

# Drought Preparedness, Mitigation and Response

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**Water for Food**  
ROBERT B. DAUGHERTY INSTITUTE



WMO, UNCCD, FAO, UN-Water - Europe Regional Workshop on National Drought Management





**The Near East  
Drought Planning Manual:**  
Guidelines for Drought  
Mitigation and Preparedness Planning



Food and Agriculture Organization  
of the United Nations  
Regional Office for the Near East,  
Cairo, Egypt



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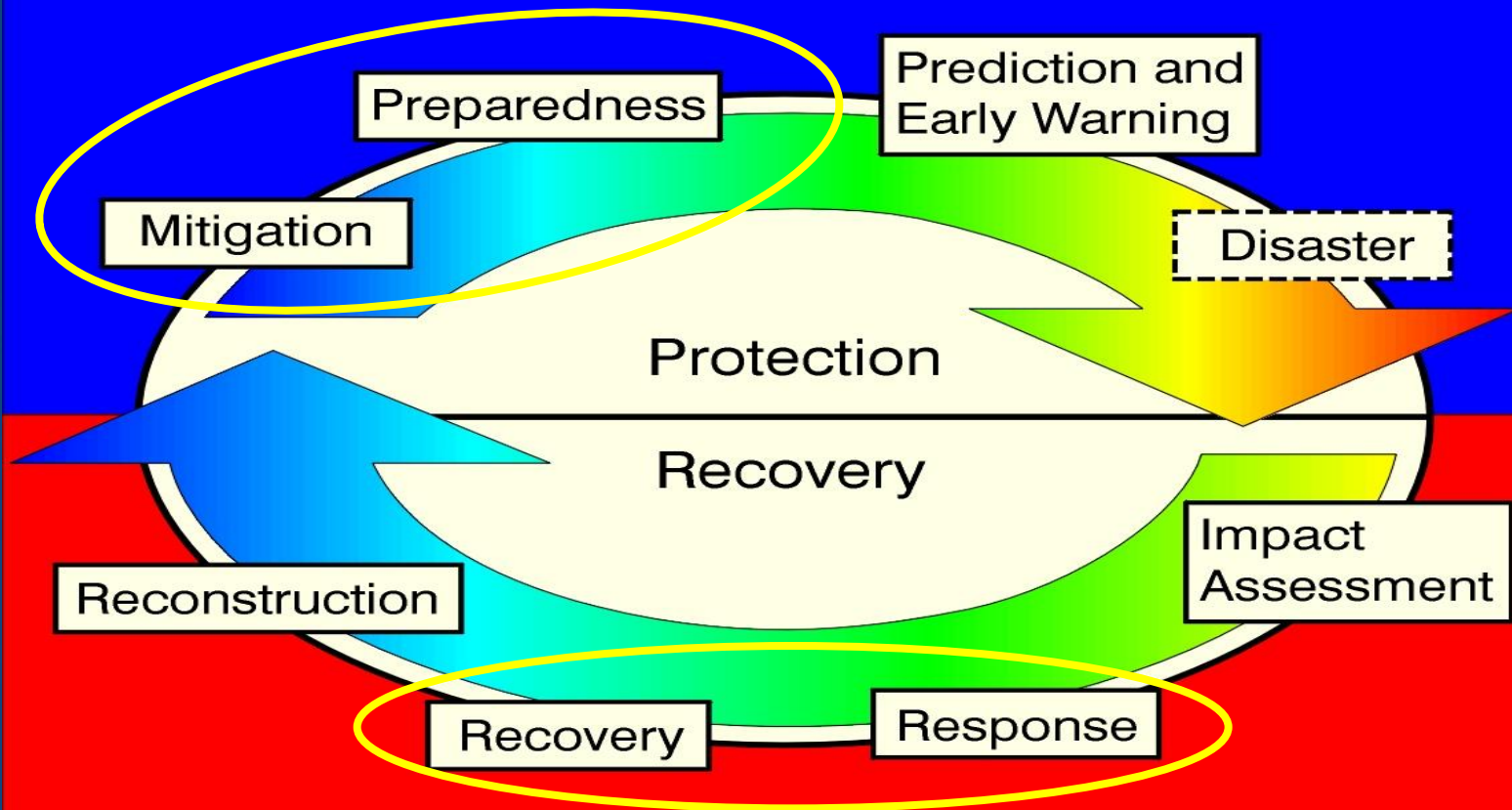
## **Drought planning**

is defined as actions taken by individual citizens, industry, government, and others before drought occurs to mitigate impacts and conflicts arising from drought.

# The Cycle of Disaster Management



**risk management**



**crisis management**

**Drought  
Preparedness**

**Drought  
Mitigation**

**Drought  
Response**

**Drought  
Recovery**



## Drought Preparedness

established policies and specified plans and activities taken before drought to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective response in a drought situation (contingency planning)

## Drought Mitigation

**any structural/physical measures (e.g., appropriate crops, dams, engineering projects) or non-structural measures (e.g., policies, awareness, knowledge development, public commitment, and operating practices) undertaken to limit the adverse impacts of drought**

## Drought Response

efforts such as the provision of assistance or intervention during or immediately after a drought disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration



## Drought Recovery

**decisions and actions taken after a drought with a view to restoring or improving the pre-drought living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce drought risk**

**Drought  
Preparedness**

**Drought  
Mitigation**

**Drought  
Response**

**Drought  
Recovery**

# Drought Mitigation and Response (and Recovery)





- **Monitoring, early warning and information delivery systems**
  - Integrated monitoring of key indicators
  - Use of appropriate indices
  - Development/delivery of information and decision-support tools
- **Risk and impact assessment**
  - Conduct of risk/vulnerability assessments
  - Monitoring/archiving of impacts
- **Mitigation and response**
  - Proactive measures to increase coping capacity



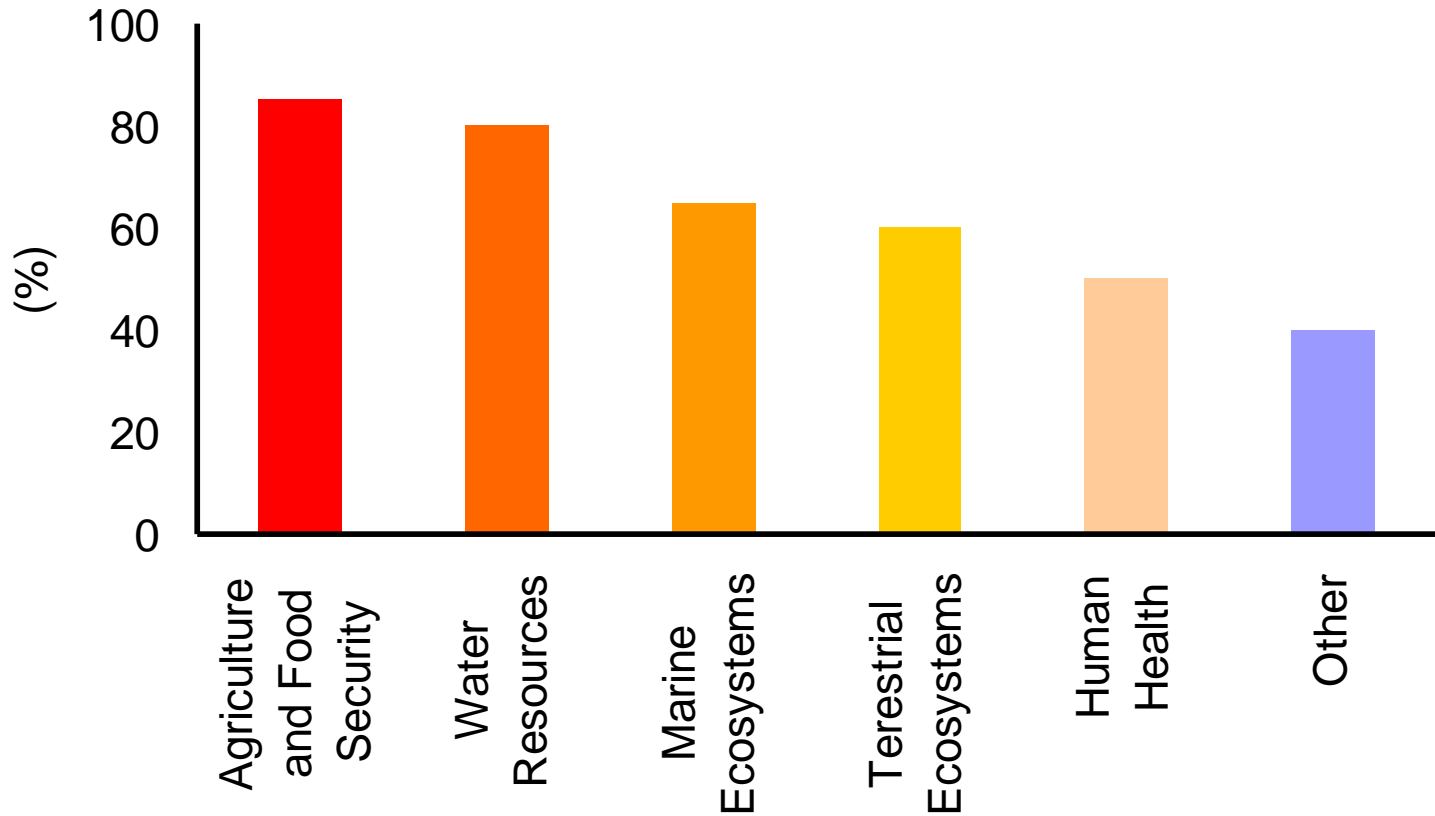
- Impact Assessment
  - \_ Social
  - \_ Environmental
  - \_ Economic
- Causal Assessment
- Temporal Trends



# Vulnerability to drought



Main vulnerable sectors to drought



(After Lulian Florin Vladu, UNFCCC, 2006)

## *Before Drought*

Objective: Determine extent of vulnerability (or of resilience) of a production system in case drought occurs

## Impact Evaluation

## *During but usually after Drought*

Objective: Determine the impacts or losses incurred by drought episode

Method and parameters are very much the same



Drought vulnerability/impacts are compared to reference years, such as:

- Previous year/growing season,
- Normal or average year,
- Last drought episode
- Record years (worst and/or best in recent past or in given time periods).





**H=Historical**

**C=Current**

**P=Potential**

## Economic

<b>H</b>	<b>C</b>	<b>P</b>	<i>Costs and losses to agricultural producers</i>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Annual and perennial crop losses
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Damage to crop quality
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Income loss for farmers due to reduced crop yields
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Reduced productivity of cropland
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Insect infestation
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Plant disease
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wildlife damage to crops
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Increased irrigation costs
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Cost of new or supplemental water resources



## 1. Climate

- Precipitation deficit (overall, during specific stages of crop growth season, by location)
- Precipitation Index
- Temperature (average, maximum, minimum, amplitude)
- Evapotranspiration
- Frost and other hazards (dry wind, sandstorm, ...)
- Soil Moisture



## 2. Water Resources

- Reduction in runoff, streamflow/river flow, spring discharge, temporary rivers, snowmelt, ...
- Water Storage (% reservoir filled)
- Groundwater recharge
- Wells (discharge reduction, number (%) of dried wells, drawdown)
- Water allocation/use by sector (% reduction)
- Wetlands hydrological capacities



## 3. Agriculture

- Cropped area (statistics by crop)
- Cultivation date
- Irrigated, rainfed areas
- Failures/delays in crop germination, plant density, number of tillers
- Onset of growth phases/stages
- NDVI
- Specific circumstances (flower loss, ...)
- Crop yield (irrigated and rainfed, per unit area, total)
- Crop loss (annual, perennial; rainfed, irrigated)
- Damage to quality of produce
- Other products (fodder, straw, etc.)



## Livestock, Forests and Rangelands

- Reduction in range and pasture lands production and quality
- Estimate of quantity or supportive capacity per unit area, vegetative cover, dominant species/quality
- Reduction in livestock (resulting from deaths, sale, slaughter, etc.)
- Reduction in birth rate, death of newly born animals
- Reduction in forest products (timber, charcoal, wood, ...)
- Fires, other drought associated hazards



## Economic Impacts (macro and micro)

- Agricultural and national GDP reduction
- Insurance paid to farmers
- Relief/Emergency costs
- Unpaid debts, debt relief
- Agricultural import/export balance
- Cost of food needs import
- Agriculture revenue per unit area and household income
- Purchasing power of rural households

## Social Impacts

- Population migration
- Diseases
- Food production/insecurity, hunger, famine
- Unemployment
- Conflicts, social unrest
- Incidence of theft, racketeering, aggressions

## Environmental Impacts

- Dried riverbeds and natural aqua-systems
- Biological degradation
- Wildlife
- Soil and water salinization
- Soil degradation (erosion, organic matter/fertility reduction, etc.)
- Extinct or threatened fauna and flora species
- Soil and water pollution
- Living conditions of rural areas and other vulnerable groups (nomads)





**Health, tourism, etc.**

## Examples of Indirect Impacts:

- Reduced income for agribusiness
- Increased prices of food and timber
- Reduced tax revenues (because of low expenditures)
- Reduced number of tourists

Indirect impacts are complex and not easily quantifiable

# Impact Assessment by Subcommittees of the Risk Management Committee

e.g. 1

- \_ Agriculture, Natural Resources, and Wildlife
- \_ Municipal Water Supply, Health, and Energy

e.g. 2

- \_ Agriculture
- \_ Drinking Water, Health, and Energy
- \_ Wildlife and Wildfire
- \_ Tourism and Economic Impact



*Steps:*

1. Identify impacts of recent/historical droughts
2. Identify drought impact trends
3. Prioritize impacts to address
4. Identify mitigation actions that could reduce impacts (short vs. long term)
5. Identify triggers to phase in and phase out actions during drought onset or termination
6. Identify agencies and organizations to develop and implement actions

## Risk Assessment Outputs



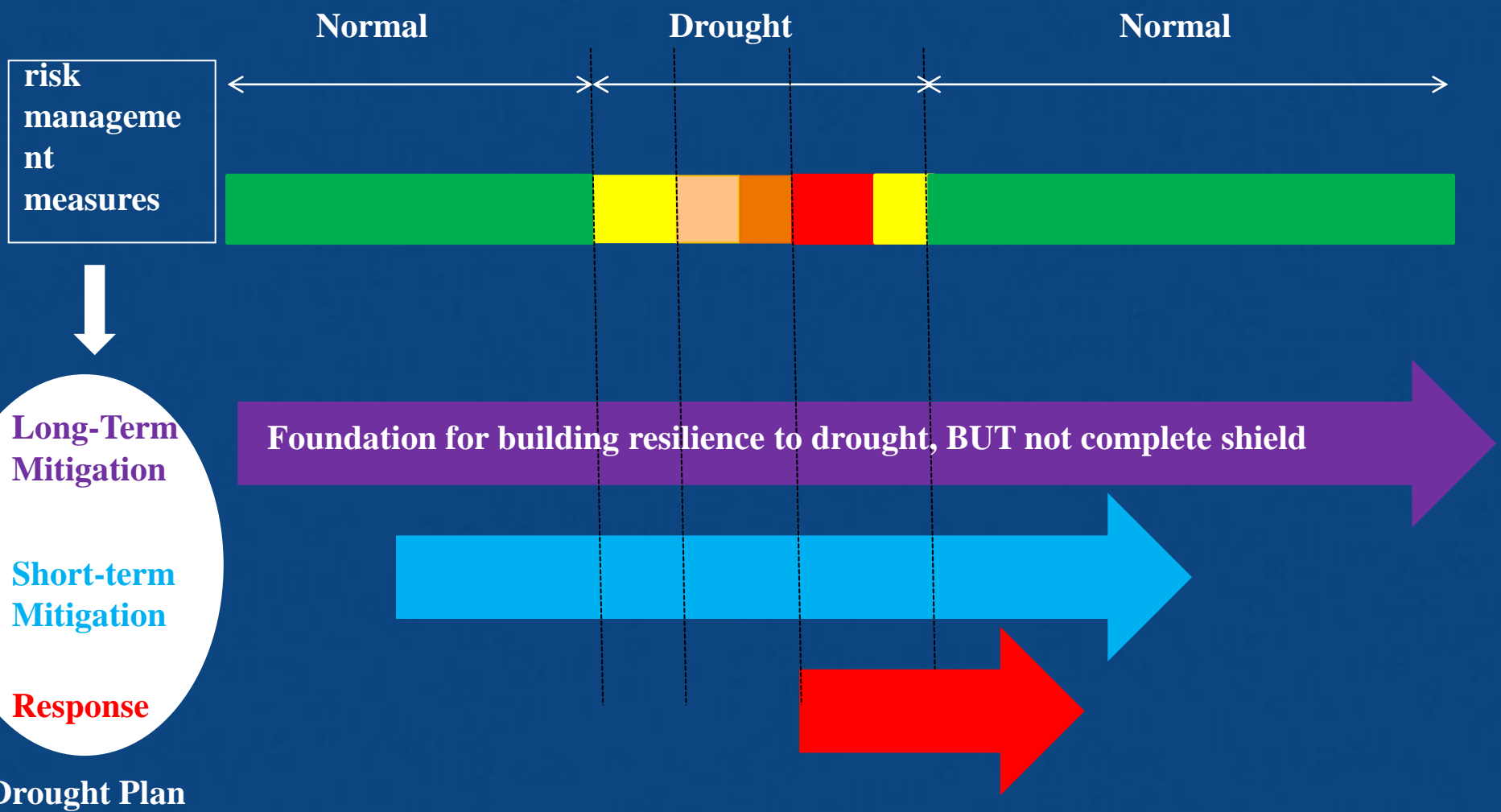
***Risk Management Options*** : List of measures and actions to take proactively to increase coping capacity and eliminate or reduce impacts

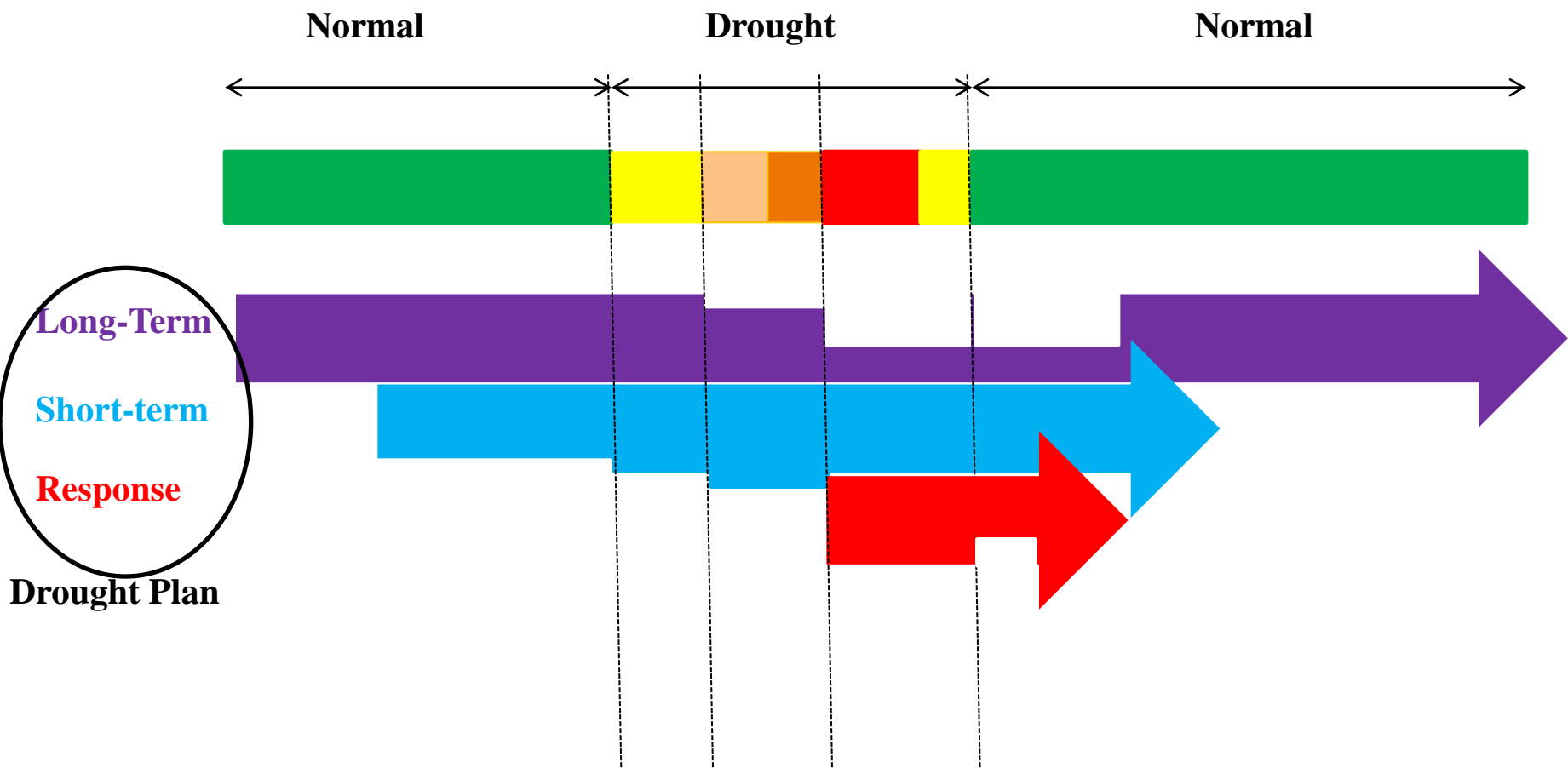
**Prioritized** on the basis of agreed criteria (for Drought Task Force)

Prepared by a “Risk Management Committee”

Risk Management options can be split into three categories, as follows:

Category	Mitigation (long-term)	Mitigation (short-term)	Response (and Recovery)
Objective	resilience building	drought mitigation	Impact Reduction
Implementation framework	regular develop. programs	drought plan	Response within drought plan
Implement. time	continuous	before, during, after drought	during, after drought





Scale: f(national, regional, district, local, ...)

Plan likely to change from one drought to another



## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

### 1. Water Resources

#### - *Enhancing supply*

- storage capacity increase
- water transfers
- locating new potential resources
- aqueducts and canals
- groundwater recharge
- small scale water collection/harvesting
- adjusting legal and institutional framework
- artificial precipitation
- desalination of brackish & saline water
- treatment & reuse of wastewater/recycling
- etc.



## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

### 1. Water Resources

#### - *Improving demand management (in all sectors/uses)*

Reducing use

Reducing losses

Reviewing water allocation

Monitoring, metering, forecasting

Conjunctive use (surface-groundwater)

Reviewing education curricula

Adopting/reviewing water tariffs

Adjusting legal & institutional framework

Voluntary insurance, pricing and economic incentives

Etc.





## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

## 2. Agriculture

- *Agric. water management (complying with water resources strategy/plan)*

- Irrigation expansion if/where possible
- Improving demand management (more efficient systems)
  - water loss reduction
  - irrig. scheme modernization/ conversion to more efficient systems
  - shift to less water-demanding crops and cropping systems
  - research of drought tolerant crops/species/genotypes
  - adjusting cropping calendars to avoid heat stress
  - use of non-conventional water resources
  - deficit irrigation, supplementary irrigation
  - conjunctive use of surface and groundwater
  - soil water conservation practices
  - adopting/reviewing water tariffs
  - etc.



## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

## 2. Agriculture

### - *Crop production*

- Breeding for drought tolerance species & adaptation to short season
- Cultural practices and techniques for conservation agriculture:
  - Proper fertilization
  - No-till/reduced tillage systems
  - Crop rotation/cropping systems
  - Seeding rate/density
  - Weeding/adapted pest management
  - Mulching/adapted soil preparation
  - Strip farming
  - Etc.



## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

## 2. Agriculture

### - *Livestock*

Drinking supplies

Balancing livestock in irrigated areas

Managing pasture and range supportive capacity

Use of indigenous breeds of feed and fodder

Genotypes of mammals / low water use

Early information for pastoralists

Forage reserves

Non conventional fodder sources

etc.



## I. Long-term

Re-visiting national policies/strategies to cater for drought preparedness

### 3. *Other sectors*

- Municipal water
- Health
- Food security
- Energy
- Transportation
- Tourism/Recreation
- Industry
- Forest/rangeland fires
- Environment
- Ecosystem services
- etc



## II. Short-term measures

### 1. Water

- *Supply augmentation (all/specified sectors)*

Mixing fresh & low quality waters

Exploiting high-cost waters

Adjusting legal and institutional framework

Locating new standby resources (for emergency)

Providing permits to exploit additional resources

Providing drilling equipment

etc.



## II. Short-term measures

### 1. Water

#### - *Demand management (all/specified sectors)*

Restricting agric. uses (rationing, subjecting certain crops to stress, ...)

Restricting municipal uses (lawn irrigation, ...)

Reviewing operations of reservoirs

Diverting water from given uses

Over-drafting aquifers (temporarily)

Reviewing water tariffs

Rationing water supply

Sensitising and awareness campaign

Adjusting legal and institutional framework

Negotiating transfer between sectors

Dual distribution networks for drinking water supply

Adopting carry-over storage

Conjunctive use

etc.



## II. Short-term measures

### 1. Water

#### - *Measures other than supply and demand*

Temporary reallocation of water (on basis of assigned use priority)

Decreasing transport and distribution costs

Banning/restricting uses

Providing emergency supplies

Elaborating set-aside regulations

Inventory private wells, negotiate purchase of water rights for public use

Elaborate regulations on water markets

Assess vulnerability & advise water users

Elaborate alert procedures

etc.



- **Incipient** : Monitoring and public education
- **Moderate**: Voluntary reduction in water use
- **Severe** : Voluntary/mandatory water use restrictions
- **Extreme**: Mandatory water use restrictions





## II. Short-term measures

### 2. Agriculture

#### – *Crop Production*

Supplementary irrigation where water can be mobilized and made available on short-term basis

Soil water conservation practices

Early warning, information and advice to farmers

Review of fertilization program

Soil mulching and crop shading

Reducing crop density

Weeding

etc.



## II. Short-term measures

### 2. Agriculture

#### – *Livestock, range and pasture lands*

Early warning / advice to herders

Destocking / incentives for owners to reduce

Review available feed and reduce animal numbers

Livestock transfer where/when possible

Watering points/ water hauling sources

Locating potential sites of water for emergency

Constituting feed stocks

Adjusting water salinity to tolerable levels

Rapid inventory of grazing potential

Protective (natural) shelters

Alternative feed (by-products, less and un-palatable shrubs, ...)

Supplementary, substitute feeds

Etc.



## III. Response and Recovery

Response options often depend on level of country development

- Drinking water supply (humans, livestock, wildlife)
- Insurance compensation
- Public aid to compensate loss of revenue
- Tax relief (reduction or delay of payment deadline)
- Safety nets
- Rehabilitation/recovery programs
- Food programs
- Feed programs
- Fire control programs
- Resolving conflicts
- Postponing payment of credits
- Implement set-aside regulations
- Etc



- Public aid to compensate loss of revenue
- Food programs
- Feed programs
- Rehabilitation/Recovery programs (**not always foreseeable and planned**)
- Etc.

In-kind contribution of beneficiaries, often in the form of work, are used to implement development programs that have been planned during the preparedness phase.

Ready to implement programs included in drought plan

e.g. food for work to be used for building a community water reservoir.

Pre-feasibility and feasibility studies done, execution plan ready, work can start at any time.



Risk Assessment Committee prioritizes all options based on agreed criteria (vulnerability, cost, etc.)

Scale (national, regional, local, specific groups, etc.)

Drought Task Force selects options to be included in drought plan

Time-bound implementation plan, based on indices/triggers from Monitoring and Early Warning

- **Indicators**: Variables to describe drought conditions.  
Examples: precipitation, streamflow, groundwater, reservoir levels, soil moisture, SPI ...
- **Indices/Triggers**: Specific values of the indicator that initiate and terminate each level of a drought plan, and associated management responses.  
Example: precipitation below the 5th percentile for two consecutive months = Level 4 Drought.

# Planned drought mitigation and response options



**Example**

**Time during normal conditions**

**Indicators**

- I-1
- I-2
- I-3
- I-4

Consider I-3 is groundwater level

**Triggers**

- I-3
- Level 1 (water level in wells  $\leq 100$  m)
- Level 2 (water level in wells from 100 to 200 m)
- Level 3 (water level in wells from 200 to 300 m)
- Level 4 (water level in wells  $\geq 300$  m)

Consider Level 2 ; ground water level of well x in zone y drops below 100 m (Moderate drought)

**Actions**

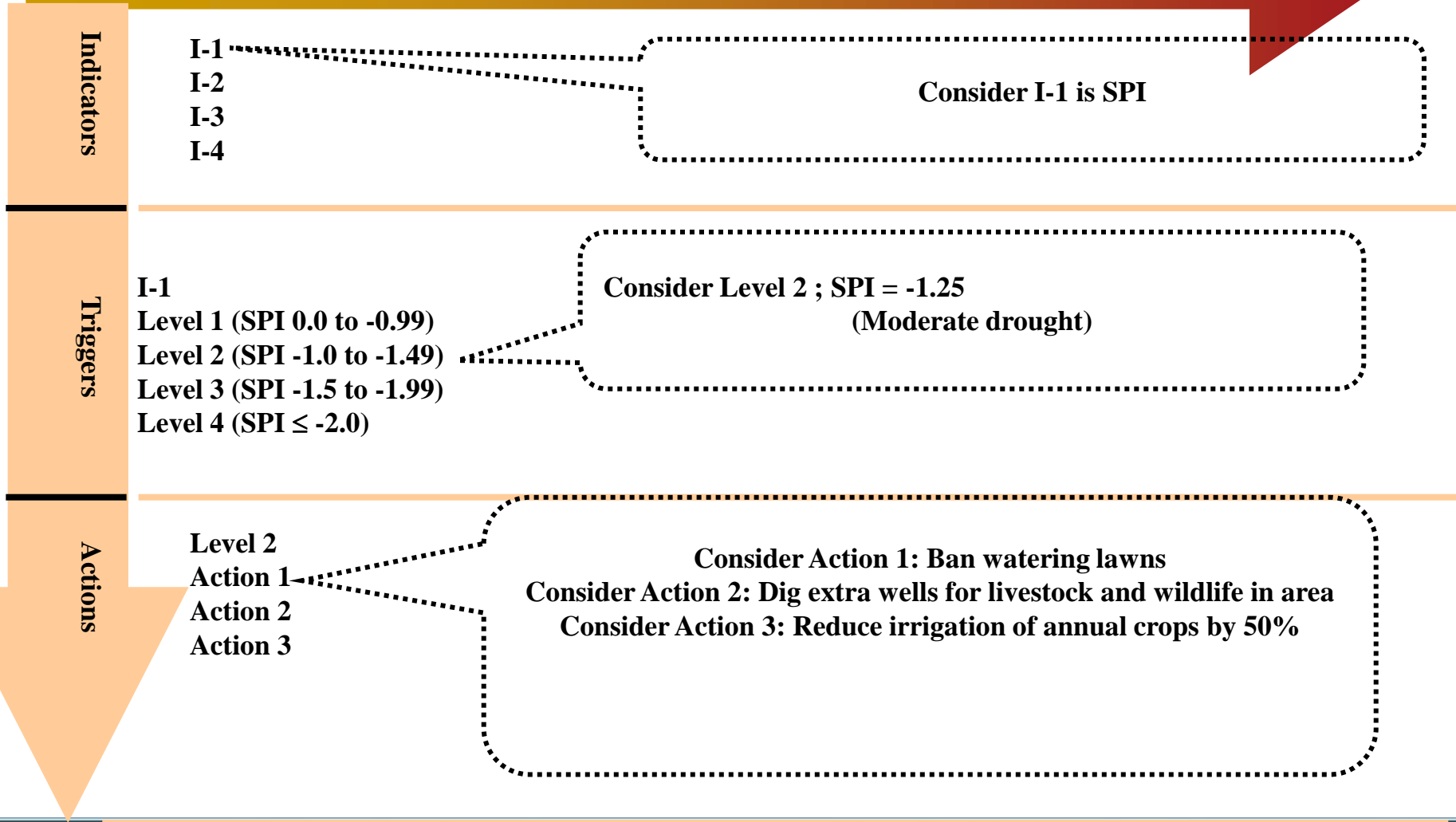
- Level 2
- Action 1
- Action 2
- Action 3
- Action 4

Consider Action 1: Ban watering lawn  
 Consider Action 2: Reuse of treated wastewater for orchards  
 Consider Action 3: inform livestock owners to destock by 50%

# Planned drought mitigation and response options



Another example





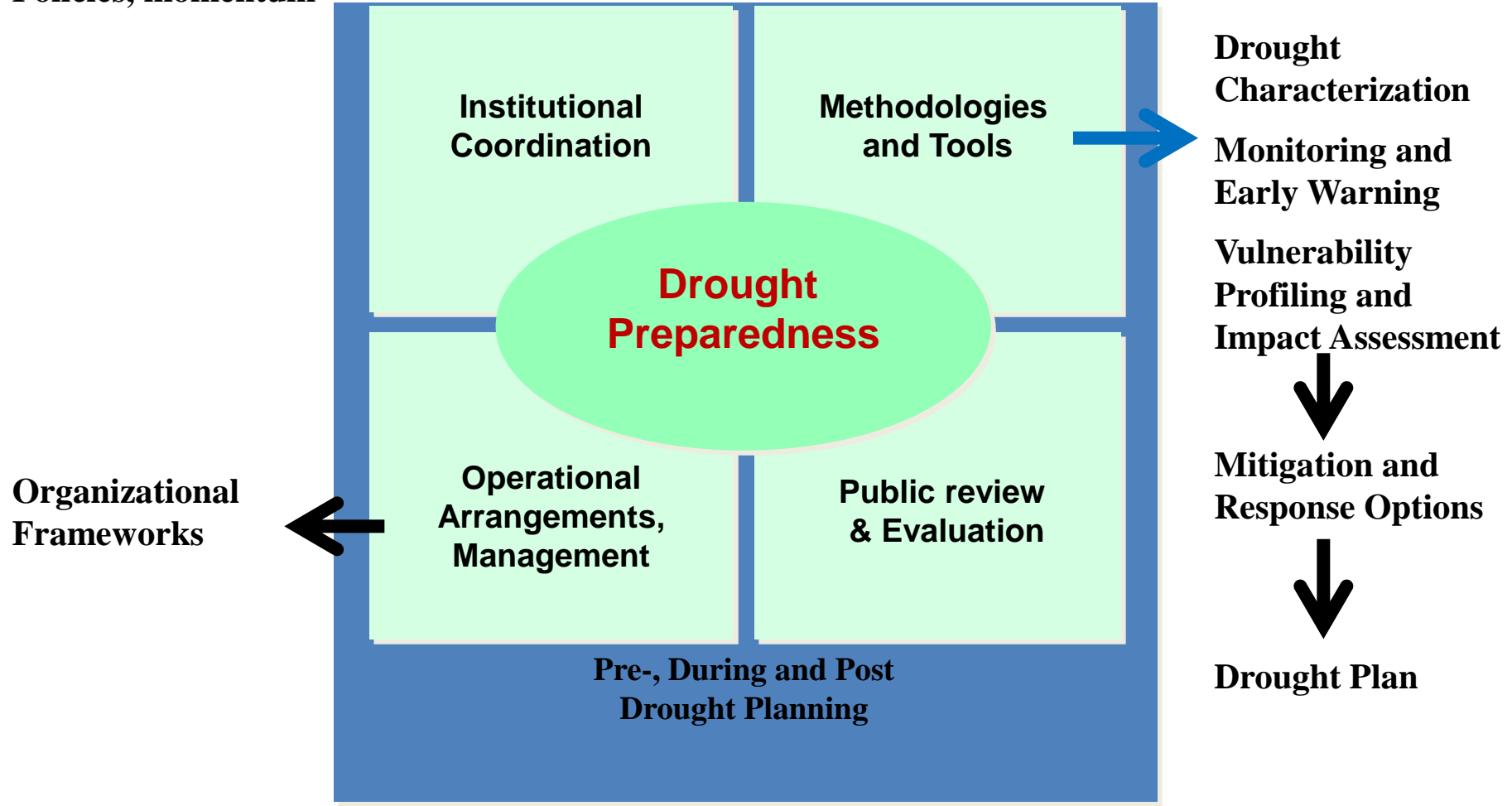


# Drought Preparedness





**Policies, momentum**





## Drought Plan Organizational Structure

## Institutional and Operational Arrangements of a Drought Plan



- National Drought Task Force
- Monitoring and Early Warning Committee
- Risk Assessment Committee
- (Planning, Mitigation and Response Committee)
- (Drought Information and Communication System)



- Nominated by a key political leader

### Mandate:

- subject matter specialists representatives of stakeholders in the different committees
  - \_ supervise, coordinate plan development and committees
- Manage drought information and communication for permanent public awareness and information of decision makers.
- During times of drought, when plan is activated, coordinate actions, oversee implementation of mitigation and response programs, and make policy recommendations to appropriate political leadership



## Composition

High level Senior Officials representatives of:

- Key line ministries/economic sectors dealing with policy issues, decision making and operational management of drought
- Institutions and civil society involved in drought management

Should reflect multidisciplinary nature of drought and its impacts as well as political and institutional infrastructure

include institutions where relevant expertise is available

Environmental and public interest groups and private sector can also be included, as appropriate



## Mandate:

- Provide timely and reliable data and information for proactive drought management.
- Provide situation reports on drought status and interact with other committees.

## Composition:

Subject matter specialists involved in drought monitoring (climate and water) and early warning, representatives of key line ministries dealing with policy issues and operational management of drought

- Committee meets regularly, especially in advance of peak demand season, and reports to DTF.
- Chairman of MEWS Committee is member of DTF and reports to it.
- Sub-committees as relevant





## Mandate:

- Develop vulnerability and impact assessment methodologies and tools
- Assess drought vulnerability, impacts and management capacity
- Provide assessment reports to DTF

## Composition:

Subject matter specialists of economic sectors, social groups and ecosystems at risk from drought, including key line ministries dealing with policy issues and operational management of drought

- May have several working groups depending on area, number of affected sectors, complexity of the economy, etc.
- Committee chairperson should be a member of DTF and reports to it.



## Mandate:

- Oversee and coordinate development of drought plan
- Oversee and coordinate implementation of drought plan

## Composition:

Could be the DTF itself or separate, in which case:

Subject matter specialists of economic sectors responsible of field implementation and operational management of drought, representatives of local communities as well as NGOs and CSOs dealing with drought issues

- May have several working groups by region.
- Committee chairperson should be member of DTF and reports to it.



## Role of communication:

- Communication and information flow between the different committees and the different stakeholders to ensure effective planning and implementation
- Coordination between committees, agencies, officials and other stakeholders
- Information of decision-makers
- Information, education and feedback provision mechanisms
- Promotion of community/public awareness and collaboration
- Open a dialogue with, and empowerment of vulnerable groups to identify problems, articulate their needs and take up informed action

Managed by DTF or separate committee



Thank you

