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Prioritization of Rainfed Areas in India based on Natural Resource Endowments

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SUMMARY

The "green revolution" era in India had largely by-passed the rainfed agriculture. In order to achieve overall development of agriculture, it is essential to bridge the yield gaps, enhance profitability, minimize risk and improve the livelihoods of millions of people dependent on rainfed agriculture. Therefore, regionally differentiated interventions befitting to the natural resource endowment are need of the hour to meet the current challenges. Further, the resources available for meeting such demands are naturally scarce. Therefore it is important to prioritize the rainfed areas and identify the possible interventions for formulating developmental programmes for correcting the plight in prioritized areas. Previous studies with this aim largely focused on variables like rainfall, irrigation etc. The present study made an attempt to prioritize the rainfed areas including variables like drought proneness and degraded and waste lands, water holding capacity of soil, ground water utilization status as well. For this purpose, district which is the lowest level administrative unit for which reasonable statistical data are available for planning and evaluation is considered as unit of study. A composite index, namely, Natural Resources Index (NRI) was developed by combining various facets of natural resource availability. Based on NRI score, the districts were ranked such that districts with low score (weak resource base) get high priority for resource conservation and upliftment. Status of natural resources (NRI) is relatively low in western, central and southern part of the country extending from Haryana to Tamil Nadu with exception of west coast region of Karnataka and Kerala. On the other hand, the NRI is relatively high in eastern parts of India particularly in West Bengal, Bihar and Orissa. The information on various facets as summarised in the form of indicators serves as guiding tool for identifying appropriate interventions.

Keywords: Rainfed areas, Prioritization, District, Natural resources.

1. INTRODUCTION

Rainfed areas currently constitute 55 per cent of the net sown area of the country. Even after realizing complete irrigation potential, about 50 per cent of the cultivated area will continue to remain rainfed. Two thirds of livestock and 40 per cent of human population of the country live in rainfed regions. Though growth performance of rainfed crops was impressive during the last decade (Raju *et al*. 2010), the yield gaps in these crops indicate huge potential yet. In order to achieve overall development of agriculture in the country, it is essential to bridge the yield gaps, enhance the profitability, minimize risk and improve the livelihoods of millions of people dependent on rainfed agriculture. Although a large number of technologies have been

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generated by the National Agricultural Research System (NARS) in India, their impact on the livelihoods of those living in rainfed regions has been limited.

The "green revolution" era had largely by-passed the rainfed agriculture. The "Everything Everywhere" approach of taking up all major interventions uniformly across all regions of the country has not paid much dividend. The specific needs of rainfed farming besides their characterization are of paramount importance. Some efforts have gone in this direction. Earlier most of the efforts of demarcation of dry farming regions in India and its characterization were on the basis of rainfall variability within the range of 400 to 1000 mm of rainfall. The rainfed areas *per se* (beyond the purview of drylands) didn't get focused attention for increasing production and productivity. Later, the efforts of prioritization were concentrated mainly on variables like percentage irrigation, aridity index, incidence of poverty etc. for delineating rainfed areas/districts. This approach also did not fully capture aspects like soil resources, land degradation and reliability of irrigation, etc. Therefore, regionally differentiated interventions befitting to the natural resource endowment are need of the hour to meet the current challenges. For this, it is important to prioritize the rainfed areas and identify the possible interventions for formulating developmental programmes for correcting the plight in prioritized areas. The present study has been carried out to identify and prioritize the areas that are relatively harsher in terms of natural resources. Identification of such 'hot spots' will enable allocate the scarce resources more efficiently and better target the technology development and transfer.

2. DATA AND METHODOLOGY

This study considered 499 districts that existed as on March 31, 2001, the date of reference for Census-2001. These districts account for more than 90% of country's population and area. The districts that could not form part of the study are the districts of Jammu & Kashmir, north-eastern region other than Assam, Goa, and Union Territories. The reason for not including them is the non-availability of data for certain key variables used in the study. Totally urban districts like Chennai, Mumbai, Kolkata and Hyderabad were also excluded from the purview of the study. Though geographical extent of districts that existed during 2001 was considered the data on majority variables refer to 2004 or later. Data of newly formed district were added to 'original district' data from which such new district was carved out (apportioned) and indicators were derived for pre-divided districts.

The variables considered for building Natural Resources Index (NRI) were set out in Table 1. The table lists the variables, their measurement units and source of data along with remarks.

Table 1. Variables considered for computation of natural resource index

Variables (No.)	Measurement/unit	Data source	Remarks
Rainfall	Annual normal rainfall measured in mm	Mostly India Meteorological Department (IMD), Pune. Other sources include State Government websites and http://www.indiawaterportal.org/ which computed district level data from Climate Research Unit (CRU) TS2.1 dataset, Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom (Mitchell and Jone 2005).	An upper limit 1500 mm was considered as cutoff to give greater emphasis to low rainfall areas. It accounts for more than 80% of the total geographical area (Mandal *et al.* 1999). Moreover, the demand to meet the potential evapotranspiration for the cropping season is well within 1500 mm for 99.8% of the total geographical area. Higher the rainfall (up to 1500 mm) higher the natural resource base.

Variables (No.)	Measurement/unit	Data source	Remarks
Drought	Measured in terms of probability of occurrence of severe drought. Computed by sum of probability of severe drought and half the probability of moderate drought. It means two moderate droughts were considered equivalent to one severe drought.	Gore *et al*. (2010)	Adopting the criteria of drought given by Gore *et al*. (2010) a negative deviation of 26 to 50% from normal rainfall was considered as a moderate drought, while negative deviation that exceeds 50% was treated as severe drought. Higher the probabilities lower the resource base.
Available Water Content (AWC) of soil	AWC is generally expressed as mm of water available to crop plants and is determined by soil depth and texture.	Derived by superimposing the soil maps developed by National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) and global data sets in GIS environment	Higher AWC means higher water availability and high resource endowment.
Area under degraded and waste lands	Area under degraded and wastelands was considered in two ways i.e., the extent (m ha) and proportion (as percent of geographical area)	ICAR (2010)	Area under degraded and wastelands was not provided for certain districts like Neemuch, Umaria etc.; but this information was available for pre-divided districts (mother district). In such cases, the area under degraded and wastelands for new districts was derived in proportion to their geographical areas.Larger area under degraded and wastelands makes the resource base weak.
Irrigated area	Net irrigated area was also considered in two ways, both in terms of extent (m ha) and proportion to net sown area.	Agricultural Census, Department of Agriculture and Cooperation (DAC), Govt. of India; Directorate of Economics & Statistics, DAC, Govt. of India; CRIDA-ICRISAT unpublished database (compilation); State Bureaus/ Directorates of economics and statistics; State Planning Departments via State government websites and District websites and correspondence with States	Net sown area and net irrigated area mostly refer to average of three years data (2004-05, 2005-06 and 2006-07). The data were not available for districts of certain states for these years. District level irrigation statistics do not vary much in 1-2 years and statistics with a lag of that extent can serve as approximation. For the districts of those states the latest years for which data were available (Gujarat up to 2003-04, Maharashtra up to 2002-03, Assam 2000-01, Jharkhand 2007-08) were considered. Higher share of irrigated area makes the resource base strong.

Variables (No.)	Measurement/unit	Data source	Remarks
Status of ground water	As per CGWB (2006), ground water status of a district or block is determined and classified based on ratio of annual ground water draft and net annual ground water availability. Scores were given to each district based on the groundwater status as safe (1), semi-critical (2), critical (3) and over-exploited (4)	Central Ground Water Board (2006)	Ground water status was not provided for certain districts. The status of such districts was ascertained from an India map showing block level ground water status published by CGWB (2006). Ground water status was found to be same (in map) for all the blocks within the districts (for which data were not available). The districts were scored accordingly. Districts with over-exploited ground water status are said to have poor resource base.
Irrigation intensity	Expressed as percentage, it is the ratio of gross irrigated area to the net irrigated area	Agricultural Census, Department of Agriculture and Cooperation (DAC), Govt. of India; Directorate of Economics & Statistics, DAC, Govt. of India; CRIDA-ICRISAT unpublished database (compilation); State Bureaus/ Directorates of economics and statistics; State Planning Departments via State government websites and District websites and correspondence with States	The data used for deriving irrigation intensity mostly refer to average of three years data (2004-05, 2005-06 and 2006-07). The data for these years were not available for districts of certain states. District level irrigation statistics do not vary much in 1-2 years and statistics with a lag of that extent can serve as approximation. For districts of those states the latest years for which data were available (Gujarat up to 2003-04, Haryana up to 2002-03, Himachal Pradesh up to 2003-04, Maharashtra up to 2002-03, Assam 2000-01, Jharkhand 2007-08 and West Bengal 2000-01) were considered.Higher the irrigation intensity higher the resource endowment.

Thus, nine variables that reflect the status of natural resource endowment and are critical to agricultural production were considered in developing the natural resource index. An understanding of the status of these natural resources will help evolve technological and policy measures needed to improve the performance of agriculture in rainfed areas.

While building a composite index it is expected that various indicators used in it are measured in same units. Often it does not happen as the present case where rainfall is measured in mm and irrigated area as per cent etc. Therefore it is customary to normalize data of indicators used before combining them to build a composite index. The method used for normalization in this study is rescaling method. Iyengar and Sudarshan (1982) suggested two ways of rescaling. As per this method the variables which are positively associated with natural resource endowment (*e.g.* Higher the rainfall a district receives more is the resource) are rescaled by using the following expression.

$$D_j = \frac{X_j - \text{Min}(X_j)}{\text{Max}(X_j) - \text{Min}(X_j)} \quad (1)$$

where D_j is rescaled value of j^{th} district w.r.t. the indicator of interest

X_j is the value of indicator in original units for j^{th} district

Min (X_j) is the minimum value of the indicator in original units

Min (X_j) is the maximum value of the indicator in original units

For variables which are negatively associated with natural resource endowment (*e.g*. Higher drought proneness of a district mean low natural resource), the rescaled score will be

$$D_j = \frac{\text{Max}(X_j) - X_j}{\text{Max}(X_j) - \text{Min}(X_j)} \quad (2)$$

Palanisami *et al.* (2010) used this method of rescaling while evaluating vulnerability of districts under Godavari river basin to climate change. The resultant scores will vary between 0 and 1. For each rescaled variable, if the value is approaching 1, the resource is high and the districts having rescaled values close to zero are said to have poor natural resource endowment.

Narain *et al*. (1991) gave a composite index to measure socio economic development for each state. It was based on standardized variables (Z scores). The composite index was calculated as square root of sum of squared deviations from best state for variables considered. The variables were combined using equal weights. Rai and Bhatia (2004) used this methodology and evaluated the status of development at district level for Assam state. Narain *et al.* (2007) modified the earlier index by weighing the deviations inversely proportional to coefficient variation and evaluated the disparities in the level of development among various districts. Yet, the variables used in building the index may not be completely independent. Nagar and Basu (2002) developed a composite index using the weights derived from Principal Component Analysis (PCA). The weights are derived objectively from correlation matrix. The principal component variables are independent. The present study used the method of Nagar and Basu (2002) for constructing Natural Resource Index (NRI) for its aforesaid merits. The procedure adopted is as under.

Let D_{ij} is a rescaled value of j^{th} district for i^{th} variable (i = 1, 2, ..., p and j = 1, 2, ..., n). Let Z_{ij} is a standardized value (obtained by shifting the origin to zero and dividing with standard deviation) corresponding to D_{ij} and $\mathbf{Z}$ be *a* $p \times n$ matrix corresponding to Z_{ij}s. A correlation matrix, R ($p \times p$ matrix) is computed from rescaled variables (the matrix will remain same to the one computed from standardized variables). Solving the determinant equation $|\mathbf{R} - \lambda \mathbf{I}| = 0$ for λ provides a p^{th} degree polynomial equation in λ's and hence p roots. These roots are called eigen values (λ's) of correlation matrix $\mathbf{R}$. The λ's are then arranged in descending order of magnitude, as $\lambda_1 > \lambda_2 > \ldots > \lambda_k > \ldots > \lambda_p$ (k = 1, 2, ..., p). Corresponding to each λ_k (k = 1, 2, …, p), the matrix equation $(\mathbf{R} - \lambda_k \mathbf{I})\alpha_k = 0$ is solved for the $p \times 1$ eigenvector α_k, subject to the condition that $\alpha'_k\ \alpha_k = 1$ (normalization condition). The vector of principal component (PC) scores corresponding k^{th} axis (Y_k) is then computed $\boldsymbol{Y}'_k = \boldsymbol{\alpha}'_k \boldsymbol{Z}$ (where $\boldsymbol{\alpha}_k$ is an eigen vector corresponding to eigen value λ_k).

It is known that $\lambda_1 = \text{var}(Y_1)$, $\lambda_2 = \text{var}(Y_2)$, ..., $\lambda_k = \text{var}(Y_k)$, ..., $\lambda_p = \text{var}(Y_p)$

Using the variation explained by various PCs as weights, the Natural Resource Index (NRI) is computed as weighted average of p principal components.

Thus, NRI for j^{th} district ($\mathbf{R}_j$) is

$$\mathbf{R}_j = \frac{\lambda_1 Y_{1j} + \lambda_2 Y_{2j} + \ldots + \lambda_k Y_{kj} + \ldots + \lambda_p Y_{pj}}{\lambda_1 + \lambda_2 + \ldots + \lambda_k + \ldots + \lambda_p} = \frac{\sum_{k=1}^{p} \lambda_k Y_{kj}}{\sum_{k=1}^{p} \lambda_k} \quad (3)$$

where Y_{kj} is k^{th} PC score corresponding to j^{th} district.

The principal component analysis was carried out using SAS software. Higher values of the index indicate a better status of natural resources. In a nutshell, the index is computed as the weighted average of all the principal component variables with corresponding eigen values as weights. The weight realized from this method for i^{th} standardized variable (Z_i) may be visualized as (in terms of eigen values and eigen vector elements)

$$W_i = \frac{\sum_{k=1}^{p} \lambda_k \alpha_{ki}}{\sum_{i=1}^{p} \sum_{k=1}^{p} \lambda_k \alpha_{ki}} \quad (4)$$

where α_{ki} is the value on eigen vector corresponding to i^{th} variable on k^{th} PC and λ_k is the eigen value corresponding to k^{th} PC.

NRI for j^{th} district may be written as

$$R_j^* = \sum_{i=1}^{p} W_i Z_{ij} \quad (5)$$

When standardized variables were combined using the weights in equation (4) and districts were ranked based on index score, there was no change in the results as compared to those obtained from equation (3).

3. RESULTS AND DISCUSSION

The level of resources in the districts considered for the study on variables used for building natural resource index has been depicted through maps. The highlights are discussed in the following sub-sections.

3.1 Rainfall

Low rainfall region (less than 500 mm) mostly spread over western part of Rajasthan and two districts of Gujarat (Fig. 3.1). Rainfall is in the range of 500-1000 mm in the interior of Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan and parts of Madhya Pradesh and Uttar Pradesh. Orissa, Chattisgarh, Bihar, Jharkand, West Bengal and Parts of Uttar Pradesh receive good amount of rainfall (more than 1000 mm).

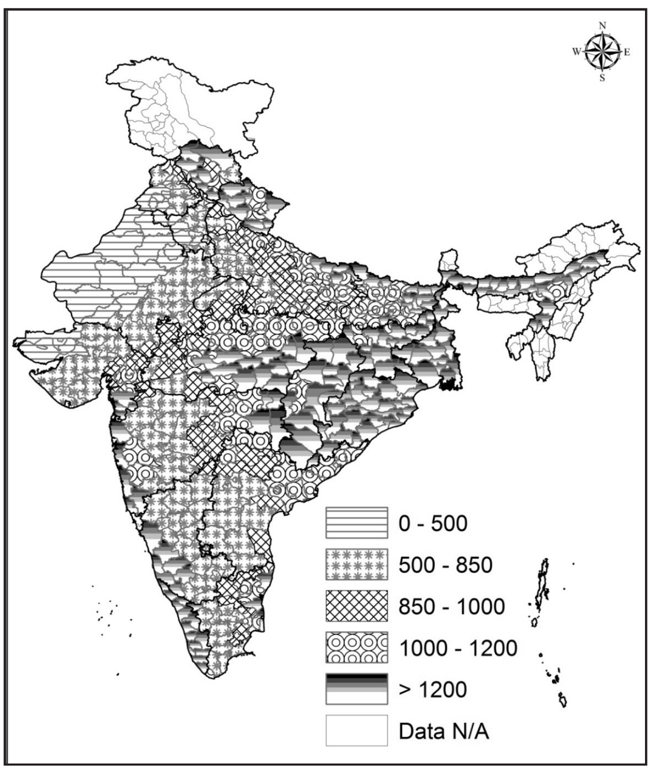

Fig. 3.1 Rainfall

3.2 Drought

Combined probability of moderate and severe drought at district level was worked out based on the IMD maps of Gore *et al.* (2010). The probability is high in Western parts of Gujarat and Rajasthan followed by Haryana (Fig. 3.2). It is moderate in the interior parts of Gujarat, Rajasthan, South India, Central India, (Maharashtra and Madhya Pradesh), and Indo-Gangetic Plains (IGP) of Punjab and Uttar Pradesh. Rest of the country has relatively low probability (<10%) of experiencing drought.

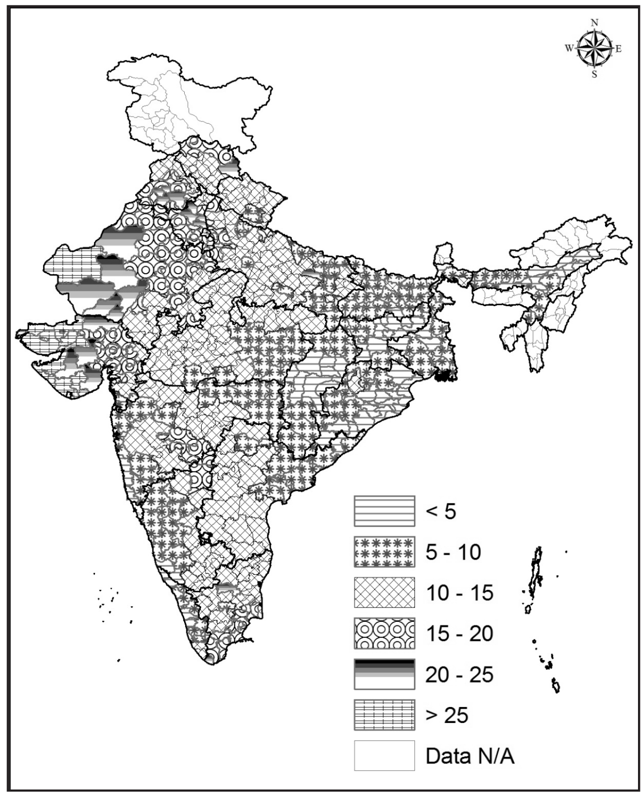

Fig. 3.2 Percent probability of occurrence of drought (in terms severe droughts) (two moderate droughts are considered equivalent to one severe drought)

3.3 Available Water Content

Available water content (AWC) indicates the storage capacity of soil and its availability to plants. AWC was found to be more than 125 mm in majority districts of Uttar Pradesh and Haryana and parts of Madhya Pradesh, Maharashtra and Andhra Pradesh. The available water content in many coastal districts in Andhra Pradesh, Tamil Nadu, Orissa, West Bengal, and Parts of Rajasthan is less than 100 mm (Fig. 3.3).

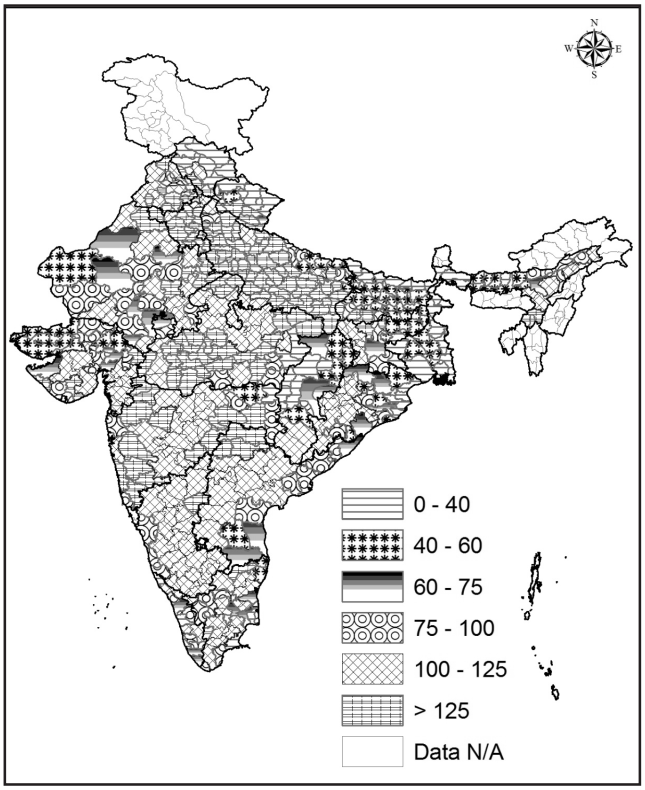

Fig. 3.3 Available water content (mm)

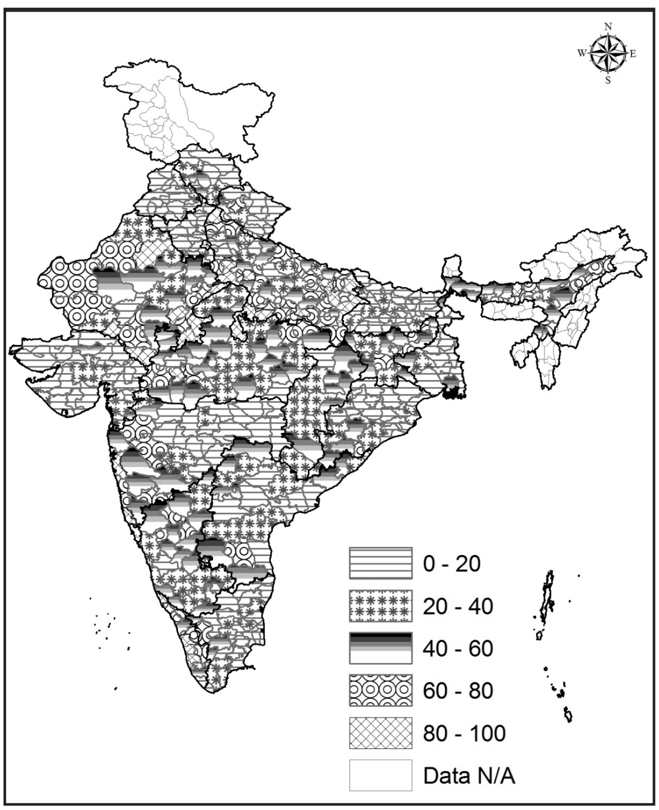

Fig. 3.4 Percent area under degraded and wasteland to total geographical area

3.4 Degraded and Wastelands

Extent of degraded and wastelands is in the range of 20-40% in majority of the districts in the country (Fig. 3.4). Severely degraded land is found in parts of Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra and in West Coast. About 60-80% district area is degraded in some of the districts of Uttar Pradesh and Madhya Pradesh. Area under degraded and wastelands in Central India, West Bengal, Orissa, Gujarat, Coastal Region of Tamil Nadu, and parts of Andhra Pradesh is less than 20%.

3.5 Irrigated Area

Based on the percent net irrigated area, districts were categorized into 4 classes i.e. up to 25%, 25-50%, 50-75% and 75-100% (Fig. 3.5). Large number of districts in Punjab, Hayana and Uttar Pradesh was found to have more than 75% irrigated area. Most of the districts in Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka, Orissa, Chhattisgarh and Jharkhand were found having less than 50% area under irrigated condition.

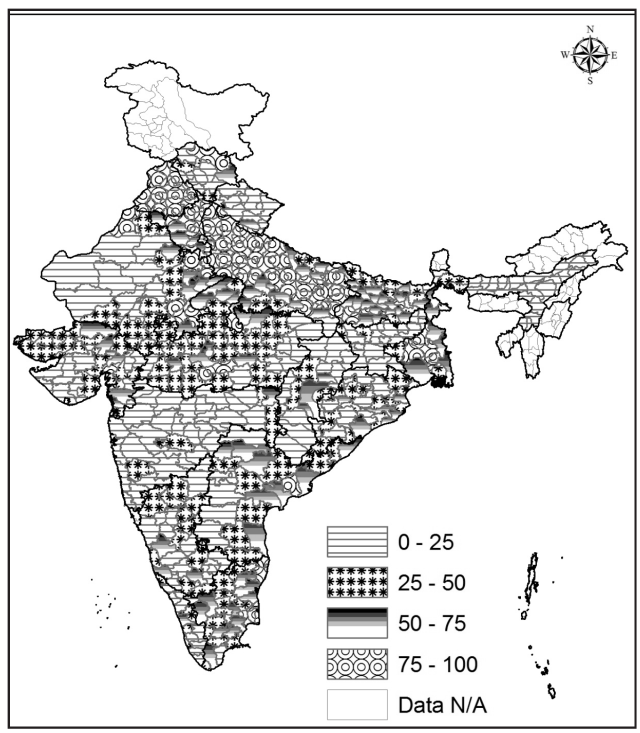

Fig. 3.5 Percent net irrigated area to net sown area

3.6 Groundwater Utilization Status

Based on groundwater utilization, the districts are categorized into safe, semi-critical, critical and over exploited by Central Ground Water Board (CGWB, 2006). Major parts of Eastern India, Central India, and Northern Parts of Andhra Pradesh are safe in terms of exploitation of groundwater (Fig. 3.6). Most parts of Punjab, Haryana, Rajasthan, Parts of Tamil Nadu are considered as over- exploited. Many districts under IGP where the recharge is mainly through canal supplies are also over-exploited indicating the need for immediate remedial measures in terms of change in cropping pattern.

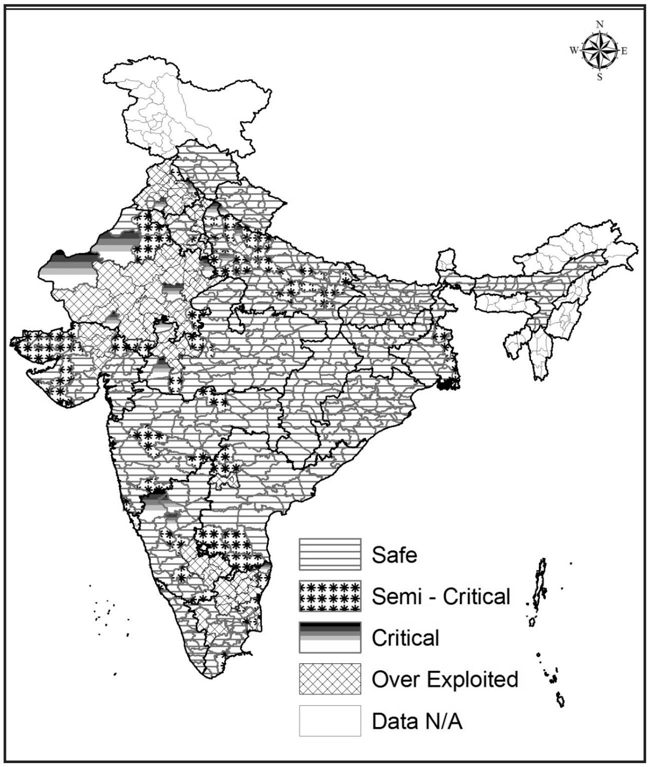

Fig 3.6 Status of groundwater (Source of data: CGWB, 2006)

3.7 Irrigation Intensity

More than 100% of irrigation intensity indicates assured availability of water for more than one cropping season in a year. Typically, these areas are located in canal command areas and deltaic areas (Fig. 3.7). Irrigation intensity is high in delta areas of Cauvery, Krishna and Godavari basins followed by the irrigated areas of Punjab, Haryana, Rajasthan and Parts of Uttar Pradesh, Parts of Orissa and West Bengal. The districts falling under these regions have more than 40% of area under cultivation for more than one cropping season.

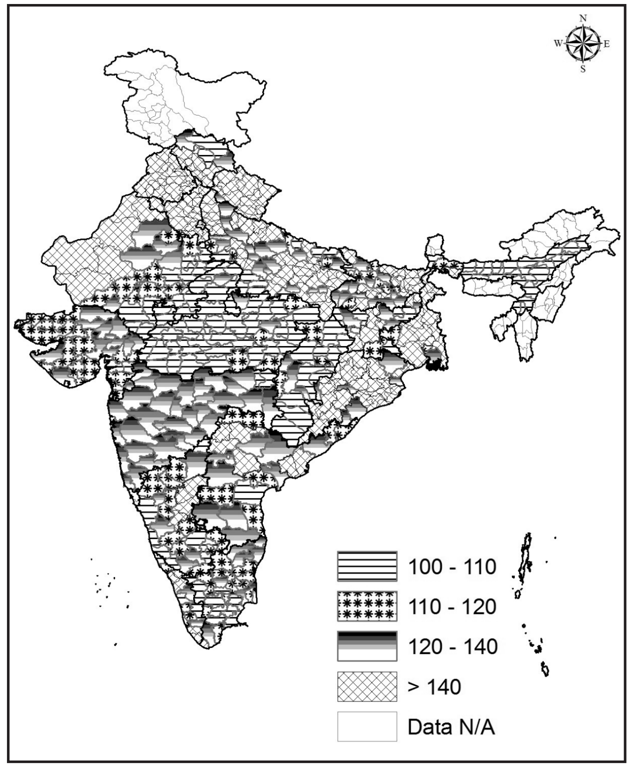

Fig. 3.7 Irrigation intensity (%)

3.8 Status of Natural Resources

Natural resources index (NRI) score was computed for each study district and the districts were evaluated for their natural resource endowments such that higher the NRI score higher the resource base. Priority ranking of districts was done across states based on score of NRI such that lower the score higher the investment priority. Accordingly a district with lowest natural resource endowment was given priority rank 1. The natural resource endowment is poor in western India as compared to eastern, north-eastern and northern India (Table 2). Natural resource base is weak in whole Rajasthan state and majority districts in Gujarat and Maharashtra states. Natural resource base is relatively low in considerable number of districts in Karnataka, Andhra Pradesh, Punjab and Madhya Pradesh. Few districts in Haryana and Tamil Nadu suffer from poor natural resource endowments. Status of natural resources is moderate in majority districts of Chhattisgarh and about half of the districts in Madhya Pradesh, Uttar Pradesh, Himachal Pradesh, Tamil Nadu, Kerala, Jharkhand and Assam states. On the other hand, eastern parts of India particularly, West Bengal, Bihar, and Orissa are better endowed in terms of natural resources. Accordingly, policies and interventions are needed to conserve and improve natural resources in western parts of the country and to harness these resources judiciously and sustainably in the eastern parts of the country. This also further underlines the need for a regionally differentiated policy in terms of technologies, policies and other measures for a more sustainable agriculture.

4. SUMMARY AND CONCLUSIONS

Based on the soil, water and climate related variables, a natural resources index was constructed for the 499 districts in India. This index reflects the relative endowment of these districts in terms the resources. Thus, districts that are better and worse off in terms of natural resources were identified. The methodology adopted is transparent in the sense that one can identify the resource that each district is most or least endowed with and thus facilitates a regionally differentiated approach towards making agriculture more sustainable. It is also useful to prioritize and target investments, interventions and policies.

The districts having relatively low natural resource base may be considered first for taking up appropriate interventions. These districts are mainly concentrated in Rajasthan, Gujarat and Maharashtra states followed by Karnataka, Andhra Pradesh, Punjab and Madhya Pradesh. The information on various sub-components (indicators) serves as guiding tool for identifying relevant interventions. Further, the prioritization can also form as an input in planning exercise in schemes like Backward Regions Grant Fund (BRGF), Command area Development programme (CADP) etc. and even in state planning.

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Table 2. Prioritization of districts based on natural resource endowments

Districts in each State with priority rank
Andhra Pradesh (inclusive of Telangana): Anantapur (7), Cuddapah (17), Kurnool (29), Mahabubnagar (48), Rangareddy (51), Adilabad (56), Chittoor (59), Prakasam (73), Medak (109), Nalgonda (142), Guntur (184), Visakhapatnam (186), Nizamabad (189), Khammam (197), Karimnagar (245), Vizianagaram (261), Warangal (268), Nellore (270), Srikakulam (359), East Godavari (371), Krishna (399), West Godavari (458)
Assam: Karbi-Anglong (168), Kamrup (258), Barpeta (283), Cachar (292), Sonitpur (309), Darrang (316), Nalbari (317), Tinsukia (323), Sibsagar (333), Golaghat (334), Dibrugarh (336), Kokrajhar (347), Goalpara (358), Nagaon (362), N C Hills (366), Hailakandi (375), Karimganj (380), Jorhat (383), Dhubri (385), Bongaigaon (408), Dhemaji (415), Lakhimpur (435), Morigaon (462)
Bihar: Gopalganj (353), Patna (361), Darbhanga (364), Samastipur (374), Madhubani (379), Champaran(East) (389), Vaishali (391), Siwan (394), Bhojpur (403), Saran (406), Muzafarpur (409), Bhagalpur (412), Champaran(West) (419), Buxar (421), Kishanganj (433), Jamui (434), Banka (444), Begusarai (445), Purnea (446), Bhabhua(kaimur) (450), Katihar (451), Nalanda (456), Araria (457), Gaya (460), Sitamarhi (464), Lakhisarai (466), Aurangabad (470), Supaul (472), Monghyr (473), Rohtas (474), Jahanabad (476), Saharsa (477), Sivhar (485), Khagaria (486), Nawadha (487), Sheikhpura (490), Madhepura (492)
Chhattisgarh: Sarguja (100), Bastar (153), Rajnandgaon (203), Dantewara (210), Durg (215), Jashpur (238), Mahasamund (260), Raigadh (267), Bilaspur (297), Kanker (298), Raipur (305), Kawardha (319), Korba (330), Koriya (331), Janjgir (442), Dhamtari (459)
Gujarat: Kutch (9), Surendranagar (19), Patan (20), Jamnagar (21), Ahmedabad (23), Amreli (24), Rajkot (27), Banaskantha (37), Junagadh (43), Porbandar (49), Bhavnagar (60), Mehsana (76), Sabarkanta (117), Gandhinagar (118), Bharuch (143), Panchmahal (163), Dahod (180), Vadodara (188), Kheda (211), Anand (277), Surat (339), Narmada (341), Dang (390), Valasad (420), Navsari (482)
Haryana: Sirsa (65), Mahendragarh (68), Bhiwani (72), Gurgaon (77), Fatehabad (102), Panipet (107), Sonipet (108), Kaithal (111), Karnal (122), Rewari (128), Jhajjar (159), Kurukshetra (160), Hissar (169), Yamunanagar (204), Jind (221), Faridabad (241), Rohtak (282), Panchkula (291), Ambala (384)
Himachal Pradesh: Kinnaur (209), Shimla (225), Kullu (228), Chamba (273), Kangra (308), Mandi (325), Una (329), Hamirpur (363), Bilaspur (392), Sirmaur (418), Lahaul & Spiti (423), Solan (426)

Jharkhand: Ranchi (176), West Singbhum (240), Gumla (264), Palamu (287), Godda (294), Dumka (310), East Singbhum (315), Hazaribag (321), Giridish (338), Bokaro (342), Deoghar (354), Dhanbad (370), Garhwa (386), Sahibganj (404), Pakur (431), Koderma (440), Chatra (453), Lohardaga (468)
Karnataka: Gulbarga (12), Chitradurga (25), Tumkur (26), Bijapur (32), Belgaum (34), Bagalkot (47), Kolar (52), Bangalore (Rural) (54), Gadag (62), Raichur (82), Koppal (83), Haveri (92), Bidar (95), Davanagere (96), Bellary (105), Chamarajanagar (125), Bangalore (Urban) (132), Dharwad (139), Mysore (185), Mandya (194), Hassan (200), Chikmagalur (326), Uttara Kannada (395), Kodagu (402), Udupi (463), Dakshina Kannada (475), Shimoga (479)
Kerala: Idukki (222), Kasaragod (288), Thiruvanathapuram (295), Kollam (296), Kozhikode (302), Kottayam (314), Kannur (318), Wayanad (327), Malappuram (332), Palakkad (345), Ernakulam (398), Pathanamthitta (413), Alappuzha (424), Thrissur (425)
Madhya Pradesh: Dhar (40), Mandsaur (55), Ratlam (57), Shajapur (63), Indore (66), Ujjain (81), Jhabua (85), Khargone(West Nimar) (87), Rajgarh (91), Guna (101), Chhindwara (103), Neemuch (113), Shivpuri (120), Khandwa(East Nimar) (121), Sidhi (126), Dewas (129), Rewa (133), Barwani (134), Shahdol (144), Bhind (146), Satna (148), Betul (157), Vidisha (171), Panna (183), Dindori (190), Morena (212), Sehore (220), Bhopal (223), Seoni (227), Sagar (230), Chhatarpur (231), Sheopur Kalan (239), Gwalior (247), Raisen (250), Datia (252), Mandla (254), Damoh (255), Katni (263), Jabalpur (300), Umaria (324), Tikamgarh (337), Narsinghpur (397), Balaghat (439), Hoshangabad (455), Harda (465)
Maharashtra: Ahmednagar (8), Solapur (13), Nasik (15), Pune (35), Sangli (39), Beed (46), Amravati (61), Yavatmal (64), Latur (67), Dhule (70), Jalgaon (78), Buldhana (86), Osmanabad (94), Aurangabad (106), Nanded (114), Jalna (124), Akola (127), Satara (140), Parbhani (149), Nandurbar (152), Washim (161), Nagpur (162), Raigad (167), Wardha (174), Ratnagiri (196), Hingoli (202), Thane (205), Sindhudurg (235), Kolhapur (259), Chandrapur (271), Gadchiroli (447), Bhandara (448), Gondia (454)
Orissa: Bolangir (269), Kalahandi (275), Sundargarh (348), Koraput (349), Gajapati (352), Phulbani (Kandhamal) (357), Keonjhar (368), Baragarh (372), Nabarangpur (376), Nuapada (393), Rayagada (401), Mayurbhanj (411), Malkangiri (427), Angul (436), Jharsuguda (438), Sambalpur (441), Ganjam (449), Nayagarh (461), Deogarh (467), Dhenkanal (469), Boudh (471), Kendrapara (478), Sonepur (480), Jajpur (481), Balasore (Baleshwar) (483), Bhadrak (488), Khurda (491), Jagatsingpur (495), Cuttack (497), Puri (499)
Punjab: Faridkot (97), Moga (104), Sangrur (112), Firozpur (115), Mansa (119), Bathinda (130), Kapurthala (131), Jalandhar (151), Patiala (155), Ludhiana (156), Nawan Shehar (166), Amritsar (178), Fathegarh Sahib (181), Gurdaspur (198), Rupnagar (236), Muktsar (243), Hoshiarpur (274)
Rajasthan: Barmer (1), Bikaner (2), Jaisalmer (3), Jodhpur (4), Churu (5), Nagaur (6), Udaipur (10), Jalore (11), Pali (14), Sikar (16), Ajmer (18), Bhilwara (22), Hanumangarh (28), Rajsamand (30), Chittorgarh (31), Sirohi (33), Jaipur (36), Tonk (41), Jhalawar (42), Bundi (44), Jhunjhunu (45), Alwar (50), Karauli (53), Dholpur (69), Sawai Madhopur (71), Kota (74), Dungarpur (79), Banswara (80), Bharatpur (89), Dausa (90), Ganganagar (93), Baran (110)
Tamil Nadu: Coimbatore (38), Salem (58), Dindigul (75), Thoothukudi (84), Dharmapuri (88), Theni (98), Namakkal (99), Ariyalur (116), Villupuram (136), Vellore (141), Thiruvannamalai (164), Virudhunagar (165), Ramanathapuram (177), Thirunelveli (193), Erode (201), Kanyakumari (206), Perambalur (213), Nagapattinam (244), Thiruvallur (266), Karur (279), Thiruchirappalli (281), Madurai (285), Thanjavur (306), Pudukkottai (312), Thiruvarur (320), Sivagangai (328), The Nilgiris (346), Cuddalore (355), Kancheepuram (405)
Uttar Pradesh: Saharanpur (123), Banda (135), Hamirpur (137), Agra (138), Jhansi (145), Hathras (147), Budaun (150), Mathura (154), Faizabad (158), Sonbhadra (170), Aligarh (172), Muzaffarnagar (175), Fatehpur (179), Bagpat (182), Bahraich (191), Chitrakut (192), Mahoba (195), Jalaun (199), Etah (207), Basti (208), Allahabad (214), Gonda (216), Sultanpur (217), Rae-Bareily (218), Bijnor (219), Kheri (224), Mirzapur (226), Shahjahanpur (229), Mainpuri (232), Farrukhabad (233), Azamgarh (237), Ballia (246), Jaunpur (248), Ghaziabad (249), Firozabad (251), Lalitpur (253), Pilibhit (256), Deoria (262), Moradabad (272), Hardoi (276), Lucknow (278), Varanasi (280), Mau (290), Kanpur (Dehat) (293), Sant Ravidas Nagar (299), Ghazipur (301), Balrampur (303), Bulandshahar (304), Kaushambi (307), J.B.Fule Nagar (311), Etawah (313), Kushi Nagar (322), Kannauj (335), Sant Kabir Nagar (340), Kanpur City (344), Pratapgarh (350), Shravasti (351), Sitapur (356), Meerut (360), Auraiya (365), Siddharth Nagar (367), Chandauli (373), Unnao (377), Bareilly (382), Gautam Buddh Nagar (388), Ambedkar Nagar (396), Barabanki (407), Maharajganj (414), Rampur (428), Gorakhpur (429)
Uttarakhand: Haridwar (173), Tehri Garwal (187), Chamoli (265), Bageshwar (286), Pauri Garhwal (343), Almora (369), Rudraprayag (378), Dehardun (381), Uttarkashi (387), Udham Singh Nagar (400), Champawat (422), Pithoragarh (432), Nainital (484)
West Bengal: 24-Paraganas (South) (234), Purulia (242), Cooch Behar (257), Jalpaiguri (284), Midnapore (289), Dinajpur (Uttar) (410), Darjeeling (416), Nadia (417), Murshidabad (430), Malda (437), 24-Paraganas (North) (443), Bankura (452), Dinajpur (Dakshin) (489), Hooghly (493), Howrah (494), Birbhum (496), Burdwan (498)

Note: Priority ranking of districts was done across states based on composite index score. A district with rank 1 should be given highest priority on account of its lowest natural resource endowment.

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