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Chapter 22

Decision Making for Responding to Drought– Ensuring they are Driven by Objective Assessments of Drought

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Abstract

This chapter reviews specific institutional mechanisms and drought response and management approaches followed in some of the developed and developing countries including India, Kenya, Australia and United States of America with the purpose of understanding the way the drought is declared and drought responses are made. It is evident from this review that the countries are at different levels of perfecting defining drought and institutional mechanisms for drought response and management. Disparities exist in terms of how drought is defined at different geographical levels and basis upon which drought response decisions are made. From this review, it is suggested that the countries need to strengthen in areas of establishing appropriate drought trigger mechanisms at national and sub-national levels, establishing clear basis for decision making that is transparent and verifiable, strengthening drought early warning and monitoring systems that is aimed at multiple stakeholders engaged in drought risk reduction, strengthening supportive input supply systems including inputs such as seeds and loans that could help farmers to take advantage of reviving rainfall conditions within a cropping period and simplifying administrative and institutional procedures to reduce the time taken to take short-term drought response related decisions.

1. Introduction

Drought is a common event that is experienced across all agricultural environments of the world, and does not discriminate according to the level of sophistication of farming systems or the level of development of a given country. For the purpose of this chapter, drought is defined as a deficiency of precipitation over an extended period of time (usually a season or longer), resulting in a water shortage for some activity, group, or environmental sector. There is a large amount of literature available that describes the nature of drought and potential management options. However, the declaration and management of drought is often driven by political motivations, rather than being based on the needs of the environment or the affected communities, or objective assessments of the agro-ecological environment.

There are a range of key questions that need to be addressed in order to develop a consistent approach to responding to drought. In answering these questions, it will become possible to develop a range of consistent approaches that can be adopted by both government and agricultural communities affected by drought. The questions include:

- What is the specific 'trigger mechanism' that initiates governments and local communities to respond to drought?
- Do governments respond to drought as a result of public outcry or other political pressure?
- Can the incidence of drought be defined according to a given level of variance in specific climate patterns and events (for example incidence and level of rainfall, variance in temperatures), resulting in an orderly monitoring and response to drought by communities and government?
- How can farming communities and governments develop drought preparedness strategies, in order to better plan for and manage drought?

Answering these questions is critical if a strategic approach by governments to prepare for and manage drought is to be developed. In order to answer these questions, we have selected a number of developed and developing countries for further investigation. For each country, drought monitoring, declaration, and response procedures were assessed and compared and this analysis provided a basis for making policy suggestions for further improvements in the way governments make drought-related decisions.

2. What constitutes drought?

Defining drought is the first step towards managing it. Though an age-old question that has already been debated quite extensively over the decades, the question of defining drought is one of the most challenging tasks in drought

management. In order to initiate timely response, a credible definition of drought is the first important step in the right direction, allowing governments and local stakeholders to monitor the situation and act proactively as soon as the on-set of drought becomes obvious and meets specific criteria. If the drought definition is subjective and poorly defined, it can be a source of problems such as misinterpretation, misjudgement, and even creeping in of vested interests in the process of political decision making.

Drought by nature is a period of temporary water stress as defined by the appropriate agency. We have looked into the definition of drought amongst the case study countries featured in this paper (Table 2). From the definitions, it can be seen that there is no uniform definition of drought in any of these countries. Some countries have varying definitions of drought for different geographical regions and purposes (e.g., India).

The definition of drought may not only vary between countries but also between the agencies engaged in providing essential services pertinent to drought risk management within the same country. For example, drought could be defined differently both by the agriculture and water departments both catering to agriculture sector. Presence of different definitions also constitute difficulty in conveying which best practices may work in one country and not another. It may often be difficult to assess if specific drought mitigation practices can be applicable to ameliorate drought impacts in another country where there are inconsistent drought definitions. Often the presence of multiple definitions will also make it difficult to achieve a united and consistent response to drought by multiple agencies where drought occurs across borders. Matters may become further complicated if the drought definitions and warning signs are often changed by authorities (Bo 2010).

In Australia, drought is conceptually defined as one of the four following scenarios (Hennessey et al 2008):

- *Meteorological drought:* a period of months to years when atmospheric conditions result in low rainfall. This can be exacerbated by high temperatures and high evaporation, low humidity and desiccating winds;
- *Agricultural drought:* short-term dryness in the surface soil layers (root-zone) at a critical time in the growing season. The start and end may lag that of a meteorological drought, depending on the preceding soil moisture status;
- *Hydrological drought:* prolonged moisture deficits that affect surface or subsurface water supply, thereby reducing stream flow, groundwater, dam and lake levels. This may persist long after a meteorological drought has ended;
- *Socio-economic drought:* the effect of elements of the above droughts on supply and demand of economic goods and human well-being.

Table 1. Definition of drought in various countries

Country	National	Regional	Reference
India	• Normal: seasonal departure of rainfall is within ± 10 percent of normal rainfall. • Drought year: Departure from normal is -11 percent or more	• Moderate drought: % of departure of rainfall is between 26-50% of normal • Severe drought: Percentage departure is more than -51% or more	Government of India, Department of Agriculture and Cooperation, Ministry of Agriculture, 2003. Drought 2002: A Report (Part 1).
Australia	The Australian Federal Government in 2014 introduced a new National Drought Program Reform, which is an agreement between the Federal and State Governments. • The key attribute of the program is to provide farmers with the skills and capabilities to better manage drought from both production and business perspectives, and in particular be able to manage the climatic risks associated with agricultural production. • Other key support initiatives include Farm Management Deposits (where farmers can deposit earnings in favourable seasons and access these funds in poor years, farm business training opportunities, and in times of drought farm household financial support. The Federal Government is specifically responsible for the following: • funding and delivering a time–limited farm household support payment based on individual need, including o reciprocal obligations aimed at driving behavioural change. o case management to support reciprocal obligations. • providing continued access to primary producer taxation	The State Governments are responsible for the implementation of the National Drought Reform Program, and work in collaboration with the Federal Government.. The change in Government Policy (from the previous Exceptional Circumstances Program) was undertaken for a number of specific reasons: a there should no longer be Exceptional Circumstances declarations or 'lines on maps'. Instead, governments should focus on addressing the specific needs of farming families, farming businesses and farming communities. b acknowledgement that drought is just one of a number of hardships that can adversely impact farmers. c recognition of the important role of farmers as the nation's food producers. d future farm family welfare assistance should require a level of mutual responsibility e for access to the income support system, farming families should have a temporary period of	Department of Agriculture and Water Resources, 2015a Department of Agriculture and Water Resources, 2015b

Country	National	Regional	Reference
	concessions that support farmer risk management, including the Farm Management Deposit Scheme • delivering Commonwealth programs under this agreement. • developing a Commonwealth implementation plan in consultation with the states and territories. • monitoring and assessing the delivery and performance of Commonwealth programs under this agreement. • reporting on the delivery of Commonwealth programs and the contribution of these programs to the achievement of outcomes as set out in this agreement.	exemption from the normal assets tests for farm assets, but otherwise receive the same access rights as the wider community. f government farm business support should assist farming businesses plan and prepare for the future. Farm business support will be based on a willingness by those businesses to prepare for the impacts of drought and climate change. g the role of farmers in natural resource management and their role in maintaining vibrant rural communities. h the importance of maintaining and supporting the natural resource base during drought and climate change. i government policies and programs should support farming communities to prepare for drought and enhance their long term sustainability and resilience.	
United States of America	• Agricultural drought declarations are typically made by the Unites States Secretary of Agriculture based on conditions reported by the U.S. Drought Monitor or upon a request by a state governor or Indian Tribal Council • A USDA drought declaration is made for a county when the U.S. Drought Monitor shows any portion of a county meets the D2 (severe drought – 6 to 10 percentile) intensity value for eight consecutive weeks, or a higher intensity value for any length of time.	• A state drought declaration may also be made by state governments to alert the public of impending drought conditions, activate state-level responses or special state powers, trigger requirements for jurisdictions or the public, or a combination of these. The U.S. Drought Monitor may be used as one trigger in addition to other relevant local indicators, which vary by state.	Farm Service Agency (2015) Fontaine et al. (2015)
Kenya	• Assessment of drought severity is based on the quartile range: Drought severity is qualified as “driest on record” for a range <Min; “dry” for Q1-Min; “near normal” for Q1-Q3; “wet” for Q3-Max and “wettest on record” for ranges >Max	N/A	Ambenje, 2000; Awange et al., 2007

Country	National	Regional	Reference
	(with Q1: 1st quartile and Q3: 3rd quartile) • Similar to the first method, once the rainfall mean was computed, the 'percent of normal' (quartile) was calculated by dividing actual precipitation by normal precipitation—typically considered to be a 30 year mean—and multiplying by 100. Then, the percentage rainfall relative to mean defines the drought range; thus, if this value is <25, it is a "extreme drought", <50: "severe drought", 75: "near normal"; 100: "normal"; 125: "near normal"; >150: "very wet" and >175: "extremely wet".		
China	A composite index has been introduced in 2007 to define five types of droughts: no drought, mild drought, moderate drought, severe drought and exceptional drought. Each level of drought is defined based on the duration of the rainless days which vary from season to season. China also introduced a composite index (meteorological drought index) based on a combination of indices including standardized precipitation index, relative moisture index, soil moisture, Palmer Drought index and precipitation anomaly percentage.	Exceptional drought is when >60% of crops are affected by drought.	Bo, 2010

Source: Authors

Part of the problem for such diverse definitions of drought is due to the nature of drought and how it progresses from one domain to another domain, as well as the differential impact of drought on local communities according to a range of factors. These factors may include the following:

1) Population pressures

   The level of dependence that a population has on agriculture as a living determines the drought vulnerability of communities and the particular country as a whole. In general, developing countries have large proportions of populations that have a much higher dependency upon agriculture as an employer and supplier of vital food and livelihood reserves as against developed countries. Even within the population of a developing country, dependency on primary production sectors (such as agriculture) exposes them to disproportionately higher levels of negative impact from drought compared to other populations that have lower levels of livelihood dependency for food production and food supply services.

2) Environmental pressures

   The degree of drought impact depends on the vulnerability of the local environment to drought. Issues such as overgrazing, deforestation and destruction of local natural resources can hasten the impacts of drought on the local population and environment. High grazing pressures will have a greater impact when there are only small variances in average seasonal conditions. Regions that have adopted conservation farming technologies will have less impact from drought due to retaining of pasture and crop residues compared with those where excessive cultivation takes place. Destruction of natural surface vegetation often leads to increased surface water runoff, limits the water infiltration and reduces available soil water for crop growth (due to limited organic matter content), all of which lead to increased and prolonged drought conditions.

3) Level of agricultural modernisation

   Farming systems that are based upon traditional hand tool or animal cultivation will generally achieve lower levels of water-use efficiency than mechanised production systems. Due to the time taken to sow crops following rains, the impact of drought will be more severe in those less developed production systems. Crop yields may suffer due to delayed sowing (beyond the optimum time of seeding), and stored soil moisture will be reduced as a result of the cultivation. It is well known that the practices such as zero tillage, smart irrigation scheduling based on crop, soil and atmospheric parameters, and soil management practices including mulching

and application of organic will assist in valuable soil moisture conservation and contribute to higher crop yields.

3. Existing drought monitoring mechanisms

A look at the existing drought monitoring mechanisms will help to understand how effective they are in different countries. It will also help us to learn from the positive aspects associated with each one. Countries often differ in political, administrative and constitutional setups and hence the subject of drought has been dealt in different ways. For example, the subject of drought has been made the sole responsibility of the state level governments in India. The central government will intervene only upon the special request made by the state level governments. Similarly in Australia, the state governments are responsible for declaring and managing support systems for farmers during periods of drought, however the Federal government provide co-funding support for drought packages, working in partnership with State governments. Table 3 provides the information on drought monitoring focal points in various countries. It can be seen that the focal points vary by country. While there are specialized agencies responsible for drought response and mitigation in some countries, in others it is under the Ministry of Agriculture.

Table 2: Central decision making authorities for drought monitoring

Nation	Apex level monitoring body	Composition	Hosting agency	Weather agency	Ministry of weather agency
India	Central Weather Watch Group	Central Relief Commissioner, Economic and statistical advisor, India Meteorological Department, Central Water Commission, Crop specialists, Agricultural input supply divisions, Agricultural extension specialists, Ministry of power, Ministry of petroleum, Indian Council of Agricultural Research	Ministry of Agriculture	Indian Meteorological Department	Ministry of science and technology
Australia	National Rural Advisory Council (NARC)	Individual State Departments of Agriculture and Primary Industries, National Farmers Federation, representatives form agribusiness, banking, sustainable agricultural development	Department of Agriculture, Forestry and Fisheries DAFF) Canberra	Bureau of Meteorology (at State and national levels)	Department of Environment
United States of America	US Drought Monitor Group	National Drought Mitigation Center, National Oceanic and Atmospheric Administration, and United States Department of Agriculture	National Drought Mitigation Center, National Oceanic and Atmospheric Administration, and United States Department of Agriculture	National Oceanic and Atmospheric Administration, United States Geological Survey, Natural Resources Conservation Service, United States Department of Agriculture	Department of Commerce, Department of Agriculture, Department of the Interior
Kenya	Kenya Food Security Meeting (KFSM)	Government ministries, donors and NGOs; National Food Security Committee (NFSC); World Food Program; UNDP	Office of the President; Ministry of State in charge of the provincial administration and the national security	Kenya Meteorological Department; IGAD Climate Prediction and Application Centre (ICPAC) – Nairobi	Ministry of Environment and Natural Resources

Source: Authors

3.1. *India*

Drought monitoring mechanisms for India are undertaken centrally by the Crop Weather Watch Group led by the Ministry of Agriculture. There are similar groups operating at the state and district levels that assist in supporting this role. With more than 70% of India's population reliant on agricultural production for their livelihoods, responsibility for drought monitoring falls under the Ministry of Agriculture.

At the national level, the responsibility of weather forecasting (an important aspect in early warning) rests with the India Meteorological Department (IMD) under the Ministry of Science and Technology. The role of IMD is restricted to making available the meteorological observations on current and forecast information for optimum operation of weather-dependent activities such as agriculture and irrigation. However, the national drought early warning system is through what is called Crop Weather Watch Group (CWWG) (personal communication, Ministry of Agriculture). The Crop Weather Watch Group consists of a group of administrators representing various government departments responsible for managing essential inputs for agriculture and scientists from the national agricultural system (Indian Council of Agricultural Research, Ministry of Agriculture).

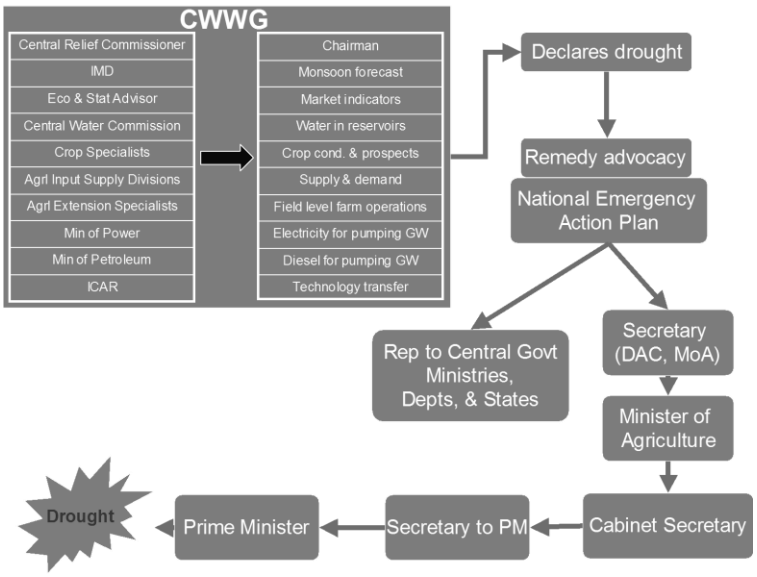


Figure 1: Information flow for declaration of national drought in India (Source: Authors)

3.2. *Australia*

The monitoring of seasonal weather patterns and the incidence of drought is undertaken by a range of government and industry organisations. The Bureau of Meteorology holds the overall responsibility of monitoring weather events on a seasonal basis, as well as analysis of trends and comparisons with historical events. This includes monitoring a range of other supportive data, such as ocean temperatures (for prediction of El Nino weather patterns). The Bureau of Meteorology provides regional, state and national specific data sets that are accessed by a wide range of government and industry stakeholders. Individual State Departments of Agriculture, Primary Industries and Natural Resources/Environment also have a range of monitoring tools and reporting mechanisms, based upon descriptive seasonal condition reports, satellite imagery and GIS.

The Federal Government appointed Agricultural Industry Advisory Council is responsible for the assessment of, and declaration of drought in Australia. Applications, which if approved lead to a range of support programs for farming families, businesses and community groups and organizations. It is the responsibility of regional bodies (industry groups, natural resource management boards and other community organizations) in collaboration with State Government agencies to prepare and submit the drought application to the Federal government body.

State governments also employ a range of other monitoring mechanisms, including district and regional reports provided by agricultural extension officers, GIS summarising decile rainfall patterns, vegetation cover and productivity trends. There are also a range of other mechanisms to collect data at the banking and industry level, in terms of forecast agricultural (crop and livestock) production, farm borrowings and profitability to name a few. Much of this data is also collected through farm surveys, conducted by the Federal Government's Australian Bureau of Agricultural Resource Economics and Science (ABARES).

A drought declaration is an official acknowledgment by the government that an area or property is drought-stricken. State declarations are triggered by severe climatic circumstances likely to occur no more than once every 10-15 years. When conditions across an area meet the declaration criteria, a Local Drought Committee may decide to recommend either an area or a shire declaration. The Minister for Agriculture and Fisheries makes the declaration on the basis of this recommendation.

3.3. *Kenya*

In Kenya the following procedures are followed in drought declaration. First, drought information is collected from the communities and is channeled to the district level (a District Steering Group) for discussion. The information is then forwarded to the Kenya Food Security Meeting (KFSM) at the national level (OP, 2003). KFSM also conducts assessments in the field to gather information related to drought such as the 2005-06 drought case (IFRC, 2006). KFSM is composed of government ministries, donors and NGOs, and has the responsibility to determine which area or district requires assistance (OP, 2003). KFSM meetings are chaired by the Office of the President and the World Food Programme representatives. Depending on the severity of the drought event, (which can be beyond KFSM resource capability), KFSM forwards its recommendations to the National Food Security Committee (NFSC), who then forwards onto the next senior administrative level of the Cabinet (chaired by the President). The latter recommends whether the President should declare a national disaster and appeal for both national and international assistance (OP, 2003).

Kenya is one of 24 eastern and southern African countries serviced by the by the Nairobi based Drought Monitoring Centre (DMC) This institution formed in 1987, works under the auspices of WMO and UNDP and in collaboration with the Kenyan Meteorological and Hydrological Services. DMC aims to provide timely climate information and prediction services for enhanced application to reduce climate and weather-related risks to food security, water resources, energy, health and disaster management (drought, floods and other extreme climate-related events) (Ogallo, 2003).

3.4. *United States*

Agricultural drought declarations in the United States are typically under the authority of the United States Department of Agriculture (USDA), and generally triggered by conditions reported in a drought region as determined by the US Drought Monitor (http://droughtmonitor.unl.edu). The Drought Monitor is a weekly assessment of drought conditions across the US developed by the National Drought Mitigation Center, National Oceanic and Atmospheric Administration, and the USDA.

For example, according the US Farm Services Agency (2015), the disaster declaration process was streamlined in 2012 to provide a nearly automatic designation when, during the growing season, any part of a county meets the D2

(severe drought) intensity value for eight consecutive weeks or a higher drought intensity value for any length of time. The new "Fast Track Secretarial disaster designation" was designed to help reduce paperwork and documentation requirements at the local level and make the process more efficient and timely, although individual producer losses still need to be documented for Emergency Loan Program eligibility.

A disaster declaration by the Secretary of Agriculture triggers the availability of low-interest loans to eligible producers in the affected counties. During especially severe droughts, the US Congress may provide supplemental funding for additional emergency assistance programs. For example, Congress passed an act in 2006 to provide approximately $3 billion in agricultural disaster aid for America's farmers and ranchers (FSA 2007b).

Other federal drought-related emergency programs are increasingly triggered by drought classifications on the US Drought Monitor. As an example of its application, according the USDA (2015), the USDA Farm Services Administration (FSA) administers the Emergency Conservation Program (ECP), which makes available cost-share dollars for developing or enhancing irrigation water efficiency in orchards and vineyards. The program does not depend on a disaster designation but must be approved by FSA county and state committees when a county experiences a 40 percent moisture loss over the prior four months, or reaches the D3 (extreme) designation on the U.S. Drought Monitor. Similarly, the FSA administers programs that can help with feed during drought conditions or recover costs incurred because of drought. The Livestock Forage Program provides financial compensation for grazing or feed losses when the U.S. Drought Monitor reaches D2 (severe) in a county for eight consecutive weeks.

The U.S. Internal Revenue Service has also granted tax extensions for livestock sales due to drought. When drought conditions result in an area being declared eligible for assistance by the federal government, taxpayers ordinarily have four years to replace — without recognizing any capital gain — the livestock that they were forced to sell because of the drought. However, because of the intense, prolonged drought in parts of the United States prior to 2015, the IRS provided additional time to replace some livestock (draft, dairy and breeding livestock) that were sold as a result of drought. For example, the four-year replacement period scheduled to end on December 31, 2015, was extended for one additional year if, for any weekly period included in the 12-month period ending on August 31, 2015, severe (D2), extreme (D3) or exceptional (D4) drought conditions were reported for any location in the county that experienced the drought as determined by the US Drought Monitor (IRS 2015).

As discussed by Fontaine et al. (2014) drought declarations may also be made by local and state governments to alert the public of impending drought conditions, activate state-level responses or special state powers, trigger requirements for jurisdictions or the public, or a combination of these. The U.S. Drought Monitor may be used as one trigger in addition to other relevant local indicators, which may vary by state.

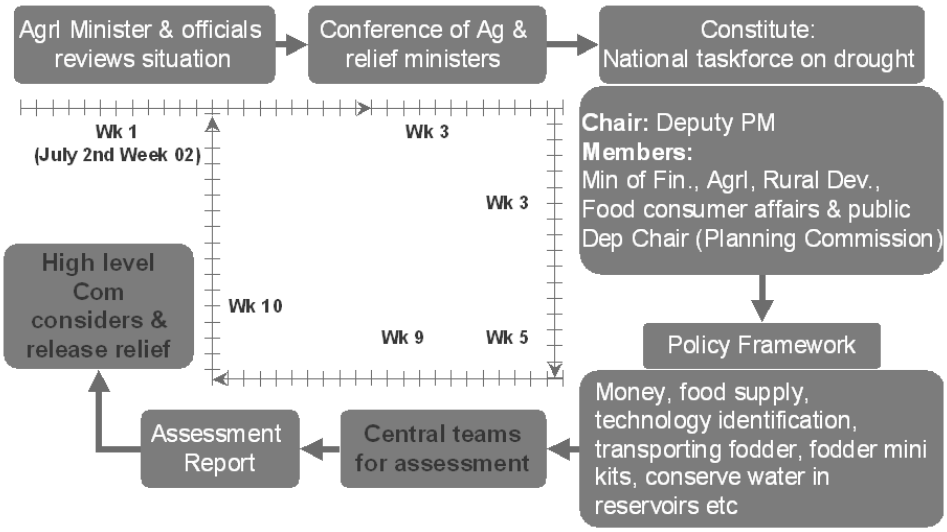
4. What triggers drought response? Case studies from specific drought events

In order to respond to a drought in a timely manner, it is important that there are effective monitoring systems that lead to a 'drought trigger(s)' being initiated. It is important that the right information is monitored and collected, from which the drought trigger would be based, and an appropriate response system employed.
Section 3 provided an overview of a range of drought monitoring systems that are utilised by agencies across the different countries. The question arises as to how effective are these monitoring systems, and do they respond in a timely manner in order to advert a major environmental disaster, or worst still food shortages or famine?
In response to this, we have examined a number of drought incidences as case studies. This approach was adopted in order to also build our understanding as to whether or not drought response by government is the result of a social outcry, or an orderly monitoring process.

4.1. *Indian drought of 2002*

The case study of 2002 drought, conducted by Someshwar and Subbiah (2003), indicated that the state government assesses the situation and sends a request for the central assistance in the 6th week after identification of drought situation in the state. It can be seen from the Fig. 2 that it took 3 weeks for the Central Government to send Central Assessment Teams for assessing the drought situation in the affected state and to respond to the assessment request by the state government. This shows the lack of capacity with the state government to deal with the debilitating disasters like droughts and lack of clarity in decision making both at central and state governments leading to loss of valuable time in response. The case study also identified crucial gaps in dissemination of climate information to the end users as the end-to-end climate applications system for drought mitigation doesn't exist in India (Someshwar and Subbiah 2003). It

shows that India has developed a fine institutional mechanism that has been perfected to initiate drought relief measures rather than to forecast in advance



that helps in mitigating the impacts of the impending drought.

Figure 2. Sequence of events that take place in the process of declaring drought (Prabhakar and Shaw, 2008)

There seems to be confusion on deciding the critical threshold of time when the drought response mechanism is to be activated. For example, taking the 2002 drought of India, the drought monitoring mechanism couldn't quite catch hold of the fact of dismal failure of July rainfall, an important month for the agriculture in the country, and nor it could take the opportunity of reviving monsoon immediately afterwards, a missed opportunity for farmers to sow short-season crops to make use of the reviving monsoon. These incidences are the reflection of lack of appropriate trigger mechanism that is quick and responsive enough to enable implement any course corrections such as provision of inputs, finances and know how to revitalize the agricultural activities.

However, initiatives have been taken up to improve upon the drought monitoring and forecasting mechanisms in India. For example, since 2013, the IMD has started using Standardized Precipitation Index (SPI) to monitor drought in compliance with the guidelines issued by the World Meteorological Organization (Rathore et al., 2014). In addition, the National Agricultural Drought Assessment and Monitoring System, a project by National Remote Sensing Center (NRSC) has been assisting the national and state governments in continuous monitoring

and assessment of drought conditions in the country up to district level by using several indices in 13 agriculturally important states in the country (NRSC, 2015) that has greatly helped improving the capacity of governments in assessing the drought conditions in the country on a regular intervals. However, it is not clear if these improvements have helped the governments to mitigate drought impacts significantly. For example, Rathore et al. (2014) indicate the need for further strengthening the capacities of local level observational network that forms backbone for any effective drought forecasting and monitoring system.

4.3. *Australian drought of 2006-07*

According to the Australian Bureau of Agricultural and Resource Economics, the drought of 2006-07 resulted in a drop in agricultural output of 23%, resulting in a reduction of the Gross Domestic Product (GDP of 0.6%. It is evident that this drought had a severe impact on Australia's agricultural production, in addition to the personal impact at the individual farm business level.

Despite this, there are often complications in the processes required to have drought 'officially recognised' by governments, in terms of the amount of data and information that needs to be collected, and often the problem of having to 'draw lines on a map', delineating those areas considered to be in drought, and those areas not specifically 'drought declared', but which can still be suffering severe reductions in productivity and 'drought-like conditions'.

The Federal Government have provided an appropriate mechanism for the formal declaration of drought on a regional basis through its' National Drought Reform program, that takes into consideration not only variability in weather events, but also specific downturns in industry/commodity sectors. This is particularly important in all Australian agricultural industries, where there are no government commodity price support mechanisms. The impact of drought will be far greater in a year of below average yields, and low commodity prices (on the world market).

The declaration of drought (through the National Drought Reform) provides a transparent process in which regional groups can apply for declaration and subsequently a range of drought support services and programs. There is always some criticism in terms of the stringent process that applicants need to adhere to, and the amount of supporting information that is required. An additional criticism is that declaration of drought in some circumstances takes place during or after the event, and as such support mechanisms are in 'response to' as opposed to 'planning for' drought events. This criticism however has been addressed in recent reform measures that the Australian Government introduced during 2014.

There are a range of other training programs that are directed towards farmers that do assist them in planning for future droughts, in addition to managing risk on-farm. These are useful strategies for those farmers that may be described as being innovative and progressive, often it is those less progressive farmers who do not plan for drought – who are most affected when a drought does occur.

4.4. *Kenya 2005-2006 Drought*

Eighty four percent of Kenya's land is classified as arid and semi-arid and is prone to successive droughts. In the last hundred years, Kenya has experienced 28 major droughts (KFSSG, 2006). In the beginning of 2006, The Government of Kenya declared the drought, which affected the most eastern and northern parts of the country, as a national disaster. The number of people affected increased dramatically from 2.5 million in 22 districts in mid-December 2005, to 3.5 million in 37 districts by mid-January 2006. According to local media reports, up to 40 people- mostly children, died due to complications arising from malnutrition. In the Kajiado district, the worst hit categories by drought-related causes were pregnant and lactating mothers and children below the age of five years (IFRC, 2006). Beside human casualties, livestock mortality was alarming particularly in Isiolo, Wajir Marsabit, Kajiado, Mandera, Garissa and Tana River districts. Due to the drought phenomena, the regenerative capacity of the perennial grasses was lost, and the remaining little pasture and vegetation were exposed to a rapid depletion, as the drought conditions accentuate. It was reported that thousands of cattle were dying daily. In the Mandera district, around 60% of the total animal population, main source of income for most communities was lost (IFRC, 2006).

In most of the areas hit by the drought, the water and sanitation issue was critical and aggravating the situation. Since several seasonal rivers had dried up and 60% of the crops had failed leading to a more pronounced water shortage and malnutrition. In this case study, an inter-agency rapid assessment team (under the KFSM-Kenyan Food Security Meeting) conducted a rapid assessment to determine emergency food needs for rapid and medium-term response for the six first months, the result of which served as the basis for a countrywide drought relief intervention. The Kenyan Red Cross Society also played an important role in the assessments and response, worked in close collaboration with the Ministry of Special Programmes, KFSM, the Arid Lands Resource Management Project (ALRMP), the National Operation Centre (NOC) and the District Disaster Committees (IFRC, 2006). Although it is still difficult to have a full picture of the factors that trigger drought response, the implementation of programmes such

as the Arid Lands Resource Management Project (ALRMP), covering 21 districts, in 2003, to empower particularly nomadic communities economically relying on livestock as well as the current local efforts on early warning system (OP, 2003) may have an important influence on the drought mitigation and response systems.

5. Policy advocacy for nations towards better drought risk management

From the foregone discussion on specific cases of how drought related decisions are made and study of specific drought events in some of the developed and developing countries indicate that countries are at different stages of perfecting their drought monitoring and response mechanisms. In this section, an effort has been made to distill important policy advocacy messages that could help governments to identify and manage drought in an effective manner. These policy messages are grouped into five areas of intervention where governments can make significant improvements:

a. Establishing appropriate drought trigger mechanisms
b. Establishing clear basis for decision making
c. Strengthening drought early warning and monitoring
d. Strengthening supportive input supply systems
e. Simplified administrative and institutional procedures

5.1. *Appropriate Drought Trigger Mechanism*

A drought trigger mechanism is one that initiates appropriate action among stakeholders including governments at national and subnational levels, water user associations, farmers and farmer associations, water managers and industries in a timely fashion. An unambiguous definition of drought is important to initiate appropriate action among these stakeholders. Several factors need consideration for an effective drought trigger mechanism: the trigger defines drought in a clear and concise manner, based on the how the drought is defined the drought is forecasted and monitored on regular intervals that meet the needs of the stakeholders whose actions are to be benefited by the trigger.

In the review presented above, it is clear that most countries have drought definitions at the national and subnational levels. However, these definitions are mostly meteorological in nature that is difficult to interpret for different stakeholders. Due to wide spatial and temporal variability in precipitation, such large definitions tend to become irrelevant for the actors that are engaged at the

local level; for example the city governments, water user associations, water managers and farmers. Hence, it is necessary that drought triggers are designed in a cascading fashion where in the meaning of national level drought triggers are conveyed or translated into local level triggers. With the growing applications of remote sensing and geographical information systems (GIS) in drought monitoring and early warning, it is now easier to design such location-specific drought trigger mechanisms to which local level administrations can respond effectively.

5.2. *Clear Basis for Decision Making*

From the review presented in this chapter, it is evident that the drought declaration mechanisms and subsequent decision making by national and sub-national governments is often time consuming, bureaucratic and not always based on clearly identified cause-effect relations and verifiable information base. Decision making is often based on unclear criteria and protocols. It is also not clear how governments translate the drought forecasting information into actionable points including identification of drought risk reduction interventions. Information is often not available on the finesses of decisions made in terms of basis for approval of certain amount of funds for affected regions in a country and compensations made. This is despite the fact that most countries have more or less well established institutional mechanisms in terms of focal ministries, institutions and decision making bodies. This leaves governments prone to criticisms related to political subjectivity and accountability. There is a need that governments and other agencies involved in drought-related decision making put in place detailed protocols and guidelines of how decisions are made at each and every stage of drought risk management within the country. There is also need that governments make the information, based on which decisions are made, available to all the stakeholders in a transparent manner. This would not only help the stakeholders engaged in drought risk management decisions but also help researchers to conduct related research for continuous improvement in the decision making.

5.3. *Drought Early Warning and Monitoring*

Drought is a slow-onset event and often starts with the failure of rainfall with cascading impact on various sectors. It is widely known that reduce rainfall immediately impacts agricultural soil moisture and surface waters with

subsequent effects on cities and industries. Hence, any early warning that integrates information starting from rainfall condition to water in reservoirs, soil moisture, industrial and household water demand and supply situation can provide a fairly robust and reliable drought early warning for various stakeholders impacted by drought. However, governance structures engaged in water resources, agriculture, urban and industrial sectors often work in isolation making it difficult to get a unified picture across sectors in a given location. The national and sub-national level drought monitoring committees are formed exactly to solve the same inter-ministerial coordination problems. However, these groups often meet in stipulated intervals those need not necessarily in synchronization with the speed at which decisions need to be made. The delay in decision making is magnified if the information on the drought situation has to come from state and sub-state levels.

The application of various climatic prediction models likewise play an important role in predicting the incidence of drought, such as is the case in Australia with *el nino* (drought prone) versus *la nina* (avoidable rainfall patterns). Other long-term weather pattern predictions provide an element of management support for farmers, and guidance for government policy and decision makers.

5.4. *Supportive Input Supply Systems*

Input supply systems, including seed industry and agriculture loans, often take time to respond to quick changes in rainfall, opportunities that uncertain monsoon systems provide which could include quick renewal of rainfall providing opportunity for farmers to be able to sow and harvest an alternative crop in the rest of the season. Input supply systems need to be highly responsive than they are currently so that farmers get access to inputs in shortest possible time in the wake of renewal of monsoons to still harness the possibility of harvesting an alternative crop.

Supportive input supply systems are required in order to assist farmers adapt and modify their agricultural production systems, from perspectives of minimizing their exposure to risk (ability to cut back on farming inputs where there are seasonal indicators predicting possible drought). In addition to this, a supportive banking/finance sector is required, in order to enable farmers to manage risk, put aside financial reserves during favorable seasons, and access credit during the poor seasons with minimal financial penalty.

5.5. *Simplified Procedures*

Drought response, in terms of how quick governments respond, has improved considerably in most countries through continuous change in institutional structure and protocols. However, by its very nature, the drought-related decision making constitute participation of multiple stakeholders and often constitute coordination of committee meetings that take valuable time especially in the initial stages of drought when quick interventions could lead to significant reduction in further impacts. Simplified decision making procedures could make significant improvements in drought related decision making.

The other issue to be considered is the hierarchy with which governments work and the capacity of local level stakeholders. Local governments are still dependent on national governments and external support in the event of severe droughts often losing valuable time. Much can be improved by strengthening the non-legislative tools such as guidelines and appropriate legislative tools including laws and policies that stipulate certain institutions to take appropriate actions without losing valuable time. The laws and policies could lead to building the capacities of the local level institutions so that they are autonomous enough to take decisions, most importantly those related to mobilization of needed finances, so that the response is not delayed. Much of this has to do with the devolution of power to local institutions.

6. Conclusion

In this chapter, drought-related decision making mechanisms prevalent in some of the developed and developing countries were reviewed. It is apparent that countries have made significant progress in the way the drought is monitored mostly through inter-ministerial coordination committees and using integrated decision making tools such as drought monitors. While this appears to work under most conditions, they often fall short of expectations in terms of speed of decision making, verifiability, accountability and prioritization basis. Countries are still in the nascent stages of taking drought-related decisions based on objective assessment of natural resource conditions. In addition, it is not very clear if drought responses over the past years have reduced the drought vulnerabilities over the years. The monitoring of climatic and environmental conditions that may lead to drought declaration is an important element to have in place. There is a need to provide consistent approaches for assisting in providing meaningful responses at national, regional and international levels.

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References

1. Ambenje, P.G., 2000. Regional drought monitoring centers – the case of Eastern and Southern Africa. In: Wilhite, D.A., Sivakumar, M.V.K., Wood, D.A. (Eds.), *Drought Preparedness and Drought Management*, Proceedings of an Expert Group Meeting, Lisbon, Portugal. World Meteorological Organization, Geneva, Switzerland.
2. Awange J.L., J. Aluoch, L. A. Ogallo, M. Omulo, P. Omondi, 2007. Frequency and severity of drought in the LakeVictoria region (Kenya) and its effects on food security, *Clim Res*, 33: 135–142, 2007. Inter-Research 2007. www.int-res.com.
3. Bo, W. 2010. Background information on classification of meteorological drought. Available at http://big5.chinanews.com/gn/news/2010/03-25/2190842.shtml.
4. Department of Agriculture and Water Resources. 2015a. National Drought Program Reform. Available at http://www.agriculture.gov.au/ag-farm-food/drought/drought-policy/drought-program-reform. Accessed 5 November 2015.
5. Department of Agriculture and Water Resources. 2015b. National Drought Program Reform. Available at http://www.agriculture.gov.au/ag-farm-food/drought. Accessed 5 November 2015.
6. Farm Services Agency (FSA). 2007. Agricultural Assistance Act of 2007, United States Department of Agriculture < http://www.fsa.usda.gov/Internet/FSA_File/disasteraid07.pdf.
7. Farm Services Agency (FSA). 2015. Emergency Disaster Designation and Declaration Process. http://www.fsa.usda.gov/Internet/FSA_File/2015_disaster_assistance_prog.pdf.
8. Fontaine, M., A. Steinemann, and M. Hayes. 2014. State Drought Programs and Plans: Survey of the Western United States. *Natural Hazards Review*, 15(1)95-99.
9. Hennessy, K., Fawcett, R, Kirono D., Mpelasoka, F., Jones, D., Bathols P., Whetton, P., Stafford-Smith M., Howden M., Mitchell, C., Plummer, N.

2008. An assessment of the impact of climate change on the nature and frequency of exceptional climatic events, CSIRO Canberra Australia.

10. IFRC. 2006. Kenya Drought. http://www.ifrc.org/cgi/pdf_appeals.pl?06/MDRKE00101.pdf.
11. Internal Revenue Service (IRS). 2015. IRS Grants Tax Relief to Drought-Stricken Farmers and Ranchers in 48 States and Puerto Rico. https://www.irs.gov/uac/IRS-Grants-Tax-Relief-to-Drought-Stricken-Farmers-in-48-States-and-Puerto-Rico.
12. KFSSG (Kenya Food Security Steering Group). 2006. Kenya long rains assessment Report 2006; Consolidated Inter-Agency Report. 99pp.
13. NRSC. 2015. National Agricultural Drought Assessment and Monitoring System (NADAMS) Hyderabad, Telangana: National Remote Sensing Center. Available at http://www.nrsc.gov.in/Earth_Observation_Applications_Agriculture_Drought_Assessment.html.
14. Ogallo, L. 2003. Kenya-based regional Drought Monitoring Centre Nairobi. *In* Disaster Reduction in Africa - ISDR Informs Issue 1/June 2003. pp38.
15. OP (Office of the President, Kenya). 2003. *Statement by Minister of State, Hon Dr Chris Murungaru*, Second International Conference on Early Warning EWC-II GoK.
16. Rathore, B.M.S., R. Sud, V. Saxena, L.S. Rathore, T.S. Rathore, V.G. Subramanyam and M.M. Roy. 2014. Drought conditions and management strategies in India. Country Report prepared for the Regional Workshop for Asia-Pacific as part of the UN-Water Initiative on "Capacity Development to Support National Drought Management Policies" organized from 6-9th May 2014 in Hanoi, Vietnam. Available at http://www.moef.gov.in/sites/default/files/India_Country%20Report%20_Hanoi.pdf.
17. Someshwar, S., Subbiah, A.R. 2003. Institutional responses to 2002–03 drought in Rajasthan and Orissa: Potential of climate information for proactive drought management. International resources Institute, Asian Disaster Preparedness Center and UNDP Report, United Nations Development Program, New Delhi, p 49.
18. United States Department of Agriculture (USDA). 2015. Help in the Midst of Drought. https://www.fsa.usda.gov/Internet/FSA_File/drought_brochure2015.pdf.