SOUTH ASIA DROUGHT MONITORING SYSTEM (SADMS)

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Content

1. Problem Statement and History of SADMS

2. Drought and Remote Sensing

3. SADMS Project Approach

4. Case Studies, Applications, Portal

5. Experimental drought forecast, SM drought indices

6. New proposal, Synergies & Interlinkages
History of drought programme implemented by IWMI

2005
South West Asia Drought Monitor
US State Department Regional Environment Office

2014
South Asia Drought Monitor (SADMS) –
IDMP(WMO/GWP), CGIAR CCAFS, WLE, Japan’s MAFF

Late 2016 - Present
Moving from monitoring to management including contingency plans and insurance application
CGIAR WLE, Japan’s MAFF and ICAR-GOI

Drought Management Plans and Policy guidelines
INDIA
SOUTH ASIA DROUGHT MONITORING SYSTEM (DMS): OVERVIEW

• **Goal** - build climate resilience, reduce economic and social losses, and alleviate poverty in drought-affected regions in SA through an integrated approach to drought management.

• **SADMS Integrates** remote sensing and ground truth data (vegetation indices, rainfall data, soil information, hydrological data).

• **SADMS supports** regionally coordinated drought mitigation efforts that can be further tailored to national level.

• **SADMS is a partnership initiative of** IWMI, IDMP (WMO / GWP), CGIAR CRP’s (CCAFS / WLE), Japan’s MAFF and Governments in SA.
SADMS Process and Implementation

April 2014
SADMS Concept

South Asia Climate Outlook Forum (SACOF-5)
Pune, India

April 2015
Prototype SADMS for pilot countries,
Validation with DoM, DMC, ID

SACOF-6
Dhaka, Bangladesh

2016
Operational implementation of SADMS,
Portal, Outlook issues,
experimental drought forecasting

SACOF-7,
Colombo, Sri Lanka & IDMP,
Geneva

2017
Regional consultative workshop with SA partners;
Pilot drought issues with GOI/ICAR;
Linking drought contingency plans, CSA and policy guidelines

SADMS support from SA Partners and ICAR-GOI
Special project;

A water-secure world

www.iwmi.org
IWMI’s Drought Monitoring Framework

**Current Drought Risk**
- Satellite-derived rainfall, temperature, soil moisture
- Calculate Monitoring Integrated Drought Severity Index (IDSI)
- Satellite Vegetation Condition

**Future Drought Risk**
- Ensemble predictions of rainfall, soil moisture, runoff
- Calculated Forecasted Drought Severity
- Satellite-derived rainfall, temperature, soil moisture

**Socioeconomic vulnerability**
- Collection of socio-economic information
- Smartphone Application
- Access to Monitoring and Forecasting Drought Condition

**Visualization and analysis of monitoring/forecasted drought condition and socio-economic conditions**

**DSS, IoT**
- Socio-economic Drought

**SADMS**

**SADEWS**
Team Members

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*We would like to acknowledge: WMO, GWP-CWP, DoM, DoA, MoDM, IARI, MNCFC, NDMC, IDMP for continued support and cooperation.*
1. Problem Statement
I. Drought

• Deficient precipitation compared to statistical multi-year average conditions (NDMC, 2008)

• significant economic, environmental and social impacts – direct and indirect

• among the most costly of all natural disasters

• ranks first in degree of severity, length of event, total areal extent and social effect when compared to other hazards (Wilhite, 2000, p. 6)

• Since 1980 more than 2.2 billion people were affected by more than 561 drought events accounting 150 billion economic damages (EM-DAT, 2017)

• Four types of droughts
  • Meteorological
  • Agricultural
  • Hydrological
  • Socio-economic
Definition of drought: Four different types

- **Agricultural drought**
  1. Soil water deficit
  2. Middle time scale (seasonal)
  3. Crop yield failure
  4. Food supply imbalance
  5. Grain market fluctuation

- **Meteorological drought**
  1. Precipitation deficit
  2. Short time scale (monthly)
  3. Precipitation decrease
  4. Relative humidity decrease
  5. Radiation increase

- **Hydrological drought**
  1. Water resource imbalance
  2. Long time scale (semi-yearly)
  3. Groundwater level decrease
  4. Rivers dry-up
  5. Reservoir depletion

- **Socio-economic drought**
Drought risk assessment

Hazard: Characterization of drought
- Spatial extent
- Magnitude / severity
- Frequency
- Intensity
- Duration
- ...

Vulnerability: Characterization of drought effects
→ The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

2. Drought Monitor using remote sensing
II. Drought Indicators and Remote Sensing

Drought Hazard vs. Drought Risk

- **Drought Hazard**: meteorological parameters (Prec., Temp., PET, SM)
  - Palmer Drought Severity Index (PDSI, Palmer 1965)
  - Standardized Precipitation Index (SPI; Guttermann, 1998)
  - Crop Moisture Index (CMI; Palmer 1968)
  - Surface Water Supply Index (Shafer and Dezmann, 1982)
II. Remote Sensing Data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Launch date</th>
<th>Spectra</th>
<th>Spatial resolution</th>
<th>Temporal resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landsat</td>
<td>1972</td>
<td>VIS, IR</td>
<td>15 - 60 m</td>
<td>16 days</td>
</tr>
<tr>
<td>RapidEye</td>
<td>2008</td>
<td>VIS, IR</td>
<td>5 x 5 m</td>
<td>1 day</td>
</tr>
<tr>
<td>Sentinel – 2</td>
<td>2015</td>
<td>VIS, IR</td>
<td>10 – 60 m</td>
<td>10 days (solo), 5 days (dual)</td>
</tr>
<tr>
<td>AVHRR</td>
<td>1978</td>
<td>VIS, IR</td>
<td>1100 x 1100 m</td>
<td>14 times each day</td>
</tr>
<tr>
<td>MODIS</td>
<td>1999</td>
<td>VIS, IR</td>
<td>500 – 1000 m</td>
<td>1 day</td>
</tr>
<tr>
<td>MERIS</td>
<td>2012</td>
<td>VIS, IR</td>
<td>300 – 1200 m</td>
<td>3 days</td>
</tr>
<tr>
<td>SPOT</td>
<td>1986</td>
<td>VIS, IR</td>
<td>1.5 – 6 m</td>
<td>2 – 3 days</td>
</tr>
<tr>
<td>Sentinel – 1</td>
<td>2014</td>
<td>SAR</td>
<td>5 x 5 m</td>
<td>10 days (solo), 5 days (dual)</td>
</tr>
<tr>
<td>TerraSAR – X</td>
<td>2007</td>
<td>SAR</td>
<td>1 – 18 m</td>
<td>2.5 days</td>
</tr>
<tr>
<td>TanDEM – X</td>
<td>2010</td>
<td>SAR</td>
<td>1 – 16 m</td>
<td>1 day</td>
</tr>
</tbody>
</table>
II. Remote Sensing Data

- Landsat
- AVHRR
- MODIS
- MERIS
- RapidEye
- Sentinel-2


SAR

Own illustration. Based on data of DLR, ESA, NASA, Planet Labs, USGS (2016).
Example: Agricultural Stress Index System (ASIS): Global and Country Analysis

Agricultural Stress Index System is based on the Vegetation Health Index (VHI) (Kogan et al. 1995)

Vegetation condition index (VCI)

\[ VCI_i = \frac{NDVI_i - NDVI_{\text{min}}}{NDVI_{\text{max}} - NDVI_{\text{min}}} \]

Temperature condition index (TCI)

\[ TCI_i = \frac{BT_{\text{max}} - BT_i}{BT_{\text{max}} - BT_{\text{min}}} \]

Vegetation Health Index (VHI)

\[ VHI = a \cdot VCI + (1-a) \cdot TCI \]

low VHI

high VHI
3. SADMS approach
Drought Monitoring Approach

**INPUT DATA**
- MOD09A1 (500m Surface Reflectance)
- MOD11A2 (1km Land Surface Temperature)
- TRMM 3B42 (27km precipitation estimates)
- GLOBELAND (30m)
- LULC 2014 (56m)
- Waterbody Mask (30m)

**DATA PRE-PROCESSING**
- MOD09A1
  - Red Band
  - NIR Band
  - NDVI Calculation
- MOD11A2
  - LST Band extraction
- TRMM 3B42
  - 8 day accumulation
  - Lag calculation (previous + current)
- GLOBELAND
  - Time-Series Precipitation
- LULC 2014
  - Multi-source Merging
- Waterbody Mask
  - Scale and projection matching

**DROUGHT MONITORING**
- Composite of long-term stack images
- Identification of Long-term anomalies
- Standardized drought index calculation
  - VCI
  - TCI
  - PCI

**DROUGHT ASSESSMENT**
- Development of Integrated Drought Severity Index (IDSI)
- Mask of Agriculture and non-agriculture areas
- Map and statistics generation

**NOTES:**
- MOD09A1 – MODIS Surface Reflectance of every 8-Day product at 500m resolution; MOD11A2 – MODIS Land Surface Temperature (LST) daily product at 1,000m resolution; TRMM – Tropical Rainfall Measuring Mission; LULC NRSC – Land Use and Land Cover from National Remote Sensing Centre; Water body mask from Landsat images; NDVI – Normalized Difference Vegetation Index; VCI – Vegetation Condition Index; TCI – Temperature Condition Index (TCI); Precipitation Condition Index (PCI); IDSI – Integrated Drought Severity Index
DMS validation from maps to field scale

Comparison of IDE, NDVI and Surface Soil Moisture anomaly for the drought year Dec 2012 – April 2013.

- High correlation observed among the IDE and other essential variables in drought prediction and early warning.
- The SM can be used to predict by 35-80 days in advance on the vegetation condition for better decision making among stakeholders.

Characterizing Drought Severity

2015 DROUGHT IN MAHARASHTRA STATE, INDIA

21
20
22
Characterizing Drought Severity

South Asia Drought Monitoring System (SADMS)
A Joint Collaborative project by IWMI, GWP and WMO under Integrated Drought Management Programme

FIELD REPORT, JULY 2015

2014_Week_30
Drought Severity
- Extremely Severe
- Very Severe
- Moderately Severe
- Stress
- Watch
- Normal
- Very Healthy
- Districts
- Waterbodies

International Water Management Institute
A water-secure world
## Characterizing Drought Severity

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Possible impacts</th>
<th>IDSI Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>D4</td>
<td>DS Extreme</td>
<td>Exceptional and widespread crop/pasture losses</td>
<td>&lt; 5 (with very low values of VCI, PCI and TCI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shortages of water in reservoirs, streams, and wells creating water emergencies</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>DS Moderate</td>
<td>Major crop/pasture losses</td>
<td>5 – 10 (with low values of VCI, PCI and TCI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Widespread water shortages or restrictions</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>DS Severe</td>
<td>Crop or pasture losses likely</td>
<td>10 – 15 (with moderate values of VCI, low PCI and TCI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water shortages common</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water restrictions imposed</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Stress</td>
<td>Some damage to crops, pastures</td>
<td>15 – 20 (with moderate VCI, low PCI and moderate TCI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Streams, reservoirs, or wells low, some water shortages developing or imminent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voluntary water-use restrictions requested</td>
<td></td>
</tr>
<tr>
<td>D0</td>
<td>Watch</td>
<td>Going into drought:</td>
<td>20 – 40 (with moderate values of VCI, PCI and TCI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>short-term dryness slowing planting, growth of crops or pastures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coming out of drought: some lingering water deficits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pastures or crops not fully recovered</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>&gt;40 (vegetation growth is normal with essential variables with a function of high VCI-TCI-PCI)</td>
</tr>
<tr>
<td>Healthy</td>
<td>Healthy</td>
<td>Healthy</td>
<td>&gt;60 (vigor vegetation with strong correlation on climate indicators)</td>
</tr>
</tbody>
</table>
Drought Indices between 2001 to 2015 for Yala season
Comparison of Good Year (2003) and Bad Year (2014)
Links of drought characteristics to agricultural production losses for the Yala seasons (SW Monsoon)
VCI, PCI and Drought Indices for drought year (2009) and normal year (2010), Rajasthan

Crop type: Maize

VCI vs. Crop Yield

- Average VCI of rain-fed season was compared with yield of major rain-fed (kharif) crops which reveals that a good agreement.
- 3-month SPI also had a good correlation with IDSI for drought year and normal year.
- High correlation co-efficient (r) was found to be 0.71, 0.72 and 0.71 (p = 0.05) for sorghum, pearl millet and maize respectively which reveals that there is a strong positive correlation present between VCI and yield of major kharif crops.
• First of its kind to establish for entire South Asia using multisource remote sensing observations;
• Historical drought risk mapping and assessment covering SA countries (2000 – Current);
• IDSI allows better understanding on drought frequency, duration over the 16 years;
• Products are useful tools in drought mitigation studies and in decision-making process;

2015 field observations in Jalna, Maharashtra
Current status of drought condition over South Asia and Rainfall distribution over India

- Drought condition over South Asia seems relatively low compared to the previous years of 2012, 2014 and 2016.
- Areas under drought condition includes India (Southern Karnataka, Marathawada, Madhya Maharashtra, East & West MP), Sri Lanka (North Central, northwestern and eastern provinces), parts of Southern Nepal.
Drought Assessment on Population Exposure and Agricultural losses

<table>
<thead>
<tr>
<th>Country Name</th>
<th>Geographical area (km²)</th>
<th>Agriculture area (km²)</th>
<th>Average</th>
<th>% from total area</th>
<th>% from Agriculture area</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>3,263,578</td>
<td>1,734,193</td>
<td>683,538</td>
<td>20.94</td>
<td>39.42</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>65,846</td>
<td>22,013</td>
<td>5,956</td>
<td>9.05</td>
<td>27.06</td>
</tr>
<tr>
<td>Pakistan</td>
<td>793,931</td>
<td>286,805</td>
<td>105,484</td>
<td>13.29</td>
<td>36.78</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>644,073</td>
<td>379,100</td>
<td>16,390</td>
<td>2.54</td>
<td>4.32</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>135,033</td>
<td>105,130</td>
<td>35,767</td>
<td>26.49</td>
<td>34.02</td>
</tr>
<tr>
<td>Bhutan</td>
<td>39,652</td>
<td>2,776</td>
<td>326</td>
<td>0.82</td>
<td>11.73</td>
</tr>
<tr>
<td>Nepal</td>
<td>146,879</td>
<td>51,216</td>
<td>12,594</td>
<td>8.57</td>
<td>24.59</td>
</tr>
</tbody>
</table>

- Average drought affected area in agriculture approx. 860,000sq.km for South Asia between 2001 to 2015;
- Among SA countries, India ranks the highest drought affected area ~683,000sq.km followed by Pakistan (105,484sq.km), Bangladesh (35,767sq.km).
- In terms of Population exposure from drought approx. 365 million people of which Indian parts covers 279million followed by 39 million in Pakistan, Bangladesh 35million and others.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>1,251,695,584</td>
<td>279,246,978</td>
<td>22.31</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>20,770,749</td>
<td>1,357,281</td>
<td>6.53</td>
</tr>
<tr>
<td>Pakistan</td>
<td>188,924,874</td>
<td>39,814,332</td>
<td>21.07</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>32,564,342</td>
<td>2,748,627</td>
<td>8.44</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>160,995,642</td>
<td>35,459,353</td>
<td>22.03</td>
</tr>
<tr>
<td>Bhutan</td>
<td>774,830</td>
<td>35,547</td>
<td>4.59</td>
</tr>
<tr>
<td>Nepal</td>
<td>28,679,524</td>
<td>5,737,401</td>
<td>20.01</td>
</tr>
</tbody>
</table>
4. Experimental SADEWS and SM Drought Indices
South Asia Drought Forecasting and Early Warning (SADEWS)

Near-real-time rainfall estimate

Rainfall forecast by NOAA GCFS and IITM

SRI: Hydrological drought severity
SSI: Agricultural drought severity

Forecasting impact on agriculture

Variable Infiltration Capacity (VIC) Macroscale Hydrologic Model

Cell Energy and Moisture Fluxes

Grid Cell Vegetation Coverage

Variable Infiltration Curve

Hydrological Drought (1-Month SRI)

Agricultural Drought (1-Month SSI)

Joint Collaboration of IIT-GN in model development and exploring with IITM/IMD to obtain weather forecast data
Summary:
The experimental drought forecast products for research/scientific use based on 10th July 2017 initial condition. These forecast products are based on the real time weekly operational forecast generated by Global ENSemble (GENS), a weather forecast model made up of 21 separate forecasts, or ensemble members developed at The National Centers for Environmental Prediction (NCEP), NOAA.

Drought Forecast Outlook:
- The initial condition has improved over Telangana, Andhra Pradesh, Rajasthan, Western UP and North-eastern states.
- Initial condition on the Soil Runoff Index (SRI) explains similar trend to SSI.
- Some level of dryness is expected in the following weeks over central parts of the region such as MP, eastern Gujarat and Jharkhand.
- The leeward side of the western ghats along the southern Maharashtra seems to be progressing towards dryness.
- In reference to IMD actual rainfall for India, several east-central states are in deficit rainfall condition which is affecting the crop productivity and advance need for State and Local authorities for better planning and coordination on water resources management.
SA-DEWS

South Asia-Drought Early Warning System (SA-DEWS) is an integrated approach based on satellite estimates of rainfall, temperature, wind and soil type utilized in VIC model and the derived outputs namely Standardized Precipitation Index (3-Month), Standardized Soil Moisture Index (SSI) and Standardized Runoff Index (SRI).

SWADI

Soil Water Anomaly Drought Index (SWADI) is derived from satellite based decadal soil moisture product of ASCAT provided by EUMETSAT.

IDSI

Integrated Drought Severity Index (IDSI) is an integrated index that has been formulated using VCI, TCI & PCI at 500m resolution for agricultural land-use over South Asia.

During this time period all the three indices show a close relation between each other. The peninsular India has reviving well from the drought situation. Parts of Bihar, Jharkhand and UP is facing some scarcity of rainfall which is well reflected in all the three indices. Some parts of Tamil Nadu is still facing moderate drought like scenario. North and Eastern parts of Sri Lanka is severely facing water stress resulting into crop damage and shortage of ground water.
Soil Moisture based Drought Index

- **Soil Water Index (SWI)**, developed by Europe's Copernicus Programme was used to calculate Soil Water Anomaly Drought Index (SWADI)

- SWADI involves the use of radar backscatter measurements from the Advanced Scatterometer (ASCAT) aboard the EUMETSAT MetOp satellite.

- Over the last 10 days, soils in parts of the region have been much drier than usual. Nowhere is current soil moisture as abnormally low as in Northern Sri Lanka and India’s Tamil Nadu state.

- Although such conditions are a regular occurrence, the current situation stands out for its intensity and persistence, as was also the case during severe droughts in 2012 and 2014.
Drought Management & Contingency Plans

Based on the previous years i.e., 2015 and 2016 experience, during Kharif – 2017 contingency plan was proposed as below

### If the rains are not received till 15th July, 2017

<table>
<thead>
<tr>
<th>S. No</th>
<th>District</th>
<th>Crop wise Normal area (ha)</th>
<th>Crop wise area likely to be sown</th>
<th>Left over area</th>
<th>Crop wise areas proposed for Contingency</th>
<th>Seed requirement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Crop Area</td>
<td>Crop/variety</td>
<td>Qty. of seed req (Qtl)</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Anantapur</td>
<td>801675</td>
<td></td>
<td></td>
<td></td>
<td>Groundnut+Redgram crops</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### If the rains are not received till 31st July, 2017

<table>
<thead>
<tr>
<th>S. No</th>
<th>Mandal</th>
<th>Crop wise Normal area (ha)</th>
<th>Crop wise area likely to be sown</th>
<th>Left over area</th>
<th>Crop wise areas proposed for Contingency</th>
<th>Seed requirement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>1</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<td></td>
<td></td>
<td>Groundnut+Redgram crops</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Joint project of ICAR-CRIDA and IWMI on promoting drought resilience in pilot states in India

Source: CRIDA
Drought Management & Contingency Plans

Crop Sensor measuring vegetation index

Stress condition of Foxtail Millet
5. SADMS Tools, Portal and Outreach
Drought Monitor tool (DMS)

The DMS tool was developed using the ESRI ArcGIS interface.
An operational platform that integrates various drought products to provide advanced drought monitoring and assessment information for various purposes.

A first regional platform for South Asia and have inherently finer spatial detail (500m resolution) than other commonly available global drought products.
More than 2800 visit to DMS and spread over 80 countries since Jan 2017
Approx. 300 visit per month and dominant being India, Sri Lanka, USA, Canada, UK
Uncertain waters: Dealing with increasing floods and droughts demands new thinking and new technologies

By David A. Hagg, IWMI

I ncreasing floods and droughts are a concern worldwide, but even more worrying for many developing countries is the fact that they may become even worse in the future due to climate change. Food security is at risk, and water for drinking and irrigation is increasingly scarce in areas where it was once abundant.

The scourge of drought and floods is one that knows no political boundaries. The technologies and solutions developed by national and international agencies need to be tested, adapted and made available to all who need it.

In South Asia, for instance, it is unlikely to have the same level of financial and technological support to combat these impacts as in the US and Europe, although there is a growing interest in using innovative techniques to monitor droughts and floods, such as remote sensing and informatics.

One of the biggest challenges is how to make the new technologies affordable and accessible to those who need them most. For instance, many smallholder farmers in the region are unable to afford technologies such as rain gauges or sensors, which are essential for monitoring droughts and floods.

There is growing interest in using remote sensing and informatics to monitor droughts and floods, but how do we ensure that these technologies are affordable and accessible to all?

A new report from the International Water Management Institute (IWMI) presents a new way of combating drought and flood hazards in South Asia. This report is based on recent studies carried out by the Adaptation to Climate Change Research Alliance (ACCRA) and the South Asia Drought Monitoring and Information System (SADMS) and provides a comprehensive overview of the issues and challenges facing the region.

The report highlights the need for new, innovative and affordable technologies to monitor droughts and floods. It also calls for increased funding to support research and development in this area.

The IWMI report also highlights the importance of sharing knowledge and experience between countries and regions. By working together, countries can develop more effective strategies to combat the impacts of droughts and floods.

In conclusion, the IWMI report provides a valuable resource for those working to combat the impacts of droughts and floods in South Asia. It is hoped that this report will help to raise awareness of the challenges facing the region and encourage action to address them.
6. SADMS Synergies and Next Steps
Linking SADMS with the national to global indicators

- Agenda 2030 – Sustainable Development Goals (SDGs)
- Resilience and risk mitigation
- Sendai Framework for Disaster Risk Reduction
- Paris Agreement
Addressing the SFDRR

Sendai Framework for Disaster Risk Reduction
2015 - 2030

Understanding drought risk and drought Preparedness;
National Targets on indicators;
Sustainable Development Goals: the relevance of space technology
New Proposal

Comprehensive Drought Management Plan (CDMP) – Sri Lanka

INTEGRATED DROUGHT MANAGEMENT

SADMS MONITORING & EARLY WARNING
Drought status

VULNERABILITY & IMPACT ASSESSMENT
Who/What is at RISK & Why?
Prioritization/ Ranking

DROUGHT CHARACTERIZATION STUDIES

FEEDBACK

INTEGRATED DROUGHT MANAGEMENT

MITIGATION, PREPAREDNESS & RESPONSE
Actions and measures to mitigate drought impacts and prepare to respond to drought emergencies more effectively

Source: IDMP
Vulnerability and Risk Assessment

Derivation of vulnerability indicators, combine information on hazard, exposure and vulnerability to assess overall drought risk and evaluate transferability of indicators between different countries.

- Drought vulnerability analysis
- Drought risk assessment
- Evaluation of indicator transferability

- Vulnerability indicators of the social-agricultural system
- Risk of people affected and loss in the agricultural sector
- Unified set of indicators versus country specific indicators

Linking SDG, SFDRR to national indicators to measure and mitigation drought impacts
Outcomes

Clearinghouse
Evolution of improved knowledge base

Shift reactive to proactive drought management

Platform
Strong drought management partnerships

Increased application of and finance for SADMS

Strengthen 3 pillars of SADMS

Governance
Improved planning and policies

Less duplication – More coherence and complementarity

Source: IDMP / IWMI
**Plans for 2017-2019**

**MONITORING/EARLY WARNING**

**Improvement of the drought monitoring**

**Drought User Service (SL-DMS)**

- system which enables more accurate and efficient drought monitoring for the entire Sri Lanka

- an innovative tool integrating all available data, including large volume of remote sensing products and serving the authorities to monitor, forecast and respond during drought development faster and with higher precision
Drought Impact Assessment
• common methodology for near real-time drought impact assessment (reporters)
• common methodology for near real-time drought impact forecast
• establishment of network of reporters as additional source of information for drought impacts in agriculture

Drought Risk Assessment
• State-of-the-art analysis
• Common methodology for drought risk assessment
• Mapping of risk – regional atlas of drought risk
Plans for 2017-2019

Mitigation & Preparedness

Overcoming gaps in decision-making processes in drought management
Improve dialogue between the scientific and policy-making communities

**Improvements of the drought management cycle** – using Guidelines for preparation of the DMP

- update current status in the region
- template for institutional mapping
- techniques for identification of the gaps in the drought management processes
- preparation of the model/scheme on how should drought management in the region (countries) work

**National and regional consultations/workshops**, etc.

- better understanding and usage of the CDMP SL (and SADMS) products
- demonstrating positive effect of changed behavior (pro-active approach)
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