Manual for Drought Management

November 2009

Department of Agriculture and Cooperation
Ministry of Agriculture, Government of India
New Delhi

MANUAL
FOR
DROUGHT MANAGEMENT

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The Manual for Drought Management has been developed by the National Institute of Disaster Management (NIDM) through a consultative process involving the concerned Central Ministries, State Governments, scientific, technical and research organisations and the grass root level organisations working for mitigation and management of drought.

NIDM is the apex training and resource center of the Government of India in the field of disaster management. It has provided various services and support to the Government of India and the State Governments for disaster management in the country. It has published various manuals, guidelines, training literature, research papers and journals on various aspects of disaster risk management. Over a period of time, it has emerged as a premier institution specializing in disaster management in South Asia.

This Manual has been developed with support and guidance from the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Acknowledgement

This Manual has been developed by a team of experts of the NIDM under the supervision of Mr. P.G.Dhar Chakrabarti, Executive Director. The team comprised of Dr. Santosh Kumar, Head of the Policy Planning Division of the Institute, Dr. V. K Sehgal, former Head of the Hydro-Meteorological Division and Dr. Rajesh K. Mall, Associate Professor of the same Division.

Dr. Krishna Vatsa, former Secretary of Relief and Rehabilitation, Government of Maharashtra was the principal consultant for drafting the Manual, while Ms. Vani Kurup edited the Manual.

The Manual has been reviewed by the officials of the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

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D. O. No. : 1523/AM/2009
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भारत सरकार
MINISTER OF AGRICULTURE
& CONSUMER AFFAIRS
FOOD AND PUBLIC DISTRIBUTION
GOVERNMENT OF INDIA

01, October, 2009

Preface

Drought management in India has evolved considerably since Independence. During the British period, every drought would threaten the availability of food and create a situation of mass hunger and famine. Millions of people perished in these famines. One of our most positive achievements since Independence has been complete avoidance of famines. The Government's emphasis on food production, distribution of foodgrains through the Public Distribution System(PDS) and the public works programme have succeeded in meeting the basic entitlements of the millions of poor towards avoiding famine and hunger.

Yet we know that drought is a serious problem for India, and it has affected many parts of the country intermittently. Certain regions of the country have been identified to be drought-prone. A deficiency of rainfall in other regions too could create a situation of drought. These droughts have called for a slew of relief measures so that hardships caused to the people are minimized. The Government of India has coordinated closely with the State Governments in responding to the drought situation and providing necessary succour to the people. Over a period of time, we have accumulated substantial experience of handling drought in the country.

Increased climate variability has made rainfall patterns more inconsistent and unpredictable in the country increasing the recurrence of drought or drought like situation. Apart from fall in agricultural production, drought has other multifarious long drawn impact, like shortage of drinking water, fodder, less water in dam / reservoirs for power generation etc., which has severe impact on the economy of the country affecting its growth. It is, therefore, important that we monitor drought closely and be prepared for dealing with its impact. We need to provide not just immediate relief, but undertake long-term mitigation measures for drought. It requires a more comprehensive approach to drought management, which encompasses early warning, monitoring, relief and mitigation.

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In view of these pressing issues arising from recurrent droughts, I consider the publication of a "Manual for Drought Management" an extremely valuable initiative taken by the Department of Agriculture & Cooperation. This Manual reflects a comprehensive approach to drought management and recommends measures, which needs to be implemented for effective drought relief and mitigation. It draws upon the rich and diverse experience of drought management and suggests an extensive list of procedures and measures that need to be taken for alleviating drought. I congratulate the team that has painstakingly produced this Manual and sincerely hope that it proves to be an effective and practical guide for administrators, experts, and civil society in implementing drought relief and mitigation measures in the country and alleviating distress of the drought affected people.

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सचिव

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Government of India
Ministry of Agriculture
Department of Agriculture & Cooperation

Foreword

Drought management in India has always been a large and complex operation, requiring close coordination among several levels of the government: central, state, district, and village level. Central and State Governments formulate policies and programmes, while the district administration and line departments implement drought relief and mitigation measures. Panchayati Raj institutions and NGOs also play an important role in providing relief to the people and ensuring that the poor and vulnerable sections of the people receive adequate and timely help during a drought. The Manual for Drought Management has been prepared with the objective of defining the roles and responsibilities of different agencies and guiding coordination among them.

The Manual refers to several programmes and schemes being implemented by the Government of India and the State Governments. It suggests that a synergy of programmes would be the most effective way of addressing drought. The Manual recognizes the potential of the National Rural Employment Guarantee Scheme and conservation of local water bodies for drought mitigation. It provides a short-term action plan for drought relief as well as a long-term strategy for drought mitigation. The Manual brings together conceptual issues, the institutional framework and operational details related to drought management. It represents a comprehensive and practical guide to drought management.

The Manual has been prepared on the strength of a long experience of drought management in India. It brings a fresh perspective on drought management through an inter-sectoral approach. It utilizes knowledge and expertise offered by the several scientific institutions working in India and includes several scientific indices for monitoring drought. The Manual recommends a Drought Management Information System based on GIS to support decision-making, and Drought

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Monitoring Centres at the national and the state levels to maintain these systems. The Manual introduces several innovative features for a knowledge-based drought management system and reflects the strength and confidence of a nation in an age of employment and food security. It replaces the colonial famine codes written largely for dealing with mass hunger and starvation.

The Manual has addressed several aspects, on which the practices being followed by states are diverse. It includes monitoring and declaration of drought, preparation and submission of a Memorandum for central assistance for drought relief and mitigation. The Manual provides relevant guidelines so that states benefit from them and pursue the most efficient and practical course of action. Though the Government of India recommends these guidelines, it needs to be made clear that these are not mandatory. We recognize that the State Governments could face situations, under which they may need to deviate from these guidelines and they have the necessary freedom to do so. The Manual does not in any way reduces the State Governments' authority to take their own decisions in a drought situation.

I would like to congratulate the National Institute for Disaster Management and the officials of the Department of Agriculture & Cooperation involved in preparing this comprehensive document through a widely consultative process. I sincerely hope that the Manual will be used extensively as a reference document as well as a guide for action by policy-makers, administrators and technical professionals.

(T. Nanda Kumar)

Date: 1st October, 2009
Place: New Delhi

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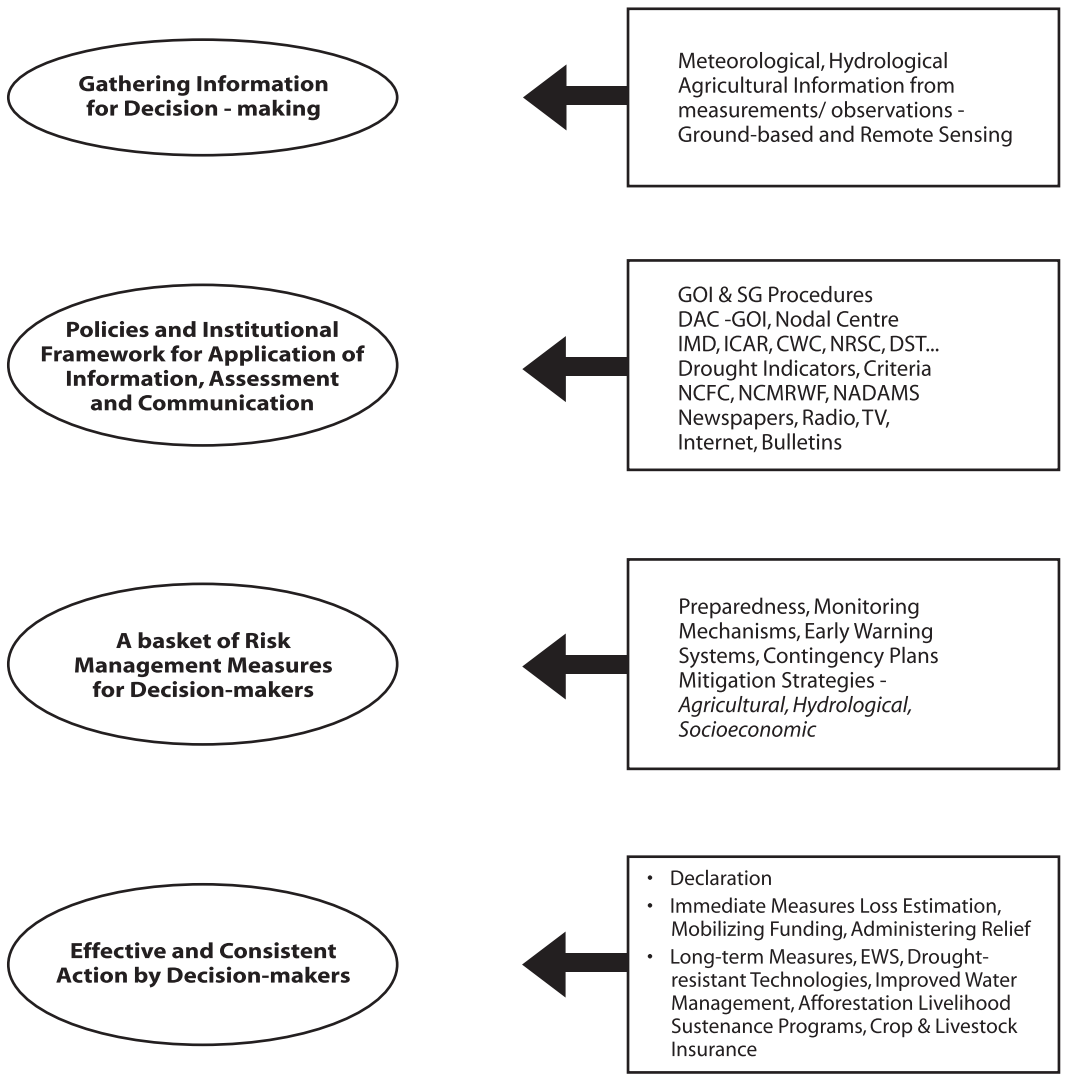
Drought Management Strategy



Source: Drought Management, Ministry of Agriculture

How to Use This Manual

This new *Manual for Drought Management* suggests a system for drought management policy and programmes to be followed by the Government of India and State Governments. It focuses on the general / common elements of drought management at the national level, while allowing the States to include their specific schemes and interventions and incorporates drought forecasting, monitoring, response and mitigation as a continuum of activities.

The objective of this *Manual* is to serve as a handbook for all the decision-makers and administrators, from the Government of India to the village-level. Yet it has the necessary flexibility to include State-level details of implementation. This *Manual* would be updated regularly at the national level on the basis of new experiences and interventions in drought management so that it includes all the evolving approaches and practices in drought management on a dynamic basis.

The manual is divided into the following sections:

Understanding Drought: This section outlines the conceptual issues related to drought. It discusses the phenomenon of drought and its impact, history of drought in India, followed by information on classification of drought, its characteristics, such as seasonal and intra-seasonal variability, duration, and geographical spread. The section concludes with a discussion on why drought recurs in India.

Monitoring Drought: This section provides information on the use of early warning systems as well as all institutions and mechanisms involved in the process. It also discusses the key indicators of drought as well as several indices used for monitoring droughts. It recommends an institutional system for monitoring drought at the national and state levels.

Declaring Drought: This section presents a combination of indicators and indices, which could be used for drought declaration as well as the processes State Governments must follow for drought declaration. The section also provides guidelines for the preparation and submission of a Memorandum to the Government of India for drought relief.

Providing Relief: This section elaborates a number of relief and response measures involved in drought management. It includes contingency crop planning, relief

employment, water resource management, food security, gratuitous assistance, relief through tax waivers and concessions, cattle camps and fodder supply, and institutional response.

Mitigating Drought: The final section provides information on the National Rainfed Area Authority, an apex-level organization set up for implementing long-term drought mitigation measures and processes that need to be followed up for implementing a mitigation programme at the State level. The section describes a number of drought mitigation measures organized into two categories -— (i) artificial recharge of ground water and (ii) traditional methods of water harvesting and conservation -— followed by a discussion of rainwater harvesting in urban areas, water-saving technologies provided by drip and sprinkler irrigation systems and improved water-saving farm practices. The section also discusses long-term irrigation management, afforestation, crop insurance and community participation in drought mitigation.

The New System for Drought Management

The drought management system that has been practiced in India since its independence is largely a continuation of the systems and schemes instituted during the colonial period. It emphasizes a relief-based approach and provides certain other small concessions, which do little to alleviate the distress caused by widespread crop failure. It functions on the basis of a conclusive evidence of drought as derived from the crop production in a particular year, which takes a lot of time as well as prevents early and timely help to farmers. It did not integrate new technologies for early warning, nor did it emphasize mitigation as an essential element of drought management. Thus, there is a strong need to introduce and institutionalize a new drought management system, which is based on the technological advances and new innovations in crop and water management. Such a system would be supported by both short-term and long-term strategies for an effective response, which would be served by linkages with the existing development programmes. While relief would always be important in the short-term, a long-term strategy would be based on implementing appropriate mitigation measures. This manual thus suggests a new approach to drought management, based on the following salient features:

Abandon the use of famine codes and varied State management plans. During the colonial period, the Government wrote famine codes for dealing with situations of mass hunger and collective penury. However, in post-independent India, due to large-scale State interventions, these famine codes are not relevant. Our national experience, however, has shown that the State management of drought operations can make a radical difference to the impact of drought; and in recent years, States have developed their own drought / scarcity manual or disaster management plan, which also address contingencies arising due to drought. However, these manuals and plans do not always reflect all systems and capabilities. While the State manuals / plans take into account the local conditions accompanying drought, they ignore a number of innovations and institutions which can help them in dealing with drought. There is thus a need for a uniform manual on drought management, which guides all States in addressing all related issues without making it mandatory for them.

Focus on mitigation measures. Almost all the drought-affected States experience enormous fiscal stress in coping with drought. There is (i) shortage in food production

due to failure of crops; (ii) shortage of water for human consumption; (iii) shortage in fodder and drinking water for cattle, migration of livestock populations, and even a decrease in the animal population; (iv) shortage in resources for agricultural operations during the subsequent year as a result of the decrease in the animal population; and (v) deforestation to meet the fuel shortage for cooking in rural areas because of non-availability of agricultural wastes and crop residues. As per the current system, the expenditure on relief measures takes precedence over mitigation, placing enormous burden on the State budget and relegating development plans. An emphasis on mitigation measures would reduce the incidence and severity of drought, improve crop production and save resources spent recurrently on relief.

Adopt newer technologies. The new system based on scientific advances in climate forecasting, information and telecommunications technology and spread of participatory democracy, emphasizes the need to develop a system of monitoring and managing drought that would guide the States in developing their forecasting and monitoring system, in laying out a crop contingency plan, in implementing relief programmes more transparently, and focusing on watershed development programmes. Due to spectacular advances in climate forecast technologies, State Governments are in a position to outsource the forecast from many agencies other than the India Meteorological Department (IMD). They can get more precise information as the density of rain gauges has increased, get real time information on all the indicators of weather and climate due to better networking and assess the implications for crops and water levels for better mitigation.

Adapt to the new legal framework. The constitutional and legal frameworks have evolved considerably during the past few decades. The local self-governments have become more important in terms of sharing authority and responsibility (due to 73rd and 74th Constitutional amendments), and it is necessary to assign meaningful roles in drought management to this level. Though the revenue administration has traditionally played the role of a relief agency and may continue to do the same, local self-governments need to promote practices and enforce regulations that prevent drought. Similarly, the Central Government has enacted the Disaster Management Act 2005 which is now being adopted by the States.

Include employment and area development programmes in drought mitigation. New employment programmes introduced by the Government of India (such as the National Rural Employment Guarantee Scheme (NREGS), which aims to provide bulk employment) as well as area development programmes by State Governments (either through their own resources or with Government of India's

support)like Backward Region Grant Fund (BRGF), Rural Infrastructure Development Fund (RIDF) can serve as standard interventions for drought management.

Prescribe standardized steps for management at the national/central level. For effective management, standardized steps need to be suggested (such as to prescribe how and when the State Government can declare drought and seek central assistance) and clear guidelines for the central team to assess the losses caused by drought. This could be done by developing a standard template for the preparation of a memorandum.

Thus, this Manual for Drought Management has been developed reflecting the need for a new system for drought management, which includes drought forecasting, monitoring, response, and mitigation, as a continuum of activities.

Section - 1

Understanding Drought

Objectives:

- What is drought?
- Impact of drought
- Drought in India, its classification and characteristics
- Why drought recurs in India

What is Drought?

It is difficult to provide a precise and universally accepted definition of drought due to its varying characteristics and impacts across different regions of the world, such as rainfall patterns, human response and resilience, and diverse academic perspectives.

Drought is a temporary aberration unlike aridity, which is a permanent feature of climate. Seasonal aridity (i.e. a well-defined dry season) also needs to be distinguished from drought. Thus *drought is a normal, recurrent feature of climate and occurs in all climatic regimes and is usually characterized in terms of its spatial extension, intensity and duration*. Conditions of drought appear when the rainfall is deficient in relation to the statistical multi-year average for a region, over an extended period of a season or year, or even more.

Drought differs from other natural hazards such as cyclones, floods, earthquakes, volcanic eruptions, and tsunamis in that:

- No universal definition exists;
- Being of slow-onset it is difficult to determine the beginning and end of the event;
- Duration may range from months to years and the core area or epicentre changes over time, reinforcing the need for continuous monitoring of climate and water supply indicators;
- No single indicator or index can identify precisely the onset and severity of the event and its potential impacts; multiple indicators are more effective;
- Spatial extent is usually much greater than that for other natural hazards, making assessment and response actions difficult, since impacts are spread over larger geographical areas;
- Impacts are generally non-structural and difficult to quantify;
- Impacts are cumulative and the effects magnify when events continue from one season or year to the next.

Impacts of Drought

Drought produces wide-ranging impacts that span many sectors of the national economy. These impacts are felt much beyond the area experiencing physical drought. The complexity of these impacts arises because water is integral to our ability to produce goods and provide services.

Drought produces both **direct** and **indirect** impacts. Direct impacts or primary impacts are usually physical / material and include reduced agricultural production; increased fire hazard; depleted water levels; higher livestock and wildlife mortality rates; and damage to wildlife and fish habitats. When direct impacts have multiplier effects through the economy and society, they are referred to as indirect impacts. These include a reduction in agricultural production that may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced purchasing capacity and demand for consumption, default on agricultural loans, rural unrest, and reduction in agricultural employment leading to migration and drought relief programmes. The more removed the impact from the cause, the more complex is the link to the cause. These multiplier effects are often so diffuse that it is very difficult to generate financial estimates of actual losses caused by a drought.

The impacts of drought are generally categorized as economic, environmental, and social.

Economic impacts refer to production losses in agriculture and related sectors, especially forestry and fisheries, because these sectors rely on surface and subsurface water supplies. It causes a loss of income and purchasing power, particularly among farmers and rural population dependent on agriculture. All industries dependent upon the primary sector for their raw materials would suffer losses due to reduced supply or increased prices. Drought thus has a multiplier effect throughout the economy, which has a dampening impact on employment, flow of credit and tax collections. If the drought is countrywide, macroeconomic indicators at the national level are adversely impacted.

Environmental impacts, such as lower water levels in reservoirs, lakes and ponds as well as reduced flows from springs and streams would reduce the availability of feed and drinking water and adversely affect fish and wildlife habitat. It may also cause loss of forest cover, migration of wildlife and their greater mortality due to increased contact

with agricultural producers as animals seek food from farms and producers are less tolerant of the intrusion. A prolonged drought may also result in increased stress among endangered species and cause loss of biodiversity.

Reduced streamflow and loss of wetlands may cause changes in the levels of salinity. Increased groundwater depletion, land subsidence, and reduced recharge may damage aquifers and adversely affect the quality of water (e.g., salt concentration, increased water temperature, acidity, dissolved oxygen, turbidity). The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.

Social impacts arise from lack of income causing out migration of the population from the drought-affected areas. People in India seek to cope with drought in several ways which affect their sense of well-being: they withdraw their children from schools, postpone daughters' marriages, and sell their assets such as land or cattle. In addition to economic hardships, it causes a loss of social status and dignity, which people find hard to accept. Inadequate food intake may lead to malnutrition, and in some extreme cases, cause starvation. Access and use of scarce water resources generate situations of conflict, which could be socially very disruptive. Inequities in the distribution of drought impacts and relief may exacerbate these social tensions further.

Drought in India

During the colonial period, many droughts turned into severe famines causing massive human losses. According to one estimate, in the latter half of the 19th century, there were approximately 25 major famines across India, which killed 30-–40 million people. The first Bengal famine of 1770 is estimated to have wiped out nearly one-third of the population. The famines continued until Independence in 1947, with the Bengal famine of 1943–44 being among the most devastating, affecting 3–4 million.

The situation improved remarkably in post-independent India. The Green Revolution in the 1960s made the country self-sufficient in food production. Though India's population has tripled since it achieved independence, there has been no famine in the past 50 years, which is certainly an impressive achievement.

In the 1990s, with the liberalization of the Indian economy and consequent accelerated growth in industry and services, the share of agriculture in gross domestic product (GDP) has fallen to barely 25% (half its share decades ago). Food grains production now accounts for only about 12% of the GDP. As a result, the country has become far more resilient in absorbing the impact of drought at the macro-economic level. Though the drought of 2002 was the severest in the past two decades, its impact on the economy was marginal. Key indicators, such as inflation and wholesale price index, were not adversely affected and conversely, the foreign exchange reserves reached an unprecedented level of $64 billion.

However, drought makes a very perceptible impact on populations that are largely dependent upon agriculture and related occupations for their livelihood. As crops are adversely affected, agricultural income shrinks and causes loss of employment in the agriculture sector. It also has an indirect impact on the other sectors of economy. On the supply side, drought causes a shortage of raw material supplies for agro-based industries and on the demand side, it reduces the demand for industrial products due to diminished purchasing capacity of the rural consumers. Most major droughts in India were followed by recession. Though drought makes its impact over time, it poses a serious challenge for human well being.

Meteorological History of Droughts in India

During 1871–2002, there were 22 major drought years, defined as years with All India Summer Monsoon Rainfall (AISMR) less than one standard deviation below the mean (i.e. anomaly below –10 percent): 1873, 1877, 1899, 1901, 1904, 1905, 1911, 1918, 1920, 1941, 1951, 1965, 1966, 1968, 1972, 1974, 1979, 1982, 1985, 1986, 1987, 2002. The frequency of drought has varied over the decades. From 1899 to 1920, there were seven drought years. The incidence of drought came down between 1941 and 1965 when the country witnessed just three drought years. Again, during 1965–87, of the 21 years, 10 were drought years and the increased frequency was attributed to the El Nino Southern Oscillation (ENSO).

Among the drought years, the 1987 drought was one of the worst droughts of the century, with an overall rainfall deficiency of 19%. It affected 59–60% of the crop area and a population of 285 million. In 2002 too, the overall rainfall deficiency for the country as a whole was 19%. Over 300 million people spread over 18 States were affected by drought in varying degrees. Around 150 million cattle were affected due to lack of fodder and water. Food grains production registered the steepest fall of 29 million tonnes. No other drought in the past had caused reduction in food grain production to this extent.

Source: Samra, 2004

Classification of Drought

In the literature, droughts have been classified into *three* categories in terms of impact.

1. Meteorological drought
2. Hydrological drought
3. Agricultural drought

Meteorological drought is defined as the deficiency of precipitation from expected or normal levels over an extended period of time. Meteorological drought usually precedes other kinds of drought. According to the legend, meteorological drought is said to occur when the seasonal rainfall received over an area is less than 25% of its long-term average value. It is further classified as *moderate drought* if the rainfall deficit is 26–50% and *severe drought* when the deficit exceeds 50% of the normal.

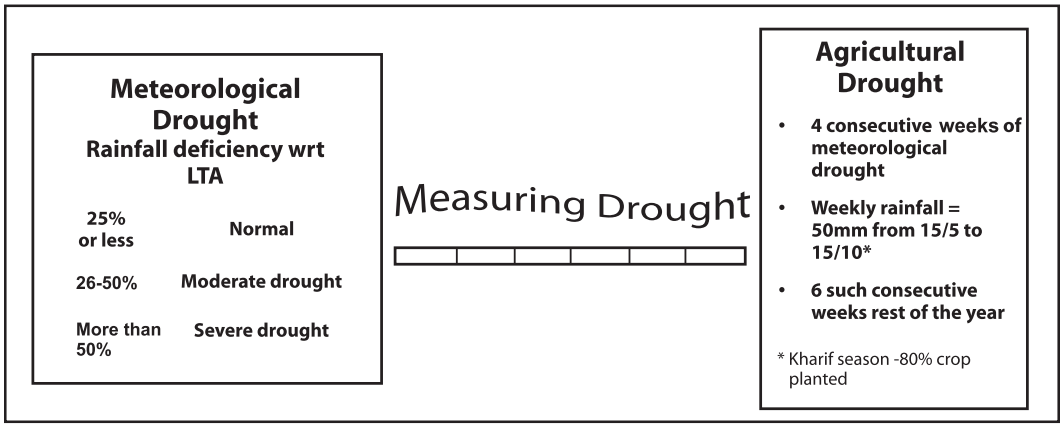
Hydrological drought is best defined as deficiencies in surface and subsurface water supplies leading to a lack of water for normal and specific needs. Such conditions arise, even in times of average (or above average) precipitation when increased usage of water diminishes the reserves.

A**gricultural drought**, usually triggered by meteorological and hydrological droughts, occurs when soil moisture and rainfall are inadequate during the crop growing

season causing extreme crop stress and wilting. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth and the physical and biological properties of the soil. Agricultural drought thus arises from variable susceptibility of crops during different stages of crop development, from emergence to maturity. In India, it is defined as a period of four consecutive weeks (of severe meteorological drought) with a rainfall deficiency of more than 50% of the long-term average (LTA) or with a weekly rainfall of 5 cm or less from mid-May to mid-October (the kharif season) when 80% of India's total crop is planted or six such consecutive weeks during the rest of the year (NRSC, Decision Support Centre).

The classification of drought as mentioned above need not be the only criteria used for declaring drought. The criteria for declaring drought has been discussed in detail in Section 3 of the Manual.

Measuring Meteorological and Agricultural Drought



India-specific Classification for Drought

A drought year as a whole is defined by the IMD as a year in which, the overall rainfall deficiency is more than 10% of the Long Period Average value (LPA) value and more than 20% of its area is affected by drought conditions, either moderate or severe or combined moderate and severe. The country experienced all-India drought years in 1972, 1979, 1987 and 2002.

Droughts are also classified according to the timing of rainfall deficiency during a particular rainfall season, usually June to September in India. An analysis of droughts in recent decades indicates that in 1972, 1987 and 2002, rainfall deficiency was the

maximum during July. These are called early season droughts and provide sufficient lead-time to mitigate the impact of drought. In 1965 and 1979, rainfall deficiency in September was the major cause of drought. These droughts are called late season droughts. Mid-season droughts occur in association with the breaks in the southwest monsoon. If the drought conditions occur during the vegetative phase of crop growth, it might result in stunted growth, low leaf area development and even reduced plant population.

In India, around 68% of the country is prone to drought in varying degrees. Of the entire area, 35% of the area, which receives rainfall between 750 mm and 1,125 mm, is considered drought-prone, while another 33%, which receives less than 750 mm of rainfall, is called chronically drought-prone. A further classification of India's regions into arid (19.6%), semi-arid (37%), and sub-humid areas (21%) has been presented in the section dealing with geographical spread of drought.

Characteristics of Drought

In India, the occurrence and conditions of drought are influenced by a number of factors. Rainfall and cropping patterns are different across many geographical regions. It is not just the deficiency of rainfall, but also the uneven distribution of rainfall across the season, duration of rainfall deficiency and its impact on different regions of the country that characterize drought conditions. The facts presented below show seasonal and regional characteristics of drought conditions in India. The information on these aspects of droughts are necessary for devising and implementing an effective mitigation programme.

Seasonal Characteristics and Intra-Seasonal Variability

India receives most of its rainfall (73%) from the south-west or "summer" monsoon (the rainfall received between June and September). The performance of the Indian economy is vitally linked with the rainfall that occurs during these months. The summer monsoon sets in during the first week of June in the south-east corner of India and gradually proceeds towards the north-west region covering the entire country by the second week of July. Monsoon starts its withdrawal during the first week of September from the west and north and gradually recedes from the entire country.

Due to this pattern of onset and withdrawal, the north-west region receives less than a month of rainy season due to late arrival and early cessation of monsoon conditions. Conversely, Kerala and north-eastern parts of India receive more than 4 months of rainfall due to the early arrival and later withdrawal of the monsoon.

Coastal areas of peninsular India and Tamil Nadu, in particular, also receive rains from October to December, primarily due to periodic cyclonic disturbances in the Bay of Bengal (north-east monsoon or post-monsoon). It also receives some rainfall during other months. The broad seasonal distribution of rainfall is presented in table 1.

Table 1: *Seasonal Distribution of Rains in India*

Season	Months	Percentage of Distribution
Pre-monsoon	March-May	10.4
South-west monsoon	June-September	73.4
Post-monsoon	October-December	13.3
Winter rains	January-February	2.9

Source: India Meteorological Department, Government of India.

Uneven distribution of rains also occurs across the monsoon season (done by analysing the number of meteorological subdivisions that receive deficient / scanty rainfall during mid-July, mid-August and mid-September during major drought years (see table 2); 1987 and 2002 were the worst years with regard to deficiency and season.

Table 2: *Sub-Division wise Distribution of Rains during Major Drought Occasions (Number of sub-divisions received deficient rainfall)*

Drought year	Mid-July	Mid-August	Mid-September
1966	19	14	16
1972	13	21	21
1979	17	15	15
1987	25	25	21
2002	25	25	21

Source: India Meteorological Department, Cited in Drought 2002 -A Report, Ministry of Agriculture, Government of India

A comparison of the 2002 monsoon with three recent major droughts (1972, 1979, and 1987) is shown in table 3. Rainfall variation in 2002 was much higher compared to the earlier drought years. A deficiency of 51% rainfall in July could not be compensated by almost average rainfall in August (4%) and September (10%).

Table 3: *Month-wise Rainfall Distribution*
(Percentage departure for the country as a whole in recent major drought years)

Year	June	July	August	September	June-Sept
1972	-27	-31	-14	-24	-24
1979	-15	-16	-19	-28	-19
1987	-22	-29	-4	-25	-19
2002	+4	-51	-4	-10	-19

Source: Source: India Meteorological Department, Cited in Drought 2002 A Report, Ministry of Agriculture, Government of India

Duration

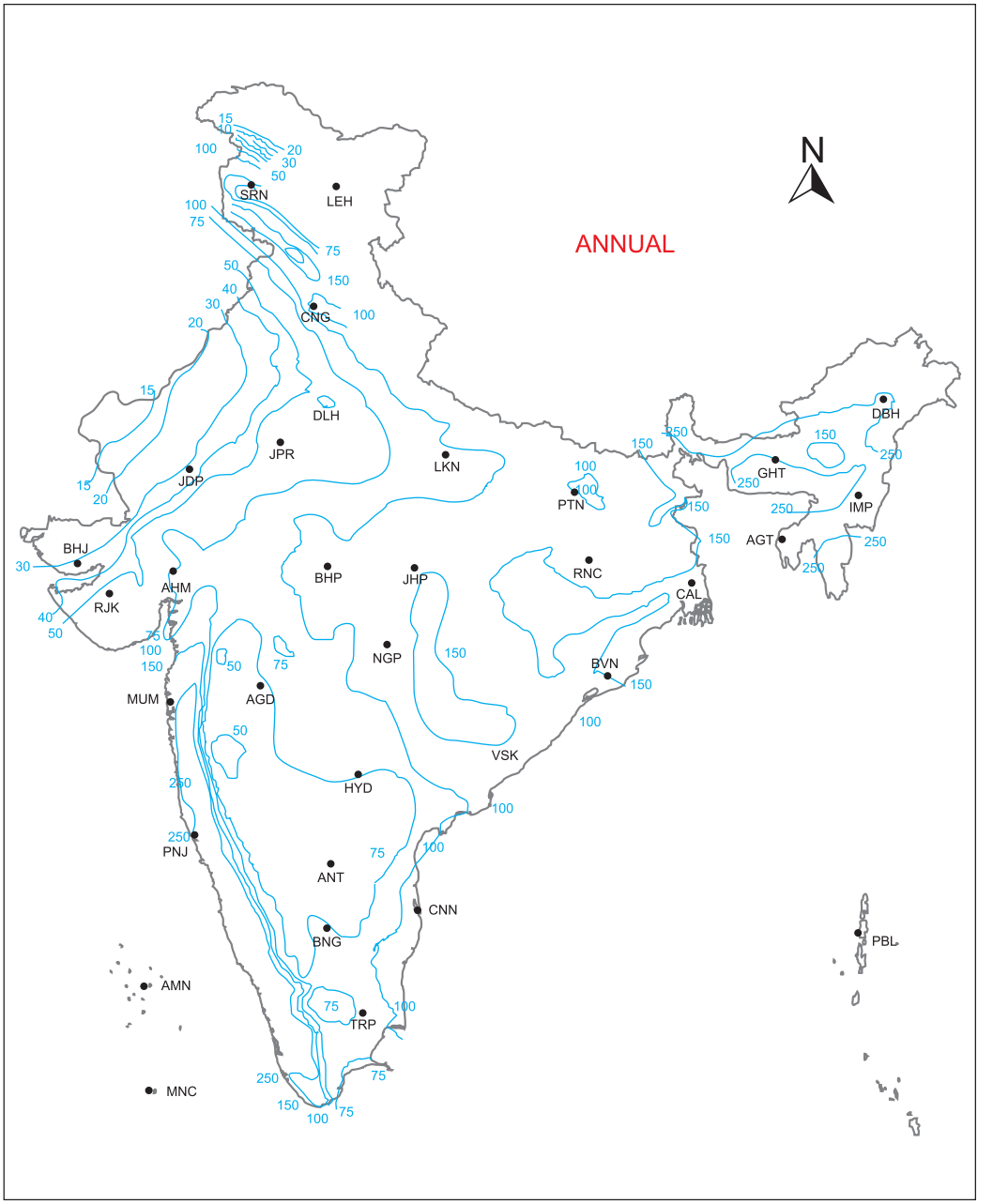
Drought conditions are prolonged due to poor rainfall in consecutive years. Prolonged drought conditions do not allow people the opportunity to recover from the impact of drought and it depletes their capacity to cope with the impact.

Table 4 shows that drought in 1965 and 1966 became severe due to failure of rainfall during successive years, though the deficiency did not hit the same area in both the years. During 1985-87, there were progressive reductions in rainfall in the same regions, with the result that 1987 experienced a multi-year drought. Year 2002 was preceded by normal monsoon years. However, after 1998, the rainfall was less than normal, though the deficiency was moderate. The subdued rainfall in 1999-2001 reduced the availability of water and moisture and aggravated the impact of the 2002 drought when the rainfall deficiency was very high.

Table 4: *Percentage Departure of Rainfall from Normal for Country as a Whole (SW Mansoon)*

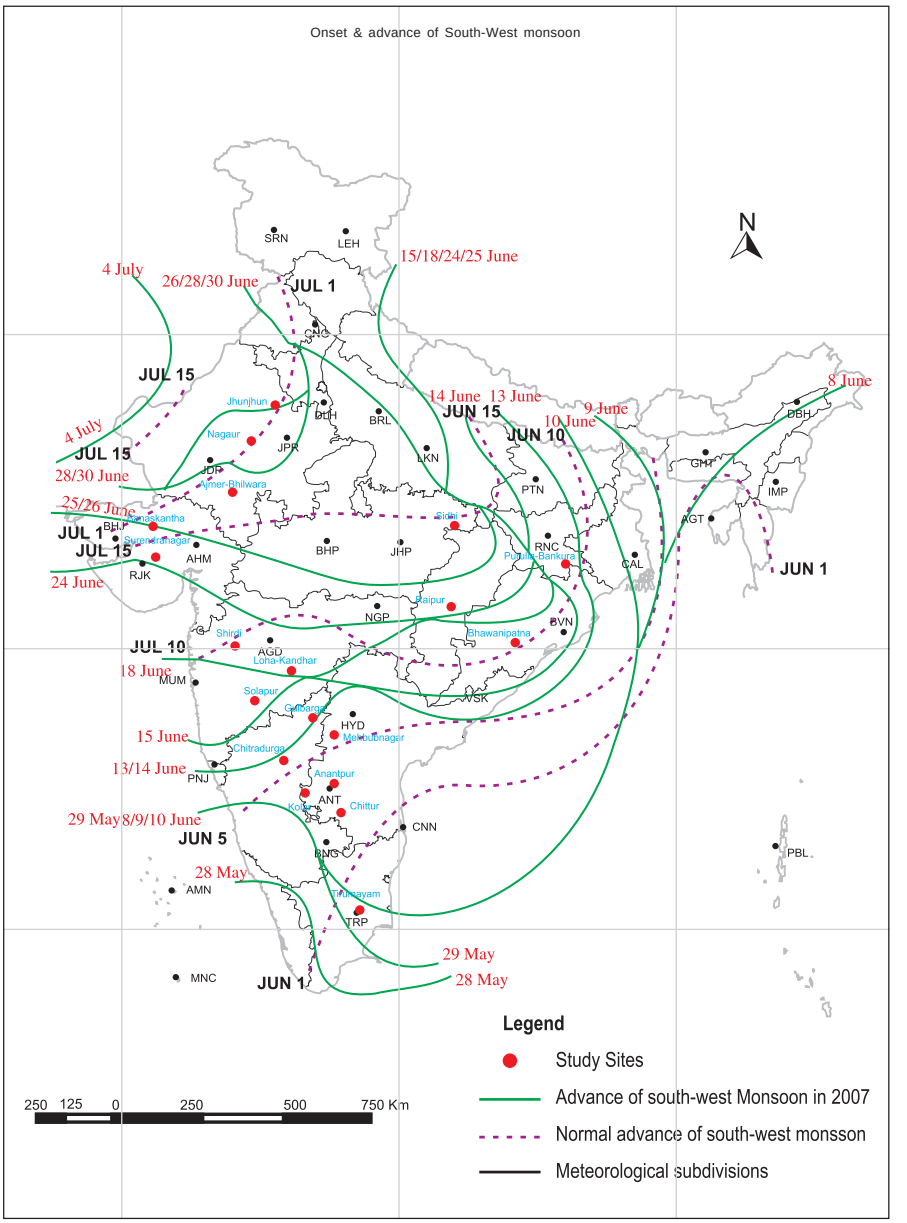
Year	Percentage Departure from Normal
1965	-18
1966	-16
1972	-24
1979	-19
1985	-7
1986	-13
1987	-19
1999	-4
2000	-5
2001	-8
2002	-19

Map 1: *Normal Annual Rainfall (cm) Map of India*



Source: Indian Meteorological Department

Map 2: *South-west Monsoon Onset and Advance Map*



Source: Indian Meteorological Department

Geographical Spread of Drought

Large parts of the country perennially reel under recurring drought; over 68%-70% of India is vulnerable to drought. As mentioned earlier, 33%, classified as "chronically drought-prone areas" receive less than 750 mm of rainfall, while 35%, classified as "drought-prone areas" receive rainfall of 750-1125 mm. The drought-prone areas of the country are confined to peninsular and western India primarily arid, semi-arid, and sub-humid regions.

Table 5: *Cropped Area Falling Under Various Ranges of Rainfall in India*

No.	Rainfall Ranges	Classification	%
1	Less than 750 mm	Low rainfall	33 %
2	750 mm to 1125 mm	Medium rainfall	35%
3	1126 mm to 2000 mm	High rainfall	24%
4	Above 2000 mm	Very high rainfall	8%

Source: Drought 2002, A Report, Ministry of Agriculture, Government of India

Table 6 below indicates that while the drought of 1965-67 and 1979-80 affected comparatively high rainfall regions, the drought of 1972, 1987, and 2002 affected mostly semi-arid and sub-humid regions. In recent years, central, north-west and peninsular India suffered frequent droughts. These are low rainfall zones and the frequent failure of monsoon aggravates the intensity of droughts in these regions.

Table 6: *Region-wise Percentage of Departure of Rainfall from Normal Long-term Average during SW Monsoon in Major Drought Years*

Region	1918	1965	1972	1979	1987	2002
All India	-26	-18	-25	-19	-19	-19
North-west	-36	-28	-36	-18	-46	-48
Central	NA	NA	NA	-31	-28	-31
East	-20	-30	-22	-23	-14	+2
Peninsular	-32	-22	-31	-14	-27	-27

Source: India Meteorological Department

Even when the overall rainfall in the country is normal, large variations in rainfall could exist across regions, or within a region or a State, and sometimes, even within a district. IMD divides the country into 36 sub-divisions, and categorizes rain in each subdivision as excess, normal, deficient or scanty. On average, each meteorological subdivision has more than a dozen districts. It is very likely that within a meteorological sub-division, certain districts are affected by drought, while others are not.

Map 3: *A Map of Drought-Prone Districts of India*

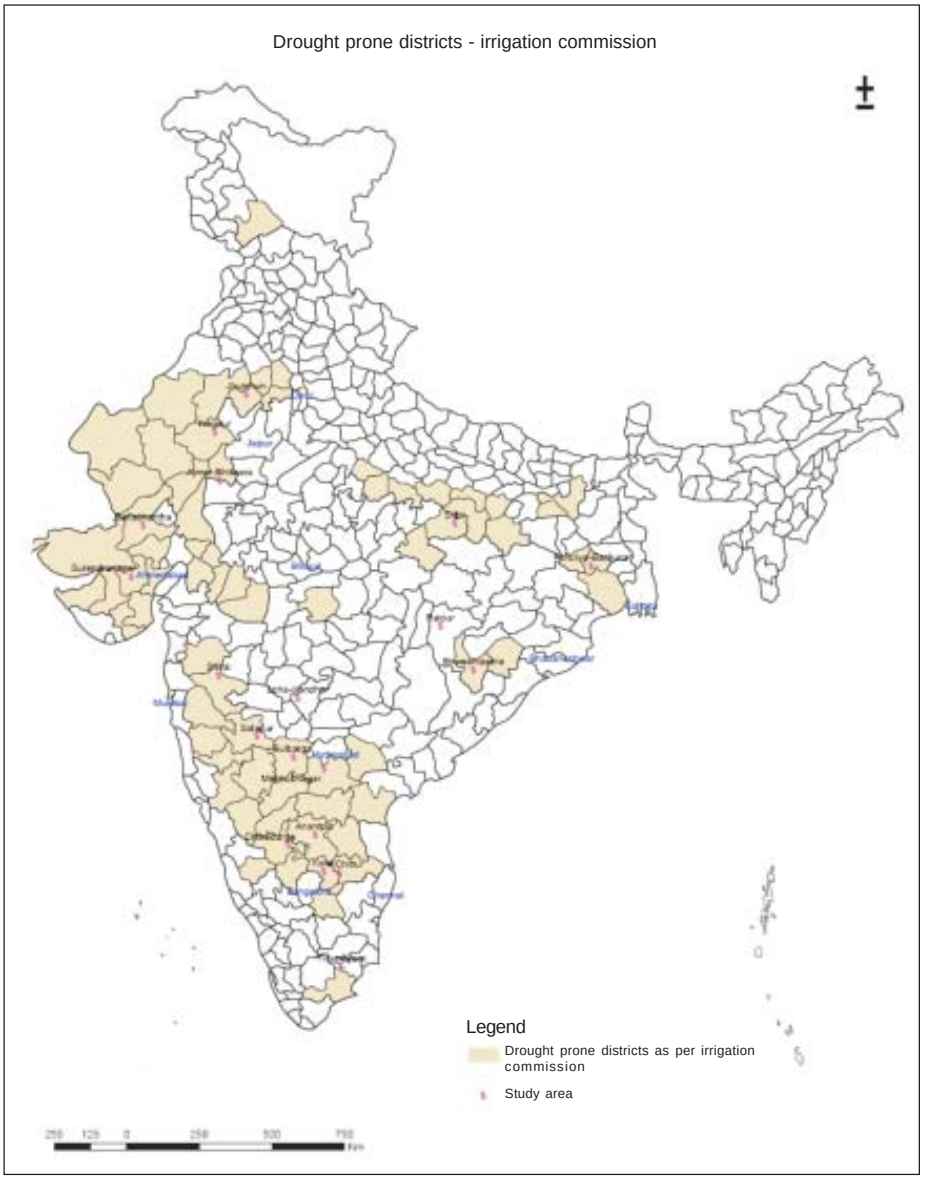


Table 7: *Administrative Districts Chronically affected by Drought Conditions*

State	Districts
Andhra Pradesh	Anantpur, Chittoor, Cuddapah, Hyderabad, Kurnool, Mehboobnagar, Nalgonda, Prakasam
Bihar	Munger, Nawadah, Rohtas, Bhojpur, Aurangabad, Gaya
Gujarat	Ahmedabad, Amreli, Banaskantha, Bhavnagar, Bharuch, Jamnagar, Kheda, Kutch, Mehsana, Panchmahal, Rajkot, Surendranagar
Haryana	Bhiwani, Gurgaon, Mahendranagar, Rohtak
Jammu and Kashmir	Doda, Udhampur
Karnataka	Bangalore, Belgaum, Bellary, Bijapur, Chitradurga, Chickmagalur, Dharwad, Gulbarga, Hassan, Kolar, Mandya, Mysore, Raichur, Tumkur
Madhya Pradesh	Betul, Datia, Dewas, Dhar, Jhabua, Khandak, Shahdol, Shahjapur, Sidhi, Ujjain
Maharashtra	Ahmednagar, Aurangabad, Beed, Nanded, Nashik, Osmanabad, Pune, Parbhani, Sangli, Satara, Solapur
Orissa	Phulbani, Kalahandi, Bolangir, Kendrapada
Rajasthan	Ajmer, Banswada, Barmer, Churu, Dungarpur, Jaisalmer, Jalore, Jhunjunu, Jodhpur, Nagaur, Pali, Udaipur
Tamil Nadu	Coimbatore, Dharmapuri, Madurai, Ramanathapuram, Salem, Tiruchirapali, Tirunelveli, Kanyakumari
Uttar Pradesh	Allahabad, Banda, Hamirpur, Jalana, Mirzapur, Varanasi
West Bengal	Bankura, Midnapore, Purulia
Jharkhand	Palamau
Chhattisgarh	Khargaon

In India drought-prone areas comprise a total land area of 329 million hectares, with three-fourths being arid, semi-arid and sub-humid areas.

- Arid zone (19.6%): Mean annual precipitation (MAP) of 100- 400 mm (water deficit throughout the year); Rajasthan, parts of Haryana and Gujarat. Droughts are severe in this zone.
- Semi-arid zone (37.0%): MAP of 400- 600 mm (water surplus in some months and deficit in other months); parts of Haryana, Punjab, west Uttar Pradesh, west Madhya Pradesh, and also most of the peninsular parts of the Western Ghats. Drought can be moderate to severe in this zone.
- Dry sub-humid zone (21.0%): MAP of 600- 900 mm in India; parts of northern plains, central highlands, eastern plateau, parts of eastern Ghats and plains and parts of western Himalayas. Droughts are moderate in this zone.
- Humid and per-humid regions, such as Assam and other north-east States rarely face drought.

Map 4: *River Basins in India*

A drought situation arising in any part of India needs to be assessed in terms of the overall seasonal rainfall and intra-seasonal distribution of rainfall. Further, the period over which the deficiency of rainfall has taken place would be a critical indicator of the severity of drought. Consecutive drought years would aggravate the impact of drought. Finally, the drought management measures would largely depend upon the area in which the drought has occurred. Relief as well as mitigation measures would be different for chronically drought-prone areas, compared to dry sub-humid areas. The drought monitoring system also needs to be adapted to these differentiated features of drought.

Why Does Drought Recur in India?

A deficiency in rainfall causes depletion of both surface and ground water levels and adversely affects agricultural operations. The conditions for onset of drought in India vary across agro-climatic zones. In the semi-arid regions, even a 400 mm rainfall would be adequate for the growth of crops, while in high rainfall regions of Assam, even an annual rainfall of 1,000 mm would create conditions for drought.

As discussed earlier, drought is a recurrent climatic phenomenon in India and is caused due to the country's peculiar physical and climatic characteristics as well as resulting economic and agricultural impacts. These include:

- High average annual rainfall of around 1,150 mm; no other country has such a high annual average; however, there is considerable annual variation.
- About 73% of the total annual rainfall is received in less than 100 days during the south-west monsoon and the geographic spread is uneven.
- Even though India receives abundant rain as a whole, disparity in its distribution over different parts of the country is so great that some parts suffer from perennial dryness. In other parts, however, the rainfall is so excessive that only a small fraction can be utilized. The variability in rainfall as compared to Long Period Average (LPA) exceeds 30% in large areas of the country and is over 40- 50% in parts of drought-prone Saurashtra, Kutch, and Rajasthan.
- Around 33% of the cropped area in the country receives less than 750 mm rain annually making such areas hotspots of drought.
- Inadequacy of rains coupled with adverse land-man ratio compels the farmers to practice rain-fed agriculture in large parts of the country.
- Irrigation, using groundwater aggravates the situation in the long term as groundwater withdrawal exceeds replenishment; in the peninsular region availability of surface water itself becomes scarce in the years of rainfall insufficiency.
- Per capita water availability in the country is steadily declining.
- Traditional water harvesting systems have been largely abandoned.

Section - 2

Monitoring Drought

Objectives:

- Monitoring and Early Warning Systems
- Key Drought Indicators
- Developing a Composite Index
- Drought Monitoring Checklist

Monitoring and Early Warning Systems

All States exposed to drought risks should set up a drought monitoring and management system.

This system would provide an integrated approach to drought management, covering all the aspects of drought: early warning and forecasting, response, and mitigation. The monitoring and early warning / forecasting system is discussed below. Response and mitigation measures are discussed in subsequent sections.

The development of such a system requires coordinated efforts on part of all the affected parties: State Governments, Government of India, Scientific Institutions, and farmers.

As drought is a slow-onset disaster, its monitoring and early warning systems are central to drought management. Drought preparedness and mitigation measures follow these initial steps in drought management.

Early warning systems

1. provide accurate, timely and integrated information on drought conditions at the level of regions, States and districts.
2. detect drought early; it allows for activation of the drought management plan and evokes both proactive (mitigation) and reactive (emergency) responses.
3. provide information on all the parameters of drought at the relevant spatial scale to the policy-makers, administrators, NGOs, and citizens. The decision support which the DEWS provides can minimize the economic, social and ecosystem losses associated with drought.
4. consist of information on a number of variables, such as climate data, soil moisture, stream flow, groundwater, and lake and reservoir levels.
5. require gathering and integration of existing data as well as seeking new information through State and national networks. It also requires a network of scientific institutions to maintain the physical observing system, collect and analyse the data, and to synthesize the information on drought impacts. For instance, it is necessary to collect and analyse information on stream flow, lake and reservoir levels, and groundwater status, as drought revolves around the supply of and demand for water.

The early warning system should function at three levels:

1. Receiving forecasts, early warning, and advisories from scientific institutions;
2. Monitoring key drought indices at the National and State levels; and
3. Developing composite index of various drought indicators.

Institutions Providing Monitoring and Early Warning

Several institutions in the country provide drought early warning through their long and medium-term forecasts.

India Meteorological Department

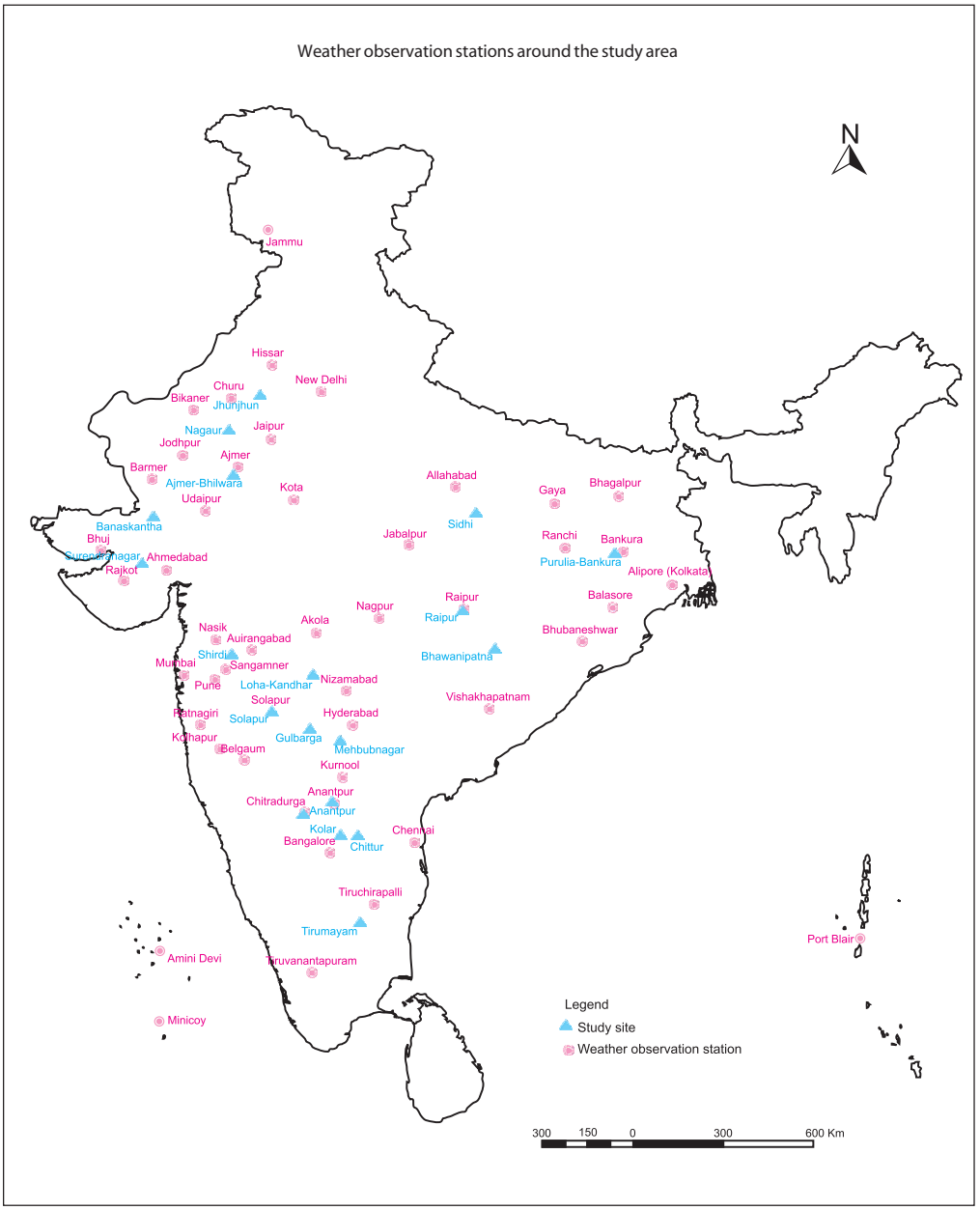
The India Meteorological Department (IMD) is the designated agency for providing drought early warning and forecasting. IMD predicted the first scientific monsoon in 1886.

IMD identifies meteorological drought for subdivisions every year based on rainfall analysis. During the past 125 years, IMD has identified meteorological droughts (moderate or severe) over meteorological subdivisions of the country using IMD criteria and also drought years for the country as a whole. And, there have been many refinements in the models and techniques applied by the IMD for weather forecast, from time to time.

IMD forecasts drought on the following bases:

- Long-range forecasts of seasonal total rainfall for the entire country, which are done be fore onset and at the beginning of the monsoon. Long-range forecast techniques require further development, for resolution on a smaller spatial and temporal scale.
- Rainfall summaries are compiled weekly giving figures of precipitation at the district level. IMD collects its rainfall data, using a network of 2,800 rain gauge stations distributed across 36 meteorological sub-divisions of the country.

Map 5: *A Map of IMD's Weather Observation Stations*



Source: Indian Meteorological Department

IMD monitors agricultural drought once every two weeks on a real-time basis during the main crop seasons (kharif and rabi) of India. For this, an aridity anomaly index developed on the lines of Thornthwaite's concept is used to monitor the incidence, spread, intensification, and recession of drought.

Aridity anomaly reports are prepared for the country as a whole during the south-west monsoon season and for 6 sub-divisions (Coastal Andhra Pradesh, Rayalaseema, South Interior Karnataka, Tamil Nadu, Pondicherry, and Kerala) during the north-east monsoon season. These anomaly reports are widely circulated to various users, such as Agromet Advisory Services, the agricultural departments of State Governments, agricultural universities, and the National Remote Sensing Centre in Hyderabad.

Agricultural Meteorology Division

The Agricultural Meteorology Division, a specialized division of the IMD, is based in Pune, and has a wide network of agro-meteorological observatories, which generate various kinds of data on agro-meteorological parameters. The Division reviews specific research problems such as water requirements for crops, pests and diseases, rainfall probabilities in the dry farming tracts, cropweather relationship, and application of remote sensing techniques in agricultural meteorology.

The Division, in coordination with the respective State agricultural departments, issues weekly/bi-weekly Agromet Advisory Bulletins from 17 agro-meteorological advisory service units located at State Meteorological Centres (SMCs) / Regional Meteorological Centres (RMCs).

The Division provides timely advice on the actual and expected weather, and its likely impact on the various day-to-day farming operations. Short-range forecasts valid for 12 to 24 hours and then extended to the following 2 to 3 days are used extensively to provide this advice. Secondly, agro-meteorological forecasts extending over a week or 10 days (medium range) are very important from the users' perspective as well as for planning various agricultural operations and strategies.

Drought Research Unit

The Drought Research Unit, set up at IMD, Pune in 1967, provides Crop Yield Forecasts (CYFs). This unit has developed pre-harvest crop yield forecasting models and issues statewise monthly crop yield and countrywide total production forecasts for the major crops kharif (rice) and rabi (wheat) crops, based on agro-meteorological models.

Pre-harvest CYFs are issued for 15 States comprising 26 meteorological sub-divisions for kharif (rice) and 12 States comprising 16 meteorological subdivisions for

rabi (wheat), and also for the total rice / wheat production of the country. The forecasts are supplied to the Directorate of Economics and Statistics, Ministry of Agriculture. The first interim forecast for kharif rice is issued in August and the final forecast is given in November/December. For wheat, the first interim forecast is issued in January and the final in March/April/May.

National Centre for Medium Range Weather Forecasting

In January 1988, the Government of India approved the establishment of the National Centre for Medium Range Weather Forecasting (NCMRWF) as a constituent unit of the Department of Science and Technology (DST) to help develop suitable numerical weather prediction (NWP) models for medium-range weather forecasts (310 days in advance) and prepare agro-meteorological advisories for the farming community in 127 agro-climatic zones of India.

The NCMRWF, in collaboration with the IMD, Indian Council of Agricultural Research (ICAR), and State Agricultural Universities (SAUs), provides agro-meteorological advisory service at the scale of agro-climatic zones to the farming community, based on location-specific medium-range weather forecasts.

NCMRWF disseminates weather forecasts (currently 4 days) to these units for their respective zones (through VSAT, fax or phone) and agricultural scientists of the concerned stations prepare advisories for the farmers which are then disseminated to the users through mass media (local newspapers radio, and TV), personal contact, extension personnel, etc. These bulletins are issued twice a week at most of these stations. Agro-meteorological advisory units also provide local agro-meteorological data and farmers' feedback on the advisories.

Box 1: *The Role of IMD and NCMRWF in Drought Monitoring*

IMD Farmers Weather Bulletins

- Provide a district-wise forecast or weather during the next 48 hour, with an outlook for the following 2 days, taking into account the effects of weather on crops grown in their respective regions.
- Daily for broadcast in different regional languages through the stations of All India Radio and their evening programs for farmers. A second bulletin is issued for broadcast in the morning during the rainy season. Also published in newspapers.

IMD Agrometeorological Advisories

- Information on past and expected weather
- Specific advice to farmers on what agricultural operations they may undertake in the context of these weather conditions.
- Useful to farmers for scheduling of irrigation to save water, and choosing the optimum timing for spraying of pesticides, application of fertilizers, etc.
- Prepared twice a week in consultation with experts of the State Agricultural Departments. Broadcast by AIR stations and also telecast by Doordarshan.
- The Service is functioning at 17 IMD Centres: Ahmedabad, Bangalore, Bhopal, Bhubaneshwar, Calcutta, Chandigarh, Chennai, Gangtok, Guwahati, Hyderabad, Jaipur, Lucknow, New Delhi, Patna, Pune, Srinagar, and Thiruvananthapuram.

IMD Agricultural Meteorology Division, Pune

- Prepares crop weather calendars depicting the state and stage of the crop under normal weather conditions and the weather elements detrimental to the crops in various growth stages. The crop weather calendars are periodically revised as new crop varieties are introduced and cropping patterns undergo changes.
- Helps agricultural planning in drought-prone and dry land farming areas of the country. An Agrodimatic Atlas of India has been prepared. Aridity anomaly maps are compiled for the country on a fortnightly basis.
- IMD also estimates the crop yields of principal crops with the help of regression models, which parameterize of effects of various weather parameters during the different growth stages of the crops.

NCMRWF Rabi Crop Advisories (Weekly)

A. District-specific Current Weather Observations (Temperature, Rainfall)
B. Weather Systems
C. Rainfall
D. Temperature
E. Crop-specific and State-specific Farm (including livstock) Advisories

Central Research Institute for Dryland Agriculture

The Central Research Institute for Dryland Agriculture (CRIDA) in Hyderabad and the All India Coordinated Research Projects on Agri-meteorology and Dryland Agriculture (AICRPAM and AICRPDA), each having 25 centres under SAUs across the country take part in drought studies pertaining to assessment, mitigation, risk transfer, and development of decision support software for drought-prone States.

Central Arid Zone Research Institute

The Central Arid Zone Research Institute (CAZRI), in Jodhpur acts as repository of information on the status of natural resources and desertification processes and their control. It maintains 6 agro-meteorological observatories in their research stations at Jodhpur, Jaisalmer, Chandan, Bikaner, Pali, and Bhopalgarh. Besides, the CAZRI shares rainfall records of 100 rain gauge stations with the Rajasthan Irrigation Department and also with the IMD network of meteorological stations for assessing agricultural drought situation in 12 arid districts of western Rajasthan. It has developed a crop moisture index to monitor the drought situation (explained later in the manual). The Institute disseminates bi-weekly crop-weather agro-advisory bulletins to the farmers and other agencies through media and a feedback on the economic impact of these advisories also are obtained from the farmers.

Ministry of Earth Sciences

Ministry of Earth Sciences in collaboration with ICAR has set up 89 centres for short and medium-range monitoring and forecasting of the weather.

National Agricultural Drought Assessment and Monitoring System

The National Agricultural Drought Assessment and Monitoring System (NADAMS) developed by the Department of Space for the Department of Agriculture and Co-operation, primarily monitors the vegetation through National Oceanic and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHHR) data. Drought assessment is based on a comparative evaluation of satellite observed green vegetation cover (both area and greenness) of a district in any specific time period, with that of any similar period in previous years. This comparative evaluation helps in fixing the current season in the scale of historic agricultural situations. The NADAMS prepares state-wise monthly reports (see more details in the chapter on Key Drought Indicators).

Institutional Mechanism for Drought Monitoring and Early Warning at the National and State Levels

The Central and State Governments should set up institutional mechanisms for drought monitoring and mechanism at the national and State levels. At present, these functions are carried out by inter-departmental agencies and scientific institutions listed above.

Considering the frequency and impact of drought, these mechanisms are not adequate for meeting the demands of drought management. As per the new drought

management guidelines, the existing capacity of these institutions needs to be strengthened for the purpose of data collection, analysis, and synthesis of information.

The existing and proposed institutional arrangements for drought management at the national and State levels are described below:

Crop Weather Watch Group

The Government of India acts upon the information, data and early warnings of the IMD through an inter-ministerial mechanism of Crop Weather Watch Group (CWWG), which works as part of the Ministry of Agriculture. The CWWG meets once a week during the rainy season (June to September) and the frequency of their meetings increases during drought occurrence. The composition of the Group and its specific areas of responsibility are given in table 8 below.

Table 8: *Composition and Role of CWWG of the Ministry of Agriculture, GOI*

Partners	Tasks
Additional Secretary, Ministry of Agriculture	Chairperson of the Group: promotes overall coordination
Economics & Statistical Advisor, MOA	Report behaviour of agro-climatic and market indicators
India Meteorological Department	Rainfall forecast and progress of monsoon conditions
Central Water Commission	Water availability monitoring in Important reservoirs
Plant Protection Division	Watch pests and diseases outbreak
Crop specialists	Report on crop conditions and production
Agricultural input supply divisions	Supply and demand of agricultural inputs
Agricultural extension specialists	Report on field-level farm operations
Ministry of Power	Manage electrical power for groundwater extraction
Indian Council of Agricultural Research	Technical input and contingency planning
National Centre for Medium Range Weather Forecasting	Provide medium-term forecasts

The CWWG evaluates information and data furnished by the IMD and other scientific and technical bodies with a view to determine the likely impacts of meteorological events and other environmental parameters on agriculture. The monitoring and information-management system of the CWWG groups is summarized in table 9.

Table 9: *Details of CWWG Monitoring and Information Management*

Parameters	National-level agencies	State-level agencies	District-level agencies	Field- level agencies	Communication Mode
A. Meteorological					
Delay in the onset	W	W	D	D	Wireless / Fax/
of monsoon					Telephone/ email
Dry spell during sowing	W	W	D	D	Wireless / Fax/ Telephone/ email
Dry spells during critical crop-growth periods	W	W	D	D	Wireless / Fax Telephone/ email
B. Hydrological					
Water availability in reservoirs	W	W	D	D	Wireless / Fax/ Telephone/ email / Written Reports
Water availability in tanks	F	F	F	W	Written Reports
Stream flow	F	F	F	W	Written Reports
Groundwater flow	S	S	S	S	Written Reports
Soil moisture deficit	F	F	F	F	Written Reports
C. Agricultural					
Delay in sowing	W	W	W	W	Wireless / Fax / Telephone/email
Sown area	W	W	W	W	Wireless / Fax / Telephone/ email
Crop vigour	F	F	F	W	Written Reports
Change in cropping	W	W	W	W	Wireless / Fax
pattern					Telephone/ email
Supply and demand agricultural inputs	W	W	W	W	Wireless / Fax / of Telephone/ email / NICNET

D= Daily; W= Weekly; F= Fortnightly; M= Monthly; S= Seasonal (pre- and post-rains)

National and State Drought Monitoring Centres

The Central and State Governments should consider setting up a monitoring mechanism at their respective levels in "*Drought Monitoring Centres*". These centres would consolidate the forecasts, advisories and bulletins emanating from all the scientific institutions at the national level or in the States, as required, analyse these inputs, and disseminate the data and advisories through various media channels (radio, television, internet and newspapers). The centres would serve as the institutional support for drought monitoring and management, and recommend short-term and long-term measures to alleviate drought distress.

These drought monitoring centres would work closely with drought early warning agencies such as the IMD and the Ministries / Departments dealing with relief and disaster management, agriculture, water conservation, water supply, and animal husbandry. It would have the capacity to interpret remote sensing data, use Geographic Information System (GIS) software to prepare maps and maintain a database related to rainfall, agriculture, water level and other related indicators on a continuous basis. It would thus provide regular monitoring support to the Government at the National and State levels.

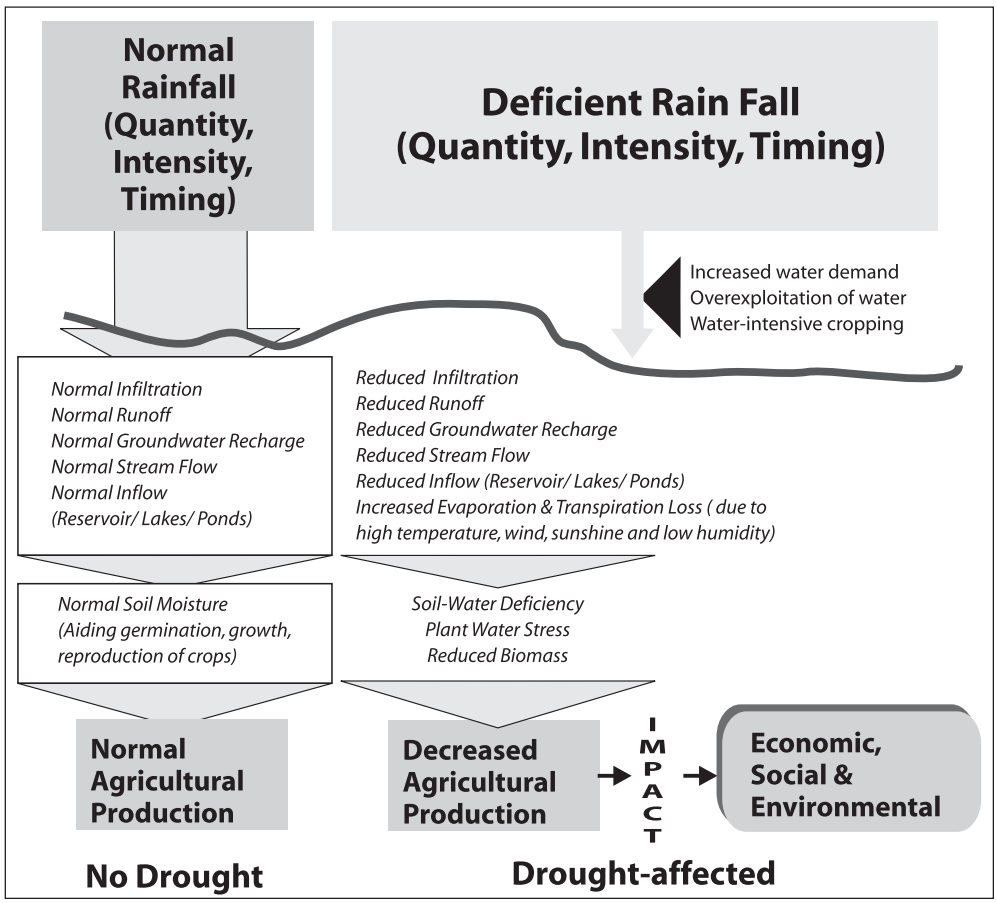
The centres would be staffed by a multi-disciplinary team of meteorologists, hydrologists and agriculture scientists and could work as autonomous bodies that network with other scientific institutions in the country and assist the Government in dealing with all aspects of drought management (i.e. early warning, response, and mitigation).

The outline for setting up Drought Monitoring Centres at the National and State levels is provided in the **Annex 2**. The Government of India and the State Governments can provide necessary variation in setting up these centres, taking into consideration their specific needs of drought monitoring.

Key Drought Indicators

State Governments monitor drought by obtaining information on the key indicators of drought from various departments. This includes information on rainfall, reservoir/lake water levels, surface water / groundwater, soil moisture and sowing / crop conditions from the revenue administration and other departments. Though the State Governments do not prepare a composite index on the basis of these data, collation of data on these indicators provides a reliable representation of the extent and severity of drought in a State.

Figure 4: *Key Drought Indices*



Rainfall

The IMD and State Governments collect data on rainfall every day during the rainy season. The IMD maintains its network of weather stations throughout the country. Within the State Government data are collected at the Tehsil / Taluka / Block level(s). Generally, the Revenue Department is entrusted with the responsibility of collecting rainfall data at the district and Tehsil levels. The actual rainfall is compared with the Long-Term Average (LTA), which has been standardized on a daily, weekly and monthly basis. Such a comparison provides information on the deficit or excess of rainfall in a particular sub-division for a certain period. According to the Indian Meteorological Department (IMD), drought sets in when the deficiency of rainfall at a meteorological sub-division level is 25 per cent or more of the LTA of that sub-division for a given period. The drought is considered "moderate", if the deficiency is between 26 and 50 per cent, and "severe" if it is more than 50 per cent.

Daily rainfall information could be collected and submitted in Form No. 1, included in the **Annex 1**.

Storage Water Levels in Reservoirs

State Governments collect data on the levels of stored water in important reservoirs through its Irrigation Department. Reservoir storage level is an useful indicator of water shortages. As data on reservoir storage are available on a regular basis, these could provide accurate information on water shortages. The Central Water Commission maintains data on water levels in 81 important reservoirs of the country, where the water storage is compared with the Full Reservoir Level (FRL). State Governments need to plan the use of reservoir storage as per their reservoir operation rules, which lay down the priority for the use of available water: drinking water, urban and industrial use and irrigation for agriculture. Reservoir water levels may fall below the expected level even when the reservoir operation rules are not followed and the usage of water is not adequately regulated.

Information on water storage in important State Government owned reservoirs could be provided in Form No. 2, included in **Annex 1**.

Surface Water and Groundwater Level

Natural discharge from shallow aquifers provides base flow to streams and sustains the water in lakes and ponds, particularly during periods of dry weather. Similarly, groundwater levels are also affected due to poor recharge, either due to lack of adequate rainfall or poor water conservation practices. As a result, water availability in deep

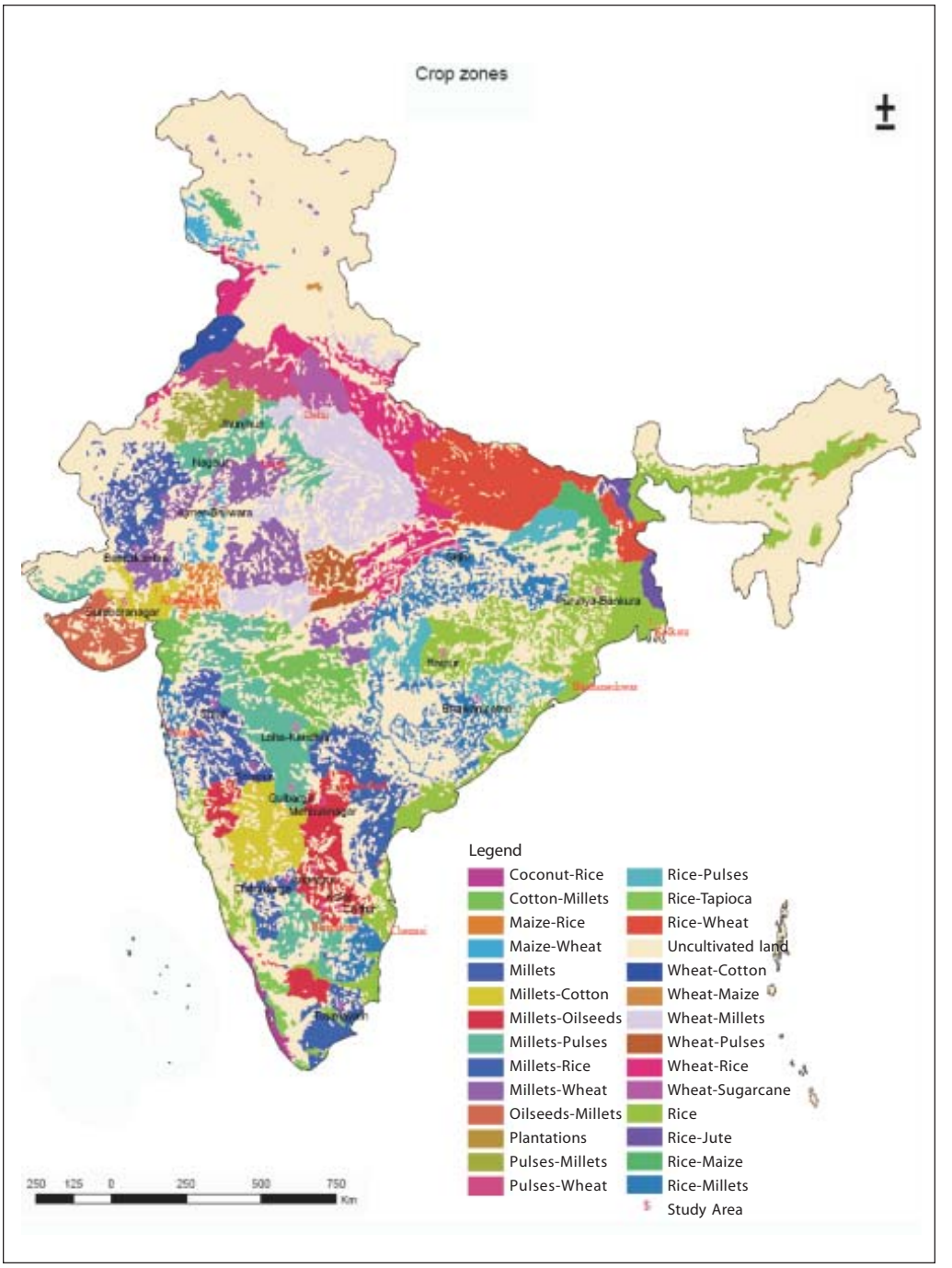
bore-wells and open wells diminishes substantially. Declining groundwater levels are important indicators of drought conditions, though these are often attributed to over-extraction of water. An annual decline in the water table of up to 2 metres is considered normal and can tolerate even a deficient rainfall the following year. A decline of up to 4 metres is a cause for concern and above 4 metres is a stress situation.

The Central Ground Water Board (CGWB), with over 15,000 hydrograph stations across the country, is responsible for monitoring India's groundwater. Monitoring, usually done four times a year, is essentially a recording of the response of the groundwater system to natural and artificial conditions or recharge and discharge. Most of the State Governments have similar groundwater boards or agencies for surveying groundwater levels and their periodical reports provide information upon declining groundwater levels.

Sowing and Crop Conditions

An important indicator of drought is the *total area sown*. The State Government agriculture department provides information on sowing on a weekly basis. A delayed sowing shows rainfall deficiency and indicates the onset of drought. Reports on crop conditions also provide an indication of the severity of the drought situation. If the crops are wilting, it indicates soil moisture stress. A crop contingency plan and other mitigation measures are implemented based on reports prepared for all the crops sown during the monsoon.

Weekly Information on the area under sowing and crop-wise sowing can be provided in Form No. 3. and Form No. 4 respectively. These forms are included in the **Annex 1**.



Source: Wasteland Atlas of India

Developing a Composite Index

While the Government of India and State Governments use the key indices mentioned in the previous chapter for drought management, the scientific community uses a number of indices to measure the intensity, duration, and spatial extent of drought. It is useful to also refer to these scientific indices for monitoring drought situation at the National and State levels.

Aridity Anomaly Index

The IMD has developed an Aridity Anomaly Index based on rainfall, potential evapotranspiration and actual evapotranspiration, taking into account soil moisture conditions and using the water budgeting method. Aridity anomalies are worked out based on this index and these anomalies are classified into various categories of arid conditions- — *Mild Arid* (aridity anomaly 1–25%), *Moderate Arid* (aridity anomaly 26–50%), and *Severe Arid* (aridity anomalies more than 50%). These anomalies are used for near real-time monitoring and assessment of agricultural droughts across the country at weekly/fortnightly intervals. This indirectly helps to assess the moisture stress experienced by growing plants.

Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is a relatively new drought index based only on precipitation. The SPI assigns a single numeric value to the precipitation, which can be compared across regions and time scales with markedly different climates. This spatial and temporal flexibility allows the SPI to be useful in both short-term agricultural and long-term hydrological applications. Since the SPI expresses the possibility of simultaneously experiencing wet conditions on one or more time scales and dry conditions at other time scales, it is often a difficult concept to convey in simple terms to decision-makers.

Palmer Drought Severity Index

Palmer Drought Severity Index (PDSI) indicates standardized moisture conditions and allows comparisons to be made between locations and months. PDSI varies roughly between –6.0 and +6.0. More wet conditions are indicated by positive values of PDSI,

while more dry conditions show negative values. Thresholds for classification of wetness are arbitrary. PDSI values between –2 and +2 would indicate normal conditions, although the sub-range of –1 to –2 could also be treated as *mild drought*. PDSI values in the range of –2 to –3 are indicative of *moderate drought*, –3 to –4 indicate *severe drought* and values below –4 would be associated with *extreme drought*.

PDSI values are normally calculated on a monthly basis. Further interpretation of monthly PDSI allows drought duration to be taken into account as well. A drought sequence is interpreted as a sequence of 3 or more consecutive months with a PDSI value $\leq$ –2.0. A series of 6 or more months is a major drought event. The end of a drought sequence is taken as the last month where the PDSI is $\leq$ –2.0.

Crop Moisture Index

The Crop Moisture Index (CMI) complements the PDSI. It measures the degree to which crop moisture requirements are met, is more responsive to short-term changes in moisture conditions and is not intended to assess long-term droughts. CMI is normally calculated with a weekly time step and is based on the mean temperature, total precipitation for each week and the CMI value from the previous week. For each growing season, CMI typically begins and ends near zero. It is, in principle, possible to use a combination of PDSI and CMI for drought monitoring, where PDSI would serve as a long-term drought-monitoring tool and the CMI may indicate the progression of seasonal water shortages during a crop growing stage.

Surface Water Supply Index

The Surface Water Supply Index (SWSI) integrates reservoir storage, streamflow, and two precipitation types (snow and rain) at high elevations into a single index number. SWSI is relatively easy to calculate and it gives a representative measure of water availability across a river basin or selected region/province. It is, however, unlikely that it could be successfully used for large regions with significant spatial hydrological variability: the weights may differ substantially from one part of the region to another.

Normalized Difference Vegetation Index

Normalized Difference Vegetation Index (NDVI) is based on the concept that vegetation vigour is an indication of water availability or lack thereof. It shows us the effects of climate on vegetation in terms of its absorptive capacity in visible light but little in the near-infrared. The difference of visible and near-infrared reflectance represents photosynthetically active vegetation; this information is used to construct a *vegetation*

index. The lowering of the vegetation index indicates moisture stress in vegetation, resulting from prolonged rainfall deficiency. High NDVI values might reflect ideal climate growing conditions so that vegetation greenness is higher than encountered in other years.

Normalized Difference Wetness Index

Normalized Difference Wetness Index (NDWI) is expected to give the vegetation or crop turgidity and health. It is based on the use of Shortwave Infrared (SWIR) band, which is sensitive to moisture available in soil as well as in crop canopy. In the beginning of the cropping season, soil background is dominant which makes SWIR sensitive to soil moisture in the top 1-2 cm. As the crop progresses, SWIR becomes sensitive to leaf moisture content. NDWI using SWIR can complement NDVI for drought assessment particularly in the beginning of the cropping season. Higher values of NDWI signify more surface wetness.

Effective Drought Index

Unlike many other drought indices, the Effective Drought Index (EDI) in its original form is calculated with a daily time step. EDI is a function of precipitation needed for a return to normal conditions (PRN). PRN is precipitation, which is necessary for the recovery from the accumulated deficit since the beginning of drought. PRN, in turn, effectively stems from daily effective precipitation (EP) and its deviation from the mean for each day.

Moisture Adequacy Index

The Moisture Adequacy Index (MAI) is obtained from weekly water balance. Drought impact is related to moisture availability at certain crop growth stages. Hence, categories of MAI (severity) at different growth stages are integrated into a single index value to identify drought impact on a particular crop. The Central Arid Zone Research Institute (CAZRI), Jodhpur monitors agricultural drought in the Indian arid regions by using MAI.

Drought Monitoring Checklist

(For Ministry of Agriculture, Government of India
and Relief Commissioner, State Governments)

Meteorological Data:

Agencies: India Meteorological Department, National Centre for Medium Range Weather Forecasting, State Governments

Indices to be Monitored: Daily, weekly, and monthly rainfall, snow fall / fog

Hydrological Data:

Agencies: Central Water Commission, Central Ground Water Board, State Governments (irrigation departments, groundwater agencies, water resources departments/ projects)

Indices to be Monitored: Water storage in reservoirs / ponds / lakes, river flow, groundwater level, yield and draft from aquifers, water loss through evaporation, leakage, seepage.

Agricultural Data:

Agencies: National Crop Forecasting Centre, Directorate of Economics & Statistics, Indian Council of Agricultural Research, Agricultural Census Data, State Government agriculture departments, agricultural universities

Indices to be Monitored: Soil moisture, area under sowing and type of crop, crop water requirement, status of growth, crop yield, alternative cropping possibilities, Land holdings

Data from Space:

Agencies: National Remote Sensing Centre

Indices to be Monitored: Vegetation monitoring, rainfall, surface wetness and temperature monitoring

Socio-economic Data:

Agencies: Planning Commission, Department of Food & Public Distribution, Department of Cousumer Affairs, Department of Rural Development. Ministry of Women and Child Development Department, of Animal Husbandry, Dairying & Fisheries, Revenue Department of state etc.

Indices to be Monitored: Availability and prices of foodgrains, availability of fodder, migration of population, distress sale of assets, vulnerable areas / population

Analysis of Data from Ground and Remote Sensing Sources

Prediction/ Forecasting / Declaration of Drought on the basis of Available Data

Section - 3

Drought Declaration

Objectives:

- Key Index 1: *Rainfall Deficiency*
- Key Index 2: *Area under Sowing*
- Key index 3: *Normalized Difference Vegetation Index*
- Key index 4: *Moisture Adequacy Index (MAI)*
- Other Factors for Consideration

Drought declaration signifies the beginning of Government response to a drought situation. Drought declaration should be a timely step so that relief assistance and other concessions can be provided to the drought-affected people at the right time. Traditionally in India, Collectors recommend the declaration of drought only after crop production estimates are obtained through the annewari / paisewari / girdawari system (this system provides an estimate of agricultural losses, which could be used as an indicator of drought). Generally, areas with less than 50% annewari / paisewari / girdawari are considered to be affected by a drought.

Final annewari / paisewari / girdawari figures for kharif crops are available only in December, while those for rabi crops are available in March. The Government of India sends a team only after drought is declared and Memorandum is sent by State Governments to assess the requirement for relief and release assistance from the NCCF. If drought is declared in January or February, the team would visit much after the crop is harvested and thus cannot assess crop losses.

However, it is not necessary to wait until the finalization of annewari / paisewari / girdawari figures for drought declaration. There are other indicators for drought, the most important being rainfall deficiency. Besides, in a number of States, the system of annewari / paisewari / girdawari arrived through crop-cutting experiment does not exist.

Information on crop-wise productivity at Taluka / Tehsil / Block / District level can be provided in Form No. 5. Information on damage to crops due to drought and Annewari / Paisewari / Girdawari can be provided in Form Nos. 6, 7 and 8.

Information on normal and actual rainfall and the number of agricultural labourers, small and marginal farmers and DPAP / DDP blocks at the level of district can be provided in Form No. 9. These forms are included in **Annex 1**.

The indicators and indices discussed in the previous section while relevant for drought declaration reflect advances in technology for monitoring drought. These have their limitations too, which arise from poor availability and reliability of data. It is clear that no one indicator or index is adequate for monitoring drought at the State level; instead, a combination of indicators and indices needs to be used for drought declaration.

On the basis of wide-ranging consultations with the meteorologists and agriculture scientists, ***rainfall deficiency, the extent of area sown, normalized difference vegetation index and moisture adequacy index are recommended as the four standard monitoring tools which could be applied in combination for drought declaration. Since the information on these indicators and indices are available at the level of Taluka / Tehsil / Block, drought may be declared by the State Government at the level of***

these administrative units on the basis of observed deficiencies.

At least three indicators or index values could be considered for drought declaration. It is recommended that these new standards / guidelines should replace the present system of drought declaration that is based on rainfall deficiency and reduction in annewari / paisewari / girdawari figures. The application of these indicators and indices are discussed in key- Indexes 1-4, given in succeeding pages.

Key Index 1: *Rainfall Deficiency*

Rainfall is the most important indicator of drought. A departure in rainfall from its long-term averages should be taken as the basis for drought declaration. The IMD can provide rainfall data to the State Government, which can also collect data through its own network of weather stations.

This rainfall data may be applied in two ways:

1. The State Government could consider declaring a drought if the total rainfall received during the months of June and July is less than 50% of the average rainfall for these two months and there is an adverse impact on vegetation and soil moisture, as measured by the vegetation index and soil moisture index. Such a rainfall deficit would cause so much damage to agriculture that it would be difficult to revive crops.
2. The State Government could consider declaring a drought if the total rainfall for the entire duration of the rainy season of the state, from June to September (the south-west monsoon) and or from December to March (north-east monsoon), is less than 75% of the average rainfall for the season and there is an adverse impact on vegetation and soil moisture, as measured by the vegetation index and soil moisture index.

Rainfall data are easily available (through the weather observatories of the IMD and State Government) and simple to apply. However, it is necessary for the State Government to standardize rainfall for all the Talukas / Tehsils / Blocks for each month and the entire rainy season.

Key Index 2: *Area Under Sowing*

Sowing is another important indicator of the spread and severity of drought. Sowing operations are linked to rainfall and availability of water. Mostly farmers undertake sowing operations at the commencement of the monsoon. If sowing fails due to water stress, farmers sow a second or even a third time. The *area under sowing* provides reliable information on the availability of water for agricultural operations.

Drought conditions could be said to exist if the total sowing area of kharif crops is less than 50% of the total cultivable area by the end of July / August, depending upon the schedule of sowing in individual states. In such situations, even if rainfall revives in the subsequent months, reduction in the area under sowing cannot be compensated for and the agricultural production would be substantially reduced. The State Government should therefore consider declaring a drought if along with the other indicators, the total area sown by the end of July / August is less than 50% of the total cultivable area.

In case of Rabi crops, the declaration of drought could be linked to the area of sowing being less than 50% of the total cultivable area by the end of November / December along with the other indicators.

The agriculture department(s) in the State Government(s) provides data on crop-wise sowing operations; generally available for all the Talukas / Tehsils / Blocks and is compiled for all the districts in a State.

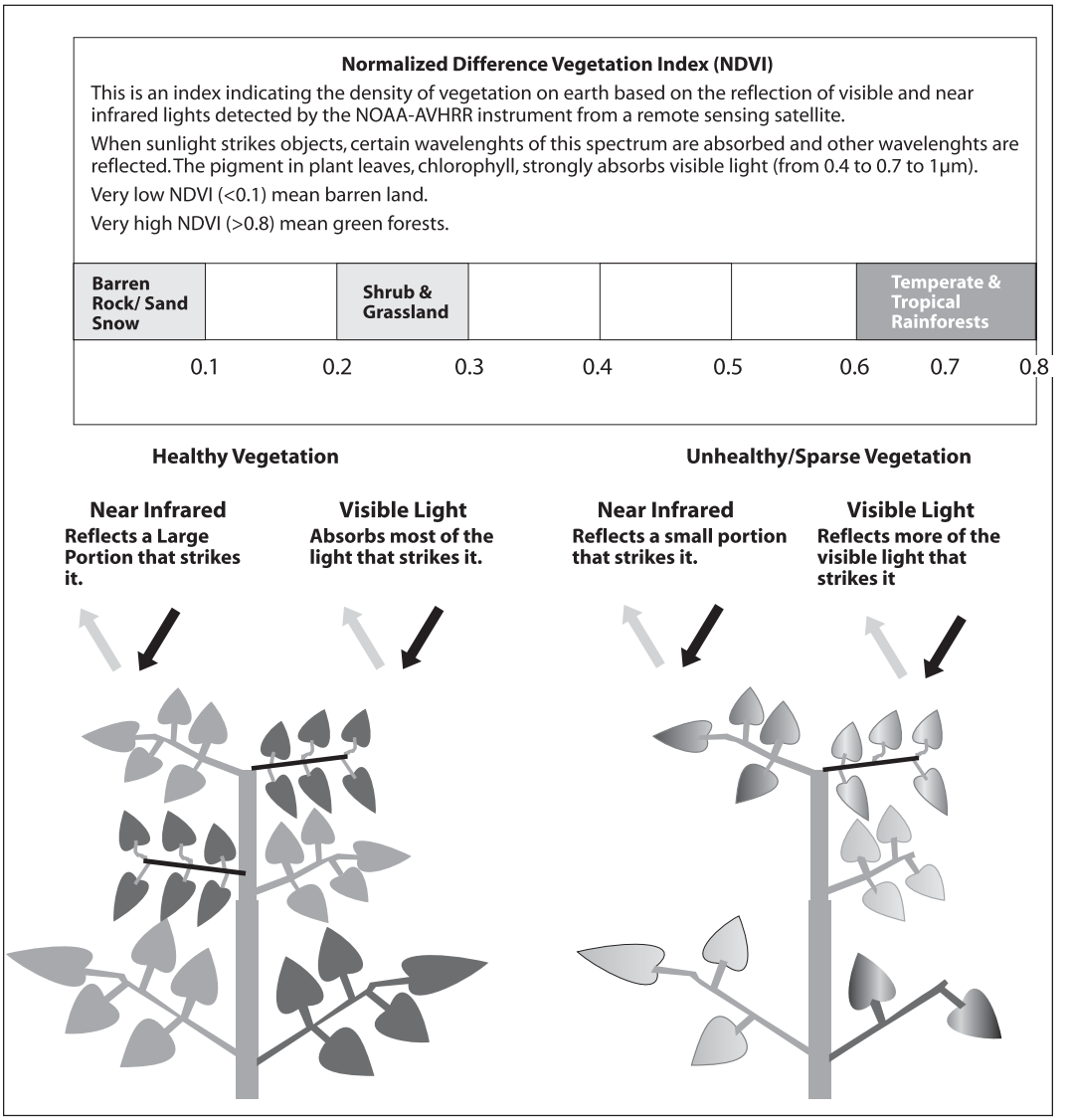
Key Index 3: *Normalized Difference Vegetation Index*

The National Agricultural Drought Assessment and Monitoring System (NADAMS), instituted by the National Remote Sensing Centre (NRSC), issues a bi-weekly drought bulletin and monthly reports on detailed crop and seasonal condition during the kharif season. These present the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Wetness Index (NDWI) from the data obtained from National Oceanic and Atmospheric Administration-–Advanced Very High Resolution Radiometer (NOAA-AVHRR) and Indian Remote Sensing (IRS) satellite Wide Field Sensor (WiFS) data. These reports provide quantitative information on sowings, surface water spread and District / Tehsil / Taluk /Block level crop condition assessment along with spatial variation in terms of maps. At present, 11 agriculturally important and drought-vulnerable States of Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu and Uttar Pradesh are covered through these reports.

The values obtained for a given NDVI always ranges from –1 to +1. A negative number or a number close to zero means no vegetation and a number close to +1 (0.8-–0.7) represents luxurious vegetation shown in the figure 5 below.

For declaring drought, States need to obtain NDVI values through the NADAMS. All the above-mentioned States receive NADAMS reports on a regular basis. Those States which do not receive the report could approach the NRSC for receiving the information. **It is necessary that the States declare drought only when the deviation of NDVI value from the normal is 0.4 or less**. **However, the NDVI value needs to be applied in conjunction with other indicators and values.** The NDVI must not be invoked for the declaration of drought in isolation from the other two key indicators.

Figure 5: *Normalized Difference Vegetation Index (NDVI)*



Key Index 4: *Moisture Adequacy Index*

Moisture Adequacy Index (MAI), which is based on a calculation of weekly water balance, is equal to the ratio (expressed as a percentage) of Actual Evapotranspiration (AET) to the Potential Evapo Transpiration (PET) following a soil–water balancing approach during a cropping season. MAI is obtained by using the following equation:

MAI = AE/PE

where, AE is actual evapotranspiration and PE is potential evapotranspiration (in %) during different phonological stages of a crop.

Water balance calculation takes into account the soil characteristic, crop growth period and water requirements of major crops. Drought is specified crop-wise on a real-time basis. MAI values are shown in table 10 below.

Table 10: *Agricultural Drought Code*

(Based on Moisture Adequacy Index)CAZRI
(Based on Moisture Adequacy Index)

AE/PE (%) during different phenophases	Drought intensity	Phenophase G wise Code		
		Seeding (S)	Vegetative (V)	Reproductive (R)
76 to 100	No drought	S_0	V_0	R_0
51 to 75	Mild Drought	S_1	V_1	R_1
26 to 50	Moderate drought	S_2	V_2	R_2
25 or less	Severe drought	S_3	V_3	R_3

Intensity of Agricultural Drought

Sr. No.	No drought	Mild	Moderate	Severe
1	$S_0V_0R_0$	$S_0V_0R_2$	$S_0V_0R_3$	$S_0V_2R_3$
2	$S_0V_0R_1$	$S_0V_1R_2$	$S_0V_1R_3$	$S_0V_3R_2$
3.	$S_0V_1R_0$	$S_0V_2R_0$	$S_0V_2R_2$	$S_0V_3R_3$
4	$S_1V_0R_0$	$S_0V_2R_1$	$S_0V_3R_0$	$S_1V_2R_3$
5	$S_1V_0R_1$	$S_1V_0R_2$	$S_0V_3R_1$	$S_1V_3R_3$
6	$S_1V_1R_0$	$S_1V_1R_1$	$S_1V_0R_3$	$S_0V_2R_3$
7	$S_0V_1R_1$	$S_1V_1R_2$	$S_1V_1R_3$	$S_2V_0R_3$

Source: Vittal, Kar, and Rao, CAZRI

MAI values are critical to ascertain agricultural drought. The State agriculture department needs to calculate the MAI values on the basis of data available to it and provide it to the Department of Relief and Disaster Management, which would ascertain that MAI values conform to the intensity of moderate drought as shown in the table above before drought is declared. As mentioned above, MAI values need to be applied in conjunction with other indicators such as rainfall figures, area under sowing, and NDVI values.

Other Factors for Consideration

Along with these indicators/indices, the State Government should also take following factors into consideration:

- Extent of fodder supply and its prevailing prices compared to normal prices;
- Position regarding drinking water supply;
- Demand for employment on public works, and unusual movement of labour in search of employment;
- Current agricultural and non-agricultural wages compared with normal times;
- Supply of foodgrains, and price situation of essential commodities

It is necessary to declare drought through a *formal notification* for the drought response measures to commence. The notification needs to be taken out at the State level, identifying districts and Talukas affected by drought. At the district level, the Collectors need to notify the talukas/mandals/villages in each of the Talukas affected by drought. The forms for the notification of drought-affected areas are provided in the **Annex 3**.

The State Government is responsible for declaring drought. Collectors can notify drought only after the State Government declares drought in the State or parts thereof.

Ideally, States should declare drought in October. The monsoon is over by this month and figures for total rainfall are available in this month. Similarly, a final picture regarding the crop conditions as well as the reservoir storage is available by the end of October. It provides adequate time for the central team to visit the State and assess the crop losses. **For the States that receive rains from the north-east monsoon, drought declaration should be done in January**. However, if the situation so warrants, such a declaration could be made earlier as well.

After drought is declared, , if the funds available under the Calamity Relief Fund (CRF) are inadequate for meeting relief expenditures, the State Governments may consider submitting a Memorandum for assistance from the National Calamity Contingency Fund (NCCF). The procedure for requesting assistance from the NCCF is explained in the chapter on *financing relief expenditures*. Guidelines for the preparation of Memorandum is included in **Annex 4**.

Section - 4

Drought Relief

Objectives:

- Contingency crop planning
- Relief Employment
- Water Resource Management
- Food Security
- Gratuitous Assistance
- Relief through Tax Waivers and Concessions
- Cattle Camps and Fodder Supply
- Health and Hygiene
- Institutional Response
- Financing Relief Expenditure
- Information Management and Media Coordination
- Drought Preparedness and Response Checklist

Following drought declaration, planning and implementation of drought relief and response measures is initiated. It is necessary that these measures are undertaken promptly, so that it would mitigate the hardships faced by the people. Though these measures are sector-specific, they require immense inter-departmental coordination. Implementing these measures would require a continuous flow of information from the village-level to the highest level of decision-making in the State and a responsive administrative structure. It would also require careful financial planning so that the implementation of these relief measures could be undertaken on a sustained basis.

This section discusses sector-specific drought relief and response, identifying lead and support agencies and detailing the measures that need to be taken. It also includes a section on institutional response and financing relief expenditure. A checklist for the Relief Commissioner and District Collectors has been provided at the end of this section.

Drought relief and response measures need to be planned and implemented as soon as the distress signs of drought are visible. These measures need not be linked to a formal drought declaration, which is necessary only for providing certain tax waivers and exemptions. Also, a Memorandum to the Government of India needs to be submitted only after the declaration of drought. All other measures could, therefore, be planned and implemented before drought declaration.

The State Government should direct all the districts to prepare a contingency plan for drought management as soon a drought situation arises. Such a contingency plan should include all the measures listed in each of the sector-specific responses. The local details may vary in these contingency plans. For example, certain States may prefer setting up fodder depots rather than cattle camps. It is necessary to evolve a consensus at the district level for implementing the contingency plan and seek a wider participation of the civil society.

Contingency Crop Planning

Lead Agencies: Ministry of Agriculture, Government of India, Indian Council of Agricultural Research (ICAR), State Government agriculture departments and agricultural universities. These agencies need to prepare the contingency crop plan and disseminate it among farmers with the help of support agencies, mentioned below.

Support Agencies: State relief / disaster management department, irrigation department, water conservation department, State electricity companies, cooperative banks.

Objectives: The objective of a contingency crop plan is to provide other cropping options to the farmers that can withstand drought conditions. The alternative crop planning involves choosing suitable crops and/or crop varieties, alternative crop strategies, mid-season corrections and crop life-saving measures.

The crop contingency plans should

- be prepared well in advance before the start of kharif and rabi crop seasons. The State Government should prepare the contingency plan in consultation with the Ministry of Agriculture, Government of India and other expert agencies. This would require data inputs from the meteorological, agricultural and hydrological communities.
- be prepared agro-climatic region wise and separate plans laid down for all the three early-, mid- and late-season agricultural droughts.
- be revised every two to three years to take advantage of release of new crop varieties and to utilize the advances made in agricultural production technology.
- be activated based on assessment of type of drought received from early warning and forecasting systems and / or based on reports received from District Collectors.
- promote short duration and less water-intensive crops. Instead of crops like paddy and sugarcane, which consume a lot of water, alternate crops such as maize, pulses, groundnut, sunflower, soyabean, fodder, and vegetables could be grown (table 11).
- advocate crop diversification, mixed / inter-cropping of main crop with drought tolerant companion crop, thinning of plant population, weed management, mulching for soil moisture conservation and drip / spray irrigation.

- Prepare agro-advisory bulletins based on crop contingency plans and widely disseminate them among farmers in drought-affected region.

Table 11: *Crop Contingency Plan*

Crops Affected due to Inadequate Rains	Alternate Crops
Paddy	Gram, pulses, oilseeds, and fodder
Maize	Pulses and oilseeds
Cotton	Soyabean and pulses
Sugarcane	Pulses, fodder

Crop contingency plan during the kharif season is usually constrained by

- Uncertainty of climate behaviour during the kharif season; and
- Lack of lead-time causing logistical problems in organizing delivery of agricultural inputs.

There is a need to utilize spatial and temporal information (table 12) on the pattern of monsoon variation from the past to improve the efficacy of contingency crop plans to minimize kharif crop losses.

It is necessary that the decision-makers get information on the likely monsoon behaviour even earlier than July to put contingency measures in place. While there are certain risks and uncertainties to respond to anomalous weather conditions in July, the confidence level for crop planning increases during pre-rabi and more certainly during rabi seasons. Better information on the extent of soil moisture and reservoir water levels can help the State Governments in issuing advisories for crop planning.

Table 12: *Temporal and Spatially Differentiated Contingency Crop Plan*

Season	Kharif	Pre-rabi	Rabi
Information Application Potential			
Crop Calendar	May–October	September-October	November–April
Availability of Climate Information	Unlikely	Likely	More Likely
Farming System Type	Rainfed	Rainfed and Irrigated	Irrigated
Regions	Northwest India	Central India	East India
Lead Time Required by Farmers	By June last week/ July 1st week	Mid-August	Mid-September

Source: Drought, 2002. Ministry of Agriculture, Government of India

State Governments need to undertake intensive campaigns through mass media (such as radio, TV, newspapers) for spreading information on the contingency cropping plan. Posters and pamphlets should be published and distributed for educating the farmers about the need to change their crop plan. Water-user associations and self-help groups should be used for disseminating information on mid-season corrections and crop-life saving measures.

Support to Farmers

To undertake alternative cropping, farmers require additional public support (inputs, credit and extension) at higher than existing levels in a timely way, as mentioned below:

When a crop contingency plan is implemented, particularly during the kharif season, the lead time is very little. Farmers, therefore, need to be supported in a number of ways on an urgent basis:

- **Agriculture Input Support**: Farmers in drought-affected areas need to be provided with input subsidy of seeds and fertilizer for second sowing or planting alternative crops. Farmers can be given cash assistance or agricultural inputs. The assistance needs to be timely, so that farmers could utilize it for their agricultural operations.
- **Energy Support**: Farmers need to be provided assured power supply for a minimum of eight hours to irrigate their lands. If drought is declared, the farmers could be given certain concessions in electricity charges through Government support. Inadequate and uncertain power supply would only aggravate the agrarian situation.
- **Extension Support**: The State department of agriculture and agricultural universities should provide extension services. These need to be organized extensively, so that farmers can be advised on crop variety, selection of seeds, soil and water conservation measures, contingency crops and cultivation methods.

Relief Employment

Lead Agencies: Ministry of Agriculture and Ministry of Rural Development, Government of India, State Government departments of revenue, relief and rehabilitation, and rural development, the district administration

Support Agencies: State Government departments of irrigation, public works and water conservation

Objectives: The most important relief component is the generation of employment provision during the drought period. Due to drought, agricultural operations are reduced substantially, restricting the scope of seasonal employment. People look for alternative employment, or migrate elsewhere for employment. As soon as drought is declared, it is, therefore, necessary for the State Governments to immediately start relief employment programmes and provide work to those who need employment within a radius of five kilometers. Income generation through these employment works helps participating workers to meet their basic needs. The Government of India is required to support these relief employment programmes with cash assistance and release of foodgrains.

Most State Governments have their own food for work programme. The Government of India has started the National Rural Employment Guarantee Scheme (NREGS), providing 100 days of employment to one person per family on demand. The scheme has been extended to the entire country. A large number of public works and watershed programmes could be supported through the NREGS. These programmes together can create substantial employment to tide over the hardship and deprivation caused by drought.

The National Rural Employment Guarantee Scheme

The NREGS has been formulated through a Parliament Act in 2005. As per the provisions of this Act, the scheme provides a legal guarantee for one hundred days of employment in every financial year to adult members of any rural household willing to undertake manual work for creation / development of public assets at the statutory minimum wage.

This scheme is aimed to provide employment and generate income for the rural poor. Roughly one-third of the stipulated work force must be women.

The Government of India will meet the cost towards the payment of wage, 75% of the cost of materials and a certain percentage of administrative cost. The State Government will meet the cost towards unemployment allowance, 25% of material cost and administrative cost of State council.

Adult members of rural households submit their name, age and address with photo to the Gram Panchayat. The Gram Panchayat registers households after making enquiry and issues a job card. The job card contains the details of adult member enrolled and his /her photo. Registered person can submit an application for work in writing (for at least fourteen days of continuous work) either to the Panchayat or Programme Officer.

The Panchayat/ Programme officer will accept the valid application and issue a dated receipt of application; the letter providing work will be sent to the applicant and also displayed at the Panchayat office. Employment will be provided within a radius of 5 km: if it is above 5 km extra wage will be paid.

If employment under the scheme is not provided within fifteen days of receipt of the application daily unemployment allowance will be paid to the applicant.

The scheme which started in February 2006 in 200 districts has been expanded over the years to cover the entire country.

As soon as drought is declared in a State, the State Government must assess the total requirement of employment during the period of drought. Such planning should be based on the number of households affected by drought and their dependence on agriculture for their livelihoods. The State Government needs to pool resources through different programmes for creating the required level of employment.

The State Relief Commissioner needs to prepare a plan, in consultation with all the departments responsible for labour-intensive works, for providing relief employment to the people at the State level. The Relief Commissioner must prepare a financial plan for meeting the expenditure incurred on relief employment works through different sources.

Relief programmes supported through the Calamity Relief Fund (CRF) or NCCF are generally inadequate to meet the needs of employment. The NREGS also restricts employment to one member per family or / and a specified number of days (100 days in a year in the case of NREGS). It is thus necessary that the State Government combines other development schemes, such as water conservation programmes with relief employment programmes. It would increase the availability of funds for relief and generate employment for a larger workforce or greater number of days. These works can be started under Integrated Watershed Management Programme (IWMP) following programmes:

The departments responsible for the implementation of these programmes need to start works under these programmes in drought-affected areas to maximize the number of people employed. If there is a need to relax certain provisions of these programmes for increasing the workers' attendance under these programmes, the State Government should make such relaxations.

Local Area Development (LAD) programmes for the Members of Parliament and Members of State Legislature can provide resources for relief employment. Further, large-scale employment can be generated through the State irrigation department. Works on canal excavation and minor irrigation projects can be started through which a large number of people can be provided with gainful employment.

The State Governments need to issue a detailed set of guidelines and directives to the district administration for commencing relief employment programmes. The district administration needs to be given all the authority and flexibility within the framework of these guidelines for implementing relief employment programmes.

At the district level, the Collector of a drought-affected district is required to prepare a district plan for relief employment, specifying the types and number of works to be taken in different pockets of the district and the total employment these works would generate.

The district administration must provide employment to people as soon as there is a demand for employment with minimum delay. While planning, it is necessary that people get employment within 1.5–5 kilometers of their residence.

The Collector should direct all technical departments to identify feasible works in all the drought-affected villages and prepare estimates for these works and provide technical sanction to these works. The Collector should prepare such a plan in consultation with all the technical departments and provide administrative and financial approval for all the works included in the plan.

The relief employment plan prepared by the District Collector should be submitted

before the District Disaster Management Committee (DDMC) or the District Relief Committee (DRC). The DDMC / DRC should approve the plan and authorize all the technical departments to start these works.

The district administration needs to keep an adequate number of works on a "shelf" so that these works can be started as soon as the demand for employment in a certain area arises. All the line departments need to be in readiness for starting these works. They need to reassign their staff and keep the equipments in readiness for starting these works. Where tools and equipment are not adequate for starting these works, the line departments need to procure them, with a defined responsibility for their safe storage.

The Collector must conduct regular meetings of all the technical departments responsible for implementing relief employment programmes. The works in progress, attendance on these works, administrative and technical issues, wage payment and release of foodgrains to the workers are issues that need to be reviewed in these meetings.

The Collectors should be authorized to redeploy technical and administrative staff within the district for implementing and supervising these works in consultation with regional heads of these departments. In such instances, where the relief works have started on a large-scale, the Collectors can request the State Government to post additional officers on a temporary basis. Collectors can be authorized to hire vehicles, provide daily allowance and get administrative support for facilitating the implementation and supervision of relief works. The Collectors need to invoke disciplinary powers for proceeding against officers found to be in dereliction of their duties in accordance with the Disaster Management Act.

In the course of implementing relief employment programmes, priority needs to be given to water conservation, harvesting works (such as check dams, gabion structures, percolation tanks), and minor irrigation works (such as tanks and farm ponds, canal excavation, community wells, nalla bunding, afforestation). These works are useful for enhancing the availability of water and agricultural production. Desilting and cleaning of canals, which is overdue on account of non-availability of resources for many years, is also helpful in supply of water to the tail-end users. Roads and metal breaking works should be taken up only when there is no scope for these productive works. For each State, these priorities may change as per the local situation. A discussion on the importance of these individual works for drought mitigation has been provided in the section on drought mitigation.

Along with the public works, it would be useful to undertake individual beneficiary

works as it creates durable assets, enhancing their sources of income. These include:

- Farm ponds
- New wells / deepening of wells / recharging of wells
- Horticulture / jatropha plantations
- Construction of new water channels / rain harvesting structures
- Sanitation latrines

The State Government should lay down the criteria for the selection of beneficiaries for taking up these individual beneficiary works. While sanctioning these works, technical and financial norms need to be fixed. For the payment of wages, the muster roll must be maintained.

In the tribal and hilly areas, the local conditions may not be conducive for large-scale employment. In such a situation, individual beneficiary works for tribals should be taken up. It should involve land development, plantations and afforestation, water conservation programmes, grass cutting and storage, construction of new farm ponds and wells and rural houses.

It is necessary that spill-over works taken in the previous years as drought relief works be taken up first. Works that can be completed or brought to a safe stage, can be next on the priority list. New works can be taken only where the spill-over plan works are not available. Only after these works are completed, should new works be taken up. A new work can be taken up for execution only after all preliminary steps, such as preparation of plans and estimates and technical sanction and administrative approval of the appropriate authority, are completed.

Collectors must report to the State Government of the number of works, the total attendance of workers, the total wages paid and the distribution of foodgrains on a weekly basis.

In the drought-affected areas, Gram Sabhas need to be convened in all the Gram Panchayats for discussing the drought situation. In the Gram Sabha, water use management, relief employment works, payment of wages, and provision of foodgrains need to be on the agenda for deliberations. Gram Sabhas can become an effective forum for conducting a social audit of drought relief operations and need to be held once a month.

While the district administration must strive to provide employment to all the able-bodied adult, men and women and there cannot be any discrimination in the provision of relief to the people, it must provide special attention to "below poverty line" families, landless labourers, and workers in the Scheduled Caste and Scheduled Tribe categories for their employment in public and individual beneficiary works.

Each worker should be issued a job card, which would help in closely monitoring the attendance on works, payment of wages and amount of foodgrains to each worker. The job card should be available to the Inspecting Officers at work sites. Under the NREGS, all participating families are given job cards. These job cards need to be extended to other relief employment programmes also.

The work hours may vary, depending upon the local conditions, such as climate and distance to work. However, the total number of working hours in a day should not exceed eight, including a lunch break of half an hour. All workers would be allowed one day of rest in a week, either on a Sunday or the local market day.

The State Government needs to lay down the wage policy for relief employment programmes. While all the State Governments are under obligation to pay statutory minimum wages, the payment of these wages need to be linked to the tasks performed by workers. It is necessary to ensure promptness and transparency in the measurement of these works and payment of wages to the workers.

The State Government needs to lay down the cash and foodgrains components of wages at the start. The ratio of cash to foodgrains could differ across programmes, but it is advisable that the same ratio be maintained for all relief employment programmes. The ratio can change, depending upon the availability of foodgrains. The provision of wages in cash and foodgrains need to be made in accordance with their share in the entire wage component.

Wages must be paid to the workers in accordance with the norms laid down for the NREGS. Officials need to make cash payments to the workers on the site. Where the workers have been asked to open bank accounts, particularly under the NREGS, the wages could be transferred to their bank accounts.

In case the State Government decides to distribute foodgrains as part of wages, food coupons may be issued to the workers. Each coupon should specify the quantity of foodgrains to be distributed per coupon. A detailed register should be maintained for the issue of food coupons, with the names of all the workers to whom the coupons have been released. It should be ensured that workers get foodgrains from the nearest available fair price shops under the Public Distribution System. It is necessary to check that the foodgrains are available in these shops before coupons are issued. The issue of coupons and provision of foodgrains through the fair price shops need to be monitored by an officer specially assigned for this purpose for each Taluka.

The district administration should consider setting up labour camps, when there is a large concentration of labourers. The site for such a labour camp should be selected with special regard to sanitation. Provision should be made for the supply of clean

drinking water, cheap grain shops, sanitary arrangements, crèches for children, schools for the children of these workers and other amenities. A mobile heath team should visit these relief works on a regular basis. However, labour camps should be organized only when it is not possible to provide them works within a radius of 5 km from their homes.

Engagement of pregnant women and children in relief works should be prohibited, and they should be provided with gratuitous relief. Similarly, sick and infirm people qualify for gratuitous relief and they should not be allowed to participate in these works.

Information on the number of people provided with relief employment under each scheme should be provided in the form prescribed for individual schemes such as the NREGS. However, information on the types of works, implementing agencies, and the total cost of relief employment can be submitted in Form No. 10 included in the **Annex 1**.

Water Resource Management

Lead Agencies: Department of Drinking Water Supply, Ministry of Water Resources, Ministry of Rural Development, Government of India, State Government departments of rural development, water supply, public health engineering, irrigation, and relief, as well as the district administration.

Support Agencies: Central Water Commission, Central Ground Water Board, Railways State Government groundwater survey and development agency, and water conservation / watershed development departments.

Objectives: Water resource management in the drought-affected areas is one of the most critical tasks of relief operations. Since water is a basic need for human and cattle population, supply of drinking water on a steady basis is the most important responsibility for the Government at all levels. It requires diverse measures such as augmentation of water supply, rationing of water use, and efficient utilization and management of water resources, in both urban and rural areas. Provision of water and its use is the most important yardstick for judging the effectiveness of relief operations.

Availability of water depends upon many factors, such as rainfall, the extent of percolation and groundwater recharge, water storage and water use. Areas with high rainfall may also experience severe scarcity of water if the run-off is very high and the level of percolation is poor. Shortage of water is one of the earliest indicators of drought, affecting the entire society, rural and urban. Assessing the demand for water and its total availability in a specific region, therefore, is extremely important for meeting the needs of different user groups.

Provision of Water

The first step involved in the water resource management process is estimating the demand for water. The district administration can undertake such an exercise on the basis of the consumption needs of the total population of the district and the demand for water from industrial, service and agriculture sectors. All the measures aimed at conserving and augmenting water supply could be organized only after estimating the total demand for water in the district.

The following measures need to be taken for managing the water situation in a drought-affected area:

Reservoir Management

- The Collector undertakes reservoir management with the help and support of the irrigation department. The irrigation department shall provide relevant information to the Collector in respect to storage of water in reservoirs and enforce his instructions regarding its distribution and use.
- As deficient or irregular rainfall may not replenish water storage in reservoirs to the full reservoir level (FRL), the Collector must decide the priorities in respect of water use available in reservoirs. The Collector must declare the reservation upon water storage in the reservoir.
- The State Government must declare the policy for laying down the priorities for use of reservoir storage. The first priority needs to be given to the provision of drinking water. According to this policy, the Collector must determine the quantity of water that is required to be reserved for drinking water purposes, and intimate the same to the concerned water supply / irrigation authorities. The Collector's order for water reservation for the purpose of drinking should be binding upon the water supply /irrigation authorities.
- As per the State policy, the Collector should, after taking into account the availability of water, decide upon other priorities: augmentation for the existing water supply scheme of any town, industrial and commercial use, power plants and irrigation.
- Water required to be supplied to a village or town for the purpose of drinking water should, as far as possible, be taken from the reservoir and conveyed to the village or town through a pipeline. Only in exceptional circumstances, such as where the village or town is situated within a short distance from the reservoir, the water could be released in the river.

Repairs and Augmentation of Existing Water Supply Schemes

- The State Government should issue special orders for repairs and augmentation of all the existing water supply schemes. This may include a piped water supply scheme, electrical pumps fitted on bore-wells, hand pumps, dug wells and any other source of drinking water.
- In repairs and augmentation of the existing water supply schemes, the Collector shall get assistance from the departments of water supply, public health engineering and rural development as the case may be. These departments will

provide necessary information regarding water supply to the Collector and implement his decisions.

- The Collector needs to prepare a Taluka-wise list of all the water supply schemes in the district which need repairs. The Collector can accordingly prepare a contingency plan, in consultation with the technical agencies and local bodies, which can provide the details of mechanical supervisors, mechanics and electricians and an inventory of spare parts and accessories. In those cases, where technically qualified people are not available with the Government agencies, they could be employed on a contract basis at the Taluka or village level.
- At the village level, it should be the duty of the Sarpanch or Gram Sevak, or any other functionary appointed for this purpose, to promptly report to the Tehsildar and Block Development Officer when any hand pump or power pump goes out of order. The Tehsildar and Block Development Officer, with the assistance of engineers of the relevant departments, should ensure that the hand pump or the electrical pump fitted on a bore-well is immediately repaired. In many cases where the repairs needed are major, a mobile repairs unit can be sent for carrying out the necessary repairs.
- When drought is declared, a district-level campaign should be organized for repairing all the hand pumps and electricity pumps fitted on bore-wells. The campaign would be more effective if it is supported by indenting in advance spare parts and accessories that would be required for carrying out necessary repairs to the pumps. For each hand pump and bore-well, a card can be maintained which records the visits of mechanics and electricians and the details of repairs that have been carried out.
- The village Panchayat has the overall responsibility for proper maintenance and timely repairs of the piped water supply. A levy and collection of water charges by the village Panchayat would support such repairs and maintenance. However, in a drought situation, village Panchayats can be given suitable grants by the district administration for meeting the expenditure on maintenance and repairs of the water supplies.
- The Collector should be provided funds for immediate repairs to water supply schemes, hand pumps, and bore-wells through the Calamity Relief Fund. These funds can be placed with the technical agencies for undertaking necessary repairs to these water supply schemes.

Special Measures and Schemes for Areas with Drinking Water Scarcity

- When there is inadequate rainfall, the Collector should direct the Tehsildar and Block Development Officers to visit the affected areas and draw up Taluka-wise lists of villages in which drinking water scarcity has already developed, or likely to arise. Such visits will always be undertaken with the engineers and officials of water supply, public health engineering, or rural development department, as the case may be. Such lists should be developed with maps indicating the location of villages, routes linking these villages and existing sources of water supply in these villages, such as piped water supply, bore-wells, or dug wells.
- The Collector would get the list of these problem villages counterchecked through the Sub-Divisional Officers and other district officers from the relevant departments. The Collector should also personally visit 5–10% of the villages for verifying the factual position related to availability of drinking water. The Collector should then finalize the list in consultation with the officials dealing with water supply and the State ground water survey and development agency.
- On the basis of this information, the Collector should prepare a contingency plan for provision of drinking water in all the villages that are likely to face a water scarcity. The contingency plan should lay down the priority for provision of drinking water as follows:
- Any piped water supply scheme, which is already under execution in any of these villages, should be completed expeditiously;
- Piped water supply, temporary piped water supply, or bore-wells already constructed in any of the villages which are non-functional should be made functional by undertaking necessary repairs or renovation;
- The responsibility for maintaining of hand pumps or electrical pumps fitted on bore-wells in the village should be assigned to the village Panchayats. If an existing bore-well can provide enough water to the village by installation of a power pump, then the district administration should take emergent measures to get the power pump installed;
- The feasibility of a new bore-well in the village should be assessed with the help of State ground water survey and development agency. Where feasible, a programme installing new bore-wells could be taken up. Care should be taken to avoid deep bore-wells as they damage aquifers.
- If any of the above mentioned measures are not feasible, emergent measures such as desilting, deepening, or blasting of existing wells, or construction of open wells in river beds can be undertaken, as suggested in the section on Other Emergency

Measures for Supply of Drinking Water.

- If the district administration assesses that these sources of water would not be sufficient to meet the drinking water needs of a village, they can arrange to provide drinking water through tankers or bullock carts, as suggested in the section on Supply of Water through Tankers and Bullock Carts.

Construction of Temporary Piped Water Supply

- The State Government should decide to construct temporary piped water supply in a village, if the following conditions are fulfilled:
  - No source of drinking water supply is available or is likely to be available within a distance of 0.5 kilometre of the village;
  - No possibility of constructing a new bore-well at the village or within a distance of one kilometre of the village or to undertake further drilling in the existing bore-well at the village, due to non-availability of groundwater source at the village;
  - Where at the source, water supply at the rate of 40 litres per day per head would be available for the projected population of the village;
  - Where the supply is based on a private source of water, e.g. a private well, it is ensured that the source is adequate to last until the summer season is over and the drinking water scarcity abates;
  - Where, the average per head expenditure of the supply shall not exceed a certain amount to be fixed by each State Government.
- The Collector should fix the agency for commissioning temporary water supply in consultation with the department of water supply, public health engineering, or rural development department, as the case may be. It could either be implemented by the agency responsible for water supply in the State or a local body.
- Each State Government should assign powers of technical and administrative approval of the temporary water supply schemes to authorities at different levels, within certain financial limits.The level of approvals would go up if the cost increases and when a certain amount is exceeded, new water supply schemes would be approved only by the State Government.
- All temporary water supply schemes would be handed over to the village Panchayat for maintenance. Such a scheme can be taken for execution only when the village Panchayat passes a resolution to take over the scheme and maintain it after its completion.

Construction of Bore-wells

- A bore-well programme can be taken up in a village, which is facing or is likely to face drinking water scarcity, if it is technically feasible to construct bore-wells at such a village. Sites for bore-wells can be selected on the basis of recommendations made by the State ground water survey and development agency.
- Bore-wells with a hand pump fitted thereon can be set up for a population of 250. If the population exceeds 250, more than one bore-well can be installed to serve the village.
- The Collector can request the departments of water supply, public health engineering, or rural development department, as the case may be, to deploy drilling machines for installing bore-wells. Where it is necessary to obtain additional drilling machines, these can be obtained on hire from private owners.
- When a village has power supply, for a population of at least 500 one or more bore-wells having high yield power pumps may be installed only on one such bore-well for solving the problem of drinking water in the village.
- When a bore-well programme is undertaken in a village, it is necessary to take into account the cattle population of the village. Along with bore-wells, it would be necessary to provide water taps and troughs for the cattle.

Other Emergency Measures for Supply of Drinking Water

- The Collector should undertake emergency measures such as de-silting or deepening of existing public wells to increase the availability of water. Other measures such as in-well drilling, blasting and revitalization can also be attempted for augmenting the capacity of these wells. These measures need to be planned with the support of departments of water supply, public health engineering, or rural development department, as the case may be,
- Where no public well is available or is likely to be successful after taking such measures, the Collector may authorize and make available a private well on rent, if the owner of the well agrees to allow public consumption with no discrimination against any caste, creed or religion. In all the cases where a private well is being brought under use, the Collector should fix the rent for drawing drinking water and make the payment to the owner of the well and also make an announcement to this effect so that the owners of private wells come forward to offer their wells for supply of drinking water at a rent fixed by the district administration.
- Old wells that have fallen into disuse should be repaired for ensuring drinking water supply to the villagers if the State ground water survey and development

agency certifies that after carrying out the necessary repairs the well would provide adequate water supply. Before these old wells are used for drawing drinking water, it should be ensured that water is properly chlorinated, and a certificate obtained from the State health department stating that the water is fit for human consumption.

- Where the water in a river or stream gets scarce, holes could be dug in the beds of the stream or river. Where water has been impounded by putting a temporary bund, such holes could preferably be dug on the banks near the impounded water and the water is reserved in those holes for drinking purposes. This would provide practically filtered water to the villagers for the purpose of drinking.
- Where the water has sunk much below the bed, it may be necessary to sink concrete pipes in the holes dug in the bed so that water gets collected in the pipes and could then be used for drinking water purposes.
- When a certain area faces acute drinking water scarcity, it may become necessary to save and preserve water, particularly from small and shallow tanks, for drinking water purposes by controlling evaporation losses. Certain chemicals can be spread over surfaces of water storages, which would control evaporation. However, such a measure needs to be undertaken in consultation with the State health department. The district administration would be responsible for ensuring that chemicals used for controlling evaporation are safe and would not cause any health hazard to the people consuming such water.
- The details of expenditure on installation, augmentation and repairs to all water supply schemes and sources can be provided in Form No. 11, included in **Annex 1**.

Supply of Water through Tankers and Bullock Carts

- The Collector should take the decision to supply water through tankers or bullock carts to a village or town in the drought-affected area, where no other source of water supply is available. The Collector should decide after obtaining reports from Taluka / Block-level officials, which are counterchecked by Sub-divisional Officers. In such cases too, the Collector should decide to supply water by a tanker or bullock cart, where a permanent or temporary water supply system is under repairs, till the time these repairs are completed.
- While making the survey of villages for supply of water through tankers or bullock carts, it shall be obligatory for the departments of water supply, public health engineering or rural development department, as the case may be, to provide necessary technical, administrative and logistical help.

- The State Government should issue orders, authorizing the Collector to requisition Government tankers from all the departments for the supply of drinking water. It would be the responsibility of all the departments to provide tankers along with the services of a driver when the Collector makes a demand.
- If any of the tankers are in disrepair, it should be the responsibility of the officers of the concerned department to undertake necessary repairs to the tanker before making it available to the Collector.
- The Collector would first deploy Government tankers for the supply of drinking water.
- Private tankers can be hired only when Government tankers are not available or inadequate for ensuring uninterrupted supply of drinking water to the affected villages. The Collector should hire these vehicles by inviting tenders and fixing the rate for trips involving different distances. The Collector should issue instructions for the maintenance of logbooks of these vehicles, as payment to the owners of these tankers is to be made on the basis of entries in these logbooks. The operations of these tankers need to be regulated carefully. The Collector should discontinue the deployment of tankers immediately after local sources of water have been recharged or re-developed.
- Where water supply is being arranged through tankers or bullock carts, the Government should consider providing big storage tanks in villages or towns with a capacity of more than 5,000 litres, so that water wastage is minimized.
- In villages where roads are not motorable, it may be more convenient and economical to engage bullock carts for supplying water. The Collector should hire local bullock carts for supplying water. In all such cases, the Collector should fix the number of trips to be made by bullock carts and pay per trip to the bullock cart owner.
- In extra ordinary drought situation the drinking water requirement may also be arranged through Railways.
- Information on supply of drinking water through tankers and bullock carts can be provided in Form No. 12, included in **Annex 1**.

Food Security

Lead Agencies: Ministry of Consumer Affairs, Food and Public Distribution, Ministry of Agriculture, Ministry of Rural Development, Food Corporation of India, Government of India, State Government departments of food and civil supplies, rural development, and relief and rehabilitation, and the district administration
Support Agencies: Indian Railways, State Government departments of women and child, and education
Objectives: Food security is one of most important objectives of drought management. It is provided through food-for-work programmes, which are started by the State governments to provide relief employment. Wages on these relief employment works are paid in the form of foodgrains, on a full or partial basis. The distribution of foodgrains as wages works as a buffer against inflation, increases real wages, and ensures food security at the household level.

The Government of India has started the National Rural Employment Guarantee Scheme (NREGS), which has now been extended to all the districts across the country. This scheme guarantees employment opportunities in the rural areas by providing work that taps labour intensive community assets. It assures manual work to one person per family for a maximum of 100 days in a year.

Provision of Food

Foodgrains are provided through the Public Distribution System (PDS), which is operated under the joint responsibility of the Central and State Governments. PDS with a network of about 4.74 lakh Fair Price Shops (FPS) is one of the largest networks in the world.

In June 1997, a targeted PDS was introduced, which follows a two-tier subsidized pricing for people "Below Poverty Line" (BPL) and "Above Poverty Line" (APL). In the district, the entire FPS network runs under the direct control and supervision of the Collector.

Ensuring food security in the drought-affected areas requires the following actions to be taken with the support of State department of civil supplies:

- The Collector needs to assess the foodgrains requirement in the drought-affected

area on the basis of number of households, size of households, the population below poverty line and the local patterns of consumption.

- The Collector should exercise surveillance over prices of essential commodities. If the local prices of foodgrains increase, the Collector should bring it to the notice of the State Government.
- Wherever required, the Collector should take steps to prevent hoarding of essential commodities and prevent manipulation in prices through creation of artificial scarcities.
- The Collector should ensure the availability of foodgrains by starting relief employment works under the NREGS or any other food-for-work programme. Wages can be paid to the workers in the form of foodgrains.
- The Collector should request the State Government to allocate foodgrains for wage payment to the workers. The State Government would fix the ratio of foodgrains to cash for wage payment. The State Government can accordingly make a separate allocation of foodgrains for the wage component.
- The State Government should release foodgrains through the PDS. The Collector should in turn allocate foodgrains to the Fair Price Shop, located close to the work sites. Food coupons could be distributed among the workers, who can redeem them through the nearest Fair Price Shop (FPS).
- The State Government should request the Ministry of Agriculture, Government of India, to allocate foodgrains for the purpose of wage distribution. The Government of India could consider the allocation of foodgrains for this purpose on the basis of total attendance on relief employment works, shortage of agricultural production, and its likely impact on prices.
- If it is not necessary to start relief employment works, the State Government can increase the availability of foodgrains through releasing increased quantities through the PDS. It would mean greater availability of foodgrains per unit.
- Collector should ensure that Fair Price Shops are distributing foodgrains to the people in the drought-affected areas. There should be necessary vigilance against any diversion of foodgrains or its misutilization.
- In those places, where Fair Price Shops are not available, new ones for the distribution of foodgrains can be started through self-help groups or cooperatives or even village Panchayats.
- In remote and difficult to reach areas, mobile Fair Price Shops can be arranged. The schedule of movement of these mobile shops can be fixed and publicized.
- In the drought-affected area, the State Government should take a decision to

distribute foodgrains to the APL families at the same price as BPL families in view of all-pervasive hardship.

- The Collector should monitor the distribution of food coupons, the receipt of foodgrains in Government warehouses and distribution of these foodgrains to the FPS', on a regular basis.
- The Collector should monitor how much foodgrains the households are buying on their ration cards. Monitoring the sale of foodgrains through Fair Price Shops would provide patterns of needs and consumption at the community and household levels. The Collector can accordingly modify the allocation of foodgrains to these shops.
- Inspection of warehouses and Fair Price Shops should be intensified during the drought period. It would ensure the distribution of foodgrains to the people who are genuinely in need of such support.
- Information on the stock of foodgrains in the district and Taluka / Tehsil / Block can be provided in Form Nos. 13 and 14, included in **Annex 1**.

Nutrition Aspects of Food Security

The State Government should address the nutritional aspects of food security through schemes such as the Integrated Child Development Services (ICDS) and Mid-day Meals. The ICDS is implemented for pre-school children, while mid-day meal has recently been introduced for school-going children.

Integrated Child Development Services (ICDS)

The ICDS scheme was initiated in 1975 to improve the health and nutritional status of children in the 0–6 age-group by providing supplementary food and coordinating with State health departments to ensure the delivery of the required health inputs. It also provides food supplements to pregnant and lactating women. The type of food supplements in the ICDS programme varies widely, from ready-to-eat food to the supply of supplements cooked in Aanganwadis.

The ICDS programme is centrally sponsored. The centre bears the cost of maintaining the infrastructure, while the State bears the expenditure on the food component. The programme has expanded and central expenditure on the scheme exceeds Rs. 1,000 crores.

In a drought situation, the ICDS can be used as the main instrument for ensuring nutritional security among the vulnerable sections, which constitute bulk of beneficiaries under this programme even during 'normal times'. Under this arrangement,

ICDS centres / Aanganwadis register additional beneficiaries. The additional cost is a legitimate charge on relief expenditure.

The Government is seeking the services of self-help groups for providing supplementary food to Aanganwadis. During a drought situation, the role of self-help groups can be increased for monitoring the health and nutritional status of women and children. Wherever it is necessary to open additional Aanganwadis temporarily, the Government should sanction them and provide finances for these Aanganwadis through the relief funds.

Mid-day Meal Programmes

The National Programme of Nutritional Support to Primary Education commonly known as Mid-day Meals Scheme was launched in August 1995 as a 100% centrally funded scheme. The objective of this scheme is to give a boost to universalisation of primary education by increasing enrolment, retention and attendance and simultaneously improving the nutritional status of students in primary classes. During drought, it is necessary to increase monitoring of this scheme, as it is an important source of supplementary nutrition.

Community Kitchens

In drought situations where certain segments of people, such as the old, disabled, and women, are extremely distressed, the Collectors should start community kitchens, which could be run by the Government itself or through NGOs. These kitchens should be run only during the drought situation and need to be closed when the situation improves, either through provision of relief employment or improving the state of agriculture.

Gratuitous Assistance

Lead Agency: Ministry of Agriculture, Ministry of Home Affairs, Government of India, State Government department of relief and rehabilitation, and district administration
Support Agency: Ministry of Finance, Government of India, and State Government department of finance
Objectives: Provision of gratuitous assistance to the drought-affected people is an important aspect of relief administration. An effective drought relief programme would require that gratuitous assistance be disbursed to the people who are not in a position to participate in the relief employment programmes or who are in the category of dependents. In those situations, where cash assistance to the people may not be adequate, other forms of assistance such as food could also be arranged to protect their basic entitlements.

- All old, disabled, and destitute persons who are 60 years and above and do not receive social benefits through the old age pension scheme or other scheme, or any post-retirement benefit, are entitled to receive gratuitous assistance.
- Those who cannot take up any work due to physical or mental disability, though they may not have reached the age of 60, may also be considered for the provision of gratuitous assistance.
- Pregnant women and young children whose relatives will not or cannot support them are also entitled to gratuitous assistance.

Survey of Eligible Persons

- As soon as drought is declared, the Collector should survey the population and prepare a list of people who are eligible for gratuitous assistance either through village-level officials or NGOs. All villages should be surveyed to identify such people.
- Village-level officials or NGOs can undertake this survey by visiting the village and assembling and identifying such people with the help of village elders.
- In the Gram Sabha, convened for the purpose of discussing drought, the list of people eligible for gratuitous assistance can be presented and approved.
- The list of people qualifying for gratuitous assistance would be regularly maintained and made available for inspections.

- The local district official such as the Tehsildar / Block Development Officer / Circle Officer should compile a list of all persons identified for the distribution of gratuitous assistance and forward it to the Collector. In certain cases, the district officials can test-check the list.
- In certain cases, where hardship has become acute, the Collector should not wait until a formal declaration of drought and should provide gratuitous assistance to people who cannot attend relief employment works.

Distribution of Gratuitous Assistance

- Gratuitous relief can be provided in two ways: (i) provision of cash assistance; and (ii) distribution of foodgrains. In certain cases, cash assistance could be given, but adequate precaution needs to be taken to disburse money to those included in the list. Each State Government should take a decision on how much cash relief should be disbursed to the people in different age-groups. If foodgrains are to be distributed, food stamps may be issued to the people eligible for such assistance.
- People showing signs of emaciation or poor health should be admitted to the gratuitous relief assistance. Food stamps may be issued by way of relief. Such situations will typically arise in tribal areas.
- These food stamps can be redeemed through the nearest PDS shop. Foodgrains to the PDS shop would be allocated as per the total number of food stamps issued in that village.
- The total number of food stamps issued and the foodgrains delivered against them for every village needs to be reconciled every week.
- When acute drought conditions prevail in a village, cases are likely to occur where as a result of infirmity, sickness, old age or otherwise, some persons may face starvation. In such cases, it is necessary to organize community kitchens or supply cooked food for such time till they could be given cash relief or food stamps.
- In remote areas, the Government may also consider setting up foodgrains bank to support the destitute, infirm, and old on a temporary basis. The Government may also ask the Gram Panchayat or a NGO to operate the foodgrains bank. Detailed instructions need to be issued for setting up and operating foodgrains bank.
- Where reports on malnutrition and starvation deaths come to the notice of the district administration, the Collector should conduct an enquiry into the causes of these deaths, invoke the provisions of Disaster Management Act 2005 and submit a report to the State Government detailing the above-mentioned remedial steps taken by the district administration.

Administration of Gratuitous Relief

- At the village-level, the Village Officer (Gram Sevak / Patwari / Talathi) is responsible for the distribution of gratuitous assistance. Village-level officials would maintain a record of cash disbursement or the distribution of foodgrains.
- The Tehsildar / Block Development Officer / Circle Officer should submit to the Collector a weekly return form showing the number of men, women and children admitted to "village gratuitous relief programme" during the week ending Saturday, together with the cost of providing relief. The weekly return form can be submitted through Form No. 15, included in **Annex 1**.
- All expenditures incurred on granting gratuitous relief should be debited to the budget head used for natural calamities.
- The norms / guidelines for relief as applicable under the CRF / NCCF may be adopted.

Relief through Tax Waivers and Concessions

Lead Agency: State Government departments of revenue, relief and rehabilitation, cooperation, and energy, and the district administration
Support Agency: Finance department of the State Government
Objectives: The primary objective of the tax waivers and concessions would be to help people meet their basic entitlements. The State Government can take a conscious decision to provide a number of tax waivers and concessions when a drought is declared. These tax waivers and concessions should be decided on the basis of the entitlement needs of certain segments of the population and the fiscal implications of such a relief to the State Government.

Each State Government may decide on tax waivers and concessions to the people affected by drought, depending on fiscal situation of the State and severity of the drought. The waivers and concessions which can be considered by the State are as follows:

- The State Government can decide to grant remission of land revenue as payable under the relevant Land Revenue Code for those farmers in the area affected by drought. Declaration of such a waiver may be linked to annewari / paisewari / girdawari, or any other measure of crop losses, prevalent in the State.
- The State Government may decide to postpone the recovery of certain dues from the farmers. It may include Tagai / Taccavi, arrears of water, irrigation and electricity charges, or any other dues related to agriculture. If recovery is not postponed, the State Government can issue instructions for not recovering these dues from the farmers and other agricultural workers by applying coercive measures.
- In drought-affected areas, the State Government can consider providing certain concessions for electricity and water charges. It could approve a partial or complete remission of these charges, with a due consideration to its financial implications, in consultation with the concerned State energy / water regulatory authority.
- The State Government may consider converting short-term loans and reschedule current installment of medium-term loans for farmers in the drought-affected areas. The State Government should make necessary provision for restructuring / rescheduling of these loans and pay to the concerned banks.
- The State Government may issue instructions to all cooperative banks through the

department of cooperation to convert or reschedule kharif loans by the end of March, when assessment of crop losses are available and final annewari / paisewari values are published.

- The Collector should furnish details of annewari / paisewari values or any other assessment of crop losses to cooperative banks to facilitate the conversion or re-scheduling of such loans. Tehsildars / Block Development Officer / Circle Officer can issue necessary certificates to the District Registrar of Cooperatives to enable the banks to grant conversion facility to the affected farmers.
- The State Government may issue instructions to the cooperative banks not to apply coercive measures for recovering their loans or dues in the drought-affected areas.
- The State Government can decide to waive education / examination fees for the students in Government schools located in drought-affected areas.

Cattle Camps and Fodder Supply

Lead Agency: Ministry of Agriculture, Government of India, State Government departments of animal husbandry, agriculture, and forests, and the district administration.
Support Agency: Indian Grassland Forest Research Institute (IGFRI), Veterinary Organisation, Railways, State Agriculture Universities and Tribal / Forests produce marketing agencies
Objectives: State Governments need to support their farmers in protecting their cattle population during a drought situation by providing necessary assistance for fodder, feed, and cattle health. This would discourage distress selling of cattle and help farmers to maintain a very important part of their asset base.

Cattle wealth is the mainstay of the rural economy. As small and marginal farmers constitute about 80% of the total community of farmers in the country, their only asset is cattle apart from their small landholdings. Cattle ownership diversifies production and resource management options, increases total farm production and income, provides year-round employment and spreads risk. In all the studies related to vulnerability of farmers, it has been found that the more cattle heads a farmer owns, the less vulnerable the farmer is to fluctuating finances.

During a drought situation, every measure needs to be taken to save useful cattle. When cattle wealth is seriously depleted, the recovery is very slow. While sheep and goats have a potential for rapid growth, perhaps 25% a year or more, the growth of cows, buffaloes, and camels is much slower, rarely more than 1–2% a year in a sustained manner. It is necessary to provide support to farmers for fodder so that they do not engage in distress selling of their cattle. It is also very important that they continue to sell milk and other products so that they have an alternative stream of income.

Steps to provide fodder and save cattle wealth:

- On receiving information about fodder scarcity becoming imminent as a result of failure or inadequacy of July–August rains in kharif areas or failure or inadequacy of September–October rains in rabi areas, the Collector should ask his subordinate officers to make rapid tours of the area and submit reports giving their own assessment of the situation. Such reports provide information on availability and the requirement of fodder for the cattle population in the area.

- The Collector can get information on cattle population in the area through available census figures or a quick survey. On this basis, the Collector can assess the fodder requirement of the area, in consultation with the District Animal Husbandry Officer. Taking into account the total availability of fodder in the local area, the Collector can estimate the extent of fodder scarcity that is likely to develop in the area. The Collector can project fodder scarcity for each successive month of drought.
- The Collector should submit a detailed report to the State Government, which provides information on the cattle population, the area under fodder, the estimated fodder production and the shortage of fodder in the district. The Collector can suggest measures for increasing fodder supply in the area.
- The State Government, upon the receipt of such a report, may consider declaring a drought as supported by other factors as well, or pass orders recognizing the area in which fodder scarcity has developed. The State Government should issue detailed instructions for maintaining the supply of fodder, either through procurement of fodder, or by setting up cattle camps or fodder depots / bank, or by encouraging farmers to undertake fodder cultivation.

Preservation of Fodder

The State Government should authorize the Collector to ensure the availability of fodder in the drought-affected areas by taking the following steps:

- Encourage farmers to undertake fodder cultivation on the banks of canals or other areas under irrigation. Subsidy in the form of seeds should be provided for fodder cultivation;
- Request the Chief Conservator of Forests and Divisional Forests Officer to protect the available grass and grazing in the forests; and
- Consider imposing a ban on the movement of fodder from the district to another district or outside the State.

Special Measures for Increasing Fodder Supply

The State Government should issue instructions to the Collector to take the following measures for increasing the supplying of fodder:

- Procure fodder through the Forests Department or the Forest Development Corporation at a price fixed by the State Government;
- Procure fodder through traders, tribals, private cultivators, Tribal Development Corporation, etc. at a price declared by the State Government;

- Procure fodder from the neighbouring States, through negotiations either through the Forest Department or the private traders;
- Procure feed blocks if necessary for milk-producing cattle and arrange strategic placement of feed reserves;
- Establish fodder depots in the drought-affected Talukas for selling fodder, cattle feed and concentrates at a price fixed by the State Government;
- Fix the price of fodder so that it is affordable to the farmers. Provide subsidy for the purchase of fodder supplied through fodder depots. The price should be published and displayed prominently in the fodder depot to make the farmers aware;
- Maintain accounts of sale of fodder through fodder depots. These accounts need to be open to inspection;
- Organize distribution of fodder through societies by way of Tagai / Taccavi to the needy agriculturists and particularly to small holders in the affected areas;
- Set up cattle camps or feeding centres for feeding the cattle of agriculturists, either through district administration or the NGOs;
- Allow each cattle camp a minimum of 50 and a maximum of 500 cattle. Such a number would make it easier for those who organize cattle camps to give good attention to cattle health.
- Fix the quantity of fodder and feed to be provided in the cattle camp with the assistance of the State animal husbandry department. Fodder and feed should be issued for each cattle in accordance with these standards.
- Arrange water supply for all the cattle camps in accordance with the total number of cattle admitted in these camps.
- Maintain accounts of the fodder and feed provided through the cattle camps and reconcile it with the number of cattle staying in a cattle camp. Each cattle camp must maintain a register, showing the number of cattle staying there and the total stock of fodder and feed on a daily basis.
- Conduct necessary inspection of cattle camps to ensure that fodder and feed are being provided to cattle in these camps and sanitation and cleanliness measures in these camps are adequate.
- Arrange for grazing of cattle in army establishments, such as training centres or firing ranges;
- Start a special scheme for arranging the supply of nutritious cattle feed to owners of milch cattle in consultation with the State Dairy Development Department;
- Arrange with Gaushalas and other NGOs for taking care of cattle, on a per cattle head payment basis;

- In extraordinary situation, the fodder requirement may be arranged through Railways from surplus states
- Increase awareness among farmers about the feeding requirements of cattle during drought to ensure their health and productivity; and
- Information on cattle camps and fodder supply through fodder depots can be provided through Form Nos. 16 and 17, included in **Annex 1**. Information on transport of fodder can be provided through Form No. 18.

Role of the Animal Husbandry Department

- At the request of the Collector, the State Animal Husbandry Department should fix the fodder, feed, and water requirement for each cattle.
- The Animal Husbandry Department would check the quality of feed and fodder supplied through the fodder depots and cattle camps. It would ensure and certify that the feed and fodder being provided are fit for cattle consumption.
- The Animal Husbandry Department would provide minerals, vitamins, medicines and vaccines at minimum cost to the farmers. The Department would also carry out the necessary inspections and checks in drought-affected areas to ensure that cattle are maintained in good health.
- The Animal Husbandry Department would depute inspectors who would check the health of cattle in cattle camps at frequent intervals, at least once a week, and undertake all precautionary measures to avoid outbreak of any disease.
- The Animal Husbandry Department would undertake campaigns in the drought-affected areas to increase the awareness of farmers about cattle health issues related to fodder and feed, vitamin and minerals and other sanitation issues.

Role of the Forest Department

- At the request of the Collector, the Forest Department / Forest Development Corporation should cut and stock grass available within its area at places where arrangements are available for safe stocking. The cutting of grass should be completed as early as possible. It should be properly dried, converted to hay and stocked. The Forest Department should also make arrangements for the transportation of fodder to places suggested by the Collector. The Government should sanction the necessary expenditure for fodder operations to be undertaken by the Forest Department.
- At the request of the Collector, the Forest Department could permit local farmers to take forest produce, such as cutting fodder yielding trees, free of charge or on payment of fees.

Role of the Agriculture Department

- The Agriculture Department would encourage individual farmers to undertake cultivation of fodder, wherever possible. It would provide fodder seeds and fertilizers to the farmers for cultivating fodder, wherever possible; and extension services for undertaking short duration grasses and seasonal fodder crops.
- The Agriculture Department can also undertake cultivation of fodder on the land owned by the agriculture universities. Generally, agriculture universities have huge tracts of land, which could be used for this purpose. The Government needs to provide subsidy to the agriculture universities for cultivating fodder.
- The Agriculture Department can also grow fodder on the seed farms, wherever available. The Government should provide a grant for seeds, fertilizers and other expenditures, depending on the extent of area covered under fodder cultivation.

Role of the Irrigation Department

- The irrigation department should extend all necessary cooperation to the Collector for promoting fodder cultivation by providing water for irrigation on a priority basis. Such water could be provided to the farmers at a cheaper rate.
- The irrigation department should consider allowing reservoir and tank beds under its control to be leased out for cultivating short duration grasses or seasonal fodder crops. The Collector, with the permission of the irrigation department, could lease out the reservoir and tank bed land on short-term lease subject to the condition that the lessees should grow fodder crop therein and agree to sell the grass / fodder to needy farmers at the price to be fixed by the Collector.

Health and Hygiene

Lead Agencies: Central Govt, M/o Health Family welfare, M/o Urban Development State Government public health department
Support Agencies: State Government water supply department, Zilla Parishads, Municipal Councils / Corporations
Objectives: An important objective of the Government's intervention is to provide necessary support for maintaining health and hygiene standards of the drought-affected people.

In a drought situation, health issues are largely related to contamination of water and spread of infection among the workers participating in public works programmes. People have less immunity in drought situations due to poor levels of nutrition. Necessary precautions need to be taken to prevent the spread of any water-borne epidemic and other infectious diseases.

Steps for maintaining health and hygiene in drought-affected areas are as follows:

- The State public health department should undertake a campaign for disinfecting all drinking water sources with disinfectants such as chlorine. Since water availability is at a shallow level, it is more likely to be contaminated. Necessary care needs to be taken to clean water and disinfect it before using it for the purpose of drinking. It may be necessary to train the community in disinfecting water and checking its quality for the purpose of drinking.
- The State water supply department should conduct a regular surveillance of all the drinking water sources in the drought-affected areas.
- The State water supply department should take a special campaign for providing clean drinking water in those areas which are affected by arsenic and fluoride contamination.
- The State public health department should maintain sufficient stock of chlorine and other disinfectants in the drought-affected areas.
- A public health campaign should be organized for immunizing and inoculating the entire population against likely diseases such as typhoid and cholera.
- Mobile health teams should be organized for visiting all public works. Doctors and

medical interns from urban areas need to be organized in teams for visiting these public works programmes for medical check-ups and immunization.

- The State public health department should organize medical camps for villages and communities affected by severe droughts. People need to be checked for infections and vitamin deficiencies and treated for night blindness and other ailments.
- The district administration should ask local medical colleges to run medical camps. Medical college teachers and students should participate in these camps.
- The State public health department should consider providing doses of vitamins in case of vitamin deficiency, particularly to children and women.
- The district administration should arrange for requisition of vehicles and procurement of necessary drugs and medicines and other facilities for setting up medical camps.

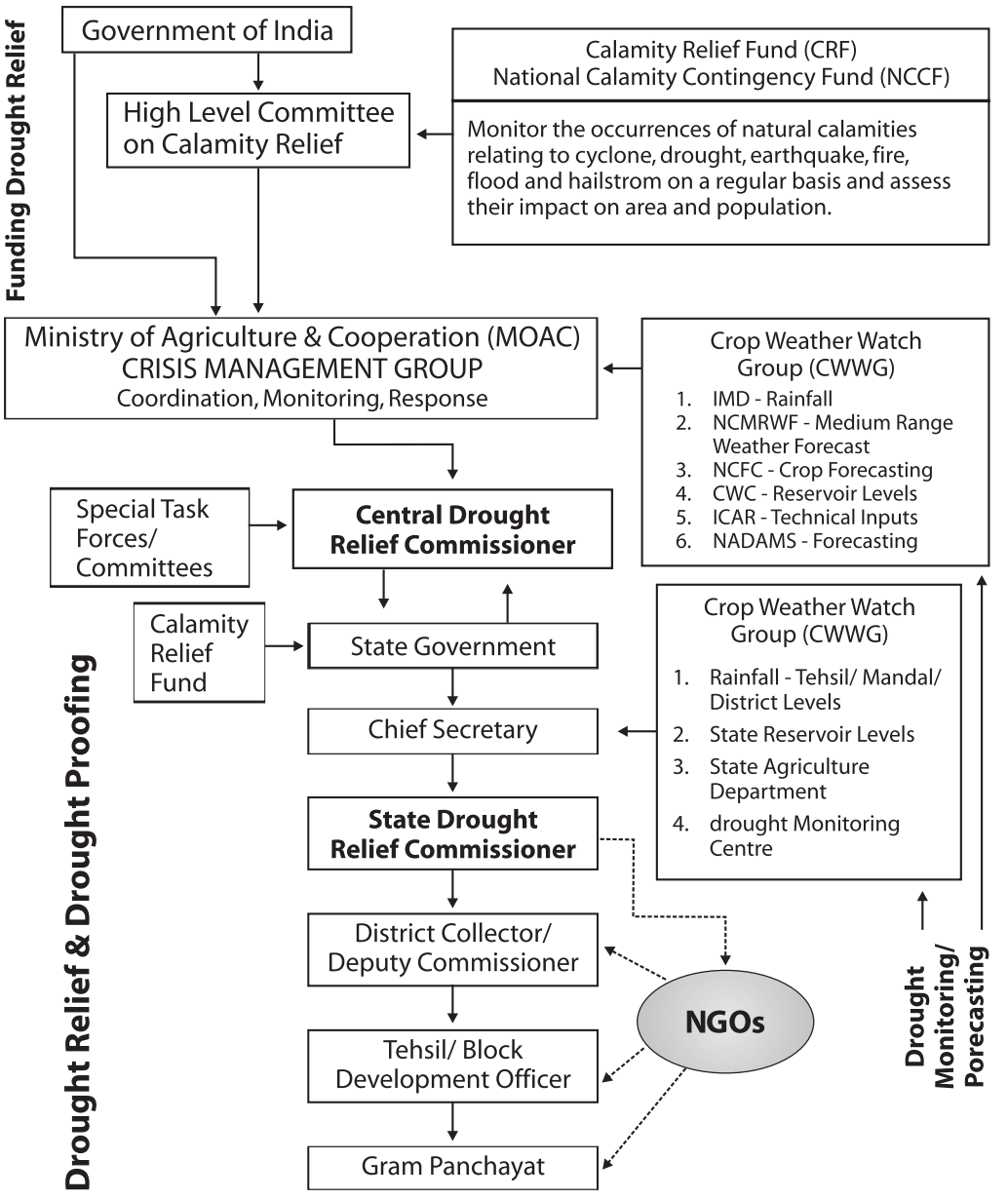
Institutional Response

Drought management is always a measure of responsiveness and resourcefulness of Governments at different levels. It requires a strong institutional structure to monitor and provide a timely response to drought. While it is primarily the responsibility of the State Government to manage drought, the Central Government also plays an important role in monitoring drought and providing financial assistance to the States. The district administration headed by the Collector plays the most critical role in responding to drought on the ground. Drought thus requires a well-coordinated response at all the levels of Government.

Role of the Central Government

- At the central level, the Ministry of Agriculture is the department responsible for drought monitoring and management.
- In the Ministry of Agriculture, the Drought Management Division of the Department of Agriculture and Cooperation coordinates relief measures. An officer of the rank of an Additional Secretary is designated as the "Central Drought Relief Commissioner" for this purpose. The schemes of CRF and NCCF are, however, administered by the Ministry of Home Affairs and assistance under these schemes is released by the Ministry of Finance.
- A Crisis Management Group functions under the Chairmanship of the Central Drought Relief Commissioner with representatives of ministries and organizations whose involvement is necessary. The Crisis Management Group should meet regularly to review the drought situation in the country and progress of relief measures.
- The CWWG, which is an on-going arrangement for early warning and monitoring, assists the Crisis Management Group through provision of data and information relevant to drought.

Figure 5: *Institutional Framework for Drought Management*



- In all those States, where a drought has been declared, the Crisis Management Group must ask for periodical reports on the drought situation and review the progress of relief measures.
- Above the Crisis Management Group, there is a National Crisis Management Committee (NCMC), which operates in respect of all calamities under the Chairmanship of the Cabinet Secretary. Members of the NCMC include secretaries of various ministries and heads of agencies concerned with the exigencies of a particular calamity.
- In a situation of severe drought, the Central Government normally constitutes a Cabinet Sub-committee or a Group of Ministers for taking policy decisions speedily for dealing with drought.
- It is necessary that the Ministry of Agriculture raises relevant policy issues at the appropriate level. For example, the allocation and distribution of foodgrains would require the involvement of Department of Food and the Food Corporation of India. The movement of foodgrains requires the cooperation of the Indian Railways. Inter-ministerial mechanisms at different levels can effectively address these issues.

Role of the State Government

- The State "Department of Relief", which has now been renamed as "Department of Disaster Management" in many States, is responsible for directing drought operations in the State.
- The Department of Relief, headed by Relief Commissioner (renamed as Secretary, Disaster Management in many States) is assisted by the Additional Relief Commissioner in certain States or Directors and Deputy Secretaries and other ministerial staff.
- The Relief Commissioner / Secretary, Disaster Management monitors the drought situation in the State on the basis of information available through various departments and agencies and submits reports to the Government at different levels.
- The Relief Commissioner / Secretary, Disaster Management recommends the declaration of drought on the basis of situation on the ground. Once the State Government declares drought, all the necessary orders for concessions and waivers are issued by the Relief Commissioner.
- Relief Commissioner / Secretary, Disaster Management issues various instructions to the Collectors for provision of relief assistance to the people affected by drought.
- Relief Commissioner / Secretary, Disaster Management should take steps for

communicating all decisions taken at the State level to the district level. Since a delay in the communication of these decisions may have a very adverse impact on drought management, it is necessary that all decisions taken are communicated to the district administration or other field agencies by e-mail and fax and posted on the web site.

- The Relief Commissioner / Secretary, Disaster Management administers the Calamity Relief Fund (CRF) of the State and issues orders for release of all financial assistance to the district administration and other departments.
- The Relief Commissioner / Secretary, Disaster Management conducts the assessment of losses and relief needs. On the basis of this assessment, the Relief Commissioner submits a Memorandum to Government of India through the State Government for seeking financial assistance from the National Calamity Contingency Fund (NCCF).
- Additional mechanisms should be set up for managing drought. These mechanisms may vary from one State to another. In some States, a Cabinet Sub-committee is set up for taking policy decision on drought on a regular basis. In other States, a Secretaries' Committee is set up under the Chairmanship of the Chief Secretary.
- Drought management requires coordination with departments of agriculture, animal husbandry, water conservation, irrigation and finance. It is always easier to settle these issues through an empowered committee, such as a Cabinet Sub-committee or Secretaries' Committee.

Role of the District Administration

- The district administration under the leadership of the Collector implements all the decisions related to drought management on the ground. The implementation takes places through a number of line departments and field agencies working on the ground. The effectiveness of drought management is very much dependent upon coordination among agencies working at the district level.
- The Collector heads the revenue administration at the district level and is the most important official in respect of drought management. As per the relevant revenue codes, the expression "Collector" includes all the subordinate officials of the Revenue Department such as Additional Collector, Deputy Collector, Sub-divisional Officer and Tehsildar. All the subordinate officers perform their tasks and exercise powers related to drought management on behalf of the Collector.
- The Collectors should monitor all the indicators of drought on the ground: collect data on rainfall on a daily basis, important water storages in the district and monitor

the progress of sowing operations. The Collector should also monitor all local information related to demand for relief employment, prices of foodgrains and the availability of fodder.

- The Collector needs to conduct crop-cutting experiments and report annewari / paisewari / Girdewari values for all the Revenue Circles / Talukas to the Government.
- The Collector must submit periodical reports on all the important indicators of drought to the Government. On the basis of all the indicators, the Collector should recommend declaration of drought to the State Government.
- All administrative and financial powers related to drought management, such as relief employment, distribution of foodgrains, supply of drinking water and procurement and sale of fodder, should be delegated to the Collector. The State Government must ensure that that the delegation of authority to the Collectors is real and substantive.
- The Collector must be authorized to direct all the line departments at the district level to participate in drought management, prepare contingency plans and mobilize their staff and resources, as per the relevant sections of this manual. For example, the Collector can ask all the technical departments to identify works and prepare estimates so that there is adequate work on the shelf to provide relief employment in the drought-affected areas. The Collector should requisition vehicles and equipments, on payment basis, for using them in drought situation.
- The Collector needs to assess the situation related to scarcity of drinking water and fodder, and should issue appropriate instructions regarding reservation of drinking water, supply of drinking water through tankers, procurement and sale of fodder, and setting up of fodder depots and cattle camps as mentioned in the relevant sections of the manual. The Collector should exercise similar authority in any other area, which is affected by drought.
- The role of the Collector is that of an effective coordinator of drought management. The Collector must be able to provide a sense of mission and direction to all the line departments and agencies working for drought relief. It is necessary that the Collector provides the necessary help and support to all the agencies for performing their tasks more effectively.
- At the district level, a district drought / disaster management committee should be set up under the chairmanship of the Collector. It should consist of the local members of the Parliament (MP), Members of the Legislative Assembly (MLAs), Panchayati Raj officials, and the district officials. The Committee should meet frequently and review the progress of drought relief measures in the district. The

district-level committee can become a very effective forum for addressing peoples' concerns and applying correctives in drought management.

Role of Panchayati Raj Institutions

- It is necessary to involve the Panchayati Raj institutions (PRIs)—Zilla Parishads, Panchyat Samitis, and Village Panchayats—in the implementation of drought management programmes.
- PRIs need to provide funds from different sources, particularly the devolution of funds through successive Finance Commissions, for water conservation and maintenance of water supply schemes.
- Almost 50% of the NREGS is implemented through village Panchayats. PRIs need to use funds for starting relief employment programmes as well as building community assets such as percolation tanks, village tanks, wells and canals, which reduce the impact of drought.
- The PRIs need to play an important role in the regulation of water use at the individual household and village level. It should recommend using water resources for the purpose of drinking and fodder cultivation.

Role of Non-Government Organizations (NGOs) and Civil Society Organizations (CSOs)

- The State Government and district administration need to involve NGOs in organizing drought relief. NGOs and CSOs have the advantage of local presence and community outreach which could be utilized for organizing distribution of relief assistance and implementing mitigation programs. NGOs can also be very effective in providing feedback to the Government and securing corrective actions.
- The State Government and district administration can set up a coordination forum for NGOs and CSOs at the state and district levels respectively. The coordination forum meetings can be convened to discuss the drought situation and the implementation of relief programmes.
- NGOs and CSOs can monitor various indicators of drought, particularly its impact on the people, and bring these to the attention of the State Government. The State Government can initiate necessary relief measures in drought-affected areas, based on the feedback from these organizations.
- NGOs and CSOs can convey the local demand for relief employment to the district administration. They can suggest specific works to be started so that the people are provided with employment within a short distance of their homes. These

organizations can help the district administration in planning relief employment in a way that durable community assets are created. They can also coordinate with the local administration in ensuring the payment of wages and foodgrains on time.

- NGOs and CSOs can work with the local community in augmenting the sources of drinking water through repairing wells, hand-pumps, tanks, ponds and any other local water structure. They can also help the community in regulating water use within the community and ensuring equitable distribution of available water.
- NGOs and CSOs can monitor the distribution of foodgrains through Fair Price Shops and prevent hoarding and diversion of foodgrains in the open market. They can ensure that foodgrains are supplied to all the Fair Price Shops, particularly those in the remote areas and all the people in the drought-affected areas can purchase foodgrains through these shops as per their entitlements. NGOs and CSOs can also monitor that the people are paid their wages in the form of foodgrains as per the norms fixed by the government.
- NGOs and CSOs can provide assistance to the sick, elderly and disabled people in the drought situation. They can run community kitchens with Government assistance. NGOs need to bring the cases of hunger and starvation to the attention of the Government.
- In consultation with the Government, NGOs and CSOs can monitor the functioning of ICDS and mid-day meals so that the children get necessary nutrition during the period of drought. They can also bring to the attention of the Government the cases of malnutrition among infants and children.
- NGOs and CSOs can set up cattle camps and fodder depots after obtaining the necessary authorization from the Government. They can receive Government assistance as per the CRF / NCCF norms as well as the necessary veterinary care for this purpose.
- NGOs and CSOs need to help the Government in dealing with the public health aspects of drought. They can assist the Government in disinfecting sources of water, creating awareness about public health issues and monitoring malnutrition and disease among drought-affected population.

Financing Relief Expenditure

In post-independent India, financing relief expenditure has largely been arranged through the Finance Commission appointed under Article 280 of the Constitution. In the earlier phases, the role of the Commission was restricted to suggesting the pattern of financial assistance by the centre. Subsequently, the recommendations were enlarged to cover the "scheme of financing relief expenditure".

The present arrangement of financing relief expenditure has two streams: (i) CRF and (ii) NCCF.

The CRF envisaged the contribution of Central and the concerned State Governments in the ratio of 3:1 for a fund to be kept outside the Government Account so that there is no cash flow constraint for initiating relief operations. The Centre's share is normally released in two half-yearly installments, subject to the guidelines in this regard. Funds from the CRF are to be spent on specific, pre-determined items of expenditure at predetermined scales, as specified in the CRF guidelines. The NCCF provides funds for natural calamities of severe nature when the balances available in the CRF are not adequate for meeting relief expenditures. This fund was created with an initial corpus of Rs. 500 crores. It is replenished through a surcharge of certain central taxes. The Eleventh Finance Commission had recommended the use of NCCF for "calamities of severe nature", this fund is used to meet the expenditure on all natural calamities as recommended by Finance Commissions from time-to-time, where relief expenditure exceeds the amount balance in the CRF.

The Ministry of Finance (Department of Expenditure), Government of India releases assistance from both the CRF and NCCF. The CRF is released to all the States in normal course, irrespective of its level of relief expenditure, while the NCCF funds are released when the States make specific requests, following a well-laid out procedure.

The Disaster Management Act, 2005 has proposed disaster response and mitigation funds at the national, state, and district levels. These funds are in the process of being set up.

Administration of CRF

The State Government needs to take following steps for the administration of CRF:

- Check the opening balance of the CRF in the beginning of the financial year. All

money that remains unspent at the end of preceding financial year is shown as the opening balance in the next financial year.

- Submit an utilization certificate for the amount spent through the CRF, well in time so that the CRF allocations are released twice in an year.
- Get the CRF expenditures audited through the Office of Accountant-General. These audit reports must be submitted to the Ministry of Home Affairs, Government of India.

Release of NCCF Funds

- Whenever a State faces a calamity of severe nature and the expenditure from the CRF exceeds its existing balance, it makes a request to the Government of India for release of funds from the NCCF. For drought, hailstorm, and pest-attack, the request is made to the Ministry of Agriculture and for other identified natural calamities, the Ministry of Home Affairs has the necessary jurisdiction.
- The State Government submits the request for release of NCCF funds through a Memorandum. A Memorandum is an important representation of the State Government, providing detailed information on the geographical extent and severity of drought, losses and damages in all the sectors, relief needs, and the request for assistance from the NCCF.
- A Memorandum needs to be a balanced document, objectively describing the drought situation, assessing the impact and estimating the relief needs. The request for NCCF assistance need not be excessive as is the current practice. The structure and template for preparation of a Memorandum is included in the **Annex 4**.
- The State Government should submit the Memorandum to the Ministry of Agriculture only after declaring drought.
- After the State Government declares drought and submits the Memorandum, the Ministry of Agriculture normally sends a "Central Team" to the concerned State for making an assessment of the drought situation. This team consists of officials from different central Government departments, such as agriculture, animal husbandry, food, and rural development.
- The team visits drought-affected areas in the State for at least 2–3 days, meet the officials, farmers, PRI members, women's groups, etc. and assess the drought situation by cross-checking official information with the situation on the ground.
- The team then submits a report to the Ministry of Agriculture immediately after conclusion of its visit. The report should provide an assessment of the drought situation in terms of severity, geographical spread, impact on agriculture, availability of water, food, and fodder.

- In the report, the team makes a recommendation for NCCF assistance in accordance with the CRF guidelines. The recommendation needs to be clear, precise and objective; mention certain special circumstances that need to be considered. It should not deviate from the CRF / NCCF norms.
- The report of the team is considered by an Inter-Ministerial Group (IMG) chaired by the Secretary, Ministry of Agriculture, Government of India. The IMG recommends the quantum of assistance to be provided from the NCCF.
- The IMG's recommendation is considered by a High-Level Committee (HLC), of which the Agriculture Minister, Finance Minister, Home Minister, and Deputy Chairman, Planning Commission are members. The HLC is chaired by the senior-most Union Cabinet Minister.
- After the HLC approves the IMG's recommendation, the Department of Expenditure releases funds from the NCCF after adjusting the existing balance in the CRF, as determined by the MHA.

Development Programmes for Drought Relief

- In addition to the CRF and NCCF, the State Government needs to consider the possibility of reorienting regular development programmes for drought relief and management.
- The most important programmes, which can be used for drought relief and management, are the NREGS and water conservation programmes supported by the Government of India.
- All the districts covered through these programmes need to be directed about using these programmes for generating employment in the drought-affected areas and building assets, such as tanks and wells, which can reduce the impact of drought.
- At the State and district levels, water supply schemes, regular schemes for fodder cultivation and agriculture can be used for supporting various measures of drought relief.
- The State Government needs to release the amount towards subsidy on premium for crop insurance. It is necessary that the payment of premium is made on time, so that farmers can get their claims paid.

Monitoring Drought Expenditures

- The State Government should monitor their drought expenditures regularly. Such monitoring mechanisms should consist of monthly expenditure statements, utilization certificates and internal and external audits.

- The district administration must provide monthly expenditure statements on various relief measures in a format prescribed by the Government.

- The district administration and implementing departments / agencies should submit utilization certificates for the amount released for drought relief. Further releases should not be made until the utilization certificate is provided.

- The State Government needs to organize concurrent audit of expenditures through its internal audit wings so that course corrections can be applied on expenditures for various relief measures.
- Information on drought relief expenditures can be submitted in Form Nos. 19 and 20, included in **Annex 1**.

Information Management and Media Coordination

- The Central and State Governments should provide information on all aspects of drought to the people and media. It is necessary to inform the people about the severity and impact of drought and the measures being taken to alleviate the drought situation.
- The State Government should develop a Drought Management Information System (DMIS) at the state level on different aspects of drought management. Such an information system should be replicated at the District and Taluka / Block levels, with information at each level supporting the DMIS at the higher level.
- DMIS for drought should include information upon key indicators of drought as well as the important interventions for drought relief: employment, support to farmers, food security, drinking water, supply of feed and fodder and health and hygiene. DMIS should be updated on a weekly basis during the period of drought.
- DMIS should be prepared on the GIS platform. The State Government should seek the help of State Remote Sensing Centre and other technical resources to develop the GIS-based DMIS.
- DMIS should be accessible through Internet. State Government and districts should post the DMIS on their web sites and update it on a regular basis.
- Secretary, Disaster Management / Relief Commissioner should consider providing information management specialist support for collecting and uploading DMIS on the web site and updating it on a regular basis.
- Secretary, Disaster Management / Relief Commissioner should consider preparing bi-monthly reports on the drought situation and submit it to all relevant authorities. Form No. 21, included in **Annex 1**, can be used for preparing such a report.
- Secretary, Disaster Management / Relief Commissioner should consider documention of the drought management efforts. Such documentation is very helpful in drawing lessons from previous droughts and dealing with droughts in future. The documentation should be made available on the Government web site.

Coordination with Media

- Sharing information with print, radio and television media, is an important aspect of drought management.

- Secretary, Disaster Management / Relief Commissioner and Collectors should be accessible to media for providing information on drought. They should organize weekly press briefings for drought management.
- Secretary, Disaster Management / Relief Commissioner and Collector should have a communication outreach strategy. They should be able to provide information upon drought management to the people through radio and television.
- Secretary, Disaster Management / Relief Commissioner and Collectors should provide regular brief on drought management to the Chief Minister and other Ministers in the Government so that they can provide information to the media.

Drought Preparedness and Response Checklist

for Relief Commissioner and District Collector

Activate State / district disaster management authorities: Following action points need to be checked upon the occurrence of a drought situation:

- Meetings of State / district disaster management authorities have been convened.
- Information has been obtained on all the key indicators of drought.
- Proposal has been prepared for the declaration of drought.
- Relief Commissioner / District Collector has developed a strategy for drought management in active consultation with all the participating heads of departments.
- A contingency plan for drought management has been developed.
- A control room for drought management has been set up.
- All the departments / agencies have prepared their own contingency plans.
- Memorandum has been prepared and submitted to the Government of India for assistance from the NCCF.
- Necessary funds / authorization for drought relief measures have been obtained.

Monitoring Water Sources:

Agencies: Departments of revenue, irrigation, water supply and water conservation

Indices to be monitored: Daily, weekly and monthly rainfall, groundwater sources, water storage levels in reservoirs / ponds /lakes

Drought relief measures to be organized:

- Reservation orders have been issued for drinking water.
- Water is being equitably distributed for multiple purposes: drinking, commercial, industrial and agricultural.
- Temporary water supply schemes have been sanctioned.
- Supply of drinking water is being organized through tankers / bullock carts / trains.
- A ban on digging deep bore-wells has been enforced.

Crop Management:

Agencies: State departments of agriculture and revenue, State agricultural universities

Indices to be monitored: Soil moisture, area under sowing and type of crop, status of growth, crop yield, alternative cropping possibilities

Drought relief measures to be organized:

- Seeds for second sowing have been secured and supplied.
- A crop contingency plan (less-water consuming, drought-resistant crops) has been developed.
- Crop insurance premium has been paid by the Government.
- Micro-irrigation equipments (sprinkler and drip irrigation systems) are available to the farmers for using water optimally.

Fodder Management:

Agencies: State departments of animal husbandry, agriculture and revenue

Indices to be monitored: Availability of fodder, fodder prices, fodder cultivation, availability of water for fodder cultivation.

Drought relief measures to be organized:

- Supply of fodder increased through getting fodder from surplus States / districts.
- Coordination mechanism set up with the forest department and agriculture university.
- Farms to get surplus fodder.
- Fodder cultivation encouraged and incentives provided through Government schemes.
- Ban imposed on taking fodder from the State.
- Fodder depots set up and the prices fixed at levels, which farmers can buy.
- Cattle camps set up through the Government, NGOs and cooperative societies.
- Water supply arranged for cattle camps.
- Vaccination and other health measures organized for cattle.

Relief Employment:

Agencies: Department / agencies implementing the National Rural Employment Guarantee Scheme (NREGS) and other schemes such as Pradhan Mantri Gram Sadak Yojana (PMGSY) and Swaranjayanti Gram Swarozgar Yojana (SGSY)

Indices to be monitored: Demand for relief employment, number of relief works on shelf, number of works in progress, attendance of workers, wages distributed

Drought relief measures to be organized:

- Demand for relief employment assessed.
- Job cards available with the people.
- Relief employment plan prepared in consultation with the agencies.
- Number of sanctioned works available on shelf.

- People informed of their rights and entitlements under the NREGS.
- Relief works started in response to the people's demands.
- All the amenities organized on the sites of relief works.
- Distribution of wages supervised to ensure it is timely and fair.
- Attendance on relief works reported on a daily/ weekly / monthly basis.

Food Security:

Agencies: Food and Civil Supplies Corporation / Department, Food Corporation of India (FCI)

Indices to be monitored: Availability of foodgrains, foodgrains prices in open market, free movement of foodgrains, practice of hoarding foodgrains, stock of foodgrains in FCI and Government warehouses, functioning of Public Distribution System (PDS) shops, availability of kerosene oil, open and PDS price of kerosene oil.

Drought relief measures to be organized:

- Enough foodgrains available in the open market.
- Drive against hoarding foodgrains initiated.
- Stock of foodgrains available in FCI and Government warehouses adequate.
- PDS shops lifting foodgrains from warehouses as per the number of ration card holders.
- PDS shops selling foodgrains at the rates fixed by the Government.
- Access to foodgrains for all ration card holders.
- Foodgrains available for distribution as wages on relief employment works.
- Kerosene oil available through the PDS system.
- Food supplies augmented through monitoring of other social security schemes: Antyodaya Anna Yojana, National Old Age Programme, Annapurna Scheme, Integrated Child Development Services, Mid-day Meals for school children

Distribution of Relief Assistance:

Agencies: State revenue and agriculture departments

Indices to be monitored: Funds available through CRF and NCCF, funds allocated for distribution of input subsidy, distribution of input subsidy and gratuitous relief

Drought relief measures to be organized:

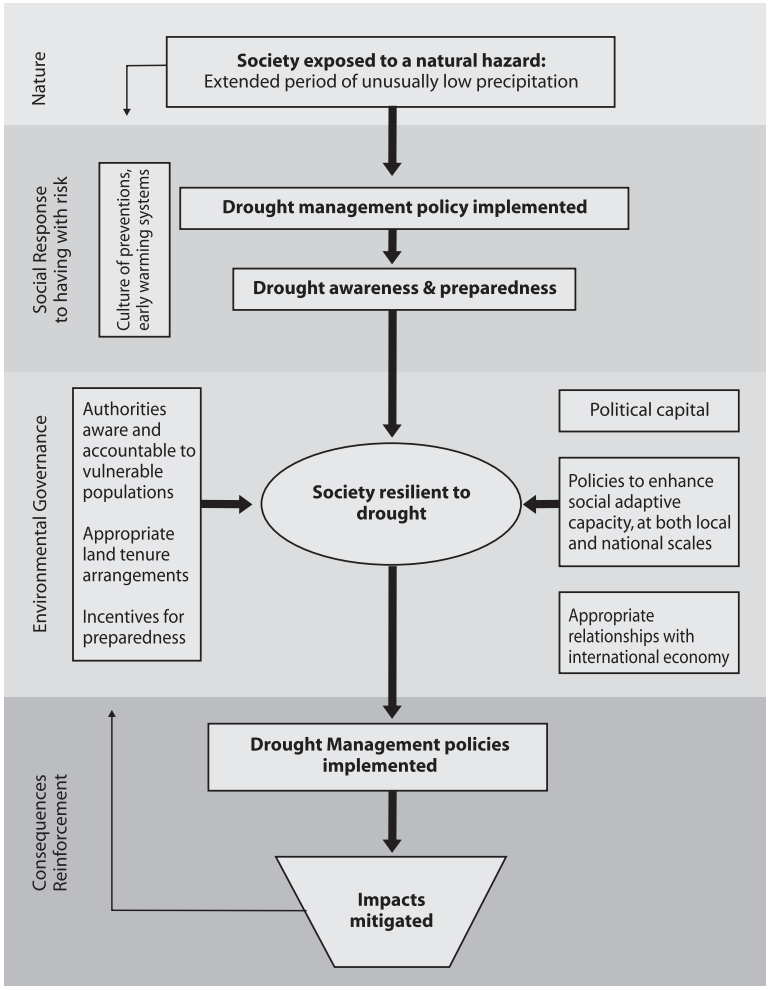
- Seeds stock available for distribution among the farmers
- Enough seeds available in the open market for agricultural operations
- Tie-up with seeds corporations arranged.
- Information on the cultivable areas affected by drought collected.
- Information on small and marginal farmers' landholding available.
- Request submitted to the Government of India for NCCF assistance.
- Financial assistance made available to the farmers for purchasing inputs.
- Financial assistance made available for distribution of relief assistance
- Financial assistance made available through bank transfer.

Section - 5

Drought Mitigation

Objectives:

- Current Drought Mitigation Programmes
- New Guidelines for Drought Mitigation
- Implementing Drought Mitigation Measures



A number of measures have been discussed in the foregoing sections about drought relief and management. Though these measures are extremely important for helping people to cope with drought and reduce adverse impacts on their well being, these are mostly contingent measures. Considering the increase in frequency of droughts in different parts of the country, it is necessary that there is a shift in public policy from drought management *to drought mitigation measures*.

Mitigation means actions that can be taken before or at the beginning of drought to help reduce the incidence or impacts of drought. These measures are important for adapting to climate change, restoring ecological balance and bringing development benefits to the people. Most of these measures are related to integrated soil, water, and forest management and form part of soil conservation, watershed development, and forestry programmes.

Drought mitigation programmes are never stand-alone interventions to be taken in the wake of a drought; but are very much a part of development planning. These measures need to be implemented by the Government of India and State Governments as part of their regular development programmes.

While drought mitigation programmes have been in existence for a long time, they have not been effective due to many reasons. Individual departments with a narrow focus usually run most of these programmes, with allocations thinly scattered over a large area. There is no sustained dialogue with the people about the benefits of these programmes and the need for their participation and ownership. As these programmes are fragmented in their implementation, the accountability mechanisms are very weak and all programmes experience serious lacunae. Thus there is a need to revise the strategy for implementing drought mitigation programmes by undertaking integrated watershed development projects on a mission basis, which can be implemented in the identified areas with active participation of the people.

At the national level, there cannot be a standard strategy for drought mitigation. This section describes the mainstream programmes for drought mitigation --— Drought Prone Areas Programme and Desert Development Programme. It also discusses all the essential processes and measures for developing a drought mitigation strategy at the State level. State Governments should consider these essential steps for developing and implementing their own drought mitigation strategy with the assistance of the National Rainfed Area Authority (NRAA).

Current Drought Mitigation Institutions and Programmes

National Rainfed Area Authority

The Government of India set up the NRAA, in the Ministry of Agriculture, to address the issue of drought mitigation on a long-term basis, based on the recommendations of the Parthasarathy Committee (see box). The Authority has a two-tier structure consisting of a Governing Board, chaired by the Minister of Agriculture, and the Executive Committee headed by the Chief Executive Officer, NRAA. It has its own budget for programme implementation.

The NRAA comprises experts who provide knowledge inputs regarding systematic upgradation and management of the country's dryland and rainfed agriculture. It is an advisory, policy-making and monitoring body responsible for developing guidelines for existing schemes and formation of new schemes, including all externally aided projects in the rainfed areas.

The NRAA aims to bring convergence and synergy among the numerous ongoing water conservation and watershed development programmes and monitor their implementation. It focuses on issues related to landless and marginal farmers, particularly their farming practices and livelihood systems.

The NRAA's mandate as formulated by the Ministry of Agriculture, Government of India is as follows:

- To prepare a perspective plan, outlining the national strategy and road map for holistic and sustainable development of rainfed farming areas.
- To evolve common guidelines for all schemes of different ministries including externally-aided projects for development of rainfed / dryland farming systems.
- To coordinate and bring convergence within and among agricultural and wasteland development programmes being implemented in rainfed areas of the country.
- To identify rainfed areas in different States that need priority attention and prepare watershed development programmes for integrated natural resource management, in consultation with States, by focusing on multi-dimensional crop, livestock, horticulture, agri-pasture integrated systems and programmes for landless farming communities.
- To identify gaps in input supply, credit availability, dissemination of appropriate technology and other requirements relevant for the development of rainfed areas.

- To guide the implementing agencies on priority setting and monitoring the specific interventions required.
- To develop plans / programmes for capacity building of Central / State Government functionaries in rainfed areas.
- To suggest modalities to strengthen national and State-level institutions, concerned with the rainfed / dryland areas and establish institutional linkages with prioritized watersheds.
- To monitor disbursement of rural credit / insurance cover / safety net programmes developed for rainfed areas.
- To set the research agenda including a critical appraisal of on-going programmes and promote diffusion of required knowledge for integrated farming in the rainfed areas to district and lower-level authorities.
- To evaluate the effectiveness of completed watershed and concurrent evaluation of on-going programmes.

The NRAA should consult the State Governments for developing and implementing drought mitigation strategies, which would best suit their water resource endowments and agro-climate conditions.

Drought-Prone Areas Programme and Desert Development Programme

The Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP) are area development programmes implemented by the Government of India since 1973–74 and 1977–78, respectively. DPAP and DDP are meant for drought proofing and combating desertification to tackle the special problems faced by fragile areas in the arid, semi arid and dry-sub humid regions that are constantly affected by severe drought conditions and desertification. Large human and cattle populations that are continuously putting heavy pressure on the already fragile natural resource base for food, fodder and fuel characterize these areas. This continuous biotic pressure is leading to fast and continuous depletion of vegetative cover, increased soil erosion and fast receding groundwater levels.

Until 1994, DPAP and DDP were being implemented on a sectoral basis where major activities, such as soil–moisture conservation, water resource development, afforestation, pasture development, were implemented in a fragmented manner by the different line departments. Isolated implementation of wide-ranging sectoral activities over a widely disjointed area of very small sizes failed to bring about any noticeable impact and programme objectives remained farfetched.

In 1994, a High Level Technical Committee under the Chairmanship of Shri Hanumantha Rao reviewed these programmes (see box). Based on the recommendations of the Technical Committee, comprehensive Guidelines for Watershed Development were issued in October 1994. These Guidelines were applicable to three main programmes, namely, Integrated Wastelands Development Programme (IWDP), Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP). These guidelines have been revised periodically. The latest guidelines that have been issued in consultation with the Planning Commission in 2008 are aimed at developing a unified perspective by all ministries. Referred to as "Common Guidelines for Watershed Development Projects", these guidelines are applicable to watershed development projects in all departments / ministries of Government of India concerned with Watershed Development Projects and indicate a fresh framework for the next generation watershed programmes. The key features of this new unified approach are outlined as follows:

I. **Delegating Powers to States:** States will now be empowered to sanction and oversee the implementation of watershed projects within their areas of jurisdiction and within the parameters set out in these guidelines.

II. **Dedicated Institutions:** There would be dedicated implementing agencies with multi-disciplinary professional teams at the national, State and district levels for managing the watershed programmes.

III. **Financial Assistance to Dedicated Institutions:** Additional financial assistance would be provided for strengthening of institutions at the district, State and national levels to ensure professionalism in management of watershed projects.

IV. **Duration of the Programme**: With the expanded scope and expectations under this approach, the project duration has been enhanced in the range of 4 years to 7 years depending upon nature of activities spread over 3 distinct phases viz., preparatory phase, works phase and consolidation phase.

V. **Livelihood Orientation:** Productivity enhancement and livelihoods shall be given priority along with conservation measures. Resource development and usage will be planned to promote farming and allied activities to promote local livelihoods while ensuring resource conservation and regeneration. The new approach would systematically integrate livestock and fisheries management as a central intervention and encourage dairying and marketing of dairy products. In the rain-fed areas, animal resources become a major source of income for the people. When effectively integrated with the Watershed Development Projects, a comprehensive animal husbandry component would contribute significantly to

ensuring a better and sustainable livelihood for the people of the rainfed areas.

VI. **Cluster Approach**: The new approach envisages a broader vision of geo-hydrological units normally of average size of 1,000 to 5,000 hectares comprising clusters of micro-watersheds. If resources and area exist additional watersheds in contiguous areas in clusters may be taken up. However smaller size projects will be sanctioned in the hilly / difficult terrain areas.

VII. **Scientific Planning**: Special efforts need to be made to utilize information technology and remote sensing inputs in planning, monitoring and evaluation of the programme.

VIII. **Capacity Building:** Capacity Building and training of all functionaries and stakeholders involved in watershed programme implementation would be carried out aggressively with a definite action plan, requisite professionalism and competence.

IX. **Multi Tier Approach:** A multi tier ridge to valley sequenced approach should be adopted towards the implementation of the Watershed Development Projects. The higher reaches or the forests are actually where the water sources originate. The approach, therefore, would be to identify an area and first look at the forest and the hilly regions in the upper water catchments, wherever possible. When suitable treatment is undertaken, with the support of the Ministry of Environment and Forests, or from the States' forest programmes or other sources, the hardest part of the watershed is tackled. The forest department is managing structures, such as check dams, contour-bunds,. to arrest erosion and degradation of the forests, which in turn, actually benefits the lower tiers. Thus, in the upper reaches, which are mostly hilly and forested, the onus of implementation would mainly lie with the forest departments and the Joint Forest Management Committees (JFMC).

The second tier is the intermediate tier or the slopes, which are just above the agricultural lands. In the intermediate slopes, the watershed management approach would address all the necessary issues by reviewing all the best possible options, including treatment, cropping pattern, horticulture, agro-forestry, among others.

In the third level, that of the plains and flat areas, where typically the farmers operate, there would be a large concentration of labour intensive works. The watershed development process would be synergized with employment generating programmes, such as the National Rural Employment Guarantee Scheme (NREGS), Backward Regions Grant Fund (BRGF), thus providing strong coordination.

Table 13: *State-wise Coverage of DPAP Area*

States	No. of Districts	No. of Blocks	Area in Sq. Kms.
Andhra Pradesh	11	94	99218
Bihar	6	30	9533
Chhatisgarh	8	29	21801
Gujarat	14	67	43938
Himachal Pradesh	3	10	3319
Jammu & Kashmir	2	22	14705
Jharkhand	14	100	34843
Karnataka	15	81	84332
Madhya Pradesh	23	105	89101
Maharashtra	25	149	194473
Orissa	8	47	26178
Rajasthan	11	32	31969
Tamil Nadu	16	80	29416
Uttar Pradesh	15	60	35698
Uttaranchal	7	30	15796
West Bengal	4	36	11594
Total	**182**	**972**	**745914**

Source: Ministry of Rural Development, Government of India

The Desert Development Programme (DDP) was started both in the hot desert areas of Rajasthan, Gujarat and Haryana as well as the cold deserts of Jammu & Kashmir and Himachal Pradesh in 1977–78. During 1995–96, on the recommendations of the Hanumantha Committee Report, the coverage was extended to a few more districts in Andhra Pradesh and Karnataka. In hot sandy desert areas, sand dune stabilization and shelterbelt plantations were given greater weightage. While in cold desert areas, since rainfall is negligible, crop cultivation and afforestation could be taken up only through assured irrigation.

Table 14: *State-wise Coverage of DDP Area*

States	No. of Districts	No. of Blocks	Area in Sq. Kms.
Andhra Pradesh	1	16	19136
Gujarat	6	52	55424
Haryana	7	45	20542
Himachal Pradesh	2	3	35107
Jammu & Kashmir	2	12	96701
Karnataka	6	22	32295
Rajasthan	16	85	198744
Total	**40**	**235**	**457949**

Source: Ministry of Rural Development, Government of India

Rajasthan has distinct problems because of large tracts of hot arid (sandy) areas. In view of this sand dune stabilization is being done in 10 districts of this State (Barmer, Bikaner, Churu, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali and Sikar), and special projects under the DDP are being implemented since 1999–2000 for combating desertification by way of shelterbelt plantation, sand dune fixation and afforestation.

The DDP is a centrally sponsored programme and funds are directly released to DRDAs / Zilla Parishads for implementation of the programme. Several evaluations have shown that due to the implementation of watershed projects under DDP, the overall productivity of the land and the water table have increased and there has been a positive and significant impact on the overall economic development of the project areas. The studies also showed that the green vegetative cover has improved in desert areas which would have a positive impact in checking soil erosion by water and wind.

Convergence Approach: It is important to pursue convergence of other development schemes and programmes with watershed development projects. The resources available under other Government of India programmes such as the Backward Regions Grants Fund (BRGF) and the National Rural Employment Guarantee Scheme (NREGS) could be utilized for implementing artificial ground water recharging, renovation and repairs of tanks and wells, and other water resources.

Box: Watershed Development in India:
Recommendations of Hanumantha Rao and Parthasarathy Committee Report

A High-Level Technical Committee under the chairmanship of Prof. C.H. Hanumantha Rao, Ex-Member Planning Commission, constituted in April 1993 to revamp DPAP and DDP, suggested a set of common guidelines for bringing together different schemes under the Ministry of Rural Development (MoRD). The committee suggested active encouragement of community participation and a greater role for NGOs.

The common Guidelines for Watershed Development provide for a uniform strategy in the implementation of all area development programmes. The main features of this strategy are:

- Area development programmes to be implemented exclusively on watershed basis.
- Programme activities to be confined to the identified watershed of about 500 hectares and to be executed on a project basis spanning a period of 4–5 years.
- Watershed project to cover one whole village, as far as possible.
- Direct participation of the people in planning and development of watershed areas and maintenance of assets in the post-project period.
- Panchayati Raj Institutions have the right to monitor and review the programme at district, block and village levels. They can also function as project implementation agencies if they so desire.

A new technical committee under the chairmanship of S. Parthsarathy was constituted by the Ministry of Rural Development to review the issues relating to the organization and implementation of the watershed programme, prioritize areas and suggest approaches to special problem areas such as DPAP and DDP.

The Parthasarathy Committee Report has suggested a reformed and expanded watershed programme, which would include a package of sustainable dryland agriculture practices. The report emphasized the issues of participation, transparency and equity in the implementation of watershed programmes. It has recommended the inclusion of development of fodder banks, dairying, and fisheries in watershed programmes.

Regarding the implementation mechanism, the report recommended that the functional responsibility for preparing, implementing and managing the watershed action plan would be vested with a Village Watershed Committee (VWC). While the VWC is empowered to decide and implement works, the details of the action plan formulated after consulting members of the community has to be approved by the Gram Sabha after an open discussion. At the national level, all functions relating to watershed development would be vested with a separate and autonomous entity, now known as the NRAA.

Source: Ministry of Rural Development, Government of India

Integrated Watershed Management Programme (IWMP)

Watershed development programmes envisage a greater role for PRIs, particularly Gram Panchayats and self-help groups / user groups particularly during implementation. It is stipulated that project implementing agencies be preferably selected from amongst the PRIs. Further, it is mandatory for the Secretary, Watershed Committee to provide all information regarding the action plan — the funds earmarked for various activities, details of expenditure incurred, progress of work and future action plans — to the Gram Panchayats / Gram Sabhas. The watershed action plan should also form part of the annual action plan of the Gram Sabha.

The DPAP and DDP emphasize activities based on low-cost and locally accessed technology. Accordingly, land development including in-situ soil and moisture conservation measures, water resource development to increase land productivity, afforestation for biomass production and pasture development to support livestock population are the broad categories of activities under the programme. Besides, these programmes also include a component for alternative livelihood creations for the landless by organizing self-help groups.

In 2009, Integrated Wastelands Development Programme (IWDP), Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP) have been consolidated into a single programme named Integrated Watershed Management Programme (IWMP) in place of all the above mentioned three Area Development Programmes. The cost norm will be Rs.12,000/ - per hectare for the plains and Rs.15,000/ - per hectare for the hilly and difficult areas. The cost will be shared in the ratio of 90:10 between Centre and States. All the watershed projects being implemented under the NREGS too will apply the same cost norms as the IWMP.

At present, 972 blocks of 182 districts in 16 States are covered under the programme. The most recent identification of DPAP blocks was made on the recommendations of the Hanumantha Rao Committee in 1994–95 (Table 13). The States are Andhra Pradesh, Bihar, Chattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Rajasthan, Uttaranchal, Uttar Pradesh and West Bengal.

Recommendations for Drought Mitigation

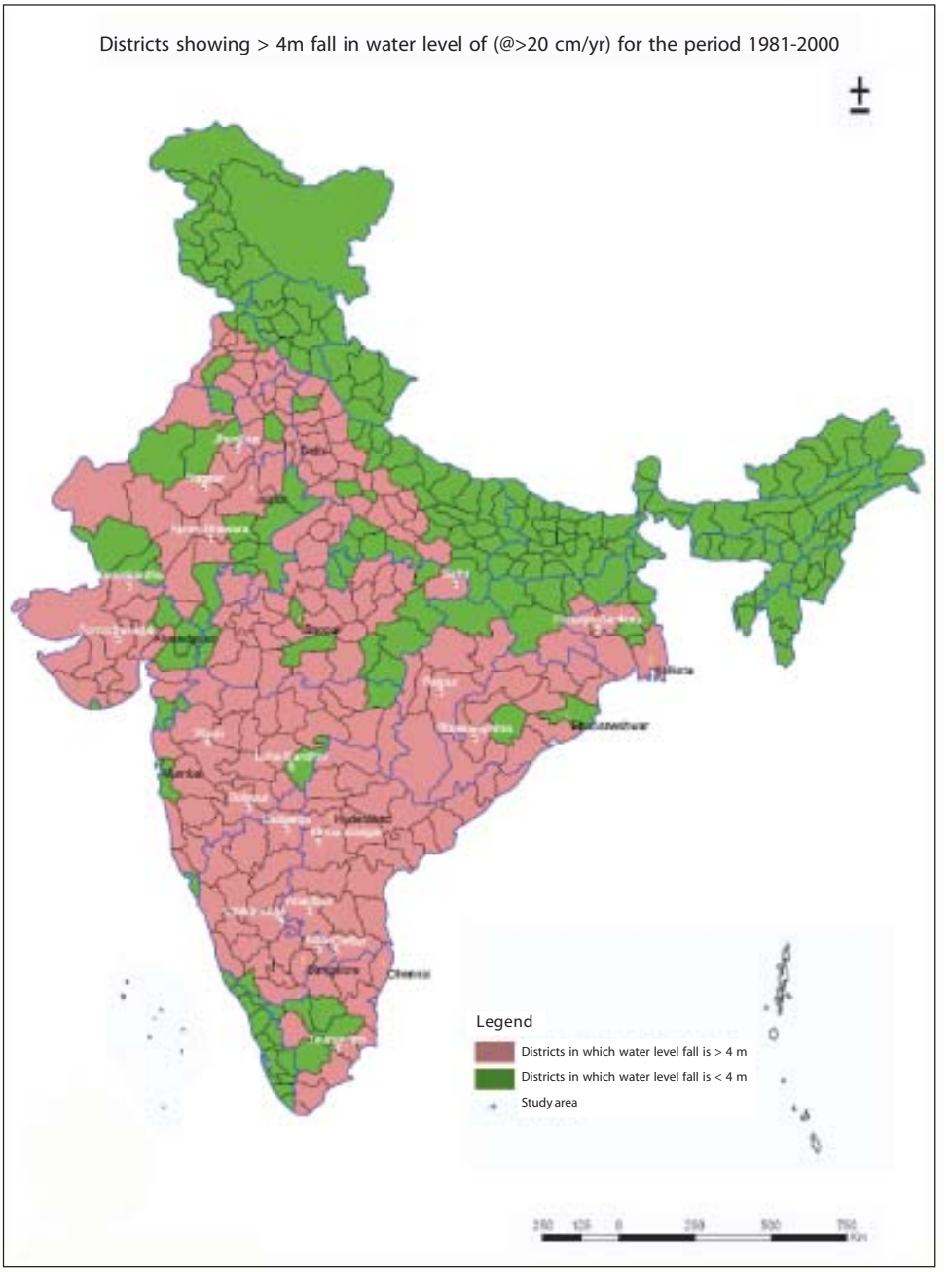
Set up a Mission / Task Force on Drought Mitigation

- The State Government should set up a mission / task force on drought mitigation. The mission / task force would not engage in actual day-to-day drought management, which would be handled by the relief administration. It would be a body advising the State Government on policies and programmes.
- The mandate of the mission / task force should consist of analyzing the patterns of drought, distribution of impacts across sectors in the State, developing a database on the different indices of drought and suggesting policies and programmes for drought mitigation.
- The mission should include experts on water resources, agriculture, forestry and related subjects, senior Government officials dealing with these subjects, and NGOs.
- The mission should be supported by a small secretariat through the departments of disaster management / water conservation / agriculture.

Conduct Drought Risk and Vulnerability Assessment

- The mission / task force on drought mitigation should conduct a drought risk and vulnerability assessment for the State.
- Risk assessment should include identification of drought-prone areas of the State, nature and severity of drought, vulnerable economic sectors, communities and individuals. The assessment would evaluate the socio-economic cost of drought, by estimating crop losses, decline in dairy production, livestock losses, industrial and energy production losses and the adverse impact on environment in the State. Such an assessment is important for presenting an economic rationale for interventions and identifying mitigation measures.
- Vulnerability assessment study underlying socio-economic factors which aggravate the impact of drought. It would examine the livelihood patterns, impact on income and consumption, social capital, migration and social security system, which influence the vulnerability of people. Such an assessment would be necessary to suggest measures for developing new watershed, irrigation and agricultural practices, for diversifying rural economy and introducing new risk management measures in the primary sector.

Map 7: *Decline in Water Level during 1981–2000*



Source: Central Ground Water Board

- A composite risk and vulnerability assessment would help develop long-term policies and programmes for drought risk mitigation at the State level. It would address emerging issues of climate variability and natural resource management and contribute to a national strategy for addressing these critical issues.

Identify Programmes and Measures for Drought Mitigation

- The mission / task force should identify programmes and measures for drought mitigation on the basis of the various indices of drought. These programmes and measures relate to the management of irrigation, crop planning, soil and water conservation, agro-forestry, among others. Depending on the actual situation, the mission should recommend the implementation of certain programmes, which can alleviate the situation.
- The mission / task force should recommend bringing together these programmes and measures for drought mitigation, often implemented individually by different departments. It would create better synergy among programmes and have a better impact on mitigating drought. The mission / task force should prioritize programmes that include the completion of unfinished irrigation and watershed development projects.
- The mission / task force should suggest new innovations for drought risk management, which may include weather insurance, trade in water use, wetland banks, inter-basin and intra-basin water use planning and mandatory urban rainwater harvesting.
- The mission / task force should suggest amending existing laws and regulations for improving the use of ground and surface water and other natural resources for reducing the drought risk.
- The mission / task force should recommend to the Government for increased financial allocation for implementing measures related to drought mitigation.

Develop a Decision Support System for Drought Management

- The mission / task force should recommend establishing automated weather stations and rain gauges to improve the collection of information, promote the use of data related to soil, vegetation and water resource obtained through remote sensing technology and actively support research on climate and natural resource management. Such information provides more analytical tools for understanding drought and making informed policy choices for drought mitigation.

- The mission / task force should recommend the development of a monitoring system within the State for climatic conditions, soil, vegetation and water resources. The monitoring system could be developed on the basis of a data network connecting institutions and agencies responsible for different aspects of drought mitigation. The monitoring system would not only provide information on different aspects of drought, but also assess the effectiveness of any mitigation actions that are implemented.
- The mission / task force should network with all the established research institutions at the national level dealing with remote sensing satellite data, dryland agriculture and natural resource management. It should provide the State with the necessary technical expertise for mitigation solutions. The networking should be anchored through a State institution dealing with drought.

Promote Education and Awareness of Mitigation Policies and Measures

- The mission / task force should encourage education and awareness of drought mitigation issues. People must be informed of the importance of water conservation and harvesting, optimal water use and the need for increasing forest cover. A wide public awareness about the importance of natural resource management is a very important aspect of a long-term drought mitigation programme.
- The mission / task force should serve as a forum for bringing together policymakers and scientific experts. Policymakers tend to have a limited understanding of the scientific and technical issues underlying drought, while scientists have a poor understanding of existing policy constraints for responding to the impacts of drought. The mission / task force should bring these two communities together for developing feasible and practical public policies.
- The mission / task force should encourage academic research on the key indicators of drought and seek more informed public policy choices for drought mitigation. It should serve a much wider purpose if the academic institutions are asked to participate actively in drought mitigation programmes.

Encourage Community-level Plans for Drought Mitigation

- The mission / task force should consider involving different community institutions actively in drought mitigation. Wider the community participation, greater is the public awareness about drought issues and policies and regulations for drought mitigation are likely to be more acceptable in such a situation.

- The mission / task force should consider recommending the necessary policy, programme, and financial support to the PRIs for encouraging drought mitigation. A large number of programmes are being implemented through the PRIs and it is necessary that these institutions are sensitive to the drought mitigation issues. Though the PRIs are generally very active in monitoring local interventions, there is a need to present a bigger picture of the drought risks arising out of mismanagement of drought issues.
- All over the country, self-help groups are being set up, seeking the participation of women in large numbers. Women bear a disproportionate share of the consequences of drought in terms of having to get water from long distances. It would be much easier to initiate an active dialogue with women for pursuing a drought mitigation strategy based on conservation and optimal use of water. The mission / task force should consider encouraging self-help groups to take up drought mitigation programs and for that these groups should be allowed access to resources, knowledge and information.
- The mission / task force should consider involving NGOs and community-based organizations in implementing the drought mitigation strategy. Several Government programmes in soil and water conservation and water supply are being implemented through NGOs. The mission / task force should recommend implementing these programmes in a more integrated manner for effective drought mitigation. The participation of NGOs or community-based organizations in drought mitigation is often problematic for several reasons and the mission / task force should facilitate their participation by removing barriers and establishing an effective partnership with the Government.

Implementing Drought Mitigation Measures

The objectives of these mitigation measures are to reduce soil erosion, augment soil moisture, retard the drainage of rainwater and improve the efficiency of water use. It involves a wide range of soil and water conservation measures and farm practices.

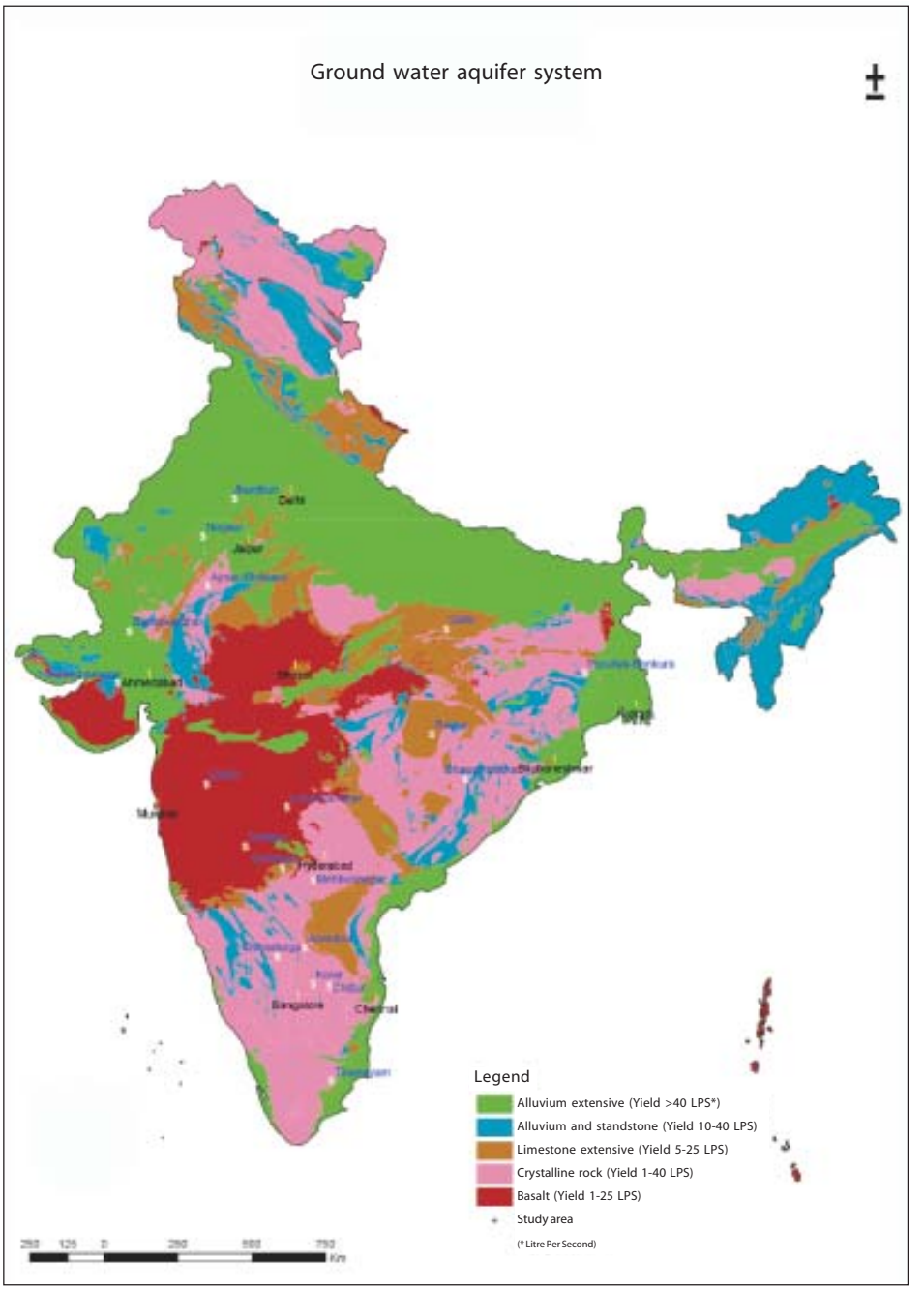
Water Harvesting and Conservation

Water harvesting and conservation refer to processes and structures of rainfall and run-off collection from large catchments area and channelling them for human consumption. In India, these processes and structures have been in existence since antiquity, but the increasing frequency and severity of droughts and population growth have focused on the revival of these practices and structures. Every household's minimum water requirements can be easily met by collecting rainwater locally from village / community ponds / large manmade containers, by diverting and storing water from local streams / springs and by tapping sub-surface water below river / stream beds.

There are two methods for water conservation: (i) artificial recharge of groundwater, and (ii) traditional methods. While the artificial recharge of groundwater is used extensively in all the watershed development programmes being implemented, traditional methods of water collection and harvesting through ponds / tanks are even more important for assuring continuous and reliable access to water. Both methods include measures which are low-cost, community-oriented and environment-friendly. It is necessary for the Government and NGOs working in the area of water conservation to promote both sets of measures, depending on the local conditions.

These methods are considered very useful for groundwater recharge both when rainfall is deficient and when there are flash floods (that result in overtopping of defined courses of rivers / streams and their spreading into flood plains). Harvesting and conservation of floodwater to rejuvenate depleted high-capacity aquifers by adopting integrated groundwater recharge techniques, such as dams, tanks, anicuts, percolation tanks, could improve water availability and create a water buffer for dealing with successive droughts.

Map 8: *India's Groundwater Aquifer System*



Source: Central Ground Water Board

Artificial Recharge of Ground Water

A typical watershed development programme has several components, depending on the topography (shape, configuration and slope of the land), nature and depth of soil cover, type of rocks and their pattern of formation and layout, water absorbing capacity of land, rainfall intensity and land use. These include the following:

Contour Bunding

Contour bunding is one of the most widely practiced soil and water conservation measures, which controls erosion, conserves moisture, recharges groundwater and prevents silting of tanks and reservoirs in the downstream. The practice comprises constructing narrow-base bunds on contour to impound runoff water behind them, so that impounded water is absorbed gradually into the soil profile.

Contour bunding works are undertaken in shallow and medium soils. An area extending from the ridge-line (topmost line) to the valley-line (lowest line) is called a *catchment*. For a bunding project, a self-defended catchment (i.e. the topmost end of the catchment in the selected area is such that no water from outside the catchment drains into it) is selected. In the selected catchment, bunds are constructed on contours. The bunds are normally impounded up to a height of 30 cm. The spacing of the bund is decided based on the slope of the land and the nature of the soil. For gently sloping lands, with 2–3% slope, the bunds are nearly 200 feet apart. The section of a bund is also dependent on the value of the soil. In light soil, the section is 10 square feet, whereas in medium soil it is 24 square feet. About 25 mm of rainwater could be stored at a soil depth of 130–150 mm for growing crops. On average, contour bunds had 27% higher soil moisture and 14–180% higher yield than flat surfaces.

Contour Trenching

This consists of excavating shallow / intermittent trenches across the land slope and forming a small earthen bund on the downstream side. Plantation is done on the bund to stabilize the bund. The trenches retain the runoff and help in the establishment of plantations made on the bund.

Trenches are useful where the land surface is fairly porous. Rainwater that gets collected in the trenches can quickly percolate into the ground. The spacing of trenches and their size (i.e. length, width and depth) should be adequate to intercept about 50% of the peak rainfall in semi-arid regions (annual rainfall of about 400–550 mm). The trenches should be cleaned and desilted periodically.

Contour Cultivation

Contour operations are done across the slope by cultivating crops and trees on the contour. The contour furrows created would form a multitude of mini barriers across the flow path of the runoff. Contour cultivation remains the most effective on moderate slopes of 2–7%. The water in the furrows gets collected in the depressions. Perennial grasses can be grown in such depressions. Another practice called strip cropping involves growing parallel rows of erosion-resistant crops to control loss of surface soil, with other crops grown in between.

Bench Terracing

Bench terracing is practiced on steep hilly slopes where agriculture has replaced natural forest and grasslands since a long time. Thus, further reduction in slope length would reduce the intensity of runoff water. Bench terracing involves converting the original ground into level step-like fields constructed by half cutting and half filling, which reduces the degree of the slope. This approach of bench terracing for agro-forestry models is gradually becoming popular in the hilly areas of Nilgiris, north-east India and Himachal Pradesh.

Graded Bunding

Graded bunds are constructed in relatively high rainfall areas. The excess water has to be removed out of the field to avoid water stagnation, especially in deep black soils. These bunds are outlets for safe removal of water. The channels of graded bunds are wide and shallow.

Gully plugging

Gully plug, as the name implies is a small conservation structure across small gullies and streams in hilly areas to slow the run-off of the flowing water. Gullies result from functional disorder of the land, improper land use and are the most visible result of severe soil erosion. They are small drainage channels, which cannot be easily crossed by agricultural equipment. Gully plugging measures include vegetative plantings and brushwood check dams, boulder bunds, brick masonry and earthen bunds or a combination of both and sand bag plugs.

Check Dams / Nalla Bunding Construction

Check dam / nalla bunding work consists of construction of a masonry embankment across a stream or nalla with surplussing arrangement (waste weirs, at suitable intervals).

These works are undertaken to hold maximum runoff water to create temporary flooding in the stream with arrangements to drain water at suitable intervals. Such embankments depend on the slope of the nalla or off-stream and the quantity of water expected to flow. The impounding of water facilitates percolation of water into deeper soil and makes it possible to bring under cultivation the land under the bed of the nallas. The water released from these bunds is free from silt and very low in velocity and thus unable to cause erosion. Thus, water can be utilized optimally.

Gabion Structure

This is a commonly constructed check dam across small streams to conserve stream flows with practically no submergence beyond the stream course. Locally available boulders are stored in a steel wire. This is put up across the stream's mesh to make a small dam by anchoring it to the streamside. The height of such structures is around 0.5 m and is normally used in 10–15 m wide streams. The cost of such structures is around Rs.10,000–15,000. The excess water overflows from this structure storing some water in reserve which serves as a source of recharge. The silt content of stream water in due course is deposited in the interstices of the boulders to make it more impermeable. These structures are common in Maharashtra, Madhya Pradesh and Andhra Pradesh..

Stream Bank Protection

Eroding stream banks not only damage adjoining agricultural lands but also contribute large quantities of sediment load to the river systems. Under the watershed management programme, bank protection of only small / minor streams is included. However, works of this nature should only be taken up if the benefits justify the cost of construction.

The works usually involved are that of boulder pitching on banks of about 20–30 cm thickness after dressing the bank to a stable slope. Where the flow velocity of the stream is high (1.5 m/sec or more) gabion structures should be built at the toe of the bank with the foundation firmly embedded in the streambed and bank.

Farm Ponds

In any watershed management programme farm ponds are an important component and useful in storing water for irrigation. They also retard sediment and flood flows to the downstream river system. In a relatively flat terrain with good soil cover, a farm pond has an earth section with usually 3:1 side slopes on the waterside and 2:1 side slopes on the downstream face (a uniform side slope of 2½:1 on both sides can be

adopted at some sites). The sides are sodded. A natural depression nearby should be used as an earthen spillway with minimum channel section construction. A pipe drop inlet spillway and an irrigation outlet are also provided. A key trench is dug to provide good bondage between the original ground and the filled earth. Storm riprap against wave action may be required in some cases. The pond crest usually serves as a farm road (provide 4.25 m roadway for motorable roads).

A good pond site should possess the following traits:

- The site for the earthen bund should be a narrow gorge with a fan shaped valley above so that a small amount of earthwork provides large storage.
- The drainage area above the pond should be large enough to fill the pond in 2 or 3 spells of good rainfall
- The pond location should be near where the water is to be used; e.g. for irrigation, it should be above the irrigated fields and for sediment control it should intercept the flow from the most erodible parts of the catchment.
- The junction of two drainage channels or large natural depressions should be preferred.
- The land surface should not have excessive seepage losses unless it is meant to serve as a percolation tank for groundwater recharge.

Percolation Tanks (PT) / Spreading Basin

One of the effective measures by which groundwater recharge can be achieved, is by the construction and use of percolation tanks. The efficacy and feasibility of percolation tanks is better established in hard rock formation where the rocks are highly fractured and weathered.

In Maharashtra, Andhra Pradesh, Madhya Pradesh, Karnataka and Gujarat, numerous percolation tanks are constructed in basaltic lava flows and crystalline rocks.

Percolation tanks are constructed for very small catchments up to 10–12 sq. km., where minor irrigation schemes, bandharas or other storage schemes are not technically and economically feasible. Percolation tank schemes are intended mainly for recharging aquifers and improving the groundwater supply to the wells for drinking water and irrigation. In comparison to ponds, percolation tanks conserve water to a greater extent because the filling and recharge occur mostly during the monsoons when the evaporation rate is about the half of the potential rate in summer through which ponds contain water. Selection of a suitable site for the construction of percolation tanks and subsequent maintenance is crucial for its effective functioning. Where hydro-geological conditions are favourable, percolation rates may be increased by constructing recharge (intake) wells within percolation tanks.

Important Aspects of Percolation Tanks

- A detailed analysis of the rainfall pattern, number of rainy days, dry spells, evaporation rate and detailed hydro-geological studies are required to demarcate suitable percolation tank sites.
- For India's semi arid climate, the storage capacity of the percolation tank needs to be designed so that water percolates to the groundwater reservoir by January since the evaporation losses would be high subsequently.
- Percolation tanks should normally be constructed on second-to-third order streams as the catchment as well as the submergence area would be smaller. The submergence area should be in uncultivable land as far as possible.
- Percolation tanks should be located on highly fractured and weathered rock for speedy recharge. In case of alluvium, bouldary formations are ideal for locating percolation tanks.
- The benefited area should have sufficient number of wells and cultivable land to develop the recharged water.
- Detailed hydrological studies for run off assessment should be done and design capacity should not normally be more than 50% of the total quantum of rainfall in the catchment.
- Waste weir or spillway should be suitably designed to allow the flow of surplus water based on single day maximum rainfall after the tank is filled to its maximum capacity.
- Cut off trench should be provided to minimize seepage losses both below and above the stream bed. To avoid erosion of the embankment due to ripple action, stone pitching should be provided upstream up to HFL (High Flood Line).

Anicuts

An anicut is a small water harvesting masonry dam constructed across a stream to hold sufficient water and submerge the upstream area during the rainy season. The height of the anicut above ground level is about 22 feet. Anicuts are built to serve many purposes among which, recharge of groundwater in adjacent wells, providing water for consumption for animals, for bathing and providing a reservoir of water in water-scarce years, are critical. If the submerged area is large, bed cultivation is practiced using the stored soil profile moisture.

Anicuts are constructed all over the country and are considered very useful in those States where droughts are very common. Anicut construction can be undertaken on a large-scale to seek community participation in watershed development and make them self-reliant in water resource use.

Sub-surface Barriers

A sub-surface barrier is the most suitable artificial structure for promoting groundwater recharge. Since it is constructed below the riverbed on impervious subsurface strata, the structure is secure from floods, does not need elaborate overflow arrangements or periodic desilting and has limited evaporation. In addition, sub-surface structures do not require extensive areas of land for their implementation and hence have minimal ecological repercussions following their construction.

The construction of a sub-surface barrier needs a concrete or brick masonry wall, 30–60 cm wide, extending down to the impermeable / compact basement. A sub-surface barrier should also be constructed with angular rock pieces arranged in the form of a 100 cm wide dry masonry wall or with a 250-micron polyethylene sheeting, properly embedded in the soil. Some arrangement for sub-surface outflow from the dike is often desirable to avoid waterlogging.

Two sub-surface dikes of 100 m length each, within 300 m upstream and downstream of the water supply well, can capture and infiltrate enough water to service potable water requirements of a village with a population of up to 500.

Injection Wells

Injection wells are structures similar to a tube well but with the purpose of augmenting the groundwater storage of a confined aquifer by pumping in treated surface water under pressure. Injection wells are advantageous where land is scarce.

Hydraulically, the effective induction of water in an injection well is determined by the pumping rate, permeability of the aquifer, distance from the stream, natural groundwater gradient and the type of well.

In alluvial areas, an injection well for recharging a single aquifer or multiple aquifers can be constructed on a normal gravel packed pumping well. An injection pipe with an opening against the aquifer to be recharged may be sufficient. However, if there are a number of permeable zones separated by impervious rocks, a properly designed injection well with an inlet pipe against each aquifer to be recharged needs to be constructed. The injection wells as a means of artificial recharge are comparatively costlier and require specialized techniques of tubewell construction supported by operation and maintenance to protect the recharge well from clogging.

Traditional Water Harvesting and Conservation

In India, water harvesting and conservation has been practiced for a long time by local communities through traditional methods and structures. Different eco-regions have

their own water harvesting and conservation structures, which the State Governments should aim to revive and rejuvenate through special schemes. Some of the important structures are discussed below:

Dug Well Recharge

In alluvial as well as hard rocky areas, there are thousands of dug wells either gone dry or with declining water levels. These dug wells can be used as structures to recharge. Ground water reservoirs (storm water, tank water, canal water) can be diverted into these structures to directly recharge the dried / drying aquifer. By doing so the soil moisture losses during the normal process of artificial recharge are reduced.

A dry / unused well can be recharged by installing a pipe to the bottom of the dug well or below the water level to avoid scouring of the bottom and entrapment of air bubbles in the aquifer. The quality of source water including the silt content should be such that the quality of the groundwater in the reservoir is not deteriorated. The bottom of the dug well should be cleaned and all fine deposits should be removed before recharging. The recharge water should be silt-free. The well should be cleaned regularly and periodic chlorination should be done to prevent bacteriological contamination.

In Maharashtra, a two-pit well recharging technology has been used successfully to recharge dug wells. Two percolation pits are dug next to the well, one large and one small. The smaller pit is filled with stones, gravel and coal, which act as a filter. A cement pipe fitted with a wire mesh filter is fixed at the bottom of the smaller pit. This pipe opens into the well. Rainwater that collects in the larger pit, flows into the smaller pit and is filtered before it flows into the well through the pipe. The silt that accumulates in the pits can be used in the fields. In this way, soil is conserved as well.

Village Pond / Tank

Village ponds / tanks are the most commonly used method to collect and store rainwater. Most ponds have their own catchments, which provide requisite quantity of water during the rainy season. Where the catchments are too small to provide enough water, water from nearby streams is diverted through open channels to fill the ponds. In some places water from irrigation canals is also used to fill ponds.

Ponds are excavated in different shapes and sizes depending on the nature of the terrain, availability of land and water requirements of the village community. Pond water is available for 2 months to a year after the rains, depending on the catchment characteristics and the amount and intensity of rainfall. Ponds / tanks are known by different names in different regions (Table 15).

Table 15: *Village Ponds / Tanks in India*

Andhra Pradesh	Tank (Mainly for irrigation)
Assam	Dong
Bihar	Katas, Mundas, Bandhas, Ahars
Gujarat	Kunda (Sacred Ponds), Jheel
Jammu	Chhapris
Karnataka	Volakere, Katte or Kunte, Kola or Kunda, Kalyani
Kerala	Tank (Mainly for irrigation)
Ladakh	Zing
Maharashtra	Sathwan Talav
Nagaland	Zabo
Rajasthan	Johad, Nadi, Talab, Dhab, Toba, or Talai
Sikkim	Khup
Uttar Pradesh	Talab, Johad or Pokhar

Tankas / Kunds / Kundis

In the desert and arid areas of Rajasthan people build unique underground structures of various shapes and sizes to collect rainwater for drinking purposes. These structures called tankas, kunds or kundis are constructed in a variety of places, such as courtyards, in front of houses and temples, in open agricultural fields, barren lands. These are built both for individual households as well as for village communities using locally available materials. While some structures are built in stone masonry with stone slab coverings, others are built with only rudimentary plastering of bare soil surfaces of the tank with cement or lime and covered with *Zizyphus numularia* thorns. Some "kuccha" structures have a convex covering of local wood with mud plaster. Inlet holes are provided in the convex side at the ground level to facilitate entry of rainwater into the tank. In "pucca" structures (e.g. tanka) the wall of the tank is projected above the ground to provide inlet holes.

Since tankas are the main source of drinking water in these areas, people zealously protect and maintain them. Just before the onset of the monsoons, the catchment area of the tanka is cleaned up to remove all possible pollutants, and human activity and grazing of cattle in the area is prohibited. Even though the average annual rainfall in these areas varies from 200 mm to 300 mm with the minimum as low as 120 mm, these structures provide enough drinking water to tide over the water scarce summer months. In many, the stored water lasts for the whole year. These simple traditional water harvesting structures are useful even during years of below-normal rainfall.

Khadin

The khadin, a runoff farming and groundwater recharging system, is popular in hyper-arid parts of Rajasthan. Its main feature is a very long (100–300 m) earthen embankment built across the lower hill slopes lying below gravel uplands. Sluices and spillways allow excess water to drain off. The *khadin* system is based on the principle of harvesting rainwater on farmland and subsequent use of this water-saturated land for crop production. A khadin farm is developed based on rainfall probability, available catchment area and its runoff generation potential. Apart from the submerged area, khadin beds are cultivated from top to bottom, the line of receding moisture. Ponding of water in a khadin induces continuous groundwater recharge.

Vav / Vavdi / Baoli / Bavadi / Jhalara

These are traditional stepwells in Rajasthan and northern India. Often rectangular in design, these structures have steps on three or four sides. These ancient water harvesting systems collect subterranean seepage of a talab or a lake located upstream. They were mainly set up by the nobility in cities and big towns to provide water supply to the community. They were constructed at exorbitant cost and were often monumental, with fine stone work covering large areas and were associated with religion and culture.

Hill Slope Collection

This system is common in many hilly areas with good rainfall (in Uttarakhand, Himachal Pradesh, Meghalaya, Arunachal Pradesh). It consists of lined channels that are built across the hill slopes to intercept rainwater. These channels convey water for irrigating terraced agricultural fields. The water is also used to fill small ponds for domestic use and for cattle.

Spring Water Harvesting

In the Lahaul and Spiti areas of Himachal Pradesh, water from hill streams are diverted through small excavated channels, called kuls, for domestic use and irrigation. In Jammu region these are called kuhals. This practice can also be seen in Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Sikkim and Darjeeling area of West Bengal. Where the springs are merely in the form of water trickling through layers and joints in rocks, split bamboo channels are used to trap and convey water up to the village / hamlet for drinking purposes.

Rainwater Harvesting in Urban Areas

Rainwater harvesting involves the collection, storage and distribution of rainwater from the roof, for use inside and outside the home or business. In most urban centres, rainwater harvesting has become necessary to address the acute water scarcity, which they experience and the flooding during short spells of heavy rainfall. Most of the rain falling on the surface tends to flow away rapidly leaving very little for recharge of groundwater. Capturing the runoff is therefore an important solution to the worsening urban water situation.

Rainwater harvesting has several benefits. It helps in utilizing the primary source of water, and prevents the runoff from going into sewers or storm drains, thereby reducing the load on treatment plants. It also reduces urban flooding and by recharging water into the aquifers, helps in improving the quality of existing groundwater through dilution.

Rainwater harvesting can be harvested from the following surfaces:

Rooftops: If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and can provide enough supply.

Paved and unpaved areas: Landscapes, open fields, parks, stormwater drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using the ground as a collecting surface is that water can be collected from a larger area. This is particularly advantageous in areas with low rainfall.

Waterbodies: The potential of lakes, tanks and ponds to store rainwater is immense. The harvested rainwater not only meets the water requirements of the city, it also recharges groundwater aquifers.

Stormwater drains: Most of the residential colonies have a proper network of stormwater drains. If maintained neatly, these offer a simple and cost-effective means for harvesting rainwater.

The decision on whether to store or recharge water depends on the rainfall pattern and the potential to do so, in a particular region. The sub-surface geology also plays an important role in making this decision.

For example, in Delhi, Rajasthan and Gujarat where the total annual rainfall occurs during 3 or 4 months, are examples of places where groundwater recharge is usually practiced. In places such as Kerala, Mizoram, Tamil Nadu and Bangalore where rain falls throughout the year barring a few dry periods, a small-sized tank for storing rainwater is enough, since the period between two spells of rain is short. Wherever sub-strata are impermeable, recharging would not be feasible. Hence, it would be ideal to opt for storage.

Features of Roofwater Harvesting Systems

Rainwater is clean and can usually be used for drinking and domestic purposes without filtering, depending on the cleanliness of the roof and storage system. In many cities, it is now mandatory for the residents to install roofwater harvesting systems with the following main features:

- *Basic requirements*: a roof (preferably rectangular), gutters, down pipe, cement base and storage system. Corrugated iron or tiled roof preferable, but closely packed thatching also works (do not use asbestos). Low cost guttering systems can be made from split bamboo.
- *Storage systems* range from earthenware jars to large tanks of 30,000 litres capacity.
- *Below ground storage systems*: generally are cheaper to construct because of the support of the sidewalls but they require a pump to lift the water and are more difficult to clean.
- *Partial below ground systems*: a circular hole is dug into the ground and lined with polyethylene or concrete plastering. It is covered with a roof (from thatch or iron sheets) to protect the water from sunlight, birds and animals.
- *Above ground storage*: constructed from curved galvanised sheets, ferro-cement or bricks to form a round tank. This system does not require a pump, cleaning is easier and leaks can be detected easily. A concrete base is desirable.

Storage systems should prevent mosquitoes entering and breeding in the water, and prevent sunlight that stimulates algae growth. Easy access to all storage systems is necessary for periodic cleaning. A first flush system can be incorporated to flush away the first rainwater which has dislodged leaves and dirt after a long dry spell.

- *Amount of water collected*: A house with a 7 m x 7 m roof can capture 500 litres of water from 10 mm of rainfall. An area with an annual rainfall of 750 mm and a 75% efficient well designed and constructed system, yields 28,000 litres per year. If an average family consumes 100 litres per day then there is enough water for 280 days (assuming there is sufficient storage).

Water Saving Technologies: Drip and Sprinkler Irrigation Systems

State Governments are encouraging adoption of water-saving technologies, such as sprinkler and drip irrigation systems, through provision of subsidies to the farmers on the purchase of these systems. These technologies are recommended for achieving higher irrigation efficiencies and could be used for very small-sized holdings.

While sprinklers require energized pump sets, microtube drips can work under a very low-pressure head, with as little as a bucket full of water. Sprinklers tend to irrigate

more uniformly than gravity systems and therefore efficiencies typically average about 70%. But in windy and dry areas much water can be lost due to evaporation in this system. The sprinkler system is particularly effective in sandy undulating terrain. For fruits, vegetables and orchard crops, drip irrigation (also known as trickle irrigation) is more suitable.

These systems require much less maintenance when compared with the conventional pressurized irrigation systems. The ease of maintenance is more significant in microtube drip systems. However, the adoption of these technologies by poor farmers would depend heavily on the supply of information, materials and services for installation.

Improved Water Saving Farm Practices

It is necessary to adopt farm practices which can progressively reduce the water requirement of existing crops and improve primary productivity of the cultivated land. Such practices are particularly important for semi-arid regions which have already taken to intensive farming with irrigation water, both from canals and aquifers. These practices include the increased use of organic manure with the gradual reduction of chemical fertilizers, vermin-culture and agronomic practices, such as mulching, crop rotation and the use of biopest control measures. Organic manure can help regain structure and texture of soils and enhance their moisture retention capacity along with improving soil nutrients. Use of farm management practices, such as mulching, can reduce evaporation from the soil surface, thereby increasing the efficiency of irrigation water utilization.

Long-term Irrigation Management

A long-term strategy is required for managing water resources through irrigation projects in India. It consists of several measures which would expand the area under irrigation and reduce the incidence of drought. All State Governments need to develop policies and procedures for utilization of irrigation resources. The State irrigation department should formulate long-term policies and management practices for the use of irrigation resources. The important elements of these policies and management practices are listed below:

Monitoring Reservoirs: It is necessary for the State irrigation department to set up a monitoring system for water stored in reservoirs, exercise appropriate control on releases of water from these reservoirs and plan for judicious use of water resources. The State irrigation department should prepare a water budget for every reservoir

covering drinking water, kharif / rabi requirements and evaporation losses. Many details of reservoir management have been discussed in the chapter on water resource management in the previous section.

Setting up Water Users Association: State Governments should provide incentives for setting up Water Users Association (WUA) to involve communities in the management of irrigation resources. WUAs should be formed at the minor canal level (average command of 500 hectares). The responsibility for maintaining the minor and smaller channels can be entrusted with the WUAs. The State irrigation department should charge WUAs on the basis of the volume of water actually taken. Incentives for setting up WUAs could be provided to the farmers by relaxing designated crop restrictions and restrictions on conjunctive use of surface and groundwater, channel repairs, rebates for prompt payment of irrigation fees, volumetric fees lower than crop-area fees and maintenance grants.

Conjunctive Use of Surface and Groundwater: This concept is very essential, especially in drought areas to increase the production per unit of water. It allows flexibility in cropping patterns and multi-cropping in the canal command. For proper water management it is necessary to treat the command areas as one composite unit and the two resources managed judiciously to achieve optimal benefits. This concept use has been successfully implemented in various States. Conjunctive use of surface and groundwater supplies needs careful planning on more scientific lines to achieve full benefits.

Prevention of Evaporation Losses from Reservoirs: Shallow tanks having large surface areas located in the drought-affected regions lose nearly half the volume of stored water by evaporation during the summer months. The evaporation is quite high (250 cm or more) in West Rajasthan, Saurashtra, Deccan Plateau and Southern Coastal regions of Tamil Nadu. In these areas use of a chemical retardant to minimize evaporation losses may be economically viable. A layer of chemicals like cetyl, steary and fatty alcohol emulsions when applied on the water surface can help reduce evaporation. It has been reported that fatty alcohol emulsions can effectively retard evaporation, saving around 40% of the normal evaporation losses.

Increasing Storages through Expeditious Completion of Irrigation Projects: Water storage capacity in the States could be increased through expeditious completion of irrigation projects. Many States that started a large number of irrigation projects, could not complete them due to inadequate resources. States should seek resources through the Accelerated Irrigation Benefits Programme (AIBP) of the Government of India for completing these projects and increasing the area under irrigation.

Integrating Small Reservoirs with Major Reservoirs: As large dams are difficult to construct due to high costs and large-scale displacement of people, there is an increased emphasis on creating small reservoirs. A number of small reservoirs could be created to replace a single large reservoir. However, in many cases a group of small schemes may not provide the same benefits as a large project can. It is, therefore, very important that minor schemes are integrated with the canal systems of major reservoirs.

Integrated Basin Planning: This concept is aimed at coordinating water resources plans throughout a river basin, the most important example of which is the Tennessee Valley Authority in the USA. In India, the Damodar Valley Corporation covering the river Damodar and its tributaries in Bihar and West Bengal was modeled on the lines of the Tennessee Valley Authority.

The philosophy of river basin development, however, underwent significant changes during the latter half of the twentieth century. In 1950, the construction of multiple-purpose dams and other engineering works along a river's main channel was central to the concept. The region benefited through navigation, flood control, hydropower generation and distribution, and agricultural development. By the end of the century, however, the concept shifted and broadened and laid emphasis on the values of biodiversity, nonstructural means of improved water management and stakeholder participation in watershed-level initiatives. All States need to adopt integrated basin planning for addressing wide-ranging issues of natural resource management.

Inter-basin Transfer of Water: The permanent long-term solution to the drought problem may be found in the basic principles of transfer of power from surplus river basins to the areas of deficit. Many basins in the country have surplus water resources while others face serious shortages. Creation of storages and inter-basin transfer of water from surplus to deficit regions could therefore be an option for achieving more equitable distribution and optimal utilization of water resources. It has been argued that a National Water Grid could be set up by linking resource abundant rivers such as the Brahmaputra and Ganga with other rivers. Long distance water transfer is not a new concept in India. There are a number of canals, such as the Western Yamuna Canal and Agra Canal in north India, and the Kurnool–Cuddapah Canal and the Periyar–Vaigai Canal in south India, which have carried water for long distances and irrigated water deficient areas. However, these projects would require huge commitment of resources as well as popular support across the States.

Afforestation

It is well-known that the development of forests in areas, which are susceptible to periodic recurrence of drought, is indeed a very effective drought-resistant measure. Areas which are devoid of tree growth suffer serious erosion and need to be covered with vegetation in the shortest possible time with a view to mitigate drought conditions.

Drought-affected areas have vast expanses devoid of vegetation, depleted of tree growth and exposed parent rocks and boulders. The accelerated run-off in these areas is so large that all the surrounding agricultural land cannot even support marginal or subsistence agriculture. To remedy this, vegetation on hill slopes, catchments and other vulnerable areas need to be undertaken, particularly where rainfall is low.

Trees and vegetation not only protect the soil, improve its water holding capacity, minimize run-off, regulate drainage (both surface and underground), but also preserve and improve the productive capacity of the soil and fertility of agricultural land in the vicinity. The tree foliage or foliage of any effective vegetation, whether it is shrubs, bushes or even well-pastured grass, forms a sheltering shield or canopy which breaks down the intensity of torrential rain and thus reduces its erosive action on the soil below. Furthermore, when this water with reduced velocity reaches down, it does not flow down to the rivers and onwards to sea but is absorbed at the surface due to the vegetation. This recharges ground and surface waters resulting in water reservoirs with perennial rather than seasonal storage.

Before the afforestation programme is taken up, a thorough inspection and classification of the areas needs to be conducted. The land identified for afforestation should be divided into three categories: (i) areas with adequate depth of soil to make afforestation feasible; (ii) areas with shallow soils fit for supporting grass and shrub growth but not fit for tree growth; (iii) badly degraded and eroded areas unfit for tree growth and shrubs and where only soil and moisture conservation operations should be carried out.

In drought-prone areas, planting of drought-resistant varieties of trees should be considered. Fruit trees, such as sitafal (annona squamosa) and drought-resistant fodder species, may not only be useful as an afforestation measure, but also enable the supply of fodder to the cattle. Different species of bushes and shrubs should be planted, which not only prevent soil erosion but also provide a leaf-hedge against cattle and barrier against fire when planted like a boundary or fence.

Afforestation should be financially supported through the social forestry programme or watershed development programme which normally includes a budget for this activity. Afforestation should be taken up on a large scale with the participation of PRIs.

Crop Insurance

The adverse financial impact of drought on the farmers can be mitigated through agricultural insurance. Though agricultural insurance schemes have not been very successful, the Government of India has taken several initiatives towards increasing its coverage and reach.

An All-Risk Comprehensive Crop Insurance Scheme (CCIS) for major crops was introduced in 1985 and subsequently replaced by the National Agricultural Insurance Scheme (NAIS) in 1999. The scheme, at present, is being implemented in a large number of States and Union Territories.

As per provisions of the scheme, farmers are not required to file / lodge any claims. The scheme operates on an area-based approach. Accordingly, the payment of claims in a notified area become payable if there is a short fall in yield against guaranteed yield due to any non-preventable risk. In other words, if the current season's yield is less than the threshold yield of the notified unit area for the insured crop, all farmers in the notified area growing insured crop become eligible for compensation. Indemnity claims under the scheme are calculated and settled by the Agriculture Insurance Company of India Ltd. (AIC) which is the Implementing Agency of the Scheme.

The Government of India set up the Agriculture Insurance Company of India (AIC) in 2003 to subserve the needs of farmers better and to move towards a sustainable actuarial regime.

A number of schemes should be introduced for providing farmers suitable protection against the impact of drought. At present, the AIC is implementing "Sookha Suraksha Kavach (Drought Protection Cover)" in Rajasthan for popular crops, such as guar, bajra, maize, jowar, soyabean and groundnut. The policy compensates the insured against the likelihood of diminished agricultural output / yield resulting from shortfall in the actual normal rainfall index within a specific geographical location and specified time period subject to a maximum of the sum insured specified in the schedule to the policy.

Another scheme is the Varsha Bima (rainfall insurance), which covers anticipated shortfall in crop yield on account of deficit rainfall. Varsha Bima is voluntary for all classes of cultivators who stand to lose financially due to adverse incidence of rainfall. The Government of India has introduced a Weather-based Crop Insurance Scheme (WBCIS), which is intended to provide insurance protection to the farmers against adverse incidence, such as deficit and excess rainfall that are deemed to adversely impact crop production. The WBCIS is based on actuarial rates of premium but to make the scheme attractive, premium actually charged from farmers have been restricted

to be at par with NAIS. A number of similar insurance products need to be developed for the different agro-climatic zones providing coverage against drought. AIC is expected to invest in the development and testing of insurance products for protecting farmers against the vagaries of nature. Other insurance companies also need to participate in the development of agricultural insurance so that farmers have a greater choice of insurance policies and schemes.

State Governments need to participate in these agricultural insurance programmes and if necessary provide subsidy on the premium paid by farmers. Farmers need to be informed about the availability of insurance products and educated about the need for managing their yield and income risks by getting insurance coverage. As the coverage of agricultural insurance in the country increases, insurance schemes for drought protection would become more viable.

Community Participation in Drought Mitigation

Community participation is an essential feature of drought mitigation programmes. As local water management and rainwater harvesting hold the key to drought mitigation, Government policies should emphasize community-based water resource management. Community-based institutions, such as WUAs, can play important roles in managing water resources at the micro level.

Build on Micro-level Experiences: The villages of Sukhomajri in Haryana and about 100 communities in Alwar have improved their socio-economic conditions through community-led water management. These communities used traditional water harvesting structures, such as village tanks and johads, which increased the groundwater table in the area, resulting in increased water storage and substantial increase in crop production and resultant income. Ralegan Siddhi and Hirve bazar from Ahmednagar district are the other successful examples of community-based initiatives in water resource management. These micro-level success stories need to be spread to other parts of the country for other communities to replicate.

Innovate Community-based Institutions: Several models of community-based institutions have emerged, which are effectively managing surface and groundwater. In Orissa, the 'Pani Panchayat programme' assigns various roles to the community and the local self-government in water management and is preparing community-based drought management plans. In Ozhar, Maharashtra WUAs are enabling farmers to manage irrigation water. In Banikhet, Himachal Pradesh the lift irrigation project deals with various aspects of water use, such as water charges, local maintenance. In Rajasthan, communities are participating in checks on rainwater loss and thus ensuring the

enhancement of groundwater. State Governments need to build on these examples and encourage the formation of community-based organizations for effective management of water resources.

As discussed above, State Governments need to encourage the formation of WUAs for community-based management of water delivery system. Maharashtra has taken the lead in 1990 in forming WUAs, and its State Government has handed over the management of the entire irrigation systems of Niphad block, where the irrigation dam is situated, to the WUA network. WUA-like initiatives have been launched in Tamil Nadu, Andhra Pradesh, Rajasthan, Madhya Pradesh and Orissa, which also suffer from water scarcity. Legislations dealing with transferring of water management to WUA-like groups are being formulated in all these States.

Organize Community-based Consultations through Gram Sabha: Community-based consultations refer to community decisions, collective contribution, self-regulations, and negotiations with the Government conducted through Gram Sabhas, in particular and PRIs in general. These processes can be very important for the management of water, fodder and crops at the community-level. Further, these processes can also lead to meeting the basic entitlements through provision of work and food to people affected by drought.

Strengthen Women's Self-help Groups: Self-help groups empower women and help them to access resources. Women start economic activities and generate an independent stream of income. While it has an empowering impact on women, it also increases resilience of the households in responding to drought. Those households who depend solely on agriculture for their livelihoods suffer badly due to income and consumption losses, while diversified households cope with the impact better. These self-help groups could be formed and strengthened through many interventions at the community level.

Women's self-help groups can play an important role in a large number of measures targeted at drought mitigation. They could be involved in rainwater harvesting, running PDS shops, Aanganwadis and day care centres and overseeing water distribution and utilization in their community. Since women are the most affected in a drought situation, they could plan several measures that reduce their hardships and promote greater equity and efficiency in natural resource management. Women's self-help groups could also come forward in addressing special needs of certain groups, such as pregnant women, school-going children and the old and disabled people. During a drought situation, the well being of these groups can only be ensured through the active support of women's groups.

Empower Panchayati Raj Institutions: Several drought relief and mitigation measures could be implemented through the PRIs more effectively. The necessary budget allocations and implementation support should be provided to these institutions for launching programmes in drought-affected areas. PRIs improve the delivery mechanism and reduce the impact of drought. The examples of several droughts have shown the importance of involving these institutions in drought management.

Climate Variability and Adaptation

Climate variability refers to the climatic parameter of a region varying from its long-term mean. Every year in a specific time period, the climate of a location is different. Some years have below average rainfall, some have average or above average rainfall. Due to the phenomenon of climate change affecting India, such variability would have an impact on agriculture. As a result of variability, the hydrological cycle is likely to be altered and the severity of droughts and intensity of floods in various parts of India is likely to increase. Further, a general reduction in the quantity of available run-off is predicted. Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increases in different parts of India.

Incidence of **pests and diseases** may increase with climate variability and climate change. With long dry spells and more intense rainfall, the resulting decline in water quality will lead to greater risk of water-borne diseases. Changing temperatures and rainfall in drought-prone areas are likely to shift populations of insect pests and other vectors and change the incidence of existing vector-borne diseases in both humans and crops.

Livelihood activities that rely on sensitive agricultural systems will be more vulnerable to climate change. Trends such as population growth, pollution, increasing demand for food and water and market fluctuations can compound the impact of climate variability and climate change.

Climate variability would require farmers to adapt. **Adaptation** is a process by which strategies to moderate, cope with or take advantage of the consequences of climatic events are enhanced, developed and implemented.

Adaptation options need to benefit the community and ensure community participation so that experiences of local-level adaptation strategies can be shared. To implement adaptation measures in the agriculture sector, it is necessary to understand the potential impacts of climate change and local perceptions. The basic understanding in the context of climate change adaptation in drought-prone areas is that the

adaptation option should have the potential to improve the livelihood assets (human, natural, financial, physical and social) of rural people.

Through efforts to determine the viability of adaptation options, it is actually possible to create a menu of adaptation options for the development planning process with the potential to be integrated into the existing institutional agenda. Short-term cropping, inter-cropping, small-scale fodder cultivation, small-scale fish cultivation in mini-ponds, homestead gardens and farm ponds for rainwater harvesting are some of the examples of adaptation practices that can be adopted at the local level. These livelihood practices which improve the adaptive capacity of the farmers is likely to be a regular feature of the drought management program.

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ANNEXURES

Annex 1: Drought Forms

Form No.1

Daily Rainfall at Taluka / Tehsil/ Block Level / District Date:

Sr. No	Taluka Tehsil / Block / District	Actual Rainfall as on the Day	Average Rainfall during 1st June to 30th Sept.	Average Rainfall on the Date	Actual Rainfall during 1st June to the Date	Actual Rainfall up to this Date in the Last Year	Percentage

Form No. 2

Important State

Water Storage in Major Irrigation Projects

Sr. No.	Irrigation Project	District	Full Reservoir Level (FRL) (MCFT)	Live Storage (MCFT)			Last Year (MCFT)
				Projected	Today	Percentage	

Form No. 3

Area Under Agriculture at Taluka / Tehsil / Block / District Level

Taluka / Tehsil Block/ District	Area Under Irrigation	Normal Area Under Sowing	Total Area Sown	Total Area Unsown	Percentage of Unsown Area

Form No. 4

Crop-wise Sowing at Taluka / Tehsil / Block / District Level

Taluka Tehsil/ Block/ District	Cereals			Pulses			Cotton / Sugarcane / Soyabean / Spices		
	Normal	Actual	Percentage	Normal	Actual	Percentage	Normal	Actual	Percentage

Form No. 5

Crop-Wise Productivity at Taluka / Tehsil / Block / District Level

Crop	Normal Productivity (Kg. / Per Ha.)	Total Production (As per normal productivity in M.T.)	Actual Productivity (Kg. / Per Ha.)	Total Production (As per Actual productivity in M.T.)	Difference in Total Production (+ -) (in M.T.)	Monetary Value

Form No. 6

Damage to Agricultural Crops due to Drought

Sr. No.	Name of the district	Crops (ha)						
		Normal area	Percentage area irrigated	Area unsown	Area damaged	Percentage of damage more than 50 %	Overall loss	
							Area (ha.)	Procudction (M/T)
1	2	3 (a)	3 (b)	3 (c)	3 (d)	3 (e)	3 (f) (i)	3 (f) (il)

Form No. 7

Annewari / Paisewari / Girdawari at Taluka / Tehsil / Block / for Kharif and Rabi

Village	Paisewari / Annewari / Girdawari (1-100 paise or 1-16 Annas)

Form No. 8

Annewari / Paisewari / Girdawari at District Level for Kharif and Rabi

Taluka	Total Number of Villages	Number of Villages below 50 Paise / 50 percent / 8 Annas	Number of Villages Above 50 Paise / 50 percent / 8 Annas

Form No. 9

Rainfall and Agricultural Data for Drought

		Rainfall			Number of					
Sr. No.	**Name of districts**	**Normal**	**Actual**	**Percentage deficit**	**Agricultural labourers**	**Small farmers**	**Marginal farmers**	**Whether the district is covered by DPAP / DDP**	**Funds available under DPAP / DDP**	**No. of farmers covered by DPAP / DDP**
1	**2**	**3(a)**	**3(b)**	**3(c)**	**4(a)**	**4(b)**	**4(c)**	**5**	**6**	**7**

Form No. 10

Cost of Employment Generation Schemes

Sr. No.	Items of work for employment generation	Department agency in-charge	Plan Outlay in pervious financial year	Plan outlay in the current financial year	Amounts spent in the current financial year	Balance available from plan outlay	Amount available from non-plan budget	Amount available from Centrally (Sponsored schemes/special programmes as including foodgrains under the food work progress. Special food for work progr.	Total amount available in terms of Rs. in crores	Employment generated likely to be generated in man days from the total amount available (to be indicated separately for each month)	Additional mandays of employment to be generated
1	2	3	4	5	6	7	8	9	10	11	12
(a)	Major Irrigation										
(b)	Medium Irrigation										
©	Minor Irrigation										
(d)	Soil conservation and water management										
(e)	Afforestation										
(f)	Roads										
(g)											
(h)											
(i)											

Form No 11

Expenditures on Temporary Water Supply Scheme and Sources

Taluka / Tehsil / Block:				
	New Installation (Rs.)	**Augmentation**	**Repairs**	**Total**
Permanent Water Supply Scheme				
Temporary Water Supply Scheme				
Bore-wells				
Hand Pumps				
Dug wells				
Tanks / Ponds				
Other Water Supply Sources				

Form No. 12

Supply of Drinking Water through Tankers and Bullock Carts

Taluka / Tehsil / Block / District: Week-ending:

Village/Taluka /District	Current Week		Previous Week	
	Number of Tankers	Number of Bullock Carts	Number of Tankers	Number of Bullock Carts

Form No. 13

Foodgrains Stock in District

District:

Sr. No.	Name of Taluka	No. of affected villages	No. of population affected	Food stock position in Government Godowns in M.T.					
				(a) Wheat	(b) Rice	(c) Jawar	(d) Sugar	(e) Edible Oil	(f) Kerosene K.L.
1	2	3	4	5	6	7	8	9	10

Form No. 14

Foodgrains Stock in Taluka / Tehsil / Block

Taluka / Tehsil / Block:			**Week-ending:**			**Stock of Foodgrains (Metric Tonnes)**
Godown	**(a) Wheat**	**(b) Rice**	**(c) Jowar**	**(d) Sugar**	**(e) Edible Oil**	**(f) Kerosene Oil**

Form No. 15

Weekly Report on Distribution of Gratuitous Relief

Village: Taluka: Month:

Sr. No.	Name of Taluka	No. of villages	Total number of persons relieved during the week				Amount of grain distributed	Amount of cash paid	Total expenditure for the week ending	Rate if gratuitous relief quoting authority under which it is fixed	Remarks
			No. of men a	No. of women b	No. of children c	Total d					
1	2	3	4				5	6	7	8	9

Form No. 16

Information on Cattle Camps

Place:	Taluka / Tehsil / Block:			Organization:			
Name of Cattle Owner	Heads No. of Cattle	Cows / Bullocks (Major)	Cows / Bullocks (Minor)	Buffaloes (Major)	Buffaloes (Minor)	Others (Major)	Others (Minor)

Form No. 17

A Statement of Fodder Supply through Fodder Depot

Name of person to whom given	Village	How many bales	Weight of each bale	Amount Received from the Person	Tagavi or cash	Amount debitable	Remarks
1	2	3	4	5	6	7	8

Form No. 18

Accompaniment to despatch note No.
Wagon No. or Truck No.

Sr. No. of bale	Weight in Kg.
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Countersignatures of the Hay producer

Signature of the Hay Inspector

Form No. 19

A Monthly Report of Expenditure on Different Relief Measures

Drought Relief	Expenditure During the month	Progressive Total
Drought		
(a) Gratuitous Relief		
(i) Cash doles or village kitchen		
(ii) Food and clothing		
(iii) Housing		
(iv) Supply of fodder		
(v) Supply of seeds		
(vi) Other items		
(b) Drinking water supply		
(i) Emergency measure Tanker		
/Bullock cart		
(ii) Installation / Augmentation		
/ Repairs of Water Supply Schemes		
(c) Input Subsidy		
(d) Other Expenditure		
(i) Direction and Administration		
(ii) Miscellaneous		

Form No. 20

Cost of Emergent Relief Measures for Droughts
(Other than employment generating schemes)

Name of work	Expenditure incurred	Period of operation	No. of beneficiaries	Sources of funds	Balance available out of each source
1	2	3	4	5	6
(a) Gratuitious relief					
(b) Free supply of clothings, blankets, etc.					
© Supply of fodder					
(d) Cattle camps					
(e) Fodder depots					
(f) Supply of medicines, disinfectants					
(g) Transporting drinking water by trucks/tankers					
(i) Contingent charges					
(j) Relief camps					
(k) Any other items					

Form No. 21

(A bi-monthly report needs to be sent by the district administration providing details on following parameters)

1. Number of labourers on relief employment works
2. Number of labourers on departmental works
3. Number of persons in receipt of gratuitous relief or special relief of all kinds (including the dependents of workers relieved on works and workers and artisans relieved in their own trade)
4. Whether distress is acute or slight, increasing or decreasing the classes mostly affected and the cause of any marked rice or fall in the number of persons reported on relief
5. Whether there is much wandering, any general appearance of emaciation among applicants for relief, any large influx of labour from neighbouring States
6. The physical condition of the people on relief, particularly of the women and children and of the labouring and cultivating classes generally.
7. The sufficiency of relief measures and any special measure such as relief to weavers and artisans in their own trade importation of fodder for cattle, measures to improve the water supply etc.
8. The State of the public health and the prevalence of epidemics
9. The need for private charitable relief for clothing medical comforts, to and the extent to which it is being met
10. When private or aided works are affording important relief, the number of persons relieved on such works, so far as known.
11. Remarks

Annex 2: National and State Drought Monitoring Centres Mandate and Organization

Background

At present, the Ministries / Departments responsible for drought management at the national and state levels get inadequate technical support for drought early warning and monitoring. It has a serious impact on the timeliness and scale of operations for drought management.

The Government of Karnataka set up a Drought Monitoring Cell in the year 1988. This institution has taken a lead in monitoring and managing the recurring drought situation in the state on a scientific basis. Drought Monitoring Cell is thus considered to be a success in terms of knowledge management and decision support system. It is proposed that an organization on similar lines, Drought Monitoring Center, be set up at the national and state levels.

The Drought Monitoring Center (DMC) would monitor all the indices and indicators of drought on a scientific basis and provide technical advice to the Government. It would interact with multiple national and state-level scientific institutions, ministries and departments, obtain relevant information related to different aspects of drought, and assist the Government in the management of drought relief and mitigation.

Objectives

The objectives of DMC at the national and state levels are as follows:

a. To act as the scientific and technical advisor to the Government on all aspects of drought management;
b. To undertake studies and research on various scientific and technical issues related to drought management;
c. To develop a database on various drought related indices and indicators; precipitation, evapotranspiration, groundwater levels, surface water bodies, land use, soils and forest cover;
d. To provide drought early warning information to the Government and other stakeholders;
e. To develop short-term and long-term drought mitigation measures and recommend them to the various institutions and farmers;
f. To develop a network of various resources and user agencies so that the information and database management could be strengthened through collective inputs of these agencies; and

g. To initiate, support and coordinate applied research programs in universities and other institutions related to drought monitoring and mitigation.

Activities

DMC would conduct a number of core activities in relation to drought management. These core activities are as follows:

(i) Build and Maintain a Database on Drought Indices and Indicators: DMC would regularly collect and analyze data of various indicators of drought such as rainfall, land use patterns, agricultural conditions, groundwater and surface water levels, and socio-economic conditions such as migration, distress sale of assets, etc. Such a database would be maintained on GIS platforms, and be accessible to all the users.

(ii) Preparation and Issuance of Periodical Reports on Drought: DMC would prepare and disseminate reports prepared on daily, weekly, monthly, seasonally, and annual basis on different aspects of drought management. It would include reports on rainfall, various stages of agricultural operations, crop conditions, reservoir levels, fodder, and drinking water situations.

(iii) Inter-disciplinary Studies on Drought Management: DMC would support inter-disciplinary studies on drought management to develop a knowledge-based public policy on drought management. It would combine aspects of climate change, meteorology, agriculture, irrigation, water conservation, and coping strategies adopted by the people. Such studies would provide insights into natural resource management, and suggest feasible mitigation measures.

(iv) Maintenance and Operation of a Weather Stations Network: DMC may consider setting up telemetric rain gauges / weather stations in the state, maintaining the network, and improving the database on climate and rainfall.

DMC's subsidiary activities are described as follows:

(i) Satellite-based drought monitoring in collaboration with National Remote Sensing Agency (NRSA), Hyderabad through obtaining vegetation index

(ii) Crop yield estimation in collaboration with Space Application Center (SAC), Ahmadabad and other agriculture-related institutions

(iii) Water balance studies and preparation of Moisture Adequacy Index (MAI)

(iv) Crop water budgeting studies for the districts and Talukas / Tehsils / blocks, crop-wise

(v) Impact assessment of watershed development programs

(vi) Standardization of average rainfall for all the Talukas / Tehsils / blocks and districts

(vii) Assist the Government in the processes leading to the declaration of drought
(viii) Assist the Government in preparation of loss estimates due to drought and preparation of Memorandum for submission to the Government of India
(ix) Documentation of drought management efforts
(x) Advise the Government on different aspects of water and soil management

Organizational Set up

DMC ideally should be set up as an autonomous institution under the Society Registration Act. DMC's autonomy is critical in view of its mandate to pursue scientific research and undertake technical programs.

DMC could have a Governing Board, which is chaired by the Secretary, Agriculture at the level of Government of India, and Chief Secretary at the level of State Government. Secretaries of other concerned departments, representatives of scientific institutions, subject matter experts, and Director of the DMC would be the members of the Governing Board. It would also have an Executive Committee, which would be chaired by Joint Secretary in the Government of India or the Secretary, Relief and Disaster Management or any other Secretary which the State Government considers fit. A few key officials and experts including the Director, DMC would be the members of the Executive Committee.

DMC would be supported by a small core staff on a full-time basis:

Technical	
Director	1
Deputy Directors	2
Junior Scientific Officers	3
Scientific / Computer Assistants	4
Data Entry Operator	4
Sub-total	14
Non-technical	
Administrative Officer	1
Accounts Officer	1
Office Assistants	2
Driver	1
Sub-total	5
Total	19

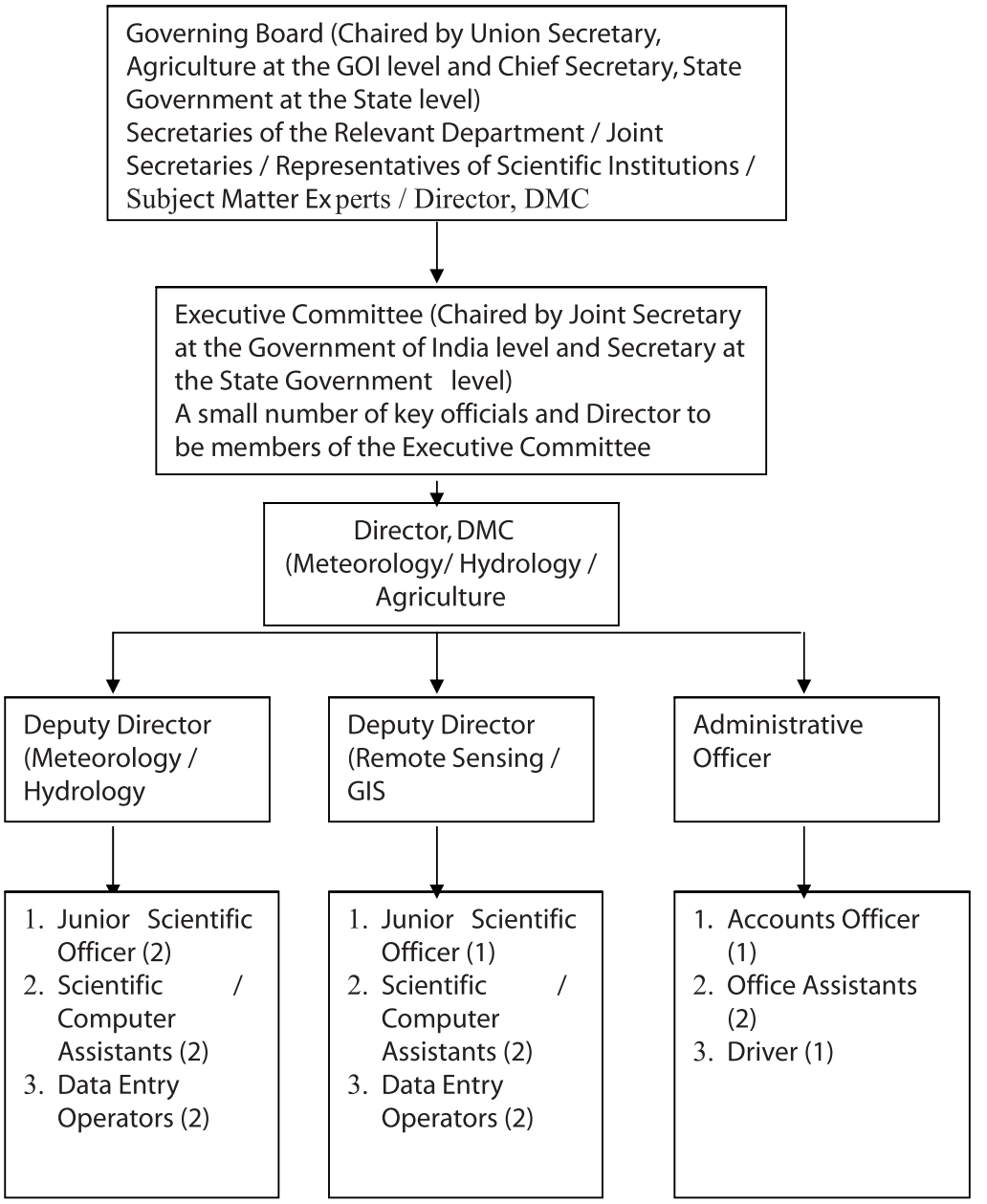
The core staff as shown in the Table above would predominantly be from a technical background. Director and Deputy Directors could be selected from the background of meteorology, hydrology, agriculture, and remote sensing and GIS. Junior Scientific Officers could also come from similar technical backgrounds.

DMC would establish the qualification and experience of its technical and non-technical staff. It would establish its own recruitment rules for the hiring of these staff.

DMC would outsource many of its activities through engaging consultants or getting work done through other scientific / technical agencies. DMC would have the necessary autonomy for hiring consultants or engaging scientific resources (JRF/ SRF) on a short-term basis.

DMC would be authorized to undertaken work on behalf of other departments / agencies on a consultancy basis. DMC would thus be able to raise its resources independently.

Disaster Management Center (DMC): Organizational Structure



Annex 3: Drought Declaration Certificates

CERTIFICATE

Declaration of Paisewari / Annewari / Girdawari

Date:
Place:

This is to certify that Kharif / Rabi crops for the year..... in the following villages were damaged due to ..... and the yield in terms of Paisewari / Annewari was 50 paise / 8 anna or below.

The Paisewari / Annewari / Girdawari has been arrived through the crop-cutting experiment or eye estimation conducted during months of in accordance with the procedures laid down for it.

Sr. No.	Name of the Villages	Names of Crops Damaged	Extent of Damage in Terms of Percentage
		1	
		2	
		3	

District Collector / Deputy Commissioner
District

CERTIFICATE

Declaration of Drought

Date:

Place:

Having taken into account the conditions as arising from rainfall deficiency, decline in the availability of ground and surface water, and poor crop conditions, and ascertained the distress situation that is likely to develop in the area affected by these conditions, on the basis of reports available from the Collectors / Deputy Commissioners of concerned districts, the State Government has decided to declare drought in the following districts:

1. .....
2. .....
3. .....

The declaration of drought would come into effect on _____ and would continue to be in effect till the State Government issues a revocation order.

The State Government hereby authorizes the Collectors / Deputy Commissioners of the concerned districts to notify the Talukas / Tehsils / Blocks and the villages included therein as drought-affected and disseminate the notification through public display and mass media. All the relief measures to be implemented upon the declaration of drought will commence after the notification of drought, specifying the Talukas / Tehsils / Blocks and the villages included therein is issued by the Collector.

By the Order and in the name of Honourable Governor,

Relief Commissioner/ Secretary, Disaster Management
State Government

CERTIFICATE

Notification of Drought

Date:

Place:

Upon the declaration of drought by the State Government on which includes this district, I, Collector / Deputy Commissioner, of district, hereby notify the Talukas / Tehsils / Blocks and the villages included therein, shown in the Table below, as affected by drought. I have satisfied myself through the reports of the field agencies in the district that the all the conditions, necessary for the declaration of drought, as specifically mentioned in the State Government's order dated exist manifestly in these Talukas / Tehsils / Blocks and the villages included therein:

	Villages Included
Talukas / Tehsils / Blocks	
Talukas / Tehsils / Blocks	

The notification shall be effective from today till the date the State Government revokes the drought through a specific order. Upon the issue of such an order revoking the declaration of drought, this notification shall stand cancelled / revoked on its own.

It is directed that all the concerned Departments at the district level commence relief programmes immediately upon the declaration of the notification and submit the progress of their schemes to the District Administration through various returns prescribed in the Manual on Drought Management. It is also directed that information upon all the relief schemes be made available to the people of the district through the Government web site, local newspapers and other channels of mass media.

District Collector / Deputy Commissioner
District

Annex 4: Preparation of Memorandum to Government of India

Assistance from the National Contingency Calamity Fund (NCCF)

State governments submit Memorandum to the Ministry of Agriculture, Government of India seeking assistance for drought relief from the National Contingency Calamity Fund (NCCF). The Memorandum is submitted after the State Government formally declares drought.

There is generally a tendency on part of the State governments to make the Memorandum a very long document, providing many unrelated details and demanding huge assistance through the NCCF. Such a strategy does not succeed, and reinforces the assumptions that the State governments make unrealistic demands. It is necessary to write a Memorandum which provides information upon the drought situation systematically and objectively, and requests assistance from the NCCF in accordance with the guidelines framed for the CRF / NCCF.

The Memorandum should not generally exceed 10,000 words or 30 pages. It should be neatly printed in 12" font size with 1.5 space between lines. The document must be paginated with a table of contents. It should also provide an executive summary of the main contents in the beginning of the Memorandum. The Memorandum must be addressed to the Union Secretary, Ministry of Agriculture through a covering letter. The State Government should submit at least 30 copies of the Memorandum to the Government of India, accompanied with a soft copy on a CD-ROM.

The Memorandum should be organized into four parts. The first part of Memorandum may provide the background information upon the agriculture, irrigation, poverty, and socially weak and marginal groups in the state. The background information must be supported through the necessary facts and figures.

The second part of Memorandum may provide details of the key indicators of drought: rainfall, sowing, normalized different vegetation index, and moisture adequacy index. The section may also provide information on other indicators of drought: intra-seasonal variation in rainfall, crop condition, Paisewari / Annewari / Girdawari, foodgrains prices, availability of fodder, migration, sale of assets, withdrawal of children from schools, etc.

The third part of the Memorandum may provide information on all types of drought relief and mitigation programs. It may include details of relief employment, provision and distribution of foodgrains, supply of drinking water, cattle camps and fodder depots, and any other relief measure organized by the State Government and other organizations. This part should also include the details of expenditures incurred by the State Government on all kinds of relief assistance.

The fourth part of the Memorandum should provide the details of assistance requested from the NCCF. Such a request needs to be framed in accordance with the guidelines prescribed for the CRF / NCCF. The request for each of the items needs to be justified with the necessary statistics and details. The section should also provide information on the expenditures incurred through the CRF, and the balance amount available with the CRF.

The Memorandum must include the map of drought-affected areas, remote sensing images of water bodies and vegetation cover, charts and diagrams, and photographs, which substantiate the hardships associated with drought.

Structure and Contents of Memorandum

	Table of Contents	
	Executive Summary	Basic Information upon Drought, Magnitude of Relief Efforts, and the Total Demand for Assistance through the NCCF
I	**Introduction**	a. Area b. Population (Proportion of Scheduled Caste / Tribe Population) c. Cultivable Area Crop-wise d. Area under Irrigation and Dryland Farming f. Total number of farmers in the State (District-wise) g. Number of small and marginal farmers h. Number of landless agricultural labourers i. Agriculture: Its contribution to State GDP
II	**Incidence and Spread of Drought**	a. Declaration of Drought (Notification to be attached) and grounds for such a declaration b. Deficiency in Rainfall c. Area under Sowing d. Normalized Differential Vegetation Index e. Moisture Adequacy Index f. Water Storage in Irrigation Projects g. Depletion of Groundwater h. Paisewari / Annewari / Girdawari i. Availability and prices of foodgrains k. Migration of Population
III	**Drought Relief and Mitigation Measures**	a. Relief Employment under the NREGS (District-wise Number of works and total number of workers attending) b. Provision and Distribution of Foodgrains c. Availability and supply of drinking water: Number of Tanker/ Trains / Bullock Carts c. Implementation of Temporary Water Supply Schemes d. Information upon Cattle Camps and Fodder Depots e. Information upon any other relief measures f. Expenditure on Drought Relief and Mitigation Measures
IV	**Request for Central Assistance**	a. Agriculture (Assistance to small and marginal farmers for irrigated and dryland cultivation)

	b. Horticulture (Assistance to small and marginal farmers) c. Water Supply (Temporary Water Supply Schemes) d. Water Supply (Deployment of Tankers / Bullock Carts/ Trains) e. Cattle camps and fodder depots f. Medical care for cattle against epidemics g. Relief Employment (Estimated Demand for work) h. upplementary Nutrition i. Total funds available under the Calamity Relief Fund j. Total Requirement of assistance through the NCCF

Abbreviations and Acronyms

AET	Actual Evapotranspiration
AIBP	Accelerated Irrigation Benefits Programme
AIC	Agriculture Insurance Company of India Ltd
AICRPAM	All India Coordinated Research Projects on Agri-Meteorology
AICRPDA	All India Coordinated Research Projects on Dryland Agriculture
AIR	All India Radio
AISMR	All India Summer Monsoon Rainfall
APL	Above Poverty Line
AVHHR	Advanced Very High Resolution Radiometer
BPL	Below Poverty Line
BRGF	Backward Regions Grant Fund
CAZRI	Central Arid Zone Research Institute
CCIS	Comprehensive Crop Insurance Scheme
CGWB	Central Ground Water Board
CMI	Crop Moisture Index
CRF	Calamity Relief Fund
CRIDA	Central Research Institute for Dry-land Agriculture
CWC	Central Water Commission
CWWG	Crop Weather Watch Group
CYF	Crop Yield Forecast
DAC	Department of Agriculture and Cooperation
DDMC	District Disaster Management Committee
DDP	Desert Development Programme
DEWS	Drought Early Warning Systems
DMC	Disaster Management Centre / Drought Monitoring Centre
DPAP	Drought Prone Areas Programme
DRC	District Relief Committee
DRDA	District Rural Development Agency
DST	Department of Science and Technology
EDI	Effective Drought Index
ENSO	El Niño Southern Oscillation

EP	Effective Precipitation
EWS	Early Warning Systems
FCI	Food Corporation of India
FPS	Fair Price Shops
FRL	Full Reservoir Level
GDP	Gross Domestic Product
GIS	Geographic Information System
GOI	Government of India
HFL	High Flood Line
HLC	High Level Committee
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Services
IMD	India Meteorological Department
IMG	Inter-Ministerial Group
IRS	Indian Remote Sensing
IWDP	Integrated Wasteland Development Programme
IWMP	Integrated Watershed Management Programme
JFMC	Joint Forest Management Committees
LAD	Local Area Development
LPA	Long Period Average
LTA	Long Term Average
MAI	Moisture Adequacy Index
MLA	Member of Legislative Assembly
MoA	Ministry of Agriculture
MoES	Ministry of Earth Sciences
MoRD	Ministry of Rural Development
MP	Member of Parliament
NADAMS	National Agricultural Drought Assessment and Monitoring System
NAIS	National Agricultural Insurance Scheme
NCCF	National Calamity Contingency Fund
NCCM	National Centre for Calamity Management
NCFC	National Crop Forecasting Centre
NCMC	National Crisis Management Committee
NCMRWF	National Centre for Medium Range Weather Forecasting
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Wetness Index

NGO	Non-Governmental Organization
NIC	National Informatics Centre
NOAA	National Oceanic and Atmospheric Administration
NRAA	National Rainfed Area Authority
NREGS	National Rural Employment Guarantee Scheme
NRSA	National Remote Sensing Agency
NRSC	National Remote Sensing Centre
NWDPRA	National Watershed Development Programme for Rainfed Areas
NWP	Numerical Weather Prediction
PDS	Public Distribution System
PDSI	Palmer Drought Severity Index
PET	Potential Evapotranspiration
PMGSY	Pradhan Mantri Gram Sadak Yojana
PRI	Panchayati Raj Institutions
PRN	Precipitation Needed for a Return to Normal Conditions
PT	Percolation Tanks
RMC	Regional Meteorological Centre
SAC	Space Applications Centre
SAU	State Agricultural Universities
SG	State Government
SGRY	Sampoorna Grameen Rozgar Yojana
SGSY	Swarnajayanti Gram Swarozgar Yojana
SMC	State Meteorological Centre
SPI	Standardized Precipitation Index
SWSI	Surface Water Supply Index
VSAT	Very Small Aperture Terminal
VWC	Village Watershed Committee
WBCIS	Weather Based Crop Insurance Scheme
WiFS	Wide Field Sensor
WUA	Water Users Association

Glossary of Terms

The glossary defines certain terms as they need to be explained to the uninitiated and understood in the context of this Manual. Some of these terms have been defined in more precise terms in relevant laws and administrative orders, for which those documents could be referred. This glossary conveys a general sense of these terms.

Aanganwadi
A Government-sponsored child-care and mother-care centre in India.

Adaptation
Adjustment in natural or human systems in response to changing climate and policies to minimize the predicted impacts of climate change.

Annewari / Paisewari / Girdawari
An estimate of crop production on the basis of crop-cutting experiment. It is expressed in varying units across the states.

Block
An Administrative unit, which comprises of several Village Panchayats. Several blocks constitute a district.

Block Development Officer
The officer in-charge of development at the block level.

Central Drought Relief Commissioner
An officer of the rank of Additional Secretary to the Government of India in the Ministry of Agriculture, responsible for management and coordination of drought relief at the national level.

Collector
The administrative head of a district.

Crop Rotation
Crop rotation is the practice of growing a series of dissimilar types of crops in the same area in sequential seasons for various benefits such as to avoid the build up of pathogens and pests that often occurs when one species is continuously cropped.

Finance Commission
A Constitution of India-mandated expert body to deliberate and decide upon the distribution of tax revenues between the Centre and States.

Gaushala
A protective centre for the cows, including those which are neglected.

Gram Panchayat
An elected local government at the village level. All the development functions at the village level are vested in Gram Panchayat.

Gram Sabha
All men and women in the village who are above 18 years of age form the Gram Sabha. The Gram Sabha meets twice a year. Meetings of the Gram Sabha are convened to ensure the development of the people through their participation and mutual co-operation.

Gram Sevak
A Government functionary assigned to the Village Panchayat for carrying out administrative and development functions. In some States, Village Administrative officer supported by staff carry out the functions.

High-level Committee
A Committee of Central Ministers which decides upon the quantum of assistance from the National Calamity Contingency Fund on the basis of recommendations from the Inter-Ministerial Group.

Kharif
Kharif crops are usually sown with the beginning of the first rains in June-July, during the south-west monsoon season, and harvested in autumn.

Minimum wage
Minimum wage ensures basic subsistence. It is fixed and enforced as per the provisions of the Minimum Wages Act, 1948.

Mitigation
Drought mitigation implies taking actions in advance of drought to reduce its long-term risk. It would include policies, activities, plans, and programs, which reduce drought risks.

Mulching
Mulching refers to placing materials on the soil surface to improve soil structure, oxygen levels, temperature, and moisture availability,.

Patwari / Talathi
A revenue department functionary at the village level, entrusted with the responsibility of maintaining land records and land revenue administration.

Panchayat Samiti
Co-terminus with Block. A group of Gram Panchayats constitute a Panchayat Samiti / Block

Rabi
Refers to the winter crop, which is sown in November-December and harvested in February-March.

Sarpanch / Mukhia
The elected head of the Gram Panchayat

Secretary, Disaster Management / Relief Commissioner
An officer of the rank of Secretary to the State Government, responsible for relief administration and disaster management of the entire state.

Self-Help Group
A group of men / women formed with a common development objective. Self-help groups are useful for securing small loans without collateral security. Members of self-help group collectively monitor loan repayment and income-generation activities.

Sub-divisional Officer
Administrative head of the Sub-division, a constituent unit of the district. A district is divided into sub-division, and sub-division consists of two or three Talukas / Tehsils.

Tagai / Taccavi
A short-term agricultural loan advanced to the farmers for making improvements on their land at a moderate interest. During the British period, farmers availed of Tagai / Taccavi loans on a large-scale during the period of famine.

Tehsil / Taluka
An administrative unit, at times co-terminus with Block, which comprises of several Revenue villages. Several Talukas constitute a district.

Tehsildar
A Revenue Officer, who is head of the administrative set up of a Tehsil / Taluka.

Weather Insurance
Weather insurance is provided by insurance companies against weather variations. Insurance payoff is linked to a well-defined threshold, for example, when the actual rainfall is deficient compared to the average seasonal rainfall. Weather variations could be of many kinds.

Wetland Banks
A wetland bank is a wetland stream, or other water body that has been restored, established, or enhanced for the purpose of providing compensation for unavoidable impacts to water bodies elsewhere.

Zila Parishad / Panchayats
An elected local Government, representing village and block Panchayats, at the district level. Supported by a Constitutional provision, the structure of Zila Parishads vary across the States.

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