Revisiting Drought-Prone Districts in India

B VENKATESWARLU, B M K RAJU, K V RAO, C A RAMA RAO

The Drought-Prone Areas Programme and the Desert Development Programme launched by the Government of India during the 1970s used rainfall and irrigation as the two criteria to ameliorate the impact of drought in the targeted districts. This article revisits the eligibility criteria in light of the recent climatic classification and irrigation statistics.

Indian agriculture continues to be a gamble with the monsoon as more than half of the sown area does not have any access to irrigation. The incidence of drought remains a threat to the country's agricultural production at macro level and to the livelihoods of people dependent on agriculture at micro level. The adverse impacts of the incidence of drought are particularly high where rain-fed agriculture is predominant and in the areas where the incidence of drought is more frequent. Equity and inclusive growth have always been the mantras of planning in India, either explicitly or implicitly. With a view to support farming in these areas, the Government of India (GoI) in 1973-74 launched a special programme called Drought-Prone Areas Programme (DPAP), to address the special problems faced by dryland areas, which suffer frequent droughts. The basic objectives of the programme are to minimise the adverse effects of droughts on the production of crops and livestock as well as to improve natural resources like land and water thereby leading to drought-proofing of the affected areas. This programme aims at promoting overall economic development and improving the socio-economic conditions of the resource-poor people inhabiting these areas, through creation, widening and equitable distribution of the resource base and increased employment opportunities. The objectives of the programme are being addressed by taking up development works through watershed approach for land development, water resource augmentation and afforestation/pasture development.

Another special programme, viz, Desert Development Programme (DDP) was started in 1977-78 in the arid areas of Rajasthan, Gujarat and Haryana and the cold deserts of Jammu and Kashmir (J&K) and Himachal Pradesh. From 1995-96, the coverage has been extended to a few more districts in Andhra Pradesh and Karnataka. Major interventions under this programme included sand dune stabilisation and shelter belt plantations in hot arid regions, and water resources development by construction of channels for diversion of water flow from the glaciers and springs to the fields and lift irrigation works in the cold desert areas. The programme has been conceived as a long-term measure for restoration of ecological balance by conserving, developing and harnessing land, water, livestock and human resources.

Review of the Programmes

During late 1980s it was expected that DPAP and DDP would have made an appreciable impact at least in some areas in terms of a spread of irrigation and completed drought-proofing/control of desertification as was desired and that these districts would not need any external assistance through these programmes. However, several state governments were pressing for inclusion of more areas under DPAP and DDP, in addition to the areas already covered under the programme. To sort out the issues a national committee on DPAP and DDP was set up under the chairmanship of Y K Alagh, the then member of Planning Commission, to review the programmes. Later, L C Jain, who was a Planning Commission member took charge of the subject. The report was submitted in 1990. The committee, however, did not go into the specific terms of reference and recommended that the centrally-sponsored schemes of DPAP/DDP may be transferred to the state governments and merged with the state plan and funds may be allotted in the annual plan outlay of the states. The GoI, however, did not agree to the recommendation of the committee and decided to continue these two programmes as centrally-sponsored schemes. It, therefore, became necessary to have a committee to go into the technical parameters to precisely

B Venkateswarlu (*vbandi_1953@yahoo.com*), B M K Raju, K V Rao and C A Rama Rao are with the Central Research Institute for Dryland Agriculture, Hyderabad.

delineate drought-prone areas. Accordingly, the GoI in 1993 constituted a technical committee under the chairmanship of C H Hanumantha Rao, former member, Planning Commission to review the DPAP and DDP programmes and refine the criteria for identifying areas for inclusion under the programmes which are critical and really need assistance.

The committee felt that the criteria of rainfall and percentage covered by irrigation for identification of DPAP and DDP areas adopted till then were only broad parameters. It suggested a more scientific criteria on the basis of moisture index (MI) (an internationally accepted criterion for the identification of aridity) and level of irrigation (MoRD 1994: 73). The eligible blocks in these districts again should be selected on the basis of the level of irrigation and slope of the terrain.

Computation of MI (Thornthwaite and Mather 1955: 104) was simplified using annual average data (Krishnan 1992) as

$$MI = \left[\frac{(P-PE)}{PE}\right] * 100$$

where P = Precipitation and PE = Potential Evapotranspiration

Based on the MI value, the climate of each district was identified as in Table 1.

Table 1: Moisture Index Value Per Climatic Zone

Value of MI	Climatic Zone
< -66.7	Arid
-66.6 to -33.3	Semi -arid
-33.3 to 0	Dry sub-humid
0 to + 20	Moist sub-humid
+20.1 to + 99.9	Humid
100 or more	Per-humid

In other words moisture inadequacy is more acute in arid zones followed by semi-arid and dry sub-humid regions. From moist sub-humid zones onwards, the moisture is adequate for normal crop production. While addressing the problem of desertification, which is diminution of productivity due to land degradation caused by human intervention and/or climatic change, the United Nations at the 1992 Rio Conference focused on the arid, semi-arid and dry sub-humid ecosystems. Therefore, it was proposed by the committee to include three ecosystems – arid, semi-arid and dry sub-humid – under DDP/DPAP, instead of "desert" and "drought-prone" areas. Irrigation is useful in bringing stability to production of crops and livestock. However, as the rainfall increases, the need for irrigation to bring stability/sustainability becomes less important. In other words, the need for irrigation would be relatively more in the arid ecosystem than in the dry sub-humid region.

Keeping these facts in view, the following criteria were proposed on district basis by C H Hanumantha Rao Committee (Table 2).

Table 2: Proposed Programmes in the Hanumantha Rao Commmittee

Moisture Index	Programme Permissible	Ecosystem	% Irrigataed Area
< - 66.7	DDP	Arid	50
-66.6 to -33.3	DPAP	Semi-arid	40
-33.2 to 0	DPAP	Dry sub-humid	30

The committee made a number of recommendations and formulated a set of guidelines that brought DDP, DPAP and the Integrated Wastelands Development Programme (IWDP) under a single umbrella called the Integrated Watershed Management Programme (IWMP) in 2009-10. The programme is now being implemented as per the Common Guidelines for Watershed Development Projects-2008 (NRAA 2011: 59). The guidelines view the watershed development as an important vehicle for development of wastelands, drought-prone areas and desert areas.

Need for Revisiting Drought-Prone Districts

The climatic classification used by the C H Hanumantha Rao Committee was found to be the same as the one given by Krishnan (1988) (except Wardha and Nagpur in Maharashtra and a handful of districts in Himachal Pradesh and J&K which was not clear in Krishnan (1988)). The classification was based on MI of Thornthwaite and Mather (1955) computed using annual average data of rainfall and potential evapotranspiration (PE). The climatic data sets used were related to the period earlier to 1970. Gore et al (2011: 12) observed the changes in land degradation between 1901-50 and 1941-90 and identified the districts where aridity was found to increase. They also used relatively older climatic data sets (rainfall up to 1990 and PE data published in 1971). Climate change literature pertaining to India shows enough evidence of rising mean temperatures during the post-1970 period. Kumar et al (2011) observed greater warming (mean annual surface air temperature) of 0.21°C/10 years during the post-1970 period as compared to 0.51°C/100 years during the past century. Though the all-India average monsoon rainfall is found trendless over an extended period starting from 1871, significant spatial variations were found at the division level. Raju et al (2013) revisited climatic classification with district as a unit using the climatic data sets published by the Indian Meteorological Department (IMD) for the period 1971-2005. The study revealed climatic shifts in about 27% of geographical area in India and reported that moist sub-humid pockets in Chhattisgarh, Odisha, Jharkhand, Madhya Pradesh and Maharashtra had turned to dry sub-humid to a larger extent.

As per the GoI (2012) statistics, net irrigated area (NIA) as per cent of net sown area (NSA) in India rose from 33.58% during 1990-91 to 45.18% during 2009-10. Considering the observed changes in climate and the investments made in expanding irrigation, it is appropriate to revisit the eligibility of districts to DPAP and DDP as per the criteria given by C H Hanumantha Rao Committee. This study would facilitate the extension of support to those districts that may now meet the requirements to be included in these programmes.

In fact, a committee was set up by the Ministry of Rural Development (MoRD) in 2005 under the chairmanship of S Parthasarathy, to reassess the categorisation of districts into DPAP and DDP taking into account the changed climatic/biotic factors (GoI 2006: 222). However the committee deferred categorisation of DDP and DPAP and prioritisation of IWDP blocks (the first two terms of reference) to a separate stage of work saying that it involves the collation and analysis of massive amounts of block-level data from across the country. Against this background, this study revisits the districts of India taking into account the changed climatic and irrigation factors.

The study confines itself to the reassessing of districts' eligibility to DPAP and DDP with the criteria developed by the Hanumantha Rao Committee. Such an analysis at the sub-district level will be helpful further and deserves the attention of those concerned.

Methodology and Data Used

This study used climatic classification given by Raju et al (2013) while evaluating districts for climate. Regarding irrigation, the NSA and NIA statistics used in the study refer to the average of latest two years for which data are available (mostly 2007-08 and 2008-09). The district level data[1] on NSA and NIA were collected from various sources including the Department of Agriculture and Cooperation, GOI, agricultural census, GOI, state bureaus/directorates of economics and statistics, state planning departments via state government websites, district websites, Centre for Monitoring Indian Economy, Ministry of Water Resources, etc. Using the dual criteria of climate and irrigation in a district as used by MORD (1994), the eligibility of districts to DDP and DPAP was evaluated in the light of updated data.

Irrigation Development in India

It was not clear from the report of the MORD (1994) the reference year to which the irrigation statistics refer to. As the report was published in 1994, the present study considered average of 1990-91 and 1991-92 irrigation statistics for the sake of comparison. There was a substantial expansion in the NIA in India in the last 20 years. If we put in numbers, the increase was 15.23 mha (it was 48.02 mha in 1990-91 and 63.26 mha in 2009-10). However, the NSA was stagnant at about 140 mha only. This makes the NIA as a percentage of the NSA rise. For each district the NIA to NSA percentage was computed[2] during 1990-92 and the latest two years. Figures 1 and 2, respectively, give the status of NIA as percentage of NSA at two points of time. A look at the status of irrigation during 1990-92 and the recent period shows that there was a noticeable expansion in the irrigation owing to large investments. This is, however, more evident in the districts across Indo-Gangetic plains, Gujarat, Andhra Pradesh and also in eastern India.

Figure 1: Per Cent Net Irrigated Area to Net Sown Area
(average of 1990-91 and 1991-92)

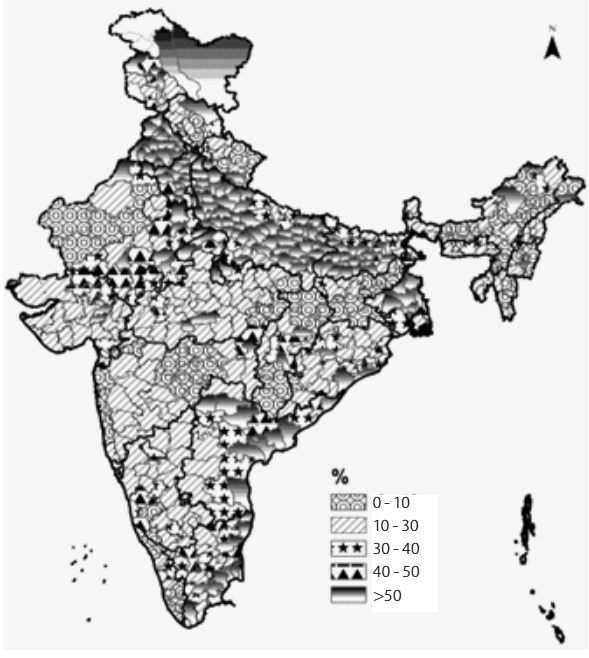
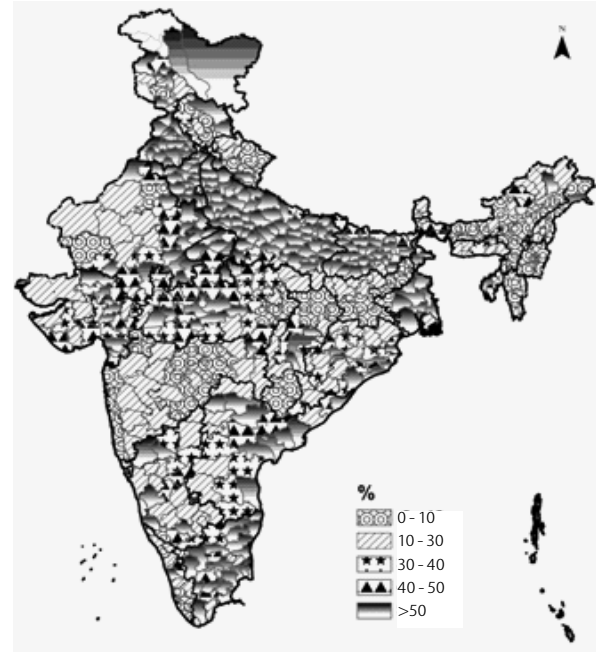


Figure 2: Per Cent Net Irrigated Area to Net Sown Area
(average of 2007-08 and 2008-09)



Revisiting DPAP and DDP Districts

India has witnessed reorganisation of districts several times. For the sake of comparison at two points of time we need to have a common base. For this purpose the districts that existed as on the reference date of the Census of 2001 were considered in this study. Each union territory (UT) was considered as a single entity. Urban districts like Mumbai, Hyderabad, Kolkata and Chennai and UTs like Chandigarh and Lakshadweep and the National Capital Territory of Delhi, were not considered in the study. Thus, the study was finally made for 571 spatial units (districts). According to this base, the number of the districts that were accorded the status of DPAP were 181 and DDP were 40 by the Hanumantha Rao Committee. Of the 40 DDP districts, three districts, namely, Ajmer and Udaipur of Rajasthan and Davangere of Karnataka appeared in both lists. We considered these three districts in the DDP list only. As a result we were left with 178 districts in the DPAP list. Figure 3 (p 74) shows the districts covered under DDP/DPAP as in 1994. Figure 4 (p 74) shows the revised status of districts. Meanwhile, Table 3 (p 74) gives the shifts in eligibility of districts to DPAP or DDP.

At the first instance we focused on the districts that are newly qualified for DPAP in the light of updated data. Twenty-seven districts now became eligible for DPAP. Eighteen of these 27 belong to eastern states, viz, Jharkhand, Chhattisgarh and Odisha. The districts, namely, Ranchi, Gumla, East Singbhum and

Figure 3 : DPAP and DDP Districts (1994)

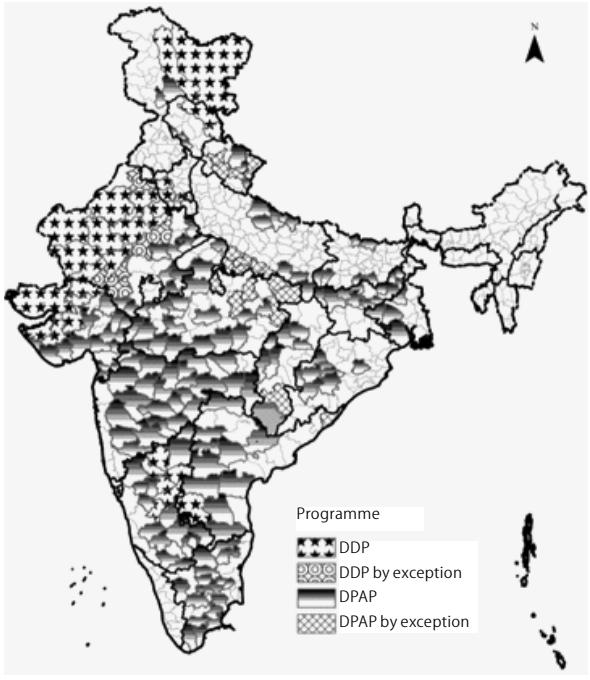
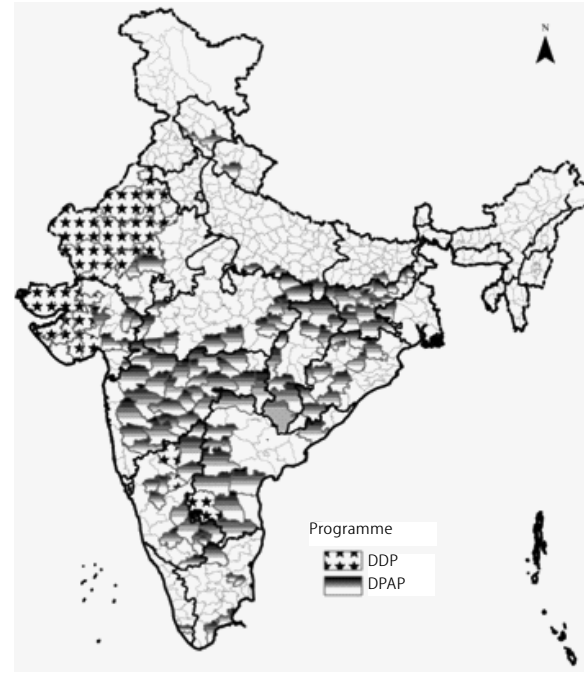


Figure 4: Revised Eligibility of Districts to DPAP and DDP (2008-09)



West Singbhum of Jharkhand, Jharsuguda, Sundargarh, Kendujhar, Koraput and Rayagada of Odisha and Sarguja, Koriya, Raigarh, Jashpur and Kanker of Chhattisgarh were eligible under DPAP due to climatic shift in these districts from moist sub-humid to dry sub-humid. The districts from other states that became eligible to DPAP due to a change of climate were Shimla from Himachal Pradesh, Dindori and Mandla from Madhya Pradesh and Wardha from Maharashtra, Kollam from Kerala and UT of Daman and Diu. The districts, namely, Bhilwara of Rajasthan and Visakhapatnam of Andhra Pradesh became eligible to DPAP due to reduction in percentage NIA to NSA. No district from the general pool became eligible under DDP.

Status of DPAP Districts

When we examined the status of 178 districts of DPAP, 83 districts were found not eligible for the programme as per the criteria and three districts were found eligible for DDP. The remaining 92 districts continue to be eligible for DPAP. The three districts that became eligible to DDP were Porbander, Amreli and Bhavanagar in Gujarat where there was a shift of climate from semi-arid to arid. The 83 districts found ineligible include 11 of the 18 exceptional districts considered for DPAP by the Hanumantha Rao Committee on grounds, viz, irrigation to NSA less than 10% and/or resource degradation due to steep slopes, less developed Bundelkhand/Vindhya districts.

It is worth comparing the level of irrigation in the 72 districts that became ineligible (83 ineligible minus 11 exceptional districts) between the 1990-92 and 2007-09 periods. In Rajasthan the irrigation expansion was substantial in the semi-arid districts, namely, Bharatpur, Sawai Madhopur, Tonk, Bhanswara and Jhalawar, which crossed the 40% cut off. Similarly, irrigation expansion was remarkable in Shivpuri, Guna, Shajapur, Dewas, Dhar, Khandwa, Raigarh, Raisen, Jabalpur and Seoni districts of Madhya Pradesh which made them ineligible to DPAP. In Gujarat, Junagarh, Vadodara and Sabarkantha districts became ineligible on account of improved irrigation, whereas Valsad became ineligible for both change of climate and improved irrigation. Two districts of Jharkhand, viz, Pakur and Dumka became ineligible to DPAP due to change of climate from dry sub-humid to moist sub-humid. Considerable improvement has occurred in irrigation levels in the districts of Tamil Nadu. As a result a good number of districts in Tamil Nadu could not qualify for DPAP. Possibly some of the 72 districts (83-11) found ineligible now would have been ineligible during 1994 also; but the state governments did not agree to drop any district covered under the programme till then.

Table 3: No of DPAP/DDP Districts in 1994 and 2013

DPAP/DDP Status (1994)	Revised DPAP/DDP Status (2013)					Total
	DPAP (121)	DPAP by Exception (11)	DDP (22)	DDP by Exception (3)	Others (414)	
DPAP (160)	85	-	3	-	72	160
DPAP by exception (18)	7	11	0	-	-	18
DDP (34)	1	-	17	-	16	34
DDP by exception (6)	1	-	2	3	-	6
Others (353)	27	-	0	-	326	353
Total	121	11	22	3	414	571

Status of DDP Districts

Let us now look at the status of 40 DDP districts. Nineteen of the 40 districts are still found eligible for DDP. These districts include Ajmer (sand movement and heavy sand deposits in agricultural fields) and Hanumangarh (resource

degradation) of Rajasthan which were given the DDP status by exception in 1994. Ajmer now gets eligibility to DDP as per the criteria due to a change of climate from semi-arid to arid. Raichur district of Karnataka lost eligibility to DDP due to shift of climate from arid to semi-arid, and consequently became eligible for DPAP. Rajsamand district of Rajasthan which was considered for DDP by exception (due to sand movement and heavy sand deposits in agricultural fields) now became eligible for DPAP. The remaining 19 districts do not qualify for DDP now. These districts include the three of the five districts in Rajasthan considered for DDP by exception (sand movement and heavy sand deposits in agricultural fields and water bodies was a problem). After considering the exceptions, 16 districts (19-3) could not qualify for DDP now. In seven out of the 16 districts, there was a shift of climate from arid to non-arid. These are Ladakh and Kargil of J&K, Lahul and Spiti and Kinnaur of HP, Jajjar and Rewari of Haryana and Bellary of Karnataka. Districts, viz, Mahendragarh and Bhiwani of Haryana, Jhunjhunun of Rajasthan, Bhagalkot of Karntaka could not qualify for DDP due to irrigation improvement (more than 50%). In case of DDP also, a few districts were ineligible to DDP during 1994, but states resisted excluding them.

Summary

With expansion in irrigation and noticeable changes in climate, we observed some changes in the composition of districts that can be included in the DPAP/DDP following the same criteria that were used earlier. These findings may be relevant in identifying and prioritising districts for making investments and interventions towards drought proofing under IWMP. The changes in the climate and irrigation observed will also have implications for the choice of technological and other interventions.

NOTES

1 For certain districts, data were available for one year only which was taken as it is without averaging.

2 Average of two consecutive years' data on NSA and NIA were used for computing percentage. For Maharashtra district level data of NIA was available till 2002-03 only. Due to non-availability of reliable data for north-east states during 1990-92 the data of second minor irrigation census (refer to 1993-94) or agricultural census (refer 1995-96) were used. For some of the districts newly carved out between 1993 and 2001, irrigation status of mother district during 1990-92 was considered for comparison.

REFERENCES

Gore, P G, B A Roy and H R Hatwar (2011): "Impact of Climate Change on Land Degradation over India", India Meteorological Department, National Climate Centre Research Report 1/2011, Pune.

GoI (2006): "From Hariyali to Neeranchal: Report of the Technical Committee on Watershed Programmes in India", Department of Land Resources, Ministry of Rural Development, Government of India, New Delhi.

– (2012): "Land Use Statistics at a Glance – Statewise: 2000-2001 to 2009-10", Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

Krishnan, A (1988): "Delineation of Soil Climatic Zones of India and Its Application in Agriculture", *Fertilizer News,* 33(4), 11-19.

– (1992): "Climatic Classification and Agricultural Droughts" in S Venkataraman and A Krishnan (ed.), *Crops and Weather* (New Delhi: Publications and Information Division, Indian Council of Agricultural Research), pp 458-508.

Kumar, Krishna K, S K Patwardhan, A Kulkarni, K Kamala, K Koteswara Rao and R Jones (2011): "Simulated Projections for Summer Monsoon Climate over India by a High Resolution Regional Climate Model", *Current Science,* 101(3), 312-26.

MoRD (1994): "Report of the Technical Committee on Drought Prone Areas Programme and Desert Development Programme", Ministry of Rural Development, Government of India, New Delhi.

NRAA (2011): "Common Guidelines for Watershed Development Projects-2008", National Rainfed Area Authority, Planning Commission, Government of India, New Delhi.

Raju, B M K, K V Rao, B Venkateswarlu, A V M S Rao, C A Rama Rao, V U M Rao, B Bapuji Rao, N Ravi Kumar, R Dhakar, N Swapna and P Latha (2013): "Revisiting Climatic Classification in India: A District-level Analysis", *Current Science,* 104(4): 492-95.

Thornthwaite, C W and J R Mather (1955): "The Water Balance", *Climatology,* Vol 8, No 1, Drexel Institute of Technology, Laboratory of Climatology, Centerton, New Jersey, p 104.