK 3	36	Valley temperate zone of JK	> 600	Sub-mountane/old alluvial
30	JK 5	–	Cold arid zone of JK	80-115	Skeletal (montane meadow soils, tarai soils)
31	KK 3	40	Northern dry zone of KK	465-786	Medium black/deep black/red sandy
	MR 6	70	Scarcity zone of Maharashtra	500-700	Medium black/deep black
32	KK 5	42	Eastern dry zone of KK	679-889	Red loamy/red sandy/lateritic
	TN 2	99	NW Tamil Nadu	875-970	Red loamy
33	KK 6	43	Southern dry zone of KK	670-889	Red loamy/red sandy
	KK 7	44	Southern transition zone of KK	611-1054	Red sandy
34	KK 8	45	Northern transition zone of KK	619-1303	Medium black/deep black/red loamy
	MR 5	69	Western Maharashtra plain	700-1250	Medium black/deep black
35	KK 9	46	Hill zone of KK	904-3695	Red loamy
	K 4	51	High altitude zone of Kerala	3350-3600	Red loamy
	TN 6	103	High rainfall zone of TN	1469-1670	Red loamy/coastal alluvium
	TN 7	104	High altitude zone of TN	1000-5000	Red loamy/mixed red and black
36	KK 10	47	Coastal zone of KK	3010-4694	Red loamy/coastal alluvium/laterite
	K 1	48	Northern zone of Kerala	> 3000	Laterite/red loamy/coastal alluvium
37	K 2	49	Southern zone of Kerala	2000-3000	Lateritic/red loamy/coastal alluvium
	K 3	50	Central zone of Kerala	2115-3100	Laterite/red loamy/coastal alluvium
38	K 5	52	Problem area of Kerala	1000-2600	Coastal alluvium/lateritic
39	MP 1	53	Chhattisgarh plain	1000-1500	Red and yellow/deep black
	O 8	81	Western undulating land of Orissa	1350-1375	Red and yellow
	O 9	82	West central table land of Orissa	1500-15550	Red and yellow
	O 10	83	Mid central table land of Orissa	1400-1450	Red and yellow
40	MP 3	55	North hill area of MP	1000-2000	Red and yellow
41	MP 4	56	Kymore plateau	1000-1200	Red and yellow/medium black/mixed black and red
	UP 10	114	Vindhyan zone of UP	1100-1250	Red and yellow/alluvial
42	MP 5	57	Vidhya plateau	1000-1250	Medium black
	MP 9	61	Satpura plateau	1000-1200	Shallow black/mixed red and black
	MP 10	62	Malwa plateau	800-1000	Medium black/mixed red and black
43	MP 6	58	Central Narmada Valley	1000-1200	Deep black/skeletal
44	MP 7	59	Gird zone of MP	600-800	Medium black/alluvial
	R 9	97	SE humid plains of Rajasthan	650-1000	Medium black
45	MP 8	60	Bundelkhand	800-1000	Mixed red and black
	UP 7	111	Bundelkhand zone of UP	700-1000	Mixed red and black

(Contd.)

RAZ	State-wise NARP zone No.	NARP zone No.	Region	Rainfall (mm)	Major soils
46	MP 11	63	Nimar Valley	600-800	Shallow red/medium black
47	MR 1	65	South Konkan	> 2500	Laterite/red loamy/coastal alluvium
	MR 2	66	North Konkan coast	1500-2000	Red loamy/coastal alluvium
48	MR 3	67	Western Ghat	2000-2500	Red loamy
	MR 4	68	Sub-montane area of MR	700-2500	Shallow red/medium to deep black
49	MR 7	71	Central Maharashtra plateau	700-900	Medium black/deep black/shallow red
50	P 3	86	Central plains of Punjab	500-800	Alluvial (Recent)
51	R 1	89	Arid western plains of Rajasthan	100-300	Desert (Rhegosolic)
52	R 3	91	Transitional plains of Rajasthan	300-500	Desert/grey brown
	R 4	92	Transitional plain of Luni basin	300-500	Desert/grey brown
53	R 5	93	Semi-arid eastern plains of Rajasthan	500-600	Alluvial
	R 6	94	Flood prone east region of Rajasthan	500-600	Alluvial (Recent)
54	TN 3	100	Western zone of Tamil Nadu	600-650	Mixed red and black
	TN 5	102	Southern zone of Tamil Nadu	750-800	Mixed red and black/coastal alluvium
55	TN 4	101	Cauvery Delta of TN	900-1000	Deltai alluvium/red loamy/coastal alluvium
56	UP 2	106	Bhabar and tarai region of UP	> 1400	Tarai/alluvial
	UP 4	108	Mid-western plain of UP	850-1450	Alluvial/tarai
57	WB 1	115	Hilly zone of west Bengal	2500-3000	Brown hill soils
58	WB 2	116	Tarai zone of west Bengal	2100-3000	Tarai soils
59	WB 3	117	Old alluvial region of WB	1100-1500	Red loamy/alluvial/laterite
	WB 4	118	New alluvial region of WB	1200-1500	Red and yellow/alluvial (Recent)
60	WB 6	120	Coastal saline area of WB	1450-1925	Deltaic alluvium
61	–	–	Andaman & Nicobar Islands	> 3000	Red loamy
62	–	–	Lakshadweep Islands	< 1500	Sandy

RAZ : Regrouped NARP

AP	: Andhra Pradesh	JK	: Jammu & Kashmir	P	: Punjab
AS	: Assam	KK	: Karnataka	R	: Rajasthan
B	: Bihar	K	: Kerala	TN	: Tamil Nadu
G	: Gujarat	MP	: Madhya Pradesh	UP	: Uttar Pradesh
H	: Haryana	MR	: Maharashtra	WB	: West Bengal
HP	: Himachal Pradesh	O	: Orissa		

was divided into 126 agro-climatic (NARP) zones for 17 states and 6 states/Union territories of north Eastern Hill Region. Later on, three more zones for Andaman-Nicobar Islands and two zones for Pondichery were delineated (Ghosh, 1991). However, they have maintained the state boundaries and delineated at times on either side of the state boundary into separate agro-climatic zones. In this paper, all the NARP contiguous zones, having homogeneous agro-climatic conditions are regrouped, removing the state boundaries.

The regrouped ICAR zones (RAZs), after deletion of the state boundaries, are presented in Fig. 1. All the 120 NARP zones could be regrouped into a manageable number of

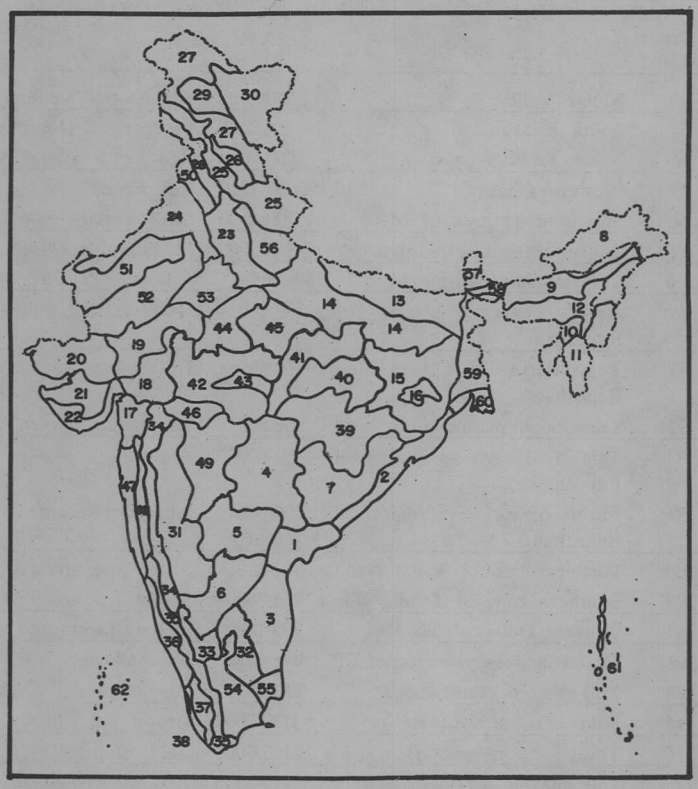

Fig. 1. Regrouping of ICAR agro-climatic zones.

60 zones, in addition to the zones representing Andaman-Nicobar and Lakshadweep islands.

Thus, when looked for homogenous agro-climatic zones, considerable scope arose to regroup the NARP zones (Table 1). For example, the 2nd NARP zones of Andhra Pradesh and 3rd and 4th NARP zones of Orissa, with an annual rainfall of 1000-1568 mm and mostly coastal/deltaic alluvium, can be regrouped into a single agro-climatic zone (RAZ-2). The 3rd NARP zone of Andhra Pradesh and 1st NARP zone of Tamil Nadu, having annual rainfall of 700-1054 mm and red sandy/loamy condition, can be regrouped into a single zone (RAZ-3). The 4th NARP zone of Andhra Pradesh, 8th and 9th NARP zones of Maharashtra, which have medium black soil and an annual rainfall of 900-1402 mm, can be regrouped into a single zone (RAZ-4).

Similarly, the high altitude and highland NARP zones of 7th in Andhra Pradesh, 5th, 6th and 7th zones of Orissa and 2nd in Madhya Pradesh have similar agro-climatic conditions, with an annual rainfall of 1400-1600 mm and red loamy/sandy soil conditions, can be regrouped into a single zone (RAZ-7). Some of the valley areas in the 2nd, 3rd and 4th NARP zones with an annual rainfall of 1400-2300 mm and with alluvial soils, can be regrouped into a single zone (RAZ-9). The plain lands of 1st and 2nd NARP zones in Bihar and 8th NARP zone of Uttar Pradesh,

with an annual rainfall of 1211-1470 mm under alluvial soils, can be regrouped into a single zone (RAZ-13).

Details of other regrouped NARP zones are given in Table 1 and Fig. 1. Wherever regrouping is not possible, due to dis-similarity in the agro-climatic conditions, the NARP zone was given a separate identity for a single zone. For example, the 1st NARP zone of Assam is given as RAZ-8, 5th NARP zone in Assam as RAZ-10, 6th NARP zone of Assam as RAZ-12 and likewise. Thus, all the NARP zones are regrouped into 62 homogeneous agro-climatic zones including two island zones.

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