National Disaster Mitigation Plan (Drought and Cold Wave/Frost)

2.4 Drought

2.4.1 General

Drought is a normal, recurrent feature of climate and characterized in terms of its spatial extension, intensity and duration. Conditions of drought appear when rainfall is deficient in relation to the statistical multi-year average for a region, over an extended period of a season or a year, or even more. Drought is a temporary aberration unlike aridity, which is a permanent feature of climate.

Drought produces wide-ranging impacts that span across many sectors of the economy and are felt far beyond the area experiencing physical drought. Direct or primary impacts of droughts are usually associated with reduced agricultural production; depleted water levels; higher livestock mortality rates and damage to wildlife and fish habitats. When direct impacts have multiplier effect through the economy and society, they are referred to as indirect impacts in terms of reduced income for farmers and agri-business, increased prices for food and timber, unemployment, reduced purchasing capacity and demand for consumption, default on agricultural loans, and reduction in agricultural employment leading to migration etc.

971 blocks of 183 districts covering an area of about 74.6 million hectare have been identified as drought prone areas of the country. Most of the drought prone areas lie in the *arid, semi-arid and sub-humid* regions.

States experience enormous fiscal stress in coping with drought as expenditure on relief measures often takes precedence over mitigation, placing acute burden on the State budget and thus relegating development plans. A greater emphasis on mitigation measures can reduce incidence and severity of drought, sustain crop production and save resources spent recurrently on relief. Scientific advances in climate forecasting, information and telecommunications technology and spread of participatory democracy provide tremendous opportunities to develop an effective system for monitoring and managing drought, establishing drought forecasting systems, laying out location specific crop contingency plans, implementing timely relief programmes and focusing on long term drought proofing programmes e.g. watershed development, water harvesting etc.

2.4.2 Drought Mitigation

Mitigation measures are initiatives undertaken to reduce the incidence or minimise impacts of drought. Besides drought proofing, these measures help in adapting to climate change, restoring ecological balance and bringing development benefits to the people. However,

drought mitigation programmes are not to be construed stand-alone interventions that are to be implemented only in the wake of a drought; but must form part of developmental planning in the domain of soil conservation, watershed development and forestry. As such, drought mitigation measures are to be mainstreamed in regular development programmes of Central and State Governments.

Government's policy towards drought management has changed considerably over the years and now rests upon early warning & preparedness, crisis management response, medium and long-term drought mitigation measures with greater application of state-of-the art technology and scientific tools. A number of Central Governments Schemes/Programmes have evolved over time to address the need for medium and long-term drought mitigation requirements. Notable among them are Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Integrated Watershed Management Programme (IWMP), subsuming erstwhile Drought Prone Area Programme (DPAP)), National Rural Drinking Water Programme (NRDWP), Swarna-jayanthi Grameen Swarozgar Yojana (SGSY), Rashtriya Krishi Vikas Yojna (RKVY), Fodder & Feed Development Scheme etc. Besides, various 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) are contributing significantly to enhance drought resilience. Central and State Governments continue to consider further possibilities of reorienting/synergising regular development programs for achieving a robust drought resilient regime.

The operational framework for drought mitigation comprises of (i) drought risk and vulnerability assessment, (ii) forecasting and early warning and (iii) structural & non-structural measures including drought proofing programmes/schemes, (iv) awareness generation, (v) research & development and (vi) community participation.

2.4.2.1 Vulnerability and Risk Assessment

State Governments are primarily responsible for mitigation of drought. The Manual for Drought Management (2009)[1] stipulates that State Governments should set up a mission/task force on drought mitigation for advising them on policies and programmes. The said mission/task force should also conduct drought risk and vulnerability assessment for identifying drought prone areas, nature and severity of drought, vulnerable economic sectors, communities and individuals etc. Such an assessment will provide an economic rationale for interventions and in identifying mitigation measures. A composite risk and vulnerability assessment would help in developing long term policies and programmes for drought risk mitigation at the State level and in framing appropriate strategies for addressing the critical gaps during drought relief. As a part of this exercise, States would need to

1 Manual for Drought Management; November, 2009; Dept. of Agriculture & Cooperation, Ministry of Agriculture, Govt. of India, available at http://agricoop.nic.in/imagedefault/DroughtManual.pdf.

prepare vulnerability maps especially in the case of rainfed areas in order to bring them under assured irrigation to the extent possible.

The State Governments shall keep the Department of Agriculture and Cooperation (DAC) and other concerned Ministries/Departments of the Government of India apprised about their drought mitigation efforts. The State Disaster Management Department, often part of Revenue Department, shall involve concerned line Departments of the State government, State Agricultural Universities and ICAR Institutes located in the States while framing mitigation strategies so that adequate attention is accorded to mitigation measures in various on-going and new schemes/programs of the Government and appropriate provisions, wherever possible, are embedded.

Department of Agriculture and Cooperation, Government of India in collaboration with experts from the Central Ground Water Board (CGWB), Central Water Commission (CWC), India Meteorological Department (IMD), National Remote Sensing Centre (NRSC), National Rainfed Area Authority (NRAA) and Indian Council of Agricultural Research (ICAR) Institutes will facilitate States in finding desirable solutions to the issues pertaining to Drought Mitigation and Management.

2.4.2.2 *Forecasting and Early Warning*

The Crop Weather Watch Group (CWWG), an Inter-Ministerial forum at Central level, meets on regular basis to take stock of rainfall, weather forecast, progress of sowing, crop health, storage level in major water reservoirs, pest control, inputs availability etc. Observations of CWWG are shared among Central Ministries/Departments and State Governments for formulating appropriate strategy to meet drought related contingencies, if any. Efforts of State Governments are supplemented from Central resources, whenever the situation warrants for mitigating hardships in agriculture and allied sectors.

Early warning systems can be further strengthened through following initiatives (illustrative):

(i) Strengthening of long range, medium range and short range forecasting of monsoon by IMD at Meteorological Sub-Division, District and Taluka level;

(ii) Strengthening of National Agricultural Drought Assessment and Monitoring System (NADAMS) currently implemented by Mahalanobis National Crop Forecasting Centre (MNCFC) in collaboration with NRSC for forecasting specific and early indicators of drought using Geographical Information System (GIS) & Remote Sensing (RS) technology. NADAMS should also include advance forecast of soil moisture stress before onset of monsoon in different districts, weekly assessment and forecast of drought etc.;

(iii) Improvement in the Aridity Anomaly Report of IMD by giving comparative status with previous weeks and that of corresponding period of previous drought years;

(iv) Maintenance of database by MNCFC in consultation with National Informatics Centre (NIC), IMD and other institutions in the country for providing early warning signals of drought through their long and medium forecasts as envisaged in Manual for Drought Management (2009);

(v) Key drought indicators have been enumerated in Manual for Drought Management (2009) incorporating parameters viz., rainfall deficiency, storage of water levels in reservoirs, surface and ground water levels, sowing and crop conditions etc. These indicators alongwith Aridity Anomaly Index., Standardized Precipitation Index, Palmer Drought Severity Index, Crop Moisture Index, surface Water Supply Index, Normalized Difference Wetness Index, Effective Drought Index and Moisture Adequacy Index can be taken into consideration for developing a composite index for facilitating early detection and declaration of drought;

(vi) Use of in-situ and remotely sensed observations for drought assessment and monitoring by NRSC can also be utilized for overall assessment of the situation by the States and the Centre;

(vii) Continuous assessment of soil moisture stress, assessment of vegetation through remote sensing supported by ground truthing with the help of NRSA and State Agricultural Universities;

(viii) Extensive use of spatial data (GIS platforms) and scientific tools for developing decision support systems, enhancing efficacy of vulnerability analysis, risk management and improving early warning & forecasting systems.

National Remote Sensing Centre (NRSC), NIC and IMD can collaborate in strengthening ongoing NADAMS under MNCFC by including customised application of GIS & RS platform. State Drought Management Centres (SDMC) can facilitate the integration of data and expertise from multiple Institutions such as MNCFC, ICAR, NRSC, IMD, State Agricultural Universities, State Departments of Irrigation, Ground Water, Revenue, Agriculture etc., to evolve a robust method for drought intensity assessment at sub-district levels.

2.4.2.3 Structural Mitigation Measures

Structural mitigation measures include involvement of Central and State Governments by providing technological solutions to drought mitigation primarily through developmental programmes and relief operations.

2.4.2.3.1 Structural Measures: *On-going Programmes/Schemes:*

Several on-going programmes of Government of India address the need for drought mitigation through various drought proofing interventions. Notable among them are Integrated Watershed Management Programme (IWMP, that subsumed erstwhile Drought Prone Area Programme-DPAP, Integrated Wasteland Development Project-IWDP, Dessert Development Programme-DDP) under Department of Land Resources (DoLR), Rashtriya Krishi Vikas Yojna (RKVY), National Food Security Mission (NFSM), National Horticulture Mission (NHM) under Department of Agriculture and Cooperation (DAC), Command Area Development and Water Management Programme (CADWM), Repair, Renovation and Restoration of Water Bodies (RRR) & Artificial Recharge to Ground Water through Dugwell (ARGWD) under Ministry of Water Resources, National Rural Drinking Water Programme (NRDWP) under Ministry of Drinking Water & Sanitation, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) under Department of Rural Development, Integrated Child Development Services Scheme (ICDS) under Ministry of Women & Child Development, Fodder & Feed Development Scheme under Department of Animal Husbandry Dairying & Fisheries, Backward Regions Grant Fund Programme (BRGF) under Ministry of Panchayati Raj, NGO based programmes under Council for Advancement of People's Action and Rural Technology (CAPART), Rural Infrastructure Development Fund (RIDF) under NABARD, National Afforestation Programme (NAP) under Ministry of Environment & Forests, Public Distribution System (PDS) under Department of Food & Public distribution etc.

The Manual for Drought Management (2009) emphasises the need for convergence of development schemes and programmes with watershed development/harvesting projects. For example, financial resources available under BRGF and physical labour under MGNREGS can be converged for creating water conservation & water harvesting structures, undertaking various drought proofing measures including afforestation & tree plantation, irrigation canals including micro and minor irrigation works; provision of minor irrigation facilities, land development etc. Programme implementing Ministries/Department may therefore have a relook or revisit their on-going programmes for ensuring that drought resilience measures are appropriately embedded in them.

2.4.2.3.2 Structural Measures: *Action Plan for revisiting on-going and formulating future Programmes/Schemes*

Design of any future developmental programmes will invariably have to be compatible with the imperatives of drought resilience. Such an approach will naturally vary for different agro-climatic zones depending upon their vulnerability profile and thus be selective and priority driven. Some illustrative drought mitigation measures that may be considered for embedding/mainstreaming in ongoing as well as future programmes/schemes are as under:

a) Artificial recharging of ground water, watershed programmes in privately owned small/marginal farms, laying of pipes/channels for exclusive transportation of water to dry areas;

b) Programme for reconstruction and preservation of traditional water harvesting structures, construction of canals for transportation of water from surplus to non-surplus areas, establishment of cost-effective drip /sprinkle irrigation practices etc.

c) Construction of watershed structures at the right place where water recharge can be enhanced/will be used for life saving irrigation at critical stages of crop growth and during drought situations.

d) Construction of "Community Ponds" through Panchayati Raj Institutions (PRI) and maintenance by levying user charges.

e) Augmentation of agro-based food processing industries in rural areas for sustenance of employment,

f) Establishing chain of cold storages to minimise post-harvest losses along with adaptation of appropriate post-harvest management practices like pre cooling, cold storages and refrigerated transport. Pre-harvest losses due to diseases and pests can also be minimized through better management practices;

g) Construction of shelters for cattle and development of infrastructure for storage and transportation of dry and green fodder etc.;

h) Ensuring provision of medicines and critical health care in the risk prone areas during drought for humans and animals;

i) Ensuring efficient functioning of the PDS in drought affected areas;

j) Provision of adequate infrastructure for dissemination of weather based advisories to the farming community on real-time basis in regional languages through extension machineries;

k) Providing credit promptly in the drought affected areas and extending marketing and price support to farmers;

l) Insurance products need to be developed for different agro-climatic zones providing coverage against drought. The Central/State Governments need to promote, agricultural insurance programmes and ensure that farmers are informed about the availability of insurance products and educate them about the need for managing their yield and income risks through insurance coverage;

m) Identifying, procuring and keeping in readiness drought proofing materials in required quantities before the onset of monsoon season such as :-

    (i) Seed & fodder Plan (including alternative varieties, mini kits etc. keeping in view the impending drought);

(ii) Health care (which would include state of readiness for attending to human beings and animals attacked by heat stroke, procurement and storage of medicines, state of the art mobile medical services, sanitation etc.);

(iii) Water availability plan (including movement plan through railways and tankers, exploitation of ground water for irrigation, restriction on water-use by industrial units /amusement parks etc.);

(iv) Advance credit plan for easy availability of credit, entitlement and repayment of claims for insurance;

(v) Assessment plan of food grains under Public Distribution System (PDS), Integrated Child Development Services (ICDS) and Antyodaya Schemes;

(vi) Advance plans for electricity and fuel requirement and their allocation on demand;

It will also be imminent to pursue convergence of various developmental schemes & programmes at both Central and State levels to minimise duplicity of efforts and investment in order to derive maximum results in managing drought with available resources. As enunciated in Manual for Drought management (2009), it is imperative to establish a dedicated Drought Monitoring Cell (DMC) at State level with requisite communication network to facilitate dissemination of the required information through Agricultural Extension agencies, Kisan Call Centres (KCC), Media Advisories, Web Portal etc. The Control Room/Cells at Central and State Government levels may remain functional throughout the year and they can be suitably strengthened for effective management of drought. Drought being directly associated with climatic variability, it will be useful to strengthen existing institutional framework for monitoring, assessment and dissemination of real-time forecast on drought.

2.4.2.4 Non-Structural Mitigation Measures:

2.4.2.4.1 Enhancing management skills

The non- structural measures envisage enhancing management skills to improve preparedness of vulnerable communities, Panchayati Raj Institutions (PRI), urban local bodies and State authorities to mitigate the risks and respond effectively to drought situations. The following illustrative non-structural measures may be considered to facilitate this:

(i) Hazard-zoning by the State Governments (identification of drought prone areas in 124 agro-climatic zones) using '*Vulnerability Mapping*' (e.g. real time display of aridity maps, soil moisture stress maps, Normalized Difference Vegetation Index Maps, Normalized Difference Water Index Maps besides an e-atlas for drought)

and '*Risk Assessment Analysis*' (e.g. standardization of risk assessment analysis in quantitative and qualitative terms as per the Manual for Drought Management);

(ii) Preparation of inventory of resources by the State governments to meet likely emergency requirements of inputs (seeds, fertilizers etc.) and energy (power & diesel for pump sets), tankers & wagons (for drinking water movement), fodder availability (planning for movement from surplus areas including those from forest areas), availability of food grains and advance allocation plan, agricultural credit, planning for risk insurance etc.

(iii) Knowledge networking of best practices both at the State and Central levels (e.g. experiences at international and national level on preventive measures, preparedness and mitigation, best practices at micro level by voluntary and non-governmental organizations in drought prone areas for sustenance of livelihood through watershed-management projects, change of cultivation methods, use of modern irrigation methods such as drip irrigation etc.). As envisaged in the Manual for Drought Management (2009), the State Governments besides Panchayati Raj Institutions need to actively involve non-governmental Organizations (NGOs) and Civil Society Organizations (CSOs) in effectively managing droughts by drawing upon their past experiences and best practices on drought mitigation.

2.4.2.4.2 Non-Structural Measures: Techno-Legal Regime

For creating an enabling environment for the mitigation measures existing laws including the following (illustrative) would need to be considered/reviewed/updated:-

(i) Revisiting Mahatma Gandhi National Rural Employment Guarantee Act/Operational Guidelines of MGNREGS to include/strengthen drought mitigation measures;

(ii) Updating of State Scarcity Relief Manuals which replaced the erstwhile famine codes on the lines of Manual for Drought Management at National level;

(iii) Establishing a definite procedure and fixing of time frame for attending to drought relief measures;

(iv) Establishing an appropriate water regulatory regime in consultation with the States; and

(v) Empowerment of Panchayats, Municipalities, Local bodies and inclusion of drought mitigation measures as part of their role in Eleventh and Twelfth Schedules of Constitution of India.

2.4.2.5 Awareness Generation

The Manual for Drought Management (2009) envisages that the Central and State Governments should provide information on all aspects of drought to the people. It also suggests that the State Governments should develop a Drought Management Information System (DMIS) on different aspects of drought management. The DMIS alongwith (i) identification of vulnerable communities; (ii) sensitization programmes-drought management educational programmes; (iii) training and capacity building of communities; and, (iv) media management will help in creating public awareness with special emphasis on risk reduction and preparedness to handle drought situation.

2.4.2.6 Research & Development (R&D)

Large scale drought mitigation projects will have to be preceded by pilot /special studies and customised research programmes. An illustrative outline of such studies/programmes can be as under:

(i) Research programme in Agricultural Universities to study rainfall patterns and forecasting of drought at sub-district level, in the chronically drought affected areas;

(ii) Evaluation Programme for vulnerability and impact analysis of interventions by Central and State Government in drought affected States through reputed Institutes like National Institute of Nutrition, National Institute of Rural Development, MANAGE, etc., and

(iii) Developing and introducing drought tolerant varieties of crops.

2.4.2.7 Community Participation

Community participation is an essential feature of drought mitigation programmes. Rainwater harvesting holds the key to drought mitigation and the government policies emphasize community-based water resource management. Women's Self-Help Groups (SHGs) can play an important role in a large number of measures targeted at drought mitigation. SHGs can be involved in rainwater harvesting, running PDS and day care centres and overseeing water distribution and utilization in their community. They will also take measures to promote greater equity and efficiency in natural resource management. Drought relief and mitigation measures shall be, to the extent possible, implemented through the Panchayati Raj Institutions in order to improve the efficacy of delivery.

2.5 Cold Wave/Frost

2.5.1 General

Cold wave/frost is a localised seasonal phenomenon prevalent in the country except in Southern India. Frost damage to crops occurs when moisture within the plant is frozen, gets crystallized and expands. This causes cells to rupture and fluid to leak out, thus the watery appearance of plant tissue or seed after a damaging frost. Different parts of plant, different stages of development of plant, and different types of plants can have varying levels of these 'antifreeze' compounds that result in a range of susceptibility to frost.

The extent of damage caused by cold wave depends on temperature, length of exposure, humidity levels, and the speed at which freezing temperature is reached. It is difficult to predict a definite temperature level upto which crops can tolerate cold wave/frost because many other factors also affect it. For example, when air temperature reaches zero (0) degree centigrade, crop itself can be 4 or 5 degree cooler, because plants lose heat faster than the surrounding air temperature. Frost and cold waves greatly impacts pulse crops. During flowering stages, these crops are likely to be adversely affected at temperature of -2 to -3 degree C. Those in podding stage are a bit more tolerant but are likely to be damaged at a temperature of -3 to -4 degree C. As pulses often mature from bottom of the plant towards the top, frost injury may be much greater on plant tops.

2.5.2. Mitigation Measures for Crops:

Department of Agriculture & Cooperation, Ministry of Agriculture closely monitors cold wave situation in consultation with India Meteorological Department (IMD) and State Governments. In case of cold wave/frost situation, States needs to initiate location specific measures as outlined in District Crop Contingency Plans and in consultation with respective State Agricultural Universities to minimise its impact.

Farmers are to provide light irrigation as per need, immediately prune damaged tips of branches or shoot, burn leave/waste material in the orchard to create smoke and manage rejuvenation of damaged crops through pruning of dead material, application of extra doses of fertilizer through foliar sprays. Illustrative example of mitigation measures during different vegetative stages are as under:

Sl No	**Stages of plant growth**	**Measures to be taken by farmers**
1	Seedling/ Nursery Stage	Change of micro climate by smoking around the field especially during night.

2	Vegetative Stage	Irrigating the field, smoking the field during night.
3	Reproductive Stage	
4	Harvesting Stage	Harvest the crop at physiological maturity stage

Crops: Soybean, Maize, Jowar, Arhar, Cotton, Chick Pea, Wheat etc.

(Source: Contingency Plan developed by Central Research Institute for Dryland Agriculture (CRIDA), available at http://www.crida.in/)

As Cold Wave/Frost is a localised disaster event, location specific mitigation plans are to be drawn up by the concerned State Governments instead of a National level plan.